application [*i.e.*, the average fire retardant application covers about 800 ft (244 m) by 50-75 ft (15-23 m) (USFS 2011)].

However, fire retardant application within the range of thornmint is most likely to occur during the primary fire season in southern California, which is August to October. Since the flowering season for thornmint is April to May (USFWS 2009h), most fire retardant applications in habitat for this species would occur after seed-set and plant senescence.

Also, while the average fire retardant application covers about 1-1.5 ac (0.4-0.6 ha), applications are linear, so only a small portion of a given application would be expected to occur in thornmint occupied habitat. Thus, a fire retardant application is not likely to completely cover a thornmint population and the portions of a thornmint population subject to the direct impacts of a fire retardant application are likely to recover by re-establishment from directly adjacent thornmint, as necessary.

Indirect Effects

Nonnative plants could be enhanced by fire retardant application and impact thornmint. Nonnative plants could decrease water availability for thornmint via competition and create a thatch from dead grasses that prevents thornmint seedling establishment. Also, nonnative plants could shade thornmint and reduce access to sunlight and photosynthesis (52 FR 36265). Further, nonnative plants could alter the fire regime including the frequency, intensity, extent and seasonality of fire, resulting in a feedback cycle for further enhancement of nonnative plant growth (Brooks et al. 2004) and ultimately result in type conversion. In addition, nonnative plants can change soil properties, resulting in alterations in plant community composition (Ehrenfeld et al. 2001).

While fire retardant could enhance nonnative plants, it could also enhance growth. Fire retardants contain nitrogen and phosphorus that could act as nutrients to thornmint. Individual and plant community responses from changes in nutrient availability are complex and site specific, and most studies address the potential effects to crop species. Studies on the potential benefits to native plant species from nutrients in fire retardants are limited, and no such studies exist that focus on thornmint.

Regardless, if fire retardant is applied to thornmint occupied habitat, the Forest Service will monitor the site and implement actions to remove nonnative plants upon detecting the enhancement of nonnative plants due to fire retardant application. Based on the implementation of these measures, impacts to thornmint due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

Effect on Recovery

No recovery plan exists for thornmint, but a 5-year review was completed on August 12, 2009, which provided management recommendations for the next five years for this species (USFWS 2009h). Regardless, based on the discussion above, fire retardant application in thornmint occupied habitat should occur rarely, especially during the flowering season. If fire retardant application does occur in thornmint occupied habitat during the flowering season, impacts are expected to be effectively avoided or minimized due to the size and linear nature of fire retardant applications and the proposed removal of nonnative plants, as appropriate. With monitoring and appropriate nonnative plant removal, long term changes to thornmint populations or habitat conditions are not likely to occur. Thus, the ability of this species to recover should not be affected.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of thornmint. We reached this conclusion for the following reasons:

1. The potential for an application of fire retardant in thornmint occupied habitat is low due to the amount of fire retardant applied annually compared to the extent of Forest Service land. Also, applications in occupied habitat will only occur due to misapplications or to save human life, and misapplications occur rarely.

2. Direct impacts should be effectively avoided or minimized due to the application of fire retardant in thornmint occupied habitat primarily outside the flowering season and the size and linear nature of fire retardant applications.

3. Due to the proposal to conduct monitoring after a fire retardant application in thornmint occupied habitat and remove nonnative plants, as appropriate, impacts due to nonnative plants enhanced from a fire retardant application should be short term and temporary.

4. Due to the expected short term and temporary nature of the potential impacts and size of potential impacts, we do not expect that the proposed action will impact the ability of this species to recover.

Santa Ana Sucker *(Catostomus santaanae)*

Environmental Baseline

The Santa Ana sucker (―sucker") occurs on the Angeles National Forest in the East, West, and North forks of the San Gabriel River (including the Big Mermaids Canyon, Bear Canyon, Bichota Canyon, Cattle Canyon, and Cow Canyon tributaries) (75 FR 77962) and in Big Tujunga Canyon (Swift *et al*. 1993). The Forest Service identifies 2,521 acres (ac) (1,020 hectares (ha)) of sucker occupied habitat, all on the Angeles National Forest (USFS 2005). Populations in the

Santa Clara River and Sespe, Piru, and San Francisquito creeks are not considered to be the listed entity. Suckers were historically in the upper Santa Ana River within the San Bernardino National Forest, but they have not recently been observed there.

The sucker occupies approximately 23 miles (mi) (37 kilometers (km)) of stream habitat within the San Gabriel River system of the Angeles National Forest. Suckers appear to be more prevalent within the East Fork of the San Gabriel River, but are consistently found throughout the three forks of the San Gabriel River. Much of the sucker occupied habitat and the tributaries leading to sucker habitat within the San Gabriel River system are within or bordered by designated or proposed wilderness areas, which will be maintained in a natural, undeveloped state. Specifically, Big Mermaids Canyon, Bear Canyon, and much of the West Fork San Gabriel River watershed is within the San Gabriel Wilderness. In addition, the Forest Service has proposed an expansion of the Sheep Mountain Wilderness which includes Cattle Canyon, portions of the East Fork San Gabriel River, and large portions of the East Fork San Gabriel River watershed (USFWS 2005a).

Nonnative species are a threat to the sucker within the San Gabriel River system. Green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*) occur within this system and may prey on suckers (USFWS 2011a).

Several biological opinions have been issued regarding the sucker in the San Gabriel River, although none involved the permanent loss of sucker habitat. In 2005, a non-jeopardy biological opinion was issued regarding use of the 153-ac (62-ha) San Gabriel Canyon Off-Highway Vehicle area on the Angeles National Forest (USFWS 2005b). The area is managed to allow stream crossings only at designated areas. In 2005, two non-jeopardy biological opinions were issued regarding sediment removal activities behind San Gabriel Dam from 2004 to 2008 (USFWS 2005c, d). This project involved the short distance relocation of sucker out of the project area. In 2007, a non-jeopardy biological opinion was issued regarding the use of recreation residences and potential effects to the sucker. This biological opinion addressed nine residences within San Gabriel Canyon. Conservation measures included the removal of non-native species from around residences, the use of best management practices, the fixing of faulty septic systems, and education of permittees.

The sucker occupies about 6 mi (10 km) in the Big Tujunga River system on the Angeles National Forest, including from Big Tujunga Dam to the boundary of the Angeles National Forest (USFWS 2011a). Swift (in Moyle and Yoshiyama 1992) summarized the status and threats facing suckers in Big Tujunga Canyon below Big Tujunga Dam. Fluctuations in water quality and quantity pose problems for all fish in this reach. Nonnative species such as red shiners (*Cyprinella lutrensis*) are a potential egg predator and green sunfish are likely to prey on juveniles.

In 2007, a non-jeopardy biological opinion was issued regarding the use of recreation residences and potential effects to the sucker (USFWS 2007a). This biological opinion addressed forty-six residences in Big Tujunga Canyon. Conservation measures included the removal of non-native species from around residences, the use of best management practices, the fixing of faulty septic systems, and education of permittees. In 2009, twenty-six of the residences in the Big Tujunga tract burned during the Station Fire (USFWS 2011a).

In 2009, large portions of the Big Tujunga River watershed burned during the Station Fire, including most of the watershed in the Angeles National Forest. Habitat conditions for the sucker are expected to be altered for several years, with the potential for debris flows, altered substrates due to ash and debris deposition, and increased water temperatures due to the removal of vegetation (USFWS 2011a).

Critical Habitat

There are three units of designated critical habitat for sucker which partially occur on National Forest System lands, including Unit 1A on the San Bernardino National Forest and Units 2 and 3 on the Angeles National Forest. About 220 ac (89 ha) of Unit 1A occurs on the San Bernardino National Forest, including portions of City and Mill creeks. About 1,010 ac (409 ha) of Unit 2 and 411 ac (166 ha) of Unit 3 occurs within the Angeles National Forest. Unit 2 includes the San Gabriel River system and Unit 3 includes the Big Tujunga River system.

The primary constituent elements of designated critical habitat include: 1) a functioning hydrological system within the historical geographic range of sucker that experiences peaks and ebbs in the water volume (either naturally or regulated) that encompasses areas that provide or contain sources of water and coarse sediment necessary to maintain all life stages of the species, including adults, juveniles, larvae, and eggs, in the riverine environment; 2) stream channel substrate consisting of a mosaic of loose sand, gravel, cobble, and boulder substrates in a series of riffles, runs, pools, and shallow sandy stream margins necessary to maintain various life stages of the species, including adults, juveniles, larvae, and eggs, in the riverine environment; 3) water depths greater than 1.2 inches (in) (3 centimeters (cm)) and bottom water velocities greater than 0.01 foot per second (0.03 meters (m) per second); 4) clear or only occasionally turbid water; 5) water temperatures less than 86 °F (30 °C); 6) instream habitat that includes food sources (such as zooplankton, phytoplankton, and aquatic invertebrates), and associated vegetation such as aquatic emergent vegetation and adjacent riparian vegetation to provide: a) shading to reduce water temperatures when ambient temperatures are high, b) shelter during periods of high water velocity, and c) protective cover from predators; and 7) areas within perennial stream courses that may be periodically dewatered, but that serve as connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted.

Effects of the Action

This biological opinion does not rely on the regulatory definition of –destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete our analysis on the effects of the proposed project on critical habitat.

Fire retardant application in sucker occupied and designated critical habitat should occur rarely. Only a small portion of the Angeles and San Bernardino national forests will be subject to fire retardant applications annually. Based on data from 2000-2010, these forests averaged 561 ac (227 ha) of fire retardant applications per year over 1,346,355 ac (544,850 ha) of Forest Service land. Given the relatively low percentage of Forest Service land with fire retardant applications per year (<0.1 percent), the chance of an application in sucker habitat is generally low. Also, since the Forest Service proposes to avoid fire retardant application in sucker habitat by providing maps and guidance to aerial fire-fighting personnel, the potential for an application to occur in sucker habitat is further minimized. Only in cases of a misapplication or to protect human life would fire retardant be applied in sucker habitat and misapplications occur. Data from 2008-2010 indicate that misapplications represent less than one percent of fire retardant applications (USFS 2011). In addition, since the listing of the sucker in 2000, no fire retardant applications within its habitat have been reported with use of a 300-foot (91 m) generic avoidance zone for rivers and streams. Under the proposed action, the avoidance zone would be 600 ft (183 m) around sucker habitat, further decreasing the potential for a misapplication.

Use of fire retardant has the potential to benefit the sucker. Wildfires in southern California have resulted in devastating impacts to federally listed aquatic species in some cases. Much of Big Tujunga Canyon was burned during the Station Fire in 2009 with potential impacts to habitat conditions for the sucker. If use of fire retardant can help avoid or minimize the impacts of wildfire on the sucker, it may be overall beneficial even if some level of adverse impacts may occur.

Direct Effects

Mortality of sucker adults, juveniles, fry and eggs could occur from fire retardant due to the intake and build-up of ammonia. According to a simulation provided in Norris and Webb (1989), the streams most closely aligned with the San Gabriel and Big Tujunga rivers could have mortality to all age classes of sucker from 1,968 to 7,218 ft (600 to 2,200 m) downstream from a direct application of fire retardant to water. This probably overestimates the extent of impacts to the sucker, since the creeks used by Norris and Webb (1989) in their simulation are considerably smaller in size than the Big Tujunga or San Gabriel rivers.

To determine how often this impact would occur during the life of the project (10 years), we can use the history of fire retardant applications in sucker habitat. Since listing of the sucker in 2000, no fire retardant use within the 300-foot (91-m) buffer from sucker occupied habitat has been reported, despite large wildfires in this habitat in 2002 and 2009. Under the proposed action, the avoidance zone from sucker occupied habitat will be increased to 600 ft (183 m), which should further decrease the potential for a misapplication. Based on this history and the larger buffer, it appears that the potential for a fire retardant application in sucker occupied habitat is low. We estimate that over the life of the proposed action no more than one fire retardant application will occur within the buffer zone of sucker occupied habitat that will impact this species.

Thus, presuming a reasonable worst case scenario of direct application to water, mortality of sucker could occur over 1,968 to 7,218 ft (600 to 2,200 m) of stream habitat once every 10 years. This constitutes about ten percent of the occupied habitat within the Big Tujunga River watershed and six percent of the occupied habitat within the San Gabriel River watershed.

In addition to mortality, sublethal effects could occur to the sucker including skin, eye, and gill damage; reduced hatching success; reduced growth rate; impaired morphological development; injury to gill tissue, liver, and kidneys; and the development of hyperplasia (USFS 2011). These impacts could potentially occur within a greater reach of the rivers than the area of mortality.

However, Buhl and Hamilton (1998) suggest that chronic impacts to fish due to fire retardant are not likely since most of the ammonia in a stream is transformed into nitrate and soluble organic nitrogen within 24 hours. Regardless, the potential for low concentrations of ammonia to cause problems for fish for an extended timeframe is a possibility. Since the estimate for lethal impacts likely overestimates the distance where lethal impacts will occur and given the size of the Big Tujunga and San Gabriel River watersheds, we expect that sublethal impacts will not extend beyond 1,968 to 7,218 ft (600 to 2,200 m).

Regardless, populations of suckers in the East, West, and North forks of the San Gabriel River are likely to survive a direct fire retardant application to water due to the multiple stretches of stream available to provide refugia and the perennial streamflow, which should help flush retardant. Unlike the San Gabriel River, Big Tujunga Canyon can dry in the late summer to early fall to the point that suckers are restricted to isolated pools for some areas (65 FR 19686) with a low streamflow (USFWS 2007a). However, suckers also occur intermittently over many miles of habitat within the Big Tujunga River watershed, including within at least two tributaries, at Haines Creek and Little Tujunga canyons (USFWS 2011a). Thus, due to the dispersed nature of the species combined with the extent of the watershed, a fire retardant application within the Big Tujunga River watershed is unlikely to extirpate this species from this area.

Further, fire retardant application within the range of sucker is most likely to occur during the primary fire season in southern California, which is August to October. Since the primary spawning season for the sucker is mid-March to early July (USFWS 2011a), most fire retardant applications in habitat for this species would occur after the spawning season. Thus, the impact to the sucker should also be minimized by the temporal nature of the impacts and the fecund nature of the species, which has adapted to re-populate rapidly following flood events. Females can produce 4,000-16,000 eggs (65 FR 19686); thus, this species can repopulate streams temporarily affected by a fire retardant application.

Finally, according to the simulation by Norris and Webb (1989), not all suckers would die within the 1,968 to 7,218 ft (600 to 2200 m) area downstream from a fire retardant application. The amount of mortality is likely to decline as fire retardant becomes diluted and moves downstream within this area. Norris and Webb (1989) indicated that the point at which mortality would be expected to decline depends on the width, depth, and velocity of the stream and other stream characteristics (amount of riffles, pools, and channelization). Based on the Norris and Webb (1989) simulation and using the streams most closely aligned with the Big Tujunga and San Gabriel River watersheds, mortality should sharply drop from one hundred percent after reaching 1,968 to 4,593 ft (600 to 1,400 m) downstream from a fire retardant application.

Indirect Effects

Fire retardant applications to aquatic systems could result in the mortality of macroinvertebrates, a food source for sucker. Macroinvertebrates show variable responses from no response to high mortality due to fire retardant (USFWS 2008). Macroinvertebrates drift to escape fire retardant applications, but many may still die (USFWS 2008). However, macroinvertebrates account for only about one percent of the diet of the sucker (Greenfield et al. 1970); thus, the impacts due to temporary loss of macroinvertebrates should be minimal.

Effects on Critical Habitat

A fire retardant application in designated critical habitat could impact primary constituent elements 4 (water quality) or 6 (food sources). Designated critical habitat may become unusable to the sucker until the fire retardant is flushed from the system, which could reduce the ability of the habitat to provide reproductive opportunities and access to some food resources.

However, the impacts to designated critical habitat for the sucker should be temporary since the fire retardant will eventually be flushed from the system, and most of the ammonia in a stream would be transformed into nitrate and soluble organic nitrogen within 24 hours. Further, the San Gabriel River Unit contains multiple tributaries that contain refugia for the sucker, and these are not likely to be impacted simultaneously. The Big Tujunga and Santa Ana units contain substantial areas off of Forest Service lands that can provide refugia for the sucker until fire retardant is flushed from the system. Finally, fire retardant application in sucker designated critical habitat should be rare due to the low levels of misapplications and the proposed mapping and implementation of a 600-foot (183-m) avoidance area for designated critical habitat.

Effect on Recovery

No recovery plan exists for sucker, but a 5-year review was completed on March 10, 2011, which provided management recommendations for the next 5 years for this species (USFWS 2011a). Based on the discussion above, fire retardant application in sucker occupied and designated critical habitat should occur rarely, especially during the spawning season. If fire retardant application does occur in sucker occupied or designated critical habitat during the spawning season, impacts are expected to be minimal due to the extent of occupied and designated critical habitats, the amount of these areas off Forest Service lands, the temporary nature of the impacts to habitat conditions, and the fecund nature of the species. Thus, implementation of the recommendations for this species in the 5-year review should not be impeded and the ability of this species to recover should not be affected.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the sucker and is not likely to adversely modify designated critical habitat. We reached this conclusion for the following reasons:

1. The potential for an application of fire retardant in sucker occupied and designated critical habitat is low due to the amount of fire retardant applied annually compared to the extent of Forest Service land. Also, applications in occupied and designated critical

habitat will only occur due to misapplications or to save human life, and misapplications occur rarely.

2. Impacts should be effectively minimized based on the sucker's high fecundity and ability to repopulate following catastrophic events, the extent of sucker populations within the Big Tujunga and San Gabriel watersheds, and the temporary nature of the impacts to habitat conditions.

3. Impacts to designated critical habitat will not result in a permanent loss of habitat and substantial areas of designated critical habitat will be available to provide refugia for the sucker post-fire retardant application.

4. No recovery plan exists for sucker. However, implementation of the management recommendations from the 5-year review should not be impeded. Due to the extent of populations in the Big Tujunga and San Gabriel watersheds compared to the potential impacts, the temporary nature of the impacts, and the fecund nature of the species, we do not expect that the proposed action will impact the ability of this species to recover.

Shasta crayfish (*Pacifastacus fortis*)

Environmental Baseline

As of 2011, the California Department of Fish and Game's (CDFG) California Natural Diversity Database (CNDDB) indicated 19 occurrences for this species in Shasta County (CNDDB 2011). Three of these occurrences have been determined to have been extirpated and four and portions of another occurrence have been possibly extirpated (CDFG 2011, Spring Rivers Ecological Sciences LLC 2011). None of these locations are on Forest Service lands; however, they are hydrologically connected to Forest Service lands.

Shasta crayfish are found in the Fall River, Rising River, and Hat Creek subdrainages, the mainstem Pit River between the Fall River confluence and the Pit 1 Powerhouse, and Sucker Springs Creek, which is a tributary to the Pit River between the Pit 1 Powerhouse and Hat Creek. Within the Fall River subdrainage, Shasta crayfish are now found only in the headwaters and upper reaches, and are generally associated with springs. Similarly, Shasta crayfish in Sucker Springs Creek and in the mainstem Pit River are generally associated with springs. When surveyed in the mid-1990s, Shasta crayfish within the lower Hat Creek subdrainage were only found in the tributaries, namely Crystal Lake and the Rising River subdrainage. In the Rising River subdrainage, Shasta crayfish were found in areas away from spring inflows.

Fall River Drainage-Shasta crayfish are found in four geographic regions within the headwaters of the Fall River drainage: the upper Fall River, Spring Creek, Lava Creek, and the Upper Tule River and Big Lake.

Upper Fall River -Two Shasta crayfish subpopulations of substantial size exist in the upper Fall River (Thousand Springs above the barrier and Rainbow Spring), but both are threatened by non-native signal crayfish (Spring Rivers Ecological Sciences LLC 2009). The remaining subpopulations in the Upper Fall River are either declining or have been extirpated. The Upper Fall River Crayfish Barrier Project benefits the Shasta crayfish in the upper Fall River at Thousand Springs by creating a barrier to continued upstream migration of the non-native signal crayfish and by including efforts to remove signal crayfish. Shasta crayfish have also been found in the upper Fall River between the barrier and the limits of navigation downstream of Thousand Springs and Rainbow Spring, but numbers have been declining since the invasion of signal crayfish. In the 1990's, Shasta crayfish were found at Fletcher's bend and Lennihan's footbridge but are now believed to have been extirpated (Spring Rivers Ecological Sciences LLC 2009). Thousand Springs is approximately 1,000 feet from Lassen National Forest lands.

Spring Creek -The subpopulation of Shasta crayfish in the upper coves of Spring Creek appears stable, but the invasion of signal crayfish remains a serious threat. The Spring Creek Road Crossing Cavity-Filling Project protects Shasta crayfish by eliminating potential refugia for signal crayfish and by the inclusion of surveys to remove non-native signal crayfish. Potential refuges for non-native crayfish were eliminated by filling the voids, gaps, and cavities in the upstream face of the Spring Creek Road Crossing. The non-native crayfish removal surveys seek to at least control signal crayfish populations in Spring Creek upstream of the road crossing. The Shasta crayfish population in the lower coves of Spring Creek is small and has been declining in recent years, however, as the population of signal crayfish continues to increase (Spring Rivers Ecological Sciences LLC 2009). The Spring Creek population is hyrdrologically connected to Thousand Springs and is approximately 6,000 feet from the Lassen National Forest.

Lava Creek -The Lava Creek population is small and has declined since 1990 when signal crayfish were first found in Lava Creek (Ellis 1999). Recent surveys show that signal crayfish outnumber Shasta crayfish by 10 to 1 (Spring Rivers Ecological Sciences LLC 2009). Lava Creek is approximately 5,000 feet from Lassen National Forest lands.

Upper Tule River-Big Lake -In the upper Tule River, Shasta crayfish have been found in Ja She Creek, northern Big Lake, and along portions of the Tule River levee system (U.S. Fish and Wildlife Service (Service) 1998, Ellis 1999). Along the Tule River levee system; Shasta crayfish have been found at only three sites, all of which are along the PG&E Levee on the south shore of Big Lake, the south shore of the upper Tule River, and the northernmost portion of the east shore of the upper Tule River. In the 1990s, Shasta crayfish were also found along two sections of the abandoned (i.e., unmaintained) levees at Horr Pond and northeast upper Tule River opposite Rat Farm. During crayfish surveys between 1990 and 1992, the majority of Shasta crayfish living along the levees were found along the south shore of Big Lake. Only four Shasta crayfish were found along the south shore of the upper Tule River in 1992, but numerous signal crayfish were found in this area. Shasta crayfish have not been found along PG&E's Lower McArthur Levee. Signal crayfish are now found throughout the upper Tule River. Non-native northern crayfish are also found along the levees and in other relatively warm areas in the upper Tule River (Spring Rivers Ecological Sciences LLC 2009). Big Lake is approximately 1,000 feet from Lassen National Forest lands.

Hat Creek Drainage-During the 2007 Hat Creek surveys, 131 Shasta crayfish were found, accounting for approximately 9 percent of all crayfish captured. Except for two adult Shasta crayfish at the Crystal Lake Outflow, all Shasta crayfish were found in Southwest Crystal Lake. The 1,379 signal crayfish found in Crystal and Baum Lakes accounted for the other 91 percent of all crayfish captured (Ellis and Cook 2008). Crystal Lake is approximately 2,000 feet from Lassen National Forest lands.

The only clear trend in the Shasta crayfish population in the Hat Creek Project area has been the decline of the Shasta crayfish population at the Crystal Lake outflow. In 1978, Daniels (1978, 1980) estimated the size of the Crystal Lake outflow Shasta crayfish population to be 2000 to 3000 individuals and one of the largest, densest populations that he surveyed. In 2007, only two Shasta crayfish were found at the Crystal Lake outflow. The removal of signal crayfish during the monitoring surveys: 2458 in 2003, 1717 in 2004/2005, and 457 in 2007 appears to have resulted in a significant decrease in size of the signal crayfish population at Crystal Lake Outflow. Although removal of signal crayfish during the monitoring surveys will not eradicate the species from this or other areas, it might keep signal crayfish numbers depressed and promote Shasta crayfish survival.

Rising River Drainage-The Rising River Shasta crayfish populations were free of signal crayfish as of the last comprehensive surveys conducted in 1995. At that time, signal crayfish were found in Rising River, approximately 0.78 mile below the Cassel Road Bridge (Service 1998). Given that there are no barriers to the upstream migration of signal crayfish, the Rising River population may have already been invaded by signal crayfish since the 1995 surveys. It is unknown if this population is stable or declining. Efforts are being made to obtain landowner permission to survey Rising River as it has not been surveyed since 1995. Portions of Rising River occur on Lassen National Forest lands.

Pit River Drainage-Although Shasta crayfish have been found in four locations in the mainstem Pit River, three upstream (i.e., Pit 1 Bypass Reach) and one downstream of the Pit 1 Powerhouse, they are currently only found at two locations, both in the Pit 1 Bypass Reach upstream of the approximately 30-foot high Pit River Falls. Shasta crayfish are not believed to occupy the mainstem Pit River downstream of the Pit 1 Powerhouse since none have been found during multiple surveys conducted in this area since 1978.

Shasta crayfish are known to occur in an approximately 1,970-foot long reach of the mainstem Pit River that is cooled by springs a short distance upstream of the Pit River Falls (Spring Rivers

Ecological Sciences LLC 2009). Sampling difficulties created by the large substrate (the average substrate size in the Pit River is larger than can be moved by hand) make it difficult to determine the size of the Shasta crayfish population in the Pit 1 Bypass Reach. Nevertheless, a significant decline in Shasta crayfish numbers in this 1,970-foot reach has been observed since the new license flow regime was implemented (USFWS 1998, Ellis 1999, Spring Rivers Ecological Sciences LLC 2009). In October 2005, a total of 21 Shasta crayfish (6 adults, 7 juveniles, and 8 young-of-year) were found in this reach, but only one adult male Shasta crayfish was found in September 2008 (Spring Rivers Ecological Sciences LLC 2009). This population is approximately three miles from Lassen National Forest Lands.

Shasta crayfish were also found near an outflow of a spring in the lower Pit 1 Bypass Reach

1.3 miles downstream of the Pit River Falls and 0.8 mile upstream from the Pit 1 Powerhouse tailrace (Service 1998). After an extensive survey of this area in 1995, a single dead juvenile male Shasta crayfish was found under a cobble in the outflow area of the spring. A single dead juvenile male Shasta crayfish was also found at this site 15 years earlier during a survey in 1980 (Service 1998, Ellis 1999). No Shasta crayfish have been found at this site during subsequent surveys (Spring Rivers Ecological Sciences LLC 2009).

The Sucker Springs Creek subpopulation of Shasta crayfish currently reside only in Pond 1 and is estimated at fewer than 100. A multi-year restoration project is currently being implemented with the first phase consisting of signal crayfish eradication. Sucker Springs is approximately 3,000 feet from Lassen National Forest Lands.

Effects of the Action

Direct Effects

Since Shasta crayfish do not occur on Forest Service lands, the Service does not anticipate any direct effects from the project.

Indirect Effects

As cited in the BA, simulations run by Norris and Webb (1989) showed ammonia concentrations could remain at lethal levels between 0 and 6.2 miles downstream, depending on stream characteristics and the size of the retardant load. Van Meter and Hardy (1975) also found that concentrations of retardant high enough to kill 10 percent of the fish population were measurable over 4 miles downstream. Additionally, as cited in the BA, sublethal effects are expected to occur further downstream than the 6.2-mile lethal distance.

While the likelihood is low, if misapplication of retardant occurs on or adjacent to a Shasta crayfish-occupied water body or retardant run-off enters Shasta crayfish-occupied waterways, it is expected to adversely affect Shasta crayfish. If retardant enters occupied habitat, Shasta crayfish are susceptible to lethal effects. Fire retardant is slight to moderately toxic to the amphipod crustacean *Hyalella azteca* (Adams and Simmons 1999, McDonald *et al.* 1997). Limited studies have been done on crayfish species with no assessment for effects to Shasta crayfish. One study incidentally reported that crayfish climbed out of the stream during exposure to the retardant 128 mg GTS-R/liter (Little and Calfee 2004), however Shasta crayfish cannot leave the water due to biological limitations of this species. Alternatively, the Shasta crayfish's non-native predator/competitors, signal crayfish (*Pacifastacus leniusculus*) and fantail crayfish (*Orocenectes virilis*), can leave the water and may be able to avoid lethal effects from fire retardant. The potential mortality of Shasta crayfish coupled with the ability for their predator/competitors to possibly avoid lethal effects may compound adverse effects to the population. Additionally, the non-native Guar gum, a flocculant additive to retardants, may inhibit respiration and egestion in bottom-dwelling invertebrates such as amphipods (referenced in Adams and Simmons 1999). Although crayfish were not discussed in this study, since they are bottom-dwelling invertebrates, we presume they could be adversely affected as well. Sublethal effects with this project may include altering nutrient and food base that the Shasta crayfish are dependent upon.

Conclusion

After reviewing the current status of the Shasta crayfish, the environmental baseline for the action area, and the effects of the proposed action, it is the Service's biological opinion that the Nationwide Aerial Application of Fire Retardant on National Forest System Land Project is not likely to jeopardize the continued existence of Shasta crayfish. While there is a small chance that retardant may enter a waterway, there are no known populations on Forest Service lands and the likelihood of a population being exposed to retardant is anticipated to be marginal with the implementation of the 1,000 buffer around hydrological connected waterways within the 6.2-mile lethal zone and the implantation of the additional conservation measures. We based this conclusion on the following: (1) Shasta crayfish do not occur on Forest Service lands, (2) the Forest Service will implement the conservation measures including the 1000-foot buffer from waters hydrologically connect to occupied habitat and (3) the small likelihood of misapplication in waters hydrologically connected to occupied habitat.

Slender orcutt grass (*Orcuttia tenuis*)

Environmental Baseline

On the Lassen and Modoc National Forests, *Orcuttia tenuis* occupies a wide range of habitats, even sometimes including more or less artificial habitats such as creek flood plains, borrow pits, and the margins of stock ponds and reservoirs (USFWS 2005). Across the volcanic landscape of the southern Cascades and Modoc Plateau it has been found at elevations ranging from approximately 3,050 feet up to 5,760 feet (Lepley and Merriam 2011). The Modoc-Cascades vernal pools containing *O. tenuis* may be of any size from a tiny wetland to a lake, always seasonal in nature, over a water-obstructing substrate of volcanic origin (Lepley and Merriam 2011). These montane pools underlain by volcanic material have been classified as Northern Basalt Flow or Northern Volcanic Mudflow vernal pools, depending on the precise nature of the underlayer (USFWS 2005).

The vegetation surrounding Modoc-Cascades vernal pools is generally a pine forest of *Pinus ponderosa* or *P. jeffreyi* or both (yellow pines), in some places mixed with *Quercus garryana* (white oak) or *Juniperus occidentalis* (western juniper), or an open habitat of grasses, sagebrush, and other shrubs (Lepley and Merriam 2011). On the margins of vernal pools, where *O. tenuis* occurs, there is typically a sparse to moderate cover of herbs and forbs (Lepley and Merriam 2011, p. 7). The species may or may not mix with *Eleocharis macrostachya* (pale spikerush) and *Eryngium mathiasiae*, *E. alismaefolium*, or *E. articulatum* (coyote thistle) in the deeper parts of pools (Lepley and Merriam 2011). In some pools *Artemisia cana* (silver sage) is also part of the mix (Lepley and Merriam 2011).

The current threats to *Orcuttia tenuis* on the Forest Service lands within northeast California are associated with anthropogenic hydrologic alterations, livestock activity, recreational/OHV use, and vegetative competition (Lepley and Merriam 2011). Current conditions of vernal pool habitats on the Modoc and Lassen National Forest are driven by these factors. In addition, livestock grazing on Federal lands in the Modoc-Cascade region resulted in heavy use of vernal pools by livestock as a water source (Lepley and Merriam 2011). Off-highway vehicle and recreationalists will, in many cases, drive through vernal pools creating deep ruts and compacting the soil thereby altering the hydrology of the pool (Lepley and Merriam 2011). If left undisturbed vernal pools are generally resistant to invasive species (Stone 1990). However, disturbance and alteration of their hydrologic functions allows for colonization of nonnatives that are adapted for shorter or longer periods of water inundation (Lepley and Merriam 2011).

Currently, there are 610 vernal pools identified on the Modoc National Forest's 2009 ―vernal pool" GIS layer, totaling 31,589 acres. They range in size from 0.03 acres to 202 acres. A comprehensive assessment of potential habitat quality in these vernal pools has not been completed. However, current occupied habitat has been assessed and their quality ranges from poor to excellent (Lepley and Merriam 2011).

Surveys have occurred on the Modoc National Forest in an attempt to determine the locations of more populations on Federal lands (J. Perkins, personal communication, 2011). Approximately 12,396 acres of vernal pool habitat have been surveyed since 2001 at least once (J. Perkins, personal communication, 2011). Currently there are 31 known populations of *O. tenuis* on the Modoc National Forest. Population size estimates range from 31 individuals-18,500,000 individuals. Total population estimate for *O. tenuis* on the Modoc National Forest is 38,299,582 individuals. There is very little population trend data available for *O. tenuis* on the Modoc National Forest.

On the Lassen National Forest, *Orcuttia tenuis* is known from 20 occurrences, and of these only 14 are found within the 10 Designated Critical Habitat Unit core areas found on the forest, which total approximately 21,885 acres on National Forest System lands. The 20 known occurrences of *O. tenuis* on the forest are known from all three Ranger Districts and there is also one occurrence found on private lands within the administrative boundary of the Almanor Ranger District (USDA 2010).

Effects of the Action

Retardant formulations in use today are primarily inorganic fertilizers (USDA 2011). The best available science suggests that any misapplications and situations with extenuating circumstances that result in an aerial drop of retardants on vernal pool habitats will result in the introduction of both nitrogen and phosphorus into the terrestrial and aquatic systems. These two nutrients are consumed in relatively large quantities by plants (Gardiner 2011). Subsequently, if they are absent from the system they are limiting to plant growth and are therefore commonly added as fertilizers (Gardiner 2011). This increase of nutrient availability has the potential to induce the growth of non-native plants outside the vernal pools that could invade the vernal pools when the vernal pool is dry or during *O. tenuis'* terrestrial and dry phases (Kneitel and Lessin 2010) While periodic water inundation creates inhospitable habitats for most nonnative species, a vernal pool would be vulnerable to this effect of a retardant drop under two scenarios: 1) the retardant drop occurs in a vernal pool during a year with limited water inundation and/or prior to a year with limited water inundation; or 2) if that vernal pool has sustained hydrologic alterations. Increased competition from nonnative plants would likely reduce population numbers and reproductive efforts. In addition, an increase of upland grasses due to an increase of limited nutrients can change the hydrologic function of a vernal pool by decreasing run-off into the vernal pool (Barry 1998). The alteration of the hydrologic function of the vernal pool has the potential to affect *O. tenuis* through the reduction in available habitat. However, at this time, there is no information available to indicate that the interactions with nonnative plant species or reduction in habitat that may be facilitated by the proposed action will result in the extirpation of individual *O. tenuis* populations.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, it is the Service's biological opinion that the proposed actions are not likely to jeopardize the continued existence of *Orcuttia tenuis*.

Our conclusion is based on the following reasons: (1) the spatial extent of the anticipated effects is small in comparison to the species' current distribution; (2) adverse effects are considered relatively minor; and/or (3) the Service does not anticipate the loss or reduced viability of plant populations within the action area.

We concur that these designated critical habitats are not likely to be adversely affected by the proposed action for the following reasons: 1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated critical habitats; and 3) the potential effects to the primary constituent elements and essential features is considered short-term and/or insignificant

Slender-horned Spineflower (*Dodecahema leptoceras*)

Environmental Baseline

Five of the twenty remaining populations of slender-horned spineflower (–spineflower") occur on Forest Service lands, including a population at Arroyo Seco on the Cleveland National Forest and four populations on the San Bernardino National Forest. The populations on the San Bernardino National Forest include two populations at Bautista Canyon, one population at the North Fork San Jacinto River, and one population at Cajon Wash (USFS 2008, USFWS 2010). The Arroyo Seco population is estimated to include 512 plants (USFWS 2010), the Bautista Canyon populations are estimated to include 900 plants (USFWS 2010), the San Jacinto River population is estimated to include between several hundred to 1,000 plants (USFS 2008), and the Cajon Wash population is estimated to include 5,000 plants (USFS 2008). However, the number of spineflower plants within a population can change from year to year, so the number and distribution of populations is the best reflection of overall abundance (USFWS 2010).

Small population size threatens spineflower. With the exception of the Bautista Canyon populations, spineflower populations within the action area are isolated from other spineflower. Pollen and seed transport between the isolated populations and other spineflower would likely be low, if it happens at all (USFWS 2010). If extirpation of one of the isolated populations occurs, natural re-establishment is unlikely.

Spineflower within the action area may also be threatened by competition with nonnative plants, although specific information regarding the nature or extent of this threat is limited. Extirpation of at least one spineflower population was attributed to nonnative plants (USFWS 2010).

Effects of the Action

Fire retardant application in spineflower occupied habitat should occur rarely. Only a small portion of the San Bernardino or Cleveland national forests will be subject to fire retardant applications annually. Based on data from 2000-2010, these forests combined averaged 376 ac (152 ha) of fire retardant applications per year over 1,346,355 ac (544,850 ha) of Forest Service land (USFS 2011). Given the relatively low percentage of Forest Service land with fire retardant applications per year (<0.1 percent), the chance of an application occurring in the relatively small area occupied by spineflower is generally low. Also, since the Forest Service proposes to avoid fire retardant application in spineflower occupied habitat by providing maps and guidance to aerial fire-fighting personnel, the potential for an application to occur in spineflower occupied habitat is further minimized. Only in cases of a misapplication or to protect human life would fire retardant be applied in spineflower occupied habitat and misapplications occur rarely. Data from 2008-2010 indicate that misapplications occur on less than one percent of fire retardant applications (USFS 2011).

Direct Effects

Fire retardant applications could impact spineflower via short-term (1-2 growing seasons) phytotoxic effects, including leaf burning, shoot die-back, a decrease in germination, and plant death. These impacts could occur over about 1-1.5 ac (0.4-0.6 ha) for the average fire retardant application [*i.e.*, the average fire retardant application covers about 800 feet (ft) (244 meters (m)) by 50-75 ft (15-23 m) (USFS 2011)].

However, fire retardant application within range of spineflower is most likely to occur during the primary fire season in southern California, which is August to October. Since the flowering season for spineflower is April to June (Hickman 1993), most fire retardant applications in habitat for this species would occur after seed-set and after plant senescence.

Also, while the average fire retardant application covers about 1-1.5 ac (0.4-0.6 ha), applications are linear, so only a small portion of a given application would be expected to occur in spineflower occupied habitat. Thus, it would be unlikely for a population to be completely covered by fire retardant.

Finally, studies indicate that the seedbank for spineflower is long-lived (Ferguson and Ellstrand 1999), and some level of disturbance may aid germination (USFWS 2010). Thus, the portions of a spineflower population subject to the direct impacts of a fire retardant application are likely to recover either by re-establishment from directly adjacent spineflower individuals or via the seedbank.

Indirect Effects

Nonnative plants could be enhanced by fire retardant application and impact spineflower. Many spineflower populations are located proximal to nonnative plants (52 FR 36265) that could be enhanced by fire retardant. Nonnative plants could decrease water availability for spineflower via competition and create a thatch from dead grasses that prevents spineflower seedling establishment. Also, nonnative plants could shade spineflower and reduce access to sunlight and photosynthesis (52 FR 36265). Further, nonnative plants could alter the fire regime including the frequency, intensity, extent and seasonality of fire, and result in a feedback cycle for further enhancement of nonnative plant growth (Brooks et al. 2004) and ultimately result in type conversion. In addition, nonnative plants can change soil properties, resulting in alterations in plant community composition (Ehrenfeld et al. 2001). Finally, enhanced nonnative plants could help attract additional grazing animals, which may trample or consume spineflower.

While fire retardant could enhance nonnative plants, it could also enhance spineflower growth. Fire retardants contain nitrogen and phosphorus that could act as nutrients to spineflower.

Individual and plant community responses from changes in nutrient availability are complex and site specific, and most studies address the potential effects to crop species. Studies on the potential benefits to native plant species from nutrients in fire retardants are limited, and no such studies exist that focus on spineflower.

Regardless, if fire retardant is applied to spineflower occupied habitat, the Forest Service will monitor the site and implement actions to remove nonnative plants upon detecting the enhancement of nonnative plants due to fire retardant application. Based on the implementation of these measures, impacts to spineflower due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

Effect on Recovery

No recovery plan exists for spineflower, but a 5-year review was completed on October 1, 2010, which provided management recommendations for the next five years for this species (USFWS 2010). Based on the discussion above, fire retardant application in spineflower occupied habitat should occur rarely, especially during the flowering season. If fire retardant application does occur in spineflower occupied habitat during the flowering season, impacts are expected to be effectively avoided or minimized due to the size and linear nature of fire retardant applications and the proposed removal of nonnative plants, as appropriate. With monitoring and appropriate nonnative plant removal, long term changes to spineflower populations or habitat conditions are not likely to occur and implementation of the recommendations for this species in the 5-year review should not be impeded. Thus, the ability of this species to recover should not be affected.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of spineflower. We reached this conclusion for the following reasons:

1. The potential for an application of fire retardant in spineflower occupied habitat is low due to the amount of fire retardant applied annually compared to the extent of Forest Service land. Also, applications in occupied habitat will only occur due to misapplications or to save human life, and misapplications occur rarely.

2. Direct impacts should be effectively avoided or minimized due to the application of fire retardant in spineflower occupied habitat primarily outside the flowering season, the size and linear nature of fire retardant applications, and the long-lived nature of the spineflower seedbank.

3. Due to the proposal to conduct monitoring after a fire retardant application in spineflower occupied habitat and remove nonnative plants, as appropriate, impacts due to nonnative plants enhanced from a fire retardant application should be short term and temporary.

4. No recovery plan exists for spineflower. However, implementation of the management recommendations from the 5-year review should not be impeded. Due to the expected short term and temporary nature of the potential impacts, we do not expect that the proposed action will impact the ability of this species to recover.

Smith's blue butterfly (*Euphilotes enoptes smithi*)

Environmental Baseline

The Smith's blue butterfly's range consists of an approximately 80 linear mile strip along the coast of central California; 45 of these miles lie within the boundaries of the Los Padres National Forest. In the Monterey Ranger District (MRD) of the Los Padres National Forest, the Smith's blue butterfly's host plant, seacliff buckwheat (*Eriogonum latifolium*), is distributed throughout cliffside chaparral, coastal scrub, and coastal grassland communities and their ecotones. Seacliff buckwheat is also present along road cuts and in ruderal or disturbed areas. Comprehensive surveys for the Smith's blue butterfly have not been conducted within the Los Padres National Forest, although during the flight season of 2002, Arnold (2002) documented more than 346 adults at 69 locations in the greater Big Sur area and the MRD of the Los Padres National Forest. Long-term monitoring has not occurred for any population of the Smith's blue butterfly. Most of our knowledge of the distribution of the species is the result of singular observations made in the past 30 years. Therefore, the number, size and persistence of colonies throughout the range of the species are not well understood. The Forest Service has identified and mapped approximately 543 acres of Smith's blue butterfly occupied habitat.

Effects of the Action

Based on the general effects of the action, fire retardant applications in occupied habitat could potentially kill adults or larvae due to exposure to toxic retardant chemicals. Adults would be vulnerable during their single flight season from mid-June to early September, while larvae would be vulnerable between mid-August and early September, when they pupate. The Forest Service proposes to avoid fire retardant application in Smith's blue butterfly occupied habitat by providing maps and guidance to aerial fire-fighting personnel, the potential for an application to occur in Smith's blue butterfly occupied habitat is minimized. Only in cases of a misapplication or to protect human life would fire retardant be applied in Smith's blue butterfly occupied habitat and misapplications do not occur often. Three years of data, from 2008-2010, indicate that misapplications occur in less than 0.1 percent of fire retardant applications (USFS 2011).

Based on the general effects of the action, nonnative plants could be enhanced by fire retardant application. Nitrogen and phosphorus could be increased in the soil through the application of ammonium-based retardants, which would encourage the growth of nonnative invasive species and give them a competitive advantage over seacliff buckwheat. These invasive plant species may have the ability to displace seacliff buckwheat by outcompeting and monopolizing the limited resources (soil nutrients, water, sunlight, pollinators), with the potential effects of preventing growth and recruitment.

We have found that non-native plants are contributing to the fragmentation of habitat for the Smith's blue butterfly because Smith's blue butterflies abandon areas where seacliff buckwheat is replaced by other vegetation (USFWS 2004). Adults would be expected to disperse and colonize new areas that contain adequate patches of host buckwheat plants but as the quality of suitable habitat is degraded, the distance dispersing adults must travel to reach other suitable habitat is increased. Adult Smith's blue butterflies are neither strong nor active fliers; therefore, colonies may become isolated if suitable habitat is not available nearby for dispersal and colonization (USFWS 2004). Arnold (1991) found that the density and age class distribution of seacliff buckwheat and coast buckwheat appear to be important determinants for the establishment and persistence of Smith's blue butterfly populations in some locations.

If fire retardant is applied to Smith's blue butterfly occupied habitat, the Forest Service will monitor the site where retardant was dropped and implement actions to remove nonnative plants if colonization by nonnative plants due to fire retardant application is observed. With implementation of monitoring and removal of nonnative species, impacts to the Smith's blue butterfly population due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the Smith's blue butterfly, environmental baseline for the action area, effects of potential misapplication of retardant on occupied Smith's blue butterfly habitat, and cumulative effects, it is our biological opinion that the use of aerially-applied fire retardant on National Forest System lands is not likely to jeopardize the continued existence of the Smith's blue butterfly. The proposed action would not lead to a substantial decline in number of Smith's blue butterfly and would not preclude the recovery of Smith's blue butterfly. This conclusion is based on the following reasons:

9. The Forest Service will establish a 300-foot buffer on known Smith's blue butterfly occupied habitat and retardant applications in occupied habitat will only be the result of misapplications, which occur rarely, or by exception to save human life.

10. The Forest Service proposes to conduct monitoring after a fire retardant application in Smith's blue butterfly occupied habitat and remove invasive nonnative plants so that impacts due to nonnative plants enhanced from a fire retardant application should be short term and temporary.

11. Due to the expected short term and temporary nature of the potential impacts, we do not expect that the proposed action will impact the ability of this species to recover.

The USFS determined there would be no effect from the use of aerially-applied fire retardant on National Forest System lands on critical habitat for this species; therefore, the USFWS did not address critical habitat for this species.

Springville clarkia *(Clarkia springvillensis)*

Environmental Baseline

The Sequoia National Forest is known to contain nine occurrences of *Clarkia springvillensis* growing in openings within the chaparral and foothill woodland plant communities in the Tule River watershed near Springville, California (USDA 2010). Of the nine occurrences, there is no information regarding either the area occupied or the number of individual plants. Currently, nonnative plants such as *Bromus* species, *Brassica* species, *Torilis* species (hedge-parsley), and *Centaurea melitensis* are known to occur within habitats occupied by *C. springvillensis*.

Effects of the Action

Clarkia springvillensis flowers from May to late June, thus the plant is active during times when fire retardant may be used. However, there is no specific information available to determine whether the application of fire retardant will directly affect *C. springvillensis*. *Clarkia springvillensis* tends to grow in open, relatively unvegetated areas. Several of these populations cover long, linear areas (approximately 0.25 to 1 mile in length and 300 feet wide), parallel and adjacent to streams. Being adjacent to a stream, these locations have a reduced probability of a retardant drop hitting a population due to the 300-foot buffer zone guidelines. However, if a retardant drop was keyed into a water course adjacent to a Springville Clarkia population, it is highly unlikely that the entire population would be hit by the retardant because of the long, linear nature of these populations; rather a small portion of a population may be affected.

The primary threat to *Clarkia springvillensis* is competition and thatch build-up from non-native plants (USFWS 2008). Retardant formulations in use today are primarily inorganic fertilizers (USDA 2011) and based on the general effects of the action, nonnative plants could be enhanced by fire retardant application. Since *C. springvillensis* is known to occur in areas occupied by nonnative plant species if retardant were dropped on *C. springvillensis*, we would expect increased competition from non-native plants that may reduce population numbers and reproductive efforts of *C. springvillensis* in that area. Given the geographic extent of an individual plant population within the action area, we do not anticipate the proposed action would result in extirpation of the *C. springvillensis* populations on the Sequoia National Forest.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, it is the Service's biological opinion that the proposed actions are not likely to jeopardize the continued existence of *Clarkia springvillensis*.

Our conclusion is based on the following reasons: (1) the spatial extent of the anticipated effects is small in comparison to the species' current distribution; and (2) the Service does not anticipate the loss of plant populations within the action area.

Stebbins' morning glory (*Calystegia stebinsii*)

Environmental Baseline

Calystegia stebinsii is known to occur within an 80-acre area on the Tahoe National Forest within an area dominated by manzanita and mixed brush (VanZuuk 2010). The *C. stebinsii* in the Tahoe National Forest is located in an area that is currently affected by off-highway vehicle use, invasion of nonnative plant species, and conversion of habitat due to the planting of conifers (VanZuuk 2010).

Effects of the Action

Calystegia stebinsii flowers from May to June, thus the plant is active during times when fire retardant may be used. However, there is no specific information available to determine whether the application of fire retardant will directly affect this species. If retardant were to be applied directly to *C. stebinsii* it is anticipated that the individual plant may senesce prior to seed set, but since *C. stebinsii* is a perennial herb that has the ability to sprout from a rootstock, we do not anticipate the loss of individual plants as a direct result on the aerial application of fire retardant. However, since *C. stebinsii* is an early successional species that occupies temporary openings and is eliminated as vegetation grows up around it invasion and competition from nonnative plants poses a threat.

Retardant formulations in use today are primarily inorganic fertilizers (USDA 2011) and based on the general effects of the action, nonnative plants could be enhanced by fire retardant application. Since *Calystegia stebinsii* is known to occur in areas occupied by nonnative plant species if retardant were dropped on habitats occupied by *C. stebinsii* we would expect increase competition from non-native plants that may reduce population numbers and reproductive efforts of *C. stebinsii* in that area. Given the size of the area occupied by the individual occurrence of *C. stebinsii*, and the average fire retardant application covers about 1-1.5 acres, only a small portion of the total population would be expected to be affected. Therefore, we do not anticipate the proposed action would result in extirpation of the *C. stebinsii* population on the Tahoe National Forest.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, it is the Service's biological opinion that the proposed actions are not likely to jeopardize the continued existence of *Calystegia stebinsii*.

Our conclusion is based on the following reasons: (1) the spatial extent of the anticipated effects is small in comparison to the species' current distribution; (2) the Service does not anticipate the loss of plant populations within the action area; and (3) the potential effects to the species are anticipated to be minor.

Thread-leaved Brodiaea (*Brodiaea filifolia*)

Environmental Baseline

There are 270 ac (109 ha) of thread-leaved brodiaea (―brodiaea") occupied habitat on national forest lands, all within the Cleveland National Forest. There are two populations on the Cleveland National Forest, at Miller Mountain and Devil's Canyon. The occurrences on the Cleveland National Forest have hybridized with Orcutt's brodiaea (*Brodiaea orcuttii*). The Devil's Canyon population has less hybridization than the Miller Mountain population and has at least 850 non-hybridized individuals (USFWS 2008g). Ninety-three percent of the occupied habitat is adjacent to or in the San Mateo Canyon Wilderness.

In 2001, a non-jeopardy biological opinion was issued on the Cleveland National Forest grazing program (USFWS 2001c), including an analysis of potential impacts to brodiaea. Grazing occurs on a significant amount of occupied habitat at Miller Mountain. The Forest Service allows grazing in brodiaea habitat from August-December and avoids most of the growing, flowering, and seed-set period for this species and the time when soil compaction is most likely to occur.

Effects of the Action

Fire retardant application in brodiaea occupied habitat should occur rarely. Only a small portion of the Cleveland National Forest will be subject to fire retardant applications annually. Based on data from 2000-2010, this Forest averaged 61 ac (25 ha) of fire retardant applications per year over 439,035 ac (177,671 ha) of Forest Service land. Given the relatively low percentage of Forest Service land with fire retardant applications per year (<0.1 percent), the chance of an application occurring in the relatively small area occupied by brodiaea is generally low. Also, since the Forest Service proposes to avoid fire retardant application in brodiaea occupied habitat by providing maps and guidance to aerial fire-fighting personnel, the potential for an application to occur in brodiaea occupied habitat is further minimized. Only in cases of a misapplication or to protect human life would fire retardant be applied in brodiaea occupied habitat and misapplications occur rarely. Data from 2008-2010 indicate that misapplications occur on less than one percent of fire retardant applications (USFS 2011).

Direct Effects

Fire retardant applications could impact brodiaea via short-term (1-2 growing seasons) phytotoxic effects, including leaf burning, shoot die-back, a decrease in germination, and plant death. These impacts could occur over about 1-1.5 ac (0.4-0.6 ha) for the average fire retardant application [*i.e.*, the average fire retardant application covers about 800 ft (244 m) by 50-75 ft (15-23 m) (USFS 2011)].

However, fire retardant application within range of brodiaea is most likely to occur during the primary fire season in southern California, which is August to October. Since the flowering season for brodiaea is March to June (USFWS 2008g), most fire retardant applications in habitat for this species would occur after seed-set.

Also, while the average fire retardant application covers about 1-1.5 ac (0.4-0.6 ha), applications are linear, so only a small portion of a given application would be expected to occur in brodiaea occupied habitat. Thus, it would be unlikely for a population to be completely covered by fire retardant and the portions of a population impacted could re-establish from nearby individuals, as necessary.

Indirect Effects

Nonnative plants could be enhanced by fire retardant application and impact brodiaea. Nonnative plants could decrease water availability for brodiaea via competition and create a thatch from dead grasses that prevents brodiaea seedling establishment. Also, nonnative plants could shade brodiaea and reduce access to sunlight and photosynthesis (52 FR 36265). Further, nonnative plants could alter the fire regime including the frequency, intensity, extent and seasonality of fire, resulting in a feedback cycle for further enhancement of nonnative plant growth (Brooks et al. 2004) and ultimately result in type conversion. In addition, nonnative plants can change soil properties, resulting in alterations in plant community composition

(Ehrenfeld et al. 2001). Finally, enhanced nonnative plants could help attract additional grazing animals, which may trample or consume brodiaea.

While fire retardant could enhance nonnative plants, it could also enhance brodiaea growth. Fire retardants contain nitrogen and phosphorus that could act as nutrients to brodiaea. Individual and plant community responses from changes in nutrient availability are complex and site specific, and most studies address the potential effects to crop species. Studies on the potential benefits to native plant species from nutrients in fire retardants are limited, and no such studies exist that focus on brodiaea.

Regardless, if fire retardant is applied to brodiaea occupied habitat, the Forest Service will monitor the site and implement actions to remove nonnative plants upon detecting the enhancement of nonnative plants due to fire retardant application. Based on the implementation of these measures, impacts to brodiaea due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

Effects on Recovery

No recovery plan exists for brodiaea, but a 5-year review was completed on August 13, 2009, which provided management recommendations for the next five years for this species (USFWS 2009i). Based on the discussion above, fire retardant application in brodiaea occupied habitat should occur rarely, especially during the flowering season. If fire retardant application does occur in brodiaea occupied habitat during the flowering season, impacts are expected to be effectively avoided or minimized due to the size and linear nature of fire retardant applications and the proposed removal of nonnative plants, as appropriate. With monitoring and appropriate nonnative plant removal, long term changes to brodiaea populations or habitat conditions are not likely to occur and implementation of the recommendations for this species in the 5-year review should not be impeded. Thus, the ability of this species to recover should not be affected.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of brodiaea. We reached this conclusion for the following reasons:

1. The potential for an application of fire retardant in brodiaea occupied habitat is low due to the amount of fire retardant applied annually compared to the extent of Forest Service land. Also, applications in occupied habitat will only occur due to misapplications or to save human life, and misapplications occur rarely.

2. Direct impacts should be effectively avoided or minimized due to the application of fire retardant in brodiaea occupied habitat primarily outside the flowering season, and the size and linear nature of fire retardant applications.

3. Due to the proposal to conduct monitoring after a fire retardant application in brodiaea occupied habitat and remove nonnative plants, as appropriate, impacts due to nonnative plants enhanced from a fire retardant application should be short term and temporary.

4. No recovery plan exists for brodiaea, but implementation of the management recommendations from the 5-year review should not be impeded. Due to the expected short term and temporary nature of the potential impacts, we do not expect that the proposed action will impact the ability of this species to recover.

We concur that these designated or proposed critical habitats are not likely to be adversely affected by the proposed action for the following reasons: 1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats. Finally, the potential impact to the primary constituent elements of these critical habitats would occur from nonnative plants. However, the Forest Service will monitor areas of fire retardant application within critical habitats and remove nonnative plants, as appropriate. Thus, any potential enhancement of nonnative plants would be short term and temporary.

Tidewater goby *(Eucyclogobius newberryi)*

Environmental Baseline

No range-wide, long-term monitoring program is currently being conducted for the tidewater goby, and data on population dynamics are limited. Estimates of population size are generally lacking due to the constant variability in local abundance. Seasonal changes in distribution and abundance further hamper efforts to estimate population size for this short-lived species (Service 2007). Tidewater gobies are not present on National Forest Service lands but indirect effects from dropping fire retardant into streams that connect to downstream tidewater goby habitats may occur. The biological assessment states that lethal effects of fire retardant would extend 6.2 miles downstream and sublethal effects may occur much further downstream. However, for the purpose of this consultation, we will use the 6.2 miles as the furthest extent of downstream effects. The following localities of tidewater goby occupied habitat could be affected by fire retardant drops within the Six Rivers National Forest and Los Padres National Forest boundaries.

Six Rivers National Forest

Tidewater goby populations in Tillas Slough are within 6.2 miles of the Six Rivers National Forest (Waln, pers. comm. 2011). The following description of the habitat is found in Chamberlin (2006): Tillas Slough is within the Smith River estuary. Available tidewater goby habitat encompasses approximately 5 to7.5 acres but there may be as much as 500 acres of habitat in the Smith River estuary. All land adjacent to Tillas Slough is privately owned. The area where tidewater gobies have been detected is small and immediately down channel from a metal culvert crossing. Although connected hydrologically to the Smith River estuary, this site is the only recorded location of tidewater gobies in the Smith River watershed.

Los Padres National Forest

Tidewater goby populations in 17 localities within San Luis Obispo County and Santa Barbara County are within 6.2 miles of the Los Padres National Forest (Waln, pers. comm. 2011). In San Luis Obispo County, tidewater gobies in Toro Creek, Cayucos Creek, Old Creek, Chorro Creek, Little Cayucos Creek, Willow Creek, Morro Creek, and Los Osos Creek fall within this distance from the forest. In Santa Barbara County, Arroyo Hondo, Arroyo Quemado, Eagle Canyon, Tecolote Canyon, Devereaux/Phelps Creeks, Goleta Slough, Sycamore Creek, Andre Clark Bird Refuge, and Rincon Creek may be affected.

Recovery Plan for the Tidewater Goby

The overall strategy for recovery of the tidewater goby focuses on 4 primary tasks: (1) monitor, protect, and enhance current habitat conditions for extant populations; (2) conduct research to acquire additional information needed for management; (3) restore degraded habitats to suitable conditions and reintroduce or introduce tidewater gobies to those habitats; and (4) develop and implement an information and education program (Service 2005). These tasks must be carried out in each of the six tidewater goby recovery units delineated in the recovery plan. From north to south, these units are: North Coast, Greater Bay, Central Coast, Conception, LA/Ventura, and South Coast. Tillas Slough is included in the North Coast recovery unit and the goby populations in San Luis Obispo County and Santa Barbara County are within the Central Coast and Conception recovery units, respectively.

Effects of the Action

The Forest Service proposes to avoid fire retardant application in all waterbodies by providing maps and guidance to aerial fire-fighting personnel so that the potential for a misapplication to occur upstream of tidewater goby occupied habitat is minimized. However, the possibility exists of accidental application of retardant (misapplication) or application by exception to protect human life. While there is no way to predict when an exception to protect human life would occur, in the case of misapplication, 3 years of data from 2008 to 2010 indicate that misapplications do not occur often, i.e. less than 0.1 percent of all fire retardant applications (USFS 2011).

Direct effects to tidewater gobies from misapplications of fire retardant would be unlikely because the species does not occur in portions of streams that are within Forest boundaries where retardant could be directly applied. However, indirect effects to tidewater gobies from misapplications of retardant upstream of occupied habitat could adversely affect individuals resulting from exposure to the toxic effects of ammonia, phosphorus, and nitrate washed downstream into the estuary or lagoon. Of these chemicals, ammonia is the most toxic to fish because even in small amounts, ammonia causes stress and damages gills and other tissues. Fish exposed to low levels of ammonia over time are more susceptible to bacterial infections and have poor growth rates. When fire retardant initially enters a stream, there is an immediate spike in ammonia concentration in the receiving stream (Forest Service 2011). The peak of the spike and area affected depends on many factors, such as volume of retardant to hit the water, volume of water to dilute the retardant, and turbulence of the stream. The biological assessment reports that a study running downstream flow simulations showed that ammonia concentrations could remain at lethal levels for fish between 0 and 6.2 miles. Another study found that concentrations of retardant high enough to kill 10 percent of a fish population were measurable over 4 miles downstream (Forest Service 2011). However, exposure could be transient and of limited duration, particularly to populations located downstream from the misapplication point of entry into water. Little and Calfee (2003) found rapid recovery of fish when removed from exposure, indicating the duration of exposure and hence the residence time of the chemical in the habitat is a critical variable.

Tidewater gobies may also be indirectly affected by misapplication of fire retardant upstream through processes of eutrophication in the downstream estuary or lagoon containing tidewater goby habitat. Because the fire retardants used by Forest Service are nitrogen based, retardants that enter a body of water will eventually break down to become nitrogenous nutrients. Eutrophication is when excess nutrients cause excessive plant growth and decay and would be a substantial problem in waters that already have poor water quality, particularly estuaries and lagoons. Eutrophication in estuaries occupied by tidewater gobies would impair light penetration, submerged vegetation, and nursery habitat (Forest Service 2011). Increased nutrients could also negatively impact food resources that gobies depend upon, such as causing a decreased abundance in macroinvertebrates or by changing macroinvertebrate species composition.

Los Padres National Forest has had 433 fires in the past 11 years, from 2000 to 2010, and made 2,811 retardant drops, more than any other national forest during the same period. The Six Rivers National Forest has had 786 fires and 234 retardant drops in the same 11-year period. The historical fire data provided in the biological assessment covers 11 years but the timeframe for this consultation is 10 years. Assuming that national forests will continue to drop retardant at the same rate in the future, we extrapolated those numbers over the next 10 years. Table 1 shows this difference in magnitude of retardant drops for each Forest. The biological assessment also assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Based on this assumption, we expect that over the life of the consultation, 0.42 percent (0.0042) of all drops on each Forest will result in delivery to a waterway with potential adverse effects to tidewater gobies if the stream is occupied downstream, as shown in Table 59 below.

Table 58. Number of Applications of Retardant Expected to Enter Waterways

Forest	Total number of fires in 2000-2010 (11 years)	Total number of retardant drops in 2000-2010	Expected total number of retardant drops over 10 years	Number of drops expected to enter water ways (multiplied by 0.42 percent (0.0042) and rounded up)
Los Padres	433	2,811	2,555	11
Six Rivers	786	234	213	1

To capture the extent of exposure risk for tidewater gobies, we calculated the number of miles of perennial streams within each Forest and how many miles of tidewater goby occupied habitat in those perennial streams are within 6.2 miles of Forest boundaries, as shown in Table 60. Finally, Table 3 presents the total percentage of occupied tidewater goby habitat that may be adversely affected by retardant in the next 10 years.

Table 59. Miles of Tidewater Goby Occupied Habitat on Los Padres National Forest and Six Rivers National Forest

Forest	Miles of perennial streams on Forest	Miles of tidewater goby occupied habitat within 6.2 miles of Forest boundaries (number of streams x 6.2 miles)
Los Padres	776	105
Six Rivers	1,566	6

Table 60. Percentage of Occupied Tidewater Goby Habitat That May Be Adversely Affected

Forest name	Miles of perennial streams on Forest	Miles of tidewater goby occupied habitat	Percent of total perennial streams that are occupied	Number of drops expected to hit stream	Total stream miles affected by retardant (6.2 miles per drop to water)	Percent of tidewater goby occupied habitat potentially affected by retardant over

						10 years
Los Padres	776	105	14%	11	11 x 6.2 = 68.2 miles	0.14 x 68.2= 9% (9.5 miles)
Six Rivers	1,566	6	0.38%	1	1 x 6.2 = 6.2 miles	0.0038 x 6.2 = 3.3 % (0.2 mile)

Effect on Recovery

The proposed action is designed to protect occupied habitat for the tidewater goby downstream of Forest boundaries, which is consistent with the first task of the recovery plan. The proposed action would not reduce appreciably the likelihood of recovery of tidewater gobies because the action area currently does not support a population of the species and the Forest Service proposes to implement stream avoidance zones to conserve downstream habitat for tidewater gobies.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the tidewater goby, environmental baseline for the action area, effects of potential misapplication of retardant on occupied tidewater goby habitat, and cumulative effects, it is our biological opinion that the use of aerially-applied fire retardant on National Forest System lands is not likely to jeopardize the continued existence of the tidewater goby. We have reached this conclusion for the following reasons:

1) As described in the Effects Analysis section, the proposed action would not directly affect tidewater gobies because the species does not occur in portions of streams that are within Forest boundaries where retardant would be directly applied;

2) Indirect effects to tidewater gobies would come primarily from misapplications of retardant on Forest Service lands over the next 10 years that may expose the species to diluted toxic chemicals carried downstream or from eutrophication processes that would degrade occupied habitat. Approximately 9 percent of tidewater goby occupied habitat that is within 6.2 miles of the Los Padres National Forest and Six Rivers National Forest

boundaries could potentially be affected. We expect the remaining 91 percent of occupied habitat for tidewater gobies throughout the species range to continue to support tidewater gobies and to accommodate any population recolonization or expansion the species experiences; and

3) The Forest Service has proposed measures to avoid retardant drops in waterbodies; however, indirect effects cannot be completely avoided or minimized to the point where the tidewater goby would not be affected. Nevertheless, the action area is adjacent to a small percentage of tidewater goby populations throughout the species range so that the indirect effects we expect due to the proposed action over the next 10 years are not likely to reduce the numbers, reproduction, or distribution of the species. Because we do not anticipate an appreciable decline in the population of tidewater gobies that are downstream of the action area, we also do not believe that the proposed action will appreciably reduce the likelihood of the species' survival and recovery in the wild, supporting our conclusion that the use of fire retardant would not appreciably reduce the likelihood of the recovery of the tidewater goby.

Fire retardant is not anticipated to adversley affect tidewater goby critical habitat. Indirect effects to tidewater goby critical habitat would come primarily from misapplications of retardant on Forest Service lands over the next 10 years that may expose the primary constituent elements of tidewater goby critical habitat to diluted toxic chemicals carried downstream, leading to habitat degradation from eutrophication processes. Approximately 5 critical habitat units are within 6.2 miles of the Los Padres National Forest and Six Rivers National Forest boundaries could potentially be affected: Lake Earl/Talawa in Del Norte County and the following in Santa Barbara County: Gaviota Creek, Mission Creek/Laguna Channel, Arroyo Burro, and Winchester/Bell Canyon. Based on our analysis for adverse effects to the occupied habitat, we expect 91 percent of occupied habitat for tidewater gobies throughout the species range to continue to support tidewater gobies and to accommodate any population recolonization or expansion the species experiences. Likewise, the effects of retardant use on Los Padres National Forest lands will be discountable to the primary consituent elements of critical habitat for tidewater gobies because none of the critical habitat units are within the action area of the project and only a small portion of critical habitat for the species throughout its range will be indirectly affected.

Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*)

Environmental Baseline

Populations of Unarmored Threespine Stickleback (UTS) on National Forest System lands are found in Soledad and Bouquet Canyons in the Angeles National Forest and in Shay Creek in the San Bernardino National Forest. The following information is from the recently completed 5-year review for UTS (USFWS 2009):

Angeles National Forest

Soledad Canyon: This location includes the uppermost reach of the Santa Clara River. Girard (1854) was the first to describe UTS from this location. UTS are known to occur within the Arrastre Canyon, a tributary to the Santa Clara River, at the eastern limit of occupied habitat for this subspecies in this locality. UTS are also known to occur within the mainstem of the Santa Clara River in Soledad Canyon from Arrastre Canyon downstream to Bear Canyon Creek. A continuous flow of water in the upper canyon is maintained in dry seasons by several feeder springs, but water levels in the lower canyon retreats for much of the year below the surface of the streambed. Most of the Santa Clara River in Soledad Canyon is privately owned with the exception of approximately 2.86 river miles owned and managed by the Angeles National Forest. Several ponded areas located within Soledad Canyon are connected the Santa Clara River. These ponds tend to be artificially maintained by private land owners for various reasons. Bell (1976) indicated that the best habitat is a small clean pond in the stream with constant flow of water through it.

Bouquet Canyon: This location is a tributary to the Santa Clara River. UTS are known to occupy a reach of Bouquet Creek approximately 6.4 km (4 mi) upstream from the confluence with the Santa Clara River. Water flow in Bouquet Creek is dependent on rainfall and releases from Bouquet Dam that are managed by the Los Angeles County Department of Water and Power. Most of Bouquet Creek is owned and managed by the Angeles National Forest Service; however, the some of the lower portions of Bouquet Creek are owned by Los Angeles County, the City of Santa Clarita, or by private entities. The Angeles National Forest currently manages a Recreation Residence Tract in Bouquet Canyon. The Bouquet Canyon Recreation Residence Tract consists of 102 cabins near Bouquet Creek. Residences are located along a 4.3 mile section of Bouquet Canyon, beginning approximately 4.5 miles north of the Forest Boundary and ending just below Bouquet Reservoir. The Bouquet Canyon recreation residences may potentially impact UTS through water extraction, streambed alteration, introduction of toxins, grey water and sewerage discharge, road use, stream crossings, recreational use, fuel reduction and invasive species originating from the recreation residence lots. Bouquet Creek is stocked with rainbow trout for recreational fishing purposes and is a popular destination for anglers and picnic use. The area experiences disturbance due to dispersed and developed recreation use, the existence and use of summer recreation residences, and the use and maintenance of Bouquet Canyon Road and the side roads leading to summer recreation residences in the canyon.

San Bernardino National Forest

Shay Creek: The Shay Creek UTS population is unique in that it occurs at a high elevation, about 6,700 ft above sea level, while all other populations inhabit streams below 3,000 ft. Limited data exist regarding the number of individuals or the relative abundance within Shay Pond, due to lack of consistent or systematic surveys. Shay Creek is fed by several springs and is hydrologically connected to Green Canyon and May Van Canyon creeks, which drain the north side of Sugarloaf Mountain and an associated ridge that extends to the east (Forest Service 2001). Shay Creek runs downstream through Shay Meadow for approximately 1.3 miles to Baldwin Lake. Shay Creek and its pool are located in close proximity to a developed area and approximately 19 ft from a paved road. This location is threatened by eutrophication from nuisance flow contaminated with horse manure. The possibility also exists at this site that roadside dumping of toxic materials or release of exotic fishes could adversely impact this population of UTS. Development of properties continues in areas adjacent to the creek and its pool that will likely result in the loss of the creek.

Recovery Plan for the Unarmored Threespine Stickleback

The UTS recovery plan (Revised) was published in 1985 (Service 1985) and designated three areas as very important for the survival and recovery of the species: (1) two disjunct reaches of the Santa Clara River in Los Angeles County; (2) a short reach of San Francisquito Canyon; and (3) and the lowermost 8.4 miles in San Antonio Creek in Santa Barbara County. The recovery plan does not specify the recovery function of any of the units. UTS on the Angeles and San Bernardino National Forests are not within these recovery areas.

Effects of the Action

The Forest Service proposes to avoid fire retardant application in all waterbodies by providing maps and guidance to aerial fire-fighting personnel so that the potential for a misapplication to occur upstream of UTS occupied habitat is minimized. However, the possibility exists that accidental application of retardant (misapplication) or application by exception to protect human life will occur. While there is no way to predict when an exception to protect human life would occur, in the case of misapplication, 3 years of data from 2008 to 2010 indicate that misapplications do not occur often (i.e., less than 0.1 percent of all fire retardant applications) (USFS 2011). The Forest Service has indicated that retardant applications to protect property is a lower priority than listed species management, so as long as the threat to people has been ameliorated, the Forest Service would avoid application within the 600-foot buffer (P. Krueger pers. comm. 2011d). In the event of a fire within or that may encroach on the 600-foot buffer, an evacuation will be attempted to remove people from the structures within the buffer to further reduce the likelihood that fire retardant will need to be applied to protect human life (P. Krueger pers. comm. 2011d).

Angeles National Forest has had 1,240 fires in the past 11 years, from 2000 to 2010, and made 1,257 retardant drops. San Bernardino National Forest has had 1,463 fires and 1,607 retardant drops in the same 11-year period. As opposed to only 3 years of misapplication of retardant data, the historical fire data provided in the biological assessment covers 11 years. However, the timeframe for this consultation is 10 years; assuming that national forests will continue to drop retardant at the same rate in the future, we extrapolated those numbers over the next 10 years. Table 62 shows this difference in magnitude of retardant drops for each Forest. The biological assessment also assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Based on this assumption, we expect that over the life of the consultation, 0.42 percent (0.0042) of all drops on each Forest will result in delivery to a waterway with potential adverse effects to UTS if the stream is occupied, as shown in Table 62 below.

Table 61. Number of Applications of Retardant Expected to Enter Waterways

Forest	Total number of fires in 2000-2010 (11 years)	Total number of retardant drops in 2000-2010	Expected total number of retardant drops over 10 years	Number of drops expected to enter water ways (multiplied by 0.42 percent (0.0042) and rounded up)
Angeles	1,240	1,257	1,143	5
San Bernardino	1,463	1,607	1,461	6

To capture the extent of exposure risk for UTS, we calculated the number of miles of perennial streams within each Forest and how many miles of UTS occupied habitat in those perennial streams are within each Forest, as shown in Table 63. Finally, Table 64 presents the total percentage of occupied UTS habitat on each Forest that may be adversely affected by retardant in the next 10 years. Our calculations show a potential for loss or degradation of 5 percent of occupied habitat for the Soledad, Bouquet and Shay Creek populations from misapplications of retardant in a 10 year period.

Table 62. Miles of UTS Occupied Habitat on Angeles National Forest and San Bernardino National Forest

Forest	Miles of perennial streams on Forest	Miles of UTS occupied streams
Angeles	489	6
San Bernardino	732	1

Table 63. Percentage of Occupied UTS Habitat That May Be Adversely Affected

Forest name	Miles of perennial stream on Forest	Miles of occupied streams habitat on Forest	% of total perennial streams which are occupied	Number of drops expected to hit streams over 10 years	Total stream miles affected by retardant (6.2 miles per drop to water[1])	% UTS occupied steams affected by retardant
Angeles	489	6	1%	5	5 x 6.2 =	0.01x31= 0.3 miles

					31 miles	**(5%)**
San Bernardino	732	1	0.13%	6	6 x 6.2 = 37.2 miles	0.0013 x 37.2 = 0.05 miles **(5%)**

[1]The BA states that lethal effects extend 6.2 miles and sublethal effects may occur much further downstream. For the purpose here, we will use the 6.2 miles as the furthest extent of downstream effects.

Because the possibility exists of an application by exception to protect human life, the most direct adverse effect of the action would be if retardant was dropped directly into a waterbody containing UTS. We note that the populations of UTS in Soledad Canyon and Shay Creek are either impacted by urbanization or face the imminent threat of urbanization, and UTS in Bouquet Canyon are impacted by the recreation residence tract that is adjacent to the creek. Therefore, all three of these UTS localities are highly susceptible to fire and fire retardant drops due to the possible need to protect the residences adjacent to the UTS habitat. Although the drops are supposed to avoid aquatic systems by at least 300 feet, a drop over any of these populations would be necessary to protect the scattered homes in the vicinity. If fire retardant reached any of these watercourses, the UTS populations there could be severely affected due to the aquatic toxicity of the chemical (we have no data on the pH of these waters to assess whether the toxicity would be exacerbated by alkalinity). We would expect that a retardant drop on or upstream of the Soledad Canyon, Bouquet Canyon, or Shay Creek populations would result in extirpation of the population. Additionally, the Soledad and Shay Creek populations are distinguished by being both native occurrences and free of hybridization with armored species of *Gasterosteus aculeatus*. The loss of either of these native occurrences of genetic purity would interfere substantially with the species' recovery in the wild. However, the Forest Service has stated that there will not be any use of fire retardants during fire suppression in Soledad Canyon, Bouquet Canyon, and the portion of Shay Creek on San Bernardino National Forest land unless an exception to save human life decision is necessary (Krueger, pers. comm. 2011). The Forest Service also stated that people will be evacuated in Soledad Canyon, Bouquet Canyon, and Shay Creek if a wildfire threatens the area, eliminating the need to drop retardant within UTS occupied habitat.

According to the BA, lethal effects of retardant could extend at least 6.2 miles downstream and sublethal effects may occur much further downstream (USFS 2011). UTS may be indirectly affected if a misapplication is applied upstream of UTS occupied habitat and toxic chemicals reached downstream UTS localities, or by eutrophication processes degrading occupied habitat resulting from the fertilizer effects of retardant. Because the fire retardants used by Forest Service are nitrogen based, retardants that enter a body of water will eventually break down to become nitrogenous nutrients. Eutrophication is the excessive growth of aquatic vegetation resulting from the input of nutrients, particularly phosphate and nitrate (Ricklefs 1990). Oxygen depletion occurs as a result of eutrophication and can cause fish kills. Oxygen reduction is usually associated with abundant growth of rooted vegetation, heavy algal blooms, or high concentration of organic matter (e.g., fertilizers, sewage, livestock feces). The oxygen required during the decay of plants and breakdown of organic matter by bacterial flora, coupled with consumption by fish and other biota, may exceed the oxygen available in the water. Feldmeth and Baskin (1976) and Baskin (1975) showed that UTS has a moderate tolerance to oxygen reduction (to 2.0 parts per thousand (ppm)). They pointed out that as oxygen concentration approaches 2.0 ppm, UTS must increase the amount of energy put into respiration detracting from growth, reproduction, and activity. Thus, sub-lethal reductions of dissolved oxygen may reduce growth and reproduction of UTS, possibly placing it at a competitive disadvantage with other fishes.

Because the UTS populations are isolated and widely scattered, the loss any of the three populations could severely restrict the range of the UTS. In addition, the population of UTS in Shay Creek is genetically distinct from the other UTS populations so the loss of the UTS in Shay Creek alone could represent a loss of genetic diversity in the species. To reduce the risk of retardant misapplication exposing UTS to the toxic chemicals in fire retardant, and the risk of those chemicals degrading occupied habitat by eutrophication, the Forest Service proposes to establish a 600-ft fire retardant exclusion zone on occupied habitat in Soledad Canyon, Bouquet Canyon, and the portion of Shay Creek on San Bernardino National Forest land (Krueger, pers. comm. 2011).

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of UTS, environmental baseline for the action area, effects of potential misapplication and application by exception of retardant on occupied UTS habitat, and cumulative effects, it is our biological opinion that the use of aerially-applied fire retardant on National Forest System lands is not likely to jeopardize the continued existence of UTS and should not appreciably reduce the likelihood of survival and recovery of the populations. We base our conclusion on a written statement from the Forest Service that fire retardants will not be used during fire suppression activities in Soledad Canyon, Bouquet Canyon and the portion of Shay Creek on the San Bernardino National Forest unless an exception to save human life is necessary, however this need is unlikely because the Forest Service will evacuate people from these areas when a fire is near these areas; and because the Forest Service will place a 600-ft fire retardant exclusion zone on occupied habitat for UTS.

Vail Lake Ceanothus (*Ceanothus ophiochilus*)

Environmental Baseline

Two populations of Vail Lake ceanothus (―ceanothus”) occur on the Cleveland National Forest (USFWS 2008f). One population is mostly within the Agua Tibia Wilderness Area and contains 500-4,000 plants over 10.2 ac (4.1 ha). The second population is entirely within the Agua Tibia Wilderness Area and contains 500-12,000 plants over 9.9 ac (4 ha) (USFWS 2008f). These populations are threatened by hybridization with hoary-leaved ceanothus (*Ceanothus crassifolius*); 50 percent of the northern population is hybridized with this species. In addition fire frequency is a concern for this species. Ceanothus needs 5-25 years between fires to replenish the seedbank. Wildfires occurred in the northern population in 1989 and 2000 and in the southern population in 2000 (USFWS 2008f).

Critical Habitat

The only unit of designated critical habitat for ceanothus occurs on the Cleveland National Forest and covers 203 ac (82 ha). The primary constituent elements of designated critical habitat include: 1) flat to gently sloping north to northeast facing ridge tops with slopes in the range of 0 to 40 percent slope that provide the appropriate solar exposure for seedling establishment and growth; 2) soils formed from metavolcanic and ultra-basic parent materials and deeply weathered gabbro or pyroxenite rich outcrops that provide nutrients and space for growth and reproduction; and 3) chamise chaparral or mixed chamise-ceanothus-arctostaphylos chaparral at elevations of 2,000 to 3,000 ft (610 to 914 m) that provide the appropriate canopy cover and elevation requirements for growth and reproduction.

Effects of the Action

Fire retardant application in ceanothus occupied or designated critical habitat should occur rarely. Only a small portion of the Cleveland National Forest will be subject to fire retardant applications annually. Based on data from 2000-2010, the Cleveland National Forest averaged 61 ac (25 ha) of fire retardant applications per year over 439,035 ac (177,671 ha) of Forest Service land. Given the relatively low percentage of Forest Service land with fire retardant applications per year (<0.1 percent), the chance of an application occurring in the relatively small area of occupied or designated critical habitat for ceanothus is generally low. Also, since the Forest Service proposes to avoid fire retardant application in ceanothus occupied or designated critical habitat by providing maps and guidance to aerial fire-fighting personnel, the potential for an application to occur in ceanothus occupied or designated critical habitat is further minimized. Only in cases of a misapplication or to protect human life would fire retardant be applied in ceanothus occupied or designated habitat and misapplications occur rarely. Data from 2008-2010 indicate that misapplications occur on less than one percent of fire retardant applications (USFS 2011).

Direct Effects

Fire retardant applications could impact ceanothus via short-term (1-2 growing seasons) phytotoxic effects, including leaf burning, shoot die-back, a decrease in germination, and plant death. These impacts could occur over about 1-1.5 ac (0.4-0.6 ha) for the average fire retardant application [*i.e.*, the average fire retardant application covers about 800 ft (244 m) by 50-75 ft (15-23 m) (USFS 2011)].

However, fire retardant application within the range of ceanothus is most likely to occur during the primary fire season in southern California, which is August to October. Since the flowering season for ceanothus is generally mid-February to March (USFWS 2008f), most fire retardant applications in habitat for this species would occur after seed-set.

Also, while the average fire retardant application covers about 1-1.5 ac (0.4-0.6 ha), applications are linear, so only a small portion of a given application would be expected to occur in ceanothus occupied habitat. Thus, a fire retardant application is not likely to completely cover a ceanothus population and the portions of a ceanothus population subject to the direct impacts of a fire retardant application are likely to recover by re-establishment from directly adjacent ceanothus, as necessary.

Indirect Effects

Nonnative plants could be enhanced by fire retardant application and impact ceanothus. Nonnative plants could decrease water availability for ceanothus via competition and create a thatch from dead grasses that prevents ceanothus seedling establishment. Further, nonnative plants could alter the fire regime including the frequency, intensity, extent and seasonality of fire, resulting in in a feedback cycle for further enhancement of nonnative plant growth (Brooks et al. 2004) and ultimately result in type conversion. In addition, nonnative plants can change soil properties, resulting in alterations in plant community composition (Ehrenfeld et al. 2001).

In addition, phosphorus-deficient soils may be essential for the continued reproductive isolation of ceanothus (USFWS 2008f). Hybrids are generally found on the periphery of ceanothus occurrences, where the transition occurs between the harsh, phosphorus-deficient soils that the species favors and the milder soils that support hoary-leaved crassifolius (USFWS 2008f). Thus, the addition of phosphorus from a fire retardant application could enhance hybridization and lead to or enhance an outbreeding depression. However, the potential for this impact should be minimized by the size of the occupied habitat compared to the extent of a given fire retardant application, the low amount of fire retardant applied annually compared to the extent of Forest Service land, and the efforts of the Forest Service to avoid application within occupied habitat, to the extent feasible.

While fire retardant could enhance nonnative plants, it could also enhance growth. Fire retardants contain nitrogen and phosphorus that could act as nutrients to ceanothus. Individual and plant community responses from changes in nutrient availability are complex and site specific, and most studies address the potential effects to crop species. Studies on the potential benefits to native plant species from nutrients in fire retardants are limited, and no such studies exist that focus on ceanothus.

In addition, fire frequency may be a concern to this species due to the timing of recent fires and the need of this species for time between fires to replenish the seedbank. If use of fire retardant could prevent wildfires from entering occupied habitat, it could be beneficial to this species.

Regardless, if fire retardant is applied to ceanothus occupied habitat, the Forest Service will monitor the site and implement actions to remove nonnative plants upon detecting the enhancement of nonnative plants due to fire retardant application. Based on the implementation of these measures, impacts to ceanothus due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

Effects on Critical Habitat

Fire retardant application in ceanothus designated critical habitat could enhance nonnative plant growth. Nonnative plants could impact soil properties and primary constituent element 2 (soils). This could occur over about 1-1.5 ac (0.4-0.6 ha) for the average fire retardant application.

As described above for ceanothus occupied habitat, fire retardant applications in ceanothus designated critical habitat should occur rarely. In addition, the Forest Service will monitor an area of ceanothus designated critical habitat with fire retardant application and implement actions to remove nonnative plants upon detecting the enhancement of nonnative plants. Based on the implementation of these measures, impacts to ceanothus designated critical habitat due to nonnative plants enhanced from a fire retardant application should be short-term and temporary.

In addition, as described above, phosphorus-deficient soils may be essential for the continued reproductive isolation of ceanothus (USFWS 2008f). However, the potential for this impact should be minimized by the size of designated critical habitat compared to the extent of a given fire retardant application, the low amount of fire retardant applied annually compared to the extent of Forest Service land, and the efforts of the Forest Service to avoid application within designated critical habitat to the extent feasible.

Effect on Recovery

No recovery plan exists for ceanothus, but a 5-year review was completed on July 21, 2008, which provided management recommendations for the next five years for this species (USFWS 2008f). Regardless, based on the discussion above, fire retardant application in ceanothus occupied or designated critical habitat should occur rarely, especially during the flowering season. If fire retardant application does occur in ceanothus occupied or designated critical habitat during the flowering season, impacts are expected to be effectively avoided or minimized due to the size and linear nature of fire retardant applications and the proposed removal of nonnative plants, as appropriate. Thus, the ability of this species to recover should not be affected.

Cumulative Effects

We are not aware of any cumulative effects that would affect this species.

Conclusion

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of ceanothus and is not likely to adversely modify designated critical habitat. We reached this conclusion for the following reasons:

1. The potential for an application of fire retardant in ceanothus occupied habitat is low due to the amount of fire retardant applied annually compared to the extent of Forest Service land. Also, applications in occupied habitat will only occur due to misapplications or to save human life, and misapplications occur rarely.

2. Direct impacts should be effectively avoided or minimized due to the application of fire retardant in ceanothus occupied habitat primarily outside the flowering season and the size and linear nature of fire retardant applications.

3. Due to the proposal to conduct monitoring after a fire retardant application in ceanothus occupied habitat and remove nonnative plants, as appropriate, impacts due to nonnative plants enhanced from a fire retardant application should be short term and temporary.

4. The potential for an application in designated critical habitat is low due to the amount of fire retardant applied compared to the extent of Forest Service land. Also, applications in designated critical habitat will only occur due to misapplications or to save human life, and this should occur rarely. Finally, the extent of fire retardant application that could occur in designated critical habitat is low compared to the size of designated critical habitat.

5. Due to the expected size of potential impacts and the proposed removal of nonnative plants, we do not expect that the proposed action will impact the ability of this species to recover.

INCIDENTAL TAKE STATEMENTS

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without specific exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm in the definition of take in the Act means an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

Reasonable and prudent measures and their terms and conditions are non-discretionary, and must be undertaken by the Forest Service so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Forest Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Forest Service (1) fails to assume and implement the terms and conditions or (2) fails to require an applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Forest Service must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)].

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the Act prohibits the removal and reduction to possession of Federally listed endangered plants or their malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law. As such, no reasonable and prudent measures or terms and conditions apply.

REGION 1

Bull Trout

Amount or Extent of Take Anticipated

The Service anticipates that activities associated with the misapplication of fire retardant will result in incidental take of bull trout in the form of harm, harassment or mortality related to the expected short-term degradation of aquatic habitat parameters (water quality) because of increased levels of ammonia in the water. The amount of take expected due to changes in water quality is difficult to quantify given the level of information in the BA. Changes to water quality will likely result in take of the egg, larval, juvenile, subadult and adult life history stages by harming or impairing feeding and sheltering patterns or direct mortality of bull trout.

The extent of incidental take of bull trout from aerial application of fire retardant is difficult to quantify. Because of the inherent biological characteristics of the species and the nature of its habitat, the likelihood of discovering and recovering individual mortalities attributable to fire retardant is small and dependent on many site specific variables, including size and duration of the fire incident, terrain, size of stream, weather conditions, and available personnel. Also, because of the small size of resident bull trout, cryptic coloration and behavior, remoteness of occupied bull trout habitat, presence of riparian vegetation, cobble and rubble with interstitial spaces where bull trout are likely to remain undetected, and presence of woody debris, the extent of take will be difficult to monitor. Losses of bull trout in any life stage may be masked by wide seasonal fluctuations in numbers and the effects of the fire itself. Aquatic habitat modifications are difficult to ascribe to particular sources, especially in watersheds with high levels of degradation immediately after a disturbance event such as fire.

Because of the variance of population densities, and because we cannot determine which populations of bull trout are most likely to be affected given the extent of the action area, in order to determine the extent of effects, we will use habitat as a surrogate. Bull trout within this area are likely to be adversely affected by retardant. All adult and juvenile bull trout found within these distances of stream and exposed to a misapplication of fire retardant would be harmed. To estimate take, we used numbers of occupied bull trout habitat, amount of critical habitat, amount of drops expected to contact streams, and distance of downstream effects from misapplication to quantify effects to bull trout habitat that are likely to be caused by the proposed action. Based on information provided in the BA, downstream effects of misapplication is likely to occur for 6.2 miles. This should be considered the worst case, or likely full extent, of downstream effects to bull trout. Although many studies have concluded effects may be more localized, due to the various bull trout population dynamics, habitats, and stream conditions, the Service has chosen to adhere to the worst case extent of effects. There is not enough information at this time to ―average" the extent of expected effects. Table 65 shows the extent of take exempted for each forest.

Table 64. The amount and extent of take exempted for each forest

Forest name	Miles of perennial stream on Forest	Miles of occupied streams or BT critical habitat on Forest	% of total perennial streams which are occupied or CH	Number of drops expected to hit stream	Total stream miles affected by retardant (6.2 miles per drop to water)	% BT occupied steams or CH affected by retardant (miles)	Extent of take (miles)
Beaverhead Deerlodge	4,501	163	3.6	2	12.4	.04x12.4=0.5	10
Bitterroot	2,865	476	16	1	1x6.2=6.2	.16x16.2=1.1	3
Boise	4,985	1,244	25	3	18.6	5	5

Clearwater	4,192	666	16	0.3	0.3x6.2=1.86	.16x1.86= .3	1.0
Colville	2,246	131	5.8	1	6.2	6.2/131=5%	6.2
Deschutes	621	115	18.4	3	3x6.2=18.6	.184x18.6	3.4
Flathead	3,758	936	25	3	3x6.2=18.6	.17x18.6=4.6	5
Fremont-Winema	1,315	30	2.3	5	5*6.2=31.0	.023*31.0=0.7	1.0
Gifford Pinchot	2,881	24.7	0.87	1	6.2	1.0	1.0
Helena	1,181	35	3	2	2x6.2=12.4	.03x12.4=.4	.4
Humboldt-Toiyabe	4,364	118	2.7	2	2*6.2=12.4	(.027*12.4= 0.3 mi)/118 =0.3%	0.3
Idaho Panhandle	4,692	645	13.7	2.	2x6.2=12.4	.137x12.4=1.7	1.7
Kootenai	2,343	399	17	.3	6.2	.17x2=.34	.06
Lolo	2,693	703	26	1	6.2	.26x6.2=1.6	1.6
Malheur National Forest	2,355	232	9.9	1	6.2	0.099x6.2=0.61	0.61 2 adults
Mt Baker-Snoqualmie	7,134	418	5.86	1	6.2	0.36	0.36
Mt. Hood	2,555	39	1.5	1	1x6.2=6.2	1.5% x6.2=0.1	0.1
Nez Perce	4,643	766	16	0.8	0.8x6.2=4.34	0.16x4.34= 0.7	0.7
Ochoco	999	18	1.8	0.3	0.3x6.2=1.9	.018x1.9=0.03	.03
Okanogan-Wenatchee	5,251	807	15	7	43.4	15.4%	6.7
Olympic	2,280	82	3.60	1	6.2	0.22	0.22
Payette	4,316	1,221	28	3.9	3.9x6.2=24	0.28x24=	6.78

						1.36	
Salmon-Challis	6,143	1,856	30	2	12.4	0.6	12.4
Sawtooth	3,497	590	16.9	1.3	1.3x6.2=8.06	0.169x8.06= 1.36	1.36
Umatilla	2,401	365	15.2	2	2 x6.2= 12.4	.152x12.4=1.9	1.9
Wallowa-Whitman	4,398	700	15.9	3	3 x6.2= 18.6	.159x18.6=3.0	3.0
Willamette	4,150	78	1.9	2	2x6.2=12.4	1.9% x 12.4=0.24	0.24 1 adults

In summary, all bull trout located in the 74 miles of affected occupied habitat are likely to be harmed, harassed or injured.

Effect of the Take

Within each core area, we have determined that this level of anticipated take is not likely to result in jeopardy to bull trout or in adverse modification of critical habitat for bull trout. Therefore, at the recovery unit level the level of anticipated take is not likely to result in jeopardy to bull trout, or in adverse modification of critical habitat for bull trout.

Reasonable and Prudent Measures

The Service concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the take of bull trout.

1. Monitor the effects of the action to ensure the actual levels of effects do not exceed the effects or incidental take levels anticipated by this assessment and its associated biological opinion.

Terms and Conditions

1. No later than June 30, 2012, the local offices of the Forest Service in coordination with the Fish and Wildlife Service shall develop a plan to monitor water quality for occupied waterways and/or adjacent waterways in the event of a misapplication of aerial fire retardant, contingent on final approval by the local FWS office. A minimum downstream distance of 6.2 miles should be monitored if aerial applied fire retardant is misapplied in these waterways on NFS lands by the USFS. Monitoring of water quality, or other appropriate agreed upon habitat measures, will start within 24 hours of notification of a

misapplication of fire retardant or when safe to enter the area. Results will be provided to the Service 48 hours from completion of lab analysis.

2. If it is determined that water quality has been affected by a misapplication of aerial applied fire retardant the Forest Service shall ensure that surveys are conducted for bull trout for 3 consecutive years. Yearly reports will be submitted to the Service for review. Annual/semi-annual meetings with the Service will occur to determine if a population decline has occurred or if any modification needs to be done to the monitoring protocol.

Marbled Murrelet

Amount or Extent of Take Anticipated

We anticipate that incidental take of murrelets will be difficult to detect because the species is cryptic, and actual murrelet nest locations are rarely located. Given the tremendous variability in the density of murrelets at inland nest sites, we are limited in our ability to accurately correlate direct habitat effects to the actual number of murrelets that may be affected by a given action. Therefore we estimated the amount of nesting habitat that would be exposed to actions that could result in take as a surrogate measure for this species.

In the accompanying biological opinion, we determined that noise and activity associated with the aerial application of fire retardant is likely to result in the incidental take of murrelets nesting in close proximity to fire retardant drop sites on National Forests. In Washington, we determined that although there is a potential for take to occur, we concluded that such take was not reasonably certain to occur. The mere potential for take is not a legitimate basis for a take exemption; therefore, there is no take anticipated or exempted for National Forests in Washington. For National Forests in Oregon and California, the total area of murrelet nesting habitat likely to be exposed to aircraft noise disturbance is high enough that exposure of nesting murrelets to aircraft noise disturbance is reasonably certain to occur. This take is in the form of harassment, through the significant disruption of normal nesting behaviors. The disturbance from these activities is anticipated to create a likelihood of injury by increasing the risk of predation, premature fledging, or decreasing the fitness of chicks through missed feedings. We expect murrelets associated with up to 26,725 acres of nesting habitat distributed across four National Forests in Oregon and California will be exposed to disturbance harassment over a period of 10 years (Table 66).

Table 65. Summary of incidental take of marbled murrelets for each National Forest

Administrative Unit	Total 10-year average number of retardant drops on National Forest	No. of retardant drops expected to result in Incidental Take of Murrelets	Incidental Take in the Form of Harassment (Habitat Acres)
Olympic National Forest	4	-	-
Mt. Baker-Snoqualmie	3	-	-

National Forest			
Okanogan-Wenatchee National Forest	1,325	-	-
Gifford Pinchot National Forest	59	-	-
Siuslaw National Forest	123	123	9,919
Rogue River- Siskiyou National Forest	258	145	7,452
Klamath National Forest	246	32	2,223
Six Rivers National Forest	213	119	7,131
Totals	2,231	419	26,725

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and Prudent Measures

1. To ensure that activities are completed as described in the BA and in this Opinion, and that the protective measures are effective, complete a post-incident report of any misapplications to species habitat to ensure the terms and conditions in this incidental take statement are effective to avoid and minimize the likelihood of take from proposed activities.

Terms and Conditions

1. To determine that (1) the number of retardant drops within the range for MAMU for each National Forest, and (2) the estimated acres of suitable habitat exposed directly to retardant and aircraft noise has not exceeded the incidental take level for a given forest, the Forest Service shall compile the number and approximate locations (pre-drop GPS coordinates of fire) of each aerial application of fire retardant drops by Forest. Information compiled by each Forest should be submitted to the U.S. Fish and Wildlife Service Regional Office in Portland, Oregon by March 1 of each year.

Northern Spotted Owl

Amount or Extent of Take

Excessive aircraft noise at low altitude is likely to harass spotted owl pairs at 96 spotted owl nest sites. This will create the likelihood of injury to 70 young spotted owls during the 10-year term of the proposed action. Number of sites harassed and number of juveniles harmed are allocated by National Forest.

Table 66. Summary of incidental take of northern spotted owl for each National Forest

National Forest	Number of Nest Sites Subject to Excessive Noise Levels Likely to Harass Northern Spotted Owls	Number of Disturbed Nest Sites that are Expected to be Occupied by Spotted Owls[1]	Loss of reproduction (number of young harmed) from Disturbed and Occupied Sites[1]
Deschutes	3	1	1
Fremont-Winema	12	5	3
Gifford Pinchot	3	1	1
Klamath	12	6	3
Lassen	0	0	0
Mendocino	19	9	5
Modoc	0	0	0
Mt. Baker-Snoqualmie	0	0	0
Mt Hood	11	5	3
Okanogan-Wenatchee	24	7	12
Olympic	0	0	0
Rogue River Siskiyou	16	8	10
Shasta-Trinity	54	23	13
Siuslaw	11	3	5
Six Rivers	19	9	5
Umpqua	12	6	4
Willamette	27	13	7

Total	223	96[2]	72[2]

Reasonable and Prudent Measures

1. To ensure that activities are completed as described in the BA and in this Opinion, and that the protective measures are effective, complete a post-incident report of any misapplications to species habitat to ensure the terms and conditions in this incidental take statement are effective to avoid and minimize the likelihood of take from proposed activities

Term and Conditions

1. To determine that (1) the number of retardant drops within the range for NSO for each National Forest, and (2) the estimated acres of suitable habitat exposed directly to retardant and aircraft noise has not exceeded the incidental take level for a given forest, the Forest Service shall compile the number and approximate locations (pre-drop GPS coordinates of fire) of each aerial application of fire retardant drops by Forest. Information compiled by each Forest should be submitted to the U.S. Fish and Wildlife Service Regional Office in Portland, Oregon by March 1 of each year.

Warner Sucker

Amount or Extent of Take Anticipated

Because of the inherent biological characteristics of aquatic species such as Warner suckers, the likelihood of discovering an individual death or other taking attributable to retardant application is very small. For example, behavioral modifications before death, presence of aquatic vegetation, stream flow, destruction of the carcass, and rapid rates of decomposition make finding an individual incidentally taken fish is extremely unlikely. Furthermore, potential sub-lethal effects of fire retardant application are largely unquantifiable in the short term, and may only be measurable as long term effects on the species' habitat or population levels. Therefore, even though the Service expects incidental take to occur from the effects of fire retardant application to waterways occupied by Warner sucker, the best scientific and commercial data available are not sufficient to enable the Service to estimate a specific amount of sub-lethal incidental take to the species itself.

Based on information provided in the biological assessment (Forest Service 2011) and reports of Warner sucker distribution and density (Scheerer et al. 2011), the Service estimates that a total incidental lethal take of

> 2 to 96 Warner suckers within a 1.2-mile reach of Honey Creek is likely to occur following a misapplication of fire retardant on the Fremont-Winema National Forest.

Table 67. Amount of take of the Warner sucker in terms of stream miles of occupied habitat

Amount of take to habitat	Honey	Deep	Twentymile	Twelvemile

in stream miles	Creek	Creek	Creek	Creek
occupied Warner sucker habitat	1.2 miles	0 miles	0 miles	0 miles

Effect of the Take

In this biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Warner sucker or destruction or adverse modification of critical habitat because the harm that may occur is temporary in nature, and such impacts will be minimized through application and buffer standards designed to minimize impacts to the Warner sucker. Effects to Warner sucker would occur indirectly through introduction of fire retardant to streams in which Warner suckers are present in downstream sections of the affected stream. Effects to habitat upstream of occupied habitat may also indirectly affect the Warner sucker by affecting stream conditions, energy and nutrient inputs to the stream which contribute to Warner sucker feeding, breeding and survival downstream.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the Warner sucker:

1. To ensure that activities are completed as described in the BA and in this Opinion, and that the protective measures are effective, complete a post-incident report of any misapplications to species habitat to ensure the terms and conditions in this incidental take statement are effective to avoid and minimize the likelihood of take from proposed activities

Terms and Conditions

In order to be exempt from the prohibitions of Section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

To implement reasonable and prudent measure number one, the following terms and conditions shall be implemented:

1. No later than June 30, 2012, the local offices of the Forest Service in coordination with the Fish and Wildlife Service shall develop a plan to monitor water quality for occupied waterways and/or adjacent waterways in the event of a misapplication of aerial fire retardant, contingent on final approval by the local FWS office. A minimum downstream distance of 6.2 miles should be monitored if aerial applied fire retardant is misapplied in these waterways on NFS lands by the USFS. Monitoring of water quality, or other appropriate agreed upon habitat measures, will start within 24 hours of notification of a misapplication of fire retardant or when safe to enter the area. Results will be provided to the Service 48 hours from completion of lab analysis.

2. If it is determined that water quality has been affected by a misapplication of aerial applied fire retardant the Forest Service shall ensure that surveys are conducted for warner sucker for 3 consecutive years. Yearly reports will be submitted to the Service for review. Annual/semi-annual meetings with the Service will occur to determine if a population decline has occurred or if any modification needs to be done to the monitoring protocol.

REGION 2

Apache trout (Oncorhynchus apache)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Apache trout is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of Apache trout will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Apache trout will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from 3 fire retardant misapplications on Forest Service lands in Arizona. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

1. Two drops within Apache trout occupied habitat affecting 12.4 stream miles in Apache-Sitgreaves National Forest.
2. One drop within Apache trout occupied habitat affecting 6.2 stream miles in Kaibab National Forest

Take will be considered to have been exceeded if any National Forest surpasses the amount of misapplication drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Apache trout. No critical habitat has been designated for this species.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Chihuahua Chub (Gila nigrescens)

Amount or Extent of Take Anticipated

Incidental take in the form of harm and harassment of the Chihuahua chub is reasonably certain to occur as a result of the proposed action. However, the Service anticipates incidental take will be difficult to identify because population numbers for Chihuahua chub in the action area are uncertain. In addition, finding a dead or impaired specimen is unlikely and losses may be masked by seasonal fluctuations in environmental conditions and population numbers. Therefore, it is not possible to provide exact numbers of Chihuahua chub that will be harassed or harmed from the proposed action.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extent of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Chihuahua chub will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from two fire retardant misapplications on the Gila National Forest. Over the next 10 years we anticipate impacts, as described above, to occur from the following number of drops:

- Two drops in occupied Chihuahua habitat affecting 12.4 stream miles in the Gila National Forest

Effect of the Take

In this biological opinion, we find that this level of anticipated take is not likely to jeopardize the continued existence of the Chihuahua chub.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Chihuahua chub:

To ensure that activities are completed as described in the BA and in this Opinion, and that the protective measures are effective, complete a post-incident report of any misapplications to species habitat to ensure the terms and conditions in this incidental take statement are effective to avoid and minimize the likelihood of take from proposed activitiesTerms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the U.S. Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1. If a retardant drop occurs that affects the species, incorporate appropriate components of the Chihuahua chub Recovery Plan.

    a. Participate the annual Gila Trout and Chihuahua Chub Recovery Team meeting, and implement recommendations to alleviate the effects the retardant drop as coordinated with the Recovery Team.

    b. Provide Chihuahua chub status updates as they relate to a retardant misapplication that affected the species on Gila National Forest lands at the Gila Trout and Chihuahua Chub Recovery Team meetings.

Chiricahua Leopard Frog (*Lithobates chiricahuensis*)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Chiricahua leopard frog is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of will be difficult to since dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

We describe incidental take in terms of impacts from the proposed action, and use river miles as a surrogate measures to identify when take has been exceeded. We also include acres of lentic habitat that may be affected by misapplications of fire retardant in occupied frog habitat. This number is based on the the estimated average size of stock ponds, spring pools, and small lakes that support viable populations of Chiricahua leopard frogs. We anticipate that take will occur from 17 fire retardant misapplications on Forest Service lands in Arizona and New Mexico. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

1. Two drops in occupied frog habitat on the Apache-Sitgreaves National Forest affecting 12.4 stream miles or 0.5 acres of non-fluvial, standing water and one drop on the Coconino National Forest affecting 6.2 stream miles or 0.25 acres of non-fluvial, standing water (18.6 miles or 15 acres total).

2. Four drops in occupied frog habitat affecting 24.8 stream miles or 1 acre of non-fluvial, standing water on the Tonto National Forest.

3. Five drops in occupied frog habitat on the Gila National Forest in New Mexico affecting 31.0 miles or 2.5 acres of non-fluvial, standing water.

4. Six drops in occupied frog habitat on the Coronado National Forest affecting 32.7 miles or 3 acres of non-fluvial, standing water.

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Chiricahua leopard frog or adversely modify its proposed critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Desert pupfish (Cyprinodon macularius)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of desert pupfish is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of desert pupfish will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of desert pupfish will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from three fire retardant misapplications on Forest Service lands in Arizona. Over the next 10 years we anticipate impacts, as described above, to occur from the following number of drops in each Forest described below:

- Three drops in occupied pupfish habitat affecting 18.6 stream miles in Tonto National Forest

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of desert pupfish or adversely modify its critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Cumulative Effects

The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape included in the action area, the uncertainties associated with non-Federal actions are difficult to predict. Whether those effects will increase or decrease in the future is not known; however, based on the human subpopulation and growth trends effects of non-Federal actions are likely to increase. Effects from these non-Federal activities on listed species and habitats are expected to be similar to those that occur on Federal lands, although the size, magnitude, and potential for adverse effects may differ due to less restrictive management standards.

Gila chub (Gila intermedia)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Gila chub is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of Gila chub will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Gila chub will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from 21 fire retardant misapplications on Forest Service lands in Arizona and New Mexico. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

1. Two drops in occupied habitat affecting 12.4 stream miles in Apache-Sitgreaves National Forest.
2. One drop in occupied habitat affecting 6.2 stream miles in Coconino National Forest
3. Six drops in occupied habitat affecting 37.2 stream miles in Coronado National Forest
4. Three drops in occupied habitat affecting 18.6 stream miles in Prescott National Forest
5. Four drops in occupied habitat affecting 24.8 stream miles in Tonto National Forest
6. Five drops in occupied habitat affecting 31 stream miles in Gila National Forest

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above and there are impacts to Gila chub.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Gila chub or adversely modify its critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Gila topminnow (Poeciliopsis occidentalis)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Gila topminnow is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of Gila topminnow will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Gila topminnow will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from 11 fire retardant misapplications on Forest Service lands in Arizona. Over the next 10 years we anticipate impacts, as described above, to occur from the following number of drops in each Forest described below:

1. One drop in occupied habitat affecting 6.2 stream miles in Coconino National Forest
2. Six drops in occupied habitat affecting 37.2 stream miles in Coronado National Forest
3. Four drops in occupied habitat affecting 24.8 stream miles in Tonto National Forest

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Gila topminnow.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Cumulative Effects

The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape included in the action area, the uncertainties associated with non-Federal actions are difficult to predict. Whether those effects will increase or decrease in the future is not known; however, based on the human subpopulation and growth trends effects of non-Federal actions are likely to increase. Effects from these non-Federal activities on listed species and habitats are expected to be similar to those that occur on Federal lands, although the size, magnitude, and potential for adverse effects may differ due to less restrictive management standards.

Gila trout (Oncorhynchus gilae)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Gila trout is reasonably certain to occur, as explained in the effects of the action. Harassment to individual fish may occur from activities conducted within occupied streams, and harm to the species occurs through activities that alter the suitability of the habitat to support Gila trout. However, we anticipate incidental take of Gila trout will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect, are likely to be carried downstream or scavenged, and may be masked by seasonal fluctuations in environmental conditions and fish numbers.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Gila trout will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from 27 fire retardant misapplications on Forest Service lands in Arizona and New Mexico. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

1. Six drops in occupied habitat affecting 37.2 stream miles in Coronado National Forest
2. Three drops in occupied habitat affecting 18.6 stream miles in Prescott National Forest
3. Six drops in occupied habitat affecting 37.2 stream miles in the Apache Sitgreaves National Forest
4. Eight drops in occupied habitat affecting 49.6 stream miles in the Gila National Forest.

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Gila trout.

Reasonable and Prudent Measures

We believe the following reasonable and prudent measures are necessary and appropriate to minimize take of Gila trout:

1. Minimize take of Gila trout on National Forest lands through implementation of proposed conservation measures and monitoring, remediaion and reporting requirements.

Terms and Conditions

The following terms and conditions will implement reasonable and prudent measure 1:

1.2 If a misapplication occurs in an occupied habitat incorporate appropriate components of the Gila Trout Recovery Plan.

   a. Participate in the annual Gila Trout and Chihuahua Chub Recovery Team meeting and implement recommendations as they relate to a misaaplication that affected a population.

   b. Provide Gila trout status updates on National Forest lands at the Gila Trout and Chihuahua Chub Recovery Team meetings as they relate to the effects of a misapplication that affected a population.

Spinedace

Amount or Extent of Take Anticipated

Due to the factors discussed above, we are describing take in terms of stream miles potentially affected, rather than number of fish.

One drop in occupied habitat affectingto 7.32 miles of occupied habitat on the Coconino National Forest.

One drop in occupied habitat affecting 9.11 miles on Apache-Sitgraves National Forest.

Effect of the Take

We find the anticipated level of take is not likely to jeopardize the continued existence of spinedace or adversely modify its critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Mexican Spotted Owl (*Strix occidentalis lucida*)

Amount or Extent of Take Anticipated

We anticipate harassment and harm to Mexican spotted owls through the implementation of the proposed action. Based upon analyses of Forest Service projects within previous biological opinions, we anticipate the majority of incidental take from the proposed action will be in the form of harassment on an annual basis, with most of it occurring during the breeding season (March 1 through August 31). As noted above, we believe the majority of potential effects from retardant drops on MSO include single disturbance events (a ―single disturbance" is defined as a non-habitat altering action [such as noise, etc.] that disrupts or is likely to disrupt normal behavior patterns, including but not limited to, breeding, feeding, or sheltering that occurs within/over the course of one breeding season). Owls experiencing harassment may fail to successfully rear young or desert the area because of disturbance, but this disturbance will not occur over multiple breeding seasons or years, and the long-term integrity of the habitat should be maintained for use by owls. Incidental take in the form of harm is also anticipated albeit at a lesser amount. Harm is either the direct mortality of individual birds, or the long-term (multiple breeding seasons) alteration of habitat that affects behavior (i.e., breeding or foraging) of birds to such a degree that the birds are considered lost as viable members of the population. Consistent with past biological opinions, we used the management territory (i.e., PAC) to quantify incidental take.

Our policy states that incidental take can only be supported if an activity compromises the integrity of an MSO PAC (USDI Fish and Wildlife Service 1996). The Service anticipates that the proposed action will result in incidental take of MSOs in the form of harm and harassment due to the proposed action. This determination is based on the knowledge that the proposed action has the potential to either alter MSO habitat or directly affect MSOs (USDI Fish and Wildlife Service 1995).

We anticipate the following incidental take, annually, for MSO:

<u>Cibola National Forest</u>

> One MSO PAC taken by harassment (permitted take is one pair of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and
>
> One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

<u>Gila National Forest</u>

Two MSO PACs taken by harassment (permitted take is two pairs of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Lincoln National Forest

Three MSO PAC taken by harassment (permitted take is one pair of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Santa Fe National Forest

One MSO PAC taken by harassment (permitted take is one pair of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Apache-Sitgreaves National Forest

Four MSO PACs taken by harassment (permitted take is four pairs of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Coconino National Forest

Three MSO PACs taken by harassment (permitted take is two pairs of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Coronado National Forest

Two MSO PACs taken by harassment (permitted take is two pairs of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Kaibab National Forest

One MSO PACs taken by harassment (permitted take is four pair of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

Tonto National Forest

Two MSO PACs taken by harassment (permitted take is two pairs of MSO and/or associated juveniles in the form of single disturbance events (disturbance that occurs within/over one breeding season); and

One MSO PAC taken by harm (permitted take is one pair MSO and/or associated eggs/juveniles in the form of direct mortality through the life of the project).

We anticipate the following incidental take for MSO in Colorado for the life of the project:

Pike and San Isabel National Forest

One pair of MSO and/or associated juveniles in the form of short-term harassment or harm from air tanker overflights or the application of fire retardant during the breeding season.

No take is anticipated on the Carson NF or on any lands in PACs

Effect of the Take

In this biological opinion, we find that this 10 year level of anticipated take is not likely to jeopardize the continued existence of the Mexican spotted owl.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize take of the Mexican spotted owl:

1. Minimize take on National Forest lands through implementation of proposed conservation measures and monitoring, remediaion and reporting requirements.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1. To the extent feasible without compromising human health and safety, incorporate conservation measures during suppression of wildfire in occupied Mexican spotted owl and its habitat to limit the amount of retardant dropped, with the overall goal of containing the wildfire to limit all of the associated impacts to the species and its habitat.

New Mexico ridge-nosed rattlesnake (*Crotalus willardi obscurus*)

Amount or Extent of Take Anticipated

We anticipate the following form of take as a result of the proposed action: harm or harassment to New Mexico ridge-nosed rattlesnakes through the implementation of the proposed action. Activities associated with the implementation of this aerial retardant may kill or injure ridge-nosed rattlesnakes through chemical ingestion of prey covered in retardant. Additionally, rattlesnakes that are hit by falling retardant may be injured or killed depending on the amount of retardant falling on that location and the amount of protective cover between them and the retardant load. These activities may significantly disrupt normal behavior patterns including, but not limited to, breeding, feeding, or sheltering.

We anticipate that incidental take of New Mexico ridge-nosed rattlesnakes will be difficult to detect for the following reasons: the species has small body size and cryptic coloration, and several actions (e.g., prescribed fires) will take place on such a large scale that detection of a dead or injured individual will be extremely difficult.

We anticipate the following incidental take for the New Mexico ridge-nosed rattlesnake:

1. One New Mexico ridge-nosed rattlesnake will be killed (harm) or injured (harassed).

Effect of the Take

In this biological opinion, we find that this level of anticipated take is not likely to jeopardize the continued existence of the New Mexico ridge-nosed rattlesnake.

Reasonable and Prudent Measures

The USFWS believes the following reasonable and prudent measure is necessary and appropriate to minimize take of the New Mexico ridge-nosed rattlesnake:

1. Minimize take on National Forest lands through implementation of proposed conservation measures and monitoring, remediaion and reporting requirements.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions will implement reasonable and prudent measure 1:

1. To the extent feasible without compromising human health and safety, incorporate conservation measures during suppression of wildfire in occupied New Mexico ridge-nosed rattlesnake and its habitat to limit the amount of retardant dropped, with the overall goal of containing the wildfire to limit all of the associated impacts to the species and its habitat.

Sonora chub

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Sonora chub is reasonably certain to occur, as explained in the species' Effects of the Proposed Action section, above. However, we anticipate incidental take of Sonora chub will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

The unknown variables associated with future fire retardant misapplications make estimating the amount or extant of take impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Sonora chub will be difficult to detect, we describe incidental take in terms of the effects of the proposed action, and use surrogate measures to identify when that take has been exceeded.

We therefore anticipate that take will occur from up to 6 fire retardant misapplications on up to 37.2 stream miles on the Coronado NF over the next 10 years. Take will be considered to have been exceeded if the Coronado NF surpasses the amount of drops and affected stream mileage described above and there are effects to Sonora chub.

Effect of the Take

In this BO, the USFWS finds the anticipated level of take is not likely to jeopardize the continued existence of Sonora chub or adversely modify its critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Disposition of Dead or Injured Sonora Chub

Upon locating a dead, injured, or sick listed species initial notification must be made to the USFWS's Law Enforcement Office, 2450 W. Broadway Rd, Suite 113, Mesa, Arizona, 85202, telephone: 480/967-7900) within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

Sonoran tiger salamander (*Ambystoma mavortium tigrinum*)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Sonoran tiger salamander is reasonably certain to occur. However, we anticipate incidental take of Sonoran tiger salamander will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Sonoran tiger salamander will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from 3 fire retardant misapplications on Forest Service lands in Arizona. Over the next 10 years we anticipate six drops in species occupied habitat on the Coronado National Forest. Take will be considered to have been exceeded if misapplications on the Coronado National Forest and within the range of the Sonoran tiger salamander surpass the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Sonoran tiger salamander.

Reasonable and Prudent Measures

We believe the following reasonable and prudent measures are necessary and appropriate to avoid jeopardy of the Sonoran tiger salamander:

1. Ensure protection of the livestock tanks where Sonoran tiger salamanders occur.

Terms and Conditions:

In order to be exempt from the prohibitions of section 9 of the ESA, the U.S. Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are nondiscretionary.

To implement reasonable and prudent measure # 1,

The Forest Service shall:

1. Map all known extant populations of Sonoran tiger salamanders (regardless of the size/type of occupied habitat), in close coordination with the Service and Arizona Game and Fish Department, and where safety factors allow, include them as avoidance areas subject to the 300 foot buffer policy during retardant applications.

Spikedace and loachminnow

Amount or Extent of Take Anticipated

Incidental take of both species is expected to occur, as detailed below, due to exposure of occupied streams to fire retardant through misapplication, drift, or accidents (spills, etc.). Incidental take may be either sublethal or lethal. Sublethal effects can include skin, eye, gill, liver, and kidney damage, decreased hatching success, reduced growth rates, or impaired morphological development. Lethal effects from the action would be those that would cause death to an animal due to a build-up of un-ionized ammonia or other water quality alterations.

The BA details the results of studies, including the persistence and concentration levels of applied retardant, in various scenarios.

There are numerous uncertainties associated with the proposed action, as follows:

- The time and place at which a fire or fires will occur over the next 10 years;
- The chosen methods for fighting any fires that do ignite, and whether or not they will include fire retardant, and;
- The proximity of the fire and use of retardant to occupied or proposed or designated critical habitat for spikedace and loach minnow.

Because this information is not available, we have used the best available information, which includes the species' distribution, proposed and designated critical habitat, past fire history of these areas, as well as the data available on past fire retardant applications. Per that information, we have determined the expected total number of retardant drops over the life of the proposed action (i.e., 10 years), as well as the anticipated number of fire retardant drops.

The BA states that the Forest Service has determined that, based on the three years of misapplication data available, they predict a 0.42% chance of retardant hitting water or the established species-protection buffers. As noted in the BA, an individual misapplication may affect up to 6.2 miles of stream. The BA notes that many factors may affect the distance over which fire retardant travels downstream. However, detailed information that would allow us to increase or decrease that figure for each stream that could potentially be affected by the proposed action is not available at this time. Therefore, we have adopted the 6.2 mile derived from studies as discussed in the BA and applied it throughout this analysis.

Table 68 summarizes the total number of fire retardant drops, as derived from the BA, as well as the number of fire retardant drops expected to enter waterways, as determined by criteria used in the BA, and the total number of stream miles that may be affected.

Table 68. Anticipated fire retardant drops, retardant drops entering waterways, and stream miles affected under the proposed action

National Forest	Expected total number of retardant drops 10 years[1]	Number of drops expected to enter water ways (.42%- multiply by .0042 and round up)	Total Number of Stream Miles Potentially Affected by Misapp1ications (rounded to nearest mile)
Apache-Sitgreaves	354	2	12
Gila National Forest	1160	5	31
TOTAL			43

[1]The expected number of retardant drops is based on taking the total number of drops per forest as presented in the BA on pages 238-241, dividing that number by 11 and multiplying by 10. The data presented in the BA is based on 11 years and the timeframe for this consultation is 10 years, therefore we must account for this difference.

We believe it is unlikely that each drop that occurs on a given forest will enter a waterway currently occupied by spikedace or loach minnow, or designated or proposed as critical habitat for the two species. However, due to the factors listed above lending uncertainty to the timing and location of potential fire retardant application, we have analyzed the worst case scenario in order to provide adequate protection for the species.

For the Coconino and Prescott National Forests, we are unable to develop a level of incidental take that we believe is reasonably certain to occur on the Verde River over the time period covered by this consultation. The low numbers of events (misapplications, drift, runoff, and spills) likely to occur within proximity to occupied habitats, combined with the low numbers of fish in Verde River does not provide us with a level of certainty that take will occur.

The USFWS anticipates incidental take of individual spikedace or loach minnow will be difficult or impossible to observe for the following reasons:

- Spikedace and loach minnow eggs and fish are small, blend into their environment, and occur underwater in a flowing river.
- Typically, fire retardant is applied in an emergency situation, during which access to the project site for observation purposes is prohibited.
- During and immediately after fires in the southwest, in the monsoon season often results in rain that can wash ash and sediment into streams, increasing stream turbidity and decreasing water quality and clarity, making visual detection of individual fishes difficult.
- Water flow may move specimens out of the immediate area of detection.
- Predation on any fish killed may occur.

For these reasons, we are providing a surrogate measure to estimate the extent of take and when authorized incidental take will be considered to have been exceeded. For the proposed action under this consultation, incidental take is anticipated as follows:

National Forest	Incidental Take, in Miles of Stream
Apache-Sitgreaves	0 to 12
Gila National Forest	0 to 31

Incidental take will be considered to have been exceeded if any additional mileage is affected by misapplication, drift, or accidental spill of fire retardant into occupied stream habitat on any individual forest.

Effect of the Take

In this biological opinion we determine that this level of anticipated take is not likely to result in jeopardy to the species considered herein.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures, monitoiring, remediation and reporting requirements that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement. The proposed action is the application of fire retardant under emergency conditions to stop the spread of catastrophic wildfire. As such, any additional measures imposed at this time could result in increased damage to human life or property, as well as result in the spread of wildfire, which ultimately damages watersheds that can in turn lead to further habitat damage for spikedace and loach minnow.

Three Forks springsnail (*Pyrgulopsis trivialis*)

Amount or Extent of Take Anticipated

It is difficult to determine a level of incidental take for Three Forks springsnail that we believe is reasonably certain to occur over the time period covered by this consultation. Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Additionally, the species is currently proposed endangered, and the take provisions of the ESA do not apply to proposed species. However, due to the high-risk for fire on lands around occupied habitat, we believe exposure to retardant is a remote possibility. Because of these factors, we are using the surrogate measure stream miles affected, rather than number of springsnails, to describe incidental take. Based on data presented by Norris and Webb (1989), we are providing for the entire four miles streams of Boneyard Creek to be affected by retardant drift or runoff. We do not expect the springs themselves to be affected because retardant would need to travel upstream from the creek. Since the creek represents dispersal habitat, we believe this level of take will not affect reproduction or population viability. Lastly, any take resulting from salvage or captive rearing will be covered by a Section 10(a)(1)(A) permit.

Effect of the Take

In this conference opinion, the Service determines that this level of anticipated take is not likely to result in jeopardy to the species for the reasons stated in the Conclusion section.

Reasonable and Prudent Measures

These RPMs and accompanying T&Cs will become effective on the date that a final rule listing the species under ESA is published.

1. If a misapplication occurs in species occupied habitat or within the avoidance area surrounding habitat within the Boneyard Creek watershed, establish post-incident monitoring and remediation to avoid and minimize adverse effects species and aquatic habitat.

Terms and Conditions:

To implement reasonable and prudent measure # 1:

1. If a misapplication occurs in an occupied habitat, conduct follow up springsnail surveys and salvage in accordance with protocols established by USFS, AGFD, and Service.

Yaqui catfish (*Ictalurus pricei*)

Amount or Extent of Take Anticipated

Take in the forms of harm and/or harassment resulting in injury or death of Yaqui catfish is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of Yaqui catfish will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extant of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Yaqui catfish will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from six fire retardant misapplications on Forest Service lands in Arizona. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

- Six drops affecting 37.2 stream miles in Coronado National Forest

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Yaqui catfish.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Cumulative Effects

The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape included in the action area, the uncertainties associated with non-Federal actions are difficult to predict. Whether those effects will increase or decrease in the future is not known; however, based on the human subpopulation and growth trends effects of non-Federal actions are likely to increase. Effects from these non-Federal activities on listed species and habitats are expected to be similar to those that occur on Federal lands, although the size, magnitude, and potential for adverse effects may differ due to less restrictive management standards.

Yaqui chub (*Yaqui purpurea*)

Take in the forms of harm and/or harassment resulting in injury or death of Yaqui chub is reasonably certain to occur, as explained in the effects of the action. However, we anticipate incidental take of Yaqui chub will be difficult to detect for the following reasons:

- Human health and safety concerns may prevent qualified individuals from accessing the location of fire retardant misapplications, making it difficult to determine if take will occur.
- Dead or impaired individuals are difficult to detect and are likely to be carried downstream or scavenged.

Because of the unknown variables associated with future fire retardant misapplications, estimating the amount or extent of take is impossible and any attempt to quantify take would be biologically meaningless. Because incidental take of Yaqui chub will be difficult to detect, we describe incidental take in terms of impacts from the proposed action, and use surrogate measures to identify when take has been exceeded. We anticipate that take will occur from six fire retardant misapplications on Forest Service lands in Arizona, but the actual occur. Over the next 10 years we anticipate impacts, as described above, to occur from following number of drops in each Forest described below:

- Six drops affecting 37.2 stream miles in Coronado National Forest

Take will be considered to have been exceeded if any Forest surpasses the amount of drops described above.

Effect of Take

In this BO, the Service finds the anticipated level of take is not likely to jeopardize the continued existence of Yaqui chub.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Cumulative Effects

The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape included in the action area, the uncertainties associated with non-Federal actions are difficult to predict. Whether those effects will increase or decrease in the future is not known; however, based on the human subpopulation and growth trends effects of non-Federal actions are likely to increase. Effects from these non-Federal activities on listed species and habitats are expected to be similar to those that occur on Federal lands, although the size, magnitude, and potential for adverse effects may differ due to less restrictive management standards.

REGION 6

Greenback cutthroat trout (Oncorhynchus clarki stomias)

Amount or Extent of Take Anticipated

The extent of incidental take of GBCT from aerial application of fire retardant is difficult to quantify. Because of the inherent biological characteristics of the species and the nature of its habitat, the likelihood of discovering and recovering individual mortalities attributable to fire retardant is quite small. The amount of incidental take of the GBCT caused by the proposed action will be difficult to detect because of the small size, cryptic coloration and behavior, remoteness of occupied GBCT habitat, presence of riparian vegetation, cobble and rubble with interstitial spaces where GBCT could remain undetected, and presence of woody debris.

We used numbers of occupied GBCT habitat, amount of drops expected to contact streams, and distance of downstream effects from misapplication to quantify effects to GBCT habitat that are likely to be caused by the proposed action. We estimated that a combined total of 0.42 miles of GBCT habitat could be affected from misapplication.

Forest	Amount of Take	Form of Take
Colorado		
Arapaho-Roosevelt NF	0.1 mile	Harm, harassment
GMUG NF[1]	0.02 mile	Harm, harassment
Medicine Bow-Routt	0.02 mile	Harm, harassment
Pike and San Isabel NF	0.19 mile	Harm, harassment
San Juan NF	0.04 mile	Harm, harassment
White River NF	0.02 mile	Harm, harassment
Utah		
Manti-Lasal NF	0.03 mile	Harm, harassment

[1]Grand Mesa, Uncompahgre, and Gunnison National Forests

Effect of Take

Incidental take of GBCT in the form of harassment is anticipated from misapplication of fire retardant due to the effects of ammonia. Increased levels of ammonia may interfere with foraging and food supplies, and may temporarily decrease habitat quantity and quality (cover, substrate quality). Take is anticipated to occur in the form of harm and harassment, including injury or death of GBCT, due to the effects of ammonia as described above. All adult and juvenile GBCT found within these distances of stream potentially exposed to a misapplication of fire retardant would be harmed.

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to GBCT or result in adverse modification of critical habitat for this species since none has been designated.

Endangered and threatened species are among the many things the Forest Service must consider when making decisions under their fire suppression program. Consequently, while the avoidance areas may help prevent exposure in some cases, they cannot prevent GBCT from being exposed in all instances. We believe it is also reasonable to expect that the exposure risk is likely to increase commensurate with the Forest Service's increasing use of fire retardants.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of GBCT:

1. Protect stream, lake, and riparian habitat in occupied GBCT habitat from long-term fire retardant effects.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the Forest Service shall fully implement the following Terms and Conditions:

1. The Forest Service shall notify the Colorado Field Office – Lakewood immediately (once feasible given fire and staffing conditions) when there is any wildfire, regardless of size, in any occupied GBCT watershed or that could advance towards occupied habitat.
2. In the event of a fire retardant drop within 183 m (600 ft) of occupied GBCT habitat, the Forest Service shall report the incident to the Colorado Field Office – Lakewood at 303-236-4773.

Pawnee montane skipper (Hesperia leonardus montana)

Amount or Extent of Take Anticipated

The extent of incidental take of skippers from aerial application of fire retardant is difficult to quantify. Because of the inherent biological characteristics of the species and the nature of its habitat, we recognize the likelihood of discovering and recovering individual mortalities attributable to fire retardant is quite small.

Our estimate of anticipated take was based on the acres of skipper habitat on Forest System land within the Pike and San Isabel National Forest (17,380 acres). We multiplyed those acres by the percentage of Pike and San Isabel National Forest land that receives fire retardant at a rate of 4 gpc (0.0034 percent) and a rate of 8 gpc (0.0017 percent) (USFS 2011, Table B-3). We anticipate that both rates of application will result in take of skippers. Based on these values, we estimated that 0.59 acres of skipper habitat receives a rate of 4 gpc and 0.30 acres of skipper habitat at 8 gpc annually, for a combined annual totally of 0.89 acres. Given the 10-year period for this project, we estimated that the project could result in the application of fire retardant on 8.9 acres of skipper habitat for the life of this project. Based on an average density of 2 adult skippers per acre, the proposed project could result in the take of 18 adult skippers in the form of harm and harass. We recognize that incidental take will also result to skipper larvae, pupae, and eggs but are not able to quantify this amount due to difficulty in detecting these life stages.

Effect of Take

Incidental take of skippers is anticipated to occur in the form of harm and harassment, including injury or death of skippers, of all life stages of skippers. In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to skippers or result in adverse modification of critical habitat for this species since none has been designated.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of the Pawnee montane skipper:

1. The Forest Service should minimize impacts of aerial fire retardant on the skipper.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the Forest Service shall fully implement the following Terms and Conditions:

1. If it is deemed necessary to use fire retardant in skipper habitat, the Forest Service shall minimize the use of fire retardant to the extent possible and shall minimize areas of overlapping fire retardant application.
2. In the event of a fire retardant drop occurs within skipper habitat, the Forest Service shall report the incident to the Colorado Field Office – Lakewood at 303-236-4773.

REGION 8

Arroyo toad (Anaxyrus californicus (Bufo microscaphus californicus))

Amount or Extent of Take

We anticipate that incidental take of some arroyo toad tadpoles and newly metamorphosed toadlets would most likely result from direct exposure to retardant dropped in occupied habitat, from indirect exposure to diluted retardant chemicals dropped upstream of arroyo toad occupied habitat, and from eutrophication processes in occupied habitat. Because of the fluctuations in population densities, and because we cannot determine which populations of arroyo toads are most likely to be affected given the extent of the action area, we will use habitat as a surrogate to determine the level of take that could occur. The level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, as well as other factors. We assume that arroyo toad tadpoles and newly metamorphosed toadlets that are within 6.2 miles of a misapplication on a waterbody within the Los Padres, Angeles, Cleveland, and San Bernardino National Forests have the potential to be killed or injured by retardant. Based on our calculations in the Effects Analysis and despite the uncertainties of what the impacts, timing, and length of exposure to retardant chemicals would be for arroyo toad tadpoles and toadlets, the probability is that misapplications of retardant on the Los Padres, Angeles, Cleveland, and San Bernardino National Forests will result in incidental take of arroyo toads in the form of injury or mortality of individuals within approximately 6 percent of arroyo toad occupied habitat in the next 10 years.

Table 69. Incidental Take by Forest

Angeles National Forest	All arroyo toad tadpoles and toadlets within 6 percent (2.5 miles) of occupied habitat	Injury or mortality of individuals	
Los Padres National Forest	All arroyo toad tadpoles and toadlets within 9 percent (10 miles) of occupied habitat	Injury or mortality of individuals	
Cleveland National Forest	All arroyo toad tadpoles and toadlets within 4 percent (6 miles) of occupied habitat	Injury or mortality of individuals	
San Bernardino National Forest	All arroyo toad tadpoles and toadlets within 6 percent (3 miles) of occupied habitat	Injury or mortality of individuals	

Effect of the Take

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to arroyo toad.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

In the event of a fire retardant drop within 600 feet of occupied arroyo toad habitat, the Forest Service shall also report the incident to the Ventura Fish and Wildlife Office at 805-644-1766.

California red-legged frog (*Rana draytonii*)

Amount or Extent of Take

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because when this amphibian is not in their breeding ponds, it inhabits rodent burrows or inconspicuous cover sites, or may be difficult to locate due to their cryptic appearance and behavior; and the finding of an injured or dead individual is unlikely because of their relatively small body size. Given that California red-legged frogs utilize different habitats for breeding on the National Forests in the Sierra Nevada compared to Los Padres and Angeles National Forests, it is necessary to quantify take differently amongst the forests.

Forest	Amount of Take	Form of Take	Lifestage
Plumas National Forest	0.30 acres occupied pond habitat	Harm, harass, kill	Tadpole
Plumas National Forest	0.30 acres occupied pond habitat	Harm	Adult
Eldorado National Forest	0.5 acres occupied pond habitat	Harm, harass, kill	Tadpole
Eldorado National Forest	0.5 acres occupied pond habitat 6.2 miles occupied stream habitat	Harm	Adult
Los Padres National Forest	25 miles occupied stream habitat	Harm	Adult
Angeles National Forest	0.2 miles occupied stream habitat	Harm	Adult

Calculations used to quantify take for Los Padres and Angeles National Forests.

Los Padres National Forest has had 433 fires in the past 11 years, from 2000 to 2010, and made 2,811 retardant drops, more than any other national forest during the same period. The Angeles National Forest has had 1,240 fires and 1,257 retardant drops in the same 11-year period. The data presented in the biological assessment is based on 11 years and the timeframe for this consultation is 10 years, therefore in the next 10 years, the expected number of retardant drops is calculated by taking the total number of drops per forest as presented in the biological assessment (pg. 238-241) and dividing that number by 11 and multiplying by 10. Table 70 shows this difference in magnitude:

Table 70. Number of applications of retardant expected to enter waterways in the next 10 years on the Los Padres National Forest and Angeles National Forest

Forest	Total number of retardant drops from 2000-2010 (11 years)	Expected total number of retardant drops over next 10 years	Number of drops expected to enter water ways (.42%- multiply by .0042 rounded up)
Los Padres NF	2,811	2,555	11
Angeles NF	1,257	1,143	5

Table 71 below shows that despite the uncertainties of what the impacts, timing, and length of exposure to retardant chemicals would be for California red-legged frogs, there is a probability that 11 misapplications of retardant on the Los Padres National Forest could impact 25 stream miles of occupied California red-legged frog habitat in the next 10 years, and on the Angeles National Forest, 5 misapplications of retardant to waterways could impact 0.2 stream miles of occupied of California red-legged frog habitat in the next 10 years, which could result in injury or mortality of California red-legged frogs.

Table 71. Take in Number of Miles of Occupied Habitat

Forest name	Miles of perennial streams on Forest	Miles of occupied streams on Forest	% of total perennial streams which are occupied	Number of drops expected to hit stream	Total stream miles affected by retardant (6.2 miles per drop to water[1])	% CRLF occupied steams affected by retardant	Extent of take
Los Padres	776	278	36	11	68 miles	36x68= 25 miles	25 stream miles
Angeles	489	3	0.6	5	31 miles	0.6x31=0.02 miles	0.02 stream miles

[1]The BA states that lethal effects extend 6.2 miles and sublethal effects may occur much further downstream. For purpose here, we will use the 6.2 miles as the furthest extent of downstream effects.

Effect of Take

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the California red-legged frog.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

- In the event of a fire retardant drop within 300 feet of occupied California red-legged frog habitat, the Forest Service shall also report the incident to the Sacramento Fish and Wildlife Office at 916-414-6600.

Laguna Mountains Skipper (Pyrgus ruralis lagunae)

Amount or Extent of Take

Quantifying the precise number of skipper individuals that may be incidentally taken is not possible because the butterfly's small body size and diapause life stage make the observance or detection of mortality highly unlikely. In addition, numbers will fluctuate on a seasonal and annual basis at any occupied site. As reflected in our effects analysis above, impacts to the skipper have been quantified and evaluated based on impacts to occupied habitat. The impacts to occupied habitat provides a method to quantify the impact to the species when we cannot identify or predict the number of individuals impacted and provides a method to assess the overall impact on recovery. Consistent with our effects analysis and because we cannot reasonably identify or predict the number of skipper individuals likely to be taken, we have established a habitat-based anticipated level of incidental take that, if exceeded, will trigger reinitiation of formal consultation.

Incidental take of skipper is exempted for the Forest Service as follows:

Death or injury of adults, larvae, pupae, and eggs within up to 3 ac (1.2 ha) of skipper occupied habitat. The amount or extent of incidental take will be exceeded if more than 3 ac (1.2 ha) of skipper occupied habitat is impacted as a result of the proposed action.

Effect of the Take

In this biological opinion, we determined that the level of anticipated take is not likely to result in jeopardy to skipper.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measure is necessary and appropriate to minimize impacts of incidental take of the Laguna Mountains skipper:

1. The Forest Service shall monitor and report the impact of project activities on skipper habitat.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implements the reasonable and prudent measure described above and outlines reporting and monitoring requirements. Terms and conditions are nondiscretionary.

1.1 The Forest Service shall conduct an on-the-ground assessment of a fire retardant application in skipper occupied habitat within 1 week of the application or once feasible given fire safety conditions and availability of qualified resource personnel.

1.2 The Forest Service shall provide the Service with a report within 30 days of a fire retardant application in skipper occupied habitat that includes the acreage and location of skipper occupied habitat affected.

1.3 The Forest Service shall conduct a follow-up assessment 1 year after a fire retardant application in skipper occupied habitat and report to the Service regarding the extent of any nonnative plant enhancement detected due to the fire retardant application and describe efforts to remove nonnative plants, as appropriate.

Lahontan cutthroat trout (Oncorhynchus clarkii henshawi)

Amount or Extent of Take Anticipated

The extent of incidental take of LCT from aerial application of fire retardant is difficult to quantify. Because of the inherent biological characteristics of the species and the nature of its habitat, the likelihood of discovering and recovering individual mortalities attributable to fire retardant is quite small. The amount of incidental take of the LCT caused by the proposed action will be difficult to detect because of the small size, cryptic coloration and behavior, remoteness of occupied LCT habitat, presence of riparian vegetation, cobble and rubble with interstitial spaces where LCT could remain undetected, and presence of woody debris.

We used numbers of occupied LCT habitat, amount of drops expected to contact streams, and distance of downstream effects from misapplication to quantify effects to LCT habitat that are likely to be caused by the proposed action. We estimated that a total of 1.1 km (0.7 mi) of habitat would be affected from misapplication

Forest	Amount of Take	Form of Take
HTNF	0.8 km (0.5 mi)	Harm, harassment
Tahoe NF	0.05 km (0.03 mi)	Harm, harassment
LTBMU	0.2 km (0.1 mi)	Harm, harassment
Stanislaus	0.1 km (0.04)	Harm, harassment
Sierra NF	0.02 km (0.01 mi)	Harm, harassment
Inyo NF	0.0003 km (0.0002 mi)	Harm, harassment

Effect of Take

Incidental take of LCT in the form of harassment is anticipated from misapplication of fire retardant due to the effects of ammonia. Increased levels of ammonia may interfere with foraging and food supplies, and may temporarily decrease habitat quantity and quality (cover, substrate quality). Take is anticipated to occur in the form of harm and harassment, including injury or death of LCT, due to the effects of ammonia as described above. All adult and juvenile LCT found within these distances of stream potentially exposed to a misapplication of fire retardant would be harmed.

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to LCT or result in adverse modification of critical habitat for this species since none has been designated.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of LCT:

1. Protect occupied LCT habitat from long-term fire retardant effects.

2. Reintroduce LCT into existing stream habitat if they become extirpated from a misapplied fire retardant drop.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the Forest Service shall fully implement the following Terms and Conditions:

1. The Forest Service shall notify the Nevada Fish and Wildlife Office within 24 hours or as soon as possible when there is any wildfire, regardless of size, in any occupied LCT watershed or that could advance towards occupied habitat when possible with fire conditions and available personnel.
2. In the event of a fire retardant drop within 91 m (300 ft) of occupied LCT habitat, the Forest Service shall also report the incident to the Nevada Fish and Wildlife Office at 775-861-6300.

To implement Reasonable and Prudent Measure Number 2, the HTNF shall fully implement the following Term and Condition:

1. In the event that LCT are extirpated from a currently occupied stream as a result of a misapplication of fire retardant, the Forest Service shall coordinate with the Recovery Implementation Team to reintroduce LCT back into the stream once the fire retardant no longer exists as a threat in that stream.

Little Kern golden trout (Oncorhynchus mykiss whitei)

Amount or Extent of Take Anticipated

The Service anticipates that incidental take of the Little Kern golden trout will be difficult to detect due to the difficulty identifying and locating fish that have either been swept downstream, caught within in channel debris, caught under streambanks or scavenged upon. Therefore, the Service is quantifying take as number of stream miles anticipated to be affected by a single retardant drop. As such, we anticipate the incidental take, in the form of injury or death, of all Little Kern golden trout occupying 6.2 miles of occupied stream reaches.

Effect of the Take

Incidental take of Little Kern golden trout in the form of injury or death is anticipated from misapplication of fire retardant due to the effects of ammonia. Take is anticipated to occur in the form of harm, including injury or death of Little Kern golden trout, due to the effects of ammonia as described above. All adult and juvenile Little Kern golden trout found within these distances of stream potentially exposed to a misapplication of fire retardant would be harmed.

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to Little Kern golden trout.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of Little Kern golden trout:

1. Protect occupied Little Kern golden trout habitat from long-term fire retardant effects.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the Forest Service shall implement the following Terms and Conditions:

1. The Forest Service shall notify the Sacramento Fish and Wildlife Office within 24 hours or as soon as possible when there is any wildfire, regardless of size, in any occupied. Little Kern golden trout watershed or that could advance towards occupied habitat.
2. In the event of a fire retardant drop within 91 m (300 ft) of occupied Little Kern golden trout habitat, the Forest Service shall also report the incident to the Sacramento Fish and Wildlife Office at 916-414-6600.

Modoc sucker (Catostomus microps)

Amount or Extent of Take Anticipated

In the accompanying biological opinion (see ―likelihood of exposure to retardant" section), we used simplistic fish estimates and assumptions to try and capture the anticipated scale of impacts to individuals and life stages of Modoc suckers that could occur from the proposed action. We acknowledge that the amount of incidental take of the Modoc Sucker resulting from the project will be difficult to detect because of the inherent biological characteristics of the species and the nature of its habitat, the likelihood of discovering and recovering individual mortalities attributable to fire retardant is quite small. The amount of incidental take of Modoc sucker caused by the proposed action will be difficult to detect because of the small size Modoc sucker, nocturnal behavior, remoteness of occupied Modoc sucker habitat, presence of riparian vegetation, as well as cobble and rubble with interstitial spaces where Modoc sucker could remain undetected and the low likelihood of finding an injured or dead individual in the action area, and a high rate of removal of injured individuals by predators or scavengers. To actually monitor and measure the number of Modoc sucker taken by the effects of a fire retardant drop is at best impracticable and at worst impossible.

Since the adverse effects and take resulting from a fire retardant drop are based on the impact of toxic ammonia entering water, which directly affects Modoc sucker and their food source, the Service believes that using a measure of the amount of occupied habitat is the most practical surrogate for the take of Modoc sucker from these diversions. The Service anticipates that fire retardant application is likely to result in the death of Modoc sucker.

We used numbers of occupied Modoc sucker habitat, amount of critical habitat, amount of drops expected to contact streams, and distance of downstream effects from misapplication to quantify effects to Modoc sucker habitat that are likely to be caused by the proposed action. We estimated that 0.7 miles of occupied habitat would be affected for the species from misapplication on the Fremont-Winema National Forests. On the Modoc National Forest, we estimated that 0.06 miles of occupied habitat would be affected for the species would be affected from misapplication. All adult and juvenile Modoc sucker found within these distances of stream potentially exposed to a misapplication of fire retardant would be harmed and would eventually result in death.

Using the simplistic density numbers the Service anticipates that 21 Modoc sucker on the Fremont-Winema National Forests and 4 Modoc sucker on the Modoc National Forest could be exposed to adverse effects from the misapplication of fire retardant. We conclude that the impacts to any Modoc sucker in the impacted area are likely to die due to exposure to toxic levels of ammonia. The take of Modoc sucker is estimated at the scale or extent approximated above, but best measured by potential impacts to 0.7 miles of occupied habitat on the Fremont-Winema National Forests and 0.06 miles of occupied habitat on the Modoc National Forest.

Effect of Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the Modoc sucker or in adverse modification of critical habitat.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

Owens tui chub (Siphateles bicolor snyderi)

Amount or Extent of Take Anticipated

We anticipate that incidental take of Owens tui chub would most likely result from exposure to retardant chemicals and eutrophication of occupied habitat. Because of the variance of population densities, and because we cannot determine which populations of Owens tui chub are most likely to be affected given the extent of the action area, in order to determine the extent of take, we use habitat as a surrogate. The level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, as well as other factors, and in order to be conservative for the species, we will assume Owens tui chub that are within 6.2 miles downstream of a misapplication of retardant on the Inyo National Forest have the potential to be adversely affected by retardant. Based on our calculations in the Effects Analysis and despite the uncertainties of what the impacts, timing, and length of exposure to retardant chemicals would be for Owens tui chub, there is a probability that misapplications of retardant on the Inyo National Forest will result in incidental take of Owens tui chub in the form of harm to less than 1 percent of Owens tui chub occupied habitat over the next 10 years.

Table 72. Incidental Take by Forest

Inyo National Forest	0.08 percent (0.008 miles) of occupied habitat	Harm	

Effect of Take

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Owens tui chub.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

- In the event of a fire retardant drop within 600 feet of occupied Owens tui chub habitat, the Forest Service shall also report the incident to the Ventura Fish and Wildlife Office.

Paiute cutthroat trout (Oncorhynchus clarkii seleniris)

Amount or Extent of Take Anticipated

The extent of incidental take of PCT from aerial application of fire retardant is difficult to quantify. Because of the inherent biological characteristics of the species and the nature of its habitat, the likelihood of discovering and recovering individual mortalities attributable to fire retardant is quite small. The amount of incidental take of the PCT caused by the proposed action will be difficult to detect because of the small size, cryptic coloration and behavior, remoteness of occupied PCT habitat, presence of riparian vegetation, cobble and rubble with interstitial spaces where PCT could remain undetected, and presence of woody debris.

We used numbers of occupied PCT habitat, amount of drops expected to contact streams, and distance of downstream effects from misapplication to quantify effects to PCT habitat that are likely to be caused by the proposed action. We estimated that a total of 0.08 km (0.05 mi) of habitat would be affected from misapplication.

Forest	Amount of Take	Form of Take
HTNF	0.05 km (0.03 mi)	Harm, harassment
Sierra NF	0.02 km (0.01 mi)	Harm, harassment
Inyo NF	0.008 km (0.005 mi)	Harm, harassment

Effect of Take

Incidental take of PCT in the form of harassment is anticipated from misapplication of fire retardant due to the effects of ammonia. Increased levels of ammonia may interfere with foraging and food supplies, and may temporarily decrease habitat quantity and quality (cover, substrate quality). Take is anticipated to occur in the form of harm and harassment, including injury or death of PCT, due to the effects of ammonia as described above. All adult and juvenile PCT found within these distances of stream potentially exposed to a misapplication of fire retardant would be harmed.

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to PCT or result in adverse modification of critical habitat for this species since none has been designated.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of PCT:

1. Protect spring, stream, and riparian habitat in occupied PCT habitat from long-term fire retardant effects as a result of misapplications.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Forest Service must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the Forest Service shall fully implement the following Terms and Conditions:

1. The Forest Service shall notify the Nevada Fish and Wildlife Office within 24 hours or as soon as possible when there is any wildfire, regardless of size, in any occupied PCT watershed or that could advance towards occupied habitat.
2. In the event of a fire retardant drop (either a misapplication or an intentional application) within 183 m (600 ft) of occupied PCT habitat, the Forest Service shall report the incident to the Nevada Fish and Wildlife Office at 775-861-6300.

Shortnose sucker (*Chasmistes brevirostris*) & Lost River sucker (*Deltistes luxatus*)

Amount or Extent of Take Anticipated

Over the 10-year term of the proposed action, take of no more than 100 LRS and SNS (total of both species) in the form of kill and harm is likely to occur as a result of the proposed action on the Fremont-Winema National Forests. An explanation of how these numbers were derived follows.

We determined that over the term of this proposed action, one fire retardant drop is likely to occur in Upper Klamath Lake as a result of fire-fighting efforts at Modoc Rim. If we assume that most of a drop accidentally enters the shoreline areas of the lake where the water is 0.5 meters deep, within a short time ammonia will be released and immediately begins to form a chemical equilibrium between ionized ammonia (or the ammonium ion NH_4+) and un-ionized ammonia (NH_3). In the highly alkaline waters of Upper Klamath Lake where the pH is often 9 in summer, the toxic form of ammonia will comprise over 30 percent of the total ammonia concentration, will increase and once concentrations reach approximately 0.5 mg/L any suckers exposed for a sufficiently long period will likely die. According to the BA, some fish may detect the ammonia and avoid it. Following the initial increase in ammonia concentrations it will be diluted with the surrounding water and will also escape into the atmosphere, and within several days is unlikely to pose a risk to suckers. It is difficult to quantify the number of suckers that would be affected by the retardant if it entered LRS or SNS habitat because it depends on many variables including: distribution and abundance of suckers in the affected area, how many of them are able to detect and avoid the ammonia, how much retardant reached the water, how it was distributed over the water, how much water movement was occurring at the time of the drop, and on the physical/chemical nature of the water, such as temperature and pH. We propose one potential scenario to help understand the extent of possible effects if a full load of retardant was misapplied into sucker habitat in Upper Klamath Lake.

If a full retardant drop went into sucker habitat it would cover approximately 1.4 acres in size, as described above. For the purpose of this analysis, we assumed all of the suckers in that area would be killed or harmed before the ammonia was too dilute to harm the fish. Based on our knowledge of sucker abundances along the eastern shore of Upper Klamath Lake probably no more than 100 juvenile suckers would be in the 1.4 acres of nearshore habitat affected by the retardant. Adult suckers are unlikely to be affected because they are primarily near the west side of the lake during the summer (Banish et al. 2009). Over time the area affected by the retardant would enlarge, but the ammonia would also be diluted and therefore be less toxic.

The Service anticipates that take in form of kill of 100 juvenile Lost River and shortnose suckers on the Fremont-Winema National Forests will result from the misapplication of fire retardant. We conclude that the impacts to any Lost River or shortnose sucker in the impacted area are likely to die due to exposure to toxic levels of ammonia. The take of Lost River and shortnose sucker is estimated at the scale or extent approximated above, but best measured by potential for one accidental retardant drop into Upper Klamath Lake on the Fremont-Winema National Forest.

Effect of Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the Lost River and shortnose suckers.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

- In the event of a fire retardant drop within 91 m (300 ft) of occupied Lost River or shortnose sucker habitat, the Forest Service shall also report the incident to the Klamath Falls Fish and Wildlife Office.

Quino Checkerspot Butterfly *(Euphydryas editha quino)*

Amount or Extent of Take Anticipated

Quantifying the precise number of Quino individuals that may be incidentally taken is not possible because the butterfly's small body size and diapause life stage make the observance or detection of mortality highly unlikely. In addition, numbers will fluctuate on a seasonal and annual basis at any occupied site. As reflected in our effects analysis above, impacts to Quino have been quantified and evaluated based on impacts to occupied habitat. Measuring the impacts to occupied habitat provides a method to quantify the impact to the species when we cannot identify or predict the number of individuals impacted and provides a method to assess the overall impact on recovery. Consistent with our effects analysis and because we cannot reasonably identify or predict the number of Quino individuals likely to be taken, we have established a habitat-based anticipated level of incidental take that, if exceeded, will trigger reinitiation of formal consultation.

Incidental take of Quino is exempted for the San Bernardino National Forest as follows:

> Death or injury of adults, larvae, pupae, and eggs within up to 46 ac (19 ha) of Quino occupied habitat, defined as any suitable Quino habitat within 0.6 mi (1 km) of a Quino sighting. The amount or extent of incidental take will be exceeded if more than 46 ac (19 ha) of Quino occupied habitat is impacted as a result of the proposed action.

Incidental take of Quino is exempted for the Cleveland National Forest as follows:

> Death or injury of adults, larvae, pupae, and eggs within up to 4 ac (1.6 ha) of Quino occupied habitat, defined as any suitable Quino habitat within 0.6 mi (1 km) of a Quino sighting. The amount or extent of incidental take will be exceeded if more than 4 ac (1.6 ha) of Quino occupied habitat is impacted as a result of the proposed action.

Effect of the Take

In this biological opinion, we determined that the level of anticipated take is not likely to result in jeopardy to Quino.

Reasonable and Prudent Measures

The following reasonable and prudent measure is necessary and appropriate to minimize incidental take.

1. If a misapplication occur in species occupied habitat or within the avoidance area surrounding habitat, establish post-incident monitoring and remediation to avoid and minimize adverse effects species and aquatic habitat.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outlines reporting and monitoring requirements. Terms and conditions are nondiscretionary.

1.1 The Forest Service shall conduct an on-the-ground assessment of a fire retardant application in Quino occupied habitat within 1 week of the application or once feasible given fire safety conditions and availability of qualified resource personnel.

1.2 The Forest Service shall provide the Service with a report within 30 days of a fire retardant application in Quino occupied habitat that identifies the acreage and location of Quino occupied habitat affected.

1.3 The Forest Service shall conduct a follow-up assessment 1 year later and report to the Service regarding the extent of any nonnative plant enhancement detected due to the fire retardant application and describe efforts to remove nonnative plants, as appropriate.

Railroad Valley springfish (*Crenichthys nevadae*)

Amount or Extent of Take Anticipated

We conclude that take of Railroad Valley springfish will occur directly if fire retardant is applied within the 300 foot buffer during wildfire suppression activities. This take will occur in the form of harm and harassment, through behavioral modification, injury, or death caused by the toxicity of long-term fire retardant to aquatic species described above.

The Service anticipates incidental take of Railroad Valley springfish will be difficult to detect for the following reasons: 1) due to the inherent biological characteristics of aquatic species, the likelihood of discovering an individual death or other taking is small; 2) the small body size, behavioral modification before death, presence of aquatic vegetation, spring outflow, and rapid rates of decomposition make finding an incidentally taken individual fish extremely unlikely; and 3) the best scientific and commercial data available are not sufficient to enable the Service to estimate a specific amount of incidental take of the species themselves.

The likelihood of a misapplication of fire retardant is low; however, if it does occur, the loss of an entire population is likely due to the small amount of occupied habitat and the inability of Railroad Valley springfish to avoid to toxic effects of the fire retardant. Therefore, the amount of take authorized in the Hot Creek Canyon/Old Dugan Ranch area is one of the three populations.

Effect of Take

Incidental take of Railroad Valley springfish in the form of harm and harassment, including injury or death, are expected due to the effects of ammonia as described above. All adult and juvenile Railroad Valley springfish found within an individual spring systems potentially exposed to a misapplication of fire retardant would be harmed.

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to Railroad Valley springfish or result in adverse modification of critical habitat for this species since no designated critical habitat for the introduced population in Hot Creek Canyon/Old Dugan Ranch area.

Reasonable and Prudent Measures

The Service believes the following Reasonable and Prudent Measures are necessary and appropriate to minimize impacts of incidental take of Railroad Valley springfish:

1. Protect spring, spring outflow, riparian, and meadow habitat in the Hot Creek Canyon/Old Dugan Ranch area from long-term fire retardant effects.
2. Reintroduce Railroad Valley springfish into existing spring systems if they become extirpated from a misapplied fire retardant drop.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the HTNF must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures, described above and outline required monitoring/reporting requirements. These Terms and Conditions are non-discretionary.

To implement Reasonable and Prudent Measure Number 1, the HTNF shall fully implement the following Terms and Conditions:

1. If it is deemed necessary to use fire retardant in the Hot Creek Canyon/Old Dugan Ranch area, the HTNF shall avoid the application of retardant within 91 m (300 ft) of the occupied springs and spring outflows.
2. The HTNF shall notify the Nevada Fish and Wildlife Office within 24 hours or as soon as possible when there is any wildfire, regardless of size, in the Hot Creek Canyon/Old Dugan Ranch area or that could advance towards the Hot Creek Canyon/Old Dugan Ranch area.

To implement Reasonable and Prudent Measure Number 2, the HTNF shall fully implement the following Term and Condition:

1. In the event that Railroad Valley springfish are extirpated from a currently occupied spring system in the Hot Creek Canyon/Old Dugan Ranch area as a result of a retardant misapplication, the HTNF shall coordinate with the Recovery Implementation Team to reintroduce Railroad Valley springfish back into the extirpated spring once the effects of the fire retardant have dissipated.
2. In the event of a fire retardant drop within 91 m (300 ft) of occupied Railroad Valley springfish habitat, the HTNF shall report the incident to the Nevada Fish and Wildlife Office at 775-861-6300.

Santa Ana Sucker (Catostomus santaanae)

Amount or Extent of Take Anticipated

Quantifying the precise number of sucker individuals that may be incidentally taken is not possible because the small body size of the sucker and fry life stage make the quantification of mortality impossible. In addition, numbers will fluctuate on a seasonal and annual basis at any occupied site. As reflected in our effects analysis above, impacts to sucker have been quantified and evaluated based on the temporary loss of occupied habitat. The loss of occupied habitat provides a method to quantify the impact to the species when we cannot identify or predict the number of individuals impacted and provides a method to assess the overall impact on recovery. Consistent with our effects analysis and because we cannot reasonably identify or predict the number of sucker individuals likely to be taken, we have established a habitat-based anticipated level of incidental take that, if exceeded, will trigger reinitiation of formal consultation.

Incidental take of sucker is exempted for the Forest Service as follows:

> Death or injury of adults, juveniles, fry and eggs within up to 1,968 to 7,218 ft (600 to 2,200 m) of sucker occupied habitat. The amount or extent of incidental take will be exceeded if more than 1,968 to 7,218 ft (600 to 2,200 m) of sucker occupied habitat is impacted as a result of the proposed action.

Effect of the Take

In this biological opinion, we determined that the level of anticipated take is not likely to result in jeopardy to the sucker.

Reasonable and Prudent Measures

The following reasonable and prudent measure is necessary and appropriate to minimize incidental take.

1. The Forest Service shall monitor and report the impact of project activities as they relate to missaplication of fire retardant on suckers and their habitat.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outlines reporting and monitoring requirements. Terms and conditions are nondiscretionary.

1.1 No later than June 30, 2012, the local offices of the Forest Service in coordination with the Fish and Wildlife Service shall develop a plan to monitor water quality for occupied waterways and/or adjacent waterways in the event of a misapplication of aerial fire retardant, contingent on final approval by the local FWS office. A minimum downstream distance of 6.2 miles should be monitored if aerial applied fire retardant is misapplied in these waterways on NFS lands by the USFS. Monitoring of water quality, or other appropriate agreed upon habitat measures, will start within 24 hours of notification of a misapplication of fire retardant or when safe to enter the area. Results will be provided to the Service 48 hours from completion of lab analysis.

1.2 If it is determined that water quality has been affected by a misapplication of aerial applied fire retardant the Forest Service shall ensure that surveys are conducted for Santa Ana Sucker for 3 consecutive years. Yearly reports will be submitted to the Service for review. Annual/semi-annual meetings with the Service will occur to determine if a population decline has occurred or if any modification needs to be done to the monitoring protocol.

Shasta crayfish (*Pacifastacus fortis*)

Amount or Extent of Take Anticipated

The Service anticipates incidental take of the Shasta crayfish will be difficult to detect due to the aquatic nature of the organisms and their relatively small body size make finding a dead or impaired specimen unlikely; the species occurs in habitats that makes detection difficult; and losses may be masked by seasonal and annual fluctuations in numbers, chance events, changes in water regime, or additional environmental disturbances. Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume that Shasta crayfish 6.2 miles downstream of a misapplication have the potential to be subject to incidental take. Although, the BA states that lethal effects extend 6.2 miles and sublethal effects may occur much further downstream, for purpose of authorizing incidental take, we will use the 6.2 miles as the furthest extent of downstream effects. Therefore, Service is authorizing incidental take in the form of harm, harassment, capture, injury, and death for all Shasta crayfish within 6.2 miles of one aerial retardant misapplication over the 10-year project. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the proposed project in the form of harm, harassment, capture, injury, and death of the Shasta crayfish become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the Shasta crayfish. No critical habitat has been designated or proposed for the Shasta crayfish; therefore, none will be affected by the proposed project.

Reasonable and Prudent Measures
The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

In the event of a fire retardant drop within the 1000 foot buffer, the Forest Service shall also report the incident to the Sacramento Fish and Wildlife Office at 916-414-6600.

Smith's blue butterfly (*Euphilotes enoptes smithi*)

Amount or Extent of Take Anticipated

We anticipate that incidental take of some Smith's blue butterfly adults and larvae in the form of harm and mortality would most likely result from misapplications of retardant in occupied habitat. Smith's blue butterflies may be killed or injured by direct exposure to the toxic chemicals in retardant. They may also be harmed by the introduction of invasive plants into their habitat resulting from the fertilizer effects of retardant. The incidental take of the Smith's blue butterfly will be difficult to detect for the following reasons: (1) the Smith's blue butterfly is generally difficult to detect due to its small body size, as eggs, larvae, and pupae are generally not visible; (2) finding a dead or impaired individual is unlikely; and (3) because Smith's blue butterfly vary in abundance in a given location. The Service anticipates that a low but indeterminate number of Smith's blue butterflies may be killed or injured by a misapplication of retardant in occupied habitat.

Effect of the Take

In this biological opinion, we determined that the level of anticipated take is not likely to result in jeopardy to Smith's blue butterfly.

Reasonable and Prudent Measures

We believe the following reasonable and prudent measure is necessary and appropriate to minimize take of Smith's blue butterflies from misapplication of retardant in occupied habitat:

1. If a misapplication occur in species occupied habitat or within the avoidance area surrounding habitat, establish post-incident monitoring, reporting and remediation to avoid and minimize adverse effects species and aquatic habitat

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are non-discretionary.

1. The area affected by retardant will be monitored for a period of three years, including locating and identifying Smith's blue butterfly on Los Padres National Forest lands. If population numbers appear to be declining, the USFWS will be contacted for guidance.

2. The Forest Service must annually review the locations of occupied habitat, particularly if new stands of seacliff buckwheat have been mapped, to ensure that non-native plant impacts to Smith's blue butterfly habitat are minimized and to update the fire retardant avoidance map for this species.

Tidewater goby (Eucyclogobius newberryi)

Amount or Extent of Take Anticipated

We anticipate that incidental take of tidewater gobies would most likely result from indirect exposure to diluted retardant chemicals and eutrophication of occupied habitat. Because of the variance of population densities, and because we cannot determine which populations of tidewater gobies are most likely to be affected given the extent of the action area, in order to determine the extent of take, we use habitat as a surrogate. The level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, as well as other factors, and in order to be conservative for the species, we will assume tidewater gobies 6.2 miles downstream of Los Padres National Forest and Six Rivers National Forest boundaries have the potential to be adversely affected by retardant. Based on our calculations in the Effects Analysis and despite the uncertainties of what the impacts, timing, and length of exposure to retardant chemicals would be for tidewater gobies, we anticipate that misapplications of retardant on the Los Padres National Forest and Six Rivers National Forest will result in incidental take of tidewater gobies in the form of harm to all individuals occupying approximately 9 percent of tidewater goby occupied habitat in the Los Padres NF and approximately 3.3 percent of tidewater goby occupied habitat in the Six Rivers NF over the next 10 years.

Table 73. Incidental Take by Forest

Six Rivers National Forest	3.3 percent (0.2 miles) of occupied habitat	Harm	
Los Padres National Forest	9 percent (10 miles) of occupied habitat	Harm	

Effect of Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the tidewater goby.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

- In the event of a fire retardant drop within 91 m (300 ft) of occupied tidewater goby habitat, the Forest Service shall also report the incident to the Ventura Fish and Wildlife Office at 805-644-1766.

Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*) (UTS)

Amount or Extent of Take

We anticipate that incidental take of UTS would most likely result from exposure to retardant chemicals and eutrophication of occupied habitat. Because of the variance of population densities, and because we cannot determine which populations of UTS are most likely to be affected given the extent of the action area, in order to determine the extent of take, we use habitat as a surrogate. The level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, as well as other factors, and in order to be conservative for the species, we will assume UTS that are within 6.2 miles downstream of a misapplication of retardant on the Angeles National Forest and San Bernardino National Forest have the potential to be adversely affected by retardant. Based on our calculations in the Effects Analysis and despite the uncertainties of what the impacts, timing, and length of exposure to retardant chemicals would be for UTS, there is a probability that misapplications of retardant on the Angeles National Forest and San Bernardino National Forest will result in incidental take of UTS in the form of harm to approximately 5 percent of UTS occupied habitat over the next 10 years.

Table 74. Incidental Take by Forest

Angeles National Forest	5 percent (0.3 miles) of occupied habitat	Harm	
San Bernardino National Forest	5 percent (0.05 miles) of occupied habitat on Shay Creek	Harm	

Effect of Take

In the accompanying BO, the Service determined that this level of anticipated take is not likely o result in jeopardy to the unarmored threespine stickleback.

Reasonable and Prudent Measures

The Forest Service has included a number of conservation measures and monitoring, remediation and reporting requirements described in the federal action that serve to minimize the effects of incidental take. No additional reasonable and prudent measures are included in this incidental take statement.

- In the event of a fire retardant drop within 600 feet of unarmored threespine stickleback habitat, the Forest Service shall also report the incident to the Ventura Fish and Wildlife Office at 805-644-1766.

Reinitiation Statement

This concludes formal consultation on the proposed aerial application of fire retardant. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the Act direct Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of listed species. Conservation recommendations are discretionary agency activities to minimize or avoid effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information on listed species. The recommendations provided herein do not necessarily represent complete fulfillment of the agency's section 2(c) or 7(a)(1) responsibilities for the species listed herein.

Region 1

Macfarlanes four'o'clock (*Mirabilis macfarlanei)*

- Where possible, flag on the ground known locations of listed plant species to buffer and avoid treatment with retardant. When this is not possible, GPS coordinates of the buffer areas will be provided to the retardant droppers; and close coordination between retardant operator and local botanist/ resource advisor (who knows locations of the listed plant buffers) to insure that listed plant buffers are implemented.

- If retardant is misapplied at locations known to be occupied by the *Mirabilis macfarlanei*, these locations should be monitored for the effects of the retardant on this species. These areas should also be monitored for the effects of the retardant to the habitat (annual plants, invasive weeds, and native plants) of the *Mirabilis macfarlanei* . Reports of such misapplications and their effect on the *Mirabilis macfarlanei* and its habitat should be reported to the Service in a timely manner.

Marbled Murrelet

- We recommend that aerial operations over areas of suitable murrelet nesting habitat be restricted to occur two hours after official sunrise, and cease two hours prior to official sunset during the murrelet nesting season (April 1 to September 15 in Oregon and Washington; March 24 to September 15 in California). This restriction avoids potential disruption to murrelets during their daily peak activity periods for feeding and incubation exchanges.

- We recommend that the application of fire retardant on all National Forests within the range of the murrelet be monitored such that the acreage of suitable murrelet habitat directly exposed to retardant can be quantified and reported to the USFWS.

Northern spotted owl

- Improve upon the data available to estimate effects of retardant drops on spotted owls.

Showy Stickweed (Hackelia venusta)

- Use helicopter bucket drops (water) instead of retardant drops in the event of a fire within 1 mile of the *Hackelia venusta* population. Conduct water drops on the north and south flanks of the *Hackelia* *venusta* population, but none within or upslope of the population. Conduct bucket drops at least 100' AGL (height of bucket over the canopy) to help dissipate the erosive potential of the water.

- Maintain tree and shrub cover in all populations at a level equal to or more open than that present in 2007 in the original population, through manual removal or controlled burns."

Spaldings Catchfly

- Where possible, flag on-the-ground known locations of listed plant species to establish buffers for avoiding treatment of occupied habitat with retardant. When this is not possible, GPS coordinates of the buffer areas should be provided to the retardant droppers; and close coordination should occur between the retardant operator and local botanist/ resource advisor (who knows locations of the listed plant buffers) to insure that listed plant species buffers are effective.

- If retardant is misapplied at known listed plant locations, these locations should be monitored for the effects of the retardant on the listed population. These areas should also be monitored for the effects of the retardant to the listed species habitat (annual plants, invasive weeds, and native plants).

- The Forest Service should report any misapplications, and the effects thereof, in occupied or potential Spalding's catchfly habitat to the Service

Warner Sucker

- Surveys should be conducted to detect the presence of Warner sucker in stream reaches which are occupied by Warner sucker downstream in order to detect a distribution expansion closer to the Forest Service administered lands. Results of surveys should be provided to the Service.

- The Forest Service should support research work conducted by the Oregon Department of Fish and Wildlife investigating the life history of Warner sucker.

- In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

- Affected streams shall be monitored to determine the extent of lethal and sub-lethal effects to the Warner sucker, and the overall impact to Warner sucker habitat, including impacts to water quality, feeding behavior, population status and reproductive success.

Region 2

Canelo Hills Ladies' Tresses

- We recommend that USFS participate in efforts to identify and conserve Canelo Hills ladies' tresses throughout its range, including participation in forums that address the control of invasive, exotic plants.

Chihuahua Chub

- In cooperation with other state conservation agencies, Forest Service research stations, Service, and ongoing research efforts, monitor Chihuahua chub populations on Gila National Forest lands based on recommendations provided by the Gila Trout and Chihuahua Chub Recovery Team.

Gila Trout

- Manage riparian areas in watersheds occupied by Gila trout in order to eliminate direct effects and minimize indirect effects.
- Cooperate with state conservation agencies to eliminate the introduction and current presence of nonnative salmonid species within Gila trout habitat

Huachuca Water Umbel

- We recommend that USFS participate in efforts to identify and conserve HWU throughout its range, including participation in forums that address the control of invasive, exotic plants.

New Mexico ridge-nosed rattlesnake

- Initiate studies to determine the effects of chemical fire retardants on the montane rattlesnakes and their habitat.

- Following containment of a wildfire that burned New Mexico ridge-nosed rattlesnake habitat, if a BAER plan is developed, coordinate with U.S. Fish and Wildlife Service Biologists to incorporate actions that benefit the species.

Sonora chub

- We recommend that the USFS investigate the development of and transition to the application of effective fire retardants that are not toxic to terrestrial and aquatic life.

Three Forks springsnail

- The ASNF should move forward with plans to designate the Three Forks Recommended Research Natural Area and Associated Features (USFS 2011b). This designation would substantially contribute to the conservation of the Three Forks springsnail.

- The ASNF should conduct additional surveys within Boneyard Creek and North Fork East Black River watersheds to determine if the species occurs in other springs.

Region 8

Arroyo Toad

- The Forest Service should expand the abundance and range of arroyo toad populations through restoration of breeding habitat and restoration of natural hydrologic regimes below dams. Restoration activities for the arroyo toad include enhancing riparian habitat and vegetation; relocating or removing confining levees to allow river-channel meandering and reconnection of rivers with their floodplains; removing dams, diversions, or other obstacles to sediment transport; and providing more water for instream flows.

- The Forest Service should increase efforts to control invasive aquatic animals, particularly bullfrogs, African clawed frogs, and introduced crayfish species through a combination of eradication and trapping efforts and improved water-management practices.

- Based on the best available science and site-specific conditions, the Forest Service should design fire management policies and practices to restore the ecological integrity of natural communities.

California jewelflower

- USFS should monitor, compile information, and update the Service on the effects of nonnative plants on the population viability of *Caulanthus californicus* on the Los Padres NF.

- In the event of the aerial application of fire retardant in habitats occupied by *Caulanthus californicus*, the USFS should implement a program directed at the removal of nonnative plant species.

California red-legged frog

- USFS should avoid the aerial application of retardant in sub-watersheds occupied by the California red-legged frog.

- USFS should investigate the lethal and sublethal effects of fire retardant formulations on adult amphibian species.

- USFS should assist the Service in the implementation of the Service's 2002, Recovery Plan for California Red-legged Frog.

Camatta Canyon amole (Chlorogalum purpureum var. reductum)

- We recommend that the U.S. Forest Service prepare and implement a management plan for the Camatta Canyon amole on the Los Padres National Forest, including surveys and a monitoring program.

- We recommend that the U.S. Forest Service conduct research into designing a methodology for restoring cryptogamic crusts.

Carbonate Plants (Cushenbury Oxytheca [*Oxytheca parishii*], Cushenbury Milk-vetch [*Astragalus albens*], Cushenbury Buckwheat [*Eriogonum ovalifolium var. vineum*], Parish's Daisy [*Erigeron parishii*])

- We recommend conducting systematic monitoring of these species throughout known and potentially occupied sites as necessary to track the status of these species and identify management priorities. There is a need to continue to obtain quantitative information regarding the status of these species to evaluate the effectiveness of conservation efforts over time, especially in light of potential effects associated with global climate change.

Laguna Mountains Skipper

- We have no additional conservation recommendations beyond those provided in previous biological opinions to the Cleveland National Forest.

Greene's tuctoria (*Tuctoria greenei*)

- USFS should continue to monitor, compile information, and update the Service on the effects of nonnative plants on the *Tuctoria greenei* population viability within the Modoc Plateau Region.
- In the event of the aerial application of fire retardant in habitats occupied by *Tuctoria greenei*, the USFS should implement a program directed at the removal of nonnative plant species
- USFS should assist the Service in the implementation of the Service's 2005, Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon.

Layne's Butterweed (*Senecio layneae*)

- USFS should monitor, compile information, and update the Service on the effects of nonnative plants on the *Senecio layneae* population viability within the National Forest System Lands.
- In the event of the aerial application of fire retardant in habitats occupied by *Senecio layneae*, the USFS should implement a program directed at the removal of nonnative plant species.

Little Kern Golden Trout

- USFS should assist the Service restoration of habitats for Little Kern golden trout.

Mariposa pussypaws

- USFS should monitor, compile information, and update the Service on the effects of nonnative plants on the population viability of *Calyptridium pulchellum* on the Sierra National Forest.

Mountain Meadow Plants (Pedate Checkermallow [*Sidalcea pedata*], Slender-petaled mustard [*Thelypodium stenopetalum*], California Taraxacum [*Taraxacum californicum*], San Bernardino bluegrass [*Poa atropurpurpea*])

- The Forest Service should periodically monitor populations of these species on the San Bernardino National Forest to help track the status of this species.

- The Forest Service should pursue acquisition of occupied habitat, to help ensure that populations are not subject to development and the potential impacts from altered hydrology/water withdrawals are minimized. The Forest Service should also pursue acquisition of previously occupied habitat that could be restored. These actions are important to recovering checkermallow, in accordance with Recovery Criterion 1 of the recovery plan for this species.

- The Forest Service should identify and implement effective methods to remove the common dandelion. The Forest Service should prioritize areas for control to provide for the maximum potential benefit to taraxacum and evaluate the effectiveness of common dandelion control efforts with systematic followup monitoring.

Modoc sucker

- None

Owens tui chub

- Conduct research to determine the short term and long term effects of various fire retardants on the various life stages of the Owens tui chub.

- Conduct research to develop other methods to contain wildfires that have less environmental effects than nitrogen or phosphorous based fire retardants.

- Monitor Owens tui chub population status and trends, and habitat conditions.

- Develop and implement management plans for extant Owens tui chub populations, which address specific threats at each population location.

Pebble Plains Species (Southern Mountain Buckwheat [*Eriogonum kennedyi var. austromontanum*], Ash-grey Paintbrush [*Castilleja cinerea*], and Bear Valley Sandwort [*Arenaria ursine*])

- The Forest Service should periodically monitor the populations of the pebble plains species on the San Bernardino National Forest to help track the status. The Forest Service should collect information regarding the presence of nonnative plants within or around the pebble plains species to help identify the extent to which nonnative plants impact this species and identify priority areas for nonnative plant removal experiments.

- The Forest Service should pursue acquisition of occupied habitat that is subject to potential commercial development, in order to help ensure that these populations are not subject to development.

Quino Checkerspot Butterfly

- We recommend implementing the specific actions within the Recovery Plan for the Quino Checkerspot Butterfly (USFWS 2003) described for the Cleveland and San Bernardino national forests.

Railroad valley springfish

- Assist, in cooperation with the private landowner and recovery implementation team, in developing and implementing a habitat management plan for the Hot Creek Canyon/Old Dugan Ranch populations.

San Bernardino Mountains Bladderpod (*Physaria kingie ssp. Bernardina*)

- We recommend conducting systematic monitoring of bladderpod throughout known and potentially occupied sites as necessary to track the status of the species and identify management priorities. There is a need to continue to obtain quantitative information regarding the status of this species to evaluate the effectiveness of conservation efforts over time, especially in light of potential effects associated with global climate change.

Santa Ana sucker

- The Forest Service should implement a monitoring program for the East, West, and North forks of the San Gabriel River system to provide information regarding the status of the species and its habitat in these areas.

- The Forest Service should assess habitat conditions above Big Tujunga Dam for potential sucker re-establishment locations.

Shasta Crayfish

- The Forest Service should avoid the aerial application of retardant in waterways hydrologically connected to Shasta crayfish occupied habitat.

- The Forest Service should investigate the lethal and sublethal effects of fire retardant formulations on crayfish species.

Slender orcutt grass (*Orcuttia tenuis*)

- USFS should continue to monitor, compile information, and update the Service on the effects of nonnative plants on the Orcuttia tenuis population viability within the Modoc Plateau Region.

- USFS should assist the Service in the implementation of the Service's 2005, Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon.

Slender-horned Spineflower (*Dodecahema leptoceras*)

- The Forest Service should periodically monitor populations of spineflower to help track the status of this species. The Forest Service should collect information regarding the presence of nonnative plants within or around spineflower to help identify the extent to which nonnative plants impact this species and identify priority areas for nonnative plant removal experiments.

Smiths blue butterfly

- Where invasive non-native plants occur in areas suitable for seacliff buckwheat, invasive plants should be removed and the areas revegetated with native plants, including seacliff buckwheat.

Springville clarkia (Clarkia springvillensis)

- USFS should monitor, compile information, and update the Service on the effects of nonnative plants on the population viability of *Clarkia springvillensis* on the Sequoia National Forest.

- In the event of the aerial application of fire retardant in habitats occupied by *Clarkia springvillensis*, the USFS should implement a program directed at the removal of nonnative plant species

Stebbins' morning glory (*Calystegia stebinsii*)

- USFS should monitor, compile information, and update the Service on the effects of nonnative plants on the *Calystegia stebinsii* population viability within the Tahoe National Forest.

- In the event of the aerial application of fire retardant in habitats occupied by *Calystegia stebinsii*, the USFS should implement a program directed at the removal of nonnative plant species.

Tidewater Goby

- Development of a long-term monitoring program. We recommend that a well-developed long-term monitoring plan be developed so that: 1) sites are sampled in a common fashion throughout the species' range where possible, or at least sampled in such a way that comparisons can be made among sites based on catch per unit effort; and 2) a hierarchical sampling scheme be developed that dictates sampling in each recovery unit, sub-unit and locality at specific intervals. Standardized reporting forms should be developed to ensure consistency of environmental data and reporting detail.

- Delineation of populations. It is difficult to assess the number of populations due to the frequent loss and re-colonization of sites. Additional molecular data would be useful to quantify among-population genetic structure and the existence of tidewater goby metapopulations.

- Water quality monitoring plan. The development of a water quality monitoring plan for tidewater goby would allow better assessment of threats and provide data necessary to understand the link between water quality and tidewater goby population size.

Unarmored three-spined stickleback

- Monitor UTS population status and trends, and habitat conditions.

- Develop and implement management plans for extant UTS populations, which address specific threats at each population location.

- Work with local landowners and jurisdictions to make sure no new structures are placed within 600 feet of unarmored threespine stickleback habitat, especially at Shay Creek.

Vail Lake Ceanothus (*Ceanothus ophiochilus*)

- Examine areas within the Cleveland National Forest with appropriate soils (harsh, phosphorus-deficient soils derived from metavolcanic and ultra-basic parent materials, deeply weathered gabbro, and pyroxenite-rich outcrops, located on ridgetops, and north- to northeast-facing slopes, at elevations of 1,900 to 3,500 ft (579 to 1,067 m)), to determine whether the species could be successfully introduced into these areas.

- Determine the current distribution of hybrid individuals within the populations on the Cleveland National Forest. Determine whether hybrid individuals are located primarily on the periphery of the populations, or spread throughout the populations. Determine what effect hybrid individuals are having on the populations as a whole, and what can be done to minimize this threat.

We have no reasonable and prudent measures, terms and conditions, or conservation recommendations for the following species in Region 8:

R8 (39 of 43): Encintas Baccharis (*Baccharis vanessae*)
R8 (40 of 43): Munz's Onion [*Alium munzii*]

R8 (41 of 43): Nevin's Barberry (*Berberis nevinsii)*
R8 (42 of 43): San Diego Thornmint (*Acanthomintha ilicifolia*)
R8 (43 of 43): Thread-leaved Brodiaea (*Brodiaea filifolia*)

Literature Cited

Adams, R. and D. Simmons. 1999. Ecological effects of fire fighting foams and retardants. Conference proceedings: Australian brushfire conference, Albury, Australia. 8 pp.

Agee, J. K. 1993. Fire ecology of Pacific Northwest forests. Island Press, Washington, D.C. 493 pp.

Agee, J.K. 1993. Fire and the ecosystem. Northwest Woodlands 9:1-6.

Agee, J.K. 1994. Historical fire regimes of the Blue Mountains. Blue Mountains Natural Resources Institute Technical Notes BMNRI-TN-1. La Grande, OR. 4pp.

Akins, G.J. 1970. The Effects of Land Use and Land Management on the Wetlands of the Upper Klamath Basin, Western Washington State College. Master of Science Thesis. 128 p.

Alabaster, J.S., D.G. Shurben, and M.J. Mallett. 1983. The acute lethal toxicity of mixtures of cyanide and ammonia to smolts of salmon, *Salmo salar*, at low concentrations of dissolved oxygen. Journal of Fish Biology, 22:215-222.

Allen, C., A. Atkins, and M. Stern. 1994. Status and Recolonization of the Warner sucker (Catostomus warnerensis) and other fishes in the Warner Lakes in Southeast Oregon, 1994. Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 22 pp.

Allen, C., K. Hartzell, and M. Stern. 1996. Warner sucker progress report - 1996 findings. Unpublished report to Bureau of Land Management. 55 pp.

Allen, C., K. Hartzell, M. Stern and A. Munhall. 1995a. Status of the Warner sucker (Catostomus warnerensis) and other fishes in the Warner Basin in Southeast Oregon, 1995. Unpublished report to the Fish and Wildlife Service. 35 pp.

Allen, C., M. Stern, and A. Munhall. 1995b. Monitoring of the Warner sucker and other fishes in the Warner Basin in 1994 and 1995. Unpublished report to the Fish and Wildlife Service. 4 pp.

Andreasen, J.K. 1975. Systematics and status of the family Catostomidae in southern Oregon. Doctoral dissertation. Oregon State University, Corvallis, Oregon. 76 pp.

Angeler, D. G. and J. M. Moreno. 2006. Impact-recovery patterns of water quality in temporary wetlands after fire retardant pollution. Can. J. Fish. Aquat. Sci. 63:1617-1626.

Anthony, R.G., E.D. Forsman, A.B. Franklin, D.R. Anderson, K.P, Burnham, G.C. White, C.J. Schwarz, J. Nichols, J.E. Hines, G.S. Olson, S.H. Ackers, S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, K.M. Dugger, K.E. Fehring, T.L. Fleming, R.. Gerhardt, S.A. Gremel, R.J. Gutierrez, P.J. Happe, D.R. Herter, J.M Higley, R.B. Horn, L.L. Irwin, P.J.. Loschl, J.A. Reid, and S.G. Sovern. 2006. Status and trends in demography of northern spotted owls, 1985-2003. Wildlife Monograph No. 163.0

Apache-Sitgreaves National Forest. 2011. Fire history polygons (GIS layer). Available online at http://www.fs.fed.us/r3/gis/aps_gis.shtml. Accessed 8/19/11.

Aquatic Scientific Resources. 2005. Preliminary Research on *Aphanizomenon flos-aquae* at Upper Klamath Lake, Oregon. Prepared for USFWS, Klamath Falls, Oregon. 158p. + Appendices A through E.

Arizona State University (ASU). 2002. Lower Colorado Basin fish database. Produced for the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service by Arizona State University, Tempe, Arizona.

Arno, S.F. 2000. Fire in western forest ecosystems. Pages 97-120 in K.J. Brown and J.K. Smith (editors.), Wildland fire and ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42-vol. 2. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 pp.

Arnold, R.A. 1991. Status surveys and habitat assessment for the endangered Smith's blue butterfly at the Garland Ranch Regional Park in Carmel Valley, California. Pleasant hill, California.

Arnold, R.A. 2002. Survey protocol for presence-absence surveys of the endangered Smith's blue butterfly in the Los Padres National Forest in Monterey and northern San Luis Obispo Counties, California. Prepared for the U.S. Forest Service. Entomological Consulting Services, Inc., Pleasant Hill, California. 30 pp. and figures.

Bachelet, D., J.M. Lenihan, and R.P. Neilson. 2007. Wildfires and global climate change: the importance of climate change for future wildfire scenarios in thewestern United States. Pages 22-41 in K.L. Ebi, G.A. Meehl, D. Bachelet, J.M. Lenihan, and R.P. Neilson, R.R. Twilley, D.F. Boesch, V.J. Coles, D.G. Kimmel, and W.D. Miller (contributors), Regional impacts of climate change: four case studies in the United States. Pew Center on Global Climate Change, Arlington, Virginia.

Bahm, J. and A. Robinson. 2009. Spikedace and loach minnow survey in Eagle Creek, Greenlee and Graham counties, July – August 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona.7 pages.

Bailey, T. 2011. Personal Communication on July 21, 2011 to Gretchen Sausen concerning redd counts on N.F. Catherine Creek, Oregon Department of Fish and Wildlife, La Grande, Oregon.

Banish, N.P., B.J. Adams, and R.S. Shively. 2009. Distribution and habitat associations of radio-tagged adult Lost River and shortnose suckers in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society 138: 153-168.

Banks, B. 2009. U.S. Forest Service, Pike and San Isabel National Forests. Subject: GIS analysis of Pawnee montane skipper habitat burned in recent fires. Received by the U.S. Fish and Wildlife Service, Colorado Field Office, July 23, 2009.

Barlow, G.W. 1995. The relevance of behavior and natural history to evolutionarily significant units. Pages 169-175 in J. L. Nielsen editor. Evolution and the Aquatic Ecosystem. American Fisheries Society Symposium 17. Bethesda, Maryland.

Barnes, J.L 1996. Reproductive Ecology, Population Genetics, and Clonal Distribution of the Narrow Endemic: *Mirabilis macfarlanei* (Nyctaginaceae). Master's Thesis, Utah State University, Logan, UT.

Barnett, T.P., D.W. Pierce, H.G. Hidalgo, C. Bonfils, B.D. Santer, T. Das, G. Bala, A.W. Wood, T. Nozawa, A.A. Mirin, D.R. Cayan, and M.D. Dettinger. 2008. Human induced changes in the hydrology of the western United States. Science 319:1080-1083.

Barrett, J. A., E. Augenstein, and N. Sprague. 1985. Status report for *Hackelia venusta*. Unpublished report on file, U.S. Fish and Wildlife Service, Olympia, Washington. 30 pp.

Barry, Sheila J. 1998. Managing the Sacramento Valley Vernal Pool landscape to sustain the native flora. in Ecology, Conservation, and Management of Vernal Pool ecosystems-Proceeding from a 1996 Conference. California Native Plant Society, Sacramento, CA. pps. 236-240.

Baskin, J.N. 1975. Biology and the habitat of the unarmored threespine stickleback, *Gasterosteus aculeatus williamsoni,* in the upper Santa Clara River, California. Unpubl. Rept., Contract No. AB-27, Calif. Dept. of Fish and Game, Sacramento.

Baskin, J.N., and M.A. Bell. 1976. Unarmored threespine stickleback survey and report. Unpubl. Rept., Contract No. 39-5495. U.S.D.A., Forest Service, San Francisco.

Bates, B.C., Z.W. Kundzewicz, S. Wu, and J.P. Palutikof (editors). 2008. Climate change and water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva. 210 pp.

Baum, J. and A. Robinson. 2008. Spikedace and loach minnow survey in Eagle Creek, Greenlee and Graham Counties, July-August, 2008. Arizona Game and Fish Department, Phoenix. 8 pp.

Beal, Brian. 2008. California Department of Fish and Game.

Bedsworth, L., and Hanak, E. 2008. Preparing California for a changing climate. San Francisco, CA: Public Policy Institute of California.

Behnke, R. J. 2002. Trout and salmon of North America. The Free Press. New York.

Behnke, R.J. 1992. Native trout of Western North America. American Fisheries Society Monograph 6.

Behnke, R.J., and M. Zarn. 1976. Biology and management of threatened and endangered western trout. U.S. Forest Service General Technical Report RM-28. 45 pp.

Bell, M. A. 1976. Evolution of phenotypic diversity in *Gasterosteus aculeatus* superspecies on the Pacific coast of North America. Systemic Zoology 25:211-227.

Berg, R.K. and E.K. Priest. 1995. Appendix Table 1: A list of stream and lake fishery surveys conducted by U.S. Forest Service and Montana Fish, Wildlife and Parks fishery biologists in the Clark Fork River Drainage upstream of the confluence of the Flathead River from the 1950s to the present. Montana Fish, Wildlife, and Parks, Job Progress Report, Project F-78-R-1, Helena, Montana.

Berg, W. J. 1991. Selected observations and interpretations on the life-history of the Warner sucker (Catostomus warnerensis): conservation genetic management. Unpublished report to the Warner Sucker Working Group. 11 pp.

Bestgen, K.R. 1985. Results of identification of collections of larval fish made in the upper Salt and Gila rivers, AZ. Report. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 7 pp.

Beyer, W.N., and A. Olson. 1996. Can earthworms survive retardant application? Fire Management Notes, USDA Forest Service, 56 (1), 26-27.

Beymer, R.J., and J.M. Klopatek. 1992. Effects of grazing on cryptogamic crusts in pinyonjuniper woodlands in Grand Canyon National Park. American Midland Naturalist 127: 139-148.

Billings, W.D. 1994. Ecological impacts of cheatgrass and resultant fire on ecosystems in the Western Great Basin. In Proceedings – Ecology and Management of Annual Rangelands, S.B. Monsen and S.G. Kitchen, editors. USDA Intermountain Research Station General Technical Report INT-GTR-313, September.

Bisson, P.A., B.E. Rieman, C. Luce, P.F. Hessburg, D.C. Lee, J.L. Kershner, G.H. Reeves, and R.E. Gresswell. 2003. Fire and aquatic ecosystems of the western USA: current knowledge and key questions. Forest Ecology and Management 178:213-229.

Bloom, P. H. 1998. Report on spring and summer survey for arroyo toads in the Orange County Southern Subregion NCCP area. Unpublished report submitted to Dudek and Associates. 5 pp.

Boag, T.D. 1987. Food habits of bull char, *Salvelinus confluentus*, and rainbow trout, *Salmo gairdneri*, coexisting in a foothills stream in northern Alberta. Canadian Field-Naturalist 101(1): 56-62.

Bogan, M., C. Zugmeyer, and S. Parmenter. 2002. 2002 Monitoring of sensitive aquatic animals in the Owens Basin, Inyo and Mono Counties, California. Report prepared for California Department of Fish and Game, Eastern Sierra and Inland Deserts Region, Bishop, California. 97 pages.

Bond, C.E. 1992. Notes on the nomenclature and distribution of the bull trout and the effects of human activity on the species. Pages 1-4 in Howell, P.J. and D.V. Buchanan, editors. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Bond, C.E. and C.I. Coombs. 1985. Characteristics and life history of Catostomus warnerensis. Proc. Desert Fishes Council. 13:40-53.

Bosse, S.E., D. Hartzel, C. Allen, M. Stern, and A. Munhall. 1997. Warner Sucker Progress Report-1997 Findings. Unpublished Report to Bureau of Land Management. 78pp.

Bowles, A.L. 1995. Responses of wildlife to noise. *In* R.L. Knight and K.J. Gutzwiler (editors), Wildlife and recreationists, coexistence through management and research. Island Press, Washington, D.C.

Boyarski, D.E., A.T. Robinson, and C.D. Crowder. 2010. Repatriation of native fishes to Fossil Creek: annual summary of monitoring and stocking during 2009. Arizona Game and Fish Department. Phoenix, Arizona. 18 pages.

Boyd, S. and O. Mistretta. 1991. Survey of Cleveland National Forest for Munz's Onion. Unpublished report on file, Cleveland National Forest, San Diego, California.

Bradstock, R., J. Sanders, and A. Tegart. 1987. Short-term effects on the foliage of a eucalypt forest after an aerial application of a chemical fire retardant. Australian Forestry. 50(2):71-80.

Brewin, P.A. and M.K. Brewin. 1997. Distribution maps for bull trout in Alberta. Pages 206-216 in Mackay, W.C., M.K. Brewin and M. Monita, editors. Friends of the Bull Trout Conference Proceedings.

Bridges, P. 2011. Personal communication on August 29, 2011, between Paul Bridges, USFWS, Roseburg, OR and Gretchen Sausen, USFWS, La Grande Field Office, OR, concerning number of adult bull trout in the Pine and Powder Core Areas.

Brooks, M.L. 2008. Plant invasions and fire regimes. Pages 33-45 in K. Zouhar, J.K. Smith, S. Sutherland, and M.L. Brooks (editors), Wildland fire in ecosystems: fire and nonnative invasive plants. General Technical Report RMRS-GTR-42-volume 6. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 355 pp.

Brooks, M.L., C.M. D'Antonio, D.M. Richardson, J.B. Grace, J.E. Keeley, J.M. DiTomaso, R.J. Hobbs, M. Pellant, and D. Pyke. 2004. Effects of invasive alien plants on fire regimes. Bioscience. 54(7): 677-688.

Brouder, M. 2002. July 25, 2002 e-mail to Marianne Meding from Mark Brouder re: Verde River survey info.

Brown, D. K., A. A. Echelle, D. L. Propst, J. E. Brooks, and W. L. Fisher. 2001. Catastrophic wildfire and number of populations as factors influencing risk of extinction for Gila trout (*Oncorhynchus gilae*). Western North American Naturalist 61:139-148.

Brown, D.E. ed. 1982. Biotic Communities of the American Southwest-United States and Mexico. Desert Plants 4(1-4). University of Arizona for the Boyce Thompson Southwestern Arboretum. 342 pp.

Brown, T.J., B.L. Hall, and A.L. Westerling. 2004. The impact of twenty-first century climate change on wildland fire danger in the western United States: an application perspective. Climatic Change 62:365-388.

Brunelle, A. Associate Professor, Department of Geography University of Utah, Salt Lake City, UT. Phone conversation August 16, 2011.

Brunelle, A., T.A. Minckley, S. Blissett, S.K. Cobabe, B.L. Guzman. 2010. A ~8000 year fire history from an Arizona/Sonora borderland cienegas. Journal of Arid Environments 74:475-481.

Buchanan, D. M. and S. V. Gregory. 1997. Development of water temperature standards to protect and restore habitat for bull trout and other cold water species in Oregon. Pages 1-8 in Mackay, W.C., M.K. Brewin and M. Monita, editors. Friends of the Bull Trout Conference Proceedings.

Budy, P. 2011. Personal communication on August 25, 2011, between Phaedra Budy, Utah State University, Logan, Utah and Gary Miller, U.S. Fish and Wildlife Service, La Grande, Oregon, concerning bull trout population estimate for the Walla Walla core area.

Buettner, M. and C. Scoppettone. 1990. Life history and status of Catostomids in Upper Klamath Lake, Oregon. U.S. Fish and Wildlife Service, National Fisheries Research Center, Reno Field Station, Nevada. Completion report.

Buhl, K.J. and S.J. Hamilton. 1998. Acute Toxicity of Fire-Control Chemicals to Early Life Stages of Chinook Salmon. Environmental Toxicology and Chemistry, 17(8):1589-1599.

Buhl, K.J., and S.J. Hamilton. 1998. Acute toxicity of fire-retardant and foam suppressant chemicals to early life stages of Chinook salmon (*Oncorhynchus tshawytscha*). Environmental Toxicology and Chemistry 17:1589-1599.

Buhl, K.J., and S.J. Hamilton. 2000. Acute toxicity of fire-control chemicals, nitrogenous chemicals, and surfactants to rainbow trout. Transactions of the American Fisheries Society 129:408-418.

Burger, A.E., I.A. Manley, M.P. Silvergieter, D.B. Lank, and others. 2009. Re-use of nest sites by marbled murrelets (Brachyramphus marmoratus) in British Columbia. Northwestern Naturalist 90:217-226.

Burkey, T.V. 1989. Extinction in nature reserves: the effect of fragmentation and the importance of migration between reserve fragments. Oikos 55:75-81.

Burkhalter, D.E., and C.M. Kaya. 1977. Effects of prolonged exposure to ammonia on fertilized eggs and sac fry of rainbow trout (*Salmo gairdneri*). Transactions of the American Fisheries Society 106:470-475.

Burton, T.A. 2005. Fish and stream habitat risks from uncharacteristic wildfire: observations from 17 years of fire-related disturbances on the Boise National Forest, Idaho. Forest Ecology and Management 211:140-149.

Calfee, R.D. and E.E. Little. 2003. The effects of ultraviolet-B radiation on the toxicity of fire-fighting chemicals. Environmental Toxicology and Chemistry, 22(7): 1525-1531.

Calfee, R.D., and E.E. Little. 2003. Effects of a fire retardant chemical to fathead minnows in experimental streams. Environmental Science and Pollution Research 10:296-300.

California Department of Fish and Game (CDFG). 2002. Surveys to assess proper functioning condition in streams containing Modoc suckers, *Catostomus microps*, including: Turner, Washington, Coffee Mill, Hulbert, Garden Gulch, Johnson, and Dutch Flat creeks (Modoc County).

California Department of Fish and Game, Natural Diversity Data Base (CNDDB). 2011. Element Occurrence Reports. Unpublished cumulative data current to April 2, 2011.

California Native Plant Society. 007. Inventory of rare and endangered plants (online edition,v7-07b). Sacramento, California. Accessed 25 June 2007 from http://www.cnps.org.

California State University, Stanislaus (CSUS). 2011. California Jewelflower (Caulanthus californiicus), Endangered Species Recovery Program, California State University, Stanislaus. Visited August 8, 2011, on the Internet at: http://esrp.csustan.edu/publications/pubhtml.php?doc=sjvrp&file=chapter02A00.html

Campbell-Craven Environmental Consultants. 1994. Draft evaluation of fish passage alternatives for water diversions in Honey Creek, tributary to Hart Lake, Lake County, Oregon. Prepared for Oregon Department of Fish and Wildlife. Portland, Oregon. 16 pp.

Caplow, Florence. 2004. Botanist, Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington.

Carr, Dr. Robert L. 1996, 1998. Professor of Botany. Eastern Washington University, Cheney, Washington.

Carter, C. 2007. Three Forks loach minnow survey, August 28-30, 2007. Arizona Game and Fish Department. Phoenix, Arizona. 6 pages.

Carter, C. 2008b. March 28, 2008, email transmission from Codey D. Carter, Arizona Game and Fish Department, to K. McMillan, U.S. Forest Service re: Blue River loach minnow collection.

Carter, C., J. Chapman, D. Seidner, and J. Gamble. 2007. Upper Eagle Creek loach minnow and spikedace survey, May 8-9, 2007. Arizona Game and Fish Department. Phoenix, Arizona. 11 pages.

Casper, G.S., and R. Hendricks. 2005. *Rana catesbeiana*, American bullfrog. Pages 540-546 in M. Lannoo (editor), Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley, California.

Catlin, T.S. Rawlings, T. Contreras. 2005. Forest Health Assessment: Colville National Forest. March 4, 2005. Colville, WA. 23p.

Cavender, T.M. 1978. Taxonomy and distribution of the bull trout, *Salvelinus confluentus* (Suckley), from the American Northwest. California Fish and Game 64(3): 139-174.

CDF (California Department of Forestry and Fire Protection). 2011. Fire season website http://bof.fire.ca.gov/incidents/incidents_seasondeclarations?year=2011. Accessed 9 September 2011.

CDFG. 2007. *Chlorogalum purpureum* var. *reductum*. In: Natural diversity data base. Sacramento, California. Accessed 6 June 2007.

CDFG. 2010. Stocking records for Lahontan cutthroat trout-2010-Annual summary. Rancho Cordova, California. 2 pp.

CDFG. The status of rare, threatened, and endangered plants and animals of California 2000-2004. Sacramento, California. 568 pages.

Chamberlin, C.D. 2006. Environmental variables of northern California lagoons and estuaries and the distribution of tidewater goby (*Eucyclogobius newberryi*), U.S. Fish and Wildlife Service, Arcata Fish and Wildlife Office, Arcata Fisheries Technical Report TR 2006-04, Arcata, California.

Chang, C. 1996. Ecosystem responses to fire and variations in fire regimes. Pages 1071-1099 in Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. University of California, Centers for Water and Wildland Resources, Davis.

Chmiel, M. 2006. Verde River Trip Report, July 25-28, 2006. Arizona Game and Fish Department, Phoenix, AZ. 8 pp.

Christensen, D.P. 1984 The Revised Fisheries Management Plant for the Little Kern Golden Trout. California Department of Fish and Game. 32 p.

Clark, A. 2003. Middle Verde River Fish Survey Summary, Tuzigoot Bridge to Beasley Flat, June 2003. Arizona Game and Fish Department, Phoenix, AZ 8 pp.

Clarkson, R.W., P.C. Marsh, J.A. Stefferud, and B.R. Kesner. 2008. Fishery survey of lower Blue River, Greenlee County, Arizona, May 19-22, 2008. 5 pages.

CNHP Colorado Natural Heritage Program. 2005. Pawnee montane skipper post-fire habitat assessment survey. September 2005. Prepared for the U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. CNHP, Colorado State University.

CNHP Colorado Natural Heritage Program. 2005b. Pawnee montane skipper post-fire habitat assessment survey. September 2004. Prepared for the U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. CNHP, Colorado State University.

CNHP Colorado Natural Heritage Program. 2007. Pawnee montane skipper post-fire habitat assessment survey. September 2006. Prepared for the U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. CNHP, Colorado State University.

CNHP Colorado Natural Heritage Program. 2011. Pawnee montane skipper post-fire habitat assessment survey - September 2010. Prepared for the U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. CNHP, Colorado State University. Fort Collins, Colorado

Cochnauer, T., E. Schriever, and D. Schiff. 2001. Idaho Department of Fish and Game Regional Fisheries Management Investigations: North Fork Clearwater River Bull Trout, Project 9. F-73-R-22.

Colket, B., S. Cooke, G. Crymes, and M. Mancuso. 2006. Element Occurrence review and update for fire rare plant species. Report prepared for the Idaho Bureau of Land Management by Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, Id.

Collins, J.P., T.R. Jones, and H.J. Berna. 1988. Conserving genetically distinctive populations: The case of the Huachuca tiger salamander (*Ambystoma tigrinum stebbinsi* Lowe). Pages 45-53 in R.C. Szaro, K.C. Severson, and D.R. Patton, editors. Management of amphibians, reptiles, and small mammals in North America. USDA Forest Service GTR-RM-166, Fort Collins, Colorado.

Colyer, W.T., J.L. Kershner, and R.H. Hilderbrand. 2005. Movements of fluvial Bonneville cutthroat trout in the Thomas Fork of the Bear River, Idaho-Wyoming. North American Journal of Fisheries Management 25:954-963.

Coombs, C. I., C. E. Bond, and S. F. Drohan. 1979. Spawning and early life history of the Warner sucker (Catostomus warnerensis). Unpublished report to Fish and Wildlife Service. 52 pp.

Coombs, C.I., and C.E. Bond. 1980. Report of investigations on Catostomus warnerensis, fall 1979 and spring 1980. Unpublished report to Fish and Wildlife Service. 32 pp.

Cope, E.D. 1883. On the fishes of the recent and Pliocene lakes of the western part of the Great Basin, and the Idaho Pliocene Lake. Proc. Acad. Nat. Sci. Philadelphia. 1883:134-166.

Cordes, J.F., J.A. Israel, and B. May. 2004. Conservation of Paiute cutthroat trout: the genetic legacy of population transplants in an endemic California salmonid. California Fish and Game 90:101-118.

Courtney, S.P., J.A. Blakesley, R.E. Bigley, M.L. Cody, J.P. Dumbacher, R.C. Fleischer, A.B. Franklin, J.F. Franklin, R.J. Gutierrez, J.M. Marzluff, and L. Sztukowski. 2004. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute. Portland, Oregon.

Crabtree, D. 2011. Personal communication on June 29, 2011, between David Crabtree, Umatilla National Forest, Walla Walla, Washington and Marisa Meyer, U.S. Fish and Wildlife Service, La Grande, Oregon, concerning 2010 Bull trout spawning ground survey results.

Creef, E.D. and R. W. Clarkson. 1993. Razorback sucker (Xyrauchen texanus) and Colorado squawfish (Ptychocheilus lucius) Monitoring, Verde and Salt Rivers, Arizona 1991-1993. Special Report. Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix. 16 pp.

Crowder, C. 2011. August 23, 2011, email from C. Crowder, Arizona Game and Fish Department to C. Crowder, Arizona Game and Fish Department and others re: Results of the CAP Program monitoring at Fossil Creek the week of August 15th.

Dambacher, J. M., M. W. Buktenica, and G. L. Larson. 1993. Fishes and stream habitat in tributaries of the Klamath River in Crater Lake National Park, with special reference to the Sun Creek bull trout (*Salvelinus confluentus*) population. United States Department of Interior, National Park Service, Pacific Northwest Region.

Daniels, R. A. 1978. Distribution, status, and life history of *Pacifastacus fortis*. Unpublished final report to United States Forest Service, 14 pp.

Daniels, R. A. 1980. Distribution and status of crayfishes in the Pit River drainage, California.Crustaceana 38:131–138.

Davis, R., R. Horn, P. Caldwell, S. Cross, R. Crutchley, K. Fukuda, C. Larson, H. Wise. 2011. Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) in the Klamath Mountain Province of Oregon, 1990-2010. Unpublished progress report.

Delaney, D.K., T.G. Grubb, and L.L. Pater. 1997. Effects of helicopter noise on nesting Mexican spotted owls. A report to the U.S. Air Force 49 CES/CEV, Holloman Air Force Base. Project Order No. CE P.O. 95-4. 49 pp.

Delaney, D.K., T.G. Grubb, P. Beier, L.L. Pater, and M. Hildegard Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63(1):60-76.

Desjardins, M., and D.F. Markle. 2000. Distribution and biology of suckers in Lower Klamath Reservoirs. 199 Final Report, submitted to PacifiCorp, Portland, Oregon.

Diffenbaugh, N.S., J.S. Pal, R.J. Trapp, and F. Giorgi. 2005. Fine-scale processes regulate the response of extreme events to global climate change. Proceedings of the National Academy of Sciences 102:15774-15778.

Divoky, G.J. and M. Horton. 1995. Breeding and natal dispersal, nest habitat loss and implications for marbled murrelet populations. Pages 83-87 in C.J. Ralph, G.L. Hunt, M.G. Raphael, and J.F. Piatt (eds.). Ecology and conservation of the marbled murrelet. General Technical Report. PSW-GTW-152. Pacific Southwest Experimental Station, U.S. Forest Service, Albany, California. 420 pp.

Dodge, M. 1970. Nitrate poisoning, fire retardants, and fertilizers-any connection? Journal of Range Management. Vol. 23, No. 4: 244-247.

Donald, D.B. and D.J. Alger. 1993. Geographic distribution, species displacement, and niche overlap for lake trout and bull trout in mountain lakes. Canadian Journal of Zoology 71: 238-247.

Dowling, T.E. 2005. Conservation genetics of Modoc sucker. Final report to U.S. Fish and Wildlife, Klamath Falls, OR; Contract # 114500J516. 15 pp.

Doyle, J. 2011. Threatened and Endangered Species Annual Report pursuant to T&E Permit # 154573-0 East Fork Wallowa River – 2010. PacifiCorp Energy, Portland, OR. January 2011.

Druliner, Pam. 2011. August 19, 2011, E-mail transmitting GIS bull trout critical habitat miles data. GIS data from Service, Boise, ID.

Duffy and Weedman 2005. Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey May 16-20, 2005. Arizona Game and Fish Department, Phoenix, AZ. 6 pp.

Dugger, K., S. Ackers, R. Claremont, R. Leach, B. Meiering, D. Sedgwick, K. Skybak, and A. Smoluk. 2011. The demography of northern spotted owls (*Strix occidentalis caurina*) on the Willamette National Forest, Oregon. Unpublished progress report.

Dugger, K., S. Andrews, E. Fleigel, L. Friar, D. Strejc, and F. Wagner. 2010. Demographic characteristics and ecology of northern spotted owls (*Strix occidentalis caurina*) in the southern Oregon Cascades. Annual progress report.

Dunham, J.B. and B.E. Rieman. 1999. Metapopulation structure of bull trout: influences of physical, biotic, and geometrical landscape characteristics. Ecological Applications 9(2):642-655.

Dunham, J.B., A.E. Rosenberger, C.H. Luce, and B.E. Rieman. 2007. Influences of wildfire and channel reorganization on spatial and temporal variation in stream temperature and the distribution of fish and amphibians. Ecosystems 10:335-346.

Dunham, J.B., G.L. Vinyard, and B.E. Rieman. 1997. Habitat fragmentation and extinction risk of Lahontan cutthroat trout. North American Journal of Fisheries Management 17:1126-1133.

Dunham, J.B., M.K. Young, and R.E. Gresswell. 2003. Effects of fire on fish populations: landscape perspectives on persistence of native fishes and non-native fish invasions. Forest Ecology and Management 178:183-196.

Dunham, J.B., R.E. Schroeter, and B.E. Rieman. 2003b. Influence of maximum water temperature on occurrence of Lahontan cutthroat trout within streams. North American Journal of Fisheries Management 23:1042-1049.

Dunham, J.B., S.B. Adams, R.E. Schroeter, and D.C. Novinger. 2002. Alien invasions in aquatic ecosystems: toward an understanding of brook trout invasions and potential impacts on inland cutthroat trout in western North America. Reviews in Fish Biology and Fisheries 12:373-391.

EDAW, Inc. 2001. Encinitas baccharis (*Baccharis vanessae*) habitat management plan for the Olivenhain water storage project. Unpublished document prepared for the Carlsbad Fish and Wildlife Office of the U.S. Fish and Wildlife Service. 17 pp.

Edgerton, B.F., L.H. Evans, F.J. Stephens, and R.M. Overstreet. 2002. Synopsis of freshwater crayfish diseases and commensal organisms. Aquaculture 206:57-135.

Ehrenfeld, J.G., P. Kourtev, and W. Huang. 2001. Changes in soil functions following invasions of exotic understory plants in deciduous forests. Ecological Applications 11(5): 1287-1300.

Ellis, M. J. 1999. Species invasions and replacements in a native crayfish community. Ph.D. Dissertation, Department of Biology, University of Michigan, Ann Arbor, Michigan. 230 pp.

Ellis, S. 2008. E-mail exchange with S. Ellis regarding the effects of fire retardant on the Pawnee montane skipper; January 24, 2008.

Ellis. M. J. and J. D. Cook. 2008. Information pertinent to the 5-year review for Shasta crayfish (*Pacifastacus fortis*). Memorandum to the U.S. fish and Wildlife Service.

Emerson, K., R.C. Russo, R.E. Lund, and R.V. Thurston. 1975. Aqueous ammonia equilibrium calculations: Effect of pH and temperature. Journal of Fisheries Research Board of Canada. 32:2379-2383.

ENSR International. 2003. Pawnee montane skipper monitoring post-fire habitat assessment survey – September 2003. Final Report to U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. ENSR Corporation, Fort Collins, Colorado. Document Number 09090-045-200.

ENSR International. 2003b. Pawnee Montane Skipper 2002 Post-Fire Habitat Assessment Survey. Final Report to U.S. Forest Service South Platte Ranger District, U.S. Fish and Wildlife Service, and Denver Water. ENSR Corporation, Fort Collins, Colorado. Document Number 09075-006-200.

Environmental Research and Technology (ERT). 1986. 1986 Pawnee Montane skipper field studies. Prepared for the Denver Water Department, Denver, Colorado. 40 pp.

ERT. 1988. Pawnee Montane skipper - 1987 field studies. Prepared for the Denver Water Department, Denver, Colorado. 14 pp.

ERT. 1989. Pawnee montane skipper – 1988 field studies. Prepared for the Denver Water Department, Denver, Colorado. 23 pp.

Fagan, W.F. 2002. Connectivity, fragmentation, and extinction risk in dendritic metapopulations. Ecology 83:3243-3249.

Falk, M. 1998. Letter to J. Wade, District Ranger, Sierra Vista RD. *Lilaeopsis schaffneriana* ssp. *recurva* monitoring summary and recommendations. Letter dated July 13, 1989.

Falk, Mima. Senior Listing Biologist, U.S. Fish and Wildlife Service. Personal communication, August 5, 2011.

Falxa, G., J. Baldwin, D. Lynch, S.L. Miller, S.K. Nelson, S.F. Pearson, M.G. Raphael, C. Strong, T. Bloxton, B. Galleher, B. Hogoboom, M. Lance, and R. Young. 2011. Marbled murrelet effectiveness monitoring, Northwest Forest Plan: 2009 and 2010 summary report. 26 pp.

Fausch, K.D., and M.K. Young. 1995. Evolutionary significant units and movement of resident stream fishes: a cautionary tale. American Fisheries Symposium 17:360-370.

Feldmeth, C.R., and J.N. Baskin. 1976. Thermal and respiratory studies with reference to temperature and oxygen tolerance for the unarmored stickleback *Gasterosteus aculeatus williamsoni* Hubbs (Sic.). Bull. So. California Acad. Sci. 75:127-131.

Ferguson, N. J. and N. C. Ellstrand. 1999. Assessment of seed bank buffering of genetic change in *Dodecahema leptoceras* (slender-horned spineflower). Prepared for California Department of Fish and Game, Long Beach, California, U.S. Fish and Wildlife Service Contract. 25 pp.

Ficke, A.D., C.A. Myrick, and L.J. Hansen. 2007. Potential impacts of global climate change on freshwater fisheries. Reviews in Fish Biology and Fisheries 17:581-613.

Field, C.B., L.D. Mortsch, M. Brklacich, D.L. Forbes, P. Kovacs, J.A. Patz, S.W. Running, and M.J. Scott. 2007. North America. Pages 617-652 in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (editors), Climate change 2007: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the

Finger, A., M. Stephens, and B. May. 2008. Paiute cutthroat trout genetics report. Genomic Variation Laboratory, University of California, Davis. 26 pp.

Finger, S.E. (ed.). 1997. Toxicity of fire retardant and foam suppressant chemicals to plant and animal communities. Final Report. Columbia, MO. USGS/Biological Resources Division. 186 pp. plus executive summary.

Fish and Wildlife Service (Service). 1998a. Endangered and threatened wildlife and plants: Determination of threatened status for the Klamath River and Columbia River Distinct Population Segments of Bull trout. Federal Register 63:31647-31674. June 10, 1998.

Fish and Wildlife Service (Service). 1998b. Endangered and threatened wildlife and plants: Emergency listing of the Jarbidge River Distinct Population Segment of Bull trout. Federal Register 63:42757-42762. August 11, 1998.

Fish and Wildlife Service (Service). 1999. Endangered and threatened wildlife and plants: Determination of threatened status for the Jarbidge River Distinct Population Segments of Bull trout. Federal Register 64:17110-17125. April 8, 1999.

Fish and Wildlife Service and NMFS (National Marine Fisheries Service). 1998. Endangered Species Consultation Handbook. 351pp.

Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; Determination that the Warner Sucker is a threatened species and designation of critical habitat. Federal Register 50(188):39117-39123.

Fish and Wildlife Service. 1986. Recovery plan for the Pacific bald eagle. Portland, Oregon.

Fish and Wildlife Service. 1998. Recovery Plan for the Native Fishes of the Warner Basin and Alkali Subbasin. Portland, Oregon. 86pp.

Fish and Wildlife Service. 2002a. Chapter 1, Introduction. 137pp. In: Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon.

Fish and Wildlife Service. 2002b. Chapter 2, Klamath River Recovery Unit, Oregon. 82pp. In: Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Fish and Wildlife Service, Portland, Oregon.

Fish and Wildlife Service. 2002c. Chapter 25, St. Mary-Belly River Recovery Unit, Montana. 134 pp. In: Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Fish and Wildlife Service, Portland, Oregon.

Fish and Wildlife Service. 2002d. Chapter 16, Clearwater River Recovery Unit, Idaho. 196 pp. In: Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Fish and Wildlife Service, Portland, Oregon.

Fish and Wildlife Service. 2002e. Chapter 13, Hells Canyon Complex Recovery Unit, Oregon and Idaho. 81 p. In: U.S. Fish and Wildlife Service. Bull Trout *(Salvelinus* confluentus) Revised Draft Recovery Plan. Portland, Oregon

Fish and Wildlife Service. 2002f. Chapter 3, Clark Fork River Recovery Unit, Montana, Idaho, and Washington. In: Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Fish and Wildlife Service, Portland, Oregon.

Fish and Wildlife Service. 2005a. Bull Trout Core Area Conservation Status Assessment. Fish and Wildlife Service, Portland, Oregon. 95pp. plus appendices.

Fish and Wildlife Service. 2005b. Bull trout core area templates – complete core area by core area analysis. W. Fredenberg and J. Chan, editors. U.S. Fish and Wildlife Service. Portland, Oregon. 660 pages.

Fish and Wildlife Service. 2006. Recovery Units and Jeopardy Determinations under Section 7 of the Endangered Species Act. Director Memorandum: USFWS/AES/DCHRS/024358. March 6, 2006.

Fish and Wildlife Service. 2008a. Bull Trout (*Salvelinus confluentus*) 5-Year Review: Summary and Evaluation. 53pp.

Fish and Wildlife Service. 2008b. Genetic analysis of bull trout in the upper Klamath River basin, Oregon. Abernathy Fish Technology Center, Longview, Washington.

Fish and Wildlife Service. 1998c. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Klamath River and Columbia River Distict Population Segments of Bull Trout; Final Rule; Federal Register, June 10, 1998; Vol. 63, No. 111, pp 31647-31674.

Fish and Wildlife Service. 2004a. Draft Recovery Plan for the Jarbidge River Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Fish and Wildlife Service, Portland, Oregon. 132 + xiii pp.

Fish and Wildlife Service. 2004b. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Volume I (of II): Puget Sound Management Unit. Portland, Oregon. 389 + xvii pp.

Fish and Wildlife Service. 2004c. Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (*Salvelinus confluentus*). Volume II (of II): Olympic Peninsula Management Unit. Portland, Oregon. 277 + xvi pp.

Fish and Wildlife Service. 2004d. Chapter 10, Umatilla/Walla Walla River Recovery Unit, Oregon. 154 p. In: U.S. Fish and Wildlife Service. Bull Trout *(Salvelinus confluentus)* Revised Draft Recovery Plan. Portland, Oregon.

Fish and Wildlife Service. 2004e. Chapter 12, Imnaha-Snake River Recovery Units, Oregon and Idaho. 98 p. In: U.S. Fish and Wildlife Service. Bull Trout (Salvelinus confluentus) Revised Draft Recovery Plan. Portland, Oregon

Fish and Wildlife Service. 2010. Bull Trout Final Critical Habitat Justification: Rationale for Why Habitat is Essential, and Documentation of Occupancy. Idaho Fish and Wildlife Office, Boise, Idaho; Pacific Region, Portland, Oregon. 979 pp. plus appendix

Fishbein, M. and D. Gori. 1992. The effect of prescribed burns on the composition and structure of cienega vegetation, with special emphasis on the Canelo Hills ladies' tresses orchid, Spiranthes delitescens: post-burn responses. Report to the Nature Conservancy Field Office. 34 p.

Fisher, R. 2009. Electronic correspondence, October 1, 2009. Senior Biologist, U.S. Geological Survey, San Diego Field Station, San Diego, California.

Flebbe, P.A., L.D. Roghair, and J.L. Bruggink. 2006. Spatial modeling to project southern Appalachian trout distribution in a warmer climate. Transactions of the American Fisheries Society 135:1371-1382.

Foott, J.S., K. Nichols, and R. Harmon. 2000. Histological and hematological evaluation of juvenile Lost River suckers exposed to sub-lethal levels of ammonia. FY 2000 Investigational Report, California-Nevada Fish Health Center, Anderson, California.

Foott, Scott, Project Leader, California-Nevada Fish Health Center, Anderson, California.

Ford, T. 1977. Status summary report on the Modoc sucker. USFS, Modoc National Forest, unpublished technical report. 44 pp.

Forest Service. 2005. Population Viability Assessment Upper South Fork Clearwater River: Spring Chinook, Snake River Steelhead Trout, Westslope Cutthroat Trout, Columbia River Bull Trout, and Pacific Lamprey. Nez Perce National Forest, Grangeville, Idaho. 43 pp.

Forest Service. 2011. Nationwide aerial application of fire retardant on National Forest System land biological assessment, final revision August 30, 2011. Washington DC.

Forsman, E.D., B.L. Biswell, D. Kelso, and C. McCafferty. 2011b. Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) on the Olympic Peninsula study area, Washington, 1987-2010. Unpublished progress report.

Forsman, E.D., B.L. Biswell, D. Kelso, and M. Koranda. 2009. Demographic characteristics of spotted owls (*Strix occidentalis caurina*) on the Olympic Peninsula study area, Washington, 1987-2008. Unpublished progress report.

Forsman, E.D., B.L. Biswell, D. Kelso, K. Laubenheimer, and E. Graham. 2010a. Demographic characteristics of northern spotted owls (*Strix occidentalis caurina*) on the Olympic Peninsula study area, Washington, 1987-2009. Unpublished progress report.

Forsman, E.D., R.G. Anthony, K.M. Dugger, E.M Glenn, A.B. Franklin, G.C. White, C.J. Schwarz, K.P. Burnham, D.R. Anderson, J.D. Nichols, J.E. Hines, J.B. Lint, R.J. Davis, S.H. Ackers, L.S. Andrews, B.L. Biswell, P.C. Carlson, L.V. Diller, S.A. Gremel, D.R. Herter, J.M. Higley, R.B. Horn, J.A. Reid, J. Rockweit, J.P. Schaberl, T.J. Snetsinger, and S.G. Sovern. 2011a. Population demography of northern spotted owls. Studies in Avian Biology No. 40. Cooper Ornithological Society. U. California Press, Berkeley.

Forsman, E.D., S. Sovern, M. Taylor, J. StHilaire, and D. Phipps. 2010c. Demography of spotted owls on the east slope of the Cascade Range, Washington, 1989-2010. Unpublished progress report.

Forsman, E.D., T. Snetsinger, J. Cederstrom, R. Lee, I. Matthews, T. Plawman, N. Stephens and J. Swingle. 2010b. Demographic characteristics of spotted owls in the Oregon Coast Ranges, 1990-2009. Unpublished progress report.

Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

Fraley, J.J. and B.B. Shepard. 1989. Life history, ecology and population status of migratory bull trout (*Salvelinus confluentus*) in the Flathead Lake and River system, Montana. Northwest Science 63(4): 133-143.

Francis-Floyd, R. C. Watson, D. Petty, and D. B. Pouder. 2009. Ammonia in Aquatic Systems. Publication #FA16, University of Florida IFAS Extension. This document is FA-16, one of a series from the Department of Fisheries and Aquatic Sciences, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. First published: May 1990. Revised: June 1996, February 2009. Reviewed: February 2005. Please visit the EDIS Web Site at http://edis.ifas.ufl.edu.

Frankham, R. 2005. Genetics and extinction. Biological Conservation 126:131-140.

Franklin, A.B., P.C. Carlson, J.T. Rockweit, A.N. Canter, A. Roberts, N. Van Lanen, J. Lux, E.J. Sisson, A. C. Knox, G.C. White. 2008. Monitoring the population ecology of spotted owls (*Strix occidentalis caurina*) in northwestern California: annual results, 2007. Unpublished progress report.

Franklin, A.B., P.C. Carlson, J.T. Rockweit, K. Lewicki, M. Immel, A. Van Lanen, H. Hareza, J. Smith, W. Lanier, B.R. Barry, and K. Wilson. 2011. Monitoring the population ecology of spotted owls (*Strix occidentalis caurina*) in northwestern California: annual results, 2010. Unpublished progress report.

Franklin, A.B., P.C. Carlson, J.T. Rockweit, K. Lewicki, M. Immel, A. Van Lanen, H. Hareza, R. Wise, V. Schipani, and K. Wilson. 2010. Monitoring the population ecology of spotted owls (*Strix occidentalis caurina*) in northwestern California: annual results, 2009. Unpublished progress report.

Franklin, I. R. 1980. Evolutionary change in small populations. Pages 135-149 *in* M. E. Soule and B. A. Wilcox (eds.). Conservation biology: an evolutionary–ecological perspective. Sinauer Associates, Sunderland, Massachusetts. 395 pp.

Frid, A. and L. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6(1):11.[online] URL: http://www.consecol.org/vol6/iss1/art11

Fulé, P. 2010. Interactions of climate change, fire regimes, and hydrologic regimes. Presented at the Arizona Climate Change Adaptation Workshop for Natural Resource Managers of the Four Forest Restoration Initiative Area. April 7-8, 2010. Flagstaff, Arizona.

Gaikowski, M.P., S.J. Hamilton, K.J. Buhl, S.F. McDonald, and C.H. Summers. 1996. Acute toxicology of three fire retardant and two fire suppressant foam formulations to the early life stages of rainbow trout (Oncoryhnchus mykiss). Environmental Toxicology and Chemistry 15(8):1,365-1,374.

Gaikowski, M.P., S.J. Hamilton, K.J. Buhl, S.F. McDonald, and C.H. Summers. 1996b. Acute toxicity of firefighting chemical formulations to four life stages of flathead minnow. Ecotoxicology and Environmental Safety 34:252-263.

Gaikowski, M.P., S.J., Hamilton, K.J. Buhl, S.F. McDonald, and C.H. Summers. 1996a. Acute toxicology of three fire retardant and two fire suppressant foam formulations to the early life stages of rainbow trout (*Oncorhynchus mykiss*). Environmental Toxicology and Chemistry 15:1365-1374.

Gallegos, E., A. Backlin, S. Schuster and R. Fisher. 2010. Data Summary for the 2009 California Red-legged Frog (*Rana draytonii*) Surveys Conducted in the Angeles National Forest. U.S. Geological Survey, Sacramento, California.

Gamon, J. 1988a. Report on the status of *Hackelia venusta* (Piper) St. John. Draft revision to 1985 status report. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. 36 pp.

Gamon, J. 1988b. Habitat management guidelines for *Hackelia venusta* on the Wenatchee National Forest. Washington Natural Heritage Program, Washington Department of Natural Resources, Olympia, Washington. 5pp.

Gamon, J. 1997. Report on the status of *Hackelia venusta* (Piper) St. John. Updated revision to 1985 status report and the 1988 draft revision. Washington Natural Heritage Program, Olympia, Washington Department of Natural Resources, Washington. 38 pp.

Ganey, J. L. and S. C. Vojta. 2010. Tree Mortality in Drought-stressed Mixed-conifer and Ponderosa Pine Forests, Arizona. Unpublished abstract Presented at the Arizona Climate Change Adaptation Workshop for Natural Resource Managers of the Four Forest Restoration Initiative Area. April 7-8, 2010. Flagstaff, Arizona.

Gardiner, Duane. 2011. Chapter 10. N,P, and K in the Soil Plant Environment. http://jan.ucc.nau.edu/~doetqp-p/courses/env320/lec21/Lec21.html Last accessed 21 July, 2011.

Garside, L.J., and J.H. Schilling. 1979. Thermal waters of Nevada. Nevada Bureau of Mines and Geology. Bulletin 91. University of Nevada, Reno. 163 pp.

Geiger, N.S. 2001. Reassociating wetlands with Upper Klamath Lake to improve water quality. Paper presented at the Klamath Fish and Water Management Conference in Arcata, California, May 22-25, 2001.

Gentry, J. L., and R. L. Carr. 1976. Monograph of the Genus *Hackelia* (Boraginaceae) in North America, North of Mexico. Memoirs of the New York Botanical Garden 26:121–227.

GeoMAC. 2011. Geospatial Multi-Agency Coordination Group (GeoMAC). Fire perimeter spatial data (2000-2010) compiled by the GeoMAC project (http://geomac.gov).

Gerhardt, R. 2003. 2003 annual report: activities conducted under Recovery Permit TE-841627-4. Unpublished progress report.

Gerhardt, R. 2003. 2004 annual report: activities conducted under Recovery Permit TE-841627-4. Unpublished progress report.

Gerhardt, R. 2003. 2006 annual report: activities conducted under Recovery Permit TE-841627-4. Unpublished progress report.

Gerhardt, R. 2003. 2007 annual report: activities conducted under Recovery Permit TE-841627-4. Unpublished progress report.

Gilbert, C.H. 1897. The Fishes of the Klamath Basin. Bulletin of the U.S. Fish Commission 17:1-13.

Gill, C. 2007. Results of the Verde River, Childs to Sheeps Bridge, Fisheries Survey May 22-25, 2007. Arizona Game and Fish Department, Phoenix, AZ. 11 pp.

Giller, John, Interagency Fire Management Officer, Fremont-Winema NF, Lakeview Oregon.

Gilmore, T. 2008. Personal observation. U.S. Fish and Wildlife Service. Nevada Fish and Wildlife Office, Reno, Nevada.

Girard, C. 1854. Descriptions of new fishes, collected by Dr. A. L. Heerman, naturalist attached to the survey of the Pacific railroad route, under Lieut. R. S. Williamson, U.S.A. Proc. Acad. Nat. Sci. Philadelphia 7:129-142.

Goetz, F. 1989. Biology of the bull trout, *Salvelinus confluentus*, a literature review. Willamette National Forest. Eugene, Oregon.

Goetz, F. 1994. Distribution and juvenile ecology of bull trout (*Salvelinus confluentus*) in the Cascade Mountains. M.S. Thesis, Oregon State University, Corvallis, Oregon.

Goldstein, J., and B. Hobbs. 2009. Native fish and amphibians field trip report, Lockes Ranch and Duckwater Shoshone Reservation. Nevada Department of Wildlife, Southern Region, Las Vegas. 14 pp.

Gori, D. 1994. Monitoring plan for Canelo Hills ladies' tresses orchid (*Spiranthes delitescens*) at Canelo Hills Cienega Preserve. 14 p.

Gori, D. and D. Backer. 1999. 1999 monitoring results of Canelo Hills ladies' tresses orchid (*Spiranthes delitescens*), Canelo Hills Cienega Preserve. 2 p.

Greenfield, D.W., S.T. Ross, and G.D. Deckert. 1970. Some aspects of the life history of the Santa Ana sucker, *Catostomus* (Pantosteus) *santaanae* (Snyder). California Fish and Game 56: 166–179.

Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society, 128(2): 193-221.

Griffin, P.C., T.J. Case, and R.N. Fisher. 1999. Radio telemetry study of *Bufo californicus*, arroyo toad movement patterns and habitat preferences. Contract Report to California Department of Transportation Southern Biology Pool.

Gurtin, S. 2004. July 8, 2004, email transmission from S. Gurtin, Arizona Game and Fish Department, to Leslie Ruiz, U.S. Fish and Wildlife Service, and others, re: 3-Forks loach minnow salvage for week of July 5-9.

Gutzwiller, K.J. 1995. Recreational disturbance and wildlife communities. Chapter 10 in R.L. Knight and K.J. Gutzwiler (editors), Wildlife and recreationists, coexistence through management and research. Island Press, Washington, D.C.

Guy, T.J., R.E. Gresswell, and M.A. Banks. 2008. Landscape-scale evaluation of genetic structure among barrier-isolated populations of coastal cutthroat trout, *Oncorhynchus clarkii clarkii*. Canadian Journal of Fisheries and Aquatic Sciences 65:1749-1762.

Haak, A.L., J.E. Williams, D. Isaak, A. Todd, C. Muhlfeld, J.L. Kershner, R. Gresswell, S. Hostetler, and H.M. Neville. 2010. The potential influence of changing climate on the persistence of salmonids of the inland west. U.S. Geological Survey Open File Report 2010-1236. 74 pp.

Hadley, D., and T.E. Sheridan. 1995. Land use history of the San Rafael Valley, Arizona (1540-1960). General Technical Report GM-GTR-269. USDA Forest Service. Fort Collins, Colorado.

Hale, R. C., M. J. La Guardia, E. Harvey, and T. M. Mainor. 2002. Potential role of fire retardant-treated polyurethane foam as a source of bromated diphenyl ethers to the US environment. Chemosphere 46:729-735.

Hamit, W.E., and D.N. Cole. 1987. Wildland recreation: ecology and management. John Wiley and Sons, New York, NY. Knight, R.L. and D.N. Cole. 1995. Factors that influence wildlife responses to recreationists. In Wildlife and Recreationists: Coexistence Through Management and Research. Knight, Richard L. and Kevin J. Gutzwiller, editors. Island Press, Washington, D.C. 372 pp.

Hansen, A.J., R.P. Neilson, V.H. Dale, C.H. Flather, L.R. Iverson, D.J. Currie, S. Shafer, R. Cook, and P.J. Bartlein. 2001. Global Change in Forests: Responses of Species, Communities, and Biomes. BioScience 51(9):765-779.

Hanson, J., E. Schriever. and J. Erhardt. 2006. Final report. Bull trout life history investigations in the North Fork Clearwater River Basin. Regional fisheries management investigations, North Fork Clearwater River bull trout. Idaho Department of Fish and Game. Contract No. DACW68-96-D-0003. Boise, Idaho. 106pp.

Hargreaves, J.A. and C.S. Tucker. 2004. Managing Ammonia in Fish Ponds. SRAC Publication No. 4603, Southern Regional Aquaculture Center.

Harig, A.L., and K.D. Fausch. 2002. Minimum habitat requirements for establishing translocated cutthroat trout populations. Ecological Applications 12:535-551.

Harke, Vince. 2011. U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office, Lacey, Washington.

Harrod, R. J. 1994. The effects of the Hatchery and Rat Creek fires on endangered, threatened, and sensitive plant species. Report prepared for Leavenworth Ranger District, Wenatchee National Forest, Washington.

Hartzell, K. E, and K. Popper. 2002. Warner Sucker Progress Report-2001 Findings. Unpublished Report to Bureau of Land Management.36pp.

Harvey, J. 2011. Personal communication. U.S. Forest Service, Humboldt-Toiyabe National Forest, Sparks, Nevada. Conversation with Chad Mellison, U.S. Fish and Wildlife Service, Nevada Fish and Wildlife Office, Reno, Nevada, on August 1, 2011, regarding a recent field trip to Old Dugan Ranch to verify Railroad Valley springfish were on Forest Service lands.

Hayes, J.P. 1980. Fish of the Warner Valley. Pages 131-137 in C. Gilman and J.W. Feminella, editors. Plants and animals associated with aquatic habitats of the Warner Valley. Oregon State University, Corvallis, Oregon.

Healey, M.C. and A. Prince. 1995. Scales of variation in life history tactics of Pacific salmon and conservation of phenotype and genotype. Pages 176-184 in J. L. Nielsen editor. Evolution and the Aquatic Ecosystem. American Fisheries Society Symposium 17. American Fisheries Society, Bethesda, Maryland.

Hebert, P.N and R.T. Golightly. 2006. Movements, nesting, and response to anthropogenic disturbance of marbled murrelets (*Brachyramphus marmoratus*) in Redwood National and State Parks, California. May 2006. California Department of Fish and Game, Habitat Conservation Planning Branch Species Conservation and Recovery Program Report: 2006-02. California Department of Transportation Report Number: F/CA/IR- 2006/04. 321 pp.

Heck, M.P., P.D. Scheerer, S.L. Gunckel, and S.E. Jacobs. 2008. Status and distribution of native fishes in the Goose Lake Basin. Information Reports 2008-02. Fish Division, Oregon Department of Fish and Wildlife.

Hedrick, P.W., and S.T. Kalinowski. 2000. Inbreeding depression in conservation biology. Annual Reviews in Ecology and Systematics 31:139-162.

Hendrickson, D.A. 1993 Evaluation of the razorback sucker (Xyrauchen texanus) and Colorado squawfish (Ptychocheilus lucius) reintroduction programs in Central Arizona based on surveys of fish populations in the Salt and Verde Rivers from 1986-1990. Nongame and Endangered Wildlife Program. Arizona Game and Fish Department. Phoenix.182 pp.

Hendrickson, D.A. 1993. Evaluation of the Colorado pikeminnow (*Xyrauchen texanus*) and Colorado Squawfish (*Ptychocheilus lucius*) reintroduction programs in Central Arizona based on surveys of fish populations in the Salt and Verde rivers from 1986-1990. Final Report for Nongame and Endangered Wildlife Program, Arizona Game and Fish Department. Phoenix, AZ xx pp.

Hendrickson, D.A., and W.L. Minckley. 1984. Cienegas - vanishing climax communities of the American Southwest. Desert Plants 6(3):131-175.

Herter, D., J. Schaberl, and E. Myers. 2008. Rainier spotted owl demography study area: 2008 annual report. Annual report to Plum Creek Timber Company, National Park Service, US Forest Service, and Hancock Forest Management. Raedeke Associates, Inc., Seattle, Washington.

Hessel A and S Spackman. 1995. Effects of fire on threatened and endangered plants: an annotated bibliography. Information and technology Report. Washington, U.S. Department of Interior National Biological Service.

Hickman, J. C. 1993. The Jepson Manual: higher plants of California. University of California Press, Berkeley. xvii + 1400 pp.

Higley, J.M., and P.C. Carlson. 2007. Hoopa Valley northern spotted owl banding and monitoring report 2007. Unpublished progress report.

Hilderbrand, R.H., and J.L. Kershner. 2000. Conserving inland cutthroat trout in small streams: how much is enough? North American Journal of Fisheries Management 20:513-520.

Hilderbrand, R.H., and J.L. Kershner. 2004. Are there differences in growth and condition between mobile and resident cutthroat trout? Transactions of the American Fisheries Society 133:1042-1046.

Hill, J.L., and K.L. Gray. 2005. Demographic monitoring of Spalding's catchfly (Silene spaldingii Wats.) in Idaho Canyon Grasslands: 2004 field season. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise. 153 pp. plus appendices.

Hitchcock, C., E. Ervin, M. Warburton, S. Hathaway, and R. Fisher. 2002. Post-fire assessment of critical habitat and population status for the California red-legged frog (*Rana aurora draytonii*) and unarmored threespine stickleback (*Gasterosteus aculeatus williamsoni*) in San Francisquito Canyon. Technical Report to the Angeles National Forest, United States Geological Survey, San Diego, California.

Hobbs, B. 2007. Personal communication. Nevada Department of Wildlife, Las Vegas, Nevada.

Holdsworth, A. and D. Gori. 1996. Monitoring report for the Huachuca water umbel at Cottonwood Spring, Sonoita Creek. Report by The Nature Conservancy 4 p.

Holomuzki, J.R. 1986. Variation in microhabitat use and trophic patterns of larval tiger salamanders (*Ambystoma tigrinum nebulosum*) in Arizona. Ph.D. Dissertation, Arizona State University, Tempe, AZ.

Horan, D.L., J.L. Kershner, C.P. Hawkins, and T.A. Crowl. 2000. Effects of habitat area and complexity on Colorado River cutthroat trout density in Unita Mountain streams. Transactions of the American Fisheries Society 129:1250-1263.

Howell, P. 2010. Personal communication on November 16, 2010, between Phillip Howell, US Forest Service, Pacific Northwest Research Station, La Grande, Oregon, and Michelle Eames, U.S. Fish and Wildlife Service, Spokane, Washington, concerning 2010 Bull trout spawning ground survey results. U.S. Forest Service. 2011.

Hubbs, C.L. and R. R. Miller. 1934. Field notes - Rush Creek, 16 August 1934, Station M34-134. 2 pp.

Humboldt-Toiyabe National Forest. 2004. Mill Creek, 2004 fish and habitat survey report. Bridgeport Ranger District, Bridgeport, California. 65 pp.

Huusko, A., L. Greenberg, M. Stickler, T. Linnansaari, M. Nykänen, T. Vehanen, S. Koljonen, P. Louhi, and K. Alfredsen. 2007. Life in the ice lane: the winter ecology of stream salmonids. River Research and Applications 23:469-491.

Hyatt, M.W. 2004. Assessment of Colorado Pikeminnow and Colorado pikeminnow Reintroduction Programs in the Gila River Basin. Final Report: September 30, 2004. Submitted to U.S. Fish and Wildlife Service, Tucson, AZ by Arizona Game and Fish Department, Phoenix, AZ 28 pp.

Hyatt, M.W. 2004. Assessment of Colorado Pikeminnow and Razorback sucker reintroduction programs in the Gila River basin. Final Report. Research Branch, Arizona Game and Fish Department. Phoenix. 28 pp.

Idaho Department of Fish and Game, in litt. 1995. List of stream extirpations for bull trout in Idaho.

Independent Scientific Advisory Board (ISAB). 2007. Climate Change Impacts on Columbia River Basin Fish and Wildlife. ISAB Climate Change Report ISAB 2007-2. 136 pp.

Independent Scientific Review Panel (ISRP). 2005. The current risk of extinction of the Lost River and shortnose suckers. Cascade Quality Solutions, Natural Resource Mediation and Facilitation, Klamath Falls, Oregon. 230 p.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate change 2007: the physical science basis. Summary for policymakers. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, IPCC Secretariat, World Meteorological Organization and United Nations Environment Programme, Geneva, Switzerland. 21 pp.

Jager, H.I., W. Van Winkle, and B.D. Holcomb. 1999. Would hydrologic climate change in Sierra Nevada stream influence trout persistence? Transactions of the American Fisheries Society 128:222-240.

Jahrke, E. and D.A. Clark. 1999. Colorado pikeminnow and Colorado pikeminnow reintroduction and monitoring in the Salt and Verde rivers. Technical Report 147. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, AZ. 22pp.

Jahrke, E., and D.A. Clark. 1999. Razorback sucker and Colorado pikeminnow reintroduction and monitoring in the Salt and Verde rivers. Arizona Game and Fish Department, Technical Report 147:1-18.

Jakober, M. 1995. Autumn and winter movement and habitat use of resident bull trout and westslope cutthroat trout in Montana. M.S. Thesis, Montana State University, Bozeman, Montana.

Johnson, C. September 19, 2008. E-mail to Ray Vizgirdas with comments to Draft 5-year status review for Mirabilis macfarlanei. BLM, Cottonwood, Idaho.

Johnson, C.A. 1984. An endangered plant's (*Mirabilis macfarlanei*) response to cattle grazing and protection from grazing, and other ecological effects. File Report, Bureau of Land Management , Cottonwood Resource Area, Cottonwood, ID. 31 pp.

Johnson, C.G., Jr. and S.A. Simon. 1987. Plant Associations of the Wallowa-Snake Province. Wallowa Whitman National Forest R6-ECOL-TP-355A-86. U.S. Department of Agriculture, U.S. Forest Service, Pacific Northwest Region, Wallowa-Whitman National Forest, Baker City, Oregon. 399 pp.

Johnson, Cecilia. 2010. Retardant Composition Application, unpublished report by C. Johnson, Fire Chemicals Technical Specialist, USDA Forest Service MTDC, Missoula, Montana

Johnson, W.W. and H.O. Sanders. 1977. Chemical Forest Fire Retardants: Acute Toxicity in Five Freshwater Fishes and a Scud. Technical Papers of the U.S. Fish and Wildlife Service #91. Washington D.C. 9 p.

Jones, Patti. 2011. Fire Aviation Officer, Okanogan and Wenatchee National Forest, Wenatchee, Washington.

Kalabokidis, Kostas D. 2000. Effects of Wildfire Suppression Chemicals on People and the Environment – A review, Global Nest: the Int. J., 2(2):129-137.

Karoly, D.J., K. Braganza, P.A. Stott, J.M. Arblaster, G.A. Meehl, A.J. Broccoli, and K.W. Dixon. 2003. Detection of a human influence on North American climate. Science 302:1200-1203.

Kaushal, S.S., G.E. Likens, N.A. Jaworski, M.L. Pace, A.M. Sides, D. Seekell, K.T. Belt, D.H. Secor, R.L. Wingate. 2010. Rising stream and river temperatures in the United States. Frontiers in Ecology and the Environment 8:461-466.

Kaye, T.N. 1992. Status report update for *Mirabilis macfarlanei*. Oregon Department of Agriculture, Conservation Biology Program. 40 pp. plus maps.

Kaye, T.N. 1995. Evaluation of population monitoring for *Mirabilis macfarlanei*, 1990-1995. Cooperative Challenge Cost Share Project between Wallow-Whitman National Forest and Oregon Department of Agriculture, Plant Conservation Biology Program. 11 pp.

Kaye, T.N. and R. Meinke. 1992. Long-term Monitoring for *Mirabilis macfarlanei* in Hells Canyon, Wallowa-Whitman National Forest. ODA/USFS Challenge Cost Share project.

Keane, R.E., K.C. Ryan, T.T. Veblen, C.D. Allen, J. Logan, and B. Hawkes. 2002. Cascading effects of fire exclusion in Rocky Mountain ecosystems: a literature review. General Technical Report RMRS-GTR-91. Fort Collins, CO: U.S.pp.

Keen, F. P. 1937. Climatic cycles in eastern Oregon as indicated by tree rings. Monthly Weather Review 65:175-188.

Keenan, L.D., R.E. Stanford, S.L. Ellis and B. Drummond. 1986. Status report on: Pawnee montane skipper. Prepared for Denver Water Department, Denver, Colorado. February. 49 pp.

Keleher, C.J., and F.J. Rahel. 1996. Thermal limits to salmonid distributions in the Rocky Mountain region and potential habitat loss due to global warming: a geographic information system (GIS) approach. Transactions of the American Fisheries Society 125:1-13.

Kennedy, T.B. and J.F. North. 1993. 1992 Report: Drift behavior and distribution of Warner sucker (Catostomus warnerensis) and preliminary assessment of stream habitat conditions in the Warner Valley, Oregon. Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 25 pp.

Kennedy, T.B. and M. Olsen. 1994. Drift ecology of Warner sucker larvae (Catostomus warnerensis) and lake recolonizations by native and exotic fishes of the Warner Valley, Oregon. Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 42 pp.

Kennedy, T.L., D.S. Gutzler, and R.L. Leung. 2009. Predicting future threats to the long-term survival of Gila trout using a high resolution simulation of climate change. Climatic Change 94:503-515.

Kettratad, J. 2001. Systematic study of Modoc suckers (*Catostomus microps*) and Sacramento suckers (*Catostomus occidentalis*) in the upper Pit River system, California. M.S. Thesis, Humboldt State University, Arcata. 79 pp.

Kinsella, S.R. 2005. Weathering the Change – Helping Trout in the West Survive the Impacts of Global Warming. Available at: www.montanatu.org/issuesandprojects/climatechange.pdf (last accessed January 11, 2011)

Knapp, P.A., P.T. Soulé and H.D. Grissino-Mayer. 2004. Occurrence of sustained droughts in the interior Pacific Northwest (A.D. 1733-1980) inferred from tree-ring data. Journal of Climate 17:140-150.

Kneitel, Jamie M. and Carrie L. Lessin. 2010. Ecosystem-phase interactions: aquatic eutrophication decreases terrestrial plant diversity in California vernal pools. Oecologia 163: 461-469.

Knight, R. L. and D. N. Cole. 1995. Factors that influence wildlife responses to recreationists. Pp. 51-69 in Wildlife and Recreationists: Coexistence Through Management and Research. Knight, Richard L. and Kevin J. Gutzwiller, editors. Island Press, Washington, D.C. 372 pp.

Knowles, N., M.D. Dettinger, and D.R. Cayan. 2006. Trends in snowfall versus rainfall for the western United States, 1949-2004. Journal of Climate 19:4545-4559.

Kobetich, G. C. 1977. Report on survey of Warner Valley Lakes for Warner suckers, Catostomus warnerensis. Unpublished report to Fish and Wildlife Service. 6 pp.

Krueger, P. 2011. Email exchange between Patti Krueger (Forest Service) and Jana Affonso (Fish and Wildlife Service). Subject: RE: Fire retardant BA suggested change. Dated 8/17/2011.

Krueger, P. 2011a. Email exchange between Patti Krueger (Forest Service) and Jana Affonso (Fish and Wildlife Service). Subject: Re: Shasta Crayfish. Dated 9/14/2011.

Krueger, P. 2011b. Email exchange between Patti Krueger (Forest Service) and Jana Affonso (Fish and Wildlife Service). Subject: RE: Mariposa pussypaws measure. Dated 9/14/2011.

Krueger, P. 2011c. Email exchange between Patti Krueger (Forest Service) and Jana Affonso (Fish and Wildlife Service). Subject: RE: Unarmored threespine stickleback and owens tui chub. Dated 9/14/2011.

Krueger, P. 2011c. Email exchange between Patti Krueger (Forest Service) and Jana Affonso (Fish and Wildlife Service). Subject: RE: UTS and OTC information. Dated 9/19/2011.

Kubacki, M.F. 1998. Middle Verde River Management Report. Statewide Fisheries Investigation. Survey of Aquatic Resources. Federal Aid Project F-7-M40. Arizona Game and Fish Department, Phoenix. 23 pp.

Kubacki, M.F. 1998. Statewide Fisheries Investigation Survey of Aquatic Resources. Middle Verde River Management Rerport. Federal Aid Project F-7-M-40. Arizona Game and Fish Department, Phoenix, AZ. 23 pp.

Kundzewicz, Z.W., L.J. Mata, N.W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen, and I.A. Shiklomanov. 2007. Freshwater resources and their management. Pages 174-210 in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (editors), Climate change 2007: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

Kunkel, K.E., M.A. Palecki, L. Ensor, D. Easterling, K.G. Hubbard, D. Robinson, and K. Redmond. 2009. Trends in Twentieth-Century U.S. extreme snowfall seasons. Journal of Climate 22:6204-6216.

Kuwabara, J.S., B.R. Topping, J.L. Carter, F. Parchaso, J.M. Cameron, J.R. Asbill, S.V. Fend, J.H. Duff, and A.C. Engelstad. 2010. The Transition of Benthic Nutrient Sources after Planned Levee Breaches Adjacent to Upper Klamath and Agency Lakes, Oregon. U.S. Geological Survey, Open File Report 2010-1062.

Labat Environmental. 2007. Ecological risk assessment: wildland fire-fighting chemicals. Prepared for Missoula Technology and Development Center, USDA Forest Service. Missoula, MT. 69 pp.

Labat Environmental. 2007. Ecological risk assessment: wildland fire-fighting chemicals. Unpublished document prepared for the U.S. Forest Service. 50 pp+Appendices

LABAT Environmental. 2007.Ecological Risk Assessment: Wildland Fire-Fighting Chemicals. Prepared for Missoula Technology and Development Center, USDA Forest Service, Missoula, MT. by LABAT Environmental, Project Director Christine Modovsky, Broken Arrow, OK. 50pp + appendices

Lacey, R.C. 1997. Importance of Genetic Variation to the viability of Mammalian Populations. Journal of Mammalogy, 78(2): 320-335.

Laird, I.W. 1971. The Modoc Country. Lawton and Kennedy Printers, Alturas, CA.

Lande, R. 2002. Incorporating stochasticity in population viability analysis. Pages 18-40 in S.R. Beissinger, and D.R. McCullough (editors), Population Viability Analysis. University of Chicago Press, Chicago, Illinois.

Lande, R., and G. Barrowclough. 1987. Effective population size, genetic variation, and their use in population management. Pages 87-124 *in* M. E. Soule (ed). Viable populations for management. Cambridge University Press, Cambridge, United Kingdom.

Landres, P.R., P. Morgand, and F.J. Swanson. 1999. Overview of the use of natural variability concepts in managing ecological systems. Ecological Applications 9:1179-1188.

Larson, D. L. and D. Duncan. 1982. Annual grassland response to fire retardant and wildlife. Journal of Range Management 35(6): 700-703.

Leary, R.F. and F.W. Allendorf. 1997. Genetic confirmation of sympatric bull trout and Dolly Varden in western Washington. Transactions of the American Fisheries Society 126:715-720.

Leary, R.F., F.W. Allendorf, and S.H. Forbes. 1993. Conservation genetics of bull trout in the Columbia and Klamath River drainages. Conservation Biology 7(4):856-865.

Lease, H.M., J.A. Hansen, H.L. Bergman, and J.S. Meyer. 2003. Structural changes in gills of Lost River sucker exposed to elevated pH and ammonia concentrations. Comparative Biochemistry and Physiology. Part C 134(2003): 491-500.

Leathe, S.A. and P. Graham. 1982. Flathead Lake fish food habits study. E.P.A. through Steering Committee for the Flathead River Basin Environmental Impact Study.

Lepley, Donald E. and Kyle Merriam. 2011. Draft-Conservation strategy for Orcuttia tenuis for the Lassen National Forest, Modoc National Forest, and Alturas Field Office-Bureau of Land Management.

Lesica, P., and B. Martin. 2003. Effects of prescribed fire and season of burn on recruitment of the invasive exotic plant, Potentilla recta, in a semiarid grassland. Restoration Ecology 11:516–523.

Lessica, P. 1999. Effects of fire on the demography of the endangered, geophytic herb Silene spaldingii (Caryophyllaceae). American Journal of Botatny 86: 996-1002.

Light, J., L. Herger and M. Robinson. 1996. Upper Klamath Basin bull trout conservation strategy, a conceptual framework for recovery. Part One. The Klamath Basin Bull Trout Working Group.

Lint, J. (technical coordinator). 2005. Northwest Forest Plan—the first 10 years (1994-2003): status and trends of northern spotted owl populations and habitat. USDA Forest Service Pacific Northwest Research Station General Technical Report PNW-GTR-440. Portland, Oregon.

Littell, J.S., M. McGuire Elsner, L.C. Whitely Binder, and A.K. Snover (eds). 2009. The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate - Executive Summary. In: The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate, Climate Impacts Group, University of Washington, Seattle, Washington.

Little, E. E. and R. D. Calfee. 2002. Environmental Implications of Fire-Retardant Chemicals. Project Summary U.S. Geological Survey, Columbia Environmental Research Center, Columbia, Missouri. 9pp.

Little, E.E. and R. Calfee. 2004. Effects of Fire-retardant Chemical Products on Fathead Minnows in Experimental Streams. Report Number ECO-04US Geological Survey, Columbia Environmental Research Center, Columbia, MO. 28 pp.

Little, E.E., and R.D. Calfee. 2002. Environmental implications of fire-retardant chemicals: project summary. Report to the Forest Service, June, 2002. 9 pp.

Little, E.E., and R.D. Calfee. 2000. The Effects of UVB Radiation on the Toxicity of Fire-Fighting Chemicals. U.S. Geological Survey. Columbia Environmental Resource Center. Columbia, MO. Submitted to the USDA Forest Service. 72 pp.

Little, E.E., and R.D. Calfee. 2002. Effects of Fire-Retardant Chemical Products on Fathead Minnows in Pond Enclosures. U.S. Geological Survey. Columbia Environmental Resource Center. Columbia, MO. 28 pp.

Little, E.E., and R.D. Calfee. 2005. Environmental Persistence and Toxicity of Fire-Retardant Chemicals, Fire-Trol GTS –R and Phos-Chek D75-R to Fathead Minnows. U.S. Geological Survey. Columbia Environmental Resource Center. Columbia, MO. Final Report – CERC Ecological Branch Fire Chemical Report: ECO-05. 52 pp.

Little, E.E., J.D. Wells, and R.D. Calfee. 2006. Behavioral avoidance/attractance response of rainbow trout to fire retardant chemicals. Final Report to US Forest Service. CETC Ecology Branch Fire Chemical Report: ECO-06. 38 pp.

Loftus, M.E. 2001. Assessment of potential water quality stress to fish. Supplement to effects of water quality and lake level on the biology and habitat of selected fish species in Upper Klamath Lake. Prepared for Bureau of Indian Affairs by R2 Resource Consultants.

Lopez, M. 2000. August 30, 2000, email transmission from M. Lopez, Arizona Game and Fish Department, to P. Marsh, Arizona State University re: TICO surveys.

Maddux, H.R, W.R. Noonan, and L.A. Fitzpatrick. 1993b. Draft Colorado River endangered fishes critical habitat, biological support document. U.S. Fish and Wildlife Service, Salt Lake City, Utah. 225 pp.

Malengo, K. 1998. Monitoring of sensitive aquatic animals in the Owens Basin, Inyo and Mono Counties, California. California Department of Fish and Game, Region VI, Bishop, California. Pages 100-101.

Malmquist, Lauri. 2001, 2002, 2003, 2007. Botanist, U.S. Forest Service,Okanogan-Wenatchee National Forests, Leavenworth Ranger District,Leavenworth, Washington.

Malo, L. 2009. Electronic correspondence, September 30, 2009. Natural Resources Division Manager, URS Corporation, Santa Ana, California.

Mancuso, M. and J. Shephard. 2008. A Summary of Long-term Monitoring Results for MacFarlane's Four-o'clock (*Mirabilis macfarlanei),* a Threatened Species in Idaho and Oregon. Report Prepared for the U.S. Fish and Wildlife Service, Snake River Fish and Wildlife Office, Boise, Idaho. 27 pp. plus appendices.

Marsh, P.C. 1996. 1996 monitoring and status of fishes in Eagle Creek, Arizona. U.S. Bureau of Reclamation, Phoenix, Arizona. 15 pages.

Marsh, P.C. and J.E. Brooks. 1989. Predation by ictalurid catfishes as a deterrent to reestablishment of hatchery-reared razorback suckers. The Southwestern Naturalist 34(2):188-195.

Marsh, P.C., B.E. Bagley, G.W. Knowles, G. Schiffmiller, and P.A. Sowka. 2003. New and rediscovered populations of loach minnow, *Tiaroga cobitis* (Cyprinidae), in Arizona. The Southwestern Naturalist 48(4):666–669.

Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Science 23(2):107-116.

Martin, B.A. and M.K. Saiki. 1999. Effects of ambient water quality on the endangered Lost River sucker in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society. 128: 953-961.

Martin, M. 1967. The distribution and morphology of the North American catostomid fishes of the Pit River system, California. M.A. thesis, Sacramento State Univ., Sacramento, CA. 67 pp.

Martin, M. 1972. Morphology and variation of the Modoc sucker, *Catostomus microps* Rutter, with notes on feeding adaptations. Calif. Dept. Fish and Game 58:277-284.

Master, L.L., L.E. Morse, A.S. Weakley, G.A. Hammerson, and D. Faber-Langendoen. 2003. NatureServe Conservation Status Assessment Criteria. Nature Serve, Arlington, V.A. USA.

McClaran, M.P. and P.C. Sundt. 1992. Population dynamics of the rare orchid, *Spiranthes delitescens*. Southwestern Naturalist 37(3):299-303.

McDonald, S.F., S.J. Hamilton, K.J. Buhl, and J.F. Heisinger. 1996. Acute toxicity of fire control chemicals to *Daphnia magna* (Straus) and *Selenastrum capricornutum* (Printz). Ecotoxicology and Environmental Safety 33:62-72.

McDonald, S.F., S.J. Hamilton, K.J. Buhl, and J.F. Heisinger. 1997. Acute toxicity of fire retardant and foam suppressant chemicals to *Hyalella azteca* (Saussure). Environmental Toxicology and Chemistry 16:1370-1376.

McDonald, S.F., S.J. Hamilton, K.J. Buhl, and J.F. Heisinger. 1995. Acute toxicity of fire-retardant and foam-suppressant chemicals to Hyalella azteca (Saussure). Environmental Toxicology and Chemistry,16(7):1370-1376

McEwan, D. 1990. Utilization of aquatic vegetation and some aspects of the Owens tui chub (*Gila bicolor snyderi*) in the Hot Creek headsprings, Mono County, California. Masters Thesis, California State University, Sacramento, California. 93 pages.

McEwan, D. 1991. Microhabitat selection of the Owens tui chub, *Gila bicolor snyderi*, in the Hot Creek headsprings, Mono County, California. Desert Fishes Council Proceedings 20:11-23.

McKelvey, K.S., C.N. Skinner, C. Chang, D.C. Erman, S.J. Husari, D.J. Parsons, J.W. Van Wagtendonk, and C.P. Weatherspoon. 1996. An overview of fire in the Sierra Nevada. Pages 1033-1040 in Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for managementoptions. University of California, Centers for Water and Wildland Resources, Davis.

McKenzie, D., Z. Gedalof, D.L. Peterson, and P. Mote. 2004. Climate change, wildfire, and conservation. Conservation Biology 18:890-902.

McShane, C., T. Hamer, H. Carter, G. Swartsman, and others. 2004. Evaluation report for the 5-year status review of the marbled murrelet in Washington, Oregon, and California. Unpublished report. EDAW, Inc. Seattle, Washington. Prepared for the U.S. Fish and Wildlife Service, Region 1. Portland, Oregon.

Meefe, G.K. and C.R. Carroll. 1994. Principles of conservation biology. Sinauer Associates, Inc. Sunderland, Massachusetts.

Meisner, J.D. 1990. Potential loss of thermal habitat for brook trout, due to climatic warming, in two southern Ontario streams. Transactions of the American Fisheries Society 119:282-291.

Mellison, C. 2002. Fisheries and wildlife assessment. Burned Area EmergencyRehabilitation Report, Cannon Fire. July 4, 2002. 12 pp. + appendix.

Merriman, D. and L. Soutter. 1933. Field notes: Branch of Bauer's Creek, Lake County, Oregon. August 27, 1933 (field number M-10-33).

Metcalf, J.L, V. Pritchard, S. Silvestri, J. Jenkins, J. Wood, D. Cowley, R. Evans, D. Shiozawa, and A. Martin. 2007. Across the great divide: genetic forensics reveals misidentification of endangered cutthroat trout populations. Molecular Ecology (2007). 10 pp.

Meyer, C.B., S.L. Miller, and C.J. Ralph. 2002. Multi-scale landscape and seascape patterns associated with marbled murrelet nesting areas on the U.S. west coast. Landscape Ecology 17:95-115.

Meyer, J.S., H.M. Lease, and H.L. Bergman. 2002. Subchronic Toxicity of Low Dissolved Oxygen Concentrations, Elevated pH, and Elevated Ammonia Concentrations to Lost River Suckers. Transactions of the American Fisheries Society 131: 656-666.

Miller, J.D., H.D. Safford, M. Crimmins, and A.E. Thode. 2009. Quantitative evidence for increasing forest fire severity in the Sierra Nevada and southern Cascade Mountains, California and Nevada, USA. Ecosystems 12:16-32.

Mills, T.J. 1980. Life history, status, and management of the Modoc sucker, *Catostomus microps* Rutter, in California, with a recommendation for endangered classification. Calif. Dept. Fish Game, Inland Fisheries Endangered Species Program Spec. Publ. 80-6. 35 pp.

Minckley, W. L., D. A. Hendrickson, and C. E. Bond. 1986. Geography of western North American freshwater fishes: Description and relationships to intercontinental tectonism. Pages 519-614 in Zoogeography of North American Freshwater Fishes, C. H. Hocutt and E. O. Wiley, eds. New York: Wiley

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 293 pp.

Minckley, W.L. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region 2, west of the continental divide. Report for USFWS-R2 from Arizona State University, Tempe. 168 pp.

Minshall, G.W., C.T. Robinson, and D.E. Lawrence. 1997. Postfire responses of lotic ecosystems in Yellowstone National Park, USA. Canadian Journal of Fisheries and Aquatic Sciences, 54:2509-2525.

Mitton, J.B., J.L. Metcalf, A. Martin, B.R. Kreiser, K.L Durand, and J. Woodling. 2006. MtDNA phylogeny of the subspecies of Cutthroat Trout, *Oncorhynchus clarki.* Unpublished report. 16 pp.

Mohseni, O., H.G. Stefan, and J.G. Eaton. 2003. Global warming and potential changes in fish habitat in U.S. streams. Climate Change 59:389-409.

Monsen, S.B. 1994. The Competitive Influences of Cheatgrass (Bromus tectorum) on Site Restoration. In Proceedings – Ecology and Management of Annual Intermountain Research Station General Technical Report INT-GTR-313, September.Rangelands, S.B. Monsen and S.G. Kitchen, editors. USDA

Monsen, S.B. 1994. The Competitive Influences of Cheatgrass (Bromus tectorum) on Site Restoration. In Proceedings – Ecology and Management of Annual Rangelands, S.B.

Montana Bull Trout Scientific Group (MBTSG). 1995a. Bitterroot River drainage bull trout status report. Prepared for the Montana Bull Trout Restoration Team, Montana Fish, Wildlife, and Parks. Monsen and S.G. Kitchen, editors. USDA Intermountain Research Station General Technical Report INT-GTR-313, September.Helena, Montana.

Montana Bull Trout Scientific Group (MBTSG). 1995b. Flathead River drainage bull trout status report (including Flathead Lake, the North and Middle Forks of the Flathead River and the Stillwater and Whitefish Rivers). Prepared for the Montana Bull Trout Restoration Team, Montana Fish, Wildlife, and Parks. Helena, Montana.

Montana Bull Trout Scientific Group (MBTSG). 1998. The Relationship Between Land Management Activities and Habitat Requirements of Bull Trout. Helena, Montana. 78 pp. + vi.

Montana Department of Health and Environmental Sciences (MTDHES). 1994. Montana water quality 1994. The Montana 305(b) Report. Water Quality Division, Helena, Montana.

Montana Fish, Widlife, and Parks AND Confederated Salish and Kootenai Tribes (MFWP and CSKT). 2000. Flathead Lake and River fisheries co-management plan 2001-2010. Montana Fish, Wildlife, and Parks. Helena, Montana.

Montana Natural Heritage Program and Montana Fish, Wildlife and Parks (MNHP). 2004. Montana Animal Species of Concern. Online at http://mtnhp.org/animal/index.html.

Monzingo, J. 2009. Status and updating information on Chihuahua chub. Email. June 18, 2009. U.S. Forest Service, Gila National Forest, Silver City, New Mexico.

Monzingo, J. A. 2003. Dry Lake Complex status report. Email. August 11, 2003. U.S. Forest Service, Gila National Forest, Silver City, New Mexico.

Moskowitz, M. 1989. Final progress report on the status of Owens Valley endangered fishes - Winter 1988-1989. Contract with the U.S. Fish and Wildlife Service No. 11310-88-00311. 12 pages plus appendix.

Mote, P., E. Salathe, V. Duliere, and E. Jump. 2008. Scenarios of future climate for the Pacific Northwest. A report for the Climate Impacts Group, University of Washington, Seattle, Washington. 12 pp.

Mote, P.W., E.A. Parson, A.F. Hamlet, W.S. Keeton, D. Lettenmaier, N. Mantua, E.L. Miles, D.W. Peterson, R. Slaughter, and A.K. Snover. 2003. Preparing for climatic change: the water, salmon, and forests of the Pacific Northwest. Climate Change 61: 45-88.

Moyle, P. B. and R. M. Yoshiyama. 1992. Fishes, aquatic diversity management areas, and endangered species: plan to protect California's native aquatic biota. The California Policy Seminar, University of California.

Moyle, P.B, J.A. Israel, and S.E. Purdy. 2008. Salmon, steelhead, and trout in California: Status of an emblematic fauna. Report commissioned by California Trout. Center for Watershed Sciences, University of California, Davis, California. 316 pp. http://www.caltrout.org/SOS-Californias-Native-Fish-Crisis-Final-Report.pdf

Moyle, P.B. 1974. Status of the Modoc sucker (*Catostomus microps*) Pisces: Catostomidae. Cal-Neva Wildlife 1974: 35-38.

Moyle, P.B. 2002. Inland fishes of California – Revised and expanded. Univ. Calif. Press, Berkeley. 502 pp.

Moyle, P.B. and A. Marciochi. 1975. Biology of the Modoc sucker, *Catostomus microps*, in northeastern California. Copeia 1975:556-560.

Moyle, P.B. and R.A. Daniels. 1982. Fishes of the Pit River system, McCloud River system, and Surprise Valley region. Univ. Calif. Publ. Zool. 115:1-82.

MTBS. 2010. Monitoring Trends in Burn Severity. Fire perimeter spatial data (1984-2008) compiled by the interagency Monitoring Trends in Burn Severity project (http://mtbs.gov).

MTDEQ (Montana Department of Environmental Quality). 2005. Water Quality Restoration Plan and Total Maximum Daily Loads for the Bitterroot Headwaters Planning Area. Montana Department of Environmental Quality, Helena, Montana.

Natural Perspectives. 2008. Pawnee montane skipper monitoring study for the Upper South Platte Watershed Protection and Restoration Project – August 2007. Prepared for the U.S. Forest Service. 50 pp.

Nelson, S. Kim; Huff, Mark H.; Miller, Sherri L.; Raphael, Martin G. 2006. Marbled murrelet biology: habitat relations and populations. In: Huff, Mark H.; Raphael, M.G.; Miller, S.L.; Nelson, S.K.; Baldwin, J. tech. coords. Northwest Forest Plan—The first 10 years (1994-2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 9-30. Chapter 2.

Nelson, S.K. 1997. The birds of North America, No. 276 - Marbled Murrelet *(Brachyramphus marmoratus)*. *In* A. Poole and F. Gill (eds.). The birds of North America: life histories for the 21st century. 31 pp.

Neville, H.M., and D. DeGraaf. 2006. Reconnecting fragmented Lahontan cutthroat trout habitats: Maggie and Willow Creek, 2006. Strategies for Restoring Native Trout Report. Trout Unlimited, Boise, Idaho. 21 pp.

Neville, H.M., J.B. Dunham, and M.M. Peacock. 2006. Landscape attributes and life history variability shape genetic structure of trout populations in a stream network. Landscape Ecology 21: 901-916.

New Mexico Department of Game and Fish (NMDGF). 2008. Gila rare species collections database. Provided by Y. Paroz, New Mexico Department of Game and Fish to M. Richardson, U.S. Fish and Wildlife Service.

Newman, D. 1991. Status Report: *Spiranthes delitescens*. A report prepared for the U.S. Fish and Wildlife Service by the Arizona Nature Conservancy. 10 p.

Newton, J.A. and S. Pribyl. 1994. Bull trout population summary: Lower Deschutes River Subbasin. Oregon Department of Fish and Wildlife, The Dalles, Oregon.

Niceswanger, J. 2002. Purple amole (*Chlorogalum purpureum* var. *purpureum*) monitoring report. Results summarized for monitoring 1998, 1999 and 2000. Consultant report, Fort Hunter Liggett, California. 28 pages.

Norris, L.A. and W.L. Webb. 1989. Effects of fire retardant on water quality. US Forest Service General Technical Report PSW-109, pp 79-86

Norris, L.A., and W.L. Webb. 1989. Effects of fire retardant on water quality. Pages 79-86 in N.H. Berg (technical coordinator), Proceedings of the Symposium on Fire and Watershed Management: October 26-28, 1988. Sacramento, California. General Technical Report PSW-GTR-109. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station.

Norris, L.A., C.L. Hawkes, W.L. Webb, D.G. Moore, W.B. Bollen, and E. Holcombe. 1978. A Report of Research on the Behavior and Impact of Chemical Fire Retardants in Forest Streams. U.S. Forest Service, Forestry Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station. Corvallis OR. 287 p.

Norris, L.A., H.W. Lorz, and S.V. Gregory. 1991. Forest chemicals. American Fisheries Society Special Publication 19:207-296.

Norris, L.A., H.W. Lorz, and S.V. Gregory. 1991. Forest chemicals. In: Meehan, W.R. ed. Influence of forest and rangeland management on salmonid fishes and their habitats. Bethesda, MD: American Fisheries Society. Special Publication No. 19, Chapter 7

North, M.P., K.M. Van de Water, S.L. Stephens, and B.M. Collins. 2009. Climate, rain shadow, and human-use influences on fire regimes in the eastern Sierra Nevada, California, USA. Fire Ecology 5:20-34.

Noss, R., B. Csuti, and M.J. Groom. 2006. Habitat fragmentation. Pages 213-251 in M.J. Groom, G.K. Meffe, and C.R. Carroll (editors), Principles of Conservation Biology (Third Edition). Sinauer Associates, Inc. Sunderland, Massachusetts.

O'Farrell, M. J. 2010. Restoration and enhancement of habitat for the SBKR conservation area, Lytle Creek North Master Planned Community, San Bernardino County, California. Final Annual Report for 2009. 23 pp. + Appendices.

ODF (Oregon Department of Forestry). 2011. Southwest Oregon District Fire Statistics. http://oregon.gov/ODF/FIELD/SWO/firestats.shtml#Fire_Season_Start_End_Dates. Accessed 9 September 2011.

ODFW 2002. Electrofishing report for bull trout in Hurricane Creek. Unpublished report. ODFW, Enterprise, OR.

Olson, T. G. 2003. Carbonate habitat management strategy. Prepared for San Bernardino National Forest Association. 87 pp. + Appendices.

Opdam, P., and D. Wascher. 2004. Climate change meets habitat fragmentation: linking landscape and biogeographical scale levels in research and conservation. Biological Conservation 117:285-297.

Opler, P. 2008. Personal conversation with P. Opler regarding the effects of fire retardant use on the Pawnee montane skipper. January 29, 2008.

Overpeck, J. 2008. Climate Change in the Southwestern US: Mechanisms, Evidence and Projections. Presented at the New Mexico Climate Change Ecology and Adaptation Workshop. October 22, 2007. Albuquerque, New Mexico.

Palmerston, M., G. Tranah, and B. May. 2001. Draft report on genetics of Modoc sucker, *Catostomus microps*. Submitted to U.S. Fish and Wildlife Service – Klamath Falls Field Office; Univ. Calif. Davis.

Paroz, Y.M. and D.L. Propst. 2007. Distribution of spikedace, loach minnow, and chub species in the Gila River Basin, New Mexico, 1908-2007. Submitted to the U.S. Fish and Wildlife Service and U.S. Bureau of Reclamation. New Mexico Department of Game and Fish, Conservation Services Division, Santa Fe, New Mexico. 23 pages.

Paroz, Y.M., D.L. Propst, and J.A. Stefferud. 2006. Long-term monitoring of fish assemblages in the Gila River drainage, New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM. 74 pages.

Paysen, T.E., R.J. Ansley, J.K. Brown, G.J. Gottfried, S.M. Haase, M.G. Harrington, M.G. Narog, S.S. Sackett, and R.C. Wilson. 2000. Fire in western shrubland, woodland, and grassland ecosystems. Pages 121-159 in K.J. Brown, and J.K. Smith (editors), Wildland fire and ecosystems: effects of fire on flora. General Technical Report RMRS-GTR-42-vol. 2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 257 pp.

Peacock, M.M., and V. Kirchoff. 2007. Analysis of genetic variation and population genetic structure in Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*) extant populations. Final Report submitted to the U.S. Fish and Wildlife Service, Reno, Nevada. 109 pp.

Peery, M. Z., Beissinger, S. R., Newman, S. H., Burkett, E. and Williams, T. D. 2004. Applying the declining population paradigm: diagnosing causes of poor reproduction in the marbled murrelet. Conservation Biology 18:1088–1098.

Peery, M.Z., S. R. Biessinger, S.H. Newman, B.H. Becker, E. Burkett and T.D. Williams. 2004. Individual and temporal variation in inland flight behavior of marbled murrelets: Implications for population monitoring. The Condor 106:344-353.

Perkins, D.L., J. Kann, and G.G. Scoppettone. 2000. The role of poor water quality and fish kills in the decline of endangered Lost River and Shortnose suckers in Upper Klamath Lake. Final Report. U.S. Geological Survey, Biological Resources Division, Western Fisheries Research Center, Reno Field Station, Reno, Nevada.

Perkins, Judy. Modoc National Forest, Forest Botanist. Email dated July 19, 2011.

Pierce, D.W., T.P. Barnett, H.G. Hidalgo, T. Das, C. Bonfils, B.D. Santer, G. Bala, M.D. Dettinger, D.R. Cayan, A. Mirin, A.W. Wood, and T. Nozawa. 2008. Attribution of declining western U.S. snowpack to human effects. Journal of Climate 21:6425-6444.

Pilloid, D. S., R. B. Bury, E. J. Hyde, C. A. Pearl, and P. S. Corn. 2003. Fire and amphibians in North America. Forest Ecology and Management 178:163-181.

Poff, N.L., M.M. Brinson, and J.W. Day, Jr. 2002. Aquatic Ecosystems and Global Climate Change. Potential Impacts on Inland Freshwater and Coastal Wetland Ecosystems in the United States. Prepared for the Pew Center on Global Climate Change. 44pp.

Poff, N.L., M.M. Brinson, and J.W. Day, Jr. 2002. Aquatic ecosystems and global climate change: potential impacts on inland freshwater and coastal wetland ecosystems in the United States. Pew Center on Global Climate Change, Arlington, Virginia. 44 pp.

Poulton, B., S. Hamilton, K. Buhl, N. Vyas, E. Hill, and D. Larson. 1997. Toxicity of fire retardant and foam suppressant chemicals to plant and animal communities. Final Reoprt. Boise Idaho. 180 pp.

Poulton, B.C. 1997. Effects of fire retardant chemicals on fish and aquatic invertebrates in aquatic ecosystems of the Great Basin. Pp131-186. In S. Finger, Editor, Toxicity of Fire Retardant and Foam Suppressant Chemicals to Plant and Animal Communities. Final Report to Interagency Fire Coordination Committee, Boise, ID. December 15, 1997.

Poulton, Barry, Steven Hamilton, Kevin Buhl, Nimish Vyas, Elwood Hill, and Diane Larson. 1997. Toxicity of Fire Retardant and Foam Suppressant Chemicals to Plant and Animal Communities, Final Report prepared for Interagency Fire Coordination Committee, Boise, Idaho.

Pratt, K.L. 1992. A review of bull trout life history. Pages 5-9 in Howell, P. J. and D. V. Buchanan, editors. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Preston, B.L. 2006. Risk-based reanalysis of the effects of climate change on U.S. cold-water habitat. Climate Change 76:91-119.

Price, James, Fire Specialist, Bureau of Land Management, Lakeview, Oregon.

Prichard, D. H. Barrett, J. Cagney, R. Clark, J. Fogg, K, Gebhardt, P.L. Hensen, B. Mitchell, and D. Tippy. 1998. Riparian area management. Process for assessing proper functioning condition. USDOI, Bureau of Land Management, Denver, CO. Technical Reference 1737-9.

Pringle, C. 2006. The fragmentation of aquatic ecosystems and the alteration of hydrologic connectivity. Pages 243-246 in M.J. Groom, G.K. Meffe, and C.R. Carroll (editors), Principles of Conservation Biology (Third Edition). Sinauer Associates, Inc. Sunderland, Massachusetts.

Pritchard, V.L., K. Jones, and D.E. Cowley. 2007. Genetic diversity within fragmented cutthroat trout populations. Transactions of the American Fisheries Society 136:606-623.

Propst, D.L. 2007. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-34, 1 July 2006 – 30 June 2007. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 27 pages.

Propst, D.L., Y.M. Paroz, S.M. Carman, and N.D. Zymonas. 2009. Systematic investigations of warmwater fish communities. Performance Report FW-17-R-36, 1 July 2008 – 30 June 2009. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 26 pages.

Pyke, D.A. and S. J. Novak. 1994. Cheatgrass demography-establishment attributes, recruitment, ecotypes, and genetic variability, In Proceedings – Ecology and Management of Annual Rangelands, S.B. Monsen and S.G. Kitchen, editors. USDA Intermountain Research Station General Technical Report INT-GTR-313, September.

Quigley, T.M. and J.J. Arbelbide. 1997. An assessment of ecosystem components in the Interior Columbia Basin and portions of the Klamath and Great basins. Vol. III. 1174-1185pp.

Rahel, F.J. 2002. Using current biogeographic limits to predict fish distributions following climate change. American Fisheries Society Symposium 32:99-110.

Rahel, F.J. 2004. Unauthorized fish introductions: fisheries management of the people, for the people, or by the people? Pages 431-443 in M.J. Nickum, P.M. Mazik, J.G. Nickum, and D.D. MacKinlay, editors. Propogated fish in resource management. American Fisheries Society, Symposium 44, American Fisheries Society, Bethesda, Maryland.

Rahel, F.J., B. Bierwagen, and Y. Taniguchi. 2008. Managing aquatic species of conservation concern in the face of climate change and invasive species. Conservation Biology 22(3):551-561.

Raphael, M.G., and T.D. Bloxton. 2009. Nesting habitat and nest success of the marbled murrelet in forests around the Olympic Peninsula, Washington, USA. 2009 symposium abstracts. Northwestern Naturalist 90:165.

Raphael, M.G., D. Evans Mack, and B.A. Cooper. 2002. Landscape-scale relationships between abundance of marbled murrelets and distribution of nesting habitat. The Condor 104:331-342.

Raphael, M.G., G.A. Falxa, K.M. Dugger, B.M. Galleher, D. Lynch, S.L. Miller, S.K. Nelson, R.D. Young. 2011. Northwest Forest Plan – the first 15 years (1994-2008): status and trend of nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-848. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Raphael, M.G., G.M. Gelleher, M.H. Huff, S.L. Miller, S.K. Nelson, and R. Young. 2006. Spatially-explicit estimates of potential nesting habitat for the marbled murrelet. Chapter 5 in: Marbled Murrelet Effectiveness Monitoring Team; M. Huff, Tech. Coord. Northwest Forest Plan – The first 10 years (1994-2003): Status and trend of populations and nesting habitat for the marbled murrelet. Gen. Tech. Report. PNW-GTR-650. Portland, OR: USDA Forest Service, Pacific Northwest Research Station.

Ratliff, D. E. and P. J. Howell. 1992. The Status of Bull Trout Populations in Oregon. Pages 10-17 in Howell, P.J. and D.V. Buchanan, editors. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Reed, D.H., and R. Frankham. 2003. Correlation between fitness and genetic diversity. Conservation Biology 17:230-237.

Reid, S.B. 2007. Surveys for the Modoc sucker, *Catostomus microps*, in the Goose Lake Basin, Oregon - 2007. Final Report submitted to U.S. Fish and Wildlife Service – Klamath Falls Field Office, Cooperative Agreement No. 81450-6-J533.

Reid, S.B. 2008. Conservation Review - Modoc sucker, *Catostomus microps*. Final Report submitted to U.S. Fish and Wildlife Service – Klamath Falls Field Office.

Reid, S.B. 2009. Survey protocol for monitoring distribution and population sizes of Modoc sucker, *Catostomus microps*. Report submitted to U.S. Fish and Wildlife Service – Klamath Falls Field Office. Cooperative Agreement No. 81450-6-J532.

Rhymer, J.M., and D. Simberloff. 1996. Extinction by hybridization and introgression. Annual Review of Ecology and Systematics 27:83-109.

Rice, P.M., G.R. McPherson, and L.J. Rew. 2008. Fire and nonnative invasive plants in the Interior West Bioregion. Pages 141-173 in K. Zouhar, J.K. Smith, S. Sutherland, and M.L. Brooks (editors), Wildland fire in ecosystems: fire and nonnative invasive plants. General Technical Report RMRS-GTR-42-volume 6. Ogden, Utah: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 355 pp.

Rice, S.D. and R.M. Stokes. 1975. Acute toxicity of ammonia to several developmental stages of rainbow trout, *Salmo giardneri*. Fisheries Bulletin 73(1):207-211.

Rich, C.F., Jr. 1996. Influence of abiotic and biotic factors on occurrence of resident bull trout in fragmented habitats, western Montana. M.S. thesis. Montana State University, Bozeman, Montana.

Richardson, D.M., P.W. Rundel, S.T. Jackson, R.O. Teskey, J. Aronson, A. Bytnerowicz, M.J. Wingfield, and S. Proches. 2007. Human impacts in pine forests: past, present, and future. Annual Reviews in Ecology, Evolution, and Systematics 38:275-297.

Richardson, S.E., P.D. Sheerer, S.A. Miller, S.E. Jacobs, G. Swearingen, B. Berger, J. Deibner-Hanson, J. Winkowski, M. R. Terwilliger, and P. Hayden. 2010. Warner Sucker Investigations (2009). Oregon Department of Fish and Wildlife, Fish Research Project HLP0630009 and 134206M093, Annual Progress Report, Salem.

Ricklefs, R.E. 1990. Ecology. Third Edition. W. H. Freeman and Company, New York.

Ricklefs, R.E. 2006. The Economy of Nature: Data Analysis Update. 5th ed. W.H. Freeman and Co. Washington D.C.

Rieman, B.E. and F.W. Allendorf. 2001. Effective population size and genetic conservation criteria for bull trout. North American Journal of Fisheries Management 21:756-764.

Rieman, B.E. and J. Clayton. 1997. Fire and fish: issues of forest health and conservation of native fishes. Fisheries 22(11): 6-15.

Rieman, B.E. and J.D. McIntyre. 1993. Demographic and habitat requirements for conservation of bull trout. General Technical Report INT-302, Intermountain Research Station, U.S. Department of Agriculture, Forest Service, Boise, Idaho.

Rieman, B.E. and J.D. McIntyre. 1995. Occurrence of bull trout in naturally fragmented habitat patches of varied size. Transactions of the American Fisheries Society 124 (3): 285-296.

Rieman, B.E. and J.D. McIntyre. 1996. Spatial and temporal variability in bull trout redd counts. North American Journal of Fisheries Management 16: 132-141.

Rieman, B.E., and D.J. Isaak. 2010. Climate change, aquatic ecosystems, and fishes in the Rocky Mountain west: implications and alternatives for management. General Technical Report RMRS-GTR-250. Fort Collins, Colorado: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 46 pp.

Rieman, B.E., D. Isaak, S. Adams, D. Horan, D. Nagel, C, Luce, and D. Myers. 2007. Anticipated climate warming effects on bull trout habitats and populations across the interior Columbia River basin. Transactions of the American Fisheries Society 136:1552-1565.

Rieman, B.E., D.C. Lee and R.F. Thurow. 1997. Distribution, status and likely future trends of bull trout within the Columbia River and Klamath basins.

Rieman, B.E., J.T. Peterson, and D.L. Meyers. 2006. Have brook trout (*Salvelinus fontinalis*) displaced bull trout (*Salvelinus confluentus*) along longitudinal gradients in central Idaho streams? Canadian Journal of Fisheries and Aquatic Sciences 63:63-78.

Rieman, B.E., R.E Gresswell, M. Young, D. Burns, D. Lee, R. Stowell, J. Rinne, and P. Howell. 2003. Current status and conservation of native fishes and issues for integration with fire and fuels management. Forest Ecology and Management 178:197-211.

Rinne, J.A. 2001. Changes in Fish Populations in the Upper Verde River, 1994-2001. 12 pp.

Rinne, J.N. 1996. Short-term effects of wildfire on fishes and aquatic macroinvertebrates in the southwestern United States. North American Journal of Fisheries Management 16:653-658.

Rinne, J.N., C. Carter, and A. Sillas. 2005. Fish assemblages in the Upper Verde River: species abundance and interaction with river hydrology, 1994-2005. Manuscript. 40 pp.

Rinne, J.N., J.A. Stefferud, A. Clark, and P. Sponholtz. 1998. Fish community structure in the Verde River, Arizona, 1974-1997. Hydrology and Water Resources of Arizona and the Southwest 28:75-80.

Robins, C.R., R.M. Bailey, C.E. Bond, J.R. Brooker, E.H. Lachner, R.N. Lea and W.B. Scott. 1980. A list of common and scientific names of fishes from the United States and Canada. American Fisheries Society Special Publication 12, Bethesda, Maryland.

Robinson, A. 2008. Muleshoe Cooperative Management Area native fish repatriations, one-year post-stocking monitoring and first augmentation September 15-17 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 23 pages.

Robinson, A. 2009b. Acquisition of loach minnow from Blue River on June 1, 2009. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 5 pages.

Robinson, A. 2007. Verde River and Horseshoe Reservoir Fish Surveys. Final Report to Salt River Project April 11, 2007. Research Branch, Arizona Game and Fish Department. Phoenix. 32 pp.

Robinson, A. 2010. Arizona Native Fish Recovery and Nonnative Fish Control. Final Report, May 28, 2010. USFWS Agreement No 201816J808. Arizona Game and Fish Department, Phoenix. 34 pp.

Robinson, A., D. Orabutt, and C. Crowder. 2009b. Loach minnow survey of East Fork Black River and tributaries during July 2009. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 6 pages.

Robinson, A.T. 2009a. Repatriation of native fishes to Fossil Creek: monitoring and stocking during 2008. Arizona Game and Fish Department, Phoenix, Arizona. 17 pages.

Robinson, A.T., C. Carter, D. Ward, and H. Blasius. 2009a. Bonita Creek native fish restoration: native aquatic species salvage, chemical renovation, and repatriation of native aquatic species. Arizona Game and Fish Department, Phoenix, Arizona.

Robson, Dr. Kali. 2001. Cowlitz and Wahkiakum Conservation Districts, Longview, Washington.

Rode, M. 1990. Bull trout, *Salvelinus confluentus* Suckley, in the McCloud River: status and recovery recommendations. Administrative Report Number 90-15. California Department of Fish and Game, Sacramento, California.

Rogers, K.B. 2008. Using amplified fragment length polymorphisms to characterize purity of cutthroat trout in Colorado: results from 2007. 74 pp.

Rosenzweig, C., G. Casassa, D.J. Karoly, A. Imeson, C. Liu, A. Menzel, S. Rawlins, T.L. Root, B. Seguin, and P. Tryjanowski. 2007. Assessment of observed changes and responses in natural and managed systems. Pages 79-131 in M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (editors), Climate change 2007: Impacts, adaptation, and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom.

Rossi, C.A. 2001. The use of Geographic Information Science and discriminant analysis to determine the habitat of an endangered fish species, *Catostomus microps*, in Northeastern California. M.S. thesis, Clark University, Worcester, MA. 45pp.

Saiki, M.K., D.P. Monda, and B.L. Bellerud. 1999. Lethal levels of selected water quality variables to larval and juvenile Lost River and shortnose suckers. Environmental Pollution. 105 (1999): 37-44.

Salathé, E.P., L.R. Leung, Y. Qian, and Y. Zhang. 2009. Regional climate model projections for the State of Washington. In: The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate,Climate Impacts Group, University of Washington, Seattle, Washington.

Saunders, D.A., R.J. Hobbs, and C.R. Margules. 1991. Biological consequences of ecosystem fragmentation: A review. Conservation Biology 5:18-32.

Sausen, G. 2011. 2010 Bull Trout Redd Monitoring in the Wallowa Mountains. Unpublished report. U.S. Fish and Wildlife Service, La Grande Field Office, La Grande, Oregon. 46 pp.

Scheerer, P. D., S. E. Jacobs, and A. V. Munhall. 2006. 2006 Warner Valley fish investigations-Warner suckers. Oregon Department of Fish and Wildlife, Fish Research Project Annual Progress Report, Salem.

Scheerer, P. D., S. E. Jacobs, M. R. Terwilliger, S.A. Miller, S. L. Gunckel, S.E. Richardson, and M.P. Heck. 2011. Status, distribution, and life history investigations of Warner suckers, 2006-2010. Oregon Department of Fish and Wildlife, Salem.

Scheerer, P.D., and S.E. Jacobs, K. Bratcher, G. Swearingen, and S. Kramer. 2008. Warner Valley fish investigations - Warner suckers, annual progress report, fish research project, Oregon Department of Fish and Wildlife, Corvallis, Or.

Scheerer, P.D., S.E. Jacobs, and M.P. Heck. 2007. Warner sucker stream investigations. Oregon Department of Fish and Wildlife, Salem.

Schill, D.J. 1992. River and stream investigations. Idaho Department of Fish and Game.

Schill, D.J. and R.L. Scarpella. 1997. Barbed hook restrictions in catch-and-release trout fisheries: a social issue. North American Journal of Fisheries Management 17(4): 873-881Schmetterling, D.A. and M.H. Long. 1999. Montana anglers' inability to identify bull trout and other salmonids. Fisheries 24: 24-27.

Schmalzer, P. A. and C. R. Hinkle. 1992. Soil dynamics following fire in Juncus and Spartina marshes. Wetlands 12:8-21.

Schmetterling, D.A. 2001. Seasonal movement of fluvial westslope cutthroat trout in the Blackfoot River drainage, Montana. North American Journal of Fisheries Management 21:507-520.

Schrank, A.J., and F.J. Rahel. 2004. Movement patterns in inland cutthroat trout (*Oncorhynchus clarki utah*): management and conservation implications. Canadian Journal of Fisheries and Aquatic Sciences 61:1528-1537.

Scoppettone, G. and P. Rissler 2001. Distribution of Cowhead Lake Tui Chub, Twelvemile Creek, Oregon. Final Report to Fish and Wildlife Service, Oregon State Office. Unpublished.

Scoppettone, G.G., J.E. Harvey, S.P. Shea, B. Nielsen, and P.H. Rissler. 1992. Ichthyofaunal survey and habitat monitoring of streams inhabited by the Modoc sucker (*Catostomus microps*). National Biological Survey, Reno. 51 pp.

Scribner, K.T., G.K. Meffe, and M.J. Groon. 2006. Conservation genetics: the use and importance of genetic information. Pages 375-415 in M.J. Groom, G.K. Meffe, and C.R. Carroll (editors), Principles of Conservation Biology (Third Edition). Sinauer Associates, Inc. Sunderland, Massachusetts.

Seager, R., T. Mingfang, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H. Huang, N. Harnik, A. Leetmaa, N. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in southwestern North America. Science 316:1181-1184.

Seamans, M.E., R.J. Gutierrez., C.A. May. 2002. Mexican spotted owl (Strix occidentalis) population dynamics: Influence of climate variation on survival and reproduction. The Auk 119(2):321-334.

Seavy, N.E., T. Gardali, G.H. Golet, F.T. Griggs, C.A. Howell, R. Kelsey, S.L. Small, J.H. Viers, and J.F. Weigand. 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. Ecological Restoration 27:330-338.

Serreze, M.C. 2010. Understanding recent climate change. Conservation Biology 24:10-17.

Sestrich, C.M., T.E. McMahon, and M.K. Young. 2011. Influence of fire on native and nonnative salmonid populations and habitat in a western Montana basin. Transactions of the American Fisheries Society 140:136-146.

Sexauer, H.M. and P.W. James. 1997. Microhabitat use by juvenile trout in four streams located in the Eastern Cascades, Washington. Pages 361-370 in Mackay, W.C., M.K. Brown and M. Monita, editors. Friends of the Bull Trout Conference Proceedings.

Seymour, B. and N.G. Collett. 2009. Effects of fire retardant application on heathland surface-dwelling ant species (Order Hymenoptera; Family Formicidae) in Victoria, Australia. Forest Ecology and Management 257(4): 1261-1270.

Shively, R.S., A.E. Kohler, B.J. Peck, M.A. Coen, and B.S. Hayes. 2000b. Water quality, benthic macroinvertebrate, and fish community monitoring in the Lost River sub-basin, Oregon and California, 1999. Report of sampling activities in the Lost River sub-basin conducted by the U.S. Geological Survey, Biological Resources Division, Klamath Falls Duty Station, 1999. 92 p.

Skinner, C.N., and C. Chang. 1996. Fire regimes, past and present. Pages 1041-1069 in Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and scientific basis for management options. University of California, Centers for Water and Wildland Resources, Davis.

Smith, G. R. 1966. Distribution and evolution of the North American catostomid fishes of the subgenus Pantosteus, genus Catostomus. Miscellaneous Publications of Zoology. University of Michigan 129:1-132.

Smith, G.R., T. Steinback, and G. Pampush. 1984. Distribution, foraging relationships and colony dynamics of the American white pelican (Pelecanus erythrorhynchos) in southern Oregon and northeastern California. Oregon Department of Fish and Wildlife Nongame Wildlife Program Technical Report 83-0-04.

Snyder, J.O. 1908. Relationships of the fish fauna of the lakes of southeastern Oregon. Bulletin of the Bureau of Fisheries 27(1907):69-102.

Soule, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. Pages 151-169 *in* M. E. Soule and B.A. Wilcox (eds.). Conservation biology: an evolutionary–ecological perspective. Sinauer Associates, Sunderland, Massachusetts. 395 pp.

Southern Appalachian Forest Coalition. Undated. The Western Fire Model Does Not Fit the Southern Appalachians. http://www.safc.org/public_lands/documents/Wildfire.pdf. Accessed September 2011.

Spring Rivers Ecological Sciences LLC. 2009. Shasta Crayfish Technical Review Committee Summary Report. Prepared for Pacific Gas and Electric Company.

Spring Rivers Ecological Sciences LLC. 2011. Shasta Crayfish Technical Review Committee 2010 Annual Report. Prepared for Pacific Gas and Electric Company.

Stefferud, S.E. and P.N. Reinthal. 2005. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Literature review and history of research and monitoring. Report to U.S. Bureau of Land Management, Safford, Arizona. Cooperative Agreement AAA000011, Task Order AAF030025. University of Arizona, Tucson, Arizona. 80 pages.

Stephens, M. R. 2007. Systematics, Genetics and Conservation of Golden Trout. Doctoral Thesis Dissertation. U.C. Davis. 161p.

Stephens, S.L., and N.G. Sugihara. 2006. Fire management and policy since European settlement. Pages 431-443 in N.G. Sugihara, J.W. Van Wagtendonk, J. Fites-Kaufman, K.E. Shaffer, and A.E. Thode (editors), Fire in California Ecosystems. University of California Press, Berkeley, California.

Stephens, Stanley 2008. California Department of Fish and Game.

Stewart, I.T., D.R. Cayan, and D.M. Dettinger. 2005. Changes toward earlier streamflow timing across the western North America. Journal of Climate 18:1136-1155.

Stone, R. D. 1990. California's endemic vernal pool plants: some factors influencing their rarity and endangerment. In: Vernal pool plants: their habitat and biology. Studies from the Herbarium No. 8 California State University, Chico. Pp.89-107.

Strand, Philip. 2008. U.S. Forest Service, Fisheries Program Manager, Sierra And Sequoia National Forests.

Stromberg, J. 1993. Element Stewardship Abstract Southern Arizona ―Cienegas". A report submitted to the Arizona Nature Conservancy May 1993. 33 p.

Stromberg, J. Associate Professor, Arizona State University. Personal communication, August 8, 2011.

Studinski, G. 1993. Habitat improvement accomplishments for the Modoc Sucker on the Devil's Garden Ranger District Modoc National Forest. Unpub. report, Devils Garden Ranger District, Modoc Natl. Forest, CA. 5 pp.

Sullivan, M.E. and M.E. Richardson. 1993. Functions and values of the Verde River riparian ecosystem and an assessment of adverse impacts to these resources. A supporting document for the initiation of the Verde River Advanced Identification. Prepared by USFWS-Arizona Ecological Services Office, Phoenix for U.S. Environmental Protection Agency, Region 9, San Francisco, California. 364 pp.

Suter, A. 2003. User Information No. 6, Guide to Coverage Levels. Wildland Fire Chemical Systems. U.S. Forest Service – MTDC.

Sweet, S.S. 1992. Initial report on the ecology and status of the arroyo toad (*Bufo microscaphus californicus*) on the Los Padres National Forest of southern California, with management recommendations. Report to United States Department of Agriculture, Forest Service, Los Padres National Forest, Goleta, California. ii + 198 pp.

Swenson, S.C. 1978. Report of investigations on Catostomus warnerensis during spring 1978. Unpublished report to Fish and Wildlife Service. 27 pp.

Swift, C.C., T.R. Haglund, M. Ruiz, and R.N. Fisher. 1993. The status and distribution of the freshwater fishes of southern California. Southern California Acad. Sci. 92(3): 101-167.

Tait, C.K. and E.J. Mulkey. 1993a. Assessment of biological and physical factors limiting distribution of stream-resident Warner suckers (Catostomus warnerensis). Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 35 pp.

Tait, C.K. and E.J. Mulkey. 1993b. Estimation of stream-resident Warner sucker abundance and total habitat area in two basins using a statistically valid sampling design. Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 40 pp.

Terwilliger, M., P. Murtaugh, and D.F. Markle. 2000. Ecology of Upper Klamath Lake shortnose and Lost River suckers. 6. Effects of water quality on growth of juvenile shortnose suckers, *Chasmistes brevirostris* (Catostomidae: Cypriniformes), from Upper Klamath Lake, Oregon. Annual Report: 1999. Oregon State University, Department of Fisheries and Wildlife, Corvallis.

The Nature Conservancy. 2006. Shapefile of perennial waters in Arizona from the Arizona statewide freshwater assessment GIS data package. Available online at http://azconservation.org/ downloads/multi/category/gis/. Accessed June 23, 2010.

Thomas, G. 1992. Status of bull trout in Montana. Report prepared for Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Thomas, J.W., E.D. Forsman, J.B. Lint, E.X. Meslow, B.R. Noon, and J. Verner. 1990. A conservation strategy for the northern spotted owl. Report of the Interagency Scientific Committee to address the conservation of the northern spotted owl. Unpublished interagency document.

Thomas, Ted. 1998. Ecologist and Endangered Species Manager, U.S. Fish and Wildlife Service, Western Washington Office, Lacey, Washington.

Thurow, R. F., J. T. Peterson, C. A. Larsen, and J. W. Guzevich. 2004. Development of bull trout sampling efficiency models final report. U.S. Forest Service, Rocky Mountain Research Station, and U. S. Geological Survey, Boise, Idaho, and Georgia Cooperative Fish and Wildlife Research Unit, Athens, Georgia. 69 pp.

Thurston, R.V., G.R. Phillips, R.C. Russo, and S.M. Hinkins. 1981. Increased toxicity of ammonia to rainbow trout (Salmo giardneri) resulting from reduced concentrations of dissolved oxygen. Canadian Journal of Fisheries and Aquatic Sciences, 38(8):983-988.

Thurston, R.V., R.C. Russo, and C.E. Smith. 1978. Acute toxicity of ammonia and nitrite to cutthroat trout fry. Transactions of the American Fisheries Society 107:361-368.

Tisdale, E. W. 1986. Canyon Grasslands and associated shrublands of west-central Idaho and adjacent areas. Bulletin No. 40. Forest, Wildlife and Range Experiment Station, University of Idaho, Moscow, Idaho. 42 pp.

Titus, J.H. and P.J. Titus. 2008. Seedbank of Bingham Cienega, a spring-fed marsh in southeastern Arizona. Southwestern Naturalist 53:393-399.

Topinka, J.R. 2006. Chapter 3. Hybridization between sympatric endemic species? The case of the Modoc (*Catostomus microps*) and Sacramento (*Catostomus occidentalis*) suckers. Ph.D. Dissertation, University of California, Davis. 39 pp.

U. S. Fish and Wildlife Service. 2000. Revised recovery plan for Macfarlane's Four-o'clock (*Mirabilis macfarlanei*). U.S. Fish and Wildlife Service, Portland, OR. 46 pp.

U.S. Army Reserve Command. 2004. Endangered species management plan for arroyo toad (*Bufo californicus*), Fort Hunter Liggett, California. Fort Hunter Liggett, California.

U.S. Bureau of Reclamation (USBR). 2001a. Biological assessment of Klamath Project's continued operations on endangered Lost River and shortnose sucker. Mid-Pacific Region, Klamath Basin Area Office. February 13, 2001.

U.S. Department of Agriculture and Fish and Wildlife Service (USDA and USDI). 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl (Northwest Forest Plan), Portland, Oregon. 232 pp.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 1995. Recovery Plan for the Mexican Spotted Owl. Albuquerque, New Mexico.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 2004.

U.S. Environmental Protection Agency, 1999. Update of ambient water quality criteria for ammonia. EPA-822-R-99-014. http://www.epa.gov/ost/standards/ammonia.

U.S. Fish and Wildlife Service (Service). 1987. Endangered and threatened wildlife and plants; proposed reclassification of the Gila trout (*Salmo gilae*) from endangered to threatened, proposed rule. Federal Register 52:37424-37427.

U.S. Fish and Wildlife Service (Service). 2002. Evaluation of Cub fire impacts on Whiskey Creek and Upper West Fork Gila River. Trip Report. New Mexico Fishery Resources Office, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (Service). 2003a. Gila trout recovery plan (third revision). U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (Service). 2003b. Evacuation of Gila trout from Upper Mogollon Creek and transfer to Mora National Fish Hatchery and Technology Center. Memorandum. July 29, 2003. New Mexico Fishery Resources Office, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (Service). 2006. Emergency evacuation procedures for Gila Trout. New Mexico Fishery Resources Office, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service (USFWS). 1967. Native fish and wildlife: Endangered species. Federal Register 32:4001. March 11, 1967.

U.S. Fish and Wildlife Service (USFWS). 1997. 50 DFR Part 17 RIN 1018-AD11 Endangered and threatened wildlife and plants: determination of endangered status for three wetland species found in southern Arizona and northern Sonora, Mexico. Federal Register 62(3):665-689.

U.S. Fish and Wildlife Service (USFWS). 2001. Intra-service Biological opinion regarding Huachuca Water Umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) and other species and the Lone Mountain Ranch land exchange. August 8, 2001 (02-21-96-F-190 from Field Supervisor, Arizona Ecological Services Field Office, USFWS, to Forest Supervisor, Coronado Nation Forest, Tucson, Arizona. 19 p.

U.S. Fish and Wildlife Service (USFWS). 2008. Biological opinion on the USDA Forest Service application of fire retardants on National Forest system lands. 156 p.

U.S. Fish and Wildlife Service (USFWS). 1999. Endangered and threatened wildlife and plants; designation of critical habitat for the Huachuca water umbel, a plant. Federal Register 64 (132); 37441-37453.

U.S. Fish and Wildlife Service (USFWS). 2007. Recovery plan for *Hackelia venusta* (Showy Stickseed). U.S. Fish and Wildlife Service, Portland, Oregon. xii + 60 pages.

U.S. Fish and Wildlife Service (USFWS). 2009. Environmental Assessment for Renovation of Stillman Lake to Remove Non-native Fishes and Repatriate Native Species. Arizona Ecological Services Office, Phoenix. 83 pp.

U.S. Fish and Wildlife Service (USFWS). 2011. Biological Assessment of the Arizona Game and Fish Department's Statewide and Urban Fisheries Stocking Program for the Years 2011-2021. Wildlife and Sportfish Restoration, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1996. Endangered and Threatened Wildlife and Plants; Reclassification of *Mirabilis macfarlanei* (Macfarlane's Four-o'clock) from the Endangered to Threatened Status. Federal Register Notice.

U.S. Fish and Wildlife Service. 2002. Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) recovery plan. U.S. Fish and Wildlife Service. Phoenix, Arizona. iv + 67 pp.

U.S. Fish and Wildlife Service. 2005. Biological Opinion (1-17-05-F-0640) for the Joseph Rangeland Analysis Project Affects to Spalding's Catchfly for the Wallowa-Whatman National Forest, Wallowa Mountains Office, Enterprise, Oregon. Opinion submitted by the Fish and Wildlife Service, La Grand Field Office, La Grande, Oregon.

U.S. Fish and Wildlife Service. 2007. Sonora tiger salamander (*Ambystoma tigrinum stebbinsi*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service. Phoenix, Arizona. 14 pp.

U.S. Fish and Wildlife Service. 2007. Recovery Plan for *Silene spaldingii* (Spalding's Catchfly). U.S. Fish and Wildlife Service, Portland, Oregon. xiii + 187 pages.

U.S. Fish and Wildlife Service. 2009. Macfarlane's Four-o'clock (*Mirabilis macfarlanei)* 5-Year Review Summary and Evaluation. U.S. Fish and Wildlife Service, Portland, OR. 26 pp.

U.S. Fish and Wildlife Service. 1998. Pawnee montane skipper Recovery Plan. Prepared by the Pawnee montane skipper Recovery Working Group for Region 6 U.S. Fish and Wildlife Service. Denver, Colorado. 16 pp.

U.S. Forest Service (Forest Service). 2011. Biological assessment for re-initiation of consultation on the continued implementation of the land and resource management plans for the eleven National Forests and National Grasslands of the Southwestern Region. U.S. Forest Service, Southwestern Region, Albuquerque, New Mexico.

U.S. Forest Service (USFS) 2008. Coronado National Forest Huachuca FireScape Project Biological Assessment Signed July 22, 2008. 110 p.

U.S. Forest Service (USFS), 2011. Biological Assessment for Nation-wide aerial application of fire retardant. 47 p.

U.S. Forest Service (USFS). 2001. Revision of the Shay Creek Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*) Biological Assessment of Ongoing Activities on the San Bernardino National Forest. 51 pp.

U.S. Forest Service (USFS). 2011. Nationwide Aerial Application of Fire Retardant on National Forest System Land. Biological Assessment. June 2011.

U.S. Forest Service, 2008. GIS point feature layer of fire occurrences on the Pike and San Isabel National Forest from 1974-2007. Available at PSICC Forest Supervisor's Office, Pueblo, Colorado.

U.S. Forest Service. 2000. Environmental Assessment for the Upper South Platte Watershed Protection and Restoration Project. USDA Forest Service, Pike National Forest, South Platte Ranger District.

U.S. Forest Service. 2009. Coconino National Forest Ecological Sustainability Report. U.S. Department of Agriculture. Forest Service Southwestern Region. September 2009. 202 pp.

U.S. Forest Service. 2010. Draft Environmental Impact Statement for Public Motorized Travel Management Plan. Apache-Sitgreaves National Forests. U.S. Department of Agriculture. Forest Service Southwestern Region. MB-R3-01-4. October 2010. 223 pp.

U.S. Forest Service. 2011. National Aerial Application of Fire Retardant on National Forest System Land. Biological Assessment, June 2011. U.S. Department of Agriculture, Washington D.C.

U.S. Forest Service. 2011. Rational for Fire Retardant Avoidance Zones. Federally Listed Threatened and Endangered (Including Designated Critical Habitat) Found Within National Forests In The USDA Forest Service Southwestern Region. May 2011. 5 pp.

U.S. Forest Service. 2011b. Three Forks Recommended Research Natural Area and Associated Features. Apache-Sitgreaves National Forests. April 20, 2011. 1 page map.

U.S.D.A. Forest Service (USFS). 2011. Aerial application of fire retardant. Draft Environmental Impact Statement. United States Department of Agriculture Forest Service. Fire and Aviation Management Washington, DC. May 2011. 370 pp.

U.S.D.A. Forest Service. 2005. Joseph Creek Rangeland Analysis EA and Biological Assessment for affects to Spalding's catchfly. Wallowa-Whitman National Forest, Wallowa Mountains Office. Enterprise, Oregon.

U.S.D.A. (Forest Service). 2006. EAWS for the Island Assessment Area. Nez Perce National Forest, Grangeville, Idaho.

U.S.D.A. Forest Service. 2000. Section 7 Consultation Watershed Baseline: Bitterroot. Region 1 Forest Service, Missoula, Montana.

U.S.D.A. Forest Service. 2003. Hells Canyon National Recreation Area Comprehensive Management Plan, Final Environmental Impact Statement, Vols. 1-3. U.S. Department of Agriculture, Forest Service, Pacific Northwest Region, June 2003.

U.S.D.A. Forest Service. 2008a. Bull Trout Biological Assessment for the Revised Land and Resource Management Plan for the Beaverhead-Deerlodge National Forest. Region 1 Forest Service, Beaverhead-Deerlodge National Forest, Dillon, Montana.

Umek, J.W. 2007. Lahontan cutthroat trout movement in a high desert watershed; inferences from a microsatellite study. Master's Thesis, University of Nevada, Reno. i-v + 34 pp.

USBR. 2002a. Final biological assessment. The effects of the proposed actions related to Klamath Project operation (April 1, 2002 - March 31, 2012) on federally-listed threatened and endangered species. Mid-Pacific Region, Klamath Basin Area Office. February 25, 2002.

USDA (USDA Forest Service). 2011. Nationwide aerial application of fire retardant on National Forest System land: biological assessment. USDA Forest Service Fire and Aviation Management, Washington, D.C.

USDA and USDI (USDA Forest Service and USDI Bureau of Land Management). 1994a. Final supplemental environmental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. (Northwest Forest Plan). Portland, Oregon. 2 vols.

USDA and USDI (USDA Forest Service and USDI Bureau of Land Management). 1994b. Record of decision for amendments to Forest Service and Bureau of Land Management Planning documents within the range of the northern spotted owl —standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. (Northwest Forest Plan). Portland, Oregon. (Document in 2 parts, NWFP ROD and NWFP S and Gs)

USDA and USDI. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl (Northwest Forest Plan), Portland, Oregon. 232 pp.

USDA, Forest Service. 2004. *Revised Land and Resource Management Plan: Sumter National Forest. Management Bulletin R8-MB 116A; 208pgs.*

USFS. 2002. Biological assessment, Bouquet and Copper Fire suppression activities and burned area emergency rehabilitation treatments. Angeles National Forest, Arcadia, California.

USFS. 2002. Meadow Habitat Management Guide. San Bernardino National Forest, Fawnskin, California. 108 pp. + Appendices.

USFS. 2005. Biological assessment for the revised Land Management Plans (Forest Plans) for the four southern California national forests. Unpublished document submitted to the U.S. Fish and Wildlife Service. 370 pp + Appendices.

USFS. 2008. Biological assessment for ongoing activities and seven aquatic and riparian wildlife species on the San Bernardino National Forest. 228 pp. + Attachments.

USFS. 2010. Biological assessment for threatened and endangered plants for the coyote springs allotment grazing management project, Hat Creek Ranger District, Lassen National Forest. August 24, 2010.

USFS. 2010. Giant Sequoia National Monument management plan. Draft biological assessment. USDA Forest Service. 89 pp.

USFS. 2011. Fire retardant biological assessment. Unpublished document submitted to the U.S. Fish and Wildlife Service. 334 pp.

USFS. 2010. Modoc National Forest -Botany Biological Assessment for Grouser 139 Pre-Commercial Thin Project. Modoc National Forest, Pacific Southwest Region, USDA Forest Service.

USFS. 2011. Aerial application of fire retardant. Draft Environmental Impact Statement. United States Department of Agriculture Forest Service. Fire and Aviation Management Washington, DC. May 2011. 370 pp.

USFWS (U.S. Fish and Wildlife Service). 1989. The northern spotted owl: a status review supplement. U.S. Fish and Wildlife Service, Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service). 1990. Endangered and Threatened Wildlife and Plants: determination of threatened status for the northern spotted owl. Federal Register Vol. 55. 123:26114-26194.

USFWS (U.S. Fish and Wildlife Service). 2001, A rangewide baseline summary and evaluation of data collected through section 7 consultation for the northern spotted owl and its critical habitat: 1994-2001. Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service). 2003. Estimates of distances at which incidental take of murrelets and spotted owls due to harassment are anticipated from sound-generating, forest-management activities in Olympia National Forest. Lacey, Washington.

USFWS (U.S. Fish and Wildlife Service). 2005. Draft: Disturbance and disruption distances for northern spotted owls. Portland, Oregon.

USFWS (U.S. Fish and Wildlife Service). 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon

USFWS (USDI Fish and Wildlife Service), USDI Bureau of Land Management, and USDA Forest Service. 2008. Methodology for estimating the number of northern spotted owls affected by proposed federal actions. Version 2.0. Oregon Fish and Wildlife Office, Fish and Wildlife Service, Portland, Oregon.

USFWS 2009. Marbled murrelet (Brachyramphus marmoratus). 5-year review. June 12, 2009. U.S. Fish and Wildlife Service, Lacey, Washington. 108 pp.

USFWS. 1999. Arroyo southwestern toad (*Bufo microscaphus californicus*) recovery plan. Portland, Oregon. 119 pp.

USFWS. 1975. Threatened status for three species of trout. Federal Register 40:29863-29864. July 16, 1975.

USFWS. 1985. Endangered and threatened wildlife and plants: Determination of endangered status for the Modoc sucker. Federal Register 50 (112):24526-24530.

USFWS. 1985. Recovery Plan for the Paiute cutthroat trout (*Salmo clarki seleniris*). Portland, Oregon. ix + 68 pp.

USFWS. 1986. Endangered and threatened wildlife and plants; determination of threatened status and critical habitat for the Railroad Valley springfish. Federal Register 51:10857-10865. March 31, 1986.

USFWS. 1997. Railroad Valley springfish (*Crenichthys nevadae*) Recovery Plan. Region 1, Portland, Oregon. 56 pp.

USFWS. 1997a. Biological opinion 1-6-97-F-4 on the wild burro management plan for the San Bernardino National Forest. January 8. Carlsbad Fish and Wildlife Field Office, Carlsbad, California.

USFWS. 1997b. San Bernardino Mountains carbonate plants draft recovery plan. U.S. Fish and Wildlife Service, Portland, Oregon. 51 pp.

USFWS. 1998. Recovery plan for the pedate checkermallow (*Sidalcea pedata*) and the slender-petaled mustard (*Thelypodium stenopetalum*). U.S. Fish and Wildlife Service, Portland, Oregon. 68 pp.

USFWS. 2000. Biological opinion on the effects of ongoing forest activities that may affect listed riparian species on the Cleveland National Forest, the Los Padres National Forest, the San Bernardino National Forest and Angeles National Forest in southern California (1-6-99-F-21). U.S. Fish and Wildlife Service. Carlsbad and Ventura Fish and Wildlife Offices.

USFWS. 2001a. Formal section 7 consultation for various ongoing and related activities affecting pebble plains, San Bernardino County, California (1-6-99-F-25). 56 pp.

USFWS. 2001b. Biological opinion on various ongoing and related activities affecting carbonate habitats, San Bernardino County, California (1-6-99-F-26). 55 pp.

USFWS. 2001c. Reinitiated Biological Opinion on the Cleveland National Forest's Livestock Grazing Program, Orange, Riverside, and San Diego Counties, California (1-6-01-F-1694). 65 pp.

USFWS. 2003. Biological Opinion: Formal Consultation on Little Kern Golden Trout 2003 Section 6 Funding of DNA Research, Tulare County, California. Sacramento Fish and Wildlife Office. Sacramento, California

USFWS. 2003. Recovery plan for the Quino checkerspot butterfly. 143 pp. + Appendices

USFWS. 2004. Biological opinion on the effects of permitted grazing allotments on the Smith's blue butterfly on the Monterey Ranger District, Los Padres National Forest, Monterey County, California (USFWS Reference # 1-8-03-F-53).

USFWS. 2004. Revised Recovery Plan for the Paiute cutthroat trout (*Oncorhynchus clarki seleniris*). Portland, Oregon. ix + 105 pp.

USFWS. 2005. Recovery Plan for the Tidewater Goby (*Eucyclogobius newberryi*), U.S. Fish and Wildlife Service, Portland, Oregon, vi+199 pp.

USFWS. 2005a. Biological and conference opinions on the revised Land and Resource Management Plans for the four southern California National Forests, California (1-6-05-F-773.9). 325 pp. + Appendix

USFWS. 2005b. Formal section 7 consultation on the Carbonate Habitat Management Strategy (1-6-05-F-4319). May 2, 2005. 38 pp.

USFWS. 2005b. Formal section 7 consultation on the San Gabriel Canyon Off-Highway Vehicle Area on the Angeles National Forest, Los Angeles County, California. 7, 2005.

USFWS. 2005c. Biological opinion for the proposed Right Star Mine Project (1-6-05-F-3450.3). May 4, 2005. 9 pp.

USFWS. 2005c. Emergency biological opinion on the 2004 San Gabriel Canyon sediment removal project on the Angeles National Forest, Los Angeles County, California. June 16, 2005. 12 pp.

USFWS. 2005d. Biological opinion on the San Gabriel Canyon sediment removal project on the Angeles National Forest, Los Angeles County, California. June 16, 2005. 14 pp.

USFWS. 2007. Tidewater Goby (*Eucyclogobius newberryi*), Five Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura, California.

USFWS. 2007a. Biological opinion for the issuance of 2-year special use permits for the North Fork San Gabriel, West Fork San Gabriel, and Big Tujunga Canyon recreation residence tracts, Los Angeles County, California. 15 pp.

USFWS. 2007b. Formal section 7 consultation on the Thomas Mountain Fuels Reduction Project, Riverside County, California. June 13, 2007. 14 pp.

USFWS. 2007c. Laguna Mountains skipper (*Pyrgus ruralis lagunae*) 5-year review: summary and evaluation. 18 pp.

USFWS. 2008. 5-Year Review: Summary and Evaluation. Paiute cutthroat trout (*Oncorhynchus clarkii seleniris*). Region 8, Sacramento, California. 39 pp. http://ecos.fws.gov/docs/five_year_review/doc1954.pdf

USFWS. 2008. Biological opinion on the USDA Forest Service application of fire retardants on National Forest System lands. February 15, 2008. 135 pp. + Appendices

USFWS. 2008. Purple Amole (*Chlorogalum purpureum*) Five Year Review. U.S. Fish and Wildlife Service, Ventura, California.

USFWS. 2008. Draft Springville Clarkia (*Clarkia springvillensis*) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. 16 pp.

USFWS. 2008a. *Taraxacum californicum* (California taraxacum) 5-year review: summary and evaluation. 25 pp+attachments.

USFWS. 2008b. (*Poa atropurpurea*) San Bernardino Bluegrass five-year review: summary and evaluation. 19 pp.

USFWS. 2008c. Southern mountain buckwheat (*Eriogonum kennedyi* var. *austromontanum*) 5-year review: summary and evaluation. 14 pp.+attachment.

USFWS. 2008d. Ash-grey (Indian) paintbrush (*Castilleja cinerea*) 5-year review: summary and evaluation. 13 pp.+attachment.

USFWS. 2008e. Bear Valley sandwort (*Arenaria ursina*) 5-year review: summary and evaluation. 14pp+attachment.

USFWS. 2008f. Vail Lake ceanothus (*Ceanothus ohpiochilus)* 5-year review: summary and evaluation. 20 pp.

USFWS. 2008g. *Brodiaea filifolia* (thread-leaved brodiaea) 5-year review: summary and evaluation. 47 pp.

USFWS. 2009. 5-Year Review: Summary and Evaluation. Lahontan cutthroat trout (Oncorhynchus clarkii henshawi). Region 8, Sacramento, California. 199 pp. http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E00Y

USFWS. 2009. Railroad Valley springfish (*Crenichthys nevadae*) 5-Year Review: Summary and Evaluation. Region 8, Sacramento, California. 36 pp. http://ecos.fws.gov/docs/five_year_review/doc2549.pdf

USFWS. 2009. Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*) Five-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura, California. 33 pp.

USFWS. 2009a. *Acanthoscyphus* (*Oxytheca*) *parishii* var. *goodmaniana* (Cushenbury oxytheca) 5-year review: summary and evaluation. 21 pp.

USFWS. 2009b. *Astragalus albens* (Cushenbury milk-vetch) 5-year review: summary and evaluation. 20 pp.

USFWS. 2009c. *Eriogonum ovalifolium var. vineum* (Cushenbury buckwheat) 5-year review: summary and evaluation. 20 pp.

USFWS. 2009d. *Erigeron parishii* (Parish's daisy) 5-year review: summary and evaluation. 20 pp.

USFWS. 2009e. *Physaria* (*Lesquerella*) subsp. *Bernardina* (San Bernardino Mountains bladderpod) 5-year review: summary and evaluation. 19 pp.

USFWS. 2009f. *Allium munzii* (Munz's onion) 5-year review: summary and evaluation. 39 pp.

USFWS. 2009g. *Berberis nevinii* (Nevin's barberry) 5-year review: summary and evaluation. 30 pp.

USFWS. 2009h. *Acanthomintha ilicifolia* (San Diego thornmint) 5-year review: summary and evaluation. 39 pp.

USFWS. 2009i. *Brodiaea filifolia* (thread-leaved brodiaea) 5-year review: summary and evaluation. 47 pp.

USFWS. 2009j. Owens Tui Chub (*Siphateles bicolor snyderi* = *Gila bicolor snyderi*) Five-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Ventura, California.

USFWS. 2010. Desert pupfish (Cyprinodon macularius) 5-Year Review: Summary andEvaluation. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, Arizona. 43pp.

USFWS. 2010. *Dodecahema leptoceras* (slender-horned spineflower) 5-year review: summary and evaluation. 37 pp.

USFWS. 2010. Five-year Review: Little Kern golden trout (*Oncorhynchus mykiss whitei*). Sacramento, California. 32 pp.

USFWS. 2010a. Reinitiation of formal consultation and revised biological and conference opinion on the construction and long-term operation and maintenance program for the Sunrise Powerlink Project, Imperial and San Diego Counties, California. 153 pp. + Attachments

USFWS. 2010b. Formal section 7 consultation for the proposed Ramona Indian Reservation Road Improvement Project. June 9, 2010. 15 pp.

USFWS. 2011a. Santa Ana sucker (*Catostomus santaanae*) 5-year review: summary and evaluation. 74 pp.

USFWS. 2011a. *Sidalcea pedata* (pedate checkermallow) 5-year review: summary and evaluation. 35 pp.

USFWS. 2011b. Formal section 7 consultation on the proposed Bonita Vista Fuel Break Project. January 21, 2011. 8 pp.

USFWS. 2011b. *Thelypodium stenopetalum* (slender-petaled mustard) 5-year review: summary and evaluation. 34 pp.

USFWS. 2011c. Formal section 7 consultation for the Garner Valley Fuels Reduction Project, Riverside County, California. February 18, 2011. 10 pp. + Appendix

USFWS. 2011d. Formal section 7 consultation on the 24-hours of Adrenaline and Idyllwild Spring Challenge Mountain Bike Races on the San Jacinto Ranger District, Riverside County, California. April 4, 2011. 8 pp.

USFWS. 1995. Biological opinion on the Bear Mountain Ski Resort expansion project (1-6-95-F-5). January 26, 1995. 5 pp.

USFWS. 1997. Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. U.S. Fish and Wildlife Service Portland, Oregon. 203 pp.

USFWS. 2002. Biological/Conference opinion regarding the effects of operation of the U.S. Bureau of Reclamation's proposed 10-year operation plan for the Klamath Project and its effect on the endangered Lost River sucker (*Deltistes luxatus*), endangered shortnose sucker (*Chasmistes brevirostris*), threatened bald eagle (*Haliaeetus leucocephalus*) and proposed critical habitat for the Lost River and shortnose suckers. Klamath Falls, Oregon. 227 p.

USFWS. 2006. Estimating the effects of auditory and visual disturbance to northern spotted owls and marbled murrelets in northwestern California. Memorandum to all interested parties. July 31, 2006. U.S. Fish and Wildlife Service, Arcata, California. 19 pp. + appendices.

USFWS. 2007. Mariposa Pussypaws (*Calyptridium pulchellum*) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, California. 15 pp.

USFWS. 2007a. Lost River Sucker (*Deltistes luxatus*) 5-year review summary and evaluation. Klamath Falls Fish and Wildlife Office, Oregon. 43 p.

Van de Water, K., and M. North. 2010. Fire history of coniferous riparian forests in the Sierra Nevada. Forest Ecology and Management 260:384-395.

Van de Water, K., and M. North. 2011. Stand structure, fuel loads, and fire behavior in riparian and upland forests, Sierra Nevada Mountains, USA: a comparison of current and reconstructed conditions. Forest Ecology and Management 262:215 228.

Van Meter, W.P. and Charles E. Hardy. 1975. Predicting effects on fish of fire retardant in streams. Res. Pap INT-166. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 16 p.

Van Wagtendonk, J.W., and J. Fites-Kaufman. 2006. Sierra Nevada bioregion. Pages 264-294 in N.G. Sugihara, J.W. Van Wagtendonk, J. Fites-Kaufman, K.E. Shaffer, and A.E. Thode (editors), Fire in California Ecosystems. University of California Press, Berkeley, California.

VanZuuk, K. 2010. E-mail to Jeremiah Karuzas, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, dated July 26, 2010. Subject: *Packera layneae*.

VanZuuk, K. 2010. USDA Forest Service. E-mail to Jeremiah Karuzas, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, dated July 26 and 27, 2010. Subject: *Packera Laynea, Calystegia stebinsii*.

Vernadero Group. 2011. Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*) San Pedro riparian national conservation area inventory report, Cochins County, Arizona. January 2011 report. 30 p.

Voeltz, J. B., and R. H. Bettaso. 2003. 2003 Status of the Gila topminnow and desert pupfish in Arizona. Nongame and Endangered Wildlife Program Technical Report 226, Arizona Game and Fish Department, Phoenix. 124pp.

Wagman, D.W. and D.F. Markle. 2000. Use of anonymous nuclear loci to assess genetic variation in *Catostomus microps* and *C. occidentalis* from California (Catostomidae). Final report to U.S. Fish and Wildlife Service, Klamath Falls, Oregon. 22 p.

Wagner, Paul. 2000. Senior Biologist and Biology Branch Manager, Washington Department of Transportation, Olympia, Washington.

Waln, K. 2011. Electronic correspondence dated September 6, 2011. Geographic Information Systems Specialist, U.S. Fish and Wildlife Service.

Waln, K. 2011. Electronic correspondence to Della Snyder-Velto, dated August 24, 2011. Geographic Information Systems Specialist, U.S. Fish and Wildlife Service, Ventura, California.

Ward, D.L. and R.A. Fritzsche. 1987. Comparison of meristic and morphometric characters among and within subspecies of the Sacramento sucker (*Catostomus occidentalis* Ayres). Calif. Fish and Game 73:175-187.

Warren, P.L., D.F. Gori, L.S. Anderson, and B.S. Gebow. 1991. Status report: *Lilaeopsis schaffneriana* subspecies *recurva*. Report submitted by The Arizona Nature Conservancy to the U.S. Fish and Wildlife Service Ecological Services Office. 30 p.

Warren, P.L., L.S. Anderson, and P.B. Shafroth. 1989. *Lilaeopsis schaffneriana* ssp. *recurva*. Pp 58-58 *In*: Population studies of sensitive plants of the Huachuca and Patagonia Mountains, Arizona. A report submitted to Coronado National Forest in completion of P.O. No. 40-8197-8-431.

Watson, G. and T. Hillman. 1997. Factors affecting the distribution and abundance of bull trout: an investigation into hierarchical scales. North American Journal of Fisheries Management 17:237-252.

Webb, B.W., D.M. Hannah, R.D. Moore, L.E. Brown, and F. Nobilis. 2008. Recent advances in stream and river temperature research. Hydrological Processes 22:902-918.

Weedman, D.,A.L. Girmendonk, and K. Young. 1996. Status Review of Gila Chub, Gila intermedia, in the United States and Mexico. Technical Report 91, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department. 120 pp

Weedman, D.A. 2002. Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey May 14-17, 2002. Arizona Game and Fish Department, Phoenix, AZ. 3 pp.

Weedman, D.A. 2001. Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey October 15-18, 2001. Arizona Game and Fish Department, Phoenix, AZ. 4 pp.

Weedman, D.A. 2003. Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey May 12-16, 2003. Arizona Game and Fish Department, Phoenix, AZ. 4 pp.

Weedman, D.A. 2004 Results of the Verde River, Childs to Sheep Bridge, Fisheries Survey June 14-17, 2004. Arizona Game and Fish Department, Phoenix, AZ. 4 pp.

Wells, J.B., E.E. Little, and R.D. Calfee. 2004. Behavioral response of young rainbow trout (*Oncorhynchus mykiss*) to forest fire retardant chemicals in the laboratory. Environmental Toxicology and Chemistry 23:621-625.

Wenger, S.J., D.J. Isaak, C.H. Luce, H.M. Neville; K.D. Fausch, J.B. Dunham, D.C. Dauwalter, M.K. Young, M.M. Elsner, B.E. Rieman, A.F. Hamlet, and J.E. Williams. pnas.1103097108.2011. Flow regime, temperature, and biotic interactions drive differential declines of trout species under climate change. Proceedings of the National Academy of Sciences www.pnas.org/cgi/doi/10.1073/

Wentworth, Jane. 2001. Program Director, King County Noxious Weed Control Board, Seattle, Washington.

Werntz, David. 2000. Science Director, Northwest Ecosystem Alliance, Bellingham, Washington.

Westerling, A.L., H.G. Hidalgo, D.R. Cayan, and T.W. Swetnam. 2006. Warming and earlier spring increase western U.S. forest wildfire activity. Science 313: 940-943.

Whisenant, S.G. 1990. Changing Fire Frequencies on Idaho's Snake River Plains: Ecological and Management Implications. *In* Proceedings-Symposium on Cheatgrass Invasion, Shrub Die-Off, and other aspects of Shrub Biology and Management. USDA Forest Service Intermountain Research Station General Technical report INT-276.

White, R. 1989. Dutch Flat Creek Modoc sucker critical habitat management plan. U.C. Davis. Final report to U.S. Fish Wildlife Service, Sacramento, CA. (Contract #11310-88-0309). 16 pp.

White, R.K., T.L. Ramsey, M.A. Stern, and A.V. Munhall. 1991. Salvage operations and investigations of the range and stream habitat characteristics of the Warner sucker, Catostomus warnerensis, during spring and summer 1991. Unpublished report to Bureau of Land Management and Oregon Department of Fish and Wildlife. 44 pp.

White, R.K., T.R. Hoitsma, M.A. Stern, and A.V. Munhall. 1990. Final report on investigations of the range and status of the Warner sucker, Catostomus warnerensis, during Spring and Summer 1990. Unpublished report to Bureau of Land Management, Oregon Department of Fish and Wildlife, and Fish and Wildlife Service. 66 pp.

Whitesel, T.A., J. Brostrom, T. Cummings, J. Delavergne, W. Fredenberg, H. Schaller, P. Wilson, and G. Zydlewski. 2004. Bull Trout Recovery Planning: A review of the science associated with population structure and size. Science Team Report #2004-01. Fish and Wildlife Service, Regional Office, Portland, Oregon.

Wilcox, C., B.J. Cairns, and H.P. Possingham. 2006. The role of habitat disturbance and recovery in metapopulation persistence. Ecology 87:855-863.

Williams, J.E., A.L. Haak, H.M. Neville, W.T. Colyer. 2009. Potential consequences of climate change to persistence of cutthroat trout populations. North American Journal of Fisheries Management 29:533-548.

Williams, J.E., M.A. Stern, A.V. Munhall, and G.A. Anderson. 1990. Conservation status of the threatened fishes of the Warner Basin, Oregon. Great Basin Naturalist 50(3):243-248.

Williams, K.A., D.W.J. Green, and D. Pascoe. 1986. Studies on the acute toxicity of pollutants to freshwater macroinvertebrates: 3. Ammonia. Archiv fuer Hydrobiologie, 106(1):61-70.

Wirt, L. and H.W. Hjalmarson. 2000. Sources of springs supplying base flow to the Verde River headwaters, Yavapai County, Arizona. Open File Report 99-0378. U.S. Geological Survey, Denver, Colorado. 50 pp.

Wootton, R.J. 1990. Ecology of Teleost Fishes. Chapman and Hall, London, England. 404 pp.

Yates, E. 2007. MacFarlane's Four-o'clock in Hells Canyon of the Snake River. Kalmiopsis, Journal of the Native Plant Society of Oregon. Volume 14: 1-7.

Yates, G. October 3, 2008. E-mail to Ray Vizgirdas with comments to Draft 5-year status review for Mirabilis macfarlanei.

Young, M.K. 1996. Summer movements and habitat use by Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in small, montane streams. Canadian Journal of Fisheries and Aquatic Sciences 53:1403-1408.

Young, M.K., P.M. Guenther-Gloss, and A.D. Ficke. 2005. Predicting cutthroat trout (*Oncorhynchus clarkii*) abundance in high-elevation streams: revisiting a model of translocation success. Canadian Journal of Fisheries and Aquatic Sciences 62:2399-2408.

Zharikov, Y., D.B. Lank, F. Huettman, R.W. Bradley, N. Parker, P.P.W. Yen, L.A. Mcfarlane-Tranquilla, and F. Cooke. 2006. Habitat selection and breeding success in a forestnesting alcid, the marbled murrelet, in two landscapes with different degrees of forest fragmentation. Landscape Ecology 21:107-120.

Ziebell, C.D. and R.R. Roy. 1989. Distribution and angler use of the roundtail chub (*Gila robusta*) in the upper Verde River. Report 89-1, May 1989. Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ 36pp.

Ziller, J.S. 1992. Distribution and relative abundance of bull trout in the Sprague River Subbasin, Oregon. Pages 18-29 in Howell, P.J. and D.V. Buchanan, editors. Proceedings of the Gearhart Mountain Bull Trout Workshop. Oregon Chapter of the American Fisheries Society, Corvallis, Oregon.

Zuhlke, A., P. Titus, and J. Titus. 2002. Huachuca water umbel monitoring – a disturbance adapted endangered wetland plant in Arizona. Poster presented at the Ecological Society of America and Society of Ecological Restoration joint meeting in Tucson, Arizona.

Appendix A. US Fish and Wildlife Service Regional Map

Appendix B. Final No Effect and Not Likely to Adversely Affect determinations presented by forest

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
1	Kincaid's lupine (Lupinus oreganus var. kincaidii)	LAA	NLAA	Umpqua National Forest	See appendix for explanation of basis for changed effects determinations.	1
2	Northern spotted owl critical habitat	NE	NLAA	Multiple	See appendix for explanation of basis for changed effects determinations.	1
3	Oregon Chub (Oregonichthys crameri)	LAA	NLAA	Umpqua NF, Willamette NF	See appendix for explanation of basis for changed effects determinations.	1
4	Oregon chub critical habitat	LAA	NLAA	Willamette NF	See appendix for explanation of basis for changed effects determinations.	1
5	Wenatchee Mountains checker-mallow (Sidalcea oregana var. calva)	LAA	NLAA	Okanogan-Wenatchee National Forest	See appendix for explanation of basis for changed effects determinations.	1
6	Alamosa springsnail	LAA	NLAA	Cibola NF	The occupied spring complexes occur upstream from Alamosa Creek that could potentially transport fire retardant runoff from Forest Service lands. Fire retardant would have to be dropped at the boundary simultaneously with a rain heavy enough to carry the retardant 0.25 miles	2

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					within 3 hours, and make its way up the spring run to affect the Alamosa springsnail. This scenario is extremely unlikely to occur.	
7	Sacramento Mountains thistle	LAA	NLAA	Lincoln NF	Due to low likelihood of fire retardants affecting more than a few of the 75-80 sites of Sacramento Mountains thistle during any one fire, the high likelihood that retardants will not be applied directly on the sites, and the dense growth of the Sacramento Mountains thistle colonies that appears to exclude other vegetation, including non-native invasive species.	2
8	Sacramento prickly poppy	LAA	NLAA	Lincoln NF	Due to the low potential for fire retardant use in much of the Sacramento prickly poppy's habitat, and the general absence of non-native invasive plants in the habitat.	2
9	Todsen's pennyroyal	LAA	NLAA	Lincoln NF	1) the distribution of the 32 populations of Todsen's pennyroyal in two mountain ranges, separated by 45 miles, makes it unlikely that fire retardant would significantly affect all of the populations, and 2) there are no non-native invasive plants in the area that are likely to increase with retardant use.	2
10	American burying beetle	NLAA	NE	Hoosier, Huron-Manistee	Not present on either Forest	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
11	Curtis' pearlymussel	NE	NLAA	Mark Twain	1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by Curtis' pearlymussel include the Little Black River.	3
12	Gray wolf	NLAA	NE	Cheqomegon-Nicolet	Aerially retardants are not used on CNNF, so should be NE. Concur with determinations for Hiawatha, Ottawa, Chippewa, Superior forests	3
13	Hines emerald dragonfly	NLAA	NLAA	Mark Twain, Hiawatha	1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is unlikely. 2. Mark Twain NF has established avoidance areas and maps to protect critical habitat of Hine's emerald dragonfly. 3. Avoidance areas are now designated as the entire area between ridges parallel to surrounding occupied fens (ridge top to ridge top) to protect from retardant runoff during heavy	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					rains. However, at no point should the buffer be less than 1/2-mile around designated critical habitat.	
14	Hines emerald dragonfly CH	NLAA	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is unlikely. 2. Mark Twain NF has established avoidance areas and maps to protect critical habitat of Hine's emerald dragonfly. 3. Avoidance areas are now designated as the entire area between ridges parallel to surrounding occupied fens (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than 1/2-mile around designated critical habitat.	3
15	Indiana bat	NLAA	NLAA	Hoosier, Huron-Manistee	BA is insufficient to conclude NLAA (I concur with NLAA after consulting with HNF staff. Retardant use is extremely unlikely and in the unlikely event it were needed it would be in spring or fall when non-volant young are not present).	3
16	Indiana bat	NLAA	NLAA	Mark Twain	The BA is insufficient, but we agree NLAA for the following reasons: 1) retardant use is unlikely to occur, 2) fire season for MTNF was noted as April to Oct. Most of the summer habitat is in north MO. Only four maternity trees have been documented in one District of MTNF and the probability of impacting a maternity tree in MTNF is very low, and 3) likewise the probability of impacting other roost trees is very low as well.	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
17	Indiana bat	NLAA	NE	Shawnee	Aerially retardants are not used on the Shawnee, so should be NE. Concur with determination for Wayne NF.	3
18	Karner blue butterfly	NLAA	NLAA	Huron-Manistee	Data on potential toxicity of fire retardants to larvae of sensitive invertebrates are lacking. However, direct effects from aerial retardant drops could potentially kill Karner blue adults, larvae, or pupae due to the effective sticky covering of the retardant itself rendering the animal immobilized, or possibly suffocating the individual and thus affecting its survival. Indirect effects, both beneficial from the fertilizing affect of retardants on vegetation, and detrimental from the possible promotion of non-native species into Karner blue habitat, could occur, given the high amount of disturbance within and adjacent to Karner blue habitat. But fire retardant has never been applied aerially anywhere in the Manistee National Forest, the only location of Karner blue butterflies in the Huron-Manistee National Forests, and it would be unlikely to be applied in these oak savanna ecosystems, making any direct or indirect effects extremely unlikely. KBB metapopulations (occupied and potentially occupiable habitat) have been identified for avoidance mapping.	3
19	Kirtland's warbler	NLAA	NLAA	Cheqomegon-Nicolet	Aerially retardants are not used on CNNF, so should be NE	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
20	Kirtland's warbler	NLAA	NLAA	Hiawatha, Huron-Manistee, Ottawa	Of all the E/T species in Michigan, Kirtland's warbler jack pine habitat is the most likely to experience high severity fires, and the most likely to require the aerial use of retardant, to protect adjacent essential habitat and human developments in the extensive Wildland-Urban Interface. Currently-occupied and potentially-occupiable Kirtland's warbler breeding habitat has been identified for avoidance mapping. However, a **May Affect – Not Likely to Adversely Affect** determination is made for Kirtland's warbler, based upon 1) the fact that fire retardant has only ever been aerially applied **once** on the Huron National Forest, the only known breeding location of Kirtland's warbler in the Huron-Manistee National Forests; and 2) **Recommended Avoidance Mapping** that would reduce likelihood of impacts from aerial application of retardant on nesting areas. Avoidance mapping for Kirtland's warbler should be updated annually, to include all currently-occupied and potentially-occupiable Kirtland's warbler breeding habitat, excluding areas no longer suitable habitat from avoidance.	3
21	Leafy prairie clover	NLAA	NE	Midewin	Midewin does not use aerially applied retardant, therefore the determination should be no effect	3
22	Mead's milkweed	NLAA	NE	Midewin, Shawnee	Shawnee and Midewin do not use aerially applied retardant, therefore the determination should be no effect. Concur with determination on Mark Twain.	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
23	Ozark hellbender	NE	NLAA	Mark Twain	1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect Ozark hellbender streams and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by Ozark Hellbenders include the North Fork of the White River, Eleven Point River, and Current River.	3
24	Pink Mucket	NE	NLAA	Mark Twain	1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by pink mucket include the Black River.	
25	Piping plover CH	none	NE		Aerially retardants are not used in piping plover habitat	3
26	Rabbitsfoot	NE	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by rabbitsfoot include the St. Francis River.	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
27	Scaleshell Mussel	NE	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by scaleshell include the Big Piney and Gasconade rivers.	3
28	Snuffbox mussel	NE	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by Snuffbox include the St. Francis River.	
29	Spectaclecase	NE	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by spectaclecase include the Big Piney, Gasconade, and Meramec rivers.	3

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
30	Topeka shiner	NE	NLAA		1. No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is extremely low. 2. Mark Twain NF has established avoidance areas and maps to protect streams with important mussel beds and connected tributaries if fire retardant is applied. 3. Avoidance areas were expanded from the original 300-foot buffer around waterways and are now designated as the entire area between ridges parallel to occupied streams (ridge top to ridge top) to protect from retardant runoff during heavy rains. However, at no point should the buffer be less than ¼-mile on either side of occupied streams. To protect from retardant input from tributaries, avoidance areas will also include a 300-foot buffer around on either side of tributaries feeding into occupied streams and extending 5 miles upstream of the confluence of the stream and tributaries. Streams occupied by Curtis' pearlymussel include the Little Black River.	3
31	Tumbling creek cavesnail	NE	NLAA	Mark Twain	No direct effects to the species or its habitat are likely because the likelihood of fire retardant use on Mark Twain NF is unlikely, and Mark Twain NF designated the entire recharge area of Tumbling Creek Cave as an avoidance area to protect Tumbling Creek cavesnail..	3
32	A Cave Crayfish	LAA	NLAA	Ozark-St Francis National Forest	See appendix for explanation of basis for changed effects determinations for Ozark St Francis NF in AR.	4
33	Amber Darter	LAA	NLAA	Cherokee National Forest, Chattahoochee-	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN and for Chattahoochee-Oconee NF in GA.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
				Oconee National Forests		
34	Appalachian Elktoe	LAA	NLAA	National Forests in North Carolina, Cherokee National Forest	See appendix for explanation of basis for changed effects determinations for NFs in NC and for Cherokee NF in TN.	4
35	Arkansas Fatmucket	LAA	NLAA	Ouachita National Forest	See appendix for explanation of basis for changed effects determinations for Ouachita NF in AR.	4
36	Blackside Dace	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4
37	Blue Shiner	LAA	NLAA	Cherokee National Forest, Chattahoochee-Oconee National Forests, National Forests in Alabama	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN, NFs in Alabama, and for Chattahoochee-Oconee NF in GA.	4
38	Britton's Beargrass	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Ocala NF in FL.	4
39	Carolina Heelsplitter	LAA	NLAA	Francis Marion and Sumter National Forests,	See appendix for explanation of basis for changed effects determinations for NFs in SC. Species is not found on or near NFs in NC.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
				National Forests in North Carolina		
40	Conasauga Logperch	LAA	NLAA	Cherokee National Forest, Chattahoochee-Oconee National Forests	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN and for Chattahoochee-Oconee NF in GA.	4
41	Coosa Moccasinshell	LAA	NLAA	Chattahoochee-Oconee National Forests, Cherokee National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN and for Chattahoochee-Oconee NF in GA.	4
42	Cracking Pearlymussel	LAA	NE	Daniel Boone National Forest	Likely extirpated from the Daniel Boone NF.	4
43	Cumberland Bean Pearlymussel	LAA	NLAA	Cherokee National Forest, Daniel Boone National Forest, National Forests in North Carolina	See appendix for explanation of basis for changed effects determinations for NFs in NC, for the Daniel Boone NF in KY, and for Cherokee NF in TN.	4
44	Cumberland Elktoe	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
45	Cumberlandian Combshell	LAA	NLAA	Cherokee National Forest, Daniel Boone NF, National Forests in Alabama	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN, NFs in Alabama, and for Daniel Boone NF.	4
46	Dromedary Pearlymussel	LAA	NE	Daniel Boone National Forest	Likely extirpated from the Daniel Boone NF.	4
47	Duskytail Darter	LAA	NLAA	Cherokee National Forest,Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN and for Daniel Boone NF in KY.	4
48	Fanshell	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4
49	Fat Pocketbook	LAA	NLAA	Ozark-St Francis National Forest	See appendix for explanation of basis for changed effects determinations for Ozark St Francis NF in AR.	4
50	Fat Three-Ridge Mussel	LAA	NLAA	National Forests of Florida	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
51	Finelined Pocketbook	LAA	NLAA	Cherokee National Forest, Chattahoochee-Oconee National Forests, National	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN, NFs in Alabama, and for Chattahoochee-Oconee NF in GA.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
				Forests in Alabama		
52	Florida Bonamia	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Ocala NF in FL.	4
53	Florida Skullcap	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
54	Godfrey's Butterwort	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
55	Harper's Beauty	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
56	Hell Creek Cave Crayfish	LAA	NLAA	Ozark-St Francis National Forest	See appendix for explanation of basis for changed effects determinations for Ozark St Francis NF in AR.	4
57	Leopard Darter	LAA	NLAA	Ouachita National Forest	See appendix for explanation of basis for changed effects determinations for Ouachita NF in AR.	4
58	Lewton's Polygala	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Ocala NF in FL.	4
59	Littlewing Pearlymussel	LAA	NLAA	National Forests in North Carolina, Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for NFs in NC and for Daniel Boone NF in KY.	4
60	Louisiana Pearlshell	LAA	NLAA	Kisatchie National Forest	See appendix for explanation of basis for changed effects determinations for the Kisatchee NF in LA.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
61	Northern Riffleshell	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4
62	Ochlockonee Moccasinshell	LAA	NE	National Forests of Florida	Species is not found on or near the Apalachicola NF	4
63	Oval Pigtoe	LAA	NE	National Forests of Florida	Species is not found on or near the Apalachicola NF	4
64	Oyster Mussel	LAA	NLAA	Cherokee National Forest, Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN. Likely extirpated from the Daniel Boone NF.	4
65	Ozark cavefish	LAA	NLAA	Ozark-St. Francis National Forest	See appendix for explanation of basis for changed effects determinations for Ozark St Francis NF in AR.	4
66	Palezone Shiner	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4
67	Pallid Sturgeon	LAA	NLAA	Ozark-St. Francis National Forest, National Forests in Mississippi	See appendix for explanation of basis for changed effects determinations for NFs in MS and Ozark St Francis NF in AR.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
68	Pink Mucket	LAA	NLAA	Ozark-St Francis National Forest, Ouachita National Forest, Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Ozark St Francis and Ouachita NFs in AR, and for Daniel Boone NF in KY.	4
69	Purple Bankclimber Mussel	LAA	NLAA	National Forests of Florida	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
70	Rough Pigtoe	LAA	NLAA	Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Daniel Boone NF in KY.	4
71	Scaleshell Mussel	LAA	NLAA	Ozark-St Francis National Forest, Chattahoochee-Oconee National Forests	See appendix for explanation of basis for changed effects determinations for Ozark St Francis NF in AR and for Chattahoochee-Oconee NF in GA.	4
72	Scrub Buckwheat	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Ocala NF in FL.	4
73	Shinyrayed Pocketook	LAA	NE	National Forests of Florida	Species is not found on or near the Apalachicola NF	4
74	Smoky Madtom	LAA	NLAA	Cherokee National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN.	4
75	Snail Darter	LAA	NLAA	Cherokee National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
76	Southern Pigtoe	LAA	NLAA	Cherokee National Forest, Chattahoochee-Oconee National Forests, National Forests in Alabama	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN, NFs in Alabama, and for Chattahoochee-Oconee NF in GA.	4
77	Spotfin Chub	LAA	NLAA	National Forests In North Carolina	See appendix for explanation of basis for changed effects determinations for NFs in NC.	4
78	Tan Riffleshell	LAA	NLAA	Cherokee National Forest, Daniel Boone National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN and Daniel Boone NF in KY.	4
79	White Bird-in-a-nest	LAA	NLAA	FL forests	See appendix for explanation of basis for changed effects determinations for Apalachicola NF in FL.	4
80	Winged Maplefoot	LAA	NLAA	Ouachita National Forest	See appendix for explanation of basis for changed effects determinations for Ouachita NF in AR.	4
81	Yellowfin Madtom	LAA	NLAA	Cherokee National Forest	See appendix for explanation of basis for changed effects determinations for Cherokee NF in TN.	4

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
82	Appalachian Monkeyface	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
83	Birdwing Pearlymussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
84	Blackside dace	LAA	NLAA	George Washington and Jefferson National Forest	Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach habitat in a concentration that will affect this species, the effects of retardant use on this species are insignificant and discountable.	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
85	Cracking Pearlymussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
86	Cumberland Bean Pearlymussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
87	Cumberland darter	LAA	No effect	George Washington and Jefferson National Forest	Not located on George Washington and Jefferson National Forest in Kentucky or Virginia.	5
88	Cumberland Monkeyface	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
89	Cumberlandian Combshell	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
90	Dromedary Pearlymussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
91	Duskytail darter	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
92	Fanshell	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
93	Finerayed Pigtoe	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
94	Green Blossom	LAA	NLAA	George Washington and Jefferson National Forest	This species is believed to be extirpated from Virginia will not be affected by actions on the George Washington and Jefferson NF.	5
95	James Spinymussel	LAA	NLAA	George Washington and Jefferson National Forest	Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach habitat in a concentration that will affect this species, the effects of retardant use on this species are insignificant and discountable.	
96	Littlewing Pearlymussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
97	Oyster Mussel	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
98	Pink Mucket	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
99	Purple Bean	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
100	Roanoke logperch	LAA	NLAA	George Washington and Jefferson National Forest	Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach logperch habitat in a concentration that will affect this species, the effects of retardant use on this species are insignificant and discountable.	
101	Rough Pigtoe	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
102	Rough Rabbitsfoot	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
103	Sheepnose	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
104	Shiny Pigtoe	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
105	Slender Chub	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
106	Snuffbox	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
107	Spectacle case	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
108	Spotfin Chub	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
109	Tan Riffleshell	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
110	Yellowfin Madtom	LAA	NLAA	George Washington and Jefferson National Forest	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	
111	Blowout penstemon	NLAA	NLAA	Medicine Bow-Routt NF and Nebraska NF & Grassland	Our conclusion is based upon the following: 1) a small representation of the blowout penstemon occur on the Nebraska National Forest and Grasslands where the species could be in a position to be affected by the proposed action; 2) the species is primarily distributed across the Nebraska Sandhills--area size approximately 32,049 square km (12,374 square mi); and 3) the species' habitat (blowouts) is not likely to carry fires that would require the use of fire retardants.	6
112	Bonytail	LAA	NLAA	Manti-LaSal NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
113	Bonytail	LAA	NLAA	Uinta-Wasatch-Cache NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
114	Bonytail	LAA	NLAA	Ashley NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
115	Bonytail	LAA	No effect	Fishlake NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No consultation required for water depletions in these drainages; No water depletions anticipated	6
116	Bonytail	LAA	NLAA	San Juan NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
117	Bonytail	LAA	NLAA	Arapahoe and Roosevelt NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams,	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	
118	Bonytail	LAA	NLAA	White River NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
119	Bonytail	LAA	NLAA	Med-Bow Routt NR	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
120	Bonytail	LAA	NLAA	Bridger-Teton NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts to be likely; No consultation required for water depletions in these drainages; No water depletions planned	6
121	Colorado pikeminnow	LAA	NLAA	Manti-LaSal NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
122	Colorado pikeminnow	LAA	NLAA	Uinta-Wasatch-Cache NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
123	Colorado pikeminnow	LAA	NLAA	Ashley NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
124	Colorado pikeminnow	LAA	No effect	Fishlake NF	Streams on Fishlake NF do not drain to occupied or critical habitat for this species, nor do water depletions in these drainages require consultation	6
125	Colorado pikeminnow	LAA	NLAA	San Juan NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
126	Colorado pikeminnow	LAA	NLAA	Arapahoe and Roosevelt NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					bodies and mixed with retardant for use by aerial or ground delivery systems."	
127	Colorado pikeminnow	LAA	NLAA	White River NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
128	Colorado pikeminnow	LAA	NLAA	Med-Bow Routt NR	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
129	Colorado pikeminnow	LAA	NLAA	Bridger-Teton NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts to be likely; No consultation required for water depletions in these drainages; No water depletions anticipated	6
130	Heliotrope milkvetch	LAA	NLAA	Manti LaSal	Avoidance areas were mapped in coordination between the Forest Service and the USFWS (UT Field Office). The avoidance buffer designated for the species is 500ft from the edge of the three known populations and critical habitat. Therefore all existing occurrences are protected with avoidance mapping. The species occurs in high elevation (10,500 to 11,000 ft) limestone barrens derived	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					from the Flagstaff Geological Formation. These sparsely vegetated areas are not likely to carry a fire resulting in the initiation of an aerial fire retardant drop, nor are they likely to receive a fire retardant drop. Therefore there is a low probability of accidental drop of retardant and a low probability for misapplication on the Manti-LaSal NF.	
131	Humpback chub	LAA	NLAA	Manti-LaSal NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
132	Humpback chub	LAA	NLAA	Uinta-Wasatch-Cache NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
133	Humpback chub	LAA	NLAA	Ashley NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
134	Humpback chub	LAA	No effect	Fishlake NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No consultation required for water depletions in these drainages; No water depletions planned	6
135	Humpback chub	LAA	No effect	Dixie NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No consultation required for water depletions in these drainages; No water depletions planned	6
136	Humpback chub	LAA	NLAA	San Juan NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
137	Humpback chub	LAA	NLAA	Arapahoe and Roosevelt NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
138	Humpback chub	LAA	NLAA	White River NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
139	Humpback chub	LAA	NLAA	Med-Bow Routt NR	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
140	Humpback chub	LAA	NLAA	Bridger-Teton NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts to be likely; No consultation required for water depletions in these drainages; No water depletions anticipated	6
141	June sucker	LAA	NLAA	Uinta - Wasatch Cache NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
142	Kendall Warm Springs dace	LAA	NLAA	Bridger-Teton NF	We negotiated a wider avoidance area buffer of 0.5 mile around the dace's warm springs habitat. This greater distance should substantially reduce the risk of slightly inaccurate retardant drops in the area from affecting dace to the point we believe impacts are not likely to occur	6
143	Pallid Sturgeon	LAA	No effect	Bridger-Teton NF	The Forest is extremely distant from where the species occurs so there would be No Effect	6
144	Pallid Sturgeon	LAA	NLAA	Medicine Bow NF	The Forest boundary is too distant from occupied or critical habitat for retardant impacts	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
145	Razorback Sucker	LAA	NLAA	Manti-LaSal NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
146	Razorback Sucker	LAA	NLAA	Uinta-Wasatch-Cache NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
147	Razorback Sucker	LAA	NLAA	Ashley NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
148	Razorback Sucker	LAA	No effect	Fishlake NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No consultation required for water depletions in these drainages; No water depletions anticipated	6
149	Razorback Sucker	LAA	No effect	Dixie NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No consultation required for water depletions in these drainages; No water depletions anticipated	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
150	Razorback Sucker	LAA	NLAA	Arapahoe and Roosevelt NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
151	Razorback Sucker	LAA	NLAA	White River NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
152	Razorback Sucker	LAA	NLAA	Med-Bow Routt NR	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Colorado, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	6
153	Razorback Sucker	LAA	NLAA	Bridger-Teton NF	Forest Service boundary is too distant from occupied or critical habitat for retardant impacts to be likely; No consultation required for water depletions in these drainages; No water depletions anticipated	6
154	water howellia	LAA	NLAA	Idaho Panhandle NF	not present on FS	6
155	water howellia	LAA	NLAA	Clearwater NF	not prestent on FS	6

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
156	water howellia	LAA	NLAA	Medocino NF	likelihood of misapplication is discountable	6
157	water howellia	LAA	NLAA	Flathead NF	likelihood of misapplication is discountable	6
158	white sturgeon	LAA	NLAA	Kootenai and Idaho Pan Handle NF	Young life stages (eggs and young fish) that would be affected by retardant are not likely present in the Montana portion of the Kootenai River (L Lockard, FWS 2011).	6
159	Bakersfield cactus	NLAA	NLAA		See BA justification.	8
160	Braunton's milk-vetch	LAA	NE		Astragalus brauntonii is endemic to coastal southern California and only occurs in five disjunct geographic areas in Ventura, Los Angeles, and Orange Counties, California. These areas are (1) Simi Hills in eastern Ventura and western Los Angeles Counties; (2) eastern Santa Monica Mountains in Los Angeles County; (3) western Santa Monica Mountains near Pacific Palisades, Los Angeles County; (4) San Gabriel Mountains in Monrovia, Los Angeles County; and (5) Santa Ana Mountains in Orange County (CNDDB 2007 in USFWS 2009). There are currently 20 known occurrences; 6 of these (30 percent) are on private lands, 8 (40 percent) are on local agency lands (city and regional parks), 4 (20 percent) are on State lands (Topanga State Park, Chino Hills State Park, and Coal Canyon Ecological Reserve), and 2 (10 percent) are on Federal lands (Santa Monica Mountains National Recreation Area; CNDDB 2007 in USFWS 2009). None of the sites are on Forest Service System lands and therefore, the species and critical habitat do not occur within the action area and will not be affected by the proposed action.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
161	California condor	NLAA	NLAA		We expect that effects of retardant use on National Forest System lands will be discountable to California condors because (1) the Forest Service will place 600 ft avoidance buffer zones around known condor nesting sites and maps of these sites will be provided to fire-fighting personnel; (2) if a wildfire occurs in condor historical nesting habitat and condors aren't currently using those sites, the Forest Service will apply retardant to protect those sites rather than let the trees burn (especially the giant sequoias and redwoods that condors have used in the past and recently); (3) during condor nesting season, the Forest Service will not allow trees that condors use for nesting to burn if the condors aren't currently using them; (4) the Forest Service will employ the avoidance buffers around nests only when the nests are active; and (5) the Forest Service will place a ¼-mile avoidance buffer around condor hacking sites, which are holding pens and release sites for condors in the wild.	8
162	California red-legged frog CH	NE	NLAA		Fire retardant is not anticipated to adversley affect designated critical habitat due to potential effects on PCE's and essential features being considered short-term and/or insignificant.	8
163	California taraxacum CH	NLAA	NLAA		1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
164	California tiger salamander	LAA	NLAA	Sierra NF	Although data on the toxicity of fire retardant to adult amphibians is lacking, given the low retadant use on the Sierra National Forest and that fire retardant is most likely to be applied at a time of year when Calafornia tiger salamanders are utilizing underground refugia, the potential for fire retadant to affect the terrestrial stage of this species is discountable. Although fire retardant has been demonstrated to be fatal to aquatic vertebrates, given the low retardant used on the Sierra National Forest, and that retardant will most likely be applied during the time of year when larval salamanders have already undergone metamorphosis and have migrated into upland areas, the potetnial for fire retardant to affect the aquatic life stage of this species is discountable.	8
165	Coastal California gnatcatcher	LAA	NLAA		There is a low likelihood of toxicological effects to the gnatcatcher due to the mobility of this species; 2) the breeding season for the gnatcatcher (late February through July) is generally outside the primary fire season in southern California (August to October), when most fire retardant would be applied; 3) low amounts of fire retardant are applied annually compared to the extent of Forest Service land (USFS 2011); 4) maps of gnatcatcher habitat will be provided to fire-fighting personnel and these areas will be avoided, to the extent feasible; and 5) low levels of misapplications have occurred in past applications. Finally, low numbers of gnatcatchers occur on Forest Service lands in southern California. The Forest Service estimates about 692 ac (280 ha) of occupied habitat occurs on the Cleveland National Forest, although only 5-8 pairs have recently been found there	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					(USFWS 2005a).	
166	Coastal California gnatcatcher CH	NLAA	NLAA		There is a low likelihood of toxicological effects to the gnatcatcher due to the mobility of this species; 2) the breeding season for the gnatcatcher (late February through July) is generally outside the primary fire season in southern California (August to October), when most fire retardant would be applied; 3) low amounts of fire retardant are applied annually compared to the extent of Forest Service land (USFS 2011); 4) maps of gnatcatcher habitat will be provided to fire-fighting personnel and these areas will be avoided, to the extent feasible; and 5) low levels of misapplications have occurred in past applications. Finally, low numbers of gnatcatchers occur on Forest Service lands in southern California. The Forest Service estimates about 692 ac (280 ha) of occupied habitat occurs on the Cleveland National Forest, although only 5-8 pairs have recently been found there (USFWS 2005a).	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
167	Conservancy fairy shrimp	LAA	NLAA	Los Padres NF	The breeding season is outside of the fire season and does not overlap. The life span of the shrimp is Dec. - May and the fire season where the shrimp is located in the forest is later due to the higher elevation. The effects of fire on the cysts are expected to be discountable as they are very resilient and are dormant during the fire season.	8
168	Conservancy fairy shrimp CH	LAA	NLAA		The PCEs for this species are not likely to be adversely affected by any retardant within the designated critical habitat.	8
169	Cushenbury Buckwheat, Cushenbury Milk-vetch, Parish's Daisy, San Bernardino Mountains Bladderpod, Munz's Onion, Nevin's Barberry, San Diego Thornmint, Thread-leaved Brodiaea, Quino Checkerspot Butterfly, and Laguna Mountains Skipper CH	NLAA	NLAA		1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
170	Cushenbury Oxytheca CH	NLAA	NLAA		1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats.	8
171	giant kangaroo rat	NLAA	NLAA		See BA justification.	8
172	June sucker CH	LAA	NLAA		Forest Service boundary is too distant from critical habitat for retardant impacts; No water depletions associated with retardant application - "For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by aerial or ground delivery systems."	8
173	Kern primrose sphinx moth	LAA	NLAA	Los Padres NF	We have determined that the proposed project is not likely to adversely affect Kern primrose sphinx moths or their critical habitat for the following reasons: (1) the adult moth flight season (January to early April) is well before typical fire season in late summer and early fall; (2) instars would be underground in summer and fall so are unlikely to be affected by wildfire or retardant drops; (3) instars spend several years in diapause buried in loose soil and their emergence is correlated to wet years (i.e. instars would come out in the springtime when weather and habitat are relatively moist, again not during fire season); and (4) the fairly wide distribution of suitable habitat on the Los Padres National Forest is in	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					sandy wash areas, well below elevations where retardant would be dropped.	
174	Kern primrose sphinx moth CH	NLAA	NE		No critical habitat has been designated for this species	8
175	least bell's vireo	NLAA	NLAA		1) there is a low likelihood of toxicological effects to the vireo due to the mobility of the species; 2) low amounts of fire retardant are applied annually compared to the extent of Forest Service land (USFS 2011); 3) maps of vireo habitat will be provided to fire-fighting personnel and these areas will be avoided, to the extent feasible; 4) low levels of misapplications have occurred in past applications; and 5) most vireos will likely have fledged by the primary fire season in southern California (August-October).	8
176	Little Kern Golden Trout CH	LAA	NLAA		Fire retardant is not anticipated to adversley affect designated critical habitat due to potential effects on PCE's and essential features being considered short-term and/or insignificant.	8
177	McDonald's rock-cress	NLAA	NLAA		(addtl to BA justifications): nutrient load as a result of drop within habitat expected to be short-term, due to predominately steep rocky terrain and well-drained character of soils; potential for exotic species invasion	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					judged relatively low on serpentine substrate, particularly in this terrain.	
178	Mountain yellow-legged frog	LAA	NLAA		1) low amounts of fire retardant are applied annually compared to the extent of Forest Service land (USFS 2011); 2) areas of mountain yellow-legged frog habitat will be buffered by a 600-foot (182-m) avoidance zone that is focused on its habitat, which is an increase from the previous 300-foot (91-m) generic avoidance zone from aquatic systems and should decrease the potential for a misapplication; 3) the mountain yellow-legged frog tends to occur in small, isolated areas and at the headwaters of streams, making it less likely that fire retardant will enter into habitat for this species from upstream or that applications will occur that are necessary to protect human life; 4) low levels of misapplications have occurred in past applications, in general; and 5) despite several wildfires proximal to or within mountain yellow-legged frog habitat, confirmed fire retardant applications in mountain yellow-legged frog habitat have not been reported since the listing of this species in 2002.	8
179	Peninsular bighorn sheep	NLAA	NLAA		Nitrate absorption by plants tends to occur only under certain circumstances such as under low light conditions and high temperatures or when drought occurs late in the growing season. In addition, the potential for nitrate poisoning lasts only a few weeks (Dodge 1970). Further, Peninsular bighorn sheep make only limited use of Forest Service lands and application rates of fire retardants are relatively low. Based on data from 2000-2010, the San	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					Bernardino National Forest averaged 315 acres (ac) (127 hectares (ha)) of fire retardant applications per year over 677,628 ac (274,226 ha) of Forest Service land (USFS 2011).	
180	San Bernadino bluegrass CH	NLAA	NLAA		1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats.	8
181	Santa Ana River woolly-star	LAA	NLAA		Species not known to occur within the action area.	8
182	Sierra Nevada bighorn sheep	NLAA	NLAA		According to the supporting information provided by the USFS, fire retardant chemicals may be toxic to ruminants because retardant application can result in high nitrate levels in plants. The increase in nitrate levels could result in nitrate poisoning of Sierra Nevada bighorn sheep that graze on affected plants. Nitrate poisoning could occur after fire retardants enter the soil, are converted to nitrates and then are absorbed by plants (Dodge 1970). However, absorption by plants tends to occur only under certain circumstances such as under low light conditions and high temperatures or when drought occurs late in the growing season. In addition, the potential for nitrate poisoning lasts only a few weeks (Dodge 1970). We expect that effects of retardant use on National Forest	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					System lands will be discountable to Sierra Nevada bighorn sheep based on the following reasons: (1) the likelihood of Sierra Nevada bighorn sheep would be in an area where a fire retardant drop would occur is low because they typically inhabit steep, open terrain, where fire retardant would be of little use; (2) Sierra Nevada bighorn sheep may be in lowland areas in winter; however, fires are unlikely during that time of year; (3) if retardant was accidentally dropped on an area where Sierra Nevada bighorn sheep were located, some individual Sierra Nevada bighorn sheep could be affected but the effect of retardant chemicals on ruminants is related to length and quantity of exposure and we do not anticipate that individual animals would experience the quantity and duration of exposure necessary to elicit a toxicological effect. Thus, we concur that Sierra Nevada bighorn sheep are not likely to be adversely affected by the proposed action.	
183	Southern Mountain buckwheat CH	NLAA	NLAA		1) low amounts of fire retardant are dropped annually compared to the extent of Forest Service land (USFS 2011); 2) the Forest Service will map and avoid application of fire retardant to these areas, to the extent feasible; and 3) the typical fire retardant application (about 1-1.5 ac ((0.4-0.6 ha)) would cover a small amount of any of these designated or proposed critical habitats.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
184	Tidewater goby CH	LAA	NLAA		Indirect effects to tidewater goby critical habitat would come primarily from misapplications of retardant on Forest Service lands over the next 10 years that may expose the primary constituent elements of tidewater goby critical habitat to diluted toxic chemicals carried downstream, leading to habitat degradation from eutrophication processes. Approximately 5 critical habitat units are within 6.2 miles of the Los Padres National Forest and Six Rivers National Forest boundaries could potentially be affected: Lake Earl/Talawa in Del Norte County and the following in Santa Barbara County: Gaviota Creek, Mission Creek/Laguna Channel, Arroyo Burro, and Winchester/Bell Canyon. Based on our analysis for adverse effects to the occupied habitat, we expect 91 percent of occupied habitat for tidewater gobies throughout the species range to continue to support tidewater gobies and to accommodate any population recolonization or expansion the species experiences. Likewise, the effects of retardant use on Los Padres National Forest lands will be discountable to the primary consituent elements of critical habitat for tidewater gobies because none of the critical habitat units are within the action area of the project and only a small portion of critical habitat for the species throughout its range will be indirectly affected.	8
185	triple-ribbed milk-vetch	LAA	NLAA		Species not known to occur within the action area.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
186	Vernal pool fairy shrimp	LAA	NLAA	Los Padres NF	The breeding season is outside of the fire season and does not overlap. The life span of the shrimp is Dec. - May and the fire season where the shrimp is located in the forest is later due to the higher elevation. The effects of fire on the cysts are expected to be discountable as they are very resilient and are dormant during the fire season.	8
187	vernal pool tadpole shrimp	LAA	NLAA		The breeding season is outside of the fire season and does not overlap. The life span of the shrimp is Dec. - May and the fire season where the shrimp is located in the forest is later due to the higher elevation. The effects of fire on the cysts are expected to be discountable as they are very resilient and are dormant during the fire season.	8
188	Yreka phlox	LAA	NLAA		Yreka phlox is endemic to serpentine soils. Suitable habitat does not have fuel ladders, decadent shrub canopies, or other heavy accumulations of fuels. Therefore, suitable habitat is considered a natural barrier where fire retardant is not used. From 2000 to 2008, all fires on Soap Creek Ridge were suppressed with helicopter water drops on single lightning-ignited pine trees until local fire crews could be deployed. The spur ridges on Soap Creek Ridge would not be used as anchor points.	8

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
189	Ouachita rock pocketbook	LAA	NLAA	Ouachita National Forest	See appendix for explanation of basis for changed effects determinations for Ouachita NF in AR.	4
190	Rayed Bean	LAA	NLAA	George Washington and Jefferson National Forests	This species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. Based on information from GWJNF, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. The forest types in the GWJNF (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. Consequently, taking into account the combination of the infrequent, small, and low intensity	5

Number	Species or Critical Habitat (CH)	Original USFS determination	USFWS final determination	Applicable area	Justification	USFWS Region (see appendix A)
					wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.	

Appendix C. Region 1 Analytical Frameworks

USFWS Pacific Region, Portland, Oregon

Nationwide Aerial Application of Fire Retardant on National Forest System Land: Justifications for Changed Determinations

Kincaid's lupine (*Lupinus oreganus* var. *kincaidii*)

In the action area, Kincaid's lupine (*Lupinus oreganus* var. *kincaidii*) is known to occur on Umpqua National Forest. The occurrence on the Umpqua National Forest is on a low ridge in a wildland urban interface directly adjacent to private land. The risk of retardant drops on ridgelines formed the basis for the Forest Service's (FS) may effect, likely to adversely affect determination. However, the following factors have led us to determine that the proposed action is not likely to adversely affect *Lupinus oreganus* var. *kincaidii*.

Large fires are unlikely to occur in next ten years in the small 0.3-acre area where the species occurs on the Umpqua Forest. Only a very small percentage of land is expected to have fire retardant applied to it annually (less than 0.025% by any individual forest). Furthermore, fuel loads are not very high due to a recent thinning project adjacent to 0.3-acre occurrence. Water is often used in area to control the smaller, more frequent fires that may occur on the Forest. A 300-foot retardant use avoidance area has been mapped around known species occurrences on the Umpqua National Forest. In conclusion, it is our determination that the proposed action may effect, but is not likely to adversely affect *Lupinus oreganus var. kincaidii*.

Wenatchee Mountains checker-mallow (*Sidalcea oregana* var. *calva*)

In the action area, Wenatchee Mountains checker-mallow (*Sidalcea oregana* var. *calva*) is know from two populations on or immediately adjacent to the Okanogan-Wenatchee National Forest. The FS based its may effect, likely to adversely affect determination for *Sidalcea oregana var. calva* on historical use of retardant in the past which has been more than 0.01% annually on Okanagan-Wenatchee combined with the fact that the species occurs in small isolated population increasing the risk that unknown occurrences may be hit with retardant or that invoking an exception to the guidelines could occur. However, the following factors have led us to determine that the proposed action may effect, but is not likely to adversely affect *Sidalcea oregana var. calva*.

A modified project description was delivered via a September 14, 2011, email sent from Mr. Mark Skinner, Regional Botanist of the Forest Service's Region 6, to Mr. Daniel Brown, U.S. Fish and Wildlife Service's Region 1. The record of this email in our files is sufficient to establish a commitment by the FS to this change in the project description of the proposed action. The following changes were made. Mapped avoidance areas have been expanded for *Sidalcea* and its designated critical habitat to a distance of 0.5-mile. With this expanded avoidance area in place, the potential for retardant misapplication to impact *Sidalcea* is extremely unlikely to occur for the following reasons.

Misapplication resulting from pilot error, encroaching into the edge of the avoidance area (edge) is extremely unlikely to occur due to the moderately steep terrain associated with the edge of the avoidance area and the heavy fuel concentrations; fire retardant application would simply be too difficult to apply and its effectiveness would be very low in heavy fuels. Misapplication from pilot error that leads to direct exposure from accidental or intentional drop inside the avoidance area (core) is also extremely unlikely for both of the reasons stated above. In conclusion, it is our determination that the proposed action may effect, but is not likely to adversely affect *Sidalcea oregana var. calva*.

Oregon chub (*Oregonichthys crameri*)

In the action area, Oregon Chub (*Oregonichthys crameri*) is known from eight sites, totaling approximately 24 acres in the Middle Fork Willamette River subbasin that occur within the boundaries of the Willamette NF. One Oregon chub site (1.8 acres) within the Coast Fork Willamette River subbasin is located within the boundaries of the Umpqua NF. The FS has established 300-foot avoidance areas around known occurrences for this species and its critical habitat.

None of the small fires of the past ten years required aerial applications of fire retardant in the vicinity of Oregon chub habitat. It is unknown whether aerial applications would be necessary for future fires. Typically, however, if fire retardant is used it would be applied at or near the ridgeline. This is a safe distance from Oregon chub habitat.

Based on information presented in the BA, the 302 retardant drops are expected to occur during the ten year timeframe of this consultation in the 1.6-million acre Willamette NF. Nationally, forests have a 0.42 percent chance of misapplication in waterbodies. Assuming the same rate of misapplications, we would expect to see 1.3 misapplications in the Willamette NF over the next ten years. Fewer than two misapplications (on average) affecting an area of 1.4 acres over a 10-year period on the Willamette NF, which encompasses 1.6 million acres, is extremely unlikely to impact Oregon chub habitat encompassing less than 24 acres.

Less than one misapplication (on average) affecting an area of 1.4 acres over a 10-year period on the Umpqua NF, which encompasses 1 million acres, is extremely unlikely to impact Oregon chub habitat encompassing less than 2 acres.

Given the size of the areas subject to misapplication and the size of Oregon chub-occupied areas within these two National Forests, what would be very atypical use of fire retardant in areas occupied by Oregon chub, and the extra protection afforded by 300-foot avoidance areas, the likelihood of adverse effects caused by the proposed action is extremely unlikely to occur and therefore discountable. In conclusion, it is our determination that the proposed action may effect, but is not likely to adversely affect the Oregon chub.

Oregon chub critical habitat

Within the action area, critical habitat is only designated within the Willamette NF. Two misapplications affecting an area of 1.4 acres over a 10-year period on the Willamette NF, which encompasses 1.6 million acres, are not likely to impact chub critical habitat encompassing 16.5 acres. Given the size of the areas subject to misapplication and the size of chub critical habitat within this National Forest, what would be very atypical use of fire retardant in areas designated as Oregon chub critical habitat, and the extra protection afforded by 300-foot avoidance areas for Oregon chub critical habitat, adverse effects caused by the proposed action are discountable. In conclusion, it is our determination that the proposed action may effect, but is not likely to adversely affect Oregon chub critical habitat.

Northern spotted owl critical habitat

Critical habitat for the northern spotted owl comprises forest types that support spotted owls across the range that occur in concert with either nesting, roosting, foraging habitat or dispersal habitat. Spotted owl critical habitat comprises 23% of the Forest Service acres within the range of the northern spotted owl. The Forest Service BA notes that retardant drops may damage the forest canopy. This would result in damage to PCEs listed above. Additional alteration of the PCEs may occur as a result of the effects of the ammonium sulfates and organic polysaccharides that can kill leaves as addressed in the BA. Leaf death could result in a decrease in canopy cover, which is a PCE listed above. Therefore, we can not conclude that there is no effect to northern spotted owl critical habitat as was suggested in the Forest Service BA.

We do believe the likely effects associated with retardant drops are insignificant, however, and is therefore not likely to adversely affect northern spotted owl critical habitat for the following reasons. Retardant drops cover a small footprint on the landscape. Typical drops are 50-75 feet wide and up to 800 feet long, according to the BA (p. 14). This results in a drop footprint of 1.4 acres. Retardant drops that damage forest canopy from the force of impact tend to be the exception and not the rule. Potential damage at that scale is not expected to change the functionality of critical habitat. Damage to the forest canopy from needle death would be short term, with new needles growing in the following year. Furthermore, the agent responsible for the needle death is found in only one of the retardants used by the Forest Service, and that retardant is being phased out. In conclusion, it is our determination that the proposed action may effect, but is not likely to adversely affect northern spotted owl critical habitat.

Nationwide Aerial Application of Fire Retardant on National Forest System Land: Justifications for NLAA Concurrences

Gentner Mission Bells (*Fritillaria gentnerei*)

The USFS BA presented the following justification for their may effect, not likely to adversely affect determination for Gentner mission bells (*Fritillaria gentnerei*). Fires mostly occur in this forest after this species has completed its annual growth and is beginning summer dormancy, and since the plant grows from a bulb in a fairly broad range of microsite conditions, it is presumably not sensitive to the retardant salts or changes in the environment that the retardant could cause so retardant is not likely to adversely affect individuals or populations.

Our assessment follows. Rangewide, *Fritillaria gentnerei* occurs over a 2,500 square mile area in 2 southwest Oregon counties (Jackson and Josephine) and Siskiyou County in northern California. The species covers an area roughly of approximately 333 acres. The two population sites on the Rogue River – Siskiyou National Forest cover approximately 0.25 acres or 0.08 percent of the total species' range.

Fires typically occur from late May to September. The *Fritillaria gentnerei* growing season is from February through June, but in the Rogue River National Forest *Fritillaria gentnerei* populations, the dormant season begins in mid-May. Therefore the fire and growing season windows overlap minimally. With a relatively small risk of early season fires, it is unlikely fire retardant will be dropped on a population during the plant's growing season.

Large fires in next 10 years (when retardant would be applicable) in the two small areas where the fritillary occurs (0.25 acres, collectively) would be extremely unlikely given that only a very small percentage of land is expected to have fire retardant applied to it annually (less than 0.025% by any individual forest). Water is more often used in the areas to control smaller, more frequent fires. Weeds are unlikely to become established as a result of a single retardant drop in one year and populations outside of the Jacksonville area, especially of areas within the forest, are not as stressed by competition of invasive noxious weeds, such as yellow starthistle (*Centaureum solstitialis*) and Scotch broom (*Cytisus scoprarius*).

In conclusion, based on the factors presented above, we concur with the FS determination that the proposed action may effect, but is not likely to adversely affect *Fritillaria gentnerei*.

Northern Idaho ground squirrel (*Spermophilius bruenneus bruenneus*)

The USFS BA presented a screening process for determining that the proposed action is unlikely to adversely affect small mammals, including northern Idaho ground squirrel (*Spermophilius bruenneus bruenneus*) (NIDGS). The basis for the FS' NLAA determination is ground squirrel species are fossorial and can avoid direct impacts from the potential use for aerial application of fire retardant by retreating to burrows underground. In addition, the BA suggested high use of aerial application of fire retardant and high potential for NIDGS occupied habitat areas on the Boise National Forest will be offset by avoidance mapping when areas are determined occupied. This mitigation measure of avoiding occupied NIDGS sites when using aerial retardant is consistent with the Payette National Forest's BA for the action of fire management activities that resulted in our concurrence that the use of retardant in this manner may effect, but is not likely to adversely affect the NIDGS.

There are 2,300 acres of known occupied habitat for the northern Idaho ground squirrel. Of those 2,300 acres, 1,025 acres, approximately 45% of known occupied habitat, occur on the Payette National Forest. Avoidance mapping of all currently occupied habitat will minimize potential adverse effects to the species. Northern Idaho ground squirrel occupied habitat areas on the Boise National Forest will receive avoidance mapping when areas are determined occupied. According to the BA, typical retardant swath widths and lengths varies based on delivery of aircraft, but on average is 50-74 feet by up to 800 feet long. The Payette National Forest averages 92 fire retardant drops a year (the Forest is 2,424,840 acres) and, according to the BA, estimated acres of retardant applied averages 196 acres. Based on the number of acres that receives retardant on the Forest each year, and the avoidance mapping of occupied habitat, the unlikelihood of misapplication into that avoidance area, the potential for northern Idaho ground squirrel to be adversely affected by the action is discountable. Effects will be considered insignificant. Fire Management Actions, including the use of fire retardant, on the Payette National Forest was also considered and consulted upon in 2009, and concurrence of NLAA was provided by the Service at that time.

In conclusion, based on the factors presented above, we concur with the FS determination that the proposed action may effect, but is not likely to adversely affect the northern Idaho ground squirrel.

Woodland Caribou (*Rangifer tarandus caribou*)

The USFS BA presented a screening process for determining that the proposed action is unlikely to adversely affect large mammals, including woodland caribou (*Rangifer tarandus caribou*). The basis for the FS' NLAA determination is caribou is large and highly mobile.

The mountain ecotype of woodland caribou, to which the Selkirk Mountains population belongs, occurs in high elevation (generally above 4,000 feet elevation), steep terrain of the mountainous southeastern and east-central portions of B.C., and the Selkirk Mountains of northern Idaho and northeastern Washington. Mountain caribou are closely tied to old-growth coniferous forests of the Interior Wet-belt ecosystem of B.C. and the United States. This caribou ecotype primarily occupies old-growth cedar/hemlock and spruce/fir forests that typically have high snow levels. Suitable habitat is defined as old-growth forests (at least 150 years old) which support abundant arboreal lichens.

Although woodland caribou are considered present within the action area, their numbers are extremely low (estimated at approximately 45 individuals) and most of the population generally occupies habitat in British Columbia. According to the BA, typically retardant swath widths and lengths varies based on delivery aircraft but on average is 50-75 feet wide by up to 800 feet long. Additionally, according to the BA, estimated acres of retardant applied per forest ranges between 1 to 367 acres (less than 0.0025 percent) of Forest Service land annually. Thus, given the low numbers of caribou, coupled together with their mobility and the limited scope of area potentially affected by aerial fire retardant drops, the potential for caribou to be directly affected is discountable. Similarly, the limited frequency of fire retardant drops and limited area potentially affected through such actions have little ability to effect any significant habitat changes that would result in significant indirect effects to the species.

Furthermore, fire retardant drops, to the extent they reduce the overall area impacted by wildfire may indirectly beneficially affect caribou.

In conclusion, based on the factors presented above, we concur with the FS determination that the proposed action may effect, but is not likely to adversely affect the Woodland Caribou.

Wenatchee checker-mallow critical habitat

The USFS BA presented the following justification for their may effect, not likely to adversely affect determination for Wenatchee checker-mallow (*Sidalcea oregana* var. *calva*) critical habitat. Critical habitat for this species has been mapped with a 300-foot avoidance area. The primary constituent elements for this species includes: surface water or saturated upper soil profiles; a wetland plant community dominated by native grasses and forbs, and generally free of woody shrubs and conifers, would produce shade and competition for *Sidalcea oregana* var. *calva*; seeps and springs on fine textured soils (clay loams and silt loams), which contribute to the maintenance of hydrologic processes necessary to support meadows which remain moist into the early summer; and elevations of 488–1,000 m (1,600– 3,300 ft) (66 FR 46536-46548). Impacts to PCE's are expected to be minor and may be affected but not likely to be adversely affected.

Our assessment follows. The potential for impacts to designated critical habitat for *Sidalcea oregana* var. *calva* are discountable for many of the same reasons as presented in the species analysis, but is also insignificant. The primary constituent elements of designated critical habitat for *Sidalcea oregana* var. *calva* are mainly associated with the hydrology (i.e., maintaining surface water and saturated upper soil profiles), species composition of a wetland plant community (i.e., one that is native and has minimal shade and competitive effects), and seeps and springs that support wet meadow hydrological processes. Fire retardant misapplication is not expected to have any effect on the hydrology of designated critical habitat for *Sidalcea oregana* var. *calva*.

In conclusion, based on the factors presented above, we concur with the FS determination that the proposed action may effect, but is not likely to adversely affect designated critical habitat for *Sidalcea oregana* var. *calva.*

Appendix D. Region 2 Analytical Frameworks

This explains how to move forward with the fire retardant consultation. We will be using Table 1 out of the bulltrout template, in which you adjust the number of retardant drops for each forest provided in the BA by dividing the total number of retardant drops by 11 years and multiplying by 10 years. This gets you to an estimate for the proposed life of the action of 10 years (whereas the BA reported 11 years). Then you take that number and multiply it by 0.42, the number of drops expected to enter waterways. This is what got me to the "1" for the Apache-Sitgreaves. EX: A-S had 390 drops. 390/11 = 35.454545 etc. x 10 = 354.5 expected fire retardant drops in 10 years. 354.5 x.0042 = 1.4890908. So, I'm rounding up to 2 anticipated misapplications for the A-S.

Key points:

- Spell out all of your assumptions and make note of any weaknesses/shortcomings, use of worse case scenario, etc.
- As far as take versus reinitiation triggers, we could use the multiplier of 0.42 as the proposed action, as this is the figure they provide in the BA. So that gives the Apache-Sitgreaves the 2, and any misapplications beyond that would trigger reinitiation. I am going to use 6.2 miles of habitat as my take statement for each mile. So, for the Apache-Sitgreaves example, any habitat take beyond that 12.4 miles would be an exceedance of take.

Appendix E. Region 4 Analytical Frameworks

CTFO—Cherokee National Forest

May Affect—Not Likely to Adversely Affect Determinations

The Cookeville Tennessee Field Office (CTFO) discussed additional avoidance measures with the U.S. Forest Service for the Cherokee National Forest in areas where 14 aquatic species are present. The trend in the use of fire retardant on the Cherokee NF has been decreasing in the past decade (Jim Herrig, Cherokee National Forest pers. comm. 2011). These additional commitments, combined with the low likelihood of fire retardant use allows the CTFO to concur with a May Affect—Not Likely To Adversely Affect determination for these 14 aquatic species. The CTFO recognizes, however, that in the rare instance that fire retardant was used on Cherokee NF there could be unavoidable, detrimental effects to listed species. A brief reasoning for MA—NLAA determinations is provided below.

Appalachian elktoe (*Alasmidonta raveneliana)*

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Nolichucky River mainstem from the NC/TN state line to Chestoah; the standard 300-foot avoidance area would apply to Nolichucky River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Cumberland combshell (*Epioblasma brevidens*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Nolichucky River mainstem from the NC/TN state line to Chestoah; the standard 300-foot avoidance area would apply to Nolichucky River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected

3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Oystermussel (*Epioblasma capsaeformis*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Nolichucky River mainstem from the NC/TN state line to Chestoah; the standard 300-foot avoidance area would apply to Nolichucky River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Tan riffleshell (*Epioblasma walkeri*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Hiwassee River mainstem from the U.S. Highway 411 crossing upstream to the NC/TN state line; the standard 300-foot avoidance area would apply to Hiwassee River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Fine-lined pocketbook (*Lampsilis altilis*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line; the standard 300-foot avoidance area would apply to Conasauga River tributaries.

2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Coosa moccasinshell (*Medionidus parvulus)*

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line; the standard 300-foot avoidance area would apply to Conasauga River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Southern pigtoe (*Pleurobema georgianum*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line; the standard 300-foot avoidance area would apply to Conasauga River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Cumberland bean (*Villosa trabalis*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Hiwassee River mainstem from the U.S. Highway 411 crossing upstream to the TN/NC state line; the standard 300-foot avoidance area would apply to Hiwassee River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Blue shiner (*Cyprinella caerulea*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line; the standard 300-foot avoidance area would apply to Conasauga River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Duskytail darter (*Etheostoma percnurum = sitikuense*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Citico Creek mainstem from the Cherokee National Forest boundary upstream to one mile upstream of the mouth of Barkcamp Creek and Tellico River mainstem from the Cherokee National Forest boundary to the Tellico Plains/Robinsville Road and Tellico River Highway split; the standard 300-foot avoidance area would apply to Citico Creek and Tellico River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Smoky madtom (*Noturus baileyi*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Citico Creek mainstem from the Cherokee National Forest boundary upstream to one mile upstream of the mouth of Barkcamp Creek and Tellico River mainstem from the Cherokee National Forest boundary to the Tellico Plains/Robinsville Road and Tellico River Highway split; the standard 300-foot avoidance area would apply to Citico Creek and Tellico River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Yellowfin madtom (*Noturus flavipinnis*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along the Citico Creek mainstem from the Cherokee National Forest boundary upstream to one mile upstream of the mouth of Barkcamp Creek and Tellico River mainstem from the Cherokee National Forest boundary to the Tellico Plains/Robinsville Road and Tellico River Highway split; the standard 300-foot avoidance area would apply to Citico Creek and Tellico River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Conasauga logperch (*Percina jenkinsi*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line; the standard 300-foot avoidance area would apply to Conasauga River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Snail darter (*Percina tanasi*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

1. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along Hiwassee River mainstem from U.S. Highway 411 crossing upstream to the NC/TN state line; the standard 300-foot avoidance area would apply to Hiwassee River tributaries.
2. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
3. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

Amber darter (*Percina antesella*)

A May affect–Not Likely to Adversely Affect determination can be reached because of the following:

4. Avoidance areas were expanded beyond the 300-foot stream buffer to a 500-foot avoidance area along Conasauga River mainstem from the Cherokee National Forest boundary upstream to the TN/GA state line;

the standard 300-foot avoidance area would apply to Conasauga River tributaries.

5. All fire crews will perform ground reconnaissance to verify that missed applications do not occur or if they occur stream water quality has not been adversely affected
6. Annual meetings (if fire retardant drops do take place) will take place to discuss results of water quality sampling.

The effects of aerial fire retardant application on listed mussels and fish on the Chattahoochee-Oconee National Forests

The U.S. Forest Service's (USFS) most recent (August 2011) Biological Assessment (BA) regarding the use of aerially-applied fire retardants, made a determination that the activity is likely to adversely affect the federally-listed finelined pocketbook (*Lampsilis altilis*), scaleshell mussel (*Leptodea leptodon*), Coosa moccasinshell (*Medionidus parvulus*), southern pigtoe (*Pleurobema georgianum*), blue shiner (*Cyprinella caerulea*), cherokee darter (*Etheostoma scotti*), amber darter (*Percina antesella*), Conasauga logperch (*Percina jenkinsi*) on the Chattahoochee-Oconee National Forest (Forest). The U.S. Fish and Wildlife Service's (Service's) Georgia Field Office has worked closely with the Forest to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential impacts to listed species. After reviewing information provided by the Forest in Georgia, we concurred with their "not likely to adversely affect" determinations for these species.

The susceptibility of southern Appalachian forests to fire is less than many other forest types in the country. The forest types (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, and high rates of decomposition naturally reduce fuel loads. In addition to the resulting lower prevalence of wildfires, these same factors tend to result in less intense fire behavior and smaller wildfires. Additionally, the forest are characterized by deep coves and folded topography (and thus a greater percentages of mesic forest) and have even fewer fires than other parts of the Southern Appalachians. The Forest has not used arial fire retardants in the last 10 years and does not expect to use retardants in the future. In the event that arial fire retardant is used Section 7 consultation will be re-initiated and post-application water quality testing combined with visual surveys will be conducted. Surveys will document changes in mortality levels of aquatics and would asses whether fire retardant entered water bodies on the Forest.

Taking into account the combination of standard forest management via prescribed fire and low intensity seasonal wildfires; extremely low historic and predicted need for and use of retardant; and the low probability of misapplication in locations and amounts that would affect listed species, the expected effects of on these listed species would be insignificant and discountable.

PCFO- Panama City Field Office, Florida

Likely to Adversely Affect to Not Likely to Adversely Affect Determinations:

Four Listed Plants: Apalachicola National Forest and Two Listed Freshwater Mussel Species

Plants

The U.S. Forest Service Biological Assessment (BA) originally made a determination that use of aerially applied fire retardants is " likely to adversely affect"(LAA) federally listed plants species on the Apalachicola National Forest (NF) including Harper's beauty (*Harperocallis flava*), Godfrey's butterwort (*Pinguicula ionantha*), White birds-in-a-nest (*Macbridia alba*) and Florida skullcap (*Scutellaria floridana*). The U.S.F.W.S. Office in Panama City Florida (PCFO) has been working closely with the National Forests in Florida (NFF) and Apalachicola National Forest staff to further evaluate the effects of the proposed action and to clarify the discussion provided in the BA for these species.

We revisited the "Analysis Process" discussed on pages 20-20 and pages 38-41 in the BA and how the process applies to these species. On 08/15/2011 NFF requested that the effects determination for the 4 plants species be changed to "not likely to adversely affect" (NLAA) (e-mail from Micah Thorning NFF staff biologist to Stan Simpkins JAFO biologist and Harold Mitchell PCFO biologist). The U.S.F.W.S. JAFO, PCFO and NFF (including the staff of the Apalachicola NF) have concluded the appropriate determination of effects for these species is NLAA for the reasons discussed below:

The NFF estimates that 58 acres of its landbase are annually treated by aerial application of fire retardant. This estimate amounts to 0.0047% of the total landbase acres treated annually. We feel that this figure does not meet the test for LAA in table BA-3 in the BA; "aerial application of fire retardant is applied on more than 0.010% of its land base annually. As documented in table PL-3 none of the Apalachicola NF listed plants species occur as populations or individuals in a single area.

More importantly these species occur in open, fire dependent, frequently burned longleaf pine or scrub vegetative communities. NFF has an aggressive prescribed fire program and the majority of the stands where the plants occur are on a prescribed fire rotation. Fire retardant on the Apalachicola NF when infrequently used, is typically used during catastrophic fire events in areas with extremely high fuel loading characterized by fuel models different from those in stands where the listed plants are known to occur. The open frequently burned communities where the 4 federally listed plant species are normally found is not characteristic of areas where fire retardant is used. Therefore, even if aerial application would occur on 0.010% or more of the NFF land base, we believe that the Apalachicola NF meets the test for NLAA in table BA-3; "if a species occurs on a forest with more than 0.01 % of its landbase annually, yet occurs in habitats with a very low likelihood of retardant application:"

Furthermore, all stands where these plants occur have been avoidance mapped. Buffers within 100 feet of known occurrences are included in the no retardant application zone.

Due to the low annual application rates of retardant on the NFF (0.0047%), the low potential for retardant to be used in habitats where the plants are known to occur, and stands where plants occur are avoidance mapped, we believe that adverse effects for the use of fire retardant on the 4 federally listed plants on the Apalachicola NF identified above are extremely unlikely to occur.

Mussels

The U.S. Forest Service Biological Assessment (BA) originally made a determination that use of aerially applied fire retardants is "likely to adversely affect"(LAA) federally listed freshwater mussel species on the Apalachicola National Forest (ANF) including the fat threeridge (*Amblema neislerii*), and purple bankclimber (*Elliptoideus slotianus*). The USFWS Office in Panama City Florida (PCFO) has been working closely with the National Forests in Florida (NFF) and Apalachicola National Forest (ANF) staff to further evaluate the effects of the proposed action and to clarify the discussion provided in the BA for these species.

The Apalachicola river runs north to south along the western side of the ANF. The buffer zones on the east and west sides of the river have been identified as "no drop" zones for the use of fire retardant even in the extremely unlikely event that retardant is used. The only way that fire retardant would be dropped in the river, or within the buffer zone of the river is in the case of an accidental missed drop or used to immediately protect life and property in the case of a catastrophic wildfire. The likelihood of either of these scenarios occurring is extremely low, given the chance for such a wildfire along the banks of the river, and the very low probability of the use of the retardant in the first place in this area (see the data for plants, above).

Given the extremely low likelihood that retardant would be used within the area where the material could enter the river, or under catastrophic wildfire conditions we believe this meets the criterion that a determination of NLAA for the freshwater mussels in the Apalachicola river is appropriate.

There are four other species of mussel that occur in the Apalachicola river drainage, but are not within proximity of any of the ANF that would be reasonably expected to have any impacts from the use of fire retardant on the ANF. For this reason, those mussel species have been removed from the consultation.

The effects of aerial fire retardant application on listed mussels, crayfish and fish within rivers and their associated watersheds (6-Digit Hydrologic Unit Code) and caves and their associated recharge areas within the Ozark-St. Francis National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect numerous endangered/threatened mussels, crayfish and fish including fat pocketbook (*Potamilus capax*), scaleshell (*Lepotodea leptodon*), pink mucket (*Lampsilis abrupta*), ozark cavefish (*Amblyopsis rosae*), pallid sturgeon (*Scaphirhynchus albus*), Benton County cave crayfish (*Cambarus aculabrum*), and Hell Creek cave crayfish (*Cambarus zophanastes*). According to USFWS records, the three cave endemic species and their associated recharge areas do not occur on the OZSFNF. The USFWS office in Arkansas (ARFO) worked closely with the Ozark-St. Francis National Forests (OZSFNF) to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential effects to listed species.

OZSFNF have maintained records of the use of aerially applied fire retardants on their forest. The air tanker base that provides aerially fire retardant support to the OZSFNF also provides support other state and federal agencies upon request. Over the past 12 years, a total of 75,000 gallons from 25 drops of retardant was applied on the OZSFNF. There has only been one retardant drop on the St. Francis NF and it was used to protect a house. There only has been two drops of retardant (3,000 gallons each) on the OZSFNF during the past six years. The majority of retardant drops (23 of 25 totaling 69,000 gallons) over the past 12 years occurred from 2000 – 2005. Depending on release rates from the tanker, a typical 3,000 gallon retardant application would cover 345 to 3,250 linear feet. Assuming an application width of 50 feet, a 3,000 gallon drop would affect 0.4 to 3.5 acres or 9.6 to 84 acres and 0.4 to 3.5 acres for the Ozark NF and St. Francis NF, respectively, for the 75,000 gallons. OZSFNF records indicate that there has never been a misapplication of fire retardant within currently established buffers for federally listed or Forest Sensitive species. With the total of approximately 1.2 million and

22,600 acres of USFS lands included within the Ozark NF and St. Francis NF, respectively, and assuming an equal probability of application on all lands, the probability of a particular site having retardant applied is approximately 0.00007 and 0.0001 percent for the Ozark NF and St. Francis NF, respectively, based on the past 12 years (maximum of 84 acres affected divided by 1.2 million acres for Ozark NF and 3.5 acres affected divided by 22,600 acres for the St. Francis NF). In addition, the use of fire retardant on the OZSFNF indicates decreasing frequency of retardant drops over the past decade.

Consequently, OZSFNF believes that establishing exclusion areas is a good approach to further reduce potential effects, and will not significantly affect their ability to suppress fires. As additional protective measures, OZSFNF has proposed to establish the following minimization and/or avoidance measures when applying fire retardant:

1. OZSFNF will establish avoidance areas and maps to protect streams inhabited by listed aquatic species within 6-Digit Hydrologic Unit Codes (HUC) watersheds and these maps will be provided to air tanker bases, dispatch center, and the incident commander.

2. OZSFNF will establish avoidance maps to protect caves inhabited by listed aquatic species within their recharge areas and these maps will be provided to air tanker bases, dispatch center, and the incident commander.

3. OZSFNF will designate the entire recharge area of the Ozark cavefish, Benton County cave crayfish and Hell Creek cave crayfish as an avoidance area to protect these species.

4. OZSFNF will expand from the original 300-foot buffer around waterways with listed aquatic species to a 500 foot buffer to protect from retardant runoff. To protect from retardant input from tributaries, avoidance areas also will include a 300 foot buffer on either side of tributaries feeding into occupied streams within the 6-Digit HUC.

5. Post drop water quality monitoring and emergency consultation will be initiated for retardant drops within the 500 foot buffer or a recharge area with a listed aquatic species. Water quality sampling will occur as soon as it is safe for personnel to enter the area.

These watershed, recharge area, and buffer boundaries are readily discernible to pilots and fire planners and therefore, are readily avoidable. Even if pilots accidentally enter these watersheds, pilot SOP instructions to use 500 and 300 foot buffers to protect waterways may further reduce potential risk of retardants entering waterways in the event of a misapplication. No application will occur within a recharge area inhabited by a listed species.

Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel habitat in a concentration that will affect mussels, the effects of retardant use on the suite on listed aquatic species of the OZSFNF are insignificant and discountable.

Literature Cited

Southern Appalachian Forest Coalition. Undated. The Western Fire Model Does Not Fit the Southern Appalachians. http://www.safc.org/public_lands/documents/Wildfire.pdf. Accessed September 2011.

The effects of aerial fire retardant application on listed mussels and fish within rivers and their associated watersheds (6-Digit Hydrologic Unit Code) within the Ouachita National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect numerous endangered/threatened mussels and fish including winged mapleaf (*Quadrula fragosa*), Arkansas fatmucket (*Lampsilis powellii*), Ouachita rock pocketbook (*Arkansia wheeleri*), pink mucket (*Lampsilis abrupta*), and leopard darter (*Percina pantherina*). The USFWS office in Arkansas (ARFO) worked closely with the Ouachita National Forest (ONF) to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential effects to listed species.

ONF have maintained records of the use of aerially applied fire retardants on their forest. The air tanker base that provides aerially fire retardant support to the ONF also provides support other state and federal agencies upon request. Over the past 12 years (2000-September 20, 2011), a total of 92,000 gallons from 31 drops of retardant was applied on the ONF. Until September 20, 2011, there had been zero drops of retardant on the ONF during the past five years. One drop totaling 2,000 gallons (0.3 to 2.5 acres) was applied to a wildfire on the ONF during the September 20th fire. The seven year period from 2000 – 2006 accounted for 30 of 31 retardant drops (90,000 gallons) on the ONF. Depending on release rates from the tanker, a typical 3,000 gallon retardant application would cover 345 to 3,250 linear feet. Assuming an application width of 50 feet, a 3,000 gallon drop would affect 0.4 to 3.5 acres or 12.3 to 107.5 acres for the total 92,000 gallons. ONF records indicate that there has never been a misapplication of fire retardant within currently established buffers (300 feet) for federally listed or Forest Sensitive species. With approximately 1.8 million acres of USFS lands included within the ONF, and assuming an equal probability of application on all lands, the probability of a particular site having retardant applied is approximately 0.00006 percent, based on the past 12 years (maximum of 107.5 acres affected divided by 1.8 million acres). In addition, the use of fire retardant on the ONF indicates decreasing frequency of retardant drops over the past 12 years. In 2011, there have been 118 fires that burned 3,878 on the ONF and 845 acres on private land. This is the most intensive fire season on the ONF since 2006, but only one retardant drop has been made during this year.

Consequently, ONF believes that establishing exclusion areas is a good approach to further reduce potential effects, and will not significantly affect their ability to suppress fires. As additional protective measures, ONF has proposed to establish the following minimization and/or avoidance measures when applying fire retardant:

1. ONF will establish avoidance areas and maps to protect streams inhabited by listed aquatic species within 6-Digit Hydrologic Unit Codes (HUC) watersheds and these maps will be provided to air tanker bases, dispatch center, and the incident commander.

2. ONF will expand from the original 300 foot buffer around waterways with listed aquatic species to a 500 foot buffer to protect from retardant runoff. To protect from retardant input from tributaries, avoidance areas also will include a 300 foot buffer on either side of tributaries feeding into occupied streams within the 6-Digit HUC.

3. Post drop water quality monitoring and emergency consultation will be initiated for retardant drops within the 500 foot buffer. Water quality sampling will occur as soon as it is safe for personnel to enter the area.

These watershed and buffer boundaries are readily discernible to pilots and fire planners and therefore, are readily avoidable. Even if pilots accidentally enter these watersheds, pilot SOP instructions to use 500 and 300 foot buffers to protect waterways may further reduce potential risk of retardants entering waterways in the event of a misapplication.

Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel habitat in a concentration that will affect mussels, the effects of retardant use on the suite on listed aquatic species of the ONF are insignificant and discountable.

Literature Cited

Southern Appalachian Forest Coalition. Undated. The Western Fire Model Does Not Fit the Southern Appalachians. http://www.safc.org/public_lands/documents/Wildfire.pdf. Accessed September 2011.

Literature Cited

Southern Appalachian Forest Coalition. Undated. The Western Fire Model Does Not Fit the Southern Appalachians. http://www.safc.org/public_lands/documents/Wildfire.pdf. Accessed September 2011.

JAFO-Jacksonville, North Florida Field Office

Likely to Adversely Affect to Not Likely to Adversely Affect Determinations:

Four Listed Plants: Ocala National Forest

The U.S. Forest Service Biological Assessment (BA) originally made a determination that use of aerially applied fire retardants is " likely to adversely affect"(LAA) federally listed plants species on the Ocala National Forest (NF) including Florida bonamia (*Bonamia grandifolia*), scrub buckwheat (*Erigonum longifolium* var. *gnaphalifolium*), Britton's beargrass (*Nolina brittonia*) and Lewton's polygala (*Polygala lewtonii*). The U.S.F.W.S. Office in Jacksonville Florida (JAFO) has been working closely with the National Forests in Florida (NFF) and Ocala National Forest staff to further evaluate the effects of the proposed action and to clarify the discussion provided in the BA for these species.

We revisited the "Analysis Process" discussed on pages 20-20 and pages 38-41 in the BA and how the process applies to these species. On 08/15/2011 NFF requested that the effects determination for the 4 plants species be changed to "not likely to adversely affect" (NLAA) (e-mail from Micah Thorning NFF staff biologist to Stan Simpkins JAFO biologist). Both the U.S.F.W.S. JAFO and NFF (including the staff of the Ocala NF) have concluded the appropriate determination of effects for these species is NLAA for the reasons discussed below:

The NFF estimates that 58 acres of its landbase are annually treated by aerial application of fire retardant. This estimate amounts to 0.0047% of the total landbase acres treated annually. We feel that this figure does not meet the test for LAA in table BA-3 in the BA; "aerial application of fire retardant is applied on more than 0.010% of its land base annually. As documented in table PL-3 none of the Ocala NF listed plants species occur as populations or individuals in a single area.

More importantly these species occur in open, fire dependent, frequently burned longleaf pine or scrub vegetative communities. NFF has an aggressive prescribed fire program and the majority of the stands where the plants occur are on a prescribed fire rotation. Fire retardant on the Ocala NF when infrequently used, is typically used during catastrophic fire events in areas with extremely high fuel loading characterized by fuel models different from those in stands where the listed plants are known to occur. The open frequently burned communities where the 4 federally listed plant species are normally found is not characteristic of areas where fire retardant is used. Therefore, even if aerial application would occur on 0.010% or more of the NFF land base, we believe that the Ocala NF meets the test for NLAA in table BA-3; "if a species occurs on a forest with more than 0.01 % of its landbase annually, yet occurs in habitats with a very low likelihood of retardant application:"

Furthermore, all stands where these plants occur have been avoidances mapped. Buffers within 100 feet of known occurrences are included in the no retardant application zone.

Due to the low annual application rates of retardant on the NFF (0.0047%), the low potential for retardant to be used in habitats where the plants are known to occur, and stands where plants occur are avoidance mapped, we believe that adverse effects for the use of fire retardant on the 4 federally listed plants on the Ocala NF identified above are extremely unlikely to occur.

The effects of aerial fire retardant application on the federally endangered Carolina heelsplitter (*Lasmigona decorata)* and its critical and occupied habitat within Sumter National Forest (SNF), South Carolina

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect numerous endangered mussels including the Carolina heelsplitter. This species occurs within tributaries in Management Area 1, SNF, Long Cane Ranger District. The USFWS office in South Carolina has worked closely with SNF to evaluate the effects of the proposed action on this species and identify reasonable measures to avoid and minimize potential impacts to listed species.

According to SNF's *Revised Land and Resource Management Plan* (2004), fire behavior and its effects vary within the Sumter National Forest. The piedmont is characterized by gentle rolling hills. Steeper, longer slopes characterize the mountains, and affect fire behavior and fire size more dramatically than the topography found in the piedmont. The Sumter National Forest suppresses an average of 30 wildland fires annually, which burn approximately 200 acres of National Forest land. Humans cause 94 percent of these fires: most are intentionally set or escaped debris burning; lightning causes 6 percent of these fires. Most fires, 86 percent, are 10 acres or fewer (SNF Revised Land and Resource Management Plan, 2004).

Within SNF, Long Cane Ranger District Management Area 1, the heelsplitter occurs within the main stem of Turkey Creek and its tributaries, including Mountain, Sleepy and Beaverdam Creeks. The heelsplitter has also been found in Cuffeytown, Little Stevens and Stevens Creeks, all of which run through or have tributaries that run through Management Area 1. USFS lands directly abut these waterways, and several small creeks and their tributaries drain from USFS lands directly into Turkey and Stevens Creeks, resulting in the potential for retardant to enter these waterways in the event of a misapplication.

As a protective measure, SNF has agreed to establish 500 foot buffers on perennial streams and 300 foot buffers on intermittent streams within Management Area 1. SNF has also agreed to insert the following language into the BA/BO as a mitigation measure: *"Prior to fire retardant application, all pilots shall be briefed on the locations of all T&E species avoidance zones in the project area."*

Consequently, taking into account the combination of the small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, as well as the additional avoidance and minimization provided by the buffer areas, and the low likelihood that retardant will reach mussel habitat in a concentration that will affect mussels, the use of retardants on SNF may affect, but is not likely to adversely affect, the Carolina heelsplitter.

References:

USDA, Forest Service. 2004. *Revised Land and Resource Management Plan: Sumter National Forest*. Management Bulletin R8-MB 116A; 208pgs.

The effects of aerial fire retardant application on listed mussels (3) and fish (1) on the Pisgah and Nantahala National Forests

The U.S. Forest Service's (USFS) most recent (June 2011) Biological Assessment (BA) regarding the use of aerially applied fire retardants, made a determination that the activity is likely to adversely affect[††] the endangered little-wing pearlymussel (*Pegias fibula*), Cumberland bean pearlymussel (*Villosa trabalis*), and the Appalachian elktoe (*Alasmidonta raveneliana*) on the

[††] In the original BA (February 2008), all four species were considered ―not likely to be jeopardized" and the ―adverse effects" and ―quantification of take" determinations were to be made during the emergency consultation process as outlined in 50 CFR 402.02.

Nantahala (NNF) and Pisgah National Forests (PNF) (Appalachian elktoe only). Additionally, the BA determined that the threatened spotfin chub (*Erimonax monachus)* was likely to be adversely affected (NNF only). The U.S. Fish and Wildlife Service's (USFWS) Asheville Field Office (AFO) has worked closely with the Pisgah and Nantahala National Forests to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential impacts to listed species. After reviewing information provided by the National Forest in North Carolina (letter dated January 22, 2008), the AFO concurred (letter dated January 31, 2008) with "not likely to adversely affect" determinations for the little-wing pearly mussel and the Appalachian elktoe on the NNF and PNF.

The susceptibility of southern Appalachian forests to fire is less than many other forest types in the country. The forest types (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. In addition to the resulting lower prevalence of wildfires, these same factors tend to result in less intense fire behavior and smaller wildfires. Additionally, the NNF and PNF (particularly the NNF) are characterized by deep coves and folded topography (and thus a greater percentages of mesic forest) and have even fewer fires than other parts of the Southern Appalachians.

The NNF and PNF have very low retardant use. On the NNP and PNF, between the years 2001 and 2010, the average wildfire covered only about 33 acres and most wildfires were smaller than 5 acres – making fire suppression without use of aerial retardants more manageable than in many other forests. Over the last 10 years (2001-2010), the NNF and PNF (combined) have average 11.2 drops per year and averaged only 1.4 retardant drops per year since 2005. Four of the last six years have had no retardant use. The average retardant drop has been about 2414 gallons, covering about 2.8 acres (generally Coverage Level 2-3, about 2 gallons/100ft^2). The NNF and PNF cover about 1.04 million acres. This equates to an average annual retardant coverage (2001 to 2010) of about 31 acres (0.00298% of the NNF and PNF). Even in the highest use year (2001), only 205 acres had retardant applied (0.0197% of the NNF and PNF) and the total coverage for the last 10 years is only 310 acres (0.0298% of the NNF and PNF). There have been no recorded misapplications in the last 11 years.

In addition to 300-foot buffer zones on both sides of all waterways (as required by the 2007 Fire Management Guidelines), both the NNF and PNF will employ the following measures to protect federally listed species and their habitats:

The USFS will provide "red-zone[‡‡]" maps and information designed specifically to avoid or minimize the effects of fire suppression on aquatic species and federally listed terrestrial

[‡‡] ―Redzones" are areas that contain species on the federal list of endangered and threatened species, critical habitats for such species, and/or areas that, if impacted, could affect these species. Fire ignition or suppression activities in ―red zones" must occur in coordination with the U.S. Fish and Wildlife Service and may require formal consultation under section 7 of the Endangered Species Act of 1973, as amended. Fire ignition or suppression activities in ―red zones" should only be conducted to protect federally listed species, enhance the recovery of federally listed species, or protect human life and property.

species to dispatch centers and all district fire management officers. These “red zones” include:

a. the aforementioned 300-foot buffer zones on both sides of all waterways,

b. all designated critical habitats for all federally listed species,

c. 1,500-foot buffers around all known occurrences of any federally listed species (dissolved into contiguous polygons where buffers overlap), and

d. polygons, encompassing significant occupied and suitable habitats but where no critical habitat has been designated (e.g., known and suitable habitats for the noonday globe), as agreed to by USFS and USFWS biologists.

In total, these buffers/red zones protect more than 29% of the two National Forests (307,447 acres).

Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach fish/mussel habitat in a concentration that will affect either, the effects of retardant use on on listed mussels and fish on the Nantahala and Pisgah National Forests are insignificant and discountable. Notably, potential adverse effect to the Cumberland bean pearly mussel are even less as the species has not be found on the NNF or PNF. This species has been found in the Hiwasee River near the far southwestern corner of the NNF. However, drainage from the NNF enters the Hiwasee River below the known location for this species.

The effects of aerial fire retardant application on the pallid sturgeon within the Big Sunflower River adjacent to the Delta National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect the pallid sturgeon. The pallid sturgeon can be found in the Lower Yellow Stone River, the Missouri River, and the lower Mississippi River. Pallid Sturgeon has been collected in the Big Sunflower River in Sharkey County, Mississippi near the Delta National Forest. The USFWS office in Mississippi (MSFO) have worked closely with the staff from the National Forests of Mississippi to evaluate the effects of the proposed action on this species and identify reasonable measures to avoid and minimize potential impacts.

The Delta National Forest in the only bottomland hardwood ecosystem in the National Forest System, containing over 60,000 acres of bottomland hardwoods and forested wetlands. The susceptibility of bottomland hardwood forests to fire is less than many other forest types in the country. The historical role of fire in the bottomland hardwood ecosystem is unclear. Drought probably played a role, and low to moderate intensity wildfires may been been frequent. Low intensity fires are the norm in these forests because fuel loads are generally light due to rapid decomposition on these moist, humid sites These characteristics help make fire suppression without use of aerial retardants more manageable than in many other forests.

Based on the information within the BA, only four fire retardant drops have occurred on the National Forests of Mississippi, which would mean there is less than a .01% chance of fire retardant drop misapplication. As an additional protective measure, the Forest Service has proposed to establish a 300 foot buffer around all waterways on National Forest Lands in MS. Because of this protection measure and the fact that the possibility of use of fire retardant near this species' habitat is so low, little disturbance is expected to occur as a result of implementing the proposed action.

The combination of these factors results in a small amount of retardant that has the potential to enter the Big Sunflower River near the Delta National Forest. Consequently, taking into account the combination of the infrequent wildfires, low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional 300 foot buffer zone, and the low likelihood that retardant will reach sturgeon habitat in a concentration that will affect sturgeon, the effects of retardant use on the pallid sturgeon are insignificant and discountable.

The effects of aerial fire retardant application on listed mussels and fish on National Forests in Alabama

The U.S. Forest Service's (USFS) most recent (August 2011) Biological Assessment (BA) regarding the use of aerially-applied fire retardants, made a determination that the activity is likely to adversely affect the federally-listed finelined pocketbook (*Lampsilis altilis*), southern pigtoe (*Pleurobema georgianum*), Cumberlandian combshell (*Epioblasma brevidens*), and blue shiner (*Cyprinella caerulea*) on National Forest in Alabama (Forest). The Forest Service previously concluded "no effect for the species on National Forests in Alabama in a prior version of the BA (June 2011). It is our understanding that they changed to one species effect determination for the each species (across the entire range). The Service continues to concur that the proposed action has a low likelihood of adverse effects to federally listed species on National Forests in Alabama and concurs with "not likely to adversely affect" determinations for these species.

The National Forests in Alabama previously indicated that it is not their intention to use aerial retardant drops for their Fire Management. The reason it was not even included as an extreme condition in the contingency plan is there is not a tanker station within flight range of National Forests in Alabama. The Forest Service's most recent BA indicates that they have not used arial fire retardantson National Forests in Alabama in the last 10 years and the overall instances of fire are historically very low. Representatives of the National Forests in Alabama think it is highly unlikely that fire retardant will be used in the future. In the event that arial fire retardant is used and federally listed species are affected, Section 7 consultation will be re-initiated.

Taking into account the combination of standard forest management via prescribed fire; extremely low historic and predicted need for use of retardant; and the low probability of misapplication in locations and amounts that would affect listed species, the expected effects of retardant use on listed species would be insignificant and discountable.

The effects of proposed aerial fire retardant application on the Louisiana pearlshell mussel on Kisatchie National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect the threatened Louisiana pearlshell mussel (*Margaritifera hembeli*). The U.S. Fish and Wildlife Service (USFWS), Louisiana Ecological Services Office has worked closely with the Kisatchie National Forest to evaluate potential effects and identify reasonable measures to avoid and minimize potential impacts of the proposed action on this species.

The Kisatchie National Forest has maintained records of the use of aerially applied fire retardants on the forest. Aerial fire retardant has been applied to the forest only twice, despite the common occurrence of low-intensity, seasonal wildfire. No fire retardant drops have ever been applied within Louisiana pearlshell mussel watersheds. Stands within the Louisiana pearlshell mussel watersheds on the Kisatchie National Forest are managed through prescribed burning and as a consequence of small, easily controlled seasonal wildfires. This type of fire regime keeps fuel loads down, thus decreasing the likelihood of catastrophic wildfire occurrence. Thus, the vast majority of all wildfires on the Kisatchie National Forest, and all wildfires within the Louisiana pearlshell mussel watershed, have historically been managed without the use of aerial fire retardant drops, as will likely be the case for future wildfires.

This listed mussel occurs only on private and U.S. Forest Service (USFS) lands in the Bayou Boeuf, Bayou Rapides, and the Bayou Rigolette watersheds in Rapides and Grant Parishes, Louisiana. Because the mussel is found in streams on USFS property where aerial fire retardant drops would be used as necessary for protection of life and/or property, there is the potential for misapplication into a Louisiana pearlshell mussel stream. However, avoidance mapping with 300 foot protective buffers around all streams on the forest would be implemented to reduce the risk of misapplication directly into the water. Because these streams are narrow, meandering channels, this risk is further reduced; i.e., these streams have relatively small exposed surface area that could be impacted by misapplied chemical when compared to wider streams whose increased exposed surface area inherently increases the likelihood of the chemical directly entering the water in the event of misapplication. Further, the Kisatchie National Forest maintains a forested Streamside Management Zone (SMZ) along all streams within Louisiana pearlshell mussel watersheds, where only selective timber harvest is allowed within 100 feet of each stream bank. The densely vegetated SMZs would help guard against chemical entering the stream via misapplication and/or runoff. In the case of misapplication, the intact tree canopy within the SMZ would intercept much of the retardant; and the woody ground cover, roots, and leaf litter would reduce the amount that might reach the water via runoff. Post application water quality testing combined with visual survey to document changes in mortality levels of aquatics would be used to verify that no fire retardant entered water bodies on the forest in the unlikely event that aerial fire retardant drops were applied.

Taking into account the combination of standard forest management via prescribed fire and low intensity seasonal wildfires; extremely low historic and predicted need for and use of retardant; and the low probability of misapplication in locations and amounts that would affect Louisiana pearlshell mussels due to narrow stream channels, densely vegetated SMZs, and Louisiana pearlshell mussel habitat exclusion through avoidance mapping of all streams; the expected effects of retardant use on the Louisiana pearlshell mussel on the Kisatchie National Forest would be insignificant and discountable.

The effects of aerial fire retardant application on listed mussels and fish within the Daniel Boone National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect numerous endangered mussels including Cumberland elktoe (*Alasmidonta atropurpurea*), fanshell (*Cyprogenia stegaria*), dromedary pearlymussel (*Dromus dromas),* Cumberlandian combshell (*Epioblasma brevidens*), oyster mussel (*Epioblasma capsaeformis*), tan riffleshell (*Epioblasma florentina walker*), nothern riffleshell (*Epioblasma torulosa rangiana*), pink mucket pearlymussel (*Lampsilis abrupta*), cracking pearlymussel (*Hemistena lata*), little-wing pearlymussel (*Pegias fabula*), rough pigtoe (*Pleurobema plenum*), and the Cumberland bean pearlymussel (*Villosa trabalis*). Additionally, the BA determined that three listed fish including the duskytail darter (*Etheostoma percnurum*), palezone shiner (*Notropis albizonatus*), and the blackside dace (*Chrosomus cumberlandensis*), were likely to be adversely affected.

The cracking pearlymussel, dromedary pearlymussel, and oyster mussel are not likely to be found within the Daniel Boone National Forest (DBNF). Records of these species within the DBNF are historical and these species are now considered extirpated from the forest. Therefore, these three species should be removed from consideration within the DBNF.

For the purposes of this document, the remaining eight mussel species and two fish species were analyzed together because they occupy similar habitats and are similarly affected by water quality degradation, though to differing degrees. The USFWS office in Kentucky (KYFO) has worked closely with the DBNF to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential impacts to listed species.

The susceptibility of southern Appalachian forests to fire is less than many other forest types in the country. The forest types (primarily Appalachian hardwoods) have longer natural fire return intervals; humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. In addition to the resulting lower prevalence of wildfires, these same factors tend to result in less intense fire behavior and smaller wildfires. These characteristics also help make fire suppression without use of aerial retardants more manageable than in many other forests. The DBNF believes that the use of fire retardant within the forest, in coming years, is also less likely to occur than in the past decade, due to a philosophical change to reduce intensive fire suppression.

In addition to the reduced likelihood of using fire retardant on the DBNF, the 300-foot buffer around documented occurrences of these species reduces the potential for fire retardant to be dropped over the streams and/or rivers they inhabit. Because these are primarily small intermittent and small perennial streams, the likelihood of application directly to the water is lower than for larger perennial water bodies, and smaller volumes of retardant will enter the streams compared to larger rivers. These small streams primarily flow through forested areas with an intact tree canopy which intercepts much of the retardant and further reduces the amount that is applied directly to water. In the unlikely event that an accidental drop occurs over small streams, the largest of these small streams contributes a small fraction of the flow volume to the larger rivers within the DBNF, and nearly instantaneous dilution of any retardant entering these larger rivers would result only in minor behavioral effects such as temporary cessation of siphoning for any mussels immediately downstream of the confluence of these small streams. This reaction would not cause any harmful impact to mussels because they would be similar to the effects of naturally occurring sedimentation events or other temporary reductions in water quality.

Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the utilization of the 300-foot buffer around documented occurrences, and the low likelihood that retardant will reach mussel habitat in a concentration that will affect mussels, the effects of retardant use on the suite on listed mussels and fishes in is insignificant and discountable.

Appendix F. Region 5 Analytical Frameworks

The effects of aerial fire retardant application on listed mussels and fish within mainstem rivers adjacent to the George Washington/Jefferson National Forest

The U.S. Forest Service Biological Assessment (USFS BA) made a determination that use of aerially applied fire retardants is likely to adversely affect numerous endangered mussels including fanshell (*Cyprogenia stegaria*), dromedary pearlymussel (*Dromus dromas),* Cumberlandian combshell (*Epioblasma brevidens*), oyster mussel (*Epioblasma capsaeformis*), tan riffleshell (*Epioblasma florentina walker*), pink mucket pearlymussel (*Lampsilis abrupt*), shiny pigtoe (*Fusconaia cor*), fine-rayed pigtoe (*Fusconaia cuneolus*), cracking pearlymussel (*Hemistena lata*), birdwing pearlymussel (*Lemiox rimosus*), littlewing pearlymussel (*Pegias fibula*), rough rabbitsfoot (*Quadrula cylindrica strigillata*), Cumberland monkeyface pearlymussel (*Quadrula intermedia*), Appalachian monkeyface pearlymussel (*Quadrula sparsa*), purple bean (*Villosa perpurpurea*), Cumberland bean pearlymussel (*Villosa trabalis*), rough pigtoe (*Pleurobema plenum*), spectacle case (*Cumberlandia monodonta*), snuffbox (*Epioblasma triquetra*), and sheepnose (*Plethobasus cyphyus*). Additionally, the BA determined that four listed fish including the endangered duskytail darter (*Etheostoma percnurum*) and threatened spotfin chub (*Erimonax monachus),* slender chub (*Erimystax cahni*), and yellowfin madtom (*Noturus flavipinnis)* were like to be adversely affected. This suite of species occurs only outside of the boundaries of the GWJNF within the large mainstem Clinch and Powell Rivers within the Upper Tennessee River Basin, in the vicinity of the GWJNF. For the purposes of this document, we analyzed them together because they occupy similar habitats and are similarly affected by water quality degradation, though to differing degrees. The USFWS offices in Virginia (VAFO) have worked closely with the George Washington/Jefferson National Forests (GWJNF) to evaluate the effects of the proposed action on these species and identify reasonable measures to avoid and minimize potential impacts to listed species.

GWJNF have maintained records of the use of aerially applied fire retardants on those forests. On May 16, 2011, the GWJNF sent a memorandum to their regional office identifying erroneous information on the use of fire retardants on GWJNF, and provided a copy to VAFO. That memorandum served to supplement the BA with and clarified that instead of the 51 retardant drops reported in the BA, only 11 aerial fire retardant drops had occurred on GWJNF from 2000 to 2010. A total of approximately 21,000 gallons of retardant was applied during that time period. The susceptibility of southern Appalachian forests to fire is less than many other forest types in the country. The forest types (primarily Appalachian hardwoods) have longer natural fire return intervals, humidity tends to be higher than many other forest types, high rates of decomposition naturally reduce fuel loads, as well as other factors. In addition to the resulting lower prevalence of wildfires, these same factors tend to result in less intense fire behavior and smaller wildfires. Over a 15-year period, the average wildfire size was approximately 34 acres, and 73 percent of all wildfires were smaller than 10 acres (Southern Appalachian Forest Coalition undated). These characteristics also help make fire suppression without use of aerial retardants more manageable than in many other forests. GWJNF believe that the use of fire retardant on GWJNF in coming years is also less likely to occur than in the past decade. This is due to a philosophical change to reduce intensive fire suppression. The closure of air tanker bases in the region and the increased logistical difficulty of using retardant due to the long air tanker transit times from existing tanker bases to GWJNF units makes aerially applied retardants less useful to address emergency situations and to protect infrastructure (long periods between calling for retardant application and delivery, and longer interval between successive drops). Consequently, GWJNF believe that establishing exclusion areas is a good approach to further reduce potential impacts, and will not significantly affect their ability to suppress fires on GWJNF.

Based on the information within the BA, the area treated by a single fire retardant application varies up to an area of 75 feet (ft) by 800 ft, or approximately 1.4 acres. With the total of approximately 1.8 million acres of USFS lands included within the GWJNF, and assuming an equal probability of application on all lands, the probability of a particular site having retardant applied is approximately 0.00008%, based on the past 10 years (based on GWJNF application data). As an additional protective measure, GWJNF has proposed to establish exclusion areas that encompass the entire sixth-order watersheds that support threatened and endangered aquatic species. This measure will significantly reduce the likelihood of fire retardant entering waterways, because fire fighting planning efforts will avoid the entire watersheds that support the listed species. These watershed and boundaries are readily discernible to pilots and fire planners and therefore, are readily avoidable. Even if pilots accidentally enter these watersheds, pilot SOP instructions to use 300 ft buffers to protect waterways may further reduce potential risk of retardants entering waterways in the event of a misapplication.

In the vicinity of the GWJNF, the listed mussels and fish occur within the mainstem of the Clinch and Powell Rivers. Although no USFS lands directly abut these waterways, several areas of forest lands approach these rivers to within ¼ mile, and several small waterways and their tributaries drain from USFS lands directly into the Clinch and Powell Rivers, resulting in the potential for retardant to enter these rivers in the event of a misapplication. Because these are primarily small intermittent and small perennial streams, the likelihood of application directly to the water is lower than for larger perennial water bodies, and smaller volumes of retardant will enter the streams compared to larger rivers. These small streams primarily flow through forested areas with an intact tree canopy which intercepts much of the retardant and further reduces the amount that is applied directly to water, The combination of these factors results in a small amount of retardant that has the potential to enter these streams. Furthermore, the largest of these small streams contributes a small fraction of the flow volume of the Clinch and Powell Rivers, and nearly instantaneous dilution of any retardant entering these larger rivers would result only in minor behavioral effects such as temporary cessation of siphoning for any mussels immediately downstream of the confluence of these small streams with the Clinch and Powell Rivers, and fish temporarily moving out of affected areas. This reaction would not cause any harmful impact to mussels and fish because they would be similar to the effects of naturally occurring sedimentation events or other temporary reductions in water quality.

Consequently, taking into account the combination of the infrequent, small, and low intensity wildfires, low need for use of retardant and consequent low likelihood of retardant use, low likelihood of misapplication in the event of any use, the additional avoidance and minimization provided by exclusion areas, and the low likelihood that retardant will reach mussel and fish habitat in a concentration that will affect mussels and fish, the effects of retardant use on the suite of listed mussels and fish in the Upper Tennessee River portion of the GWJNF are insignificant and discountable.

Literature Cited

Southern Appalachian Forest Coalition. Undated. The Western Fire Model Does Not Fit the Southern Appalachians. http://www.safc.org/public_lands/documents/Wildfire.pdf. Accessed September 2011.

Appendix G. Region 6 Analytical Frameworks

Greenback cutthroat trout (GBCT):

- Each forest will have the retardant avoidance area mapping as 600 feet on both sides of streams for all water occupied by GBCT, as shown in the avoidance zones maps provided by the forests.
- Misapplication, or intentional application for the protection of life or property, of retardant within mapped avoidance areas results in adverse effects to GBCT and is the basis for the LAA determination.
- Spills, mixing areas, water draws, water dips, and staging and other preparation activities are NOT included in the project description nor are they considered interrelated or interdependent actions.
- Remediation activities are not included in the project description.
- This project has a 10 year consultation timeframe.
- To capture the extent of exposure risk, our analysis relies on using historical fire data provided in the BA (Table B-3, pp. 228-236) and using the total drops from 2000-2010, dividing by 11 and multiplying by 10 (10 year timeframe for consultation).
- The effects analysis in the BO is based on misapplication rates provided in the BA. The BA assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42 percent of all drops on each Forest will result in delivery to a waterway with potential adverse effects to GBCT, if the stream is occupied. Using the percentage of perennial streams that are occupied, we then multiply that by the percentage of expected misapplications.
- Because of the variance of population densities, and because we cannot determine which populations of GBCT are most likely to be affected given the extent of the action area, in order to determine the extent of take, we will use habitat as a surrogate. Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume that fish 6.2 miles downstream of a misapplication have the potential to be adversely affected by retardant (see BA p. 119 and p. 123).
- Effects to GBCT from fire retardants primarily occur from direct application onto the stream surface.

PAWNEE MONTANE SKIPPER (Skipper) :

- Fire retardant avoidance areas will not be designated for the skipper since the effects of wildfire are considered to cause more damage to the skipper and its habitat than the effects from the application of fire retardant.
- Aerial application of fire retardant is likely to directly harm skippers and is the primary basis for the LAA determination.
- This project has a 10 year consultation timeframe.
- Remediation activities following wildfire events are not included in the project description.
- To capture the extent of the exposure risk, our analysis relied on the estimated percentage Forest System lands receiving fire retardant (USFS 2011, Table B-3), namely the Pike and San Isabel National Forest, and multiplying that value by the acres of skipper habitat within the Forest.

Appendix H. Region 2 Conservation Measures the USFS agreed to incorporate into Project Description

CONSERVATION MEASURES

The proposed action includes the following policies and procedures to minimize the risk of fire retardant products reaching aquatic habitats, and is based on information in the BA and discussions with USFS staff. Region 3 Forest Service staff accepts these conservation measures since no terms and conditions can be provided for proposed species.

General Conservation Measures

- Avoid aerial application of retardant on mapped avoidance areas for threatened, endangered, or proposed species, or within 300 feet of waterways, including species-specific avoidance mapping (USFS 2011a).
- Coordinate with local Fish and Wildlife Service (Service) offices each year prior to the onset of the fire season to ensure avoidance areas are up to date and appropriate contingency measures are identified.
- Implement monitoring and reporting procedures for misapplication of retardant.

Species Specific Conservation Measures

- Establish a 1,200-foot buffer/avoidance area (600' from either side of the waterway) around Boneyard Creek from Boneyard Bog Springs downstream to Three Forks Springs.
- Assist the Service and AGFD in the continued development and adoption of a Three Forks springsnail salvage protocol whereby springsnails may be removed and placed into facilities for repatriation stock. This salvage plan shall be in place prior to the onset of the 2012 fire season.
- Assist the Service and AGFD in the continued development and maintenance of a Three Forks springsnail captive rearing program in order to provide stock for repatriation. Assistance shall include locating suitable rearing sites, funding where appropriate, technical input, and policy guidance. This captive rearing program shall be in place prior to the 2014 fire season

Appendix I. Region 5 Conservation Measures the USFS agreed to incorporate into Project Description

Page numbering for Appendix I is not consecutive due to insertion of a PDF file composed of five documents.

From:	Carol H Croy
To:	Tylan_Dean@fws.gov; Shane_Hanlon@fws.gov; kimberly_smith@fws.gov
cc:	Sumalee_Hoskin@fws.gov; Kenneth Landgraf; Fred Huber; Dawn Kirk; Steve Croy; Dennis Krusac; Duke Rankin
Subject:	Fw: URGENT:Nation Fire Retardant Consultation- New short procedure to get species effects determinations changed from LAA to NLAA. Note: Immediate action needed
Date:	08/16/2011 04:08 PM

Hey there everyone

Based on several conversations we have had since yesterday's email below, the general consensus from the Virginia field office of the FWS is that if 6th level watersheds identified in the Fish and Mussel Conservation Plan were added to the existing list of proposed exclusion zones for the George Washington and Jefferson National Forests, this would address outstanding concerns for aquatic listed species analyzed in the National Fire Retardant BA/EIS for these two National Forests. We (Dawn Kirk, Fred Huber, Ken Landgraf, Carol Croy) have agreed to the additional exclusion zones. Steve Croy is on fire detail and could not participate, due to the short time turnaround on this request. Dawn Kirk, our acting staff officer, will be out of the office for the rest of the week. If you have any questions concerning the additions to our proposed exclusion zones, please contact Ken Landgraf, our acting Forest Supervisor (really confused yet?).

Sincerely,

Carol

Carol Croy, Ph.D.
Forest Wildlife Biologist
George Washington and Jefferson National Forests
5162 Valleypointe Parkway
Roanoke, VA 24019
540.265.5136
540.265.5145 (fax)
carolcroy@fs.fed.us

----- Forwarded by Carol H Croy/R8/USDAFS on 08/16/2011 03:49 PM -----

Dennis Krusac/R8/USDAFS

08/15/2011 02:46 PM

To David W Peterson/R8/USDAFS@FSNOTES, Richard Standage/R8/USDAFS@FSNOTES, James Whalen/R8/USDAFS@FSNOTES, Rick Dillard/R8/USDAFS@FSNOTES, John Moran/R8/USDAFS@FSNOTES, Bobby Grinstead/R8/USDAFS@FSNOTES, Michael P Joyce/R8/USDAFS@FSNOTES, Jeanne Riley/R8/USDAFS@FSNOTES, Sheryl Bryan/R8/USDAFS@FSNOTES, Dawn Kirk/R8/USDAFS@FSNOTES, Pamela J Martin/R8/USDAFS@FSNOTES, Jim Herrig/R8/USDAFS@FSNOTES, Steven R Bloemer/R8/USDAFS@FSNOTES, H S Ray/R8/USDAFS@FSNOTES, Felipe Cano/R8/USDAFS@FSNOTES, Thomas N Philipps/R8/USDAFS@FSNOTES, Dave Moore/R8/USDAFS@FSNOTES, Susan Hooks/R8/USDAFS@FSNOTES, William Carromero/R8/USDAFS@BPOS, Kenneth L Gordon/R8/USDAFS@FSNOTES, Tate Thriffiley/R8/USDAFS@FSNOTES, Gary R Shurette/R8/USDAFS@FSNOTES, Erik D Johnson/R8/USDAFS@FSNOTES, Joanne E Baggs/R8/USDAFS@FSNOTES, Robin Mackie/R8/USDAFS@FSNOTES, Gary Kauffman/R8/USDAFS@FSNOTES, Fred Huber/R8/USDAFS@FSNOTES, Steve Croy/R8/USDAFS@BPOS, David Taylor/R8/USDAFS@BPOS, Mark Pistrang/R8/USDAFS@BPOS, Steven R Bloemer/R8/USDAFS@FSNOTES, H S Ray/R8/USDAFS@FSNOTES, Felipe Cano/R8/USDAFS@FSNOTES, Jason T Nolde/R8/USDAFS@FSNOTES, Ken Dancak/R8/USDAFS@FSNOTES, Mary E Lane/R8/USDAFS@FSNOTES, Steve Duzan/R8/USDAFS@FSNOTES, Robert Csargo/R8/USDAFS@FSNOTES, Shaun C Williamson/R8/USDAFS@FSNOTES, Rick Dillard/R8/USDAFS@FSNOTES, Micah Thorning/R8/USDAFS@FSNOTES, Michael P Joyce/R8/USDAFS@FSNOTES, Mark Danaher/R8/USDAFS@FSNOTES, Sheryl Bryan/R8/USDAFS@FSNOTES, Carol H Croy/R8/USDAFS@FSNOTES, Mary C Miller/R8/USDAFS@FSNOTES, Steven R Bloemer/R8/USDAFS@FSNOTES, H S Ray/R8/USDAFS@FSNOTES, Felipe Cano/R8/USDAFS@FSNOTES, Steve Croy/R8/USDAFS@BPOS, Jeff Gainey/R8/USDAFS@FSNOTES, Robert S Potts/R8/USDAFS@FSNOTES, David C Byrd/R8/USDAFS@FSNOTES, Mary E Lane/R8/USDAFS@FSNOTES, Greg A Hatfield/R8/USDAFS@FSNOTES, Robert Piazza/R8/USDAFS@FSNOTES, Dagmar Thurmond/R8/USDAFS@FSNOTES, Carl Petrick/R8/USDAFS@BPOS, Ray M Ellis/R8/USDAFS@BPOS, MaeLee Hafer/R8/USDAFS@BPOS, Kenneth Landgraf/R8/USDAFS@FSNOTES, Mary C Miller/R8/USDAFS@FSNOTES, William Fowler/R8/USDAFS@BPOS, Peggy Anderson/R8/USDAFS@FSNOTES, Pedro Rios/R8/USDAFS@FSNOTES, Lee W Thornhill/R8/USDAFS@FSNOTES

cc Alix Cleveland/R8/USDAFS@FSNOTES, Duke Rankin/R8/USDAFS@FSNOTES, Leigh McDougal/R8/USDAFS@FSNOTES, Brad B Nelson/R8/USDAFS@FSNOTES, David Schmid/R8/USDAFS@FSNOTES, Kristi Swisher/R1/USDAFS@BPOS, Nancy Warren/R2/USDAFS@BPOS, Peter M McDonald/R2/USDAFS@BPOS, Bobbi L Barrera/R3/USDAFS@FSNOTES, Lee Jacobson/R4/USDAFS@BPOS, Patricia A Krueger/R5/USDAFS@BPOS, Sarah Madsen/R6/USDAFS@BPOS, Dennis Krusac/R8/USDAFS@FSNOTES, Rebecca Ewing/R9/USDAFS@FSNOTES, Cheryl A Carrothers/R10/USDAFS@BPOS, Duke Rankin/R8/USDAFS@FSNOTES, Joseph A Burns/WO/USDAFS@BPOS

Subject Fw: URGENT:Nation Fire Retardant Consultation- New short procedure to get species effects determinations changed from LAA to NLAA. Note: Immediate action needed

Folks: See the following direction from FWS on how to change determination of effects from Likely to Adversely Affect

(LAA) to Not Likely to Adversely Affect (NLAA). I know many of you didn't agree with the LAA determinations in the national BA, so here is your chance to fix it. Get with your local FWS Field Office and work things out if you feel NLAA is the appropriate determination of affects. This action must be done by Wednesday. Sorry for the short turn around, but FWS just agreed to this process. If you have questions, give me a call.

If a species has a LAA determination, there will be a biological opinion which will include incidental take and also the terms and conditions and reasonable and prudent measures we will have to live with.

Dennis L. Krusac
Endangered Species Specialist
USDA Forest Service, Southern Region
Suite 816 North, 1720 Peachtree Road, NW
Atlanta, GA 30309
404-347-4338; 404-347-4154 (fax); 404-660-4377 (cell)
dkrusac@fs.fed.us

"What is the use of a house if you haven't got a tolerable planet to put it on?"   Henry David Thoreau

----- Forwarded by Dennis Krusac/R8/USDAFS on 08/15/2011 02:34 PM -----

Kenneth_Graham@fws.gov

08/15/2011 11:28 AM

To dkrusac@fs.fed.us

cc

Subject Fw: Nation Fire Retardant Consultation- New short procedure to get species effects determinations changed from LAA to NLAA. Note: You need to act quickly for this shortcut!!!

Dennis,
Just wanted to make you aware that this is happening right now. Too bad we couldn't have had these instructions out a month ago to give us time to do a good job rather than this fire drill. Call me if you want to discuss this. Many FOs have contacted me on changing the National BA effects determination from LAA to NLAA. Hopefully, most of these species can be added to the list by Wednesday.
Thanks,
Ken
----- Forwarded by Kenneth Graham/R4/FWS/DOI on 08/15/2011 11:23 AM -----

Kenneth Graham/R4/FWS/DOI

08/15/2011 11:18 AM

To
Bill Pearson/R4/FWS/DOI@FWS, Brad Rieck/R4/FWS/DOI@FWS, Brian Cole/R4/FWS/DOI@FWS, Cary Norquist/R4/FWS/DOI@FWS, Dan Everson/R4/FWS/DOI@FWS, Dave Hankla/R4/FWS/DOI@FWS, Dawn Jennings/R4/FWS/DOI@FWS, Donald Imm/R4/FWS/DOI@FWS, Donna Line/R4/FWS/DOI@FWS, Edwin Muniz/R4/FWS/DOI@FWS, Jay Herrington/R4/FWS/DOI@FWS, Jim Boggs/R4/FWS/DOI@FWS, Joe Pittman/R4/FWS/DOI@FWS, John Doresky/R4/FWS/DOI@FWS, John Hammond/R4/FWS/DOI@FWS, Jon Hemming/R4/FWS/DOI@FWS, Laura Rogers/R4/FWS/DOI@FWS, Lee Andrews/R4/FWS/DOI@FWS, Marelisa Rivera/R4/FWS/DOI@FWS, Marisel Lopez/R4/FWS/DOI@FWS, Mary E Jennings/R4/FWS/DOI@FWS, Melvin Tobin/R4/FWS/DOI@FWS, Peggy Shute/R4/FWS/DOI@FWS, Pete Benjamin/R4/FWS/DOI@FWS, Robin Goodloe/R4/FWS/DOI@FWS, Sandy Tucker/R4/FWS/DOI@FWS, Spencer Simon/R4/FWS/DOI@FWS, Stephen Ricks/R4/FWS/DOI@FWS, Strant Colwell/R4/FWS/DOI@FWS, Thomas McCoy/R4/FWS/DOI@FWS

cc

Jeff Weller/R4/FWS/DOI@FWS, Janet Mizzi/R4/FWS/DOI@FWS, Allen Ratzlaff/R4/FWS/DOI@FWS, Stan Simpkins/R4/FWS/DOI@FWS, Peggy Shute/R4/FWS/DOI@FWS, Carrie Allison/R4/FWS/DOI@FWS

Subject

Nation Fire Retardant Consultation- New short procedure to get species effects determinations changed from LAA to NLAA. Note: You need to act quickly for this shortcut!!!

To Forest Service fire retardant consultation biologists,

Please take a look at the highlights of last week's National Fire Retardant Consultation meeting with the Forest Service (below). Many of you have called or emailed me asking why a given species received a Likely to Adversely Affect (LAA) determination when a Not Likely to Adversely Affect (NLAA) determination was a more appropriate effects determination for your National Forest? Now is your chance to quickly get an LAA changed to a NLAA. Unfortunately to use the greatly shortened procedure, you will need to act quickly! You must do this by close of business on Wednesday August 17, 2011.

If you act now, the Forest Service can revise their BA to incorporate the new effects determinations. If you are too late, the species effects determination can still be changed, but the procedure will be more time consuming and cumbersome. For those species where a LAA determination should really be NLAA, you need to do three steps immediately:

1. Contact your local National Forest if you have not done so yet. Discuss whether they agree that a NLAA determination is more appropriate than a LAA for those species you are concerned about. Make sure you concur on a rationale to justify why the species is NLAA for your local NF (and have some telecon notes or an email exchange memorializing the agreement and rationale for the file records).

2. Contact the National lead for that species and let them know that you have agreed with the Forest Service that a given species effect determination for your local National Forest should be changed from LAA to NLAA. If you are the National lead and other NFs are involved, contact your counterparts in other FOs and inform them of the change to NLAA for your National Forest. Suggest that they take the lead for the species accounts if they still intend to consult formally.

3. Go to the National sharepoint site. Find the table named "NLAA justifications". List your species information. For the "applicable area" column, fill in the name of your local National Forest (or Forests) if the NLAA applies to a larger area. Fill in your agreed upon rationale in the final "justification" column. One other precaution, use the drop down menu beside the NLAA justification spreadsheet to "check out" the file. Fill in your information and check it back in. That way, we won't lose anyone's edits if two or more offices try to update the spreadsheet at the same time.

In case you have misplaced the link to the national sharepoint site, it is:

http://sharepoint.fws.net/Programs/ES/National%20Fire%20Retardant%20Sections%207%20Consultation/Forms/AllItems.aspx?SortField=LinkFilename&SortDir=Asc&View=%7b5FC47C2C%2d2B63%2d4F19%2d81AC%2d4D24F9F1BBCA%7d

Here are some example justifications that might be used as rationales for the effects determination changes. Concentrate first on the reasons that make sense for your local National Forest.

1. Historically low use of fire retardants on your National Forest. Especially if the local NF historically has treated less than one acre per

thousand over the proposed life of the project.
2. Local information on historic fire retardant misapplication indicates an extremely low likelihood of a misapplication that would go inside of the avoidance zones (remember, not all species will have avoidance buffers).
3. The fuel loads are very low in the area of the listed species making the likelihood of fire (therefore fire retardant drops) in the area unlikely (discountable).
4. The species would have a very low chance of injury or death (sensitivity) if subjected a misapplication of fire retardant.
5. The species is located far from the nearest forest/urban interface making the priority for fire retardant drops very low.
6. Low likelihood of fire in the habitat surrounding your species (making the need for or likelihood of fire retardant use very low).

OK, you get the idea. Good rationale for the effects determination change based on local information for your NF.

Call me if you have questions (404) 679-7358. Fill in your changes on the NLAA justification spreadsheet on the National sharepoint site by Wednesday August 17, 2011. Send a quick list of these NLAA species to me so I can update the assignment speadsheet. If the National species lead changes, give me the new contact information.

Thanks for your quick action on this. Now is the easiest way to get these species effect determination changes in place for your National Forest.
Ken Graham

----- Forwarded by Kenneth Graham/R4/FWS/DOI on 08/15/2011 09:50 AM -----

Charisa Morris/ARL/R9/FWS/DOI
08/15/2011 09:02 AM

To: Jana Affonso/R8/FWS/DOI@FWS, Charisa Morris/ARL/R9/FWS/DOI@FWS, Daniel Brown/RO/R1/FWS/DOI@FWS, Delfinia Montano/RO/R2/FWS/DOI@FWS, Glenn S Smith/R5/FWS/DOI@FWS, Jennifer Szymanski/R3/FWS/DOI@FWS, Kenneth Graham/R4/FWS/DOI@FWS, Patricia Cole/ARL/R9/FWS/DOI@FWS, Sarena Selbo/R6/FWS/DOI@FWS, Don Morgan/ARL/R9/FWS/DOI@FWS, Rick Sayers/ARL/R9/FWS/DOI@FWS

cc

Subject: Highlights of last week's fire meetings

Good morning, folks-

Listed below are the highlights of last week's fire meetings:

Actionable items:

ACTION: USFS would like the NLAA justifications to be included IN THE BA rather than delivered in the BO. As a reminder, these are the justifications we had planned to offer in tabular form in the front of the BO to explain why a USFS LAA was determined by USFWS to be NLAA/NE.

The table is currently up on sharepoint. If possible, please enter as much information as you can by this Wednesday (8/17/11) for inclusion in the major revision of the BA, which is planned to be final by this Friday (8/19). Please 'respond to all' if this is completely unrealistic, in which case we can notify USFS that we'll have to deliver this information in the BO. note: addendums will still be accepted after this point, but we don't want to rely too heavily on them.

FYI: The justifications referenced above would be used as reinitiation triggers (i.e., if your justification for an NLAA is the low likelihood of retardant use, but retardant is actually used, USFS must reinitiate.

QUESTION: Is everyone aware that not all species will have avoidance areas? Please check the BA to see if any particular species under analysis is actually included in the list of species that will have avoidance areas. My concern is that we will have a NE/NLAA determination based on an avoidance area that does not exist.

FOLLOW UP: Regarding the 5% monitoring question - a document will be sent out this week that I will share with you - let me know if the information within satisfies your questions

ACTION: Let me (and the BA drafters through me) know if there are any avoidance area changes ASAP (i.e., widening of buffers, addition of areas) - over 10,000 maps are about to be created this week, and we need to know which ones have to be altered.

QUESTION: Which forests have refused to engage with you? USFS wants to know (somebody's getting in trouble).

Clarifications:

We need the following information to be delivered to BA drafters (up through local forests with a cc to me with subject line, "ADD TO BA") ASAP for inclusion in this Friday's BA revision. We can include this information as addendums, but we'd prefer any known changes to be delivered now:

- Changes in effects determinations
- Changes to maps
- Changes to species lists
- Any non-mappable mitigation (e.g., spotted owl issue) ---> any info regarding this would be useful, as there is currently confusion
- Any new conservation measures (e.g., seasonal restrictions)

There are four options for capturing information or changes to information:

- BA revisions (major by 8/17, minor in addendums)
- ROD
- BO
- after BO during normal reinitiation

Thanks! More to come soon,
Charisa

****

Charisa Morris
Acting Special Assistant to the Deputy Director, FWS - 8/8/2011 - 9/2/2011
Department of the Interior
1849 C Street NW, Room 3348
Washington DC 20240
(p) 202-208-3843
(f) 202-208-6817
charisa_morris@fws.gov

From:	Dawn Kirk
To:	Steve Croy; Carol H Croy; Kenneth Landgraf; Kimberly_Smith@fws.gov; Shane_Hanlon@fws.gov; Tylan_Dean@fws.gov; Fred Huber; Duke Rankin
cc:	Leigh McDougal; Dennis Krusac
Subject:	fire retardant BA information
Date:	08/02/2011 01:39 PM
Attachments:	retardant_avoidance_gwj.zip fire retardant avoidance areas.pdf

---

Tylan, Kim, and Shane,
Here is the shapefile (NAD83, zone 17) of our proposed retardant avoidance areas as per our call last week. I also created a simple pdf map for quick viewing. It includes our special biological areas, primary and secondary I-bat areas, cow knob and peaks of otter salamander areas, and 3 spinymussel watersheds. These, in addition to the 300 foot buffer on streams, include all of our T&E species on the forest, and then some. Let us know if you have any questions or need anything else.

Dawn Kirk, Forest Fisheries Biologist
George Washington & Jefferson National Forest
PO Box 10, 27 Ranger Lane
Natural Bridge Station, VA 24579
main office 540-291-2188, desk 540-291-5211
fax 540-291-1759
dkirk@fs.fed.us

United States Department of Agriculture | Forest Service | George Washington & Jefferson National Forests | 5162 Valleypointe Parkway
Roanoke, VA 24019-3050
540/265-5100

File Code: 2600/1950/5100 **Date:** May 16, 2011
Route To:

Subject: Fire Retardants Environmental Impact Statement

To: Regional Forester, R8

We have reviewed the information for the national retardant Environmental Impact Statement. We sent Leigh McDougal specific comments on the aquatic analyses. We have the following additional comments.

Currently the BA and EIS indicate that between the year 2000 and 2010 the GWJNF has had 51 aerial retardant drops. This is incorrect. Our records show that during that time period 11 drops totaling less than 21,000 gallons were made on 5 fires on the Forest. The last time aerial retardant was used was in 2007 where one drop was made. The following table details our retardant use:

Name of fire	Year	Ranger District	Approx. amt of retardant (gal)	Number of drops
Huckleberry	2001	Eastern Divide	5,000	3
Marbleyard	2002	Glenwood-Pedler	8,000	4
Strike 3	2002	Lee	2,000	1
Cardinal	2006	Lee	4,000	2
Hoot-Owl	2007	Clinch	2,000	1

In the BA a criteria used for determining level of potential affect resulting from retardant use is whether more or less than 0.01% of the land base will be treated with retardant annually. Our Forest is approximately 1,800,000 acres in size; therefore 0.01% is 180 acres. Based on the historic use over the past ten years, plus the very low likelihood of future retardant use, we have not treated, nor will treat, more than 180 acres per year in the future with aerially applied retardant.

With this information and applied to the national screening criteria used in the draft BA the correct affect determination for federally listed species on the GWJNF would be “No Effect” for terrestrial plants and animals; and “Not Likely To Adversely Affect” for aquatic species.

/s/ Ted Coffman
TED COFFMAN
Acting Forest Supervisor

Sum

USDA United States Department of Agriculture | Forest Service | George Washington & Jefferson National Forests | 5162 Valleypointe Parkway Roanoke, VA 24019-3050 540/265-5100

File Code: 2670
Date: July 3, 2007

Ms. Karen L. Mayne
Virginia Field Office
U. S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

RECEIVED
JUL 12 2007
Virginia Field Office

Dear Ms. Mayne,

In 2004 our agencies cooperatively developed and finalized the George Washington and Jefferson National Forests Federally Listed Threatened and Endangered Mussel and Fish Conservation Plan (Conservation Plan). This document provided direction for efforts to protect and restore Federally listed mussel and fish fauna within and adjacent to National Forest land. As stated in the document, Conservation Plan standards apply within the 6th level Hydrologic Unit Code (HUC) watersheds that contain one or more Federally listed fish or mussel species, or designated/proposed critical habitat. These watersheds are listed in Appendix E of the Conservation Plan. In addition, if a Federally listed fish or mussel species is found in a new watershed, that watershed would be added to the Conservation Plan.

In March 2005, the Virginia Department of Conservation and Recreation refined the boundaries of the 6th level HUC watersheds. The process was finalized in May 2007.

This letter is to update the watersheds covered by the Conservation Plan, which have been changed because of one or both of the following reasons:

1. New species locations.
2. New HUC codes and boundaries.

Attached are a map and a crosswalk of the new and old HUC watersheds. Please let me know if you concur with the changes. If you have any questions, you can call me at 540/265-5170 or Dawn Kirk at 540/291-5211.

Sincerely,

Kenneth Landgraf

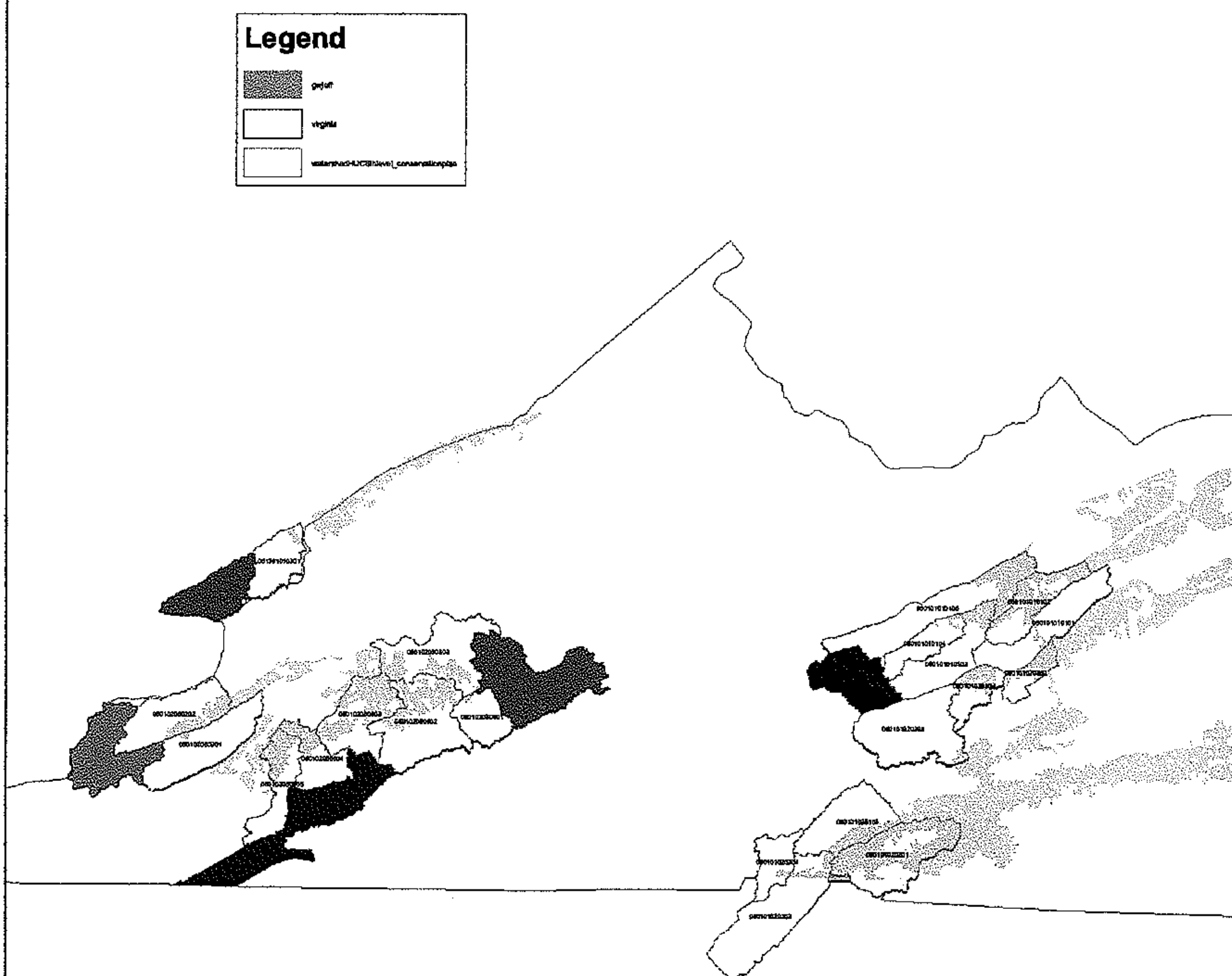
KENNETH LANDGRAF
Planning & Forest Ecology Staff Officer

George Washington & Jefferson National Forests

6th Level HUC watersheds to be included in the Fish & Mussel Conservation Plan, July 2007			
STATE	HUC6	HUC6_NAME	OLD HUC 12
WV	020802010401	South Fork Potts Creek-North Fork Potts Creek	0208020106WV
VA	020802010402	Trout Branch-Potts Creek	0208020103I10
VA	020802010403	Mill Branch-Potts Creek	
VA	020802010404	Cast Steel Run-Potts Creek	0208020103I11
VA	020802010405	Hays Creek-Potts Creek	
VA	020802010601	Wolfe Draft-Cowpasture River	0208020106I12
VA	020802010602	Shaws Fork	
VA	020802010603	Benson Run-Cowpasture River	
VA	020802010701	Scotchtown Draft-Cowpasture River	0208020106I14
VA	020802010702	Dry Run	
VA	020802010703	Thompson Creek-Cowpasture River	
VA	020802010801	Mill Creek-Cowpasture River	NOT INCLUDED IN PREVIOUS
VA	020802010803	Simpson Creek-Cowpasture River	
VA	020802011001	Trout Creek-Craig Creek	0208020108I19
VA	020802011003	Broad Run-Craig Creek	
VA	020802011101	Upper Johns Creek	0208020108I21
VA	020802011102	Lower Johns Creek	
VA	020802011201	Rolands Run Branch-Craig Creek	0208020108I22
VA	020802011202	Barbours Creek	
VA	020802011203	Mill Creek-Craig Creek	
VA	020802011204	Patterson Creek	
VA	020802011205	Roaring Run-Craig Creek	
VA	020802011302	Town Branch-Catawba Creek	0208020107I25
VA	020802011501	Purgatory Creek-James River	0208020109I27
VA	020802011502	North Creek-Jennings Creek	
VA	020802011503	Roaring Run-James River	
VA	020802011505	Elk Creek-James River	0208020109I28
VA	020802020104	Hamilton Branch	0208020201I30
VA	020802020105	Fridley Branch-Calfpasture River	
VA	020802020106	Cabin Creek-Mill Creek	
VA	020802020108	Guys Run-Calfpasture River	
VA	020802020506	Poague Run-Maury River	NOT INCLUDED IN PREVIOUS
VA	020802030201	Lynchburg Reservoir-Pedlar River	0208020301H02
VA	020802030202	Browns Creek-Pedlar River	
VA	020802030203	Horsley Creek-Pedlar River	
VA	030101010201	Dry Run-North Fork Roanoke River	0301010101L02
VA	030101010401	Buffalo Creek-Tinker Creek	0301010102L05
VA	030101010403	Glade Creek-Tinker Creek	
KY	051301010301	Bad Branch-Poor Fork Cumberland River	051301010101
VA	060101010101	McDonald Branch-North Fork Holston River	0601010101O09
VA	060101010102	Lynn Camp Creek-Lick Creek	
VA	060101010103	Sprouts Creek-North Fork Holston River	
VA	060101010104	Locust Cove Creek-North Fork Holston River	0601010101O01
VA	060101010105	Laurel Creek	
VA	060101020103	Mill Creek-South Fork Holston River	0601010201O02
VA	060101020201	Big Laurel Creek-Whitetop Laurel Creek	
VA	060101020203	Beaverdam Creek-Laurel Creek	
VA	060101020204	Rockhouse Run-South Fork Holston River	

STATE	HUC6	HUC6_NAME	OLD HUC 12
VA	060101020302	Bear Creek	NOT INCLUDED IN PREVIOUS
VA	060101020304	Hungry Mother Creek	0601010202O04
VA	060101020305	Walker Creek-Middle Fork Holston River	
VA	060102050503	Toms Creek-Guest River	NOT INCLUDED IN PREVIOUS
VA	060102050601	Sinking Creek-Clinch River	0601020504P09
VA	060102050602	Little Stony Creek-Clinch River	
VA	060102050603	Straight Fork-Stony Creek	NOT INCLUDED IN PREVIOUS
VA	060102050604	Cove Creek	0601020505P13
VA	060102050605	Stock Creek	
VA	060102060201	Camp Creek-Powell River	0601020601P19
VA	060102060202	Reeds Creek-North Fork Powell River	

Federally Listed Mussel & F
New 6th Lev



d.kirk July 3, 2007

RECEIVED
MAR 3 0 2004
Virginia Field Office

United States Department of Agriculture | Forest Service | George Washington & Jefferson National Forests | 5162 Valleypointe Parkway
Roanoke, VA 24019-3050
540/265-5100

File Code: 2670
Date: March 23, 2004

Karen Mayne
Project Leader
U.S. Fish and Wildlife Service
6669 Short Lane
Gloucester, VA 23061

Dear Ms. Mayne,

The George Washington and Jefferson National Forests have revised the Federally Listed Mussel and Fish Conservation Plan (Conservation Plan) following discussions with your office. The Conservation Plan applies to the watersheds listed in its Appendix E. These watersheds are generally any 6^{th} level watershed that contains federally listed mussel or fish species, or designated or proposed critical habitat. If a federally listed fish or mussel species is found in a new watershed, that watershed will be added to the Conservation Plan.

If a site-specific field investigation determines the need to vary the width of the Conservation Zone, that width shall become the project level Conservation Zone. This new Zone shall be determined by an interdisciplinary analysis that includes the U.S. Fish and Wildlife Service.

We believe that the implementation of the Conservation Plan will maintain riparian function, protect water quality and habitat for federally listed aquatic species, and make a positive contribution to endangered mussel and fish recovery efforts. If this Conservation Plan is fully implemented and its provisions are incorporated in actions taken by the National Forest, we feel those actions will usually result in a "may affect, not likely to adversely affect" determination, triggering informal consultation with your office.

Please review the revised Conservation Plan. If the changes are acceptable, we will implement them upon receipt of your reply.

If you have any questions please contact Dawn Kirk at 540-291-5211 or Fred Huber at 540-265-5157.

Sincerely,

Bill Damon

WILLIAM E. DAMON, JR
Forest Supervisor

Attachments

1. Mussel and Fish Conservation Plan, March 3, 2004
2. Deerfield District map of upper Cowpasture Watershed, to be added to the Conservation Plan as per USFWS recommendation.

GEORGE WASHINGTON AND JEFFERSON NATIONAL FORESTS

FEDERALLY LISTED THREATENED AND ENDANGERED MUSSEL AND FISH CONSERVATION PLAN

Dawn Kirk and Fred Huber

March 3, 2004

Table Of Contents

Introduction

The Southeastern United States supports the greatest diversity of freshwater mussel species in the world (Parmalee and Bogan 1998), and the richest freshwater fish fauna in North America north of Mexico (Warren et al. 2000). A large number of these species occur on or near the George Washington and Jefferson National Forests (the Forest), including many that are federally threatened or endangered. In fact, the upper Clinch River contains more imperiled species than any other watershed in the United States (Stein et al. 2000).

The Forest recognizes the need to be proactive and consistent in the treatment and management of these species. The purpose of this Conservation Plan is to develop standards, in cooperation with the U.S.D.I. Fish and Wildlife Service, which adequately protect federally listed mussels and fish, and their habitats. Williams et al. (1992) urged natural resource agencies to manage entire ecosystems, rather than individual species, to protect aquatic resources. Accordingly, this Plan uses a watershed approach, and contains information on life history, threats, conservation and protection strategies, and monitoring.

The imperilment of Southeastern mussels and fish is not the direct result of failed stewardship by Federal land managers, but ultimately the result of societal neglect and disregard for aquatic habitats and water quality. It is believed that, given favorable opportunities and protection of vital habitats, this fauna is capable of some level of recovery and the downward spiraling trend of these populations can be reversed.

In 2001 the U.S. Forest Service published "A Conservation Assessment of Freshwater Fauna and Habitat in the Southern National Forests" (McDougal et al. 2001) that provides a broad framework to address the conservation of at-risk aquatic species in the Southern Region. This assessment, along with other regional initiatives (including the Forest Service's Watershed Assessments (EWAP 2002) and the Jefferson National Forest Revised Land and Resource Management Plan's Riparian Corridor Prescription, The Nature Conservancy's "Rivers of Life" (Master et al. 1998), and the Southeast Aquatic Research Institute's "Aquatic Fauna in Peril" (Benz and Collins 1997)) provides a basis for this Conservation Plan. It is hoped that this Conservation Plan will provide solid direction for current and future efforts to protect and restore mussel and fish fauna within and adjacent to the George Washington and Jefferson National Forests.

Life History and Conservation

Federally Listed Freshwater Mussels

The North American freshwater mussel fauna is comprised of about 297 species, of which approximately 80 are known to occur in Virginia. Endangered or threatened mussel species that occur on or near the George Washington and Jefferson National Forests can be divided into three river system groups; the Tennessee, New, and James. The number of mussel species that occurs in each river system varies widely, with 10 species found in the New River drainage, 14 species in the James drainage, and about 56 species in the upper Tennessee drainage. See Appendix A for range and habitat information. Table 1 lists the 19 federally endangered mussel species on or near the Forest.

Table 1. Federally endangered mussel species on or near the George Washington and Jefferson National Forests.

Species name	Common name	Federal Status
Cyprogenia stegaria	fanshell	E
Dromus dromas	dromedary pearlymussel	E
Epioblasma brevidens	Cumberlandian combshell	E
Epioblasma capsaeformis	oyster mussel	E
Epioblasma florentina walkeri	tan riffleshell	E
Epioblasma torulosa gubernaculums	green-blossom pearlymussel	E
Fusconaia cor	shiny pigtoe	E
Fusconaia cuneolus	fine-rayed pigtoe	E
Hemistena lata	cracking pearlymussel	E
Lampsilis abrupta	Pink mucket pearlymussel	E
Lemiox rimosus	birdwing pearlymussel	E
Pegias fabula	little-winged pearlymussel	E
Pleurobema collina	James spinymussel	E
Pleurobema plenum	rough pigtoe	E
Quadrula cylindrica strigillata	rough rabbitsfoot	E
Quadrula intermedia	Cumberland monkeyface	E
Quadrula sparsa	Appalachian monkeyface	E
Villosa perpurpurea	purple bean	E
Villosa trabalis	Cumberland bean	E

Adult freshwater mussels are filter feeders and orient themselves in the bottom substrate to siphon water for food. Mussels are known to consume a variety of available particles including detritus, bacteria, diatoms, phytoplankton, zooplankton, and other microorganisms. Since mussels are benthic organisms and filter feeders, they are very susceptible to water pollution and physical stream changes. Suitable substrate for most of the above freshwater mussels is a mixture of coarse to fine gravel and sand, in medium to large size warmwater rivers.

The complex life cycle and specific habitat requirements of some freshwater mussels make them vulnerable to habitat changes. In comparison to other invertebrate groups, mussels are extremely long-lived, with life spans of 100 to 200 years for certain species. Species with heavy shells that inhabit large coolwater rivers tend to have longer life spans. Most mussel species have separate male and female individuals although some species are hermaphroditic. Males produce sperm, which is released into the water column, and females siphon them into their gills to fertilize eggs. The resulting zygotes become specialized larvae called glochidia. Most glochidia need to parasitize a fish host for a few weeks before they are able to transform into an adult mussel. Often, the mussel relies on a particular species of fish as a host. Many mussel species have developed ingenious ways of attracting the right fish host species by imitating prey items. The decline of specific fish host species may present a problem in mussel reproduction. See Appendix C for mussel fish host information.

Recent assessments of North America's mussel fauna recommended conservation status for 67 to 75 percent of the species (Master et al. 1998, Watters 2000). No other wide-ranging animal group in North America is undergoing such a high degree of imperilment. Thirty-seven species are presumed or possibly extinct and 69 species are federally listed as threatened or endangered (Stein et al. 2000). The adverse modification and destruction of aquatic habitats, water pollution, and the introduction of non-indigenous species, have been the major causes of mussel declines and extinctions during this century (Stein et al. 2000).

Federally Listed Fish

The Southeastern native freshwater fish fauna is comprised of about 490 species, of which 201 are known to live in Virginia, 148 in West Virginia, and 220 in Kentucky (Etnier, 1997). In Virginia alone, 21 fish species (10% of the native fish fauna) are considered imperiled. Federally threatened or endangered fish that occur on or near the George Washington and Jefferson National Forests are found in 3 distinct river systems; the upper Tennessee drainage (4 species), the Cumberland drainage (1 species), and the Roanoke drainage (1 species). These are listed in Table 2 below.

Table 2. Federally threatened and endangered fish species on or near the George Washington and Jefferson National Forests

Species name	Common name	Federal Status	Preferred Habitat*	Reason for Status**
Cyprinella monacha	spotfin chub	T	MR	Altered flow, NPSP
Erimystax cahni	slender chub	T	MR	Altered flow, NPSP
Etheostoma percnurum	duskytail darter	E	MR	Altered flow, NPSP
Noturus flavipinnis	yellowfin madtom	T	CR	NPSP
Percina rex	Roanoke logperch	E	MR	NPSP, small range
Phoxinus cumberlandensis	blackside dace	T	HW	NPSP

*MR = medium river
CR = creeks
HW = headwaters (orders 1 and 2)
**NPSP = non-point source pollution
(Table adapted from Etnier, 1997)

As demonstrated by the table above, of all the factors contributing to the jeopardized status of Southeastern native freshwater fishes, non-point source pollution (primarily siltation) and alteration of flow regimes (primarily impoundment) are the largest contributors to fish imperilment. Etnier (1997) points out that these two anthropogenic factors are responsible for 72% of imperilment problems, while 23% is the result of the non-anthropogenic factor of a small native range. The remaining 5% contribution toward jeopardizing Southeastern fish is divided between the introduction of exotics, point-source pollution, overzealous collectors, and unknown factors.

General Threats and Conservation Needs

Introduced Species - Invasive introduced and/or non-indigenous species of both mussels and fish have contributed to the extinction and decline of native species and continue to cause problems through predation, competition for food and space, and genetic swamping through hybridization (Williams and Meffe 2000). The following examples highlight the problems often caused by introduced species.

Asian clam - The introduced Asian clam, *Corbicula fluminea*, is a significant threat and is the most widespread nonindigenous mollusk in the Unites States, invading the southern region in the 1950's (Williams and Meffe 2000). Once established in a watercourse, populations of this species can expand rapidly and reach high densities. The Asian clam predominates in rivers altered by human activities, and it may exclude unionid mussels. Asian clams may out-compete native mussels because they are hermaphroditic, require no fish host, spawn twice a year, and produce large broods (U.S.D.I. Fish and Wildlife Service 1990). Currently, there is no effective means to control the Asian clam, and no management for this species is possible at this time.

Zebra mussel – This exotic species, *Dreissena polymorpha*, from the Black and Caspian Seas probably was introduced to North America in 1985 or 1986 in Lake St. Clair. By 1996 it had spread throughout the Great Lakes, the St. Lawrence, Hudson, and Mohawk rivers, and the Illinois, Ohio, and Mississippi rivers in the Midwest south to the lower Tennessee and Cumberland rivers (Parmelee and Bogan 1998). Zebra mussels were discovered August 3, 2002 by a recreational diver in Millbrook Quarry adjacent to the Broad Run near Haymarket, Virginia. It appears that they are established as there may be several year classes present. Zebra mussel colonies compete with native mussel species for food and space. They also may attach to the native mussel shells, interfering with movement or cause damage to the shell edges. Unlike unionid mussels, zebra mussels do not require a fish host and have free-swimming veliger larvae, this makes them especially mobile within a waterway.

Physical Habitat Modification (direct and indirect)

Impoundments - River impoundments in the Southeast have been responsible for the decline of many mussel and fish populations. Mussel and fish populations have been reduced or eliminated from large sections of the Tennessee and Cumberland rivers in Tennessee and Kentucky by the construction of more than 50 dams (U.S.D.I. Fish and Wildlife Service 1990). Closure of dams changes habitat from lotic to lentic conditions. Depth increases, flow decreases, and silt accumulates on the bottom. Hypolimnetic discharge lowers water temperatures downstream. Fish communities change, and mussel host fish species may be eliminated or be prevented from transporting glochidia past dams. Mussel communities change as species requiring clean gravel and sand substrate are replaced by silt-tolerant species. Impoundments have also contributed to the fragmentation of contiguous populations of species. These isolated populations are more susceptible to perturbation and extinction (Burkhead and Jelks 2000).

Stream channelization – Both fish and mussels are tied to specific habitats for all or part of their life cycles. Channelization of rivers and streams alters not only the substrate, but also water depth, velocity, and larger habitat units (i.e. pools, riffles, runs). Channelization of a river reach can make that area uninhabitable by certain fishes or mussels and can be a barrier to movement (Benz and Collins 1997).

Sedimentation – Natural sedimentation resulting from seasonal storm events probably does not significantly affect mussels, but human activities often create excessively heavy silt loads that can have severe effects on mussels and other aquatic organisms. Siltation not only changes the substrate in which the mussels live, making it less suitable habitat, but suspended sediment can clog the gills of the filter-feeding mussels and eventually suffocate them. Mussels often respond to heavy silt loads by closing their valves. This can lead to reduced siphoning activity, and, therefore, reduced feeding. Siltation can severely stress mussels and lead to chronic effects (U.S.D.I. Fish and Wildlife Service 1990). Dennis (1985) found that suspended silt is limiting to freshwater mussels due to dilution of the food source rather than by affecting filtration or respiration.

Fish are directly affected by sedimentation through abrasion on the gills and body surface. They are indirectly affected through reduced visibility for feeding, reduced oxygen in sediment-laden water, substrate alteration for spawning sites, and increased egg mortality (Jenkins and Burkhead 1994). McDougal et al. (2001) state that:

> "Sediment is probably the most pervasive nonpoint pollution that affects streams on national forests. Sedimentation is caused by soil erosion from ground-disturbing activities such as roads, poorly designed or nonbuffered land use activities, mining, and construction. Many historic roads on national forest were built in poor locations (i.e. along streams): many of which are still in use today. Sedimentation can negatively affect aquatic ecosystems by reducing habitat complexity and diversity."

Physical Damage - Livestock and vehicles in streams can cause significant mortality to mussels in isolated areas. Not only does the impact of hooves and tires crush and injure mussels (Huber and Kirk 2001 pers. obs.), it compacts and alters the substrate, making it unsuitable for future mussel colonization. In addition to physical damage to the stream channel, damage to the stream bank and riparian area can alter nutrient input into the stream, water temperature, and stream channel morphology and stability (Hornbeck and Kochenderfer 2000).

Pollutants (includes pesticides, nutrient pollution, and industrial wastes) - Freshwater mussel and fish populations have been reduced and, in some cases, completely extirpated from lakes and streams by pollutants from municipal, industrial, and agricultural sources. Agricultural runoff, including fertilizer, nutrients, and pesticides is a major source of impairment to Virginia's waterways (FORVA 2001). Effluents impacting aquatic organisms include industrial discharges, fly ash and sulfuric acid spills, acid mine drainage, organic wastes, insecticides, and chlorinated sewage. Acid rain may also pose a threat to fish and mussels inhabiting poorly buffered systems (U.S.D.I. Fish and Wildlife Service 1990). Direct effects of pollutants may include physiological stress and mortality. Indirect effects may include habitat changes and food web alterations. In addition, sub-lethal bioaccumulation of toxins can reduce overall health and fitness of an individual or population. Fish advisory warnings are currently in place on five river reaches in Virginia (for mercury, PCB's, and kepone) (FORVA 2001).

Specific Conservation and Protection Strategies

Protection of aquatic habitat and associated upstream resources on National Forest land will be achieved through the protection of riparian ecosystems from the impacts described above. In addition, a proactive approach will be taken to not only protect riparian ecosystems, but to restore degraded areas where appropriate.

True riparian ecosystems may have extremely variable widths and require site-specific delineation. Riparian areas are functionally defined as areas with three-dimensional ecotones of interaction that include both terrestrial and aquatic ecosystems. They extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain into the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width (Ilhardt et al. 2000). A Riparian Corridor, on the other hand, is a management prescription area designed to include much of the Riparian area. Within the riparian corridor management prescription area, management practices are specified to maintain riparian functions and values. As a management prescription area, this includes corridors along all defined perennial and intermittent stream channels that show signs of scour, and around natural ponds, lakeshores, wetlands, springs, and seeps. Channeled ephemeral streams, on the other hand, are ephemeral streams that have a defined channel of flow where surface water converges with enough energy to remove leaf litter, organic matter, and soil. Ephemeral streams that exhibit an ordinary high watermark and show signs of annual scour or sediment transport are considered navigable waters of the United States (USACE, Part 330- Nationwide Permit program, 2000) (33 CFR 330). The Channeled Ephemeral Zone extends 25 feet on each side of a channeled ephemeral stream.

To facilitate implementation of workable standards, a Conservation Zone will be established and managed. The Conservation Zone will include the Riparian Corridor and the Channeled Ephemeral Zone.

Forests within the Conservation Zone are important because they provide aquatic coarse woody debris recruitment, aquatic particulate and dissolved organic matter input, water temperature and light regulation, bank stability, regulation of sediment, nutrient, and organic matter movement or uptake, and terrestrial habitat for riparian species. They also provide conditions for natural floodplain function. The Conservation Zone will serve as a 1) filter strip to impede surface runoff, trap sediment, and filter and adsorb pollutants, 2) vehicle exclusion zone to prevent major ground disturbance adjacent to stream channels, and 3) shade strip to help maintain ambient stream water temperatures, moist habitats, and sources for large woody debris.

Determination of Riparian Corridors

For project planning and implementation, the following process will be used to determine the extent of site-specific riparian corridors. Riparian corridor widths are designed to encompass the riparian area defined on the basis of soils, vegetation and hydrology and the ecological functions and values associated with the riparian area.

The widths in Table 3 shall be used to define the riparian corridor if the corridor is not site-specifically determined as described below.

If a site-specific field investigation determines the need to vary the widths in Table 3, that width shall become the project level riparian corridor. This corridor shall be determined by an interdisciplinary analysis using site-specific information to ensure that riparian values and functions are maintained. Such an interdisciplinary analysis will include the US Fish and Wildlife Service.

The slope-dependent riparian corridor widths are measured in on-the-ground surface feet perpendicular from the edge of the channel or bank (stream, water body, etc.) and extend out from each side of a stream. For ponds, lakes, sloughs, and wetlands (including seeps or springs associated with wetlands) the measurement would start at the ordinary high water mark and go around the perimeter. For braided streams, the outermost braid will be used as the water's edge. An interrupted stream (a watercourse that goes underground and then reappears) will be treated as if the stream were above ground. (An acceptable level of error for on-the-ground measurements of these widths is ± 10%.) The riparian corridor includes human-created reservoirs, wildlife ponds, wetlands, and waterholes connected to or associated with natural water features. In addition, those areas not associated with natural water features, but support riparian flora or fauna, will have a riparian corridor designation.
Table 3 does not apply to constructed ponds developed for recreation uses; or to human-made ditches, gullies, or other features that are maintained or in the process of restoration. For these areas, site-specific analysis will determine the appropriate protective measures.

Table 3. Minimum Conservation Zone Widths For Federally Listed Mussel and Fish Species (In Feet, Measured As Described Above) On Each Side Of Stream

	Slope Class		
	0-10% Core Area	**11-45%** Core Area Plus Extended Area†	**45%+** Core Area Plus Extended Area†
Perennial*	100	125	150
Intermittent	50	75	100
Channeled ephemeral	25	25	25

***Perennial streams, lakes, ponds, wetlands, seeps, and springs**

†The Extended Area is the outer 25 feet (on 11-45 % slopes) and 50 feet (on 45 % + slopes). Vegetation management activities are stratified into two sections of the riparian corridor. The core of the corridor is the area within 100 feet each side of perennial streams, lakes, ponds and wetlands and the area within 50 feet each side of intermittent streams. Within the core of the riparian corridor, vegetation management activities, including prescribed fire, may take place to maintain, restore, and/or enhance the diversity and complexity of native vegetation, rehabilitate both natural and human-caused disturbances, and provide habitat improvements for aquatic and riparian- associated wildlife species (including migratory birds), provide for visitor safety, or to

accommodate appropriate recreational uses. Silvicultural treatments, including timber and vegetation removal, may occur within the riparian corridor, but the corridor will be classified as not suitable for timber production.

When slopes exceed ten percent, the riparian corridor is extended beyond the core area. Within this extended portion of the corridor, vegetation management activities may take place to meet the objectives of the adjacent management prescription. However, these activities will be constrained by the standards in this riparian corridor prescription. Silvicultural treatments, including timber and vegetation removal, may occur within the extended section of the corridor. This extended section of the corridor can be classified as suitable for timber production if the adjacent management prescription is suitable. Prescribed fire can be used within the corridor to create or maintain the composition and vitality of fire-dependent vegetative communities.

Conservation Goals, Objectives, and Standards

Where these standards apply

The standards listed in this Conservation Plan for Federally listed fish and mussels apply within the watersheds listed in Appendix E (these are generally any 6^{th} level watershed that contains one or more of these species or designated or proposed critical habitat). If a Federally listed fish or mussel species is found in a new watershed, that watershed will be added to the Conservation Plan. The Conservation Plan standards are consistent with the 2004 Revised Jefferson National Forest Land and Resource Management Plan, but vary from the 1993 Revised George Washington National Forest Land and Resource Management Plan. If the standards are modified, an interdisciplinary analysis will be needed, and will include the US Fish and Wildlife Service. See Appendix F for a description of the designated and proposed critical habitat.

A. Goals and Objectives

Goal 1 Manage watersheds to maintain or restore resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support beneficial water uses. Instream flows (or lake levels) provide the amounts necessary to: 1) maintain the capacity of the channels to transport water and sediment; 2) protect aquatic organisms; 3) sustain or restore riparian habitats and communities; and 4) provide for recreation, scenic, aesthetic, and research purposes.

Objective 1.01 Maintain or restore temperature, balance of water and sediment, chemical resilience, and biological integrity (see also Objective 3.01).

OBJECTIVE 1.03 The instream flows needed to protect stream processes, aquatic and riparian habitats and communities, and recreation and aesthetic values will be determined on selected streams as identified by the Forest.

Goal 2 Manage and restore riparian ecosystems, wetlands and aquatic systems protect and maintain their soil, water, vegetation, fish, wildlife, and other resources. Channeled ephemeral streams maintain the ability of the land to filter sediment from upslope disturbances and to provide forest material as nutrient input while achieving the goals of the adjacent management prescription area.

Objective 2.01 Streamsides are managed in a manner that restores and maintains amounts of large woody debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian species (approximately 200 pieces per stream mile).

Goal 3 Aquatic habitat conditions are suitable to maintain aquatic species native to the planning area, and to support desirable levels of selected species (e.g., species with special habitat needs, species commonly fished, or species of special interest).

Objective 3.01 Streams are managed in a manner that results in sedimentation rates that stabilize or improve the biological condition category of the stream as monitored using aquatic macroinvertebrates.

Objective 3.02 Maintain a stable and/or increasing population trend for Blackside dace and James spinymussel.

B. Standards

1. Riparian Corridor Standards (Perennial and intermittent water bodies)

Standards refer to the entire riparian corridor (core and extended area) unless specified otherwise. Numbers to the left of the standard refer to the numbers assigned in the Jefferson National Forest Land and Resource Management Plan. In addition to the standards below, all relevant sediment and erosion control standards in the respective Forest Plans will apply.

General

11-001 Any human caused disturbances or modifications that may concentrate runoff, erode the soil, or transport sediment to the channel or water body are rehabilitated or mitigated to reduce or eliminate impacts. Channel stability of streams is protected during management activities.

11-002 Motorized vehicles are restricted to designated crossings. Motorized vehicles may be allowed on a case-by-case basis, after site-specific analysis, outside of designated crossings where it can be shown to benefit riparian resources.

11-003 Management activities expose no more than 10 percent mineral soil within the project area riparian corridor.

Aquatic Habitats within Streams and Rivers

11-004 The removal of large woody debris (pieces greater than 4 feet long and 4 inches in diameter on the small end) is allowed if it poses a risk to water quality, degrades habitat for aquatic or riparian wildlife species, impedes water recreation (e.g. rafting) or when it poses a threat to private property or Forest Service infrastructure (e.g., bridges). The need for removal must be determined on a case-by-case basis.

11-005 The addition of large woody debris for stream habitat diversity will generally favor stream reaches with an average bank full width of less than 30 feet in Rosgen B channel types. Log length will generally be 50% greater than bank full width. In stream reaches where there may be potential debris impacts to downstream private or public infrastructure (e.g., bridges) or to water-based recreation (e.g. rafting), the active recruitment (placement) of large woody debris will be limited in quantity and scope.

11-006 Stocking of new nonnative species and stocking of previously unstocked areas is not allowed where it will negatively impact native aquatic species or communities. Prior to any stocking, national forests coordinate with the appropriate State and Federal agencies to ensure that populations and habitats of native species are maintained.

11-007 Restoration of chemical integrity of aquatic ecosystems (from impacts such as acid deposition and acid mine drainage) is allowed on a site-specific basis for protection or for restoration of aquatic species.

11-008 Instances where the flow regime is modified for other purposes (such as reservoir releases for recreational sports or hydroelectric demand), evaluate instream flow needs in accordance with the national strategy for water rights and instream flows.

11-009 In-stream habitat improvements, and stream-connected disturbance will be designed and implemented after consideration of the life-cycle requirements of federally listed aquatic species.

Terrestrial Species

11-010 Existing permanent wildlife openings may be maintained within the riparian corridor. However, permanent wildlife openings identified as causing environmental degradation through concentrated runoff, soil erosion, sediment transport to the channel or water body are mitigated or closed and restored. New permanent wildlife openings within the riparian corridor are permitted where needed to provide habitat for riparian species, or threatened, endangered, sensitive, and locally rare species.

11-011 Use no-till mechanical cultivation methods for maintenance of wildlife openings.

11-012 Up to 2 percent early successional forest habitat may be created when the riparian corridor falls within the Ruffed Grouse/Woodcock Habitat Management Prescription 8.E.1. (measured within riparian corridor across geographically contiguous prescription block).

Rare Communities and Old Growth

11-013 Management actions that may negatively alter the hydrologic conditions of wetland rare communities are prohibited. Such actions may include livestock grazing and construction of roads, plowed or bladed firelines, and impoundments in or near these communities. Exceptions may be made for actions designed to control undesirable impacts caused by beavers, or where needed to control fires to provide for public and employee safety and to protect adjacent private land resources. Beaver impoundments may be removed if they are negatively affecting federally listed species.

11-014 Introducing fish into wetland rare communities is prohibited.

11-015 Canebrake restoration efforts may occur on sites currently supporting cane (*Arundinaria gigantea* or *A. tecta*) and may occur on sites known to historically support cane. Management actions will be designed to increase the vigor, density, and area of existing patches of cane. Actions used to restore canebrakes will include prescribed burning on a 7 to 10 year return cycle, control of competing vegetation, and overstory reduction or removal.

Vegetation and Forest Health

11-016 Insect and disease control measures will be determined on the basis of risk to adjacent resources, long-term sustainability, and appropriate needs for the function and condition of the riparian area. Cut and leave is the preferred method for control and suppression of insects and disease in the core of the riparian corridor. Cut and remove is permitted in the extended area beyond the core. Other control measures may be used when a condition poses a risk to stream stability, degrades water quality, adversely affects habitat for aquatic or riparian species, poses a threat to public safety or facilities, or when "cut and leave" is not effective.

11-017 Tree removals from the core of the riparian corridor may only take place if needed to:

- Enhance the recovery of the diversity and complexity of vegetation native to the site;
- Rehabilitate both natural and human-caused disturbances;
- Provide habitat improvements for aquatic or riparian species, or threatened, endangered, sensitive, and locally rare species;
- Reduce fuel buildup;
- Provide for public safety;
- For approved facility construction/renovation; or
- As allowed in standards 11-012 and 11-022.

11-018 Tree removals from the extended area beyond the core of the riparian corridor may take place to meet the objectives of the adjacent management prescription.

Timber Management

11-019 Lands in the core of the riparian corridor are classified as not suitable for timber production. Vegetation management may be accomplished with commercial timber sales when that is the most practical or economically efficient method.

11-020 Lands in the extended area beyond the core of the riparian corridor are suitable for timber harvest when the adjacent management prescription is also suitable.

11-021 When timber harvest occurs in the extended area beyond the core of the riparian corridor for purposes of meeting the objectives of the adjacent management prescription, then vehicles will be excluded from the extended area.

11-022 Corridors for cable logging in areas adjacent to the riparian corridor may cross the riparian corridor. Crossing will be at as near a right angle as possible, with full suspension preferred.

11-023 In cable logging, when full suspension is not possible, partial suspension is allowed with armoring when yarding logs across perennial and intermittent streams.

Non-timber Forest Products

11-024 Do not permit commercial collection of botanical products in the riparian corridor if it would adversely affect the functions and values of the riparian area.

11-025 Permitted firewood cutting within the riparian corridor must take into consideration large woody debris needs. Ranger Districts will identify areas where firewood cutting is not permitted due to large woody debris concerns.

Wildland Fire Management

11-026 Fire retardants should not be applied directly over open water.

11-027 Use existing fire barriers; such as streams, roads, trails, etc., for control lines where possible.

11-028 When necessary to construct fire lines with heavy equipment (e.g., bulldozers) that cross riparian areas and streams, construct turnouts that will allow runoff to be dispersed and infiltrated into the soil before reaching the stream, and then cross stream at right angle. These fire lines should be stabilized and/or revegetated as soon as possible after the fire is controlled.

Prescribed Fire and Wildland Fire Use

11-029 Plan prescribed fires to use existing barriers (e.g., streams, lakes, wetlands, roads, and trails) to reduce the need for fire line construction.

11-030 Construction of firelines with heavy mechanized equipment (e.g. bulldozers) in riparian corridors is prohibited. Hand lines, wet lines, or black lines are used to create firelines within the riparian corridor to minimize soil disturbance. Water diversions are used to keep sediment out of streams. Firelines are not constructed in stream channels, but streams may be used as firelines.

Recreation

11-031 New trails will normally be located outside of the riparian corridor except at designated crossings or where the trail location requires some encroachment (e.g. to accommodate stream crossings in steep terrain, etc.), or to manage access to water bodies.

11-032 New motorized trails are prohibited within the riparian corridor except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain. When existing OHV trails within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures (which may include OHV trail closure) will be implemented.

11-033 Motorized and non-motorized trail reconstruction and relocation within the riparian corridor are allowed to reduce impacts to riparian and aquatic resources.

11-034 Proposed recreation facilities will be located outside of the riparian corridor or 100-year floodplain (Executive Order 11988) and wetlands (Executive Order 11990) unless no practicable alternative location exists. Where future facilities cannot be located out of the 100-year floodplain, structural mitigation and best management practices will be used. Trails, campsites, and other recreational developments are located, constructed, and maintained to minimize impacts to channel banks and other resources. When existing facilities are causing unacceptable resource damage appropriate mitigation measures will be implemented. Soils are stabilized on eroding trails and recreational sites.

11-035 Where a riparian area is identified as vulnerable to environmental impacts, camping trailers and vehicles should not be allowed within 50 feet of perennial streams or lakes, except at designated areas.

11-036 Overnight tethering or corralling of horses or other livestock is not allowed within 50 feet of stream courses or lakes. Existing corral sites are maintained to limit impacts to water quality and riparian corridors until alternative sites are developed.

Scenery

11-037 Management activities are designed to meet or exceed the following Scenic Integrity Objectives, which may vary by inventoried Scenic Class:

Inventoried Scenic Class	1	2	3	4	5	6	7
Scenic Integrity Objectives	H	H	M	M	M	M	M

Range

11-038 Where grazing is currently allowed and under a permit, grazing is controlled and mitigated to restore, maintain or enhance the integrity of stream channels and banks and prevent unacceptable resource damage. Reauthorizing grazing in riparian corridors within these existing allotments may occur if continued grazing would have no unacceptable resource damage on riparian resources. New grazing allotments or new permits for inactive allotments will exclude the riparian corridor.

11-039 Where authorized by permit, livestock watering areas, stream crossings, and stream banks are managed to maintain bank stability. Designated entry points, crossings, and watering points are located, sized, and maintained to minimize the impact to riparian vegetation and function.

11-040 Feeding troughs and salt and mineral blocks are not allowed inside the riparian corridor unless the entire pasture is within the riparian corridor, in which case they are located as far away from streams as possible. Watering troughs are appropriately located to protect the streams.

Minerals

11-041 The riparian corridors are available for federal oil and gas leasing with a controlled surface use stipulation to protect riparian resources and values. Other Federal minerals may be available on a case-by-case basis after full consideration of effects on the riparian corridor.

11-042 Federal oil and gas leases exist within these corridors on the Clinch Ranger District. Roads, wells, and other necessary infrastructure associated with these leases are allowed. Existing lease stipulations are used to protect the riparian corridor.

11-043 These corridors are not available for commercial or personal mineral materials. Administrative and free use of mineral materials is allowed to restore riparian areas and aquatic habitat, control erosion and sedimentation, and repair flood damage.

11-044 Private mineral rights exist in some riparian corridors across the Jefferson National Forest. Roads, wells, and other necessary infrastructure associated with these rights are allowed. Requests for access to a non-Federal interest in lands pursuant to a reserved or outstanding right are recognized, and reasonable access is granted. Encourage such interests to minimize disturbance of riparian resources and values.

Roads

11-045 New roads are located outside the riparian corridor except at designated crossings or where the road location requires some encroachment; for example to accommodate steep terrain, or are allowed within the corridor if the road will cause more resource damage if it were located outside the corridor. When existing roads within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures will be implemented.

11-046 In-stream use of heavy equipment or other in-stream disturbance activities is limited to the amount of time necessary for completion of the project. Construction of crossings is completed on all streams as soon as possible after work has started on the crossing. Permanent and temporary roads on either side of stream crossings within the riparian corridor are graveled.

11-047 When constructing roads, each road segment will be stabilized prior to starting another segment. Stream crossings will be stabilized before road construction proceeds beyond the crossing.

11-048 To minimize the length of streamside disturbance, ensure that approach sections are aligned with the stream channel at as near a right angle as possible. Locate riparian corridor crossings to minimize the amount of fill material needed and minimize channel impacts. Generally, permanent structures or temporary bridges on permanent abutments are provided when developing new crossings on perennial streams. Permanent structures, temporary bridges or hardened fords are used when crossing intermittent streams.

11-049 Design structures (culverts, bridges, etc.) to accommodate storm flows expected to occur while the structures will be in place. Use scientifically accepted methods for calculating expected storm flows.

11-050 Design crossings so stream flow does not pond above the structure during normal flows in order to reduce sediment deposition immediately above the crossing and maintain the channel's ability to safely pass high flows.

11-051 Design the crossing so that stream flow will not be diverted along the road if the structure fails, plugs with debris, or is over-topped.

11-052 If culverts are removed, stream banks and channels must be restored to a natural size and shape. All disturbed soil must be stabilized.

11-053 Fords associated with new road construction are not used in perennial streams without site-specific environmental analysis. Establish fords only under conditions that will not cause significant streambank erosion. Erosion stone or larger rock is used to increase load bearing strength at the water/land interface.

11-054 All new stream crossings will be constructed to allow the passage of aquatic organisms, and maintain natural flow regime. Exceptions may be allowed in order to prevent the upstream migration of undesired species.

Lands and Special Uses

11-055 Riparian corridors are generally unsuitable for new human created stream channel impoundments, but may be considered on a project specific basis, consistent with appropriate Federal and state regulations. Impoundments will generally be designed to allow complete draining, with minimum flows, cold-water releases, and re-aeration in trout waters and other specific waters when needed. Downstream catch basins and fish ladders are constructed for fish salvage/passage, if necessary. New human-constructed impoundments are unsuitable on streams where federally listed species will be negatively affected.

Other Ground Disturbing Activities

11-056 For activities not already covered in the above standards, ground disturbing activities are allowed within the corridor if the activity will cause more resource damage if it were located outside the corridor, on a case-by-case basis following site-specific analysis. Any activity allowed under these conditions is minimized and effective sediment trapping structures such as silt fences, brush barriers, hay bale barriers, gravelling, etc., are required. Sediment control, prior to, or simultaneous with, the ground disturbing activities, is provided.

2. Channeled Ephemeral Zone Standards

Numbers to the left of the standard refer to the numbers assigned in the Jefferson National Forest Land and Resource Management Plan.

FW-12: Motorized vehicles are restricted in the channeled ephemeral zone to designated crossings. Motorized vehicles may be allowed on a case-by-case basis, after site-specific analysis, in the channeled ephemeral zone outside of designated crossings.

FW-13: Management activities expose no more than 10 percent mineral soil in the channeled ephemeral zone.

FW-14: Up to 50% of the basal area may be removed down to a minimum basal area of 50 square feet per acre. Removal of additional basal area is allowed on a case-by-case basis when needed to benefit riparian dependant resources.

FW-15 Permitted firewood cutting within the channeled ephemeral zone must take into consideration large woody debris needs. Ranger Districts will identify areas where firewood cutting is not permitted due to large woody debris concerns.

FW-16: At least partial suspension is required when yarding logs over channeled ephemerals.

FW-17 The removal of large woody debris is allowed if it poses a significant risk to water quality, degrades habitat for riparian species, or when it poses a threat to private property or Forest Service infrastructure (i.e. bridges). The need for removal is determined on a case-by-case basis.

FW-18 The addition of large woody debris in channeled ephemeral reaches will primary be through passive recruitment rather than active placement.

FW-19 New human-constructed impoundments are allowed on a case-by-case basis, following evaluation of downstream instream flow needs.

FW-20 When crossing channeled ephemeral streams, culverts, temporary bridges, hardened fords, or corduroy are used where needed to protect channel or bank stability.

FW-21: Construction of crossings is completed on all channeled ephemerals as soon as possible after work has started on the crossing. Permanent and temporary roads on either side of crossings within the channeled ephemeral zone are graveled.

FW-22: When culverts are removed, banks and channel must be restored to a natural size and shape. All disturbed soil must be stabilized.

FW-23 Trails, campsites, and other recreational developments are located, constructed, and maintained to minimize impacts to channel banks and other resource damage. When existing facilities are causing unacceptable resource damage, appropriate mitigation measures will be implemented. Soils are stabilized on eroding trails and recreational sites.

FW-24: New non-motorized trail construction is allowed to improve existing trail configuration and improve access.

FW-25: New motorized trails are prohibited within the channeled ephemeral zone except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain.

FW-26: Motorized and non-motorized trail reconstruction and relocation within the channeled ephemeral zone are allowed to reduce impacts to riparian and aquatic resources.

FW-27 Where grazing is currently allowed and under a permit, control and mitigate to restore, enhance, or maintain the integrity of channels and banks. Grazing permit reauthorization is allowed, provided progress towards mitigation of negative impacts on the channeled ephemeral zones has occurred. New grazing permits will be designed to prevent negative impacts to the channeled ephemeral zone. Livestock will be excluded from channeled ephemeral zones whenever the zone cannot be maintained or restored otherwise.

FW-28: Feeding troughs, watering troughs, and salt and mineral blocks are not allowed inside the channeled ephemeral zone. Watering troughs are appropriately located to protect the streams.

FW-29: During prescribed fire operations in the channeled ephemeral zone, use the least ground disturbing method of fireline construction, favor blacklines and handtools.

FW-30: Do not disk, blade, or plow fireline within the ephemeral stream channels, use them as natural firebreaks (This applies to the actual stream channel, not the entire 25 foot zone).

FW-31: Revegetate and water bar firelines as quickly as possible, where necessary to prevent erosion. Use water diversions to keep sediment out of channels.

Monitoring

Implementation
Annual implementation monitoring will be conducted for projects within the Conservation Zone in watersheds listed in Appendix E to determine if standards are being followed. Implementation monitoring is done one time for a project. See Appendix G for an example of a monitoring checklist. Results of this monitoring will be sent to the U.S.D.I. Fish and Wildlife Service.

Effectiveness
Effectiveness monitoring will be conducted within the watersheds listed in Appendix E and will consist of:
1. Direct monitoring of threatened and endangered mussel and fish populations in conjunction with Virginia Department of Game and Inland Fisheries (lead agency).
2. Direct monitoring of James spinymussel populations and habitat on Forest Service property.
3. Indirect monitoring of aquatic fauna through the use of macroinvertebrates as bioindicators of the effects of management activities on stream biota (using EPA's Rapid Bioassessment Protocol II, see Objective 3.01).

Inventory
The Forest Service will continue to inventory potential Federally listed mussel and fish habitat on Forest Service land and assist the state in additional surveys.

Appendix A

Range, Habitat and Legal Status of Federally Listed Mussel Species On or Near the George Washington and Jefferson National Forests.

Species	Common name	Range	Habitat	Fed Status	G Rank
Cyprogenia stegaria	fanshell	In VA, found in the lower Clinch River in Scott County from Dungannon to the VA-TN border.	Occupies medium to large rivers, and is associated with coarse sand and gravel substrates. It inhabits shoals and riffles of rivers with a strong current; and in water 2 to 10 feet. It is associated with shoals and well washed substrates.	E	G1
Dromus dromas	dromedary pearlymussel	In VA, found in the Powell River upstream to Rose Hill, Lee County, in the Clinch River upstream to Clinchport, Scott County, and in the North Fork of the Holston River at Hilton, Scott County.	A lotic, riffle-dwelling species that usually inhabits shoals, and fords with moderate current velocities. Occurs in deeper, slow-moving waters in TN. Typically well burrowed in silt-free, stable substrates of mixed particle sizes ranging from sand to cobble.	E	G1
Epioblasma brevidens	Cumberlandian combshell	In VA, found in the Powell River upstream to Rose Hill, Lee County, in the Clinch River upstream to Clinchport, Scott County, and in the North Fork of the Holston River at Hilton, Scott County.	Found with other riverine species in clean, gravel shoals, and riffles of medium sized streams.	E	G2
Epioblasma capsaeformis	oyster mussel	Formally widespread and locally abundant in the upper TN R. system in VA, including the Clinch, Powell, and North Fork of Holston drainages. Recent surveys of the Clinch and Powell confirm the rapid decline of this species in these rivers.	Commonly inhabited riffle and shoal areas of small to medium-sized streams. It was found in fine to coarse gravel, and in pockets of gravel between bedrock ledges in areas of swift current. It also inhabited quieter shoal areas where substrates consisted of gravels, and some mud.	E	G2

Species	Common name	Range	Habitat	Fed Status	G Rank
Epioblasma florentina walkeri	tan riffleshell	In VA, reported from the Middle Fork of Holston River, Smyth County; the South Fork of Holston River, Washington County; and the Clinch River at Cedar Bluff, Tazewell County. Its entire range appears now to be limited to one reach in the Middle Fork of Holston River near Chilhowie, Smyth County, and the one site in the Clinch River.	Riffleshells are characteristically found in lotic habitats where they inhabit clean gravel substrates. The tan riffleshell has been found in riffle and shoal areas of small to medium-sized streams.	E	G1T1
Epioblasma torulosa gubernaculum	green-blossom pearlymussel	In VA, this subspecies was reported from the North Fork of Holston River as far upstream as Holston Bridge, Scott County, and from the Clinch River as far upstream as Dungannon, Scott County. Considered extirpated in Virginia.	A riverine species that seems to require a clean gravel substrate. It is found in swift flowing water with riffles, and shoals.	E	G2TX
Fusconaia cor	shiny pigtoe	Known in VA from the North Fork of Holston River above Saltville, Smyth County; the Clinch River from the VA-TN border upstream to Nash Ford, Russell County; Copper Creek, Scott County; and Powell River from the VA-TN border upstream to Hurricane Bridge, Lee County.	A lotic species, occurring at fords, shoals, and other relatively shallow areas with moderate to fast currents. It is typically well-burrowed in stable substrates ranging from sand to cobbles.	E	S1
Fusconaia cuneolus	fine-rayed pigtoe	Known in VA in the Clinch River from the VA-TN border to Cedar Bluff, Tazewell County; Copper Creek, Scott County; Little River, Russell County; and Powell River, Lee County.	A lotic, riffle-dwelling species that usually inhabits ford and shoal areas of rivers with moderate gradient. It is typically well burrowed in stable substrates of mixed particle sizes ranging from sands to cobbles.	E	G1
Hemistena lata	cracking pearlymussel	This species occurs in the Powell River from the VA-TN border upstream to Flannary Bridge, Lee County, and in the Clinch River from the VA-TN border upstream to Fort Blackmore, Scott County.	A lotic, riffle-dwelling species, occurring at fords and shoals with sand and gravel substrates and moderate current velocities. It can burrow deep into the river bottom because of an unusually long foot and is, therefore, difficult to collect.	E	G1

Species	Common name	Range	Habitat	Fed Status	G Rank
Lampsilis abrupta	Pink mucket pearlymussel	Historically, this species occurred in the Mississippi, Ohio, Cumberland, and Tennessee Rivers. In the Tennessee River it occurred up to the lower Clinch River where it is very rare (Parmalee and Bogan 1998). Although several valves were found at Pendleton Island, Virginia in the Clinch River in the 1980's (Neves pers. comm.) this species is considered extirpated in VA. (NatureServe 2002).	This species is typically found in medium to large rivers on substrates ranging from silt and sand to gravel, rubble, and boulders. In the Clinch and Holston Rivers, however, it has been collected from areas of less than three feet of water on rocky substrates. Fish hosts are freshwater drum and sauger.	E	G2
Lemiox rimosus	birdwing pearlymussel	This species is known to occur in the following river reaches: Powell River from the VA-TN border upstream to Snodgrass Ford, Lee County; Clinch River from the VA-TN border upstream to Blackford, Russell County; and lower Copper Creek.	A lotic, riffle-dwelling species that usually occurs in moderate-to fast-flowing water of shallow to moderate (6 feet) depth. It resides in stable, silt-free substrates of mixed particle size ranging from sand to cobble.	E	G1
Pegias fabula	little-winged pearlymussel	In VA, this species occurs in the Clinch and North Fork of Holston rivers. Recent specimens have come from the upper Clinch River at Cliffield, Tazewell County; the Little River, Russell County; and in North Fork of Holston River between Saltville and Nebo, Smyth County.	A lotic, riffle-dwelling species that is usually found in the headwaters of high-gradient tributary streams. Individuals have been found in the transition zone between pools and riffles, under large flat rocks, and in gravel substrates adjacent to water willow, *Justicia americana*, beds.	E	G1
Pleurobema collina	James spinymussel	Endemic to the James River drainage and is known from the following streams: Potts Creek, Alleghany County; Craig, Johns, Dicks, Patterson, and Rocky Run, Albemarle County; and Pedlar River, Amherst County, VA. The historic range of the James spinymussel was the upper James River and its tributaries above the Fall Line, but it is now restricted to small, headwater tributaries.	A lotic species that occurs in runs with moderate currents and sand, gravel, and cobble substrates. Extirpated populations resided in sandy bottoms of larger streams with rather swift currents. Present populations occur in streams with water hardness values greater than 50mg calcium carbonate per liter.	E	G1

Species	Common name	Range	Habitat	Fed Status	G Rank
Pleurobema plenum	rough pigtoe	There are no recent records of this species within the state. Since there is a population nearby in TN, it may occur in the lower Clinch River in VA, but it has not been documented.	A lotic species, residing in shoals of medium to large rivers with sand and gravel substrates. It has been collected in the Clinch River in the transition zone between pool and riffle, and in sandy substrates.	E	G1
Quadrula cylindrica strigillata	rough rabbitsfoot	Historically found in the Clinch, Powell, and Holston Rivers. The rough rabbitsfoot still occurs in the Clinch River, Scott and Tazewell counties; Copper Creek, Scott County; Powell river, Lee County; and North Fork of Holston River, Washington County, VA	Occurs only in the headwater tributaries of the TN River, often near the banks, in shoals with clean water and gravel bottoms, or in riffles of shallow water.	E	G4T2T3
Quadrula intermedia	Cumberland monkeyface	Known in VA only in the Powell River from the VA-TN border upstream to White Shoals, Lee County, Fletcher Cliff, and Fletcher Ford.	A lotic, fast water species, usually occurring in riffles and runs of small to mid-sized rivers. It has never been found in small streams or impounded portions of rivers. This species is typically well burrowed in stable substrates, and occupies the same macro habitats as the other endangered mussel species in the Powell River, Lee County, VA.	E	G1
Quadrula sparsa	Appalachian monkeyface	Known in VA from the Powell River from the VA-TN border upstream to Flannary Bridge, Lee County; and from the Clinch River between Pendleton Island and Dungannon, Scott County.	A lotic, fast water species that occurs in shallow riffles and runs. It resides in stable, silt-free areas with substrates of mixed particle size ranging from sand to cobble.	E	G1
Villosa perpurpurea	purple bean	In VA, this species occurs in the Clinch River and Copper Creek, a tributary of the Clinch River. The largest of three populations occurs in the lower portion of Copper Creek in Scott County.	A lotic, riffle-dwelling species that is restricted to headwater streams. It is found in moderate to fast-flowing water in clean-swept sand, gravel, and cobble substrates, and under large flat rocks.	E	G1

Species	Common name	Range	Habitat	Fed Status	G Rank
Villosa trabalis	Cumberland bean	The species is endemic to the tributary streams of the Tennessee and Cumberland River systems. Four extant populations persist. Three are in the tributaries to the middle Cumberland River: 1) the Little South Fork River; 2) Buck Creek; and 3) Rockcastle River. The forth population is in the Hiwassee River in Polk County, TN on the Cherokee National Forest. Considered extirpated in VA.	This species is found in large streams and small rivers in fast current with gravel or sand and gravel substrate.	E	G1

Appendix B

Range, Habitat and Legal Status of Federally Listed Fish Species On or Near the George Washington and Jefferson National Forests

Species	Common name	Range	Habitat	Fed Status	G Rank
Cyprinella monacha	spotfin chub	Known from the TN River drainage in NC, TN, and VA, formerly in AL and GA. Found recently in the North Fork of the Holston River, VA (including the Middle Fork) and TN. Threats include impoundment, siltation, coal sedimentation, pollution, releases of cold water from reservoirs, stream channelization, and interspecific competition.	Typically occupies warm, usually clear, medium streams to medium rivers of moderate gradient. Found in moderate to swift currents, preferring gravel or bedrock, and rarely occurs on sand and apparently always avoids silted areas.	T	G2
Erimystax cahni	slender chub	It was discovered in VA in 1979. It is known from only two sites in the Powell River, Lee County. Probably it was found in the Clinch River before the 1967 fish kill.	It is a warmwater riverine minnow. It is restricted to moderately to fast flowing shallow flats and shoals composed mostly of pea-sized gravel.	T	G1G2
Etheostoma percnurum	duskytail darter	Known from the Upper TN and middle Cumberland river drainages in VA and TN, where it was formerly more widespread. Found in the lower 29 rkm of Copper Creek, Scott County, VA. In 1980, one taken in the Clinch River at Speers Ferry, 1 rkm below mouth of Copper Creek. Threatened by degraded water quality mainly from poor land use practices, toxic chemical spills, excessive siltation, agricultural runoff, impoundment, and coal mine runoff.	Inhabits clear, warm, moderate gradient intermontane streams and rivers. Stream widths usually vary from 10-80m, but may be as narrow as 4m. Individuals occur in near-shore shallows, moderate mid-stream depths, and perhaps deep water. Adults occur mainly in pools and sometimes in moderately swift runs, and prefer clean gravel, rubble, and boulders. Young and juveniles prefer pools, but may be more abundant than adults in swift runs.	E	G1

Species	Common name	Range	Habitat	Fed Status	G Rank
Noturus flavipinnis	yellowfin madtom	IN VA it inhabits lower and middle Copper Creek in Scott and Russell counties, and the Powell River. It may occur in the Clinch River near Copper Creek. Also found at Buchanon Ford, TN. This madtom was historically known from the North Fork of Holston River just above Saltville. They are generally rare, but populations are difficult to inventory because of their secretive, nocturnal habits.	It occupies unpolluted medium-sized and large creeks to small rivers with moderate to gentle gradient. It is almost always found in calm water, usually in slow pools. During daylight it seeks cover under sticks, logs, leaf litter, undercut banks, rocks, and trash. It is found in open, clean gravel, and rubble areas only at night.	T	G2
Percina rex	Roanoke logperch	The Roanoke logperch is endemic to the Roanoke and Chowan River drainages of VA. In the Ridge and Valley, it is continuously distributed in the upper Roanoke River and lower North Fork and South Fork of Roanoke River and is known from lower Mason and Tinker creeks. It sparsely inhabits the Pigg River and the extreme lower reach of Big Chestnut Creek. The upper Smith River and lower Town Creek of the upper Dan River system have small populations. In the Chowan River system it is known only from the Nottoway River system, in the Nottoway River, Stony Creek, and Sappony Creek.	Inhabits medium-sized streams that are warm, usually clear, and have moderate to low gradient. Young and small juveniles usually occupy slow runs and pools, most frequently sandy areas. During warmer months, adults typically dwell on gravel and rubble in riffles, runs, and pools.	E	G2
Phoxinus cumberlandensis	blackside dace	Found in small tributaries of the upper Cumberland River above Cumberland Falls and a few km. below in Pulaski, Laurel, McCreary, Whitley, Knox, Bell, Harlan, and Letcher counties in KY and Scott, Campbell, and Claiborne counties in TN. Recently found on private land in Cox Creek, VA, tributary to the North Fork Powell River. Genetic analysis has shown that this population is introduced. Threatened by siltation from coal mining, silviculture, agriculture, and road construction, and unregulated acid mine drainage and impoundments. Other	Inhabits small upland headwaters and creeks 2-5m wide where riffle and pool areas are about equal. Associated with lush riparian vegetation, canopy cover greater than 70%, cool water, and unsilted conditions. In pools with such cover as bedrock, rubble, undercut banks, or brush.	T	G2

Species	Common name	Range	Habitat	Fed Status	G Rank
		threats are channelization and non-point source pollution. The introduced southern redbelly dace may have displaced this species from the warmer waters within its range.			

Appendix C

Host Species for Rare Freshwater Mussels in Virginia

Prepared by U.S.D.I. Fish and Wildlife Service, Virginia Field Office, Abingdon, VA
Last Revised: 6/30/98

Freshwater Mussel	Host Fishes	References
Dwarf wedgemussel (*Alasmidonta heterodon*)	[1]johnny darter (*Etheostoma nigrum*) [1]mottled sculpin (*Cottus bairdi*) [2]slimy sculpin (*Cottus cognatus*) [1]tessellated darter (*Etheostoma olmstedi*)	[1]Michaelson, D.L. and R.J. Neves. 1995. Life history and habitat of the endangered dwarf wedgemussel *Alasmidonta heterodon* (Bivalvia: Unionidae). J. N. Am. Benthol. Soc. 14(2):324-340. [2]Dr. Barry Wicklow, St. Anselm College, NH
Elktoe (*Alasmidonta marginata*)	[1,2]northern hogsucker (*Hypentelium nigricans*) [1,2]shorthead redhorse (*Moxostoma macrolepidotum*) [1,2]rock bass (*Ambloplites rupestris*) [1,2]warmouth (*Lepomis gulosus*) [1,2]white sucker (*Catostomus commersoni*)	[1]Fuller, S.L.H. 1974. Clams and mussels (Mollusca: Bivalvia). In: C.W. Hart, Jr. and S.L.H. Fuller (eds.): Pollution Ecology of Freshwater Invertebrates. New York: Academic Press, pp. 215-273. [2]Howard A.D. and B.J. Anson 1922. Phases in the parasitism of the Unionidae. J. Parasitology 9:68-82.
Brook floater (*Alasmidonta varicosa*)	[1]blacknose dace (*Rhinichthys atratulus*) [1]golden shiner (*Notemigonus crysoleucas*) [1]longnose dace (*Rhinichthys cataractae*) [1]margined madtom (*Noturus insignis*) [1]pumpkinseed (*Lepomis gibbosus*) [1]slimy sculpin (*Cottus cognatus*) [1]yellow perch (*Perca flavescens*)	[1]Dr. Barry Wicklow, St. Anselm College, NH.
Birdwing pearlymussel (*Conradilla caelata*)	[1,2]banded darter (*Etheostoma zonale*) [3]Tennessee snubnose darter (*Etheostoma simoterum*) **Possible hosts:** [1]greenside darter (*Etheostoma blennioides*) [2]mirror shiner (*Notropis spectrunculus*) [2]spotfin shiner (*Cyprinella spilopterus*) [2]whitetail shiner (*Cyprinella galactura*)	[1]Hill, D.M. 1986. Cumberlandian Mollusk Conservation Program Activity 3: Identification of fish hosts. Tennessee Valley Authority Office of Natural Resources and Economic Development. [2]U.S. Fish and Wildlife Service. 1983. Birdwing pearly mussel Recovery Plan. Atlanta, GA. [3]Based on Brian Watson's M.S. Thesis (in preparation), VA Tech (R.J. Neves, VA Coop. Fish and Wildl. Res. Unit, pers. comm. 11/97).
Spectaclecase (*Cumberlandia monodonta*)	unknown	
Fanshell (*Cyprogenia stegaria*)	[1,2]banded sculpin (*Cottus carolinae*) [1,2]greenside darter (*Etheostoma blennioides*) [2]smallmouth bass (*Micropterus dolomieu*) [2]rock bass (*Ambloplites rupestris*) [2]mottled sculpin (*Cottus bairdi*) [2]bluehead chub (*Nocomis leptocephalus*) [2]margined madtom (*Noturus insignis*) [2]fantail darter (*Etheostoma flabellare*)	[1]Based on Brian Watson's M.S. Thesis (in preparation), VA Tech (R.J. Neves, VA Coop. Fish and Wildl. Res. Unit, pers. comm. 12/5/97). [2] Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.

Freshwater Mussel	Host Fishes	References
	[2]redline darter *(Etheostoma rufilineatum)* [2]tennessee snubnose darter *(Etheostoma simoterum)* [2]banded darter *(Etheostoma zonale)* [2]tangerine darter *(Percina aurantiaca)* [2]blotchside logperch *(Percina burtoni)* [2]logperch *(Percina caprodes)* [2]gilt darter *(Percina evides)* [2] roanoke darter *(Percina roanoka)*	
Dromedary pearlymussel (*Dromus dromas*)	[1,2]fantail darter (*Etheostoma flabellare*) [1]smallmouth bass *(Micropterus dolomieu)* [1]banded sculpin *(Cottus carolinae)* [1]black sculpin *(Cottus baileyi)* [1]blacknose dace *(Rhinichthys atraulus)* [1]brown bullhead *(Ameiurus nebulosa)* [1]margined madtom *(Noturus insignis)* [1]greenside darter *(Etheostoma blennioides)* [1]redline darter *(Etheostoma rufilineatum)* [1]tennessee snubnose darter *(Etheostoma simoterum)* [1]banded darter *(Etheostoma zonale)* [1]yellow perch *(Percina flavecens)* [1]tangerine darter *(Percina aurantiaca)* [1]blotchside logperch *(Percina burtoni)* [1]logperch *(Percina caprodes)* [1]channel darter *(Percina copelandi)* [1]gilt darter *(Percina evides)* [1]roanoke darter *(Percina roanoka)*	[1] Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report. [2]Watson, B.T. and R.J. Neves. 1998. Fish host identification for two federally endangered Unionids in the Upper Tennessee River drainage. Triannual Unionid Report No. 14.
Yellow lance (*Elliptio lanceolata*)	unknown	
Cumberlandian combshell (*Epioblasma brevidens*)	[1,2,3]banded sculpin (*Cottus carolinae*) [1,2]greenside darter (*Etheostoma blennioides*) [1,2]logperch (*Percina caprodes*) [1,2,3]redline darter (*Etheostoma rufilineatum*) [1]spotted darter (*Etheostoma maculatum*) [1,2,3]Tennessee snubnose darter (*Etheostoma simoterum*) [1,2]wounded darter (*Etheostoma vulneratum*) [3]black sculpin *(Cottus baileyi)* [3]mottled sculpin *(Cottus bairdi)* [3]bluebreast darter *(Etheostoma camurum)* [3]fantail darter *(Etheostoma flabellare)* [3]roanoke darter *(Percina roanoka)*	[1]Yeager, B.L. 1987. Fish hosts for glochidia of *Epioblasma brevidens, E. capsaeformis*, and *E. triquetra* (Pelecypoda: Unionidae) from the upper Tennessee River drainage. Unpublished report on file with Office of Natural Resources and Economic Development, Tennessee Valley Authority, Norris, TN. [2]Yeager B.L. and C.F. Saylor. 1995. Fish Hosts for Four Species of Freshwater Mussels (Pelecypoda: Unionidae) in the Upper Tennessee River Drainage. Amer. Midland Naturalist 133(1):1-6. [3] Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Oyster mussel (*Epioblasma capsaeformis*)	[1,2,3,4]banded sculpin (*Cottus carolinae*)	[1]Yeager, B.L. 1987. Fish hosts for glochidia

Freshwater Mussel	Host Fishes	References
	[1,2,3]dusky darter (*Percina sciera*) [1,2,3]redline darter (*Etheostoma rufilineatum*) [1,3]spotted darter (*Etheostoma maculatum*) [2]wounded darter (*Etheostoma vulneratum*) [4]mottled sculpin *(Cottus bairdi)* [4]black sculpin *(Cottus baileyi)* [4]fantail darter *(Etheostoma flabellare)* [4]bluebreast darter *(Etheostoma camurum)* [4]Tennessee snubnose darter *(Etheostoma simoterum)*	of *Epioblasma brevidens, E. capsaeformis*, and *E. triquetra* (Pelecypoda: Unionidae) from the upper Tennessee River drainage. Unpublished report on file with Office of Natural Resources and Economic Development, Tennessee Valley Authority, Norris, TN. [2]Yeager, B.L. and C.F. Saylor. 1995. Fish Hosts for Four Species of Freshwater Mussels (Pelecypoda: Unionidae) in the Upper Tennessee River Drainage. Amer. Midland Naturalist 133(1):1-6. [3]Hill, D.M. 1986. Cumberlandian Mollusk Conservation Program Activity 3: Identification of fish hosts. Tennessee Valley Authority Office of Natural Resources and Economic Development. [4]Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Green-blossom pearlymussel (*Epioblasma torulosa gubernaculum*)	unknown	
Snuffbox mussel (*Epioblasma triquetra*)	[1,2,3]banded sculpin (*Cottus carolinae*) [1,2,3,5]logperch (*Percina caprodes*) [4]blackside darter (*Percina maculata*) [5]black sculpin *(Cottus baileyi)* [5]roanoke darter *(Percina roanoka)*	[1]Yeager, B.L. 1987. Fish hosts for glochidia of *Epioblasma brevidens, E. capsaeformis*, and *E. triquetra* (Pelecypoda: Unionidae) from the upper Tennessee River drainage. Unpublished report on file with Office of Natural Resources and Economic Development, Tennessee Valley Authority, Norris, TN. [2]Yeager, B.L. and C.F. Saylor. 1995. Fish hosts for four species of freshwater mussels (Pelecypoda: Unionidae) in the Upper Tennessee River Drainage. Amer. Midland Naturalist 133(1):1-6. [3]Hill, D.M. 1986. Cumberlandian Mollusk Conservation Program Activity 3: Identification of fish hosts. Tennessee Valley Authority Office of Natural Resources and Economic Development. [4]Hillegass, K.R. and M.C. Hove. 1997. Suitable fish hosts for glochidia of three freshwater mussels: strange floater, ellipse, and snuffbox. Triannual Unionid Report No. 13. [5]Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Tan riffleshell (*Epioblasma walkeri*)	[1]banded sculpin (*Cottus carolinae*) and/or mottled sculpin (*Cottus bairdi*) [1]fantail darter (*Etheostoma flabellare*) [1]greenside darter (*Etheostoma blennioides*) [1]redline darter (*Etheostoma*	[1]Based on work conducted by Brian Watson, graduate student at VA Tech (R.J. Neves, VA Coop. Fish and Wildl. Res. Unit, pers. comm. 7/23/96).

Freshwater Mussel	Host Fishes	References
	rufilineatum) [1]Tennessee snubnose darter (*Etheostoma simoterum*)	
Shiny pigtoe (*Fusconaia cor*)	[1,2]whitetail shiner (*Cyprinella galactura*) **Possible hosts:** [2]common shiner (*Luxilus cornutus*) [2]telescope shiner (*Notropis telescopus*) warpaint shiner (*Luxilus coccogenis*)	[1]Neves. R.J., F.X. O'Beirn, G.S. Schurig, and G.S. Libey. 1996. Fish host and propagation studies of freshwater mussels in the upper Tennessee River Drainage, Virginia and Tennessee. [2]Neves, R.J. 1991. Shiny pigtoe. Pages 272-274 in K. Terwilliger, ed. Virginia's Endangered Species, Proceedings of a Symposium. McDonald and Woodward Publishing Co., Blacksburg, VA.
Fine-rayed pigtoe (*Fusconaia cuneolus*)	[1]central stoneroller (*Campostoma anomalum*) [1]fathead minnow (*Pimephales promelas*) [1]mottled sculpin (*Cottus bairdi*) [1]river chub (*Nocomis micropogon*) [1]telescope shiner (*Notropis telescopus*) [1]Tennessee shiner (*Notropis leuciodus*) [1]white shiner (*Luxilus albeolus*) [1]whitetail shiner (*Cyprinella galactura*)	[1]Bruenderman, S.A. 1989. Life history of the fine-rayed pigtoe pearly mussel, *Fusconaia cuneolus* (Lea 1840), in the upper Clinch River, Virginia. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA.
Atlantic pigtoe (*Fusconaia masoni*)	**Possible hosts:** [1]bluegill (*Lepomis macrochirus*) [1]shield darter (*Percina peltata*)	[1]Watters, G.T. and S.H. O'Dee. 1997. Identification of potential hosts. Triannual Unionid Report No. 13.
Cracking pearlymussel (*Hemistena lata*)	[1]rock bass *(Ambloplites rupestris)* [1]banded sculpin *(Cottus carolinae)* [1]whitetail shiner *(Cyprinella galactura)* [1]central stoneroller *(Campostoma anomalum)* [1]streamline chub *(Erimystax dissimilis)* [1]striped shiner *(Luxilus chrysocephalus)* [1]margined madtom *(Noturus insignis)* [1]greenside darter *(Etheostoma blennioides)* [1]bluebreast darter *(Etheostoma camurum)*	[1]Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Pink mucket pearlymussel (*Lampsilis abrupta*)	[1]freshwater drum (*Aplodinotus grunniens*) [1]sauger (*Stizostedion canadense*) [2]largemouth bass (*Micropterus salmoides*) [2]smallmouth bass (*Micropterus dolomieu*) [2]spotted bass (*Micropterus punctulatus*) [2]walleye (*Stizostedion vitreum*)	[1]Virginia Department of Game and Inland Fisheries. 4/3/96. Fish and Wildlife Information System. Richmond, VA. [2]Barnhart, M.C., F.A. Riusech, and A.D. Roberts. 1997. Fish hosts of the federally endangered pink mucket, *Lampsilis abrupta*. Triannual Unionid Report No. 13.
Yellow lampmussel (*Lampsilis cariosa*)	unknown	
Tennessee heelsplitter (*Lasmigona holstonia*)	[1]banded sculpin (*Cottus carolinae*) [1]rock bass (*Ambloplites rupestris*) **Possible hosts:** [1]central stoneroller (*Campostoma anomalum*) [1]striped shiner (*Luxilus chrysocephalus*) [1] warpaint shiner (*Luxilus coccogenis*)	[1]Steg, M.B. and R.J. Neves. 1997. Fish host identification for Virginia listed Unionids in the Upper Tennessee River Drainage. Triannual Unionid Report No. 13.

Freshwater Mussel	Host Fishes	References
Green floater (*Lasmigona subviridis*)	unknown	
Slabside pearlymussel (*Lexingtonia dolabelloides*)	[2]smallmouth bass (*Micropterus dolomieu*) [3]rock bass (*Ambloplites rupestris*) [3]redbreast sunfish (*Lepomis auritus*) [3]central stoneroller (*Campostoma anomalum*) [3]whitetail shiner (*Cyprinella galactura*) [3]streamline chub (*Erimystax dissimilis*) [3]striped shiner (*Luxilus chrysocephalus*) [3]warpaint shiner (*Luxilus coccogenis*) [3]rosefin shiner (*Lytherus ardens*) [3]tennesse shiner (*Notropis leuciodus*) [3]silver shiner (*Notropis photogenis*) [3]rosyface shiner (*Notropis rubellus*) [3]bluntnose minnow (*Pimephales notatus*) [3]fantail darter (*Etheostoma flabellare*) [3]*Moxostoma cervinum* **Possible hosts:** [1]popeye shiner (*Notropis ariommus*) [1]saffron shiner (*Notropis rubricroceus*) [1]telescope shiner (*Notropis telescopus*)	[1]Kitchel, H.E. 1985. Life history of the endangered shiny pigtoe pearly mussel, *Fusconaia edgariana*, in the North Fork Holston River. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, VA. [2]Neves, R.J., F.X. O'Beirn, G.S. Schurig, and G.S. Libey. 1996. Fish host and propagation studies of freshwater mussels in the Upper Tennessee River Drainage, Virginia and Tennessee. [3]Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Virginia pigtoe (*Lexingtonia subplana*)	unknown	
Black sandshell (*Ligumia recta*)	[1]largemouth bass (*Micropterus salmoides*) [1]green sunfish (*Lepomis cyanellus*) [1]redbreast sunfish (*Lepomis auritus*) [1]rock bass (*Ambloplites rupestris*) [1]white perch (*Morone americana*) [1]yellow perch (*Perca flavescens*) [1]platy (*Xiphophorus maculatus*) [1]convict cichlid (*Chichlasoma nigrofasciatum*)	[1]Steg, M.B. and R.J. Neves. 1997. Fish host identification for Virginia listed Unionids in the Upper Tennessee River Drainage. Triannual Unionid Report No. 13.
Little-wing pearlymussel (*Pegias fabula*)	**Possible hosts:** [1]banded sculpin (*Cottus carolinae*) [1]redline darter (*Etheostoma ruflineatum*)	[1]Ahlstedt, S.A. 1986. A status survey of the little-wing pearly mussel *Pegias fabula* (Lea, 1838). Unpublished report on file with Endangered Species Field Office, United States Fish and Wildlife Service, Asheville, NC.
James spinymussel (*Pleurobema collina*)	[1]blacknose dace (*Rhinichthys atratulus*) [1]bluehead chub (*Nocomis leptocephalus*) [1]central stoneroller (*Campostoma anomalum*) [1]rosefin shiner (*Lythrurus ardens*) [1]rosyside dace (*Clinostomus funduloides*) [1]satinfin shiner (*Cyprinella analostana*) [1]swallowtail shiner (*Notropis procne*) [1]mountain redbelly dace (*Phoxinus oreas*)	[1]Hove, M.C. and R.J. Neves. 1994. Life history of the endangered James spinymussel *Pleurobema collina* (Conrad, 1837)(Mollusca: Unionidae). Amer. Malacological Bulletin 11(1):29-40.
Tennessee clubshell (*Pleurobema oviforme*)	[1]central stoneroller (*Campostoma	[1]Weaver, L.R., G.B. Pardue, and R.J. Neves.

Freshwater Mussel	Host Fishes	References
	anomalum) [1]common shiner (*Luxilus cornutus*) [1]fantail darter (*Etheostoma flabellare*) [1]river chub (*Nocomis micropogon*) [1]telescope shiner (*Notropis telescopus*) [1]Tennessee shiner (*Notropis leuciodus*) [1]whitetail shiner (*Cyprinella galactura*)	1991. Reproductive biology and fish hosts of the Tennessee Clubshell *Pleurobema oviforme* (Mollusca: Unionidae) in Virginia. Amer. Midland Naturalist. 126:82-89.
Rough pigtoe (*Pleurobema plenum*)	**Possible hosts:** [1]bluegill (*Lepomis macrochirus*) [1]rosefin shiner (*Lythrurus ardens*)	[1]Neves, R.J. 1991. Rough pigtoe. Pages 284-285 <u>in</u> K. Terwilliger, ed. Virginia's Endangered Species, Proceedings of a Symposium. McDonald and Woodward Publishing Co., Blacksburg, VA.
Pyramid pigtoe (*Pleurobema rubrum*) = Red pigtoe (*Pleurobema pyramidatum*)	**Possible hosts:** [1]bluegill (*Lepomis macrochirus*) [1]rosefin shiner (*Lythrurus ardens*)	[1]Neves, R.J. 1991. Pink pigtoe. Pages 285-286 <u>in</u> K. Terwilliger, ed. Virginia's Endangered Species, Proceedings of a Symposium. McDonald and Woodward Publishing Co., Blacksburg, VA.
Rough rabbitsfoot (*Quadrula cylindrica strigillata*)	[1]bigeye chub (*Hybopsis amblops*) [1]spotfin shiner (*Cyprinella spiloptera*) [1]whitetail shiner (*Cyprinella galactura*)	[1]Yeager, B.L. and R.J. Neves. 1986. Reproductive cycle and fish bosts of the Rabbit's foot mussel, <u>*Quadrula cylindrica*</u> *strigillata* (Mollusca: Unionidae) in the Upper Tennessee River Drainage. Amer. Midland Naturalist. 116(2):329-340.
Cumberland monkeyface pearlymussel (*Quadrula intermedia*)	[1,2]blotched chub (*Erimystax insignis*) [1,2]streamline chub (*Erimystax dissimilis*)	[1]Hill, D.M. 1986. Cumberlandian Mollusk Conservation Program Activity 3: Identification of fish hosts. Tennessee Valley Authority Office of Natural Resources and Economic Development. [2]Yeager, B.L. and C.F. Saylor. 1995. Fish hosts for Four Species of Freshwater Mussels (Pelecypoda: Unionidae) in the Upper Tennessee River Drainage. Amer. Midland Naturalist. 133(1):1-6.
Appalachian monkeyface mussel (*Quadrula sparsa*)	unknown	
Purple lilliput (*Toxolasma lividus*)	[1,2]green sunfish (*Lepomis cyanellus*) [1,2]longear sunfish (*Lepomis megalotis*)	[1]U.S. Fish and Wildlife Service. 1984. Pale lilliput pearly mussel Recovery Plan. Atlanta, GA. [2]Hill, D.M. 1986. Cumberlandian Mollusk Conservation Program Activity 3: Identification of fish hosts. Tennessee Valley Authority Office of Natural Resources and Economic Development.
Rayed bean (*Villosa fabalis*)	unknown	
Purple bean (*Villosa perpurpurea*)	[1]banded sculpin (*Cottus carolinae*) and/or mottled sculpin (*Cottus bairdi*) [1,2]fantail darter (*Etheostoma flabellare*) [1]greenside darter (*Etheostoma blennioides*) [2]black sculpin (*Cottus baileyi*)	[1]Based on work conducted by Brian Watson, graduate student at VA Tech (R.J. Neves, VA Coop. Fish and Wildl. Res. Unit, pers. comm. 7/23/96). [2]Jones J.W. and R.J. Neves. 2000. Life History and Artificial Culture of Endangered Mussels. VA Coop 1999 Annual Progress Report.
Cumberland bean (*Villosa trabalis*)	**Possible hosts:** [1]fantail darter (*Etheostoma flabellare*) [1]striped darter (*Etheostoma virgatum*)	[1]Based on work conducted by Jim Layzer at TN Tech (Leigh Ann McDougal, USFS, pers. comm. 11/6/97).

Freshwater Mussel	Host Fishes	References
	[1]barcheek darter (*Etheostoma obeyense*) [1]stripetail darter (*Etheostoma kennicotti*)	

Appendix D

Guidelines for Introduction of Freshwater Mussels

Any introduction or augmentation will be done in cooperation with the US Fish and Wildlife Service and state agencies, and only occur within the species' historic range.

The following are the guidelines that apply to the Upper Tennessee River Basin in Virginia as developed by the Virginia Department of Game and Inland Fisheries (VDGIF). Guidelines for freshwater restoration for the remainder of the Forest are being developed by VDGIF.

Freshwater Mussel Restoration in the Upper Tennessee River Basin of Virginia
Virginia Department of Game and Inland Fisheries
Wildlife Diversity Division - Nongame and Endangered Wildlife Program

Background

Freshwater mussels are an important component of river, lake, and stream environments. They are a food source for many animals including muskrats, minks, otters, fishes, and some birds. Mussels continuously pump water through their siphons to feed on detritus, plankton, bacteria, and other suspended particles. In the process of feeding, mussels clean the water and release unused food particles to the stream bottom that are eaten by other invertebrates such as aquatic insects. Mussel shells are used as habitat by insects and aquatic plants, and the empty shells as egg-laying sites by fish.

The life cycle of a freshwater mussel is one of the most interesting and complex in the animal kingdom. Female mussels filter the males' sperm from the water column to fertilize eggs that develop into a larval stage called the glochidium. Mussels release thousands of glochidia into the water column that must attach to the gills, fins, or scales of a suitable host fish. Most glochidia will only transform on a few fish species, and many of these host-fish/mussel relationships are still unknown. Although many game species, such as black basses and sunfishes, are hosts for certain species, the majority of mussels use darters and minnows. Once the larvae transform into juvenile mussels over a period of a few days to several weeks, they must then fall into suitable habitat to be able to survive, grow, and later reproduce. Adult mussels of some species may live over 100 years in the wild.

Freshwater mussels are present throughout the world but are especially diverse in North America. Of the original 297 species known from the United States, 102 (34%) are found in the Tennessee River system of Tennessee, Alabama, Georgia, North Carolina, and Virginia. Virginia supports 81 species with over 45 species in the upper Tennessee River tributaries of the Clinch, Powell, and Holston rivers. Nationwide, the mussel fauna in the U.S. has experienced drastic declines because of water pollution, dam construction, and exotic species introductions. The U.S. currently has 69 species (23%) listed as federally endangered or threatened (Neves 1999). In Virginia, 31 federally or state listed mussel species occur in the upper Tennessee drainage. Based on similar-sized watersheds throughout the country, the Clinch and Powell rivers are ranked first and third, respectively, for the greatest number of at-risk fish and mussel species.

Because of water pollution concerns and the loss of native aquatic species, the federal government passed the Clean Water Act in 1972. Subsequently, federal and state agencies, as well as private industry and landowners, have modified traditional methods of forestry, construction, agriculture, and other activities to manage for good water quality. Unfortunately, even with improvements in water quality, mussel populations have continued to decline. In many areas, mussel densities are so low that the eggs of females go unfertilized. For females that become fertilized and produce viable glochidia, the chances that their larvae will attach to the correct host fish are extremely low under the best conditions, and almost negligible when host densities are reduced. If the mussel survives to the juvenile stage, sufficient habitat also must be present for growth and maturation into an adult. Good water quality and habitat are essential to all stages of development, but are especially critical for the larval and juvenile stages.

Through over 20 years of coordinated research by state and federal agencies, propagation techniques have been developed to recover freshwater mussel populations. These techniques allow researchers to infest the known host fish species with glochidia and produce juvenile mussels that can be released in the wild, thereby adding significant cohorts to the population. Before releasing juvenile mussels, young of certain species can be held under semi-natural conditions and grown to larger sizes. The older mussels are less vulnerable to predation and are better able to withstand water quality and habitat perturbations, compared to younger age classes. In Virginia, two facilities presently can accomplish these tasks. These are the aquaculture center at Virginia Polytechnic Institute and State University operated by Dr. Richard Neves, and the Aquatic Wildlife Conservation Center operated by the Virginia Department of Game and Inland Fisheries. One other facility, owned by The Nature Conservancy at Cleveland Island on the Clinch River, is under development and should be operational in the near future.

Freshwater Mussel Restoration Guidelines

These guidelines are intended to provide a programmatic structure for captive propagation and release of freshwater mussels into the wild, with the goal of developing self-sustaining populations. In support of this objective, we note that each current endangered mussel recovery plan recommends propagation as a task for delisting. Furthermore, while not currently listed as threatened and endangered, many nonlisted species also are imperiled and uncommon, and would benefit from population augmentation.

In this document, we consider the following four levels of introduction: augmentation, expansion, reintroduction, and establishment. These levels have been defined by the Mollusk Recovery Group (MRG) and by the National Strategy for the Conservation of

Native Freshwater Mussels (NSCNFM) (NNMCC 1998). The MRG is comprised of representatives from the Virginia Department of Game and Inland Fisheries (DGIF), Virginia Polytechnic Institute and State University, U.S. Geological Survey, U.S. Fish and Wildlife Service, and The Nature Conservancy. The NSCNFM was developed by the Freshwater Mollusk Conservation Society, which is comprised of state and federal governmental agencies, non-governmental organizations, and private individuals, as a framework to recover freshwater mussels nationwide.

Level 1: Augmentation – release of a species in a river reach where it currently exists.

Sublevel 1A: Replacement – release of a species in a river reach where it recently existed, but is now in low numbers or extirpated because of a specific event (e.g., chemical spill).

Authority: The decision to augment species will be made by Department biologists in coordination with the Mussel Recovery Group. Because the species are extant or recently occurred in the reach, no additional regulations or special designations would be needed.

Level 2: Expansion – release of a species into suitable historical habitat in a river reach from which it has been extirpated, but where specimens currently survive upstream or downstream, and natural recolonization could occur. Release of species into such reaches that could be naturally colonized, but for which no records exist of the species' historical occurrence, would also be considered to be population expansions.

Authority: Stocking of mussels will be based on the decision of Department biologists and the recommendations of the Mollusk Recovery Group, in consultation with appropriate federal, state, and local authorities.

Level 3: Reintroduction – release of a species into suitable historical habitat from which it has been extirpated, and where natural recolonization cannot reasonably be anticipated.

Authority: Stocking of mussels will be based on the decision of Department biologists and the recommendations of the Mollusk Recovery Group, in consultation with appropriate federal, state, and local authorities. Reintroduced populations may warrant special designation as "experimental" or "non-essential."

Level 4: Establishment – release of a species into suitable habitats in reaches for which no records exist of the species' historical occurrence, and where natural colonization cannot reasonably be anticipated.

Authority: Stocking of mussels will be based on the decision of Department biologists and the recommendations of the Mollusk Recovery Group, in consultation with appropriate federal, state, and local authorities. Established populations may warrant special designation as "experimental" or "non-essential."

Based on recommendations by the MRG, initial recovery efforts will employ Level 1: Augmentation. Recovery efforts will begin by augmenting mussel species at six reaches on the Clinch, Powell, and the North Fork Holston rivers (Table 1). Additional reaches may be added to this list depending on future information and needs. All selected reaches have shown evidence of recent mussel recruitment, indicating conditions are likely suitable for augmenting species. Augmentation can occur by: 1) translocation of adult mussels from a source population; 2) release of propagated juveniles; and 3) on-site release of infected host fishes collected from the augmentation site. Before augmentation can begin at a specific river reach, a monitoring site, determined by the MRG, will be selected and surveyed within each section to obtain baseline data regarding presence, density, and recruitment of all mussel species. Each site will be revisited periodically to determine augmentation results. Sites that have experienced a catastrophic mussel kill because of events such as toxic spills may be exempted from preaugmentation surveys and instead species information will be based on the best available data.

The primary determination of which species are augmented at a specific reach will be based on verifiable species accounts since 1980 (Table 2). Other factors include the ability to successfully propagate the species under captive conditions, the number of specimens available, and the current information on a species' life history. Furthermore, additional species may be added to the list of augmented species based on new distributional records. In certain cases, individuals may need to go beyond the borders of Virginia to collect gravid mussels to conduct propagation. The DGIF will require all institutions and organizations involved in propagation to follow protocols outlined in Table 3 before, during, and after augmentation activities. These protocols will ensure that program integrity is maintained.

Literature Cited

National Native Mussel Conservation Committee. 1998. National strategy for the conservation of native freshwater mussels. Journal of Shellfish Research 17(5): 1419-1428.

Neves, R.J. 1999. Conservation and commerce: management of freshwater mussel (Bivalvia: Unionidea) resources in the United States. Malacologia 41(2): 461-474.

Table 1. Selected augmentation reaches within the Upper Tennessee River drainage of Virginia.

Reach 1: Powell River (RM 124-115.5) from the Snodgrass Ford downstream to the Virginia-Tennessee state line, Lee County (approximately 8 river miles). The Powell River from the confluence with the North Fork Powell River to the state line was impacted by a coal slurry spill in 1996.

Reach 2: Clinch River (RM 213.2-206.9) from Clinchport downstream to the mouth of Dry Valley Branch, Scott County (approximately 6 river miles).

Reach 3: Clinch River (RM 235.1, 234, 226.3) – Simones, Grays, and Pendleton islands, Scott County. All three islands are located between Reach 2 and 4.

Reach 4: Clinch River (RM 273-267) from Cleveland to Carbo, Russell County (approximately 6 river miles).

Reach 5: Clinch River (RM 329.8-317.7) from Pounding Mill to Richlands, Tazewell County (approximately 12 river miles), including the lower two miles of Indian Creek at Cedar Bluff, Virginia. The Clinch River from Cedar Bluff to Richlands (approximately 5 miles) was, until a toxic spill occurred in 1998, one of the best examples of a healthy, reproducing mussel assemblage in the Clinch River in Virginia.

Reach 6: North Fork Holston River (RM 97.8-86.2) from Riverside to McCready, Russell County (approximately 12 river miles).

Table 2. Selected freshwater mussel species and river reaches for augmentation in the Upper Tennessee River Basin of Virginia.

Common name	**Scientific name**	**Augmentation reach**
Federally Threatened or Endangered	**Quadrula sparsa**	1,2,3,4
Appalachian monkeyface		
Birdwing pearlymussel	**Lemiox rimosus**	1,2,3,4
Cracking pearlymussel	**Hemistena lata**	1,2,3,4
Cumberlandian combshell	*Epioblasma brevidens*	1,2,3
Cumberland monkeyface	*Quadrula intermedia*	1,2,3,4
Dromedary pearlymussel	*Dromus dromas*	1,2,3
Fanshell	*Cyprogenia stegaria*	1,2,3
Finerayed pigtoe	*Fusconaia cuneolus*	1,2,3,4
Littlewing pearlymussel	*Pegias fabula*	5, 6
Oyster mussel	*Epioblasma capsaeformis*	1,2,3,4
Purple bean	**Villosa perpurpurea**	3,4,5
Rough rabbitsfoot	*Quadrula cylindrica strigillata*	1,2,3,4,5,6
Shiny pigtoe	*Fusconaia cor*	1,2,3,4,6
Tan riffleshell	*Epioblasma florentina walkeri*	5
State Threatened or Endangered	*Ligumia recta*	1,2,3,4
Black sandshell		
Deertoe	*Truncilla truncata*	1,2,3
Elephantear	*Elliptio crassidens*	1,2,3
Pimpleback	*Quadrula pustulosa pustulosa*	2,3
Sheepnose	*Plethobasus cyphyus*	1,2,3
Slabside pearlymussel	*Lexingtonia dolabelloides*	1,2,3,4,6
Snuffbox	*Epioblasma triquetra*	1,2,3
Non-listed	*Medionidus conradicus*	1,2,3,4,5,6
Cumberland moccasinshell		
Elktoe	*Alasmidonta marginata*	3,4
Fluted kidneyshell	*Ptychobranchus subtentum*	1,2,3,4,5,6
Flutedshell	*Lasmigona costata*	1,2,3,4,5
Kidneyshell	*Ptychobranchus fasciolaris*	1,2,3,4,5,6
Long solid	*Fusconaia subrotunda*	1,2,3,4
Mucket	*Actinonaias ligamentina*	1,2,3,4
Mountain creekshell	*Villosa vanuxemensis*	1,2,3,4,5,6
Pheasantshell	*Actinonaias pectorosa*	1,2,3,4,5,6
Pink heelsplitter	*Potamilus alatus*	1,2,3,4
Pocketbook	*Lampsilis ovata*	1,2,3,4,5,6
Purple wartyback	*Cyclonaias tuberculata*	1,2.3,4

Rainbow mussel	*Villosa iris*	1,2,3,4,5,6
Spike	*Elliptio dilatata*	1,2,3,4,5,6
Tennessee clubshell	*Pleurobema oviforme*	2,3,4,5,6
Tennessee pigtoe	*Fusconaia barnesiana*	1,2,3,4,5,6
Threeridge	**Amblema plicata**	1,2,3,4
Wavy-rayed lampmussel	**Lampsilis fasciola**	1,2,3,4,5,6

Table 3. Protocols for the augmentation of freshwater mussels in the Upper Tennessee River Basin of Virginia.

1) All organizations and institutions conducting mussel restoration must develop an operational plan indicating their ability and expertise to hold, propagate, and augment freshwater mussels in the upper Tennessee River drainage of Virginia. A list of all species held and propagated to date must be included.
2) Prior to propagation activities, each organization and institution shall submit a proposal indicating mussel species that will be augmented and released during each calendar year. The proposal should include, but not be limited to, adult mussel source, release sites (i.e., river name, river mile), release schedule, and age classes of propagated species. The Department must approve the proposal prior to collection of adult mussels.
3) The source for adult mussels used to propagate or translocate should come from within the targeted augmentation reach. If individuals are not available from the augmentation reach, the stock source for adult mussels should come from (in declining order of preference):
    a. another metapopulation in the same stream/tributary system in the same physiographic province;
    b. another population in an adjacent stream/tributary system in the same physiographic province;
    c. another population in an adjacent stream/tributary system in an adjacent physiographic province;
    d. the only known population.
4) Prior DGIF approval will be required for interdrainage transfer of propagated and adult mussels. The Department reserves the authority to require genetic analysis of mussel populations to determine suitability for interdrainage transfer.
5) To avoid the repeated use of the same mussels, all female mussels used for propagation purposes must be marked with Hallprint™ tags before being returned to the source site. A list containing mussel species, source site, and corresponding tag numbers shall be submitted to DGIF before the end of each calendar year.
6) Any adult or juvenile mussels demonstrating signs of disease or stress shall not be returned to the river.
7) All fish used in laboratory infestations must be euthanized. This does not include fish that will be infested and immediately released at the collection site.
8) Only mussels intended for propagation purposes that will be later returned can be collected from selected monitoring areas. Mussels that will be permanently removed (e.g., for toxicity studies) must come from areas other than the monitoring sites.
9) DGIF biologists shall be notified at least two weeks prior to release of any propagated mussels.
10) A propagated mussel form (PMF) shall be submitted to DGIF within two weeks after a release of juvenile mussels or infected host fish.
11) All mussels must be collected from waters free of zebra mussels (*Dreissena polymorpha*).
12) Individuals are required to comply with all federal and state permit requirements.

13) Individuals are required to acquire landowner permission before crossing property to access augmentation sites.

Appendix E

Federally Listed Mussel and Fish Species by 6th Level Watershed

Derived from VDGIF collection records, VA Natural Heritage collection records, USFWS collection records, Jenkins and Burkhead (1994), and Stauffer et al. (1995), February 2003.

6th Level Watershed	T&E species	Number of occurrences
0208020103I10	Mussel, James spiny	2
0208020103I11	Mussel, James spiny	2
0208020103WV	Mussel, James spiny	3?
0208020106I12	Mussel, James spiny	0
0208020106I14	Mussel, James spiny	2
0208020107I25	Mussel, James spiny	2
0208020108I21	Mussel, James spiny	21
0208020108I22	Mussel, James spiny	20
0208020108I19	Mussel, James spiny	1
0208020109I27	Mussel, James spiny	1
0208020109I28	Mussel, James spiny	1
0208020201I30	Mussel, James spiny	1
0208020301H02	Mussel, James spiny	10
0301010101L02	Logperch, Roanoke	36
0301010102L05	Logperch, Roanoke	3
051301010101	Dace, blackside	1
0601010101O09	Mussel, little-wing pearly	6
0601010101O10	Chub, slender	1
	Chub, spotfin	1
	Mussel, little-wing pearly	3
	Mussel, shiny pigtoe	25
0601010201O02	Mussel, little-wing pearly	2
0601010202O04	Mussel, cracking pearly	1
	Mussel, little-wing pearly	5
	Mussel, tan riffleshell	3
0601020504P09	Mussel, Appalachian monkeyface	5
	Mussel, Cumberland bean	1
	Mussel, Cumberlandian combshell	7
	Mussel, birdwing pearly	9
	Mussel, cracking pearly	1
	Mussel, fanshell	5
	Mussel, fine-rayed pigtoe	63
	Mussel, green blossom	2
	Mussel, oyster	12
	Mussel, rough rabbitsfoot	18
	Mussel, shiny pigtoe	34
0601020505P13	Chub, slender	1
	Darter, duskytail	1
	Madtom, yellowfin	1
	Mussel, Appalachian monkeyface	2
	Mussel, Cumberland bean	1

6th Level Watershed	T&E species	Number of occurrences
	Mussel, Cumberland monkeyface	6
	Mussel, Cumberlandian combshell	76
	Mussel, birdwing pearly	32
	Mussel, cracking pearly	28
	Mussel, dromedary pearly	9
	Mussel, fanshell	33
	Mussel, oyster	66
	Mussel, fine-rayed pigtoe	85
	Mussel, green blossom	7
	Mussel, pink mucket	1
	Mussel, purple bean	7
	Mussel, rough pigtoe	1
	Mussel, rough rabbitsfoot	46
	Mussel, shiny pigtoe	73
0601020601P19	Mussel, rough rabbitsfoot	2
0601020601P20	Dace, blackside	1

Appendix F

Critical Habitat

Critical habitat has been defined by the U.S.D.I. Fish and Wildlife service as:

> a specific geographic area(s)that is essential for the conservation of a threatened or endangered species and that may require special management and protection. Critical habitat may include an area that is not currently occupied by the species but that will be needed for its recovery (U.S.D.I. Fish and Wildlife Service 1998).

Designated Critical Habitat

Yellowfin Madtom

Virginia. Lee, Scott, and Russell Counties. Powell River, main channel from the Virginia-Tennessee State line upstream through Lee County. Copper Creek, main channel from its junction with the Clinch River, upstream through Scott County and upstream in Russell County to Dickensonville (U.S.D.I. Fish and Wildlife Service 1977).

Slender Chub

Virginia. Lee and Scott Counties. Powell River, main channel from the Tennessee-Virginia State line upstream through Lee County, Va. Clinch River, main channel from the Tennessee-Virginia State line upstream through Scott County, Virginia (U.S.D.I. Fish and Wildlife Service 1977).

Proposed Critical Habitat

Unit 4. Powell River, Claiborne and Hancock Counties, Tennessee, and Lee County, Virginia

Unit 4 encompasses 154 rkm (94 rmi) and includes the Powell River from the U.S. 25E Bridge in Claiborne County, Tennessee, upstream to river mile 159 (upstream of Rock Island in the vicinity of Pughs) Lee County, Virginia. This reach is currently occupied by the Cumberlandian combshell (Ahlstedt 1991; Gordon 1991), rough rabbitsfoot (Service 2003), and oyster mussel (Wolcott and Neves 1990), and was historically occupied by the purple bean (Ortmann 1918). It is also existing critical habitat for the Federally listed slender chub (Erimystax cahni) and yellowfin madtom (Noturus flavipinnis) (U.S.D.I. Fish and Wildlife Service 2003).

Unit 5. Clinch River and tributaries, Hancock County, Tennessee, and Scott, Russell, and Tazewell Counties, Virginia

Unit 5 totals 272 rkm (171 rmi), including 242 rkm (148 rmi) of the Clinch River from rkm 255 (rmi 159) immediately below Grissom Island, Hancock County, Tennessee, upstream to its confluence with Indian Creek in Cedar Bluff, Tazewell County, Virginia; 4 rkm (2.5 rmi) of Indian Creek from its confluence with the Clinch River upstream to the fourth

Norfolk Southern Railroad crossing at Van Dyke, Tazewell County, Virginia; and 21 rkm (13 rmi) of Copper Creek from its confluence with the Clinch River upstream to Virginia State Route 72, Scott County, Virginia. The Clinch mainstem currently contains the oyster mussel, rough rabbitsfoot, Cumberlandian combshell, and purple bean (Gordon 1991; Ahlstedt and Tuberville 1997; S.A. Ahlstedt, USGS, pers. comm. 2002). Indian Creek currently supports populations of the purple bean and rough rabbitsfoot (Winston and Neves 1997; Watson and Neves 1998). Copper Creek is currently occupied by a low density population of the purple bean, and contains historic records of both the oyster mussel and rough rabbitsfoot (Ahlstedt 1981; Fraley and Ahlstedt 2001; Ahlstedt, pers. comm. 2003). Copper Creek is critical habitat for the yellowfin madtom and a portion of the proposed Clinch River mainstem section is critical habitat for both the slender chub and the yellowfin madtom (U.S.D.I. Fish and Wildlife Service 2003).

Appendix G

Implementation Monitoring of the Mussel and Fish Conservation Plan

GWJEFF NATIONAL FOREST
RANGER DISTRICT________________________________

6^{TH} LEVEL WATERSHED NUMBER______________________

PROJECT NAME________________________________

OBSERVER________________________________

DATE________________________________

INDICATE YES (Y), NO (N), OR NOT APPLICABLE (NA) NEXT TO THE STANDARD. IF NO, DESCRIBE HOW IMPLEMENTATION OF THE PROJECT FAILED TO MEET THE STANDARD AND CORRECTIVE ACTIONS, IF APPROPRIATE.

Conservation Goals, Objectives, and Standards

A. Goals and Objectives

Goal 1 Manage watersheds to maintain or restore resilient and stable conditions to support the quality and quantity of water necessary to protect ecological functions and support beneficial water uses. Instream flows (or lake levels) provide the amounts necessary to: 1) maintain the capacity of the channels to transport water and sediment; 2) protect aquatic organisms; 3) sustain or restore riparian habitats and communities; and 4) provide for recreation, scenic, aesthetic, and research purposes.

Objective 1.01 Maintain or restore temperature, balance of water and sediment, chemical resilience, and biological integrity (see also Objective 3.01).

OBJECTIVE 1.03 The instream flows needed to protect stream processes, aquatic and riparian habitats and communities, and recreation and aesthetic values will be determined on selected streams as identified by the Forest.

Goal 2 Manage and restore riparian ecosystems, wetlands and aquatic systems protect and maintain their soil, water, vegetation, fish, wildlife, and other resources. Channeled ephemeral streams maintain the ability of the land to filter sediment from upslope disturbances and to provide forest material as nutrient input while achieving the goals of the adjacent management prescription area.

Objective 2.01 Streamsides are managed in a manner that restores and maintains amounts of large woody debris (LWD) sufficient to maintain habitat diversity for aquatic and riparian species (approximately 200 pieces per stream mile).

Goal 3 Aquatic habitat conditions are suitable to maintain aquatic species native to the planning area, and to support desirable levels of selected species (e.g., species with special habitat needs, species commonly fished, or species of special interest).

Objective 3.01 Streams are managed in a manner that results in sedimentation rates that stabilize or improve the biological condition category of the stream as monitored using aquatic macroinvertebrates.

Objective 3.02 Maintain a stable and/or increasing population trend for Blackside dace and James spinymussel.

B. Standards

1. Riparian Corridor Standards (Perennial and intermittent water bodies)

Standards refer to the entire riparian corridor (core and extended area) unless specified otherwise. Numbers to the left of the standard refer to the numbers assigned in the Jefferson National Forest Land and Resource Management Plan.

General

11-001 Any human caused disturbances or modifications that may concentrate runoff, erode the soil, or transport sediment to the channel or water body are rehabilitated or mitigated to reduce or eliminate impacts. Channel stability of streams is protected during management activities.

11-002 Motorized vehicles are restricted to designated crossings. Motorized vehicles may be allowed on a case-by-case basis, after site-specific analysis, outside of designated crossings where it can be shown to benefit riparian resources.

11-003 Management activities expose no more than 10 percent mineral soil within the project area riparian corridor.

Aquatic Habitats within Streams and Rivers

11-004 The removal of large woody debris (pieces greater than 4 feet long and 4 inches in diameter on the small end) is allowed if it poses a risk to water quality, degrades habitat for aquatic or riparian wildlife species, impedes water recreation (e.g. rafting) or when it poses a threat to private property or Forest Service infrastructure (e.g., bridges). The need for removal must be determined on a case-by-case basis.

11-005 The addition of large woody debris for stream habitat diversity will generally favor stream reaches with an average bank full width of less than 30 feet in Rosgen B channel types. Log length will generally be 50% greater than bank full width. In stream reaches where there may be potential debris impacts to downstream private or public infrastructure (e.g., bridges) or to water-based recreation (e.g. rafting), the active recruitment (placement) of large woody debris will be limited in quantity and scope.

11-006 Stocking of new nonnative species and stocking of previously unstocked areas is not allowed where it will negatively impact native aquatic species or communities. Prior to any stocking, national forests coordinate with the appropriate State and Federal agencies to ensure that populations and habitats of native species are maintained.

11-007 Restoration of chemical integrity of aquatic ecosystems (from impacts such as acid deposition and acid mine drainage) is allowed on a site-specific basis for protection or for restoration of aquatic species.

11-008 Instances where the flow regime is modified for other purposes (such as reservoir releases for recreational sports or hydroelectric demand), evaluate instream flow needs in accordance with the national strategy for water rights and instream flows.

11-009 In-stream habitat improvements, and stream-connected disturbance will be designed and implemented after consideration of the life-cycle requirements of federally listed aquatic species.

Terrestrial Species

11-010 Existing permanent wildlife openings may be maintained within the riparian corridor. However, permanent wildlife openings identified as causing environmental degradation through concentrated runoff, soil erosion, sediment transport to the channel or water body are mitigated or closed and restored. New permanent wildlife openings within the riparian corridor are permitted where needed to provide habitat for riparian species, or threatened, endangered, sensitive, and locally rare species.

11-011 Use no-till mechanical cultivation methods for maintenance of wildlife openings.

11-012 Up to 2 percent early successional forest habitat may be created when the riparian corridor falls within the Ruffed Grouse/Woodcock Habitat Management Prescription 8.E.1. (measured within riparian corridor across geographically contiguous prescription block).

Rare Communities and Old Growth

11-013 Management actions that may negatively alter the hydrologic conditions of wetland rare communities are prohibited. Such actions may include livestock grazing and construction of roads, plowed or bladed firelines, and impoundments in or near these communities. Exceptions may be made for actions designed to control undesirable impacts caused by beavers, or where needed to control fires to provide for public and employee safety and to protect adjacent private land resources. Beaver impoundments may be removed if they are negatively affecting federally listed species.

11-014 Introducing fish into wetland rare communities is prohibited.

11-015 Canebrake restoration efforts may occur on sites currently supporting cane (Arundinaria gigantea or A. tecta) and may occur on sites known to historically support cane. Management actions will be designed to increase the vigor, density, and area of existing patches of cane. Actions used to restore canebrakes will include prescribed burning on a 7 to 10 year return cycle, control of competing vegetation, and overstory reduction or removal.

Vegetation and Forest Health

11-016 Insect and disease control measures will be determined on the basis of risk to adjacent resources, long-term sustainability, and appropriate needs for the function and condition of the riparian area. Cut and leave is the preferred method for control and suppression of insects and disease in the core of the riparian corridor. Cut and remove is permitted in the extended area beyond the core. Other control measures may be used when a condition poses a risk to stream stability, degrades water quality, adversely affects habitat for aquatic or riparian species, poses a threat to public safety or facilities, or when "cut and leave" is not effective.

11-017 Tree removals from the core of the riparian corridor may only take place if needed to:

- Enhance the recovery of the diversity and complexity of vegetation native to the site;
- Rehabilitate both natural and human-caused disturbances;
- Provide habitat improvements for aquatic or riparian species, or threatened, endangered, sensitive, and locally rare species;
- Reduce fuel buildup;
- Provide for public safety;
- For approved facility construction/renovation; or
- As allowed in standards 11-012 and 11-022.

11-018 Tree removals from the extended area beyond the core of the riparian corridor may take place to meet the objectives of the adjacent management prescription.

Timber Management

11-019 Lands in the core of the riparian corridor are classified as not suitable for timber production. Vegetation management may be accomplished with commercial timber sales when that is the most practical or economically efficient method.

11-020 Lands in the extended area beyond the core of the riparian corridor are suitable for timber harvest when the adjacent management prescription is also suitable.

11-021 When timber harvest occurs in the extended area beyond the core of the riparian corridor for purposes of meeting the objectives of the adjacent management prescription, then vehicles will be excluded from the extended area.

11-022 Corridors for cable logging in areas adjacent to the riparian corridor may cross the riparian corridor. Crossing will be at as near a right angle as possible, with full suspension preferred.

11-023 In cable logging, when full suspension is not possible, partial suspension is allowed with armoring when yarding logs across perennial and intermittent streams.

Non-timber Forest Products

11-024 Do not permit commercial collection of botanical products in the riparian corridor if it would adversely affect the functions and values of the riparian area.

11-025 Permitted firewood cutting within the riparian corridor must take into consideration large woody debris needs. Ranger Districts will identify areas where firewood cutting is not permitted due to large woody debris concerns.

Wildland Fire Management

11-026 Fire retardants should not be applied directly over open water.

11-027 Use existing fire barriers; such as streams, roads, trails, etc., for control lines where possible.

11-028 When necessary to construct fire lines with heavy equipment (e.g., bulldozers) that cross riparian areas and streams, construct turnouts that will allow runoff to be dispersed and infiltrated into the soil before reaching the stream, and then cross stream at right angle. These fire lines should be stabilized and/or revegetated as soon as possible after the fire is controlled.

Prescribed Fire and Wildland Fire Use

11-029 Plan prescribed fires to use existing barriers (e.g., streams, lakes, wetlands, roads, and trails) to reduce the need for fire line construction.

11-030 Construction of firelines with heavy mechanized equipment (e.g. bulldozers) in riparian corridors is prohibited. Hand lines, wet lines, or black lines are used to create firelines within the riparian corridor to minimize soil disturbance. Water diversions are used to keep sediment out of streams. Firelines are not constructed in stream channels, but streams may be used as firelines.

Recreation

11-031 New trails will normally be located outside of the riparian corridor except at designated crossings or where the trail location requires some encroachment (e.g. to accommodate stream crossings in steep terrain, etc.), or to manage access to water bodies.

11-032 New motorized trails are prohibited within the riparian corridor except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain. When existing OHV trails within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures (which may include OHV trail closure) will be implemented.

11-033 Motorized and non-motorized trail reconstruction and relocation within the riparian corridor are allowed to reduce impacts to riparian and aquatic resources.

11-034 Proposed recreation facilities will be located outside of the riparian corridor or 100-year floodplain (Executive Order 11988) and wetlands (Executive Order 11990) unless no practicable alternative location exists. Where future facilities cannot be located out of the 100-year floodplain, structural mitigation and best management practices will be used. Trails, campsites, and other recreational developments are located, constructed, and maintained to minimize impacts to channel banks and other resources. When existing facilities are causing unacceptable resource damage appropriate mitigation measures will be implemented. Soils are stabilized on eroding trails and recreational sites.

11-035 Where a riparian area is identified as vulnerable to environmental impacts, camping trailers and vehicles should not be allowed within 50 feet of perennial streams or lakes, except at designated areas.

11-036 Overnight tethering or corralling of horses or other livestock is not allowed within 50 feet of stream courses or lakes. Existing corral sites are maintained to limit impacts to water quality and riparian corridors until alternative sites are developed.

Scenery

11-037 Management activities are designed to meet or exceed the following Scenic Integrity Objectives, which may vary by inventoried Scenic Class:

Inventoried Scenic Class	1	2	3	4	5	6	7
Scenic Integrity Objectives	H	H	M	M	M	M	M

Range

11-038 Where grazing is currently allowed and under a permit, grazing is controlled and mitigated to restore, maintain or enhance the integrity of stream channels and banks and prevent unacceptable resource damage. Reauthorizing grazing in riparian corridors within these existing allotments may occur if continued grazing would have no unacceptable resource damage on riparian resources. New grazing allotments or new permits for inactive allotments will exclude the riparian corridor.

11-039 Where authorized by permit, livestock watering areas, stream crossings, and stream banks are managed to maintain bank stability. Designated entry points, crossings, and watering points are located, sized, and maintained to minimize the impact to riparian vegetation and function.

11-040 Feeding troughs and salt and mineral blocks are not allowed inside the riparian corridor unless the entire pasture is within the riparian corridor, in which case they are located as far away from streams as possible. Watering troughs are appropriately located to protect the streams.

Minerals

11-041 The riparian corridors are available for federal oil and gas leasing with a controlled surface use stipulation to protect riparian resources and values. Other Federal minerals may be available on a case-by-case basis after full consideration of effects on the riparian corridor.

11-042 Federal oil and gas leases exist within these corridors on the Clinch Ranger District. Roads, wells, and other necessary infrastructure associated with these leases are allowed. Existing lease stipulations are used to protect the riparian corridor.

11-043 These corridors are not available for commercial or personal mineral materials. Administrative and free use of mineral materials is allowed to restore riparian areas and aquatic habitat, control erosion and sedimentation, and repair flood damage.

11-044 Private mineral rights exist in some riparian corridors across the Jefferson National Forest. Roads, wells, and other necessary infrastructure associated with these rights are allowed. Requests for access to a non-Federal interest in lands pursuant to a reserved or outstanding right are recognized, and reasonable access is granted. Encourage such interests to minimize disturbance of riparian resources and values.

Roads

11-045 New roads are located outside the riparian corridor except at designated crossings or where the road location requires some encroachment; for example to accommodate steep terrain, or are allowed within the corridor if the road will cause more resource damage if it were located outside the corridor. When existing roads within riparian corridor are causing unacceptable resource damage, appropriate mitigation measures will be implemented.

11-046 In-stream use of heavy equipment or other in-stream disturbance activities is limited to the amount of time necessary for completion of the project. Construction of crossings is completed on all streams as soon as possible after work has started on the crossing. Permanent and temporary roads on either side of stream crossings within the riparian corridor are graveled.

11-047 When constructing roads, each road segment will be stabilized prior to starting another segment. Stream crossings will be stabilized before road construction proceeds beyond the crossing.

11-048 To minimize the length of streamside disturbance, ensure that approach sections are aligned with the stream channel at as near a right angle as possible. Locate riparian corridor crossings to minimize the amount of fill material needed and minimize channel impacts. Generally, permanent structures or temporary bridges on permanent abutments are provided when developing new crossings on perennial streams. Permanent structures, temporary bridges or hardened fords are used when crossing intermittent streams.

11-049 Design structures (culverts, bridges, etc.) to accommodate storm flows expected to occur while the structures will be in place. Use scientifically accepted methods for calculating expected storm flows.

11-050 Design crossings so stream flow does not pond above the structure during normal flows in order to reduce sediment deposition immediately above the crossing and maintain the channel's ability to safely pass high flows.

11-051 Design the crossing so that stream flow will not be diverted along the road if the structure fails, plugs with debris, or is over-topped.

11-052 If culverts are removed, stream banks and channels must be restored to a natural size and shape. All disturbed soil must be stabilized.

11-053 Fords associated with new road construction are not used in perennial streams without site-specific environmental analysis. Establish fords only under conditions that will not cause significant streambank erosion. Erosion stone or larger rock is used to increase load bearing strength at the water/land interface.

11-054 All new stream crossings will be constructed to allow the passage of aquatic organisms, and maintain natural flow regime. Exceptions may be allowed in order to prevent the upstream migration of undesired species.

Lands and Special Uses

11-055 Riparian corridors are generally unsuitable for new human created stream channel impoundments, but may be considered on a project specific basis, consistent with appropriate Federal and state regulations. Impoundments will generally be designed to allow complete draining, with minimum flows, cold-water releases, and re-aeration in trout waters and other specific waters when needed. Downstream catch basins and fish ladders are constructed for fish salvage/passage, if necessary. New human-constructed impoundments are unsuitable on streams where federally listed species will be negatively affected.

Other Ground Disturbing Activities

11-056 For activities not already covered in the above standards, ground disturbing activities are allowed within the corridor if the activity will cause more resource damage if it were located outside the corridor, on a case-by-case basis following site-specific analysis. Any activity allowed under these conditions is minimized and effective sediment trapping structures such as silt fences, brush barriers, hay bale barriers, gravelling, etc., are required. Sediment control, prior to, or simultaneous with, the ground disturbing activities, is provided.

2. Channeled Ephemeral Zone Standards

Numbers to the left of the standard refer to the numbers assigned in the Jefferson National Forest Land and Resource Management Plan.

FW-12: Motorized vehicles are restricted in the channeled ephemeral zone to designated crossings. Motorized vehicles may be allowed on a case-by-case basis, after site-specific analysis, in the channeled ephemeral zone outside of designated crossings.

FW-13: Management activities expose no more than 10 percent mineral soil in the channeled ephemeral zone.

FW-14: Up to 50% of the basal area may be removed down to a minimum basal area of 50 square feet per acre. Removal of additional basal area is allowed on a case-by-case basis when needed to benefit riparian dependant resources.

FW-15 Permitted firewood cutting within the channeled ephemeral zone must take into consideration large woody debris needs. Ranger Districts will identify areas where firewood cutting is not permitted due to large woody debris concerns.

FW-16: At least partial suspension is required when yarding logs over channeled ephemerals.

FW-17 The removal of large woody debris is allowed if it poses a significant risk to water quality, degrades habitat for riparian species, or when it poses a threat to private property or Forest Service infrastructure (i.e. bridges). The need for removal is determined on a case-by-case basis.

FW-18 The addition of large woody debris in channeled ephemeral reaches will primary be through passive recruitment rather than active placement.

FW-19 New human-constructed impoundments are allowed on a case-by-case basis, following evaluation of downstream instream flow needs.

FW-20 When crossing channeled ephemeral streams, culverts, temporary bridges, hardened fords, or corduroy are used where needed to protect channel or bank stability.

FW-21: Construction of crossings is completed on all channeled ephemerals as soon as possible after work has started on the crossing. Permanent and temporary roads on either side of crossings within the channeled ephemeral zone are graveled.

FW-22: When culverts are removed, banks and channel must be restored to a natural size and shape. All disturbed soil must be stabilized.

FW-23 Trails, campsites, and other recreational developments are located, constructed, and maintained to minimize impacts to channel banks and other resource damage. When existing facilities are causing unacceptable resource damage, appropriate mitigation measures will be implemented. Soils are stabilized on eroding trails and recreational sites.

FW-24: New non-motorized trail construction is allowed to improve existing trail configuration and improve access.

FW-25: New motorized trails are prohibited within the channeled ephemeral zone except at designated crossings or where the trail location requires some encroachment; for example, to accommodate steep terrain.

FW-26: Motorized and non-motorized trail reconstruction and relocation within the channeled ephemeral zone are allowed to reduce impacts to riparian and aquatic resources.

FW-27 Where grazing is currently allowed and under a permit, control and mitigate to restore, enhance, or maintain the integrity of channels and banks. Grazing permit reauthorization is allowed, provided progress towards mitigation of negative impacts on the channeled ephemeral zones has occurred. New grazing permits will be designed to prevent negative impacts to the channeled ephemeral zone. Livestock will be excluded from channeled ephemeral zones whenever the zone cannot be maintained or restored otherwise.

FW-28: Feeding troughs, watering troughs, and salt and mineral blocks are not allowed inside the channeled ephemeral zone. Watering troughs are appropriately located to protect the streams.

FW-29: During prescribed fire operations in the channeled ephemeral zone, use the least ground disturbing method of fireline construction, favor blacklines and handtools.

FW-30: Do not disk, blade, or plow fireline within the ephemeral stream channels, use them as natural firebreaks (This applies to the actual stream channel, not the entire 25 foot zone).

FW-31: Revegetate and water bar firelines as quickly as possible, where necessary to prevent erosion. Use water diversions to keep sediment out of channels.

Appendix H

References

Alderman, J.M. 1996. Status Survey for the Atlantic Pigtoe Fusconaia masoni (Conrad 1834) in Virginia. Unpublished report to the U.S.D.I. Fish and Wildlife Service. 27 pp. with maps.

Beetle, D.E. 1973. A Checklist of the Land and Freshwater Mollusks of Virginia. Sterkiana 49:21-35.

Benz, G.W. and D.E. Collins (editors). 1997. Aquatic Fauna in Peril: The Southeastern Perspective. Southeast Aquatic Research Institute Special Publication 1. Lenz Design & Communications, Decatur, GA.

Burkhead, N.M. and H.L. Jelk. 2000. "Diversity, Levels of Imperilment, and Cryptic Fishes in the Southeastern United States," in Freshwater Ecoregions of North America – A Conservation Assessment by Abell, R.A., D.M. Olson, E. Dinerstein, P.T. Hurely, J.T. Diggs, W. Eichbaum, S. Waters, W. Wettengel, T. Allnett, C.J. Loucks, and P. Hedao. Island Press, Washington, DC.

Chazal, A.C. and C.S. Hobson. 1998. 1997 Conservation Status Assessment for the Green Floater (*Lasmigona subviridis*) in Virginia. Natural Heritage Technical Report 98-5. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond. Unpublished report submitted to the U.S. Geological Survey. 29 pp.

Clayton, J.L. 1994. Freshwater Bivalves in Elk River, West Virginia with Emphasis on Federally Endangered Species. Paper presented at the 1994 West Virginia Academy of Science.

Dennis, S.D. 1985. Distributional Analysis of the Freshwater Mussel Fauna of the Tennessee River System, with Special Reference to Possible Limiting Effects of Siltation. Tennessee Wildlife Resources Agency, No. 85-2, Nashville, TN.

EPA. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/444/4-89001, May 1989.

Etnier, D.A. 1997. Jeopardized Southeastern Freshwater Fishes: A Search for Causes, pp. 86-104, in Aquatic Fauna in Peril, The Southeastern Perspective. Ed. G.W. Benz and D.E. Collins, Lenz Design & Communications, Decatur, GA.

EWAP. 2002. Eastern Watershed Analysis Proceedure, in "A Watershed Analysis for Forest Planning on the George Washington and Jefferson National Forests", January 17, 2002; by Gary Kappesser, Dawn Kirk, and Dick Patton. Roanoke VA.

FORVA. 2001. State of Our Rivers Report – For the Commonwealth of Virginia. Friends of the Rivers of Virginia. Roanoke, VA.

Grost et al. 1991. Field Comparison of Three Devices Used to Sample Substrate in Small Streams. North American Journal of Fisheries Mgmt. 11:347-351.

Hornbeck, J.W. and J.N. Kochenderfer. 2000. Linkages Between Forests and Streams: A Perspective In Time, pp. 89-98, in Riparian Management in Forests. Ed. E.S. Verry, J.W. Hornbeck, and C.A. Dolloff, Lewis Publishers, Washington, D.C.

Huber, F.C. and D.M. Kirk. 2001. Personal observation. U.S. Forest Service, 5162 Valleypointe Parkway, Roanoke, VA.

Jenkins, R.E. and N.M. Burkhead. 1994. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, MD.

Jirka, K.J. and R.J. Neves. 1990. Freshwater Mussel Fauna (Bivalvia: Unionidae) of the New River Gorge National River, West Virginia. The Nautilis 103(4):136-139.

Lipford, M.L. 1989. The Status of Freshwater Mussels (Unionidae) of Virginia. Sterkiana 72:27-31.

Markham, S.L., C.H. Hocutt, and J.R. Stauffer, Jr. 1980. The Crayfish (Decapoda: Astacidae and Cambaridae) and the Freshwater Mussels (Mollusca: Pelecypoda) of the Lower New River, Virginia and West Virginia. Natural History Miscellanea 208: 1-11.

Master, L.L., et al. 1998. Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity. The Nature Conservancy, Arlington, VA.

McDougal, L.A., et al. 2001. A Conservation Assessment of Freshwater Fauna and Habitat in the Southern National Forests. U.S. Department of Agriculture Forest Service Southern Region, Atlanta, GA.

Morris, J.S. and R.W. Taylor. 1978. A Survey of the Freshwater Mussels (Bivalvia: Unionidae) of the Kanawha River of West Virginia. The Nautilus 92(4): 153-155.

Neves, R.J. and M.C. Odum. 1989. Muskrat Predation on Endangered Freshwater Mussels in Virginia. Journal of Wildlife Management 53:934-941.

O'Neill, Jr., C.R. and D.B. MacNeill. 1991. The Zebra Mussel (*Dreissena polymorpha*): An Unwelcome North American Invader. Sea Grant Coastal Resources

Fact Sheet, November, 1991. Cornell Cooperative Extension, State University of New York, Brockport, NY.

Parmalee, P.W. and A.E. Bogan. 1998. The Freshwater Mussels of Tennessee. The University of Tennessee Press, Knoxville, TN.

Stauffer, Jr., J.R., Boltz, J.M., and White, L.R. 1995. The Fishes of West Virginia. The Academy of Natural Sciences of Philadelphia, PA.

Stein, B.A., L.S. Kuter, and J.S. Adams, eds. 2000. Precious Heritage: The Status of Biodiversity in the United States. The Nature Conservancy and Association for Biodiversity Information. Oxford University Press, New York, NY.

U.S.D.I. Fish and Wildlife Service. 1977. Federal Register. Vol. 42, No. 175/ Friday, September 9, 1977/Final Rules. Pp. 45526-45530.

U.S.D.I. Fish and Wildlife Service. 1990. James Spinymussel (*Pleurobema collina*) Recovery Plan. Newton Corner, MA.

U.S.D.I. Fish and Wildlife Service. 1998. Final Endangered Species Act Consultation Handbook, March. Government Printing Office, Washington, D.C.

U.S.D.I. Fish and Wildlife Service. 2003. Federal Register. Vol. 68, No. 106/ Tuesday, June 3, 2003/Proposed Rules. Pp. 33234-33282.

Virginia Department of Game and Inland Fisheries. 1999. Aquatic Mollusk Taskforce Committee Notes.

Virginia Department of Game and Inland Fisheries. 2003. Freshwater Mussel Restoration in the Upper Tennessee River Basin of Virginia. Virginia Department of Game and Inland Fisheries, Richmond, VA. 7 pp.

Warren, M. Jr., B. Burr, S. Walsh, H. Bart, Jr., R. Cashner, D. Etnier, B. Freeman, B. Kuhajda, R. Mayden, H. Robinson, S. Ross, and W. Starnes. 2000. Diversity, Distribution, and Conservation Status of the Native Freshwater Fishes of the Southern United States. Fisheries 25 (10):7-29.

Watters, G.T. 2000. "Freshwater mussels: a complicated resource to conserve," In Freshwater Ecoregions of North America – A Conservation Assessment by Abell, R.A., D.M. Olson, E. Dinerstein, P.T. Hurely, J.T. Diggs, W. Eichbaum, S. Waters, W. Wettengel, T. Allnett, C.J. Loucks, and P. Hedao. Island Press, Washington, DC.

Williams, J.D, et al. 1992. Conservation Status of Freshwater Mussels of the United States and Canada. Fisheries 18(9):6-22.

Appendix I
Glossary

Ephemeral streams are defined by flows that occur for short periods of time in direct response to storm precipitation or snowmelt runoff. Ephemeral stream bottoms are above the water table and do not contain fish or aquatic insects that have larvae with multiple-year life cycles. Ephemeral streams may have a defined channel or may be manifested as a natural swale or depression with vegetation and organic material covering the bottom. Ephemeral streams can serve as a conduit for much of the sediment that enters the stream system. Large woody debris associated with ephemeral streams may also contribute significantly to the stability of a stream system.

Channeled ephemeral streams are ephemeral streams that have a defined channel of flow where surface water converges with enough energy to remove soil, organic matter, and leaf litter. Ephemeral streams that exhibit an ordinary high watermark and show signs of annual scour or sediment transport are considered navigable waters of the United States (USACE, Part 330- Nationwide Permit program, 2000) (33 CFR 330).

Intermittent streams flow in response to a seasonally-fluctuating water table in a well-defined channel. The channel will exhibit signs of annual scour, sediment transport and other stream channel characteristics, absent perennial flows. Intermittent streams typically flow during times of elevated water table levels and may be dry during significant periods of the year, depending on precipitation cycles. Field identification of intermittent streams must consider geology, land use patterns, and precipitation cycles. Intermittent streams do not maintain fish populations year around or aquatic insects that have larvae with multi-year life cycles.

Perennial streams are any watercourse that generally flows most of the year, in a well-defined channel and is below the water table. Droughts and other precipitation patterns may influence the actual duration of flow. Perennial streams contain fish or aquatic insects that have larvae with multiyear life cycles. Water-dependent vegetation is typically associated with perennial streams.

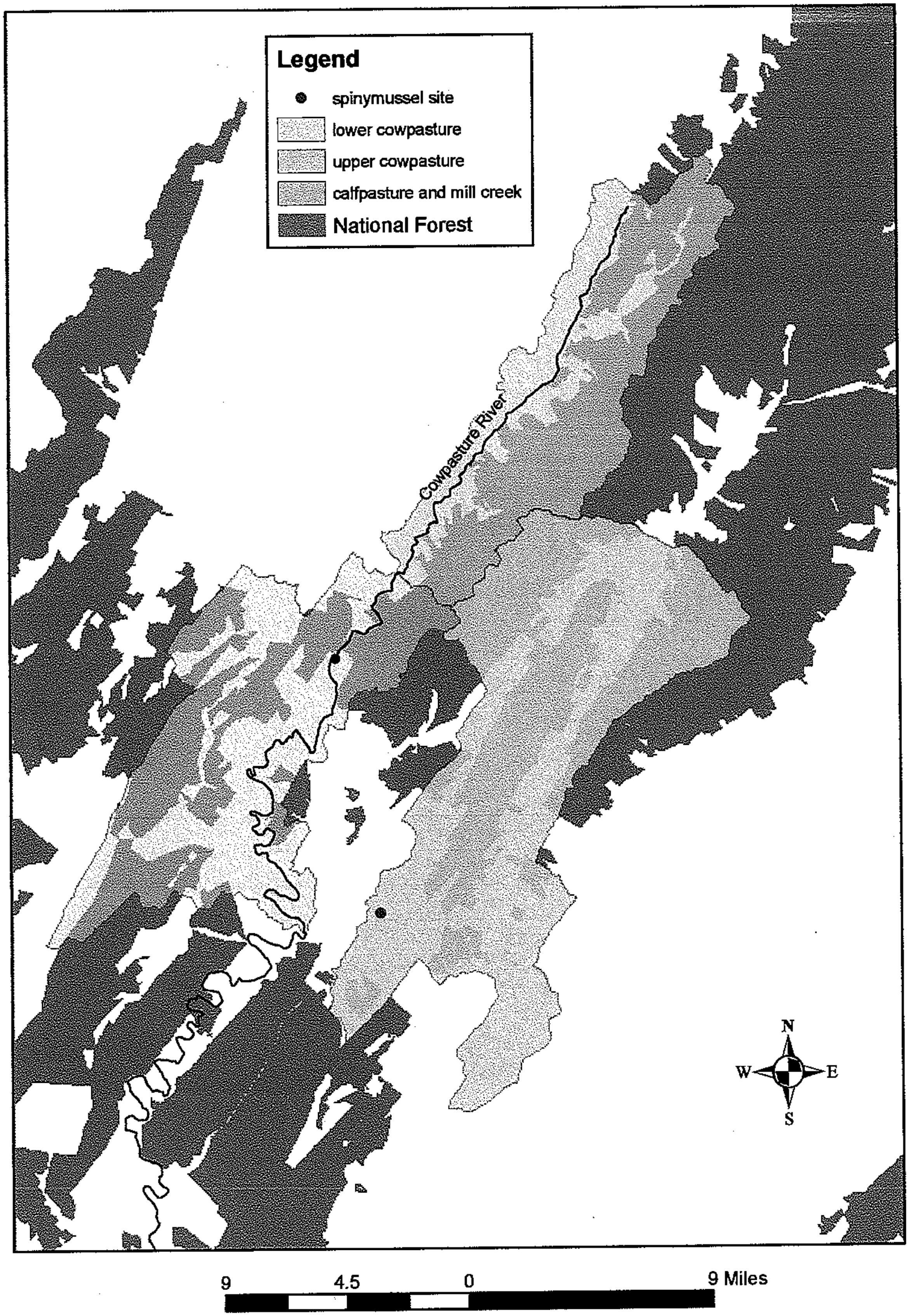
Riparian dependent species are species that are dependent on riparian areas during at least one stage of their life cycle.

A **Seep** is a wet area where a seasonal high water table intersects with the ground surface. Seeps that meet the definition of a wetland are included in the Conservation Zone.

A **Spring** is a water source located where water begins to flow from the ground due to the intersection of the water table with the ground surface. Springs generally flow throughout the year. Springs that are the source of perennial or intermittent streams are included in the Conservation Zone.

Wetlands (pursuant to the Federal Clean Water Act) are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas (40CFR232.2) and are found primarily within palustrine systems but may also be within riverine, lacustrine, estruarine and marine systems.

Spinymussel Watersheds on Deerfield



Appendix J. Region 6 Conservation Measures the USFS agreed to incorporate into Project Description

Page numbering for Appendix J J is not consecutive due to insertion of a PDF file composed of one document.

To: File

From: Region 6

Date: September 23, 2011

Re: FS Fire Retardant Consultation- Changes to project descriptions and effects determinations to include in an addendum to the BA and/or appendix to BO

1. Water depletion – In CO, WY, and UT water is rarely (if ever) used from a non-municipal source when mixing fire retardant. We believe impacts to listed fish and their critical habitats are highly unlikely and have based our analyses on water depletion levels occurring at zero to a de minimis level (0.1 acre feet/year). This assumption was vetted and confirmed at the local level (email documentation provided – pp. 8)
2. Pawnee montane skipper – No avoidance buffer area will be implemented for this species. The effects of wildfire are anticipated to be worse than impacts of fire retardant. This was agreed upon at the local and regional level (email documentation provided – pp. 3).
3. Kootenai River white sturgeon – Based on discussions at the local level we have changed the determination from LAA to NLAA (email documentation provided – pp.4).
4. June sucker – Based on discussions at the local level we have changed the determination from LAA to NLAA (email documentation provided – pp. 3).
5. Kendall warm springs dace – Based on discussions at the local level we negotiated a buffer area of 0.5 mile. This allowed us to change the determination from LAA to NLAA (email documentation provided – pp. 5).
6. Heliotrope milkvetch - Based on discussions at the local level we negotiated a buffer area of 500 feet. This allowed us to change the determination from LAA to NLAA (email documentation provided – pp. 2).
7. Water howellia - Based on discussions at the local level we have changed the determination from LAA to NLAA (email documentation provided – pp. 5).

Kevin McAbee /R6/FWS/DOI
09/16/2011 01:07 PM

To Charisa Morris/ARL/R9/FWS/DOI@FWS
cc Ann Belleman/R6/FWS/DOI@FWS, Don Morgan/ARL/R9/FWS/DOI@FWS, Leslie Ellwood/R6/FWS/DOI@FWS, Paul
bcc
Subject Re: Fire retardant water depletion issue

Sarena & Charisa,

FYI - an annual depletion of 0.1 acre feet or less in the Upper Colorado River Basin does not require formal consultation for the four endangered fish species because it is considered a 'de minimis amount'. So if the FS uses less than that (~32,585 gallons) from non-municipal sources, they are still at an NLAA determination. I assume this calculation gets tricky based on the geographic scale (forest vs. state vs. basin). If the FS can demonstrate they use less than 32,585 gallons a year for the whole Upper Colorado River Basin, then we are in the clear. I bet this will be the case based on my discussions with the local FS folks (for retardant mixing - but it gets fuzzier if we also talk about water-only drops). For Utah, as demonstrated below, the FS determined that they had <u>never</u> used a non-municipal water source because it was deemed to costly to clean.

Let me know if you need more of my help.

Thanks.

Kevin

Charisa Morris/ARL/R9/FWS/DOI

Charisa Morris/ARL/R9/FWS/DOI
09/16/2011 11:21 AM

To Sarena Selbo/R6/FWS/DOI@FWS
cc Ann Belleman/R6/FWS/DOI@FWS, Don Morgan/ARL/R9/FWS/DOI@FWS, Kevin McAbee/R6/FWS/DOI@FWS, Leslie Ellwood/R6/FWS/DOI@FWS, Paul Abate/R6/FWS/DOI@FWS
Subject Re: Fire retardant water depletion issue

Hi Sarena-

I will forward this and the other supporting records you've sent to the USFS WO in preparation for next week's 'open issues' meeting.

Thanks!
Charisa

Integrity is when what you think, say, and do are all in alignment.
****

Charisa Morris
Endangered Species Biologist
U.S. Fish and Wildlife Service
4401 N. Fairfax Dr., Suite 420
Arlington, VA 22203
(703) 358-1954
Fax (703) 358-1735

Sarena Selbo/R6/FWS/DOI

Sarena Selbo /R6/FWS/DOI
09/16/2011 01:14 PM

To Charisa Morris/ARL/R9/FWS/DOI@FWS
cc Leslie Ellwood/R6/FWS/DOI@FWS, Paul Abate/R6/FWS/DOI@FWS, Kevin McAbee/R6/FWS/DOI@FWS, Ann Belleman/R6/FWS/DOI@FWS, Don Morgan/ARL/R9/FWS/DOI@FWS
Subject Fire retardant water depletion issue

Hi Charisa,

I am sending you the email string that detailed why we thought the water issue was resolved. It is not addressed in the BA as I had expected. The BA says:

When retardant is mixed at the incident site using a portable mixing station, water sources are a municipal water source or a large lake or reservoir. The amount of water used is not at a level to cause any water depletion issues of water bodies or adverse effects to listed species

It is the "not a level" part that concerns me because in some our our rivers any removal of water is an adverse affect. Unless they can assure that they will only use municipal sources in CO, WY, and UT than I think we are looking at formal consultation on water depletions. Which long story short, the FS would need to estimate their depletion amount and participate in a long standing programmatic where they must pay a fee to the Recovery Program.

sms

----- Forwarded by Sarena Selbo/R6/FWS/DOI on 09/16/2011 11:02 AM -----

Kate P Walker/R10/USDAFS@FSNOTES
08/03/2011 10:33 AM

To Sarena Selbo/R6/FWS/DOI@FWS@DOI
cc Charisa Morris/ARL/R9/FWS/DOI@FWS, daaustin@fs.fed.us, Don Morgan/ARL/R9/FWS/DOI@FWS
Subject Re: Fw: Fire retardant

Yes I have been finding some of the same things and will describe the minimal effects that water use is for this effort

thanks

Kate

****
Kate Walker
406-329-3568 (OFFICE)
406-396-4125 (cell)
kpwalker@fs.fed.us
Sarena Selbo/R6/FWS/DOI@FWS

Sarena Selbo/R6/FWS/DOI@FWS
08/02/2011 07:42 AM

To Kate P Walker/R10/USDAFS@FSNOTES, daaustin@fs.fed.us
cc Charisa Morris/ARL/R9/FWS/DOI@FWS, Don Morgan/ARL/R9/FWS/DOI@FWS
Subject Fw: Fire retardant

Hi Kate and Dave,
Just wanted to share this message below with you to follow up on our discussion about water depletion. My biologists in WY, CO, and UT have spoken with their local FS bios and have found that water is not taken from rivers, streams, and lakes in out neck of the woods, but from municipal water sources. This should take care of our initial concern that water depletion was an effect that needed analyzing. In addition, it will change some of the effects determinations for some Forests from LAA to NLAA due to fish not being in the vicinity of these Forests, dilution effects of retardant, etc.

Sarena

----- Forwarded by Sarena Selbo/R6/FWS/DOI on 08/02/2011 07:30 AM -----

Paul Abate /R6/FWS/DOI
07/26/2011 02:15 PM

To Leslie Ellwood/R6/FWS/DOI@FWS
cc Sarena Selbo/R6/FWS/DOI@FWS, Laura Romin/R6/FWS/DOI@FWS, Kevin McAbee/R6/FWS/DOI@FWS
Subject Fw: Fire retardant

Hello Leslie,

Here is what Kevin in our office found regarding water usage for fire retardant mixing. Kevin meant to say NLAA and not "no effect" for the fish, so disregard that verbiage.

Let me know if you have any questions.

Thanks,

Paul

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Paul Abate
Fishery Biologist
US Fish and Wildlife Service, Utah Field Office
2369 West Orton Circle, Suite 50
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

West Valley City, Utah 84119

paul_abate@fws.gov
(801)975-3330 x130
(801)975-3331 (fax)

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

----- Forwarded by Paul Abate/R6/FWS/DOI on 07/26/2011 02:04 PM -----

Kevin McAbee /R6/FWS/DOI
07/26/2011 01:47 PM

To Paul Abate/R6/FWS/DOI@FWS
cc Sarena Selbo/R6/FWS/DOI@FWS
Subject Fw: Fire retardant

Paul & Sarena,

I looked into the question raised by the Colorado ES office: Does the Forest Service deplete water as part of actions considered under the national fire retardant consultation? I spoke with Paul Cowley of the U-W-C NF, who in turn spoke to Julie Campbell (Asst fire planner region 4). Their final answer was - not in Utah (see below). In Utah, the mixing of retardant on site using natural water sources is deemed too messy. Most FS lands are close enough to an airport that it is easier to use a municipal water source. In fact, onsite water usage (without retardant) is also very rare and only occurs for large timber fires.

As a result, I determine that we can continue to concur with the no effect determination for Colorado River fish species for all Forests in the State of Utah.

I hope this helps. Please feel free to add this email to the admin record.

Kevin

Kevin McAbee
Ecologist, Aquatic Endangered and Sensitive Species
US Fish and Wildlife Service
Utah Ecological Services Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119

office: 801-975-3330 ext 143
fax: 801-975-3331

http://www.fws.gov/utahfieldoffice/

----- Forwarded by Kevin McAbee/R6/FWS/DOI on 07/26/2011 01:38 PM -----

Paul Cowley <pcowley@fs.fed.us>
07/26/2011 01:34 PM

To Kevin_McAbee@fws.gov
cc Julie A Campbell <jacampbell@fs.fed.us>, Paul Cowley <pcowley@fs.fed.us>
Subject Re: Fire retardant
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

Kevin, I spoke with Julie Campbell, Assistant Fire Planner in Region 4 about using non-municipal water (from streams or lakes) mixed with retardant to fight fire in Utah. Region 4 covers all of the National Forest lands in the State of Utah. There were a couple of questions that I posed to Julie and here are her responses over a couple of phone calls:

1. Do the forests in Utah use temporary pump and storage equipment to obtain water from for areal fire fighting. Julie's response was yes we do. For helicopters we could use what is know as pumpkins (soft exterior) or heliwell (hard exterior).

2. Do we mix retardant in these storage tanks for use on fire. Julie's response, after visiting with some of the field staff, was no. They would be too difficult to clean.

For National Forest System Lands in Utah, no water from streams, ponds, lakes or reservoirs is drafted from these water bodies and mixed with retardant for use by areal or ground delivery systems.

Julie thanks for your help on this! Please double check that my points to Kevin above cover the discussions that we've had. Thanks again for the help! pc

Paul Cowley (pcowley@fs.fed.us)
Fish and Wildlife Program Manager
Uinta-Wasatch-Cache National Forest
Suite 8236, Federal Bldg.
125 S. State Street
Salt Lake City, Utah 84138
(801) 236-3442 office
(801) 440-8098 cell
pcowley@fs.fed.us

Kevin_McAbee@fws.gov

07/26/2011 11:01 AM

To Paul Cowley <pcowley@fs.fed.us>
cc
Subject Fire retardant

Paul,

Thanks for looking into answers about the fire retardant for me. I got your voicemail and look forward to chatting once you get some more specific answers.

Kevin

Leslie Ellwood /R6/FWS/DOI
09/21/2011 10:57 AM

To Sarena Selbo/R6/FWS/DOI@FWS
cc
bcc
Subject Fw: fire consultation - water depletion issue

Sarena,

Here is some information that I have gathered on the fire retardant and water depletion issue:

July 19, 2011 - Conversation with Denny Bohon, USFS, South Platte District, fisheries biologist. Denny talked with several fire operations managers about the question of using local water to remotely mix with fire retardants in Colorado. Everyone said that the planes are loaded at the airports and use municipal water. It is extremely rare for helicopters to use a remote batch site, and, if they do, they truck in municipal water.

July 28, 2011 - Conversation with Peter McDonald, USFS Region 2, Regional Office. Peter talked with Bill Ott, Regional Deputy Director of Fire and Aviation. Bill said that it is very rare to draw water for mixing for retardant and that the retardant is loaded on the planes at the airports.

Also, see below for similar discussion about fire retardant and water depletions in Wyoming.

Leslie Ellwood
Wildlife biologist
USFWS/ES/Colorado Field Office
P.O. Box 25486, DFC (MS 65412)
Denver, CO 80225-0486
Phone (303-236-4747)
Fax (303-236-4005)

----- Forwarded by Leslie Ellwood/R6/FWS/DOI on 09/21/2011 10:09 AM -----

"McCreedy, Clark" <cmccreedy@fs.fed.us>
07/21/2011 11:33 AM

To "ann_bellman@fs.fed.us" <ann_bellman@fs.fed.us>
cc "Hanvey, Gary" <ghanvey@fs.fed.us>, "Leslie_ellwood@fws.gov" <Leslie_ellwood@fws.gov>
Subject fire consultation

I talked to Vern Bentley, our Forest FMO, who says that we've never used either the Platte or the Colorado River as a water source for the mixing of retardant slurries for use on MBRTB lands. All our slurry formulation would occur (has occurred) at municipal airports where these aircraft area staged and deployed. That is, slurry would be mixed using a municipal water source.

****

Clark D. McCreedy, Forest Biologist
Medicine Bow - Routt - Thunder Basin
Supervisor's Office
2468 Jackson Street
Laramie, Wyoming 82070
Phone: 307-745-2412

Fax: 307-745-2398
cmccreedy@fs.fed.us
****

Leslie Ellwood /R6/FWS/DOI	To	Sarena Selbo/R6/FWS/DOI@FWS
09/19/2011 04:10 PM	cc	
	bcc	
	Subject	Fw: Corrections to retardant BA in the BO

Comments from FS regarding the newest BA and their changes for pawnee montane skipper and PMJM avoidance areas.

----- Forwarded by Leslie Ellwood/R6/FWS/DOI on 09/19/2011 04:09 PM -----

"McDonald, Peter" <petermcdonald@fs.fed.us>	To	"Austin, David" <daaustin@fs.fed.us>
09/14/2011 10:40 AM	cc	"Burns, Joseph" <jaburns@fs.fed.us>, "Pivorunas, David" <dpivorunas@fs.fed.us>, "Leslie Ellwood (leslie_ellwood@fws.gov)" <leslie_ellwood@fws.gov>
	Subject	RE: Corrections to retardant BA in the BO

Dave thanks for the clarification.

Peter

Peter McDonald, Asst. Program Leader
Threatened, Endangered and Sensitive Species
U.S. Forest Service - Rocky Mountain Region
740 Simms Street, Golden, CO 80401
tel: 303.275.5029 fax: 303.275.5075
www.fs.usda.gov/goto/r2/projects/scp

From: Austin, David
Sent: Tuesday, September 13, 2011 2:33 PM
To: McDonald, Peter
Subject: RE: Corrections to retardant BA in the BO

Hit the wrong button - to finish up -

Terrestrial avoidance areas may overlap with riparian/300 ft buffer for waterways. For PMJM - all the avoidance areas should overlap. Again, the forest said they would map PMJM populations so this covers it.

I took out the previous information that said up to a 600 ft or decided by the forest - so if FWS is coming back with this, they are still viewing an older version.

For Pawnee - since it is a small isolated population and limited habitat and distribution I determined (based on the wildlife screening process) to require avoidance area mapping.

The team has stated that the local forest/FWS office can make changes at their level, as long as thy document their analysis to do so and keep that as their local concurrence.

David A. Austin
Wildlife Biologist for the National IDT
Aerial Application of Fire Retardant EIS

Office: 909-382-2733
Cell: 909-677-9632

Forest Fish & Wildlife Biologist
San Bernardino National Forest
602 S. Tippecanoe Ave, San Bernardino CA 92408
email: daaustin@fs.fed.us

From: McDonald, Peter
Sent: Tuesday, September 13, 2011 12:23 PM
To: Austin, David
Subject: FW: Corrections to retardant BA in the BO

Dave see note below and let me know if you have any questions (Dave P. said to forward directly rather than go through him and Joe).

Peter

Peter McDonald, Asst. Program Leader
Threatened, Endangered and Sensitive Species
U.S. Forest Service - Rocky Mountain Region
740 Simms Street, Golden, CO 80401
tel: 303.275.5029 fax: 303.275.5075
www.fs.usda.gov/goto/r2/projects/scp

From: McDonald, Peter
Sent: Tuesday, September 13, 2011 11:29 AM
To: Burns, Joseph; Pivorunas, David
Subject: Corrections to retardant BA in the BO

I sent a note up about this sometime ago that I think went to the ID team but I was just informed by my FWS contact that something happened in the translation. So for awareness at this point and would appreciate you sharing with the team: An earlier version of the BA did not propose avoidance areas for the Pawnee montane skipper or Preble's meadow jumping mouse beyond the 300 ft. aquatic buffer. My contact says though the latest BA version she reviewed reversed that and says avoidance areas will be identified for these species. That is incorrect and the FWS will be pointing that out in their BO and separate avoidance areas will not be necessary.

Peter

Peter McDonald, Asst. Program Leader
Threatened, Endangered and Sensitive Species
U.S. Forest Service - Rocky Mountain Region

740 Simms Street, Golden, CO 80401
tel: 303.275.5029 fax: 303.275.5075
www.fs.usda.gov/goto/r2/projects/scp

Anne Vandehey /R6/FWS/DOI

09/13/2011 08:18 AM

To Sarena Selbo/R6/FWS/DOI@FWS

cc scottspaulding@fs.fed.us, Tim Bodurtha/R6/FWS/DOI@FWS, Dan Brewer/R6/FWS/DOI@FWS, Shannon

bcc

Subject Fw: retardant EIS and KRWS EIS Effects Determination call-modified to cover IDPNF, if needed

For Follow Up:	Normal Priority
History:	This message has been replied to.

Sarena...additional rationale for NLAA for Kootenai River white sturgeon for the IPNF and KNF, USFS Northern Region.

Anne Vandehey, Sec 7 Prog Coord
USFWS Montana ES Field Office
585 Shepard Way
Helena Montana 59601

406 449 5225 ext 212

----- Forwarded by Anne Vandehey/R6/FWS/DOI on 09/13/2011 08:11 AM -----

"Spaulding, Scott" <scottspaulding @fs.fed.us>

09/12/2011 03:57 PM

To "anne_vandehey@fws.gov" <anne_vandehey@fws.gov>

cc "Tim_Bodurtha@fws.gov" <Tim_Bodurtha@fws.gov>

Subject RE: retardant EIS and KRWS EIS Effects Determination call-modified to cover IDPNF, if needed

Anne and Tim. This email presents a brief rationale for why I do not feel the Likely to Adversely Affect (LAA) consultation call for the Kootenai River White Sturgeon (KRWS) on the Kootenai and Idaho Panhandle National Forests (KNF and IPNF, respectively) in the National Fire Retardant EIS is appropriate. And why it should be changed to a Not Likely to Adversely Affect (NLAA) call.

Historically KRWS were present in Montana and Idaho downstream of Kootenai Falls and used the river seasonally for spawning (and probably some rearing). However, the construction of Libby Dam and its flow management have stopped the use of KRWS to any documentable level in the Canyon Reach of the river (Libby Dam in Montana down to the Moyie River confluence in Idaho). The Canyon Reach is the only area of river where the KNF and IPNF have land in close proximity. Because this area of river adjacent to Forest ownerships is thought to be unoccupied, it was not designated as critical habitat.

Federal Register listing documentation (Federal Register Vol. 73, No. 132, Wednesday July 9th, 2008) highlights the fact that adult and juvenile fish have not been documented recently in Montana habitats and areas of the IPNF down to around Bonners Ferry (Partridge 1983, pp. 1, 23, 25; Apperson and Anders 1990, pp. 19, 22, 23, 25; Apperson and Anders 1991, pp. 36–37, 39–44, 48–49). Though there are no apparent physical barriers to sturgeon migration up the river through the IPNF and into Montana, one hypothesis is that it could be from lack of adequate depth of river in the Braided Reach. The Braided Reach is downstream of IPNF lands from the confluence of the Moyie River downstream to Bonners Ferry, ID. There maybe some successful KRWS spawning in and around the Bonners Ferry area, but the population is maintained by artificial production from a Kootenai Tribal hatchery in Idaho. In other words, the young life stages (eggs and young fish) that could potentially be affected by retardant in the river are not likely present in the river near lands managed by either the IPNF or KNF.

The above information on KRWS distribution relative to Montana and Idaho and National Forest ownership suggest that the probability for retardant to coming in contact with KRWS is extremely low. Also, the Kootenai River is a large body of water (99% exceedence probability of approximately 18,000 CFS at Libby Montana) relative to upstream Forest water bodies that would be potential sources of accidental retardant application. Thus, if a retardant drop were to hit a Forest stream and be transported downstream off of forest and down the Kootenai River to where KRWS are present, the severity, intensity and duration of potential exposures are so low that one can reasonably assume the effects to the species and its critical habitat would be discountable. I believe this information justifies a change in the existing effects determination for the species from LAA to NLAA.

Let me know if you have questions.

Scott Spaulding, Regional Fish Program Lead
Northern Region Forest Service
Fed Bld, 200 E. Broadway PO Box 7669
406-329-3287
f: 406-329-3171

Anne Vandehey /R6/FWS/DOI	To	Sarena Selbo/R6/FWS/DOI@FWS
09/09/2011 03:15 PM	cc	
	bcc	
	Subject	Fw: retardant EIS and KRWS EIS Effects Determination call DOCUMENTATION

History: This message has been forwarded.

Documentation of discussions between USFS and USFWS, as requested. All cc'd are in consensus.

Anne Vandehey, Sec 7 Prog Coord
USFWS Montana ES Field Office
585 Shepard Way
Helena Montana 59601

406 449 5225 ext 212

----- Forwarded by Anne Vandehey/R6/FWS/DOI on 09/09/2011 03:04 PM -----

"Spaulding, Scott" <scottspaulding@fs.fed.us>	To	"anne_vandehey@fws.gov" <anne_vandehey@fws.gov>
09/09/2011 02:05 PM	cc	"Tim_Bodurtha@fws.gov" <Tim_Bodurtha@fws.gov>, "Carlson, John" <jwcarlson01@fs.fed.us>, "Swisher, Kristi" <kswisher@fs.fed.us>
	Subject	retardant EIS and KRWS EIS Effects Determination call

Anne and Tim. This email presents a brief rationale for why I do not feel the Likely to Adversely Affect (LAA) consultation call for the Kootenai River White Sturgeon (KRWS) on the Kootenai National Forest in the national retardant EIS is justified. And why it should be a Not Likely to Adversely Affect (NLAA) call.

Historically KRWS were present in Montana downstream of Kootenai Falls (17 miles to Idaho and the Kootenai National Forest Boundary) and used the river seasonally for spawning (and probably some rearing). However, the construction of Libby Dam and its flow management have stopped that use of KRWS to any documentable level in the river on the Kootenai National Forest.

As such, the Kootenai River in Montana is not designated as Critical Habitat, a decision in part predicated on the lack of documentation of KRWS residency in the Montana and Kootenai National Forest portion of the River.

Federal Register listing documentation (Federal Register Vol. 73, No. 132, Wednesday July 9th, 2008) highlights the fact that adult and juvenile fish have not been documented recently in these same Montana habitats (Partridge 1983, pp. 1, 23, 25; Apperson and Anders 1990, pp. 19, 22, 23, 25; Apperson and Anders 1991, pp. 36–37, 39–44, 48–49). Though there are no apparent physical barriers to sturgeon migration up into Montana, one hypothesis is that it could be from lack of adequate depth of river in the braided reach downstream of Montana and Kootenai National Forest habitats.

There maybe some successful KRWS spawning in recent years near Bonners Ferry, Idaho, but the population is maintained by artificial production from a Kootenai Tribal hatchery in Idaho. In other words, the young life stages (eggs and young fish) that would be affected by retardant are not likely present upstream in the Montana portion of the Kootenai River.

The above information on KRWS distribution related to riverine habitats in Montana and the Kootenai National Forest, combined with the fact that the Kootenai River is a large body of water, much different than most of our Forest waterways, argues that there is so little probability of an interaction between retardant (either directly in the Kootenai River or indirectly in upstream waterways) and the KRWS that an effects destination of NLAA is well justified.

Let me know if you have questions.

Scott Spaulding, Regional Fish Program Lead
Northern Region Forest Service
Fed Bld, 200 E. Broadway PO Box 7669
406-329-3287
f: 406-329-3171

Paul Abate /R6/FWS/DOI
09/16/2011 10:12 AM

To Sarena Selbo/R6/FWS/DOI@FWS
cc Mark Capone/R6/FWS/DOI@FWS
bcc
Subject Re: Fw: Fire Retardant Consultation and June sucker

For Follow Up:	Normal Priority
History:	This message has been replied to.

Sarena,

Mark is out and will have a new baby today! Yes, the NLAA determination is for both the species and the critical habitat.

Thanks,

Paul

~~~~~~
Paul Abate
Branch Chief, Aquatic Endangered Species Branch
US Fish and Wildlife Service, Utah Field Office
2369 West Orton Circle, Suite 50
West Valley City, Utah 84119

paul_abate@fws.gov
(801)975-3330 x130
(801)975-3331 (fax)
~~~~~~

Sarena Selbo/R6/FWS/DOI

Sarena Selbo /R6/FWS/DOI
09/15/2011 08:08 PM

To Mark Capone/R6/FWS/DOI@FWS
cc Paul Abate/R6/FWS/DOI@FWS
Subject Re: Fw: Fire Retardant Consultation and June sucker

Please confirm that the NLAA determination is for both the species and the CH. Thanks.

<><><><><><><><><><><><><><><><><><><><><><><>
Sarena M. Selbo
Field Supervisor (through Oct)
Grand Junction, CO
970-243-2778 x 29

Section 7 Coordinator

Mountain-Prairie Region
U.S. Fish and Wildlife Service
303-236-4046
sarena_selbo@fws.gov
<><><><><><><><><><><><><><><><><><><><><><><><><><><>
Mark Capone/R6/FWS/DOI

Mark Capone /R6/FWS/DOI
09/08/2011 02:34 PM

To Sarena Selbo/R6/FWS/DOI@FWS
cc Paul Abate/R6/FWS/DOI@FWS
Subject Fw: Fire Retardant Consultation and June sucker

Sarena,

Please find Paul Cowley's (USFS Fish Biologist Uinta Wasatch Cache NF) response below.

Mark

Mark K. Capone

Fish and Wildlife Biologist
US Fish and Wildlife Service, Utah Field Office
2369 Orton Circle, Suite 50
West Valley City, Utah 84119

(801)975-3330x155
(801)975-3331 (fax)

----- Forwarded by Mark Capone/R6/FWS/DOI on 09/08/2011 02:28 PM -----

"Cowley, Paul"
<pcowley@fs.fed.us>
09/08/2011 02:19 PM

To "Mark_Capone@fws.gov" <Mark_Capone@fws.gov>
cc
Subject RE: Fire Retardant Consultation and June sucker

Mark I agree with your assessment in that agency (USFS) policy precludes any drop within 300 feet of a waterbody except to protect life or property, we are 5 miles from occupied or critical June sucker habitat and there have been nor are there any plans no water withdrawals from June sucker habitat that have been mixed with retardant for use on a local fire. paul cowley

From: Mark_Capone@fws.gov [mailto:Mark_Capone@fws.gov]
Sent: Thursday, September 08, 2011 12:56 PM
To: Cowley, Paul
Cc: Paul_Abate@fws.gov; Sarena_Selbo@fws.gov

Subject: Fire Retardant Consultation and June sucker

Paul,

Thank you for taking the time to discuss fire retardant application and the potential impacts to June sucker with Paul Abate and me this morning.

As we discussed, the Service feels that the appropriate determination for June sucker is "Not likely to adversely affect." We are basing this determination primarily on the two following factors:

- The National Forest boundaries are greater than 5 river miles from any occupied or critical June sucker habitat.
- There are no water depletions associated with retardant application.

Do you agree with this assessment?

Mark

Fish and Wildlife Biologist
US Fish and Wildlife Service, Utah Field Office
2369 Orton Circle, Suite 50
West Valley City, Utah 84119

(801)975-3330x155
(801)975-3331 (fax)

Ann Belleman /R6/FWS/DOI
08/15/2011 04:14 PM

To Sarena Selbo/R6/FWS/DOI@FWS
cc Charisa Morris/ARL/R9/FWS/DOI@FWS, Gary Hanvey/R1/USDAFS@FSNOTES, Alex Schubert/R6/FWS/DOI@FWS, Ann
bcc
Subject Bridger-Teton NF fire retardant buffer change around Kendall Warm Springs dace

For Follow Up:	Normal Priority
History:	This message has been replied to and forwarded.

Sarena,

The Bridger-Teton Natl. Forest and the Service negotiated a change in the fire retardant use avoidance area buffer for the Kendall Warm Springs dace, located within the Forest's Pinedale Ranger District. Under the previous USFS BA, a standard 300 ft. avoidance area buffer was used for riparian areas and as a result, the effects determination was "may affect, likely to adversely affect" for KWS dace. However, the Forest recently agreed to a mandatory 0.5 mile avoidance area buffer around the dace's warm springs habitat and we agreed with an effects determination change to "not likely to adversely affect." We believe the larger 0.5 mile buffer provides enough of a spatial boundary for aerial fire personnel dropping fire retardant to identify, thereby substantially reducing the risk of dropping retardant too close to the springs. The Forest will map this boundary using GIS.

Ann Belleman
Biologist
U.S. Fish and Wildlife Service
808 Meadow Lane
Cody, WY 82414
ann_belleman@fws.gov
307-578-5116

Ann Belleman /R6/FWS/DOI
09/19/2011 09:08 AM

To Sarena Selbo/R6/FWS/DOI@FWS
cc
bcc
Subject Fw: Fire Retardant Avoidance Data for T&E (Bridger-Teton National Forest)

For Follow Up: Normal Priority

Sarena,

This email string provides documentation for the BTNF's willingness to increase the KWSD buffer to 0.5 mile. While the info below doesn't say it, the whole purpose was to minimize or avoid impacts from potential misapplied fire retardant and subsequently change the effectsdetermination from a "LAA" to "NLAA." Please let me know if you need additional documentation. Thanks.

Ann Belleman
Biologist
U.S. Fish and Wildlife Service
808 Meadow Lane
Cody, WY 82414
ann_belleman@fws.gov
307-578-5116

----- Forwarded by Ann Belleman/R6/FWS/DOI on 09/19/2011 08:59 AM -----

Gary Hanvey <ghanvey@fs.fed.us>
05/13/2011 05:11 PM

To Ann_Belleman@fws.gov, Alex_Schubert@fws.gov
cc Alex Gardiner <tagardiner@fs.fed.us>, Clark McCreedy <cmccreedy@fs.fed.us>, Kerry M Murphy <kmmurphy02@fs.fed.us>, Lara R Oles <lroles@fs.fed.us>, Dave Fogle <dfogle@fs.fed.us>, Pam Bode <pbode@fs.fed.us>
Subject Fw: Fire Retardant Avoidance Data for T&E (Bridger-Teton National Forest)

Attached is the info provided per the May 16 data request for the Fire Retardant EIS. Also attached is the sage grouse lek site map that was used to develop avoidance polygons in the data request. Brian and I developed the Abstract to be included in the metadata. Ann, please share with Pat - I dont have her email address.

Thanks to all of you that provided assistance.

****
Gary Hanvey
Program Leader - Wildlife, Fish & Rare Plants
Bridger-Teton National Forest
Phone: 307.739.5537
EMail - ghanvey@fs.fed.us
****

----- Forwarded by Gary Hanvey/R4/USDAFS on 05/13/2011 04:59 PM -----

Brian A Goldberg /R4/USDAFS

05/12/2011 09:13 AM

To Gary Hanvey/R4/USDAFS@FSNOTES

cc

Subject Fire Retardant Avoidance Data for T&E (Bridger-Teton National Forest)

Here is the data:

And a map of the areas:

And a description of the data (included with the shapefile's metadata):

ABSTRACT:

This layer delineates avoidance polygons when using Fire Retardant on the Bridger-Teton National Forest. Avoidance polygons represent important habitat components for the Endangered Kendall Warm Springs Dace and the Greater Sage Grouse, a Candidate Species identified for listing under guidelines of the Endangered Species Act. Mapped avoidance polygons for each species are described below.

Kendall Warm Springs Dace

The dace is a fish species only known to occur in Kendall Warm Springs on the Bridger-Teton NF; after consultation with biologists with the USFWS, the avoidance polygon was developed by delineating a **1/2 mile buffer** around Kendall Warm Springs.

Greater Sage Grouse

The sage grouse is a sage brush obligate that utilizes sage brush and riparian habitat types surrounding known lek sites from March 1 to June 30 of each year for breeding, nesting and brood rearing. After consultation with biologists with the USFWS, avoidance polygons of important sage grouse habitats on the Bridger-Teton NF were developed by delineating a **4 mile buffer** around known lek sites within or immediately adjacent to Forest boundaries. Lek site data were provided by the Wyoming Game and Fish Department. Retardant avoidance areas within delineated buffers were further refined by selecting contiguous vegetation habitat zones mapped as "herbland", "shrubland", or "riparian" types from the 2007 BT Veg Map; these types are considered important to this species during the March 1 to June 30 breeding, nesting and brood rearing seasons. Only those portions of avoidance polygons that occur within Forest boundaries are depicted on the layer.

================================

Brian A. Goldberg
Resource Information and Planning
Bridger-Teton National Forest

307.739.5561 -- bgoldberg@fs.fed.us

=============================== BtFireRetardantTE.zip BT_FireRetardantAvoid_TE.pdf BT_sage_grouse_leks.pdf

Daniela Roth /R6/FWS/DOI

09/19/2011 03:18 PM

To Sarena Selbo/R6/FWS/DOI@FWS

cc Bekee Hotze/R6/FWS/DOI@FWS, Paul Abate/R6/FWS/DOI@FWS, Laura Romin/R6/FWS/DOI@FWS

bcc

Subject Fw: Fire retardant EIS

U.S. Fish & Wildlife Service
Utah Field Office
2369 West Orton Circle, Suite 50
West Valley City, UT 84119
Ph: 801-975-3330 x123
Fax: 801-975-3331

----- Forwarded by Daniela Roth/R6/FWS/DOI on 09/19/2011 03:09 PM -----

"Meccariello, Matthew" <mmeccariello@fs.fed.us>

09/19/2011 03:01 PM

To "Daniela_Roth@fws.gov" <Daniela_Roth@fws.gov>, "Prendusi, Teresa" <tprendusi@fs.fed.us>, "Laufman, Julie" <jlaufman@fs.fed.us>

cc

Subject Fire retardant EIS

Clarification on ASMO for the fire retardant EIS

The data we sent for the fire retardant EIS can be found at the following location.

O:\NFS\Collaboration\FireRetardantEIS\2010 EIS Project Record\04 Resources\Sensitive Species\Put your Regional and Forest information here\Region 4\Manti-LaSal NF

TE&S species were buffered by 500'. They are in separate shape files at the above location.

I had talked with Bekee Hotze from the FWS on August 15, 2011 and I agreed to change the determination for ASMO from likely to adversely affect to not likely to adversely affect if ASMO was buffered by 500'. I did not realize Julie Laufman and Bekee were not working on the document concurrently. After conversing with Daniela I realized there was a disconnect with the information flow and that I should have contacted Julie to make the change in the determination in the document after conversing with Bekee. Sorry for the confusion.

Mat

Mat Meccariello
Ecosystems Staff Officer
Supervisors Office
Manti-LaSal National Forest

Price, UT 84501
ph: 435.636.3509 FAX: 435.637.4940

email:mmeccariello@fs.fed.us

Anne Vandehey /R6/FWS/DOI

09/09/2011 03:05 PM

To Sarena Selbo/R6/FWS/DOI@FWS

cc

bcc

Subject Fw: Retardant effects determination for Howellia

History: This message has been forwarded.

Documentation for the water howellia NLAA

Anne Vandehey, Sec 7 Prog Coord
USFWS Montana ES Field Office
585 Shepard Way
Helena Montana 59601

406 449 5225 ext 212

----- Forwarded by Anne Vandehey/R6/FWS/DOI on 09/09/2011 03:03 PM -----

Shannon Downey/R6/FWS/DOI

09/09/2011 02:04 PM

To Anne Vandehey/R6/FWS/DOI@FWS

cc

Subject Fw: Retardant effects determination for Howellia ??

Here is the documentation of agreement by Julie Laufman. They had made a call of LAA for the Mendocino at the R5 level (of which the Mendocino was apparently not aware) because the percentage of land with retardant application reaches as high as .01. However, just as on the Flathead, retardant has *never* been applied anywhere near the Howellia pops - it's just the wrong topography.

Shannon Downey
US Fish & Wildlife Service
Montana Ecological Services
(406) 449-5225 x 214 - office
(406) 431-6440 - cell

"If God hadn't wanted us to eat meat, why did he make animals out of meat?" - Sarah Palin

----- Forwarded by Shannon Downey/R6/FWS/DOI on 09/09/2011 01:59 PM -----

"Laufman, Julie" <jlaufman@fs.fed.us>

09/08/2011 02:06 PM

To "Shelly, Steve" <sshelly@fs.fed.us>, "Shannon_Downey@fws.gov" <Shannon_Downey@fws.gov>

cc

Subject RE: Retardant effects determination for Howellia ??

Yes, I made the change to NLAA for this species and it is in the BA as such, with the justification provided from the Mendo.

Shannon, the the deadline to submit the copy to Charisa M, does not reflect this, however, it was a very quick and easy fix, and it will be reflected in the final published document. With that said, if you

agree with the call, there will not be a need to render a different opinion on this species. Please call if you have any other questions.
Julie

Julie Laufmann, PhD
Botanist, Natural Resource Planner
USDA-WO, Enterprise Technical Services
Fort Collins, CO 80526
Cell: 559-920-6086
Office: 970-226-2040

From: Shelly, Steve
Sent: Thursday, September 08, 2011 2:00 PM
To: Laufman, Julie; Shannon_Downey@fws.gov
Subject: RE: Retardant effects determination for Howellia ??

Thanks Julie. Does this mean the national call will now be NLAA?

Steve Shelly
Botany/Research Natural Areas/Invasive Species
U.S. Forest Service, Region 1
(406) 329-3041
sshelly@fs.fed.us

From: Laufman, Julie
Sent: Wednesday, September 07, 2011 9:38 AM
To: Shannon_Downey@fws.gov
Cc: Shelly, Steve
Subject: RE: Retardant effects determination for Howellia ??

Thank you for this information. Somehow, this did not get passed along to me from Patti. I have made this minor change in the BA to reflect this updated info and the justification is included in the project file.
Thanks.
Julie

Julie Laufmann, PhD
Botanist, Natural Resource Planner
USDA-WO, Enterprise Technical Services
Fort Collins, CO 80526
Cell: 559-920-6086
Office: 970-226-2040

From: Shannon_Downey@fws.gov [mailto:Shannon_Downey@fws.gov]
Sent: Tuesday, September 06, 2011 4:47 PM
To: Laufman, Julie
Cc: Shelly, Steve
Subject: RE: Retardant effects determination for Howellia ??

See the attached justification from the Mendocino botanist for NLAA call for WH on that forest. I was not aware that the call was made at the R5 level.

Shannon Downey
US Fish & Wildlife Service
Montana Ecological Services
(406) 449-5225 x 214 - office
(406) 431-6440 - cell

"If God hadn't wanted us to eat meat, why did he make animals out of meat?" - Sarah Palin

"Laufman, Julie" < jlaufman@fs.fed.us>

09/06/2011 04:36 PM

To"Shelly, Steve" <sshelly@fs.fed.us>, "Shannon_Downey@fws.gov" < Shannon_Downey@fws.gov>

cc

Subject RE: Retardant effects determination for Howellia ??

Hi there,

Sure thing

The call for plant species are made at the National Level not at individual forest levels.

1. all occurrences of WH are avoidance mapped.
2. The species determinations LAA versus NLAA come from the 'potential' of a misapplication of retardant - thus a forest that uses more retardant has a higher potential to have either an accidental drop or invoking an exception for retardant use. *We went very conservative for our determinations* .

So, the Mendo applies more retardant and thus the LAA determination. Region 5 handled all the determination calls at the regional level and this is the determination sent to me. FWS certainly has the option to render additional supporting information that indicates that the potential for a misapplication is lower in areas where this species occurs on the Mendo and this can be reflected in the BO.

We have also built in a process for completing changes to national determinations within the BA if new information comes available in the future; the 'step-down' process in the BA. The final BA was delivered to Charisa Morris (FWS) last week to distribute to their regions.

Hope this helps
All the best,

Julie

From: Shelly, Steve
Sent: Tuesday, September 06, 2011 4:09 PM
To: Shannon_Downey@fws.gov; Laufman, Julie
Subject: Retardant effects determination for Howellia ??

Hi Julie,
Shannon Downey and I have been discussing the fire retardant effects determination for *Howellia* , the wording for which is included below. The logic is a bit hard to follow, in that it first summarizes the protection afforded to all known populations by the 300' aquatic buffer, then states how little retardant is applied on the applicable Forests, but then goes on to conclude "likely to adversely affect." In the case of the Flathead NF in Region 1 at least (where we have about 150 *Howellia* occurrences on FS lands), I was under the impression that it would be a "**not** likely to adversely affect" call. That's the determination I would have made anyway. Can you clarify this for us?

Thanks, Steve

Steve Shelly
Botany/Research Natural Areas/Invasive Species
U.S. Forest Service, Region 1
(406) 329-3041
sshelly@fs.fed.us

From: Shannon_Downey@fws.gov [mailto:Shannon_Downey@fws.gov]
Sent: Tuesday, September 06, 2011 3:02 PM
To: Shelly, Steve
Subject: RE: Forest botany contacts

Steve - Here is the verbiage from the BA. I'm thinking this rationale is being applied to the Mendocino to get to a LAA call, but the Mendocino is saying NLAA because they have never had a fire in the vicinity of Howellia. Let's discuss...

Howellia aquatilis - Water howellia (FS Regions 1, 5, 6)

Environmental Baseline:
Water howellia is currently known from California, Idaho, Montana, and Washington, and historically known to occur in Oregon. The species is documented to occur in the Mendicino National Forest in California (R5), and the Flathead National Forest in Montana (R1). It is suspected to occur on the following forests located in Forest Service Regions 1, 5, & 6: Six Rivers, Lolo, Kootenei, Idaho Pandhandle, Colombia River Gorge in Oregon and Washington, Gifford Pinchot, Okanagan Wenatchee and the Mount Hood. This aquatic annual grows submerged, rooted in bottom sediments of ponds and sloughs and in small vernal wetlands with firmly consolidated bottoms. These include shallow, low-elevation glacial pothole ponds and former river oxbows with margins of deciduous trees and shrubs. These habitats are inundated by spring rains and snowmelt runoff and typically dry out by the end of the growing season. The plants tend to root in the shallow water at the edges of deeper ponds that are (at lower elevations) surrounded by deciduous trees.

Effects Determination
No critical habitat has been designated for this species; therefore, none will be affected. All known populations

are protected from direct and indirect effects and mapped as avoidance areas with species protected by the 300 ft aquatic buffer. Additional mapping of 300 feet around the furthest edge on known locations that may not necessarily be mapped with the NHD layer will also be mapped (USFS-R5 2011). Due to the fact that historical use of retardant in the past has been 0.01% of NFS landbase annually on the Mendocino and Okanogan-Wenatchee National Forests, (other NFS forests apply less retardant annually to their landbases) there is a higher likelihood that unknown occurrences may be hit with retardant or that invoking an exception to the guidelines could occur, therefore a **may affect likely to adversely affect** determination is warranted.

Shannon Downey
US Fish & Wildlife Service
Montana Ecological Services
(406) 449-5225 x 214 - office
(406) 431-6440 - cell

"If God hadn't wanted us to eat meat, why did he make animals out of meat?" - Sarah Palin

Appendix K. Region 8 Conservation Measures the USFS agreed to incorporate into Project Description

Arroyo toad (*Anaxyrus californicus* (*Bufo microscaphus californicus*))

- Each forest will have retardant avoidance mapping (600 feet land base) for all known arroyo toads locations as described in the biological assessment.

California jewelflower (*Caulanthus californicus*)

- In order to reduce the potential effects of the proposed action on *Caulanthus californicus*, the Forest Service proposes to avoid fire retardant application in *C. californicus* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

California red-legged frog (*Rana draytonii*)

- The effects analysis is based on misapplication rates as provided in the biological assessment. Effects to California red-legged frogs from fire retardant dropped outside buffer areas are not expected. The BA assumes that 0.42% of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42% of all drops on each Forest will result in delivery to a waterway with potential adverse effects to California red-legged frog, if the stream is occupied. Using the percentage of perennial streams that are occupied, we then multiply that by the percentage of expected misapplications.

- Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume that California red-legged frogs 6.2 miles downstream of a misapplication have the potential to be adversely affected by retardant (see Biological Assessment p. 119 and p. 123).

- Per the BA, critical habitat for the California red-legged frog is not going to be avoidance mapped.

Tuctoria greenei

- In order to reduce the potential effects of the proposed action on *Tuctoria greenei*, the Forest Service proposes to avoid fire retardant application in *T. greenei* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. The Forest Service has proposed not to avoidance map critical habitat for this species (P. Krueger pers. comm. 2011). However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

Lahontan cutthroat trout *(Oncorhynchus clarkii henshawi)*

- The effects analysis in the biological opinion is based on misapplication rates as provided in the BA. Effects to LCT from fire retardant dropped outside buffer areas are not expected. The BA assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42 percent of all drops on each Forest will result in delivery to a waterway with potential adverse affects to LCT, if the stream is occupied. Using the percentage of perennial streams that are occupied, we then multiply that by the percentage of expected misapplications.

Layne's Butterweed (*Senecio layneae*)

- In order to reduce the potential effects of the proposed action on *Senecio layneae*, the Forest Service proposes to avoid fire retardant application in *S. layneae* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

Little Kern golden trout (*Oncorhynchus mykiss whitei*)

- In order to reduce the potential for adverse effect to the species, the Forest Service is proposing to implement retardant use avoidance areas within specific subwatersheds for the Little Kern golden trout (see attached map).

- Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume that Little Kern golden trout 6.2 miles downstream of a misapplication have the potential to be adversely affected by retardant (see Biological Assessment p. 119 and p. 123).

Mariposa pussypaws (*Calyptridium pulchellum*)

- In order to reduce the potential effects of the proposed action on *Calyptridium pulchellum*, the Forest Service proposes to avoid fire retardant application in *C. pulchellum* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

- In the event of the aerial application of fire retardant to areas occupied by *C. pulchellum*, the Forest Service has agreed to implement the following conservation actions (P. Krueger pers. comm. 2011b):

1. The area affected by retardant will be monitored monthly for a period of three years, including locating and identifying all *Calyptridium pulchellum* plants. Yearly reports will be submitted to the Service for review. If population numbers appears to be declining, the Service will be contacted for guidance.

2. During monitoring all non-native plant species will be removed from areas known to contain *Calyptridium pulchellum*

3. All non-compatible plant species will be removed within and adjacent to known *Calyptridium pulchellum* plants.

4. All weed control will be conducted by hand.

Owens tui chub *(Siphateles bicolor snyderi*)

- Inyo National Forest will have retardant avoidance mapping (600 feet land base) for Owens tui chub occupied habitat to reduce the likelihood of effects from surface runoff into habitat.

- The effects analysis in the biological opinion is based on misapplication rates as provided in the biological assessment. Effects to species from fire retardant dropped outside buffer areas are not expected. The biological assessment assumes that 0.42% of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42% of all drops on each Forest will result in delivery to a waterway with potential adverse effects to species, if the stream is occupied. Using the percentage of perennial streams that are occupied habitat we then multiply that by the percentage of expected misapplications.

- Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we assume fish 6.2 miles downstream of a misapplication have the potential to be adversely affected by retardant (see BA p. 119 and p. 123).

Paiute cutthroat trout *(Oncorhynchus clarkii seleniris*

- Each forest will have retardant avoidance mapping of 183 m (600) for all flowing water occupied by PCT as described in the BA.

- The effects analysis in the BO is based on misapplication rates as provided in the BA. Effects to PCT from fire retardant dropped outside buffer areas are not expected. The BA assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42 percent of all drops on each Forest will result in delivery to a waterway with potential adverse affects to PCT, if the stream is occupied. Using the percentage of perennial streams that are occupied, we then multiply that by the percentage of expected misapplications.

- Because of the variance of population densities, and because we cannot determine which populations of PCT are most likely to be affected given the extent of the action area, in order to determine the extent of take, we will use habitat as a surrogate. Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume fish may be adversely affected by retardant up to 6.2 miles downstream from a misapplication (see Assessment p. 119 and p. 123).

Railroad Valley springfish (*Crenichthys nevadae*)

- The effects analysis in the biological opinion is based on misapplication rates as provided in the BA. Effects to Railroad Valley springfish from fire retardant dropped outside buffer areas are not expected. The BA assumes that 0.42 percent of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42 percent of all drops on each Forest will result in delivery to a waterway with potential adverse affects to Railroad Valley springfish, if the spring and spring outlet is occupied. Using the percentage of perennial streams that are occupied, we then multiply that by the percentage of expected misapplications.

- Because of the variance of population densities, and because we cannot determine which populations of Railroad Valley springfish are most likely to be affected given the extent of the action area, in order to determine the extent of take, we will use habitat as a surrogate. Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume fish 10 km (6.2 mi) downstream of a misapplication has the potential to be adversely affected by retardant (see BA p. 119 and p. 123).

Shasta crayfish:

- In order to reduce the potential effects of the proposed action on Shasta Crayfish, the Forest Service proposes to avoid fire retardant application in areas that are hydrologically connected to Shasta crayfish occupied habitat with a 1,000 foot buffer for the distance of 6.2 miles upstream of Shasta crayfish occurrences by providing maps and guidance to aerial fire-fighting personnel so that the potential for a misapplication to occur in hydrologically connected waterways is minimized (P. Krueger pers. comm. 2011a). However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

In the event of the aerial application of fire retardant within the 1,000 foot buffer, the Forest Service has agreed to implement to following conservation actions:

1. No later than June 30, 2012, the local offices of the Forest Service in coordination with the Fish and Wildlife Service shall develop a plan to monitor water quality for occupied waterways and/or adjacent waterways in the event of a misapplication of aerial fire retardant, contingent on final approval by the local FWS office. A minimum downstream distance of 6.2 miles should be monitored if aerial applied fire retardant is misapplied in these waterways on NFS lands by the USFS. Monitoring of water quality, or other appropriate agreed upon habitat measures, will start within 24 hours of notification of a misapplication of fire retardant or when safe to enter the area. Results will be provided to the Service 48 hours from completion of lab analysis.

2. If it is determined that water quality has been affected by a misapplication of aerial applied fire retardant the Forest Service shall ensure that surveys are conducted for Shasta crayfish for 3 consecutive years by a 10(a)(1)(A) permitted biologist. Yearly reports will be submitted to the Service for review. Annual/semi-annual meetings with the Service will occur to determine if a population decline has occurred or if any modification needs to be done to the monitoring protocol. During surveys, all non-native crayfish will be removed and destroyed.

Slender orcutt grass (*Orcuttia tenuis*)

- In order to reduce the potential effects of the proposed action on *Orcuttia tenuis*, the Forest Service proposes to avoid fire retardant application in *O. tenuis* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. The Forest Service has proposed not to avoidance map critical habitat for this species (P. Krueger pers. comm. 2011). However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

Springville clarkia (*Clarkia springvillensis*)

- In order to reduce the potential effects of the proposed action on *Clarkia springvillensis*, the Forest Service proposes to avoid fire retardant application in *C. springvillensis* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

Stebbins' morning glory (*Calystegia stebinsii*)

- In order to reduce the potential effects of the proposed action on *Calystegia stebinsii*, the Forest Service proposes to avoid fire retardant application in *C. stebinsii* occupied habitat and with a 300 foot buffer by providing maps and guidance to aerial fire-fighting personnel so that the potential for an application to occur in occupied habitat is minimized. However, the extenuating circumstances of human health and safety or misapplications are assumed to be likely to occur over the timeframe of the proposed action.

Tidewater goby (*Eucyclogobius newberryi)*

- The effects analysis in the biological opinion is based on misapplication rates as provided in the biological assessment. Effects to species from fire retardant dropped outside buffer areas are not expected. The BA assumes that 0.42% of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42% of all drops on each Forest will result in delivery to a waterway with potential adverse effects to species, if the stream is occupied or designated critical habitat. Using the percentage of perennial streams that are occupied/critical habitat we then multiply that by the percentage of expected misapplications.

- Because of the variance of population densities, and because we cannot determine which populations are most likely to be affected given the extent of the action area, to determine the extent of take, we will use habitat as a surrogate. Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we will assume fish 6.2 miles downstream of a misapplication could be adversely affected by retardant (see biological assessment p. 119 and p. 123).

Unarmored Threespine Stickleback (*Gasterosteus aculeatus williamsoni*) (UTS)

- The Angeles and San Bernardino National Forests will have retardant avoidance mapping (600 feet land base) for unarmored threespine stickleback occupied habitat to reduce the likelihood of effects of surface runoff into habitat.

- The effects analysis in the biological opinion is based on misapplication rates as provided in the biological assessment. Effects to species from fire retardant dropped outside buffer areas are not expected. The biological assessment assumes that 0.42% of all retardant drops will result in misapplication to a waterway. Therefore, the Service expects that over the life of the consultation, 0.42% of all drops on each Forest will result in delivery to a waterway with potential adverse effects to species, if the stream is occupied. Using the percentage of perennial streams that are occupied habitat we then multiply that by the percentage of expected misapplications.

- Because the level of toxicity depends on many variables, including retardant concentrations, stream flow volume, gradient, riparian vegetation, slope, soils, wind direction, ultraviolet exposure, etc., and in order to be conservative for the species, we assume fish 6.2 miles downstream of a misapplication have the potential to be adversely affected by retardant (see biological assessment p. 119 and p. 123).

Nationwide Aerial Application of Fire Retardant on National Forest System Land Biological Assessment

Amendment for the Pacific Southwest Region
26 July 2011

The Forest Service submittal of June 2011 of the Nationwide Aerial Application of Fire Retardant on National Forest System (NFS) Land Biological Assessment did not comprehensively address the intricacies of the Pacific Southwest Region and the federally listed species and critical habitat (CH) contained within the Region. Please see Appendix R5-1 for the full list of species evaluated and considered for this Biological Assessment.

Since 2008, seven Forests in the Pacific Southwest Region have had annual coordination with Fish and Wildlife Service and have provided fire retardant avoidance mapping to all applicable parties. These National Forests (NF) include the Angeles, Cleveland, Inyo, Los Padres, San Bernardino, Sequoia, and the Sierra. All forests provide oversight protection for threatened and endangered (TE) species management from a Resource Advisor during fire incidents.

Fire retardant avoidance mapping criteria in the Pacific Southwest Region is established as follows:

- waterways will not have a mapped buffer since all waterways are to be avoided by 300 feet on either side;
- 300 feet surrounding a known population if the determination statement is "may affect likely to adversely affect" (LAA) or if recommended mapping for a species with a determination statement of "may affect not likely to adversely affect" (NLAA),
- 300 feet surrounding a known occupied vernal pool or pond with a known TE population,
- boundary of critical habitat (no buffer); and
- recommended mapping of any known TE population found within 1 mile of a National Forest boundary.

Exceptions and or clarifications to the above include:

- If TE species is within a dry arroyo, or if natural fluctuating water levels are reduced significantly, or if the surface water ceases to flow and the only remaining water is reduced to pools, mapping is required for those aquatic species (i.e. Santa Ana Sucker, Lahontan Cutthroat Trout).
- For aquatic species that are further impacted by steep slopes, a 600 foot buffer is designated (i.e. Little Kern Golden Trout, Piute Cutthroat Trout).
- For mostly aquatic species that are restricted by steep slopes and isolated populations, a 600-foot buffer is designated (i.e. Arroyo Toad, Mountain Yellow-legged Frog, California Red-legged Frog).
- For vernal pool and pond species, we are mapping the species since not all vernal pools and ponds are covered in the NHD layer (i.e. Water howellia).
- For terrestrial plant species, avoidance mapping to 300 feet is given to the edge of the population or known extent of distribution predominantly due to risk of invasive should retardant be used within the area. Only Bakersfield Cactus is the exception where the risk of invasives is not a concern.
- California Condor Hacking sites will have a ¼ mile buffer.
- Mapping outside of the National Forest boundary is not required but will be shown if information is readily available (California Natural Diversity Database) and applicable.

Note: the June 2011 BA is expected to be amended/updated to show that there will be a 10-year end date to the BA, with a 5-year programmatic review (J. Burns 25 July 2011).

PLANTS

From the June 2011 BA, information changes are as follows:

- *Acanthoscyphus parishii var. goodmaniana* is found on the San Bernardino and not on the Cleveland NF.
- *Astragalus brauntonii* was found historically on Cleveland NF; but is not currently known.
- *Calystegia stebbinsii* is a new sighting on the Tahoe NF. It is thought that it may be a new species and not *C. stebbinsii.* An expert is expected to verify as necessary in summer 2011 with results forthcoming. The Forest Service is treating the locations as *C. stebbinsii* until otherwise determined.
- *Orcuttia tenuis* determination statement should be LAA due to the location on Plumas NF (high fire retardant use forest). The critical habitat should have a NLAA determination statement and will be mapped for avoidance.
- *Senecio layneae* is also found on the Tahoe NF.

AQUATIC

From the June 2011 BA, information changes are as follows:

- Owens Tui Chub determination statement is LAA and will be mapped for avoidance. The listed critical habitat is “no effect’ (NE) determination as it does not occur on NFS lands. The species is known to occur on the Inyo NF.
- Second paragraph of the “Effects to Invertebrate Species” on page 126 needs to be removed from the document or clarified that the information regarding Vernal Pool Fairy Shrimp is specific to lands adjacent to the Klamath NF only.
- Based on data from CNDDB, there is no known Tidewater Goby on the Six Rivers NF.
- Shasta-Trinity NF management area does not have records of the Shasta Crayfish. The known location is administered by the Lassen NF but is in the Congressional boundary of the Shasta-Trinity; hence Shasta Crayfish is shown on the Lassen NF.
- After further evaluation of data from CNDDB and critical habitat units from FWS, changes to the Fairy Shrimp should be as follows:
    - No Tadpole Shrimp on the Lassen NF.
    - No Vernal Pool Fairy Shrimp on the Klamath NF. Known locations are outside the forest boundary.
    - No Vernal Pool Fairy Shrimp or Vernal Pool Tadpole Shrimp on the Mendocino.
    - No Longhorn Fairy Shrimp on the Los Padres.
    - Los Padres NF also supports Vernal Pool Fairy Shrimp

Fire retardant avoidance mapping criteria for the following species are:

- Lahontan Cutthroat Trout – 300 foot buffer from known populations due to water levels decreasing and temporary restriction or isolation of movement
- Little Kern Golden Trout, Piute Cutthroat Trout, and Santa Ana Sucker: 600 ft buffer from known populations due to steep slope/terrain, reduced water levels, isolated population, risk of loss of the population (jeopardy)
- Owens Tui Chub – 300 foot buffer from known populations due to isolated populations

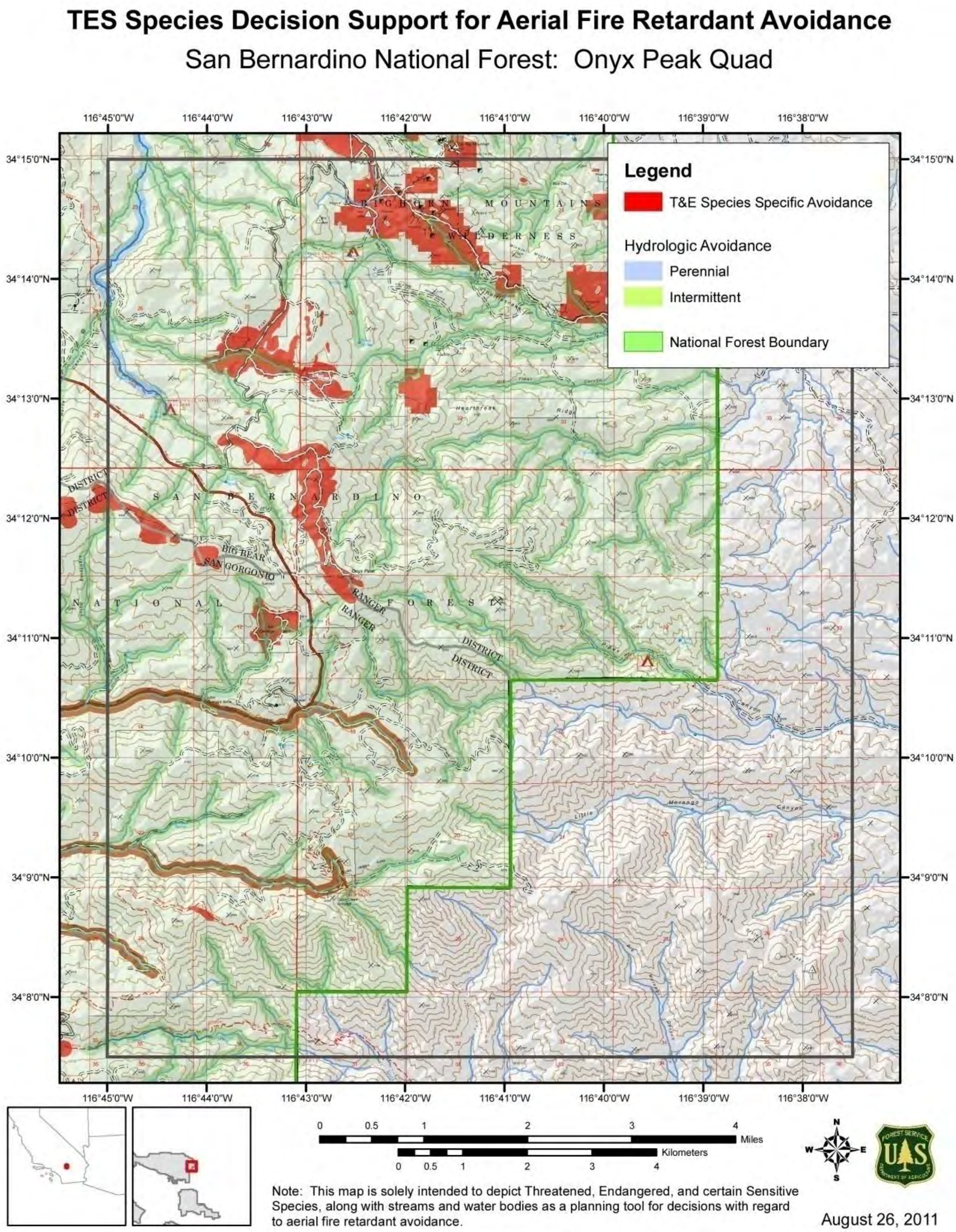
- Vernal pools with known fairy shrimp populations will be mapped with a 300 foot buffer and listed critical habitat will be mapped

WILDLIFE

From the June 2011 BA, information changes are as follows:

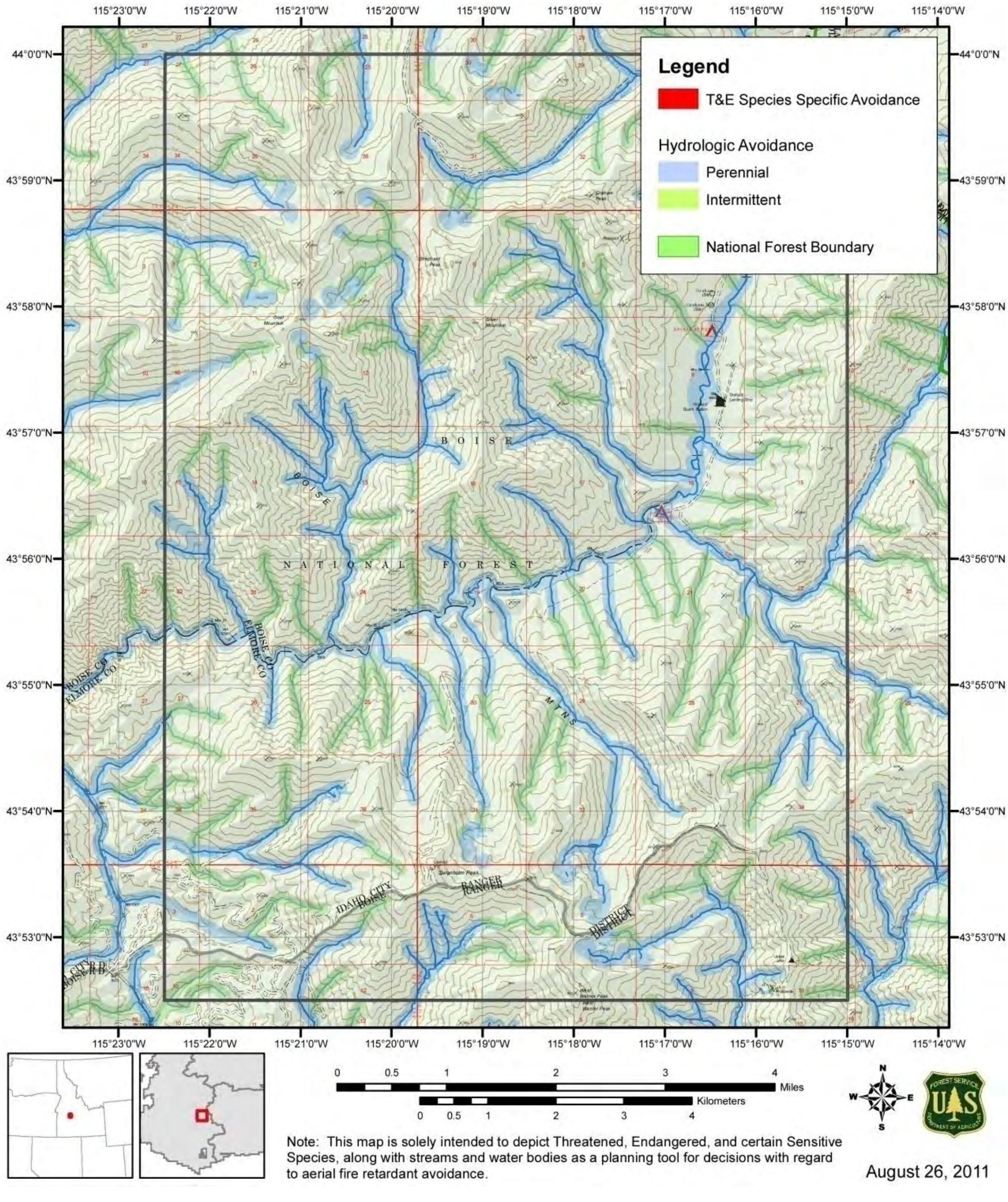
- Giant Kangaroo Rat is not known on the Los Padres NF, hence the determination statement should be NE.
- Coastal California Gnatcatcher determination state should be LAA due to the limited nature of the population and being non-migratory (see page 188)
- Coastal California Gnatcatcher critical habitat should be NLAA but will not be mapped based on the broad-brush protection of coastal sage scrub habitat. Critical habitat is designated on the Los Padres, Angeles, San Bernardino, and Cleveland NFs. However, the gnatcatcher is only known to occur on the Cleveland NF.
- California Red-legged Frog critical habitat will not be mapped. Due to the critical habitat covering large watersheds, not using fire retardant beyond the 300 foot buffer to a waterway would exasperate risk of loss of the species due to increased fire sizes.
- Kern Primrose Sphinx Moth occurs on the Los Padres NF, not the Inyo NF (page 334)

Appendix L. Example Avoidance Area Maps for San Bernadino and Boise National Forests



TES Species Decision Support for Aerial Fire Retardant Avoidance

Boise National Forest: Swanholm Peak Quad



Note: This map is solely intended to depict Threatened, Endangered, and certain Sensitive Species, along with streams and water bodies as a planning tool for decisions with regard to aerial fire retardant avoidance.

August 26, 2011

Appendix M. US Forest Service Monitoring and Reporting Checksheet

Reporting and Monitoring Requirements and Recommendations for Misapplication of Aerial Fire Retardant in Avoidance Areas

(To be completed immediately after misapplication or as soon as safe to enter)

Incident Name:	Time and Date of Occurrence:
Date of Discovery:	GPS Location of misapplication:
Physical Location of Occurrence (Unit Name, District, etc)	Type of Retardant:
Size of Fire (more than 300 acres)	Is this part of the 5% assessment of fires less than 300 acres?
Method of Delivery (air tanker/SEAT/heli)	Mis-application – accident or exception
Description of Wildland Fuel at the Site (open light fuels, brush, open timber/grass, timber/brush, heavy timber, brush):	Physical Description of the Site (steep, level, rocky, etc):
Description of Retardant Coverage at the Site (light, spotty, continuous)	Extent of Coverage within Avoidance Area (% of avoidance area and Length and Width)
# of drops in avoidance areas # of gallons dropped in avoidance area	
Name of Person Reporting Name of Resource Advisor contacted (if different)	

Site Assessment of Impacts in Avoidance Areas

Completed by trained/qualified resource personnel and completed as soon as safe to enter impacted area

Terrestrial	**Aquatic**
Field Assessment Date: Name of Person Completing Assessment: Species Avoidance area: (Name of species/ critical habitat) Amount of Avoidance Area Affected (edge, total, center) % portion Veg type: Was vegetation burned (y/n) severity (l/m/h), Retardant visible at site (y/n) % canopy cover remaining: % ground cover remaining: Soil type: Weather events post application Mitigation measures implemented NNIS presence within avoidance area or in close proximity – y/n, if yes:species/amount of area affected NNIS treatment y/n, if yes method Photos taken Type of Impact – adverse y/n Direct Indirect	Field Assessment Date: Name of Person Completing Assessment: Species Avoidance area: (Name of species/critical habitat) Amount of Avoidance Area Affected (edge, total, center) % portion Stream order and width, depth and flow estimates: Was riparian vegetation burned (y/n) severity (l/m/h)% % slope of avoidance area: % canopy cover remaining: Collect Water Quality Data (visual clarity and color, temperature, pH, conductivity) Weather events post application Mitigation measures implemented Photos taken Provide Map of the area Type of Impact – adverse y/n Direct Indirect Assessment of downstream impacts (Estimate Flow Rates and Spill Calculator Data)

Are there species specific conservation measures associated with this species as outlined within the BO? Are there local level TC/CM? Is take expected? y/n if yes, estimated amount of habitat and # of individuals Is Salvage of species necessary? Is re-initiation needed or does this trigger a restriction on future use? Is follow-up monitoring required (as determined by local FS Unit)? Have you notified other National Forests with same species occurrence? FWS Contacted: date/office/person State or other Agency Notification:	Are there species specific conservation measures associated with this species as outlined within the BO? Are there local level TC/CM? Is take expected? y/n if yes, estimated # of individuals Is Salvage of species necessary? Is re-initiation needed or does this trigger a restriction on future use? Is follow-up monitoring required (as determined by local FS Unit)? Have you notified other National Forests with same species occurrence? FWS Contacted: date/office/person NOAA Fisheries Contacted: date/office/person State or other Agency Notification:

Follow-up Monitoring Required or Recommended

Applies to either terrestrial or aquatics

Required

Follow-up Monitoring **required** as part of FWS T&C and RPA's

(See Species Specific Local Requirements)

or

Follow-up Monitoring as **required** by FS resource personnel during intial site assessment to determine effect, may be adjusted as to time frame (for instance, verification of survival of TEP or sensitive species, or documentation of potential increases in NNIS as a result of retardant application)

Recommended

Conservation Monitoring Recommendations as suggested within FWS Biological Opinion (e.g.):

- Changes in species composition after retardant application
- General population monitoring of TEP species
- General effects of NNIS to TEP species and habitats
- Viability analysis of species or habitat (species present/habitat function) after aerial retardant application
- Effectiveness of mitigation measures (i.e. reintroduction of species) may be required or recommended