United States Department of Agriculture

# Nationwide Aerial Application of Fire Retardant on National Forest System Lands

## Biological Assessment for Species within NOAA Fisheries Jurisdiction

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# BIOLOGICAL ASSESSMENT FOR NATIONAL FORESTS WITH AQUATIC SPECIES UNDER THE JURISDICTION OF NOAA FISHERIES ON NATIONAL FOREST LANDS


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# Introduction

In August 2011 the Forest Service submitted a biological assessment to the United States Department of Interior Fish and Wildlife Service (Fish and Wildlife Service) for the Nationwide Aerial Application of Fire Retardant on National Forest System Land. In September 2011 a biological assessment addressing aquatic species was submitted to the United States Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries). These biological assessments analyzed the programmatic continued use of aerially applied fire retardant on National Forest System lands throughout the United States. Biological opinions were issued by the Fish and Wildlife Service and NOAA Fisheries in November and December of 2011, respectively.

Supplemental and addendum consultations were conducted to maintain currency of the consultations. These supplemental and addendum consultations addressed changes in avoidance area maps; additions of species, species range, or critical habitat; and instances where the Incidental Take Statement was met or exceeded. A full list of subsequent consultations is found in Appendix A of the Nationwide Aerial Application of Fire Retardant on National Forest System Lands Supplemental Information Report (USDA Forest Service 2020a).

The project description in the original biological assessments stated the "timeframe for this project is January 1, 2012, to January 1, 2022, and includes a 5-year programmatic compliance review." As such, the biological opinions expire on January 1, 2022. In preparation for reinitiating consultation prior to the expiration, the Forest Service reviewed the Nationwide Aerial Application of Fire Retardant on National Forest System Land, Final Environmental Impact Statement (United States Department of Agriculture Forest Service 2011b) for new information or changed conditions. The results are documented in a supplemental information report (USDA Forest Service 2020a). Based on recommendations in the supplemental information report, the Forest Service is completing a Supplemental Environmental Impact Statement and analyzing a new proposed action. This document is the biological assessment for that action.

# Project Description

The U.S. Department of Agriculture, Forest Service, proposes to continue the nationwide use of aerial application of fire retardant. Effects described within this biological assessment refer to aerial delivery of retardant only. This analysis does not address use of foams, water enhancers, ground-based application of retardants, or the environmental effects of wildland fire.

This project begins January 1, 2022. Aerial use of fire retardant is a programmatic activity with no end date. Reinitiation of consultation according to the provisions of 50 CFR 402.16 will occur if there are changes in information that would alter the effects discussed in this consultation, or if there are changes to the federal action or to the status of species or critical habitats addressed here. Any changes to the agency action, effects to the species based on new information, or species to be considered in the future will be addressed following the provisions of 50 CFR 402.16. New retardant products can be added to the Qualified Products List under the framework of this program without requiring reinitiation of the biological opinion as long as the maximum extent and duration of effects of the new products to species under the jurisdiction of NOAA Fisheries do not exceed the effects of other products already considered.

## *Proposed Action (Modified Alternative 3)*

This proposal would allow aerially applied fire retardants, included now or in the future on the Forest Service Qualified Products list (Wildland Fire Chemicals), to be used on National Forest System lands as follows:

- Aerial retardant drops would be prohibited in aerial retardant avoidance areas (see definition below), which include:
    - Waterways or their buffers, whether mapped or not, when water is present (also referred to as aquatic avoidance areas)
    - All or part of the habitat of Endangered Species Act threatened, endangered, proposed, or candidate species or Regional Forester sensitive species, as mapped per the requirements described in the "Aerial Retardant Avoidance Areas Mapping Requirements" section of this proposal
    - Areas mapped by the local unit
- The above direction would be mandatory nationwide except when human life or public safety are threatened and retardant use in the aerial retardant avoidance area could be reasonably expected to alleviate the fire threat.
- When an intrusion (formerly termed 'misapplication', see definition below) occurs for any reason it would be reported, assessed for impacts, monitored, and remediated as necessary.

The definition of 'aerial retardant avoidance area' has been updated to clarify its purpose and ensure consistency in use. An aerial retardant avoidance area (also referred to simply as 'avoidance area') is defined as *an area in which application of aerial fire retardant is prohibited in order to avoid, limit, or mitigate potential impacts to specified resources*.

- The term 'aquatic avoidance area' refers to any avoidance area, whether mapped or not, that is based on the presence of waterways, or as mapped to protect Endangered Species Act threatened, endangered, proposed, or candidate species or critical habitat or Regional Forester sensitive species or habitat associated with waterways, waterbodies, or riparian areas..
- The term 'terrestrial avoidance area' refers to any avoidance area that is mapped to protect Endangered Species Act threatened, endangered, proposed, or candidate species or critical habitat or Regional Forester sensitive species or habitat or other resources that are not associated with waterways or riparian areas.

The term 'misapplication' has been replaced by the term 'intrusion' for clarity of meaning. An intrusion is defined as *the intentional or unintentional application of aerial fire retardant into an aerial retardant avoidance area.*

In addition to the above direction, this proposal includes five components that provide specific direction for aircraft operations, aerial retardant avoidance area mapping, coordination, reporting and monitoring, and procedures for additions to the Qualified Products List, as described below. Additional information on implementation of these components, as well as guidance on operations planning and on the role and function of resource specialists are found in the Implementation Guide for Aerial Application of Fire Retardant (USDA Forest Service 2019 or subsequent versions).

## Aircraft Operational Guidance

This guidance shall not require pilots to fly in a manner that endangers their aircraft or other aircraft or structures, or that compromises the safety of ground personnel or the public.

- Operational guidance to ensure retardant drops are not made within avoidance areas:

Incident commanders and pilots should follow guidance in the current version of the Implementation Guide for Aerial Application of Fire Retardant (USDA Forest Service 2019 or subsequent versions), which will be updated as needed. This guidance includes:

  - Requirements for providing pilots with maps or other information about the location of all avoidance areas on the unit
  - Information on performing dry runs or other methods for ensuring retardant is not applied in avoidance areas
  - Information on when and how to terminate and resume application of fire retardant when approaching and departing avoidance areas
  - Guidance on flight conditions that allow for safe and effective use of retardant, including keeping retardant out of avoidance areas.
- Operational guidance to limit potential impacts outside of avoidance areas to species listed under the Endangered Species Act or to Regional Forester sensitive species:

Whenever practical, agency administrators and incident commanders shall use water or other less toxic suppressants in habitats of species listed under the Endangered Species Act or certain Regional Forester sensitive species, where those habitats are not mapped as avoidance areas.

- Operational guidance to provide protection of cultural resources, including historic properties, traditional cultural resources, and sacred sites:

These resources cannot be mapped using a national protocol or addressed with a standard prescription that would apply to all instances. Cultural resources specialists, archaeologists, and tribal liaisons would assist on a case-by-case basis in the consideration of effects and alternatives for protection when aerial application of fire retardant is ordered. Incident commanders would consider the effects of aerial applications on known or suspected historic properties, any identified traditional cultural resources, and sacred sites.

## Avoidance Area Mapping Requirements

All forests and grasslands would review and update maps annually, following current national mapping protocols described in the Implementation Guide for Aerial Application of Fire Retardant (USDA Forest Service 2019 or subsequent versions).

Requirements for mapping or identifying aerial retardant avoidance areas are as follows:

- Any waterway (including but not limited to perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, vernal pools, and riparian vegetation) in which water is present at the time of retardant application, and buffers extending no less than 300 feet on either side of a waterway, is considered an avoidance area (also called aquatic avoidance area), whether mapped or not.
- Mapping of waterways that are dry at the time of retardant application is not required, but these may be included in avoidance areas where there is a potential for downstream effects to occur.
- Map avoidance areas where aerial application of fire retardant may impact one or more aquatic or terrestrial Endangered Species Act threatened, endangered, proposed, or candidate plant or animal species or designated critical habitat.
- Map avoidance areas where aerial application of fire retardant may impact certain aquatic or terrestrial Regional Forester sensitive species or their habitat.
- Avoidance Areas may be adjusted for local conditions. Avoidance area buffers around waterways with water present may not be less than 300 feet on either side of a waterway in which water is present but may be increased where needed. Adjustments related to Endangered Species Act threatened, endangered, proposed, and candidate species would be coordinated with the local offices

of the United States Department of Interior Fish and Wildlife Service and National Oceanic and Atmospheric Administration National Marine Fisheries Service (hereafter referred to as the 'Services').

## Annual Coordination

The Forest Service would coordinate annually with:

- local Fish and Wildlife Service and NOAA Fisheries offices,
- aviation managers and pilots, and
- cooperators/other agencies.

Coordination would ensure requirements of the provisions of the proposal are met, and would maintain relationships and allow problem resolution to occur at the lowest management level. Guidance on coordination meetings would be provided in the Implementation Guide for Aerial Application of Fire Retardant (USDA Forest Service 2019 or subsequent versions).

## Reporting and Monitoring

The Forest Service would maintain a database for reporting intrusions of aerially applied fire retardant into avoidance areas. Intrusion reporting requirements are described in the Implementation Guide for Aerial Application of Fire Retardant (USDA Forest Service 2019 or subsequent versions), and include requirements for upward reporting to the Services for any intrusions into avoidance areas for any threatened, endangered, proposed, or candidate species or critical habitat. The Forest Service would provide to the Services annual reports summarizing retardant use and intrusions, as well as a list of intrusions and a summary of observations and actions for each intrusion.

If a retardant drop occurs on a cultural resource, a traditional cultural property, or a sacred site, then the site condition would be assessed by a qualified archaeologist and reported to the State Historic Preservation Officer and, if appropriate, tribal representatives including the Tribal Historic Preservation Officer. If the affected resource is a sacred site, or a traditional cultural property, then tribal notification and consultation would be required as part of the determination of effects. If the effect is found to be adverse, then the agency would consult with the tribe to determine an appropriate course of action to mitigate or resolve the adverse effect.

## Procedures for Additions to the Qualified Products List

Private companies submit retardants to the Forest Service for qualification. New products or new formulations of existing products must meet current Forest Service specification for long-term retardant (United States Department of Agriculture, Forest Service, Specification 5100-304 Long-term Retardant, Wildland Firefighting) to be included on the Qualified Products List. In addition to meeting those specifications, any retardant added to the Qualified Products List would meet the requirements of the Endangered Species Act as follows:

- Products or new formulations do not require additional consultation as long as the maximum extent and duration of effects of the new products do not exceed the effects of other products already considered in the biological assessments and biological opinions for this action. Products will generally meet these criteria when the percentages of retardant salts, thickeners, coloring agents, and performance ingredients in the total mixed product are similar to those in products for which consultation has been completed. Retardant salts may include diammonium phosphate, monoammonium phosphate, ammonium polyphosphate and magnesium chloride. The toxicity levels must not exceed those of currently approved products, and there must be no new identified risk factors. The Fish and Wildlife Service and NOAA Fisheries will be notified of additions to the Qualified Products list.

- Products or new formulations that do not meet the above criteria will result in reinitiation of consultation with the Fish and Wildlife Service and NOAA Fisheries. The product is not eligible for the Qualified Products List until all required tests and consultation are completed.

In the future, any retardant that is added to the Qualified Products List could be used under the direction provided in this proposal.

Appendix B contains a consultation reinitiation framework. It is an updated version of a document the Forest Service provided to NOAA Fisheries in 2013 to serve as a set of standard operating procedures to clarify when reinitiation is required after new long-term retardants are developed and approved for use by the Forest Service. This framework provides additional information to help determine if new products meet the intent of the first bullet above.

## Implementation Guide

The implementation guide is a 'one-stop' resource that provides forests and regions all of the information necessary to implement national direction for aerial fire retardant use as described in the Nationwide Aerial Application of Fire Retardant on National Forest System Lands Record of Decision (USDA Forest Service 2011b). The guide provides direction for personnel, including pilots, fire management officers, incident commanders, resource advisors, and others involved in the use of aerial fire retardant. It details the requirements for: reporting and monitoring at local and national levels, mapping avoidance areas, managing data, and coordinating and reinitiating consultation with regulatory agencies. It also describes requirements for funding of reporting and monitoring. The guide is updated as needed to include any changes required by supplemental consultations per Section 7 of the Endangered Species Act, as well as to address changes in technology, data, methodology, retardant products, or other items as appropriate. The current version was updated in 2019 and is included as Appendix E. The following is a summary of key points included in the implementation guide.

Instruction for mapping of avoidance areas includes reminders to use the most up-to-date maps of designated critical habitat and species occurrence/habitat maps from the Fish and Wildlife Service and NOAA Fisheries. Requirements for coordination meetings with local offices ensure that updated current species information is used and that discussion of any proposed changes in to buffer widths occurs are discussed.

The implementation guide chapter for pilots includes direction that pilot certification includes training in the use of retardant guidelines, and that the pilots receive maps of avoidance areas and briefings on the unit in advance of retardant use. It also provides guidance about the use of "dry runs" to better ensure protection of avoidance areas, and about evaluation of flight conditions to ensure that safety is maintained, and that retardant use guidance can be followed.

Fire operations guidance states that agency administrators will include in their delegations of authority direction and expectations for operations if the fire has the potential to include or already includes any avoidance areas. The initial incident management team briefing should address areas that have been identified as potential for high risk for public and fire fighter safety that fall within or overlap avoidance areas. The exception to apply retardant may be involved in these cases, so advance awareness of the potential safety risk(s), presence of avoidance areas, and potential need for use of the exception is critical. The guide also provides an example of documentation to provide when using the exception.

The chapter on reporting and monitoring states that intrusion reporting should occur as soon as possible after discovery but not later than 30 days after drops have occurred. The required assessment and coordination with local Fish and Wildlife Services or NOAA Fisheries offices then determines what subsequent actions may need to occur. Water quality monitoring as required by terms and conditions in current biological opinions will be conducted as described in those opinions.

The guide also provides information about annual tasks to be completed (by season), annual required training, and data reporting requirements. Specific guidance for pre-fire season requirements include annual coordination meetings and pilot briefings, and training for fire management personnel and pilots. The guide includes direction for coordination and data reporting during the fire season, as well as guidance for completion and submission of summary reports of intrusions to the Services. Annual summary reports are generally to be submitted by April 1 of each year, and will include information on retardant use, reported intrusion rate, and a list of intrusions, by forest, impacting threatened or endangered species. A meeting between the Forest Service and the Services will occur by May 15 of each year to discuss the summary reports, any changes in the program, or concerns of the agencies.

## Endangered Species Act Section 7(a)(1) Requirements

Section 7(a)(1) of the Endangered Species Act states that Federal agencies shall, in consultation with and with the assistance of the Secretary, utilize their authorities in furtherance of the purposes of the act by carrying out programs for the conservation of endangered species and threatened species listed pursuant to section 4 of the Endangered Species Act. This is a summary of aerial retardant program activities that the Forest Service has undertaken in order to conserve threatened and endangered species.

The Forest Service has entered in an agreement with the United States Geological Survey, Columbia Environmental Research Center to conduct research regarding environmental impacts of firefighting chemicals. Results of multiple research studies are expected to be published over the next two years. The studies include:

- Impacts of water temperature, pH, or presence of ash on dispersal of retardant in water.
- Influence of the flow rate, water hardness, and application rate on pulsed exposure of rainbow trout to retardant chemicals.
- Influence of the duration of exposure and application rate on toxicity to rainbow trout of a pulsed retardant exposure.
- Determine 96-hour mortality to rainbow trout after a second pulsed retardant exposure
- Influence of substrate and duration of weathering on toxicity in a simulated runoff event.
- Effects of ultraviolet (UV) exposure on chemical toxicity.
- Toxicity of pulsed chemical exposure to ceriodaphnia (an aquatic invertebrate).
- Determine the concentration of chemical lethal to rainbow trout at various timepoints under 24-hours.

Additional studies, including repeating these studies on new retardant formulations, will occur as funds allow.

The FS continues to explore and use technology to increase the precision and accuracy of retardant drops to reduce the exposure of fish.  During the past eight years, all National Forests with NOAA Fisheries

Endangered Species Act listed species and Designated Critical Habitat have electronically mapped avoidance areas. These maps are geo-referenced allowing an interface with digital platforms, for use in reporting and monitoring, and use with applications on small electronic devices such as tablet computers. Maps are updated annually as needed. Some aircraft now carry electronic devices that display electronic versions of the maps. All tanker bases have the most current annually updated maps for use by pilots.

The USFS Fire Retardant Misapplication Calculator, developed in collaboration with United States Geological Survey, was released in April of 2019. This tool is commonly referred to as the spill calculator and it replaced the previous spill calculator. It provides three results: (1) the load of tank mix delivered to the stream, (2) the affected reach length, and (3) the maximum exposure time over the specified toxicity value. The toxicity value is taken as 10 percent of the median lethal concentration for the specified retardant. This tool is useful for determining potential effects of retardant intrusions into water.

In 2020 the Forest Service updated the specification for long-term retardant (United States Department of Agriculture, Forest Service, Specification 5100-304 Long-term Retardant, Wildland Firefighting). The updated version of the retardant specification changed the allowable aquatic toxicity (Section 3.5.2.2) from a median lethal concentration ($LC_{50}$) to rainbow trout of greater than 100 milligrams per liter to greater than 200 milligrams per liter. This addresses the conservation recommendation in the West Coast Region Biological Opinion (USDOC NOAA Fisheries 2019, WCRO-2018-00288) to use less toxic formulations. As advancements are made in the retardant industry, the Forest Service will continue to consider lowering the aquatic toxicity threshold in future revisions of the specifications.

# Action Area

The action area for the proposed Federal action includes all National Forest System lands encompassing 193 million acres, in 9 regions (Figure BA-1), in 42 states, and 1 territory. This includes 154 national forests, 20 national grasslands, 13 national monuments, 24 national recreational areas, 8 national scenic areas, and 21 national game refuge or wildlife preserves (Figure BA-2). It also includes areas upstream and downstream of Forest Service lands where use of retardant may affect listed species or their habitat. These areas consist of numerous types of environments including terrestrial or aquatic ecosystems containing threatened, endangered, or proposed species, and any associated critical habitats. Areas where species occurrences or critical habitats occur adjacent to or in close proximity to National Forest System lands, and aerially applied fire retardant has the potential to affect species or habitats, will be addressed on a case-by-case basis in this assessment.

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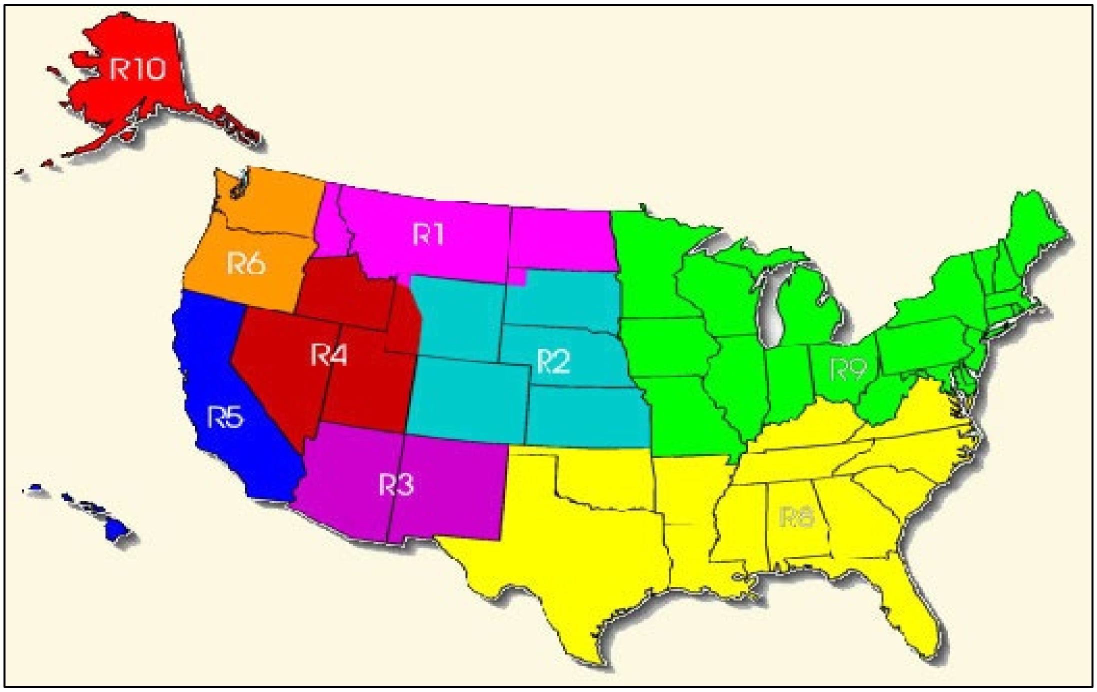


**Figure BA-1. Map of the Forest Service Regions**

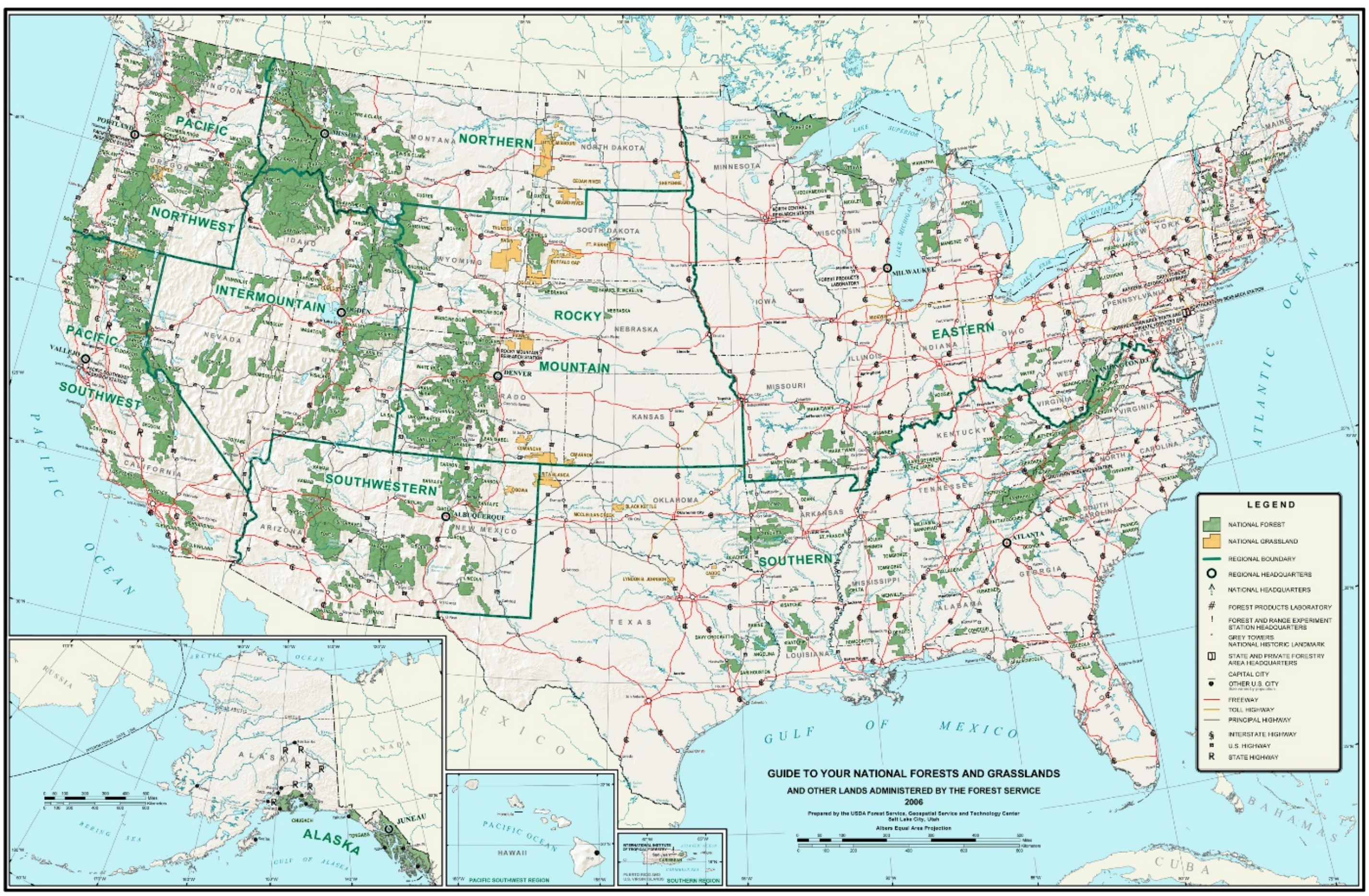


**Figure BA-2. Map of the National Forest System lands**

# Background Information

This section provides information on retardant components and testing requirements, retardant use, and monitoring and reporting data. The information helps to understand the use of retardant and analyze the effects to species and habitats.

Fire retardant, which is approximately 85 percent water, slows the rate of fire spread by cooling and coating the fuels, robbing the fire of oxygen, and slowing the rate of fuel combustion with inorganic salts that change how the fire burns. Retardant is used in conjunction with other firefighting resources, most often in the building and holding of firelines. Retardant is most effective with support from ground resources but can be used to hold a fire for long duration or even stop the fire if the overall conditions favor this. In addition, retardants are used in situations where the operational tactic is too slow to influence the forward rate of spread or where effective fireline building may be impossible by other types of resources.

Retardant coverage level is a unit of measure used to describe the thickness of the chemical on the ground and is expressed in gallons per 100 square feet, abbreviated as GPC. The coverage levels range from 0.5 GPC to greater than 8 GPC. There are general guidelines for coverage levels according to fuel type, and suggested coverage levels are intended to be used as starting points only. Feedback from crews on the ground is essential in determining the effectiveness of those drops and whether the coverage should be lighter or heavier.

## *Retardant Components and Testing Requirements*

Retardant formulations in use today are comprised primarily of inorganic salts and water. The Forest Service Specification (5100-304) includes requirements for effectiveness, safety and environmental protection, materials protection, stability, and physical properties. The Forest Service has developed unique test methods or identified standard test methods for each requirement in the evaluation process.

Although retardant is approximately 85 percent water, the inorganic salts constitute about 60 to 90 percent of the remainder of the product. The other ingredients include thickeners, such as xanthan gum; suspending agents, such as clay; dyes; and corrosion inhibitors (Johnson and Sanders 1977, Pattle Delamore Partners 1996). Corrosion inhibitors are necessary to minimize the deterioration of retardant tank structures and aircraft, which contributes to flight safety (Raybould et al. 1995).

The Forest Service is consulting on the use of aerially applied long-term retardants that meet the Forest Service (Specifications 5100-304). A summary of pertinent sections of the specification follows.

- Unacceptable ingredients (Section 3.4.1) lists the following:
    - sodium ferrocyanide,
    - dichromates,
    - thiourea,
    - borate or other boron-containing compounds,
    - polychlorinated biphenols (PCB),
    - polybrominated diphenyl ethers (PBDE),
    - nonylphenol ethoxylates (NPE),
    - ammonium sulfate,

  - per- and polyfluoroalkyl substances (PFAS) (including but not limited to perfluorooctanoic acid [PFOA] and perfluorooctanesulfonate [PFOS] compounds).
- Environmental and health regulations (Section 3.4.2) require a review of environmental regulations as they apply to the formulation and individual ingredients.
- Chemical profiles and risk assessments (Section 3.4.3) are required prior to consultation.
- Mammalian toxicity (Section 3.5.2.1) requirements:
  - Acute oral toxicity – median lethal dose (LD50) greater than 500 milligrams per kilogram for the concentrate and greater than 2000 milligrams per kilogram for the mixed product.
  - Acute dermal toxicity – median lethal dose (LD50) of greater than 2000 milligrams per kilogram for the concentrate and mixed product.
- Aquatic toxicity (Section 3.5.2.2) - median lethal concentration ($LC_{50}$) to rainbow trout of greater than 200 milligrams per liter.

The Qualified Products List is maintained on the Wildland Fire Chemicals website and will be updated as products are added or removed. **Table BA-1** lists the long-term retardants on the September 5, 2020 Qualified Products List with a summary of their aquatic toxicity and active retarding ingredients

**Table BA-1. Amounts of active retardant ingredients at specified coverage levels in fire retardants currently qualified for use by the Forest Service.**

| Retardant | Fish Toxicity (of concentrate) | 4 GPC Coverage Level | | 8 GPC Coverage Level | |
|---|---|---|---|---|---|
| **Fully qualified products** | **$LC_{50}$ (mg/L)** | **lbs $NH_3$/ft2** | **lbs P2O5/ft2** | **lbs $NH_3$/ft2** | **lbs P2O5/ft2** |
| Phos-Chek LC-95A-R | 386 | 0.0095 | 0.0301 | 0.0190 | 0.0602 |
| Phos-Chek LC-95A-Fx | 399 | 0.0095 | 0.0273 | 0.0191 | 0.0546 |
| Phos-Chek LC-95-W | 465 | 0.0095 | 0.0276 | 0.0191 | 0.0553 |
| Phos-Chek MVP-Fx | 2,024 | 0.0053 | 0.0199 | 0.0105 | 0.0399 |
| Phos-Chek 259-Fx | 860 | 0.0070 | 0.0203 | 0.0140 | 0.0406 |
| Phos-Chek LCE20-Fx | 983 | 0.0073 | 0.0208 | 0.0147 | 0.0415 |
| **Interim qualified products** | **$LC_{50}$ (mg/L)** | **lbs Mg/ft2** | **lbs Cl- /ft2** | **lbs Mg/ft2** | **lbs Cl- /ft2** |
| Fortress FR-100 | 1,762 | 0.0093 | 0.0270 | 0.0185 | 0.0541 |

## Composition of Retardants Currently Approved and Limits for New Retardants to be Included within Bounds of Existing Biological Opinion

Aerially delivered fire retardants are either a liquid concentrate or a dry concentrate. Water is added to each, diluting the products, prior to loading onto an airtanker. Various combinations of di-ammonium phosphate, mono-ammonium phosphate, ammonium polyphosphate (11-37-0), or magnesium chloride retardant salts have previously been or currently are contained in qualified retardant products that have been consulted on. Products containing ammonium sulfate, which was added to the unacceptable ingredients list (USDA Forest Service 2020c), are not considered in this discussion. In addition to salts, retardants may include thickeners, coloring agents, and performance ingredients (corrosion inhibitors, stabilizers, anti-caking agents, flow conditioners, etc.).

Fire retardant composition is described by percent of ingredient in the mixed product. Composition of retardant salts has ranged from nine to 20 percent of mixed products. Mono-ammonium phosphate and di-ammonium phosphate salts are commonly combined in the same product. Di-ammonium polyphosphate and ammonium polyphosphate are used individually. The amount (percent) of thickener in the mixed product ranges from 0.2 to 0.8 percent. Types of thickener and percent of total mixed product in previously approved products include guar (0.4 to 0.8 percent), xanthan (0.2 to 0.7 percent) and clay (0.3 to 0.5 percent). Coloring agents range from 0.1 to 0.3 percent of the total mixed product and include iron oxide, or fugitive (fading) colorant. Performance ingredients have comprised 0.1 to 0.8 percent of the mixed products.

Aerially delivered retardant is provided at specific coverage levels, expressed as gallons per 100 square feet (GPC), depending on the fuel types and conditions present. The amount of retardant salt delivered is dependent on the coverage level. The range of chemicals, in pounds per square foot, that would be delivered in a retardant drop at 8 gallons per 100 square feet coverage level for the retardants previously or currently approved are displayed in second column in Table BA-2:

**Table BA-2. Range and upper limits in pounds per square foot (lbs/ft$^2$) of allowable chemicals when applied at a coverage level of 8 gallons per 100 square feet of mixed product**

| Chemical | Range from previously or currently approved retardants | Proposed upper limit when delivered at 8 GPC |
|---|---|---|
| Ammonia ($NH_3$) | 0.0105 – 0.0191 lbs/ft$^2$ | ≤ 0.02 lbs/ft$^2$ |
| Phosphate ($P_2O_5$) | 0.0399 – 0.0602 lbs/ft$^2$ | ≤ 0.07 lbs/ft$^2$ |
| Magnesium (Mg) | 0.0185 lbs/ft$^2$ | ≤ 0.02 lbs/ft$^2$ |
| Chloride (Cl) | 0.0541 lbs/ft$^2$ | ≤ 0.06 lbs/ft$^2$ |

The Forest Service proposes that the previously approved concentrations of ammonia, phosphate, magnesium, or chloride when delivered at 8 gallons per 100 square feet and displayed in Table BA-2 (third column) be used to establish the upper limit of retardant salts that can be included in newly developed retardants without the need for re-initiation of consultation. Upper limit values provided reflect small increases in constituent levels compared to existing values to allow for minor modifications in formulations as needed by the manufacturer without the need to re-initiate consultation. For any new formulation the toxicity levels must not exceed those of currently approved products. In addition, the maximum extent and duration of effects from new products cannot exceed effects of products already considered in order to be approved without reinitiation.

The Forest Service also proposes establishing the limits of thickeners (guar, xanthan, clay), coloring agents (iron oxide, fugitive) and performance ingredients based on the concentrations found in products that have been previously approved and consulted on. The proposed upper limits are:

- 1 percent thickener (guar, xanthan, and/or clay)
- 0.5 percent colorant (iron oxide and/or fugitive)
- 1.5 percent performance ingredients

Additional information regarding reinitiation is located in Appendix B (Consultation Reinitiation Framework).

A full understanding about how retardant chemical components interacted with various elements of the environment was generally lacking during early use of the materials (pre-1990s). Over the past 2 decades, wildland firefighting agencies have conducted more monitoring and review of the environmental and safety aspects of retardant use (Auxilio August 2020 revised, Labat Environmental December 2013, Labat

Environmental April 2007, Labat March 2003, Labat-Anderson Incorporated July 1996, Labat-Anderson Incorporated August 1994a, Carmichael 1992, Finger 1997, Krehbiel 1992, Van Meter and Hardy 1975).

## Retardant Use

### Decision Authority and Tools

Incident commanders (ICs) are the decision makers for use of retardant; however, agency administrators can provide direction and expectations on the use of retardant to ICs through a delegation of authority. Every fire regardless of size class has an IC, and the IC will use the appropriate factors in determining the suppression strategy and tactics.

The single most important factor in determining strategy is the risk to human life—firefighters and the public. The Forest Service's first responsibility on every fire is to provide for firefighter and public safety (Forest Service Manual 5100). Strategies can range from quickly suppressing the fire on initial attack, to developing longer term management strategies that can simultaneously achieve Land and Resource Management Plan objectives.

One important planning tool is the Wildland Fire Decision Support System (WFDSS). WFDSS is a decision support process that provides an analytical method for evaluating alternative management strategies that are defined by different goals and objectives, suppression costs, and impacts on the land management base.

**Figure BA-3. Retardant use in close proximity to highway to reduce size and related smoke visibility**

### Delivery

#### *Aircraft*

The use of aircraft (fixed and rotor wing) for the delivery of fire retardant is one of many suppression tools used by fire managers. Retardant is delivered by airtankers, single engine airtankers (SEATS), and helicopters, and fills an essential link in the overall suppression strategy. The main principle in the use of aerially delivered retardant is to use it early in sufficient quantity, dropped from an effective altitude with minimum time lapse between each drop.

**Figure BA-4. Retardant application to build fireline**

Retardant is normally stored and mixed at an airtanker base, or in some instances, on-site near a fire incident. Containment and water treatment systems are required for retardant loading pits, mixing and pump areas, storage tanks, areas where retardant deliveries are received, and where loaded airtankers are staged for dispatch. When retardant is mixed at the incident site, a mobile retardant base (portable mixing system) is used. Water sources are typically municipal water supplies or a large lake or reservoir. The contract for mobile retardant bases requires contractors to have a site spill containment plan, secondary containment systems, and set up at least 300 feet from any waterway if water is present. It also requires compliance with the Guide to Preventing Aquatic Invasive Species Transport by Wildland Fire Operations, PMS 444 (January 2017, Guide).


**Figure BA-5. Helitanker at mobile retardant operation**

Airtanker and helicopter types are distinguished by their retardant tank capacity (PMS 200 National Wildfire Coordinating Group Standards for Wildland Fire Resource Typing). Helicopters can deliver retardant either with a bucket or with a "fixed tank", referred to as a "helitanker." Supplying helicopters is the primary reason for setting up "portable retardant bases."

### *Operational Considerations*

Fire statistics have been maintained for many years and are a key factor in the distribution of airtankers and other aerial resources during the year. Potential weather events are taken into consideration, as well as fuel moisture indices and whether there are multiple geographic areas experiencing high fire activity. In evaluating fire statistics and fire history, the number of fires successfully controlled at the initial and extended attack stages averages 95 to 98 percent nationwide.

Most retardant delivery occurs on ridge tops and adjacent to human-made or natural fire breaks, such as roads, meadows, old fire scars, and rock outcrops. Occasionally, retardant is applied adjacent to aquatic environments that are being used as a natural fire break. Applying retardant adjacent to these human-made or natural fire breaks enhances the effectiveness of fire breaks by widening the fire break. This is especially important when applying adjacent to aquatic environments.

How much fire retardant drifts depends on the height and speed of the aircraft at the time of the drop, wind direction, and wind speed. Fire retardants include a gum thickening agent which raises the viscosity and creates larger and more cohesive droplets to reduce drift (USDA Forest Service 2005). There are guidelines for the use of aircraft during suppression activities to ensure that operations can be conducted in a safe and effective manner (NWCG Standards for Aerial Supervision NFES 002544, February 2020). These include suspending flights during poor visibility and when wind conditions result in unsafe or ineffective operations.

## *Monitoring and Reporting*

Since 2012 the Forest Service has provided a yearly summary of retardant use and reports of retardant intrusions into avoidance areas to the Fish and Wildlife Service and NOAA Fisheries. The Forest Service has compiled data on aerial retardant use and fires from 2012 to 2019 (Appendix A) and provided a summary of the data (USDA Forest Service 2020b) to the Services).

### Retardant Use Data

Data derived from Aviation Business System indicates approximately 102 million gallons of retardant (approximately 56,868 drops) were aerially applied to National Forest System lands in the eight years from 2012 to 2019 (USDA Forest Service 2020b). It is estimated that the average annual acreage of National Forest System lands that have retardant applied is between 8,586 and 22,552 acres, which is approximately 0.004 to 0.012 percent of the total National Forest System landbase annually[1]. Forest Service Regions 1 (Northern Region), 3 (Southwestern Region), 4 (Intermountain Region), 5 (Pacific Southwest Region), and 6 (Pacific Northwest Region) apply higher amounts of retardant compared to other regions (Figure BA-9).

One of the tenets of the 2011 Record of Decision was to use aerially delivered water where possible to limit the impacts of aerially applied retardant. Table BA-3 displays the amount of product delivered aerially by percent of total, by year. This data is available by forest and Forest Service region in the summary report (USDA Forest Service 2020b).

**Table BA- 3. Percent of total aerially delivered fire chemical by type and year**

| Year | Retardant Percent | Water Percent | Foam or Water Enhancer Percent |
|---|---|---|---|
| 2012 | 11 | 89 | 0 |
| 2013 | 15 | 84 | 1 |
| 2014 | 15 | 84 | 0 |
| 2015 | 18 | 82 | 0 |
| 2016 | 20 | 80 | 0 |
| 2017 | 18 | 82 | 0 |
| 2018 | 58 | 41 | 0 |
| 2019 | 18 | 82 | 0 |

Aircraft use on fire contributes to disturbance effects to species and habitat. There is a potential for varying levels of effects dependent upon the type of aircraft used. Table BA-4 displays the percent of retardant

[1] *The methodology used to compute the acres impacted was updated to better reflect retardant drops on the ground. During operations retardant drops are overlapped to provide desired coverage levels. The overlap is not accounted for in these calculations, therefore the acres impacted is likely overestimated.*

delivered by airtanker or helicopter by year. This data is available by forest and Forest Service region in the summary report (USDA Forest Service 2020b). The data is not available by airtanker or helicopter type.

**Table BA-4. Percent of retardant by airtanker or helicopter by year**

| Year | Airtanker Percent | Helicopter Percent |
|---|---|---|
| 2012 | 83 | 17 |
| 2013 | 75 | 25 |
| 2014 | 82 | 18 |
| 2015 | 89 | 11 |
| 2016 | 84 | 16 |
| 2017 | 81 | 19 |
| 2018 | 98 | 2 |
| 2019 | 98 | 2 |

## Intrusions

An intrusion, previously referred to as a misapplication, is defined as "any application of aerial retardant, accidental or allowed under the exception, into an avoidance area". From 2012 to 2019 there were 245 fires with intrusions (0.46 percent of the total fires). There were a total of 455 reported intrusions on those fires. Table BA-5 summarizes the intrusion reports and Appendix D includes additional information.

**Table BA-5. Summary of intrusion reports by year**

| Year | Number of fires with intrusions | Number of intrusion reports on FS lands[2] | Number of intrusions into water | Number of intrusions into water buffer only | Number of intrusions into terrestrial avoidance areas | Number of accidental intrusions | Number of exception intrusions | Total number of fires | Total retardant used (gallons) in year | Estimated numbers of drops delivered by aircraft (gallons retardant/1800) | Total drops in avoidance areas divided by estimated drops (%) | Percent of fires with intrusions (%) | Total intrusions divided by estimated drops (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 39 | 72 | 26 | 44 | 2 | 52 | 20 | 7725 | 8,540,914 | 4745 | 2.5 | 0.50 | 1.52 |
| 2013 | 31 | 55 | 22 | 31 | 2 | 43 | 12 | 7588 | 12,218,348 | 6788 | 1.4 | 0.41 | 0.81 |
| 2014 | 31 | 37 | 21 | 15 | 1 | 33 | 4 | 6910 | 8,896,234 | 4942 | 1.2 | 0.45 | 0.75 |
| 2015 | 27 | 51 | 37 | 12 | 2 | 41 | 10 | 6835 | 11,594,937 | 6442 | 1.2 | 0.40 | 0.79 |
| 2016 | 31 | 60 | 32 | 14 | 14 | 46 | 14 | 5772 | 19,021,716 | 10568 | 1.4 | 0.54 | 0.57 |
| 2017 | 35 | 75 | 53 | 19 | 3 | 64 | 11 | 6869 | 18,943,573 | 10524 | 1.2 | 0.51 | 0.71 |
| 2018 | 35 | 88 | 46 | 26 | 16 | 76 | 12 | 5739 | 16,376,813 | 9098 | 2.1 | 0.61 | 0.97 |
| 2019 | 15 | 21 | 11 | 3 | 7 | 14 | 7 | 5412 | 6,769,496 | 3761 | 1.0 | 0.28 | 0.56 |
| Total | 244 | 459 | 248 | 164 | 47 | 369 | 90 | 52850 | 102,362,031 | 56868 | 1.5 | 0.46 | 0.81 |

[2] *1 An intrusion report refers to each location where retardant enters the avoidance area. An intrusion can consist of a single retardant drop or of multiple. The location is defined by the reported lat/long.*

Please note that this data is different than that reported to the Fish and Wildlife Service and NOAA Fisheries in the yearly monitoring report. The yearly reporting summarizes the number of intrusions into waterways and waterway buffers only. Additionally, the estimated number of drops was calculated differently over the years. The summary in Table BA-5 standardizes the calculation for estimated number of drops.

The Wildland Fire Chemical Misapplication Reporting database identifies intrusions by their location as identified by the reported latitude and longitude coordinates. Appendix C contains maps of the intrusions reported from 2012 to 2019. The maps identify the intrusions by area and type. Table BA-6 summarizes the intrusion type as accidental or exception by Forest Service Region. Possible intrusion areas include waterway; waterway buffer; dry intermittent stream; aquatic threatened, endangered, proposed, candidate or sensitive species habitat; or terrestrial threatened, endangered, proposed, candidate or sensitive species habitat. Some intrusions occur in multiple areas. In order to simplify the maps, area was identified in the following precedent order: aquatic threatened, endangered, proposed, candidate or sensitive species; terrestrial threatened, endangered, proposed, candidate or sensitive species; waterway; waterway buffer; and dry intermittent stream. Table BA-7 summarizes the intrusions by area as mapped.

**Table BA-6. Summary of intrusion reports identified by accident or exception for the period 2012 to 2019**

| Region | Accidental | Exception | Total |
|---|---|---|---|
| Region 1 | 30 | 2 | 32 |
| Region 2 | 10 | 5 | 15 |
| Region 3 | 11 | 4 | 15 |
| Region 4 | 110 | 11 | 121 |
| Region 5 | 190 | 62 | 252 |
| Region 6 | 19 | 2 | 21 |
| Region 8 | 0 | 2 | 2 |
| Region 9 | 0 | 1 | 1 |
| TOTAL | 370 | 89 | 459 |

**Table BA-7. Summary of intrusion reports identified by location of intrusion**

| Region | Aquatic TEPCS | Terrestrial TEPCS | Waterway | Waterway buffer | Dry intermittent stream | unknown | TOTAL |
|---|---|---|---|---|---|---|---|
| Region 1 | 9 | 0 | 16 | 6 | 1 | 0 | 32 |
| Region 2 | 1 | 0 | 8 | 4 | 2 | 0 | 15 |
| Region 3 | 5 | 1 | 4 | 4 | 1 | 0 | 15 |
| Region 4 | 20 | 11 | 45 | 28 | 12 | 5 | 121 |
| Region 5 | 56 | 22 | 92 | 48 | 33 | 1 | 252 |
| Region 6 | 10 | 2 | 6 | 3 | 0 | 0 | 21 |
| Region 8 | 1 | 0 | 1 | 0 | 0 | 0 | 2 |
| Region 9 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | 103 | 36 | 172 | 93 | 49 | 6 | 459 |

Some intrusions have resulted in take of threatened and endangered species, as described in the Incidental Take Statements (ITS) in the Biological Opinions (USDI Fish and Wildlife Service 2011, USDC National Oceanic and Atmospheric Administration 2011). There are incidental take statements for 73 species: 33 plants, 23 fish, 3 birds, 1 reptile, 4 amphibians, and 7 terrestrial invertebrates; 15 evolutionarily significant units of salmon; 11 distinct population segments of steelhead; and 4 anadromous fish species. The amount of take for a species was described as acres affected or miles of stream impacted, or in some cases as a number of drops/intrusions in a specified area. For some species with wide distribution, take was allocated for each Forest based on the amount of occupied or suitable habitat that occurs on the Forest. Table BA-8 provides a summary of intrusions that resulted in take from 2012 to 2019. A complete listing of intrusions into avoidance areas is found in Appendix D.

**Table BA-8. Intrusion events resulting in take of threatened or endangered species**

| Species | Forest | Incident | ITS Authorized Take | Reported Take | Take Remaining |
|---|---|---|---|---|---|
| Quino checkerspot butterfly | San Bernardino | 2013 Mountain<br>2019 Bautista | 46.0 acres | 25.1 acres<br>8.68 acres | 20.9 acres<br>12.22 acres |
| Snake River sockeye salmon, spring/summer-run chinook salmon, and steelhead | Sawtooth | 2013 210 Road | one intrusion event | one intrusion event | none |
| upper Columbia River steelhead | Okanagon-Wenatchee | 2014 Carlton Complex | one intrusion event | one intrusion event | none |
| bull trout | Okanagon-Wenatchee | 2014 Carlton Complex | 6.7 miles | 0.3 miles | 6.4 miles |
| bull trout | Boise | 2014 Bull Creek | 5.0 miles | 1.0 miles | 4.0 miles |
| bull trout | Lolo | 2017 Lolo Peak<br>2017 Rice Ridge<br>2017 Sunrise | 1.6 miles | 5.1 miles<br>24.97 miles<br>13.5 miles | take exceeded |
| Snake River spring/summer-run chinook salmon and steelhead | Sawtooth | 2016 Dry Creek | one intrusion event | second intrusion event | take exceeded |
| Arroyo toad | Los Padres | 2016 Rey<br>2016 Sobaranes | 10.0 miles | unknown<br>unknown | |
| Southern California coastal steelhead | Los Padres | 2017 Thomas | one intrusion event | one intrusion event | none |
| Southern Oregon northern California coast coho salmon | Rogue River | 2018 Nachez | one intrusion event | one intrusion event | none |

In 2016 take occurred for salmon and steelhead in the Snake River basin. Consultation was reinitiated and a new biological opinion was issued (USDC NOAA Fisheries 2016). In 2017 and 2018 take was exceeded for numerous species under the jurisdiction of the West Coast Region of NOAA Fisheries. Consultation was reinitiated and a Biological Opinion was issued in 2019 with a new incidental take statement (USDC NOAA Fisheries 2019). Take for bull trout was exceed in 2017 on the Lolo National Forest and consultation was reinitiated. The Supplemental Amendment Biological Opinion (USDI Fish and Wildlife Service 2019) adopted seven additional Conservation Measures, valid through the term of the original action, January 1, 2022.

## Avoidance Areas

Avoidance areas were mapped beginning in the 2012 fire season. Each year Forests would continue to update their avoidance area maps prior to the fire season. They would provide two data layers, a hydrologic avoidance area layer and a species avoidance area layer. These layers would then be combined to develop avoidance area maps. In 2019 a summary of the percent of total National Forest System lands in perennial stream avoidance areas, intermittent stream avoidance areas, and threatened, endangered, proposed, candidate and sensitive species avoidance areas was completed. In total, 20 percent of National Forest System lands are currently included in avoidance areas. Of that, approximately 10.1 percent are perennial stream avoidance areas, 7.9 percent are intermittent stream avoidance areas, and 3.5 percent are terrestrial species avoidance areas. The individual percentages do not total to 100 percent because of overlap in the categories. The summary report (USDA Forest Service 2020b) includes data for each Forest and Forest Service Region.

## Fire Season

Fire season generally refers to the time of the year when fires occur. It varies by location and yearly weather patterns. In general, the peak seasons are described by Forest Service region as shown in Table BA-9.

**Table BA-9. Peak fire season by Forest Service Region based on historical data.**

| Region | Peak fire season |
|---|---|
| 1 | April - October |
| 2 | June – October |
| 3 | May – July |
| 4 | June - October |
| 5 | August - October |
| 6 | June - October |
| 8 | September - July |
| 9 | April - October |
| 10 | June - September |

This information can be helpful in determining the potential for retardant use during critical life stages for a species. In recent years there is evidence that fire seasons are becoming longer and more severe. In order to look at potential changes over time, in a given year, or between regions or forests, a summary of fire statistics from 2000 to 2019 was completed from the Firestat database (USDA Forest Service 2020b). Summarized data includes number of fires by month, percent of total fires by month, acres burned by month, and percent of acres burned by month. The data is tabulated in the following groups:

- By Region for the period 2000-2019
- By Region for each year in the period 2000-2019
- By National Forest for the period 2000-2019

Charts were also created for a visual representation. Examples of the available data are provided here (Table BA-10; Figure BA-6, Figure BA-7, Figure BA-8).

**Table BA-10. Acres burned by Forest Service Region by month for the period 2000-2019. Total fire acres are attributed to the month in which the fire started.**

| Region | January | February | March | April | May | June | July | August | September | October | November | December | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 183.45 | 338.36 | 7127.86 | 23338.62 | 6801.96 | 291052 | 2194360 | 2500531 | 203901 | 5101.57 | 689.11 | 170.15 | 5233595.2 |
| 2 | 6393.03 | 12725.94 | 41488.43 | 27370.9 | 67441.06 | 996410.2 | 516573 | 473715.9 | 120333 | 76968.75 | 7910.16 | 387.55 | 2347717.9 |
| 3 | 3243.12 | 27332.08 | 504249.9 | 393431.2 | 1888943 | 2192153 | 704472.9 | 202722.5 | 89003.8 | 16049.66 | 23471.28 | 8648.99 | 6053721.1 |
| 4 | 3184.71 | 224 | 363.6 | 1339.94 | 55250.16 | 579648.8 | 3008946 | 2818069 | 366080.5 | 21633.05 | 3564.73 | 6.18 | 6858310.4 |
| 5 | 15954.66 | 22778.68 | 2238.84 | 11034.57 | 100500.6 | 1219670 | 3056888 | 1799669 | 740832.1 | 1226349 | 54577.4 | 306505.4 | 8556998.3 |
| 6 | 7 | 7.52 | 158.13 | 427.29 | 2626.65 | 237832.7 | 2413662 | 2514558 | 357797.7 | 10646.03 | 1909.03 | 120.37 | 5539752 |
| 8 | 40502.64 | 103835 | 220135.2 | 230986.3 | 189498.7 | 88771.44 | 33592.63 | 32947.72 | 26464.66 | 112578.8 | 155043.7 | 23276.72 | 1257633.5 |
| 9 | 6213.95 | 17333.66 | 41750.73 | 56408.77 | 94431.52 | 2537.5 | 40199.43 | 95998.08 | 6945.91 | 4097.29 | 23907.26 | 1514.09 | 391338.19 |
| 10 | 0 | 0 | 1.5 | 327.52 | 207.74 | 170639.4 | 23.68 | 24.71 | 13.35 | 0.65 | 0.3 | 0 | 171238.81 |

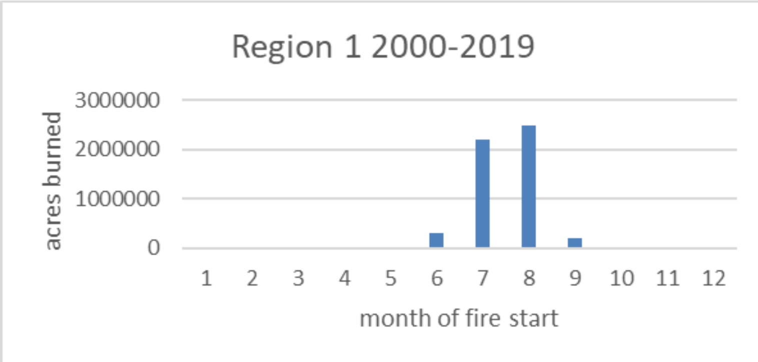


**Figure BA-6. Acres burned by month of fire start in Forest Service Region 1 from 2000-2019**

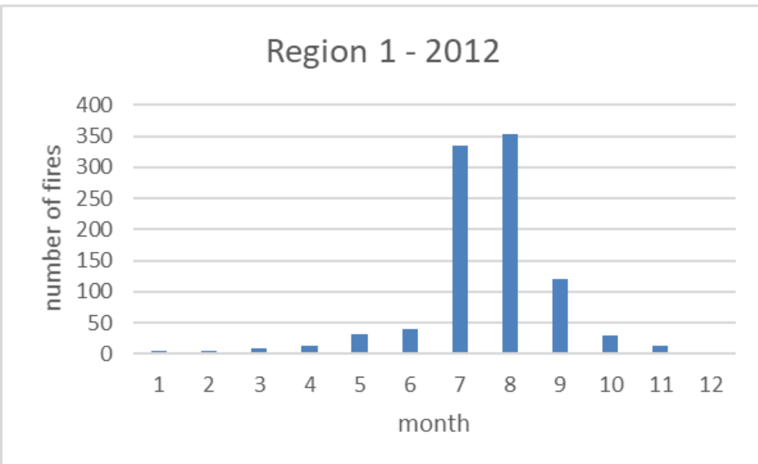


**Figure BA-7. Number of fires by month in Forest Service Region 1 in 2012**

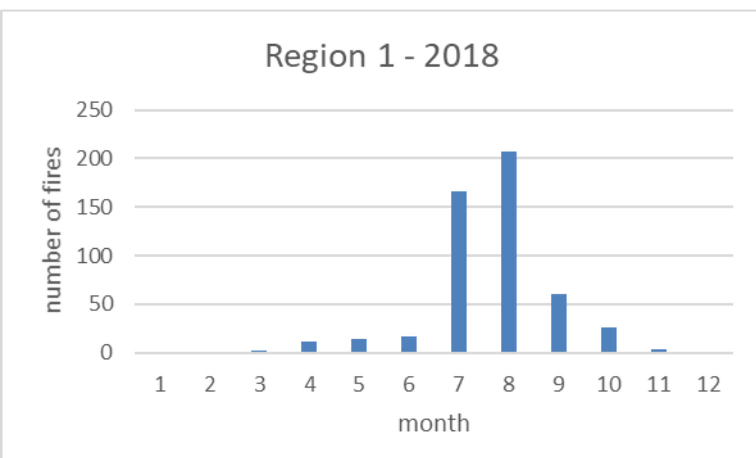


**Figure BA-8. Number of fires by month in Forest Service Region 1 in 2018**

In addition to the analysis of Firestat data, the following table (Table BA-11) was developed from retardant use data from 2012 to 2019. It provides the dates that aerially delivered retardant began and ended each year by Forest Service region. An entry of a single date indicates that is the only date when retardant was aerially delivered. This data is also found in the summary report broken out by each forest and delivery method (airtanker or helicopter) and for each Forest the number of days retardant was flown is indicated..

**Table BA-11. Beginning and ending dates of aerially delivered retardant by region and year. Region 10 (Alaska) has not used retardant on National Forest System lands so is not included in the table. No use indicates retardant was not aerially delivered.**

| Year | Region 1 | Region 2 | Region 3 | Region 4 | Region 5 | Region 6 | Region 8 | Region 9 |
|---|---|---|---|---|---|---|---|---|
| 2012 | Jul 9 - Sep 17 | Apr 24 – Sep 23 | May 8 – Nov 4 | Jun 6 – Oct 13 | May 28 – Nov 25 | Jul 9 – Sep 28 | no use | no use |
| 2013 | Jul 8 – Sep 7 | Jun 2 – Aug 31 | May 8 – Jul 1 | Jun 13 – Sep 2 | Mar 23 – Oct 27 | Jul 12 – Aug 29 | no use | no use |
| 2014 | Jul 16 – Sep 16 | Jul 7 – Aug 9 | Apr 10 – Jul 2 | Jun 3 – Sep 20 | Jan 16 – Nov 24 | Jul 5 – Sep 21 | no use | Jun 2 |
| 2015 | Jul 1 – Oct 12 | Aug 1 – Sep 29 | May 2 – Aug 31 | Jun 12 – Sep 30 | Apr 7 – Oct 29 | Jun 9 – Oct 6 | Oct 6 | May 2 – May 7 |
| 2016 | Jun 29 – Sep 4 | Jun 15 – Oct 23 | Mar 26 – July 29 | Jun 15 – Sep 10 | Jun 4 – Nov 19 | Jun 6 – Oct 1 | May 5 - Nov 17 | May 6 – May 20 |
| 2017 | Jul 8 – Sep 13 | Mar 10 – Sep 19 | Apr 4 – Jul 9 | Jun 9 – Nov 13 | Apr 22 – Dec 5 | Jun 21 – Sep 17 | Feb 25 – Apr 9 | no use |
| 2018 | Jul 16 – Sep 14 | May 10 – Oct 1 | Mar 23 – Sep 15 | Jun 7 – Sep 30 | May 27 – Nov 14 | Jun 25 – Oct 19 | no use | Feb 15 |
| 2019 | Jul 26 – Sep 4 | Jun 11 – Oct 23 | Mar 6 – Sep 22 | Jul 11 – Sep 16 | Apr 19 – Nov 26 | Jul 13 – Sep 15 | May 29 – Jun 2 | no use |

## Effects Analysis Process

Environmental effects have been analyzed on a nationwide, programmatic scale and the information and estimates contained in this analysis are derived from the most accurate, available data.

The occurrence of past fires and retardant drops provide a baseline for considering where retardant may be used in the future (Figure BA-9, Figure BA-10, and Table BA-12). Complete data by Forest is available in a separate report (USDA Forest Service 2020b). This analysis is largely qualitative in nature because of the national, programmatic scope of this analysis and the fact that the location of future retardant applications cannot be known. This effects analysis includes a description of the nature of potential effects that could occur.

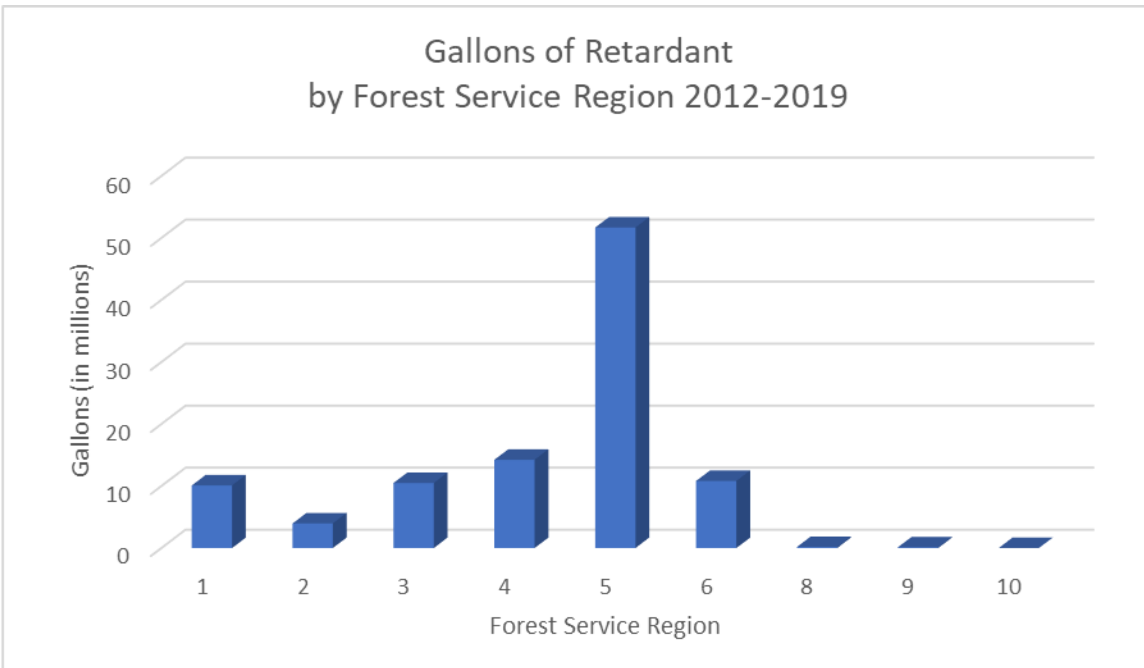


**Figure BA-9. Fire Retardant Use by Forest Service Region 2012-2019**

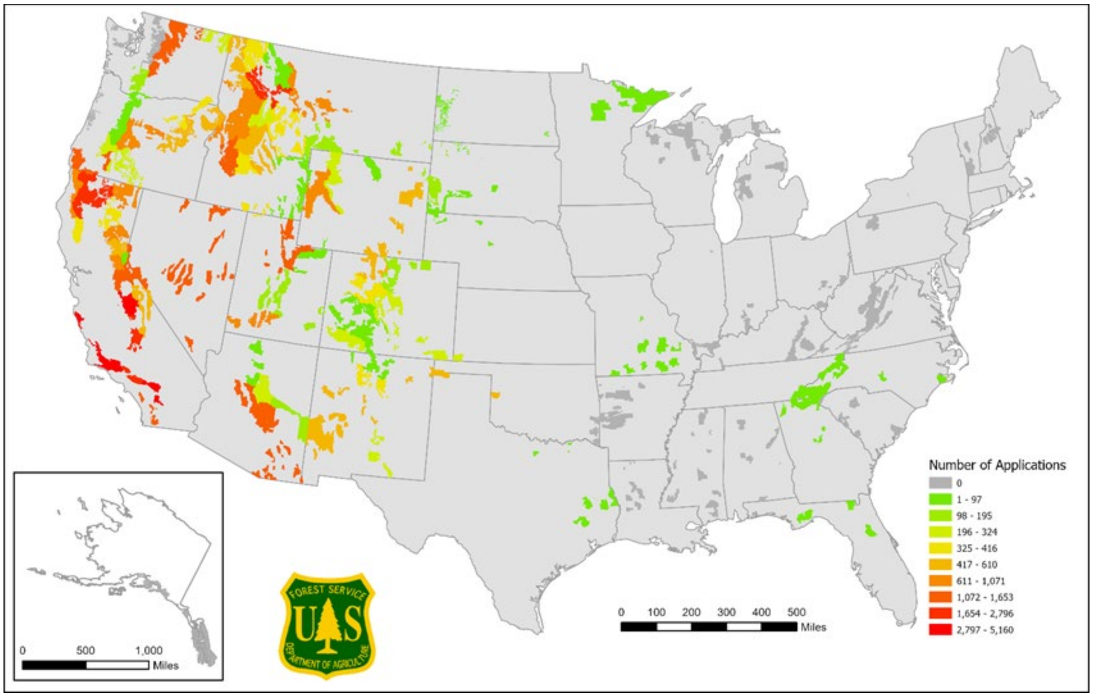


**Figure BA-10. Aerial fire retardant applications in National Forest System lands, 2012-2019**

**Table BA-12. Estimated area of fire retardant application on National Forest System lands, 2012-2019 (8 years)**

| Region | NFS Acres | Number fires | Estimated number retardant drops | Total gallons retardant | Average gallons retardant per year | Estimated acres impacted at 4 GPC | Estimated acres impacted at 8 GPC | Maximum estimated percent NFS land impacted at 4 GPC | Maximum estimated percent NFS land impacted at 8 GPC |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 25,449,819 | 6,398 | 6,055 | 10,898,227 | 1,362,278 | 1056-2401 | 914-1890 | 0.0094 | 0.0074 |
| 2 | 22,056,205 | 4,116 | 2,205 | 3,969,286 | 496,161 | 385-874 | 333-688 | 0.0040 | 0.0031 |
| 3 | 20,530,401 | 8,665 | 5,824 | 10,482,975 | 1,310,372 | 878-1997 | 878-1572 | 0.0097 | 0.0077 |
| 4 | 31,786,447 | 5,080 | 7,906 | 14,230,632 | 1,778,829 | 1056-2401 | 914-1890 | 0.0076 | 0.0059 |
| 5 | 20,261,051 | 10,415 | 28,713 | 51,683,580 | 6,460,448 | 5007-11387 | 4335-8964 | 0.0562 | 0.0442 |
| 6 | 25,114,875 | 9,893 | 6,009 | 10,816,422 | 1,352,053 | 1048-2383 | 907-1876 | 0.0095 | 0.0075 |
| 8 | 13,425,610 | 4,867 | 93 | 167,817 | 20,977 | 16-37 | 14-29 | 0.0003 | 0.0002 |
| 9 | 12,177,242 | 3,234 | 63 | 113,092 | 14,137 | 11-25 | 9-20 | 0.0002 | 0.0002 |
| 10 | 22,148,457 | 115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | 192,950,107 | 52,783 | 56,868 | 102,362,031 | 12,795,254 | 9916-22552 | 8586-17753 | 0.0117 | 0.0092 |

The following information was used to evaluate environmental consequences at a national scale:

- Species occurrences, and
- Critical habitat information and general habitat requirements.

The following information sources were used to identify species to be considered:

- Current Forest Service lists of known and suspected occurrences of species occurring on or near National Forest System lands (refer to each section on wildlife, fish, and plants),
- Current Forest Service lists of designated critical habitats occurring on or near National Forest System lands (refer to each section on wildlife, fish, and plants),
- Species specific information including listing packages, recovery plans, critical habitat designations, range distribution, habitat, threats, five-year reviews, NatureServe and any petitions, as available for each species.

## *Analysis Process Used*

The following screen (Table BA-13) was developed to standardize the species determinations. Retardant application potential is derived from retardant use data by forest from 2012 to 2019 (Appendix A). Specifically, it is determined by frequency (numbers of years retardant used over 9 year period), average amount (gallons of retardant used per year), and maximum amount (gallons of retardant used in any given year). Very low retardant application potential is a frequency of less than 0.3, average of less than 10,000 gallons, and maximum of 100,000 gallons. Low is 0.3 to less than 0.5 frequency, less than 50,000 gallons on average, and less than 200,000 gallons maximum. Moderate is 0.5 to 0.8 frequency, less than 150,000 gallons on average, and less than 500,000 gallons maximum. High retardant application potential is any forest with greater than 0.8 frequency, 150,000 gallons on average, or greater than 500,000 gallons maximum. Further analysis parameters are provided specific to aquatic species as a whole.

**Table BA-13. National effects screening process for federally listed species and critical habitat impacts**

| Impact[3] | National Screening Factor Aerially Applied Retardant | Aerial Retardant Application Potential |
|---|---|---|
| NE | Species/habitat occur in areas with no fires, therefore no potential retardant use. Examples: cliffs, caves, estuaries, marshes, lakes, ocean shoreline, sand dunes. | none |
| NE | Species occurs near, but not on national forest lands and effects from aerial retardant use on forest lands are not possible | low - high |
| NE | No retardant use recorded on forests where species occur, are suspected, or critical habitat is designated. | none |
| NE | Use of aerial fire retardant does not impact or change the Primary Constituent Elements, or physical and biological features of critical habitat. | low |
| **Aquatics** | | |
| NLAA | Species occurs on forest with very low aerial retardant use and is protected with an avoidance area | very low |

[3] *NE = no effect; NLAA = may affect, not likely to adversely affect; LAA = may affect, likely to adversely affect*

| Impact[3] | National Screening Factor Aerially Applied Retardant | Aerial Retardant Application Potential |
|---|---|---|
| NLAA | Critical habitat is protected with avoidance area mapping, or use of aerial retardant would result in discountable or immeasurable changes to primary constituent elements or the physical and biological features of critical habitat | low-moderate |
| LAA | Species occurs on forest with moderate to high aerial retardant use. | moderate - high |
| LAA | Changes to primary constituent elements, or physical and biological features of critical habitat, are anticipated. | moderate-high |
| | **Terrestrial** | |
| NLAA | Species is not an isolated population[4] and aerial fire retardant is applied on less than 0.01 percent of forest landbase on average annually where species occurs or is suspected of occurring. | low |
| NLAA | Species occurs or is suspected of occurring on a forest with more than 0.01 percent of its landbase impacted by aerial retardant on average annually but occurs in habitats with very low likelihood of retardant application. Examples include alpine habitat, talus/scree slopes, desert, | low - moderate |
| NLAA | Critical habitat is protected with avoidance area mapping or use of aerial retardant would result in discountable or immeasurable changes to primary constituent elements or the physical and biological features of critical habitat. | low - high |
| LAA | Aerial fire retardant is applied on more than 0.01 percent of forest landbase on average annually where species occurs or is suspected. | moderate - high |
| LAA | Species is a small isolated population[1] and occurs on any forest where aerial retardant application is likely to occur – recognizing potential impact to these species from an intrusion or invoking an exception. | low - high |
| LAA | Changes to primary constituent elements, or physical and biological features of critical habitat, are anticipated. | low - high |

## *Assumptions Used for the National Effects Screening Process:*

- Fire season statistics since 2012 provide a reasonable representation of the risk of retardant applications in the next 10 to 15 years relative to the Forest Service landbase even though past or future decades could have more fires (Geier-Hayes 2011).
- Known species occurrences and designated critical habitat areas would be protected from adverse effects by avoidance area designations that direct use of retardant away from these areas. Designated critical habitat where the aerial application of fire retardant does not affect or change primary constituent elements, or the physical and biological features of critical habitat, does not require protection or avoidance mapping.
- Based on 8 years of intrusion data, out of an estimated 56,868 retardant drops there were 248 intrusions into water (0.43 percent) and 164 intrusions into the waterway buffer only (0.29 percent). Overall, there were 459 intrusions into avoidance areas (0.81 percent). The intrusion rate is not expected to increase dramatically.

[4] *Small isolated population – a population where the number of individuals is low and the area occupied is geographically limited, such as occurring on a single forest or within a single drainage*

- Intrusions in terrestrial avoidance areas are assumed to have a higher potential to occur on those units that have a high rate of use of aerial application of retardant.

In addition to those assumptions, the following Forest Service actions would occur after an intrusion into an aerial retardant avoidance area:

- If assessment or monitoring at an intrusion site determines that effects occurred to threatened, endangered, proposed or candidate species or critical habitat, the FS would consider whether additional restrictions to aerial retardant use are needed. The Forest Service would discuss potential changes in retardant use, including buffer size changes, with the Fish and Wildlife Service and NOAA Fisheries.
- All retardant intrusion locations will be reported to the Forest resource specialist and / or the assigned Burned Area Emergency Rehabilitation team. The potential for non-native invasive plant species issues will be assessed by these entities, and additional measures included in forest plans would be implemented as needed.

### *Cumulative Effects*

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State or private activities, not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." These include activities on adjacent lands, private or state owned inholdings, or on rights of way across National Forest lands. Future Federal actions will be reviewed through separate section 7 consultation processes. Past Federal actions have already been added to the environmental baseline in the action area.

State or private activities, including use of aerial retardant, salt mixtures for deicing or dust abatement, or agricultural fertilizers, are likely to continue affecting Endangered Species Act-listed fish, animal, and plant species. The cumulative effects in the action area are difficult to analyze, considering the broad geographic landscape included in the action area, and the uncertainties associated with state and private actions are difficult to predict, including determining if those actions will increase or decrease in the future. However, effects from state and private actions are likely to increase.

Effects from these 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 different levels of restriction or regulation by state or private entities.

## ESA-listed Species/Critical Habitat Considered

Table BA-14 list all species (and their designated critical habitat) under the jurisdiction of the NOAA Fisheries that may be affected by the Proposed Action; including 19 salmon evolutionarily significant units, 11 steelhead distinct population segments, four sturgeon, one eulachon, five whales, one sea lion, and six marine reptiles. Critical Habitat is designated for 36 species, distinct population segments, or evolutionarily significant units. Critical habitat designations identify the physical and biological features of habitat essential to the conservation of a given species. According to updated federal regulations, physical and biological features are now used to describe the key components of critical habitat that were formerly described by primary constituent elements. Some of the species discussions below refer to primary constituent elements because critical habitat designations have not been updated to the new terminology. We describe each species and their status below.

**Table BA-14. Species and their Designated Critical Habitat considered in this consultation**

| Common Name | Scientific Name | Distinct Population Segment (DPS) or Evolutionarily Significant Unit (ESU) | Listed As | Critical Habitat |
|---|---|---|---|---|
| Chinook salmon | *Oncorhynchus tshawytscha* | Snake River fall-run ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Sacramento River winter-run ESU | Endangered | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Central Valley spring-run ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | California coastal ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Upper Columbia River spring -run ESU | Endangered | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Lower Columbia River ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Puget Sound ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Snake River spring/summer-run ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Upper Willamette River ESU | Threatened | Yes |
| Chinook salmon | *Oncorhynchus tshawytscha* | Upper Klamath-Trinity River ESU | Candidate | No |
| Chinook salmon | *Oncorhynchus tshawytscha* | Oregon Coast spring-run ESU | Candidate | No |
| chum salmon | *Oncorhynchus keta* | Hood Canal summer-run ESU | Threatened | Yes |
| chum salmon | *Oncorhynchus keta* | Columbia River ESU | Threatened | Yes |
| coho salmon | *Oncorhynchus kisutch* | Oregon coast ESU | Threatened | Yes |
| coho salmon | *Oncorhynchus kisutch* | Southern Oregon and Northern California coasts ESU | Threatened | Yes |
| coho salmon | *Oncorhynchus kisutch* | Lower Columbia River ESU | Threatened | Yes |
| coho salmon | *Oncorhynchus kisutch* | Central California Coast ESU | Endangered | Yes |
| sockeye salmon | *Oncorhynchus nerka* | Snake River ESU | Endangered | Yes |
| sockeye salmon | *Oncorhynchus nerka* | Ozette Lake ESU | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Snake River Basin DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Upper Columbia River DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Upper Willamette River DPS | Threatened | Yes |

| Common Name | Scientific Name | Distinct Population Segment (DPS) or Evolutionarily Significant Unit (ESU) | Listed As | Critical Habitat |
|---|---|---|---|---|
| steelhead | *Oncorhynchus mykiss* | Southern California DPS | Endangered | Yes |
| steelhead | *Oncorhynchus mykiss* | California Central Valley DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Central California Coast DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | South-Central California Coast DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Northern California DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Lower Columbia River DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Middle Columbia River DPS | Threatened | Yes |
| steelhead | *Oncorhynchus mykiss* | Puget Sound DPS | Threatened | Yes |
| eulachon | *Thaleichthys pacificus* | southern DPS | Threatened | Yes |
| green sturgeon | *Acipenser mediosteris* | southern DPS | Threatened | Yes |
| Gulf sturgeon | *Acipenser oxyrinchus desotoi* | not applicable | Threatened | Yes |
| Atlantic sturgeon | *Acipenser oxyrinchus* | Carolina DPS, South Atlantic DPS, Chesapeake Bay DPS, New York Bight DPS | Endangered | Yes |
| shortnose sturgeon | *Acipenser brevirostrum* | not applicable | Endangered | No |
| Steller Sea Lion | *Eumetopias jubatus* | Western DPS | Endangered | Yes |
| beluga whale | *Delphinapterus leucas* | Cook Inlet DPS | Endangered | No |
| killer whale | *Orcinus orca* | southern resident DPS | Endangered | Yes |
| fin whale | *Balaenoptera physalus* | not applicable | Endangered | No |
| sperm whale | *Physeter macrocephalus* | not applicable | Endangered | No |
| humpback whale | *Megaptera novaeangliae* | not applicable | Threatened | No |
| leatherback turtle | *Dermochelys coriacea* | not applicable | Endangered | Yes |
| olive ridley turtle | *Lepidochelys olivacea* | not applicable | Threatened | No |
| green turtle | *Chelonia mydas* | East Pacific DPS | Threatened | No |
| loggerhead turtle | *Caretta caretta* | North Pacific Ocean DPS, Northwest Atlantic Ocean DPS | Endangered | Yes |
| hawksbill turtle | *Eretmocheleys imbricata* | not applicable | Endangered | No |
| Kemp's ridley turtle | *Lepidochelys kempii* | not applicable | Endangered | No |

## Chinook Salmon - *Oncorhynchus tshawytscha*

We discuss the distribution, life history, population dynamics, status, and critical habitats of the nine species (here we use the word "species" to apply to distinct population segments, and evolutionary significant units separately; however, because listed Chinook salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across evolutionarily significant units. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), various salmon evolutionarily significant unit listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Chinook salmon are the largest of the Pacific salmon and historically ranged from the Ventura River in California to Point Hope, Alaska in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia in both fresh and saltwater habitats (Healey 1991). In freshwater, Chinook salmon prefer streams that are deeper and larger than those used by other Pacific salmon species.

### California Coastal Chinook salmon

This species was listed "threatened" on September 16, 1999 (64 FR 50394) and June 28, 2005 (70 FR 37159); updated April 14, 2014 (79 FR 20802). The Critical Habitat for this Chinook was designated September 2, 2005 (70 FR 52488).

The California Coastal Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, California. Seven artificial propagation programs were included in the ESU, however on June 26, 2013, NOAA Fisheries proposed to remove the artificial propagation programs from the ESU because the artificial propagation programs have been terminated (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-central California coast Recovery Domain" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California coast Recovery Domain" (Spence et al. 2008), listing documents (64 FR 50393; 70 FR 37160), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

Historical estimates of escapement, based on professional opinion and evaluation of habitat conditions, suggest abundance was roughly 73,000 in the early 1960s with most fish spawning in the Eel River (Good et al 2005). NOAA Fisheries listed California Coastal Chinook salmon as threatened on September 16, 1999 (64 FR 50393) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). California Coastal Chinook salmon was listed due to the combined effect of dams that prevent them from reaching spawning habitat, logging, agricultural activities, urbanization, and water withdrawals in the river drainages that support them. This ESU is at considerable risk from population fragmentation and reduced spatial diversity. There is little connectivity between the southern and northern portions of their range. At the southern portion of the ESU, only the Russian River population has had a constant run that exceeded 1,000 adult spawning fish over the last 10 years. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by loss of the spring-run race and reduction in coastal populations. Based on these factors, this ESU would likely have a low resilience to additional distress.

Specific geographic areas designated include the California Water Service's hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, Mendocino Coast and the Russian River. Primary constituent elements include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The spawning habitat in coastal streams is degraded by years of timber harvest that has produced large amounts of sand and silt in spawning gravel and reduced water quality by increased turbidity. Agriculture and urban areas have impacted rearing and migration sites in the Russian River by degrading water quality and by disconnecting the river from its floodplains by constructing levees. Water management from dams within the Russian and Eel (Scott Dam, Coyote Valley Dam) pose a threat to the survival and recovery of ESA-listed salmonids.

The loss of the spring-run life history type represents a significant loss of diversity within the ESU, as has been noted in previous status reviews (Good et al. 2005; Williams et al. 2011). A recent status review shows the short term trend as stable, but concern remains about the extremely low numbers of Chinook salmon in most populations of the North-Central Coast and Central Coast strata, which diminishes connectivity across the ESU.

## Central Valley Spring-Run Chinook salmon

The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California. Central Valley spring-run Chinook salmon have been eliminated from the San Joaquin River and its tributaries and the American River due to constructing Friant and Folsom dams, respectively. Naturally spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, and its tributaries Butte, Deer, and Mill Creeks and limited spawning occurs in the basins of smaller tributaries (CDFG 1998). This ESU includes one artificial propagation program. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (64 FR 50393; 70 FR 37160), the draft recovery plan (NMFS 2009a) and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 700,000 fish between the late 1880s and the 1940s (Fisher 1994), although these estimates may reflect an already declining population, in part from the commercial gillnet fishery that occurred for this ESU. Median natural production of spring-run Chinook salmon from 1970 to 1989 was 30,220 fish. In the 1990s, the population experienced a substantial production failure with an estimated natural production ranging between 3,863 and 7,806 fish (except 1995, which had a natural production of an estimated 35,640 adults) during the years between 1991 and 1997. Numbers of naturally produced fish increased significantly in 1998 to an estimated 48,755 adults and estimated natural production has remained above 10,000 fish since then (USFWS 2007).

The Sacramento River trends show long- and short- term negative trend and negative population growth. Meanwhile, the median production of Sacramento River tributary populations increased from a low of 4,248 with only one year exceeding 10,000 fish before 1998 to a combined natural production of more than 10,000 spring-run Chinook in all years after 1998 (data from USFWS 2007). Time series data for Mill, Deer, Butte, and Big Chico Creeks spring-run Chinook salmon (through 2006) indicate that all three tributary spring-run Chinook populations experienced population growth. Although the populations are small, Central Valley spring-run Chinook salmon have some of the highest population growth rates of Chinook salmon in the Central Valley.

NOAA Fisheries originally listed Central Valley spring-run Chinook salmon as threatened on September 16, 1999 (64 FR 50393) and reaffirmed their status on June 28, 2005 (70 FR 37160). This species was listed due to loss of historical spawning habitat, degradation of remaining habitat, and threats to genetic diversity from hatchery salmon. Risks persist to the spatial structure and diversity of the ESU. Only three extant independent populations exist, and they are especially vulnerable to disease or catastrophic events because they are near one another. In addition, until there are means to spatially segregate the spring-run and fall-run populations in the lower basin of the Feather River, some genetic introgression of the hatchery and wild races is expected to continue. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Central Valley spring-run Chinook salmon on September 2, 2005 (70 FR 52488). In total, Central Valley spring-run Chinook salmon occupy 37 watersheds (freshwater and estuarine). The total area of habitat designated as critical includes about 1,100 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisun Bay complex. Primary constituent elements include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing sites are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds which maintained cool and clean water throughout the summer. Freshwater rearing sites are degraded by floodplain habitat being disconnected from the mainstem of larger rivers throughout the Sacramento River watershed, reducing effective foraging. Migration sites are degraded by lack of natural cover along the migration corridors. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. Contaminants from agriculture and urban areas have degraded rearing and migration sites while they have lost their functions necessary to serve their intended role to conserve the species. Water quality impairments in the designated critical habitat of this ESU include fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, petroleum products, animal and human sewage, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. The condition of primary constituent elements for this ESU indicates they are not currently functioning or are degraded; these conditions are likely to maintain low population abundances across the ESU. A status review or viability assessment described the ESU as having a decreased risk of extinction.

## Lower Columbia River Chinook salmon

This Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon, east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River.

It is estimated that 31 independent Chinook salmon populations (22 fall- and late fall-runs and 9 spring- runs) are estimated to have existed historically in the Lower Columbia River. Of those 31 populations, it is estimated that 8-10 historic populations have been extirpated, most of them spring-run populations. Historically, the number of spring-run Chinook salmon returning to the Lower Columbia River may have almost equaled that of fall-run Chinook salmon. However, most of spring-run Lower Columbia River Chinook salmon populations are now extirpated and total returns are substantially lower for the fall-run component in recent years.

Historical records of Chinook salmon abundance are sparse. However, cannery records suggest a peak run of 4.6 million fish (43 million lbs) in 1883 (Lichatowich 1999). Recent trend indicators for most populations are negative. Most populations for which data are available have a long-term trend of less than one 1; indicating the population is not replacing itself and is in decline (Bennet 2005). Only the late-fall run population in Lewis River has an abundance and population trend that may be considered viable. The Sandy River is the only stream system supporting a natural production of spring-run Chinook salmon of any amount; however, the population is at risk from low abundance and negative to low population growth rates (McElhany 2007).

NOAA Fisheries listed Lower Columbia River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). This ESU was listed due to the combined effect of dams that prevent them from reaching spawning habitat, logging, agricultural activities, urbanization, threats to genetic diversity from hatchery salmon, and overexploitation. Though the basin wide spatial structure has remained intact, the loss of about 35 percent of historic habitat has affected distribution within several Columbia River subbasins. The ESU is at risk from low abundances in all but one population, combined with most populations having a negative or stagnant long-term population growth. Though fish from conservation hatcheries do help to sustain several Lower Columbia River Chinook salmon runs in the short-term, it is unlikely to result in sustainable wild populations in the long-term. Further, the genetic diversity of all populations (except the late fall-run) has been eroded by large hatchery influences. Having only one population that may be viable puts the ESU at considerable risk from environmental stochasticity and random catastrophic events. The near-loss of the spring-run life history type limits the ESU's ability to maintain its fitness in the face of environmental change. Based on these factors, this ESU would likely have a moderate (late fall-run salmon in Lewis River) to low (all other populations) resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Lower Columbia River Chinook salmon on September 2, 2005 (70 FR 52630). It includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood Rivers as well as specific stream reaches some tributary subbasins. Primary constituent elements include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Timber harvest, agriculture, and urbanization have degraded spawning and rearing sites by reducing floodplain connectivity and water quality, and by removing natural cover in several rivers. Hydropower development projects have reduced timing and magnitude of water flows, by altering the water quantity needed to form and maintain physical habitat conditions and support juvenile growth and mobility. Adult and juvenile migration sites are affected by several dams along the migration route. A status review or viability assessment described this species as stable / improving.

## Upper Columbia River Spring-run Chinook salmon

The Upper Columbia River spring-run Chinook salmon ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Six artificial propagation programs are part of this ESU.

NOAA Fisheries listed Upper Columbia River Spring-run Chinook salmon as endangered on March 24, 1999 (64 FR 14308) and reaffirmed their endangered status on June 28, 2005 (70 FR 37160). The ESU was listed due to the combined effect of dams that prevent them from reaching spawning habitat; habitat degradation from irrigation diversions, hydroelectric development, livestock grazing, and urbanization; and reduced genetic diversity from artificial propagation efforts. The reduced genetic diversity is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939-1943. Abundance data showed an increase in spawner returns in 2000 and

2001, though this increase was not sustained in subsequent years. Population viability analyses for this species (using the Dennis Model) suggest that these Chinook salmon face a significant risk of extinction: a 75 to 100 percent probability of extinction within 100 years (given return rates for 1980 to present). Based on these factors, this ESU would likely have a low resilience to additional perturbations.

The ESU historically consisted of four populations; of these, one is now extinct. Spawning escapements have declined within all extant populations (in Wenatchee, Entiat, and Methow rivers) since 1958. In the most recent 5-year geometric mean (1997 to 2001), spawning escapement for naturally produced fish was 273 for the Wenatchee population, 65 for the Entiat population, and 282 for the Methow population, only 8 percent to 15 percent of the minimum abundance thresholds. Escapement did increase substantially in 2000 and 2001 in all three river systems. Based on 1980 to 2004 returns, the average annual growth rate for this ESU is estimated at 0.93 (meaning the population is not replacing itself; Fisher and Hinrichsen 2006). If population growth rates were to continue at 1980 to 2004 levels, Upper Columbia River spring-run Chinook salmon populations are projected to have high probabilities of decline within 50 years.

NOAA Fisheries designated critical habitat for Upper Columbia River spring-run Chinook salmon on September 2, 2005 (70 FR 52630). The designation includes all Columbia River estuaries and river reaches upstream to Chief Joseph Dam and several tributary subbasins. Primary constituent elements include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing sites are degraded in tributary systems by urbanization, grazing, irrigation, and diversion. These activities have resulted in excess erosion of fine sediment and silt that smother spawning gravel and reduction in flow necessary for successful incubation, formation of physical rearing conditions, and juvenile mobility. Moreover, siltation further affects critical habitat by reducing water quality through contaminated agricultural runoff; and removing natural cover. Adult and juvenile migration sites are heavily degraded by Columbia River Federal dam projects and some mid-Columbia River Public Utility District dam projects also obstruct the migration corridor.  A status review or viability assessment described this species as stable.

### Puget Sound Chinook salmon

The Puget Sound Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula in Washington. Thirty-six hatchery populations were included as part of the ESU and five were considered essential for recovery and listed (spring-run salmon from Kendall Creek, North Fork Stillaguamish River, White River, and Dungeness River, and fall-run salmon from the Elwha River). On June 26, 2013, NOAA Fisheries proposed to change the number of artificial propagation populations considered to be part of the ESU to 27 (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), “Independent populations of Chinook salmon in Puget Sound” (Ruckelshaus et al. 2006), listing documents (63 FR 11482; 64 FR 14308; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Chinook salmon in this area Puget Sound populations include both early-returning (August) and late-returning (mid-September to October) Chinook salmon spawners (1991). However, within these generalized life histories, significant variation occurs in residence time in freshwater and estuarine environments. For example, Hayman et al. (1996) described three juvenile Chinook salmon life histories with varying residency times in the Skagit River system in northern Puget Sound return to freshwater habitats as three- to four-year-olds.

Puget Sound Chinook generally have an "ocean-type" life history. Puget Sound populations include both early-returning (August) and late-returning (mid-September to October) Chinook salmon spawners (Healey, 1991). However, within these generalized life histories, significant variation occurs in residence time in freshwater and estuarine environments. For example, Hayman et al. (1996) described three juvenile Chinook salmon life histories with varying residency times in the Skagit River system in northern Puget Sound. Puget Sound Chinook salmon return to freshwater habitats as three- to four-year-olds.

NOAA Fisheries listed Puget Sound Chinook salmon as threatened in 1999 (64 FR 14308) and reaffirmed its status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming, forest practices, agricultural practices, and urbanization; reduced genetic diversity from artificial propagation efforts; and overharvest. The spatial structure of the ESU is compromised by extinct and weak populations being disproportionably distributed to the mid- to southern Puget Sound and the Strait of Juan de Fuca. A large portion (at least 11) of the extant runs is sustained, in part, through artificial propagation. Of the populations with greater than 1,000 natural spawners, only two have a low fraction of hatchery fish. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by the disproportionate loss of the early fall-run life history. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Puget Sound Chinook salmon on September 2, 2005 (70 FR 52630). Specific geographic area include portions of the Nooksack River, Skagit River, Sauk River, Stillaguamish River, Skykomish River, Snoqualmie River, Lake Washington, Green River, Puyallup River, White River, Nisqually River, Hamma River and other Hood Canal watersheds, the Dungeness/Elwha Watersheds, and nearshore marine areas of the Strait of Georgia, Puget Sound, Hood Canal and the Strait of Juan de Fuca. Primary constituent elements include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Forestry practices have heavily impacted migration, spawning, and rearing sites in the upper watersheds of most rivers systems within critical habitat designated for the Puget Sound Chinook salmon. Degraded physical and biological features include reduced conditions of substrate supporting spawning, incubation and larval development caused by siltation of gravel, and degraded rearing habitat by removal of cover and reduction in channel complexity. Urbanization and agriculture in the lower alluvial valleys of mid- to southern Puget Sound and the Strait of Juan de Fuca have reduced channel function and connectivity, reduced available floodplain habitat, and affected water quality. Thus, these areas have degraded spawning, rearing, and migration sites. Hydroelectric development and flood control also obstruct Puget Sound Chinook salmon migration in several basins. The most functional physical and biological features are found in northwest Puget Sound: the Skagit River basin, parts of the Stillaguamish River basin, and the Snohomish River basin where federal land overlap with critical habitat designated for the Puget Sound Chinook salmon. However, estuary sites are degraded in these areas by reduction in the water quality from contaminants, altered salinity conditions, lack of natural cover, and modification and lack of access to tidal marshes and their channels. A status review or viability assessment described this species as stable / declining.

## Sacramento River Winter-Run Chinook salmon

The Sacramento River winter-run Chinook salmon ESU includes all naturally spawned populations of winter-run Chinook salmon entering and using the Sacramento River system in the Central Valley, California. The ESU now consists of a single spawning population. Two hatchery populations were included as part of the ESU, however on June 26, 2013, NOAA Fisheries proposed that one artificial propagation program be removed from the ESU, as the program has been terminated (78 FR 38270). We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (54 FR 32085, 55 FR 10260, 69 FR 33102, 70 FR 37160), the draft recovery plan (NMFS 2009a), the 5-year status review (NMFS 2011b), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

The winter-run Chinook salmon have characteristics of both stream- and ocean-type life histories. Adults enter freshwater in winter or early spring but delay spawning until late spring (May to June). Fry emerge from the gravel in late June to early July and continue through October (Fisher 1994). Young winter-run Chinook salmon start migrating to sea as early as mid-July with a peak movement over the Red Bluff Diversion Dam in September. Some offspring move downstream as fry while other rear in the upper Sacramento River and move down as smolt. Normally fry have passed the Red Bluff Diversion Dam by October while smolts may pass over the dam until March. Juvenile winter-runs occur in the Delta primarily from November through early May. Winter-run juveniles remain in the Delta until they are from 5 to 10 months of age, and then begin immigrating to the ocean as early as November and continue through May (Fisher 1994). Returning adults can be between two to six years old, but the majority return as three-year olds.

Construction of Shasta Dams in the 1940s eliminated access to historic spawning habitat for winter-run Chinook salmon. As a result, the ESU has been reduced to a single spawning population that is dependent on the availability of suitably cool water from Shasta Reservoir during periods of spawning, incubation and rearing. Winter-runs may have been as large as 200,000 fish based upon commercial fishery records from the 1870s (Fisher 1994). During the first three years of operation of the counting facility at the Red Bluff Diversion Dam (1967 to 1969), an average of 86,500 winter-run Chinook salmon were counted (CDFG 2008). Critically low levels were reached during the drought of 1987 to 1992 with a low point of 191 fish counted. The three-year average run size for the period of 1989 to 1991 was 388 fish. The population grew rapidly from the early 1990s to mid-2005; mean run size increased from 1,363 adults before 2000 to 8,470 adults between 2000 and 2006 (USFWS 2007). Abundance has declined in subsequent years (4,461 adults estimated for 2007 and a preliminary estimate between 2,600 to 2,950 adults for 2008 [USFWS 2008]) and the 10-year trend in abundance is negative.

The Sacramento River winter-run Chinook salmon ESU was first listed as threatened on August 4, 1989 under an emergency rule (54 FR 32085). On January 4, 1994, NOAA Fisheries reclassified the ESU as an endangered species because of several factors, including: (1) the continued decline and increased variability of run sizes since its listing as a threatened species in 1989; (2) the expected weak returns in coming years as the result of two small year classes (1991 and 1993); and (3) continuing threats to the species (59 FR 440). On June 14, 2004, NOAA Fisheries proposed to reclassify the ESU as threatened (69 FR 33102), but its status as endangered was upheld in the final listing determination on June 28, 2005 (70 FR 37160). Good et al. (2005) found the Sacramento River winter-run Chinook salmon ESU was in danger of extinction. The major concerns of the Biological Review Team were there was only one extant population, and it was spawning outside its historical range in artificially-maintained habitat that is vulnerable to drought and other catastrophes. Also, the ESU was expected to have lost some genetic diversity through bottleneck effects in the late 1980s and early 1990s, and hatchery releases may also have affected population genetics. Abundance data showed an increase in spawner returns from 1990s to mid-2005, though this increase was not sustained in subsequent years. The population growth rate for this ESU is negative, indicating the population has been declining and is not self-sustaining. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for this species on June 16, 1993 (58 FR 33212). The designation includes: the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the westward margin of the Sacramento-San Joaquin Delta, and other specified estuarine waters. Primary constituent elements include specific water temperature, minimum instream flow, and water quality standards. In addition, biological features vital for the ESU include unimpeded adult upstream migration routes, spawning habitat, egg incubation and fry emergence areas, rearing areas for juveniles, and unimpeded downstream migration routes for juveniles. As there is overlap in designated critical habitat for both the Sacramento River Winter-run Chinook salmon and the spring-run Chinook salmon, the conditions of the physical and biological features for both ESUs are similar. Spawning and rearing sites are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds where water maintain lower temperatures. Rearing sites are further degraded by floodplain habitat disconnected from the mainstems of larger rivers throughout the Sacramento River watershed. Migration sites are also degraded by the lack of natural cover along the migration corridors. Rearing and migration sites are further affected by pollutants entering the surface waters and river sediments as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. The current condition of primary constituent elements for the Sacramento River Winter-run Chinook salmon indicates that they are not currently functioning or are degraded. Their conditions are likely to maintain low population abundances across the ESU. A status review or viability assessment described this species as having an increased risk of extinction.

## Snake River Fall-Run Chinook salmon

The Snake River Fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam; and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. Four artificial propagation programs are included in the ESU. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), listing documents (57 FR 14653, 70 FR 37160), the 5-year status review (NMFS 2011c), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Before dam construction, fall Chinook salmon were primarily ocean-type; however, today both an ocean-type and reservoir-type occur (Connor et al. 2005). Adult ocean-type salmon in the ESU enter the Columbia River in July and August and spawn from October to November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early autumn. Reservoir-type juveniles overwinter in pools created by dams before migrating to sea; this response is likely because of early development in cooler temperatures, which prevents rapid growth. Phenotypic characteristics have shifted in apparent response to environmental changes from hydroelectric dams (Connor et al. 2005).

The Snake River fall-run Chinook salmon ESU consists of one extant population that is confined to a small fraction (15 percent) of its historic range. Two populations have been extirpated. Estimated annual returns for the period 1938 to 1949 were at 72,000 fish. By the 1950s, numbers had declined to an annual average of 29,000 fish (Bjornn and Horner 1980). Numbers of Snake River fall-run Chinook salmon continued to decline during the 1960s and 1970s as approximately 80 percent of their historic habitat were eliminated or severely degraded by constructing the Hells Canyon complex (1958 to 1967) and the lower Snake River dams (1961 to 1975). Natural-origin spawners of the ESU for 2001 (2,652 adults) exceeded 1,000 fish for the first time since counts began at the Lower Granite Dam in 1975. The recent five-year mean abundance of 871 naturally produced spawners during the 2011 status review generated concern that despite recent improvements, the abundance level is low for an entire ESU. However, during the years from 1975 to 2000, the ESU fluctuated between 500 to 1,000 natural spawners, which suggests a higher degree of stability in growth rate at low population levels than is seen in other salmonid populations. Further, numbers of natural-origin salmon in the ESU have increased over the last few years, with estimates at Lower Granite Dam of 2,652 fish in 2001, 2,095 fish in 2002, and 3,895 fish in 2003.

NOAA Fisheries listed Snake River fall-run Chinook salmon as endangered in 1992 (57 FR 14653), but reclassified their status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed because of habitat loss and degradation from the combined effects of damming; forest, agricultural, mining and wastewater management practices; and overharvest. Both long- and short-term trends in natural returns are positive. Productivity is likely sustained largely by a system of small artificial rearing facilities in the lower Snake River Basin. Depending upon the assumptions made regarding the reproductive contribution of hatchery fish, long- and short-term trends in productivity are at or above replacement. Low abundances in the 1990s combined with many hatchery derived spawners likely have reduced genetic diversity from historic levels; however, the salmon in this ESU remain genetically distinct from similar fish in other basins. Because the ESU's single population spawning activities are limited to a relatively short reach of the free flowing mainstem Snake River, it is at considerable risk from environmental variability and random events. The population remains at a moderate risk of becoming extinct (probability between 5 and 25 percent in 100 years). Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Snake River fall-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams. Specific primary constituent elements were not designated in the critical habitat final rule; instead four "essential habitat" categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The "essential features" that characterize these sites include substrate and spawning gravel; water quality, quantity, temperature, velocity; cover or shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors throughout the ESU's range. The major degraded essential habitat and features include: safe passage for juvenile migration; rearing habitat water quality; and spawning areas with gravel, water quality, cover or shelter, riparian vegetation, and space to support egg incubation and larval growth and development. Water quality impairments in the designated critical habitat are common within the range of this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and river sediments from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary. These pollutants combine and travel with contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. A status review or viability assessment described this species as improving.

### Snake River Spring/Summer-Run Chinook salmon

The Snake River Spring/Summer-run Chinook ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins. Fifteen artificial propagation programs are included in the ESU, however on June 26, 2013, NOAA Fisheries proposed the number of artificial propagation programs included in the ESU be changed to 11 (78 FR 38270). We used information available in status reviews

(Matthews and Waples 1991; Good et al. 2005), Interior Columbia Basin Technical Recovery Team reports (ICBTRT 2003), listing documents (57 FR 14653, 70 FR 37160), the 5-year status review (NMFS 2011c), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Snake River spring/summer-run Chinook salmon have a stream-type life history. Spring-run salmon of this ESU pass Bonneville Dam beginning in early March to mid-June and spawn from mid- to late August. Summer-run salmon return to the Columbia River from June through August and spawn approximately one month later than spring-run salmon. Summer-run salmon spawn lower in the Snake River drainages than spring-run fish; however, an overlap of summer-run and spring-run spawning areas does occur. In both run types eggs incubate over the winter, and hatch in late winter and early spring of the following year. Juvenile fish mature in freshwater for one year before they migrate to the ocean in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

The Interior Columbia Basin Technical Recovery Team has identified 32 populations in five major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct. The status review reports that total annual salmon production of this ESU may have exceeded 1.5 million adults in the late 1800s. Total (natural plus hatchery origin) returns fell to roughly 100,000 spawners by the late 1960s (Fulton 1968). Abundance of summer run Chinook salmon have increased since low returns in the mid-1990s (lowest run size was 692 fish in 1995). The 1997 to 2008 geometric mean total return for the summer run component at Lower Granite Dam was slightly more than 8,700 fish, compared to the geometric mean of 3,076 fish for the years 1987 to 1996 (Data from Columbia Basin Fisheries Agencies and Tribes http://www.fpc.org/). However, over 80 percent of the 2001 return and over 60 percent of the 2002 return originated from hatcheries.

NOAA Fisheries listed Snake River spring/summer-run Chinook salmon as threatened on April 22, 1992 (57 FR 14653) and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; forest, agricultural, mining, and wastewater management practices; overharvest; and artificial propagation. There is no obvious long-term positive trend, though recent trends are approaching 1, indicating the population is nearly replacing itself. Risks to individual populations within the ESU may be greater than the extinction risk for the entire ESU due to low levels of annual abundance of individual populations. Multiple spawning sites are accessible and natural spawning and rearing are well distributed within the ESU. However, many spawning aggregates have also been extirpated, which has increased the spatial separation of some populations. The South Fork and Middle Fork Salmon Rivers currently support most natural production in the drainage. There is no evidence of wide-scale genetic introgression by hatchery populations. The high variability in life history traits indicates sufficient genetic variability within the ESU to maintain distinct subpopulations adapted to local environments. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Snake River spring/summer-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Specific primary constituent elements were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The "essential features" that characterize these sites include substrate and spawning gravel; water quality, quantity, temperature, velocity; cover or shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors in some regions. The Interior Columbia Basin Technical Recovery Team reports the Panther Creek population was extirpated because of legacy and modern mining-related pollutants that created a chemical barrier to fish passage. Water quality impairments are common in the range of the critical habitat designated for this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and river bottom substrate from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and by point source discharges. A status review or viability assessment described this species as stable.

## Upper Willamette River spring Chinook salmon

The Upper Willamette River Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Seven artificial propagation programs are included in the ESU, however on June 26, 2013, NOAA Fisheries proposed to change the number of artificial propagation programs included in the ESU to six (78 FR 38270). We used information available in status reviews (Good et al. 2005; NMFS 2011d), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), listing documents (64 FR 14308, 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Upper Willamette River Chinook salmon are a spring-run, stream-type salmon. Adults appear in the lower Willamette River in February, but most of the run ascends Willamette Falls in April and May, with a peak in mid- to late May. Present-day salmon ascend the Willamette Falls by a fish ladder. Migrating spring Chinook salmon over Willamette Falls extends into July and August and overlaps with the beginning of the introduced fall-run of Chinook salmon. The adults hold in deep pools over summer and spawn from August to October, with a peak in September. Fry emerge from December to March and juvenile migration varies among three distinct emigration "runs": fry migration in late winter and early spring; sub-yearling (0 yr. +) migration in fall to early winter; and yearlings (1 yr. +) migrating in late winter to spring. Sub-yearlings and yearlings rear in the mainstem Willamette River where they also use floodplain wetlands in the lower Willamette River during the winter-spring floodplain inundation period. Fall-run Chinook salmon spawn in the Upper Willamette but are not considered part of the ESU because they are not native. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

Historically, this ESU included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Most natural spring-run Chinook salmon populations of this ESU are likely extirpated or nearly so; the spring-run in the McKenzie River is the only known remaining naturally reproducing population in this ESU. The total abundance of adult spring-run Chinook salmon (hatchery-origin + natural-origin fish) passing Willamette Falls has remained fairly steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish). However, the current abundance is an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults). Total number of fish increased during the period from 1996 to 2004 when it peaked at more than 96,000 adult spring-run Chinook salmon passing Willamette Falls. Since then, the run has steadily decreased with only about 14,000 fish counted in 2008, the lowest number since 1960. ESU abundance increased again to about 25,000 adult spring-run Chinook salmon in 2009. Runs consist of a high, but uncertain, fraction of hatchery-produced fish.

NOAA Fisheries listed Upper Willamette River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; agricultural practices; urbanization; overharvest; and artificial propagation. The McKenzie River population is the only remaining self-sustaining naturally reproducing independent population. The other natural-origin populations in this ESU have low current abundances, and long- and short-term population trends are negative. The spatial distribution of the species has been reduced by the loss of 30 to 40 percent of the total historic habitat. This loss has restricted spawning to a few areas below dams. Access of fall-run Chinook salmon to the upper Willamette River and the mixing of hatchery stocks within the ESU have threatened the genetic integrity and diversity of the species. Much of the genetic diversity that existed between populations has been homogenized. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for this species on September 2, 2005 (70 FR 52630). Designated critical habitat includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in some sub-basins. Primary constituent elements include freshwater spawning and rearing sites, freshwater migration corridors. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Migration corridors are degraded by dams altering migration timing and water management altering the water quantity necessary for mobility and survival. Migration, rearing, and estuary sites are also degraded by loss of riparian vegetation and in-stream cover. Pollutants such as petroleum products, fertilizers, pesticides, and fine sediment enter the stream through runoff, point source discharge, drift during application, and non-point discharge where agricultural and urban development occurs. Degraded water quality in the lower Willamette River where important floodplain rearing habitat is present affects the ability of this habitat to sustain its role to conserve the species. The current condition of primary constituent elements identified in this critical habitat indicate that migration corridors and rearing sites are not currently functioning or are degraded and impact their ability to serve their intended role for species conservation.  A status review or viability assessment described this species declining.

## *Chum salmon - Oncorhynchus keta*

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed chum salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews (Johnson et al. 1997; Good et al. 2005), various listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Because their range extends farther along the shores of the Arctic Ocean than other Pacific salmonid, chum salmon have the widest natural geographic and spawning distribution of the Pacific salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean to Monterey Bay, California.

Historically, chum salmon were distributed throughout the coastal regions of western Canada and the U.S. Presently, major spawning populations occur as far south as Tillamook Bay on the northern Oregon coast.

In general, North American chum salmon migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. Chum salmon usually spawn in the lower reaches of rivers during summer and fall. Redds are dug in the mainstem or inside channels of rivers from just above tidal influence to nearly 100 km from the sea. The time to hatching and emergence from the gravel redds are influenced by dissolved oxygen (DO), gravel size, salinity, nutritional conditions, behavior of alevins in the gravel, and incubation temperature (Bakkala 1970; Salo 1991; Schroder 1977). Chum salmon juveniles use shallow, low flow habitats for rearing that include inundated mudflats, tidal wetlands and their channels, and sloughs. The duration of estuarine residence for chum salmon juveniles are known for only a few estuaries. Observed residence time ranged from 4 to 32 days, with about 24 days as the most common.

Immature salmon distribute themselves widely over the North Pacific Ocean and maturing adults return to the home streams at various ages, usually at two to five years old, and sometimes up to seven years (Bigler, 1985). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus Oncorhynchus (steelhead, coho, and most types of Chinook and sockeye salmon). Stream-type salmonids usually migrate to sea at a larger size, after months or years of freshwater rearing. Thus, survival and growth for juvenile chum salmon depend less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and other salmonid species is that chum salmon form schools. Presumably, this behavior reduces predation (Pitcher 1986) especially if fish movements are coordinated to swamp predators (Miller and Brannon 1982). All chum salmon are semelparous (they die after spawning) and exhibit obligatory anadromy (there are no recorded landlocked or naturalized freshwater populations; they must spend portions of their lives in both salt and freshwater habitats).

Chum salmon feed on various prey organisms depending upon life stage and size. In freshwater chum salmon feed primarily on small invertebrates; in saltwater, their diet consists of copepods, tunicates, mollusks, and fish.

On June 28, 2005, as part of the final listing determinations for 16 ESUs of west coast salmon, NOAA Fisheries amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At designation, primary constituent elements are identified and include sites necessary to support one or more chum salmon life stages. For both ESUs discussed below, primary constituent elements include freshwater spawning, rearing, and migration areas; estuarine and nearshore marine areas free of obstructions; and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat designation identified for each ESU contains additional details on the areas included as part of the designation, and the areas that were excluded from designation.

## Columbia River Chum Salmon

The Columbia River chum salmon ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon. Three artificial propagation programs are part of the ESU. We used information available in status reviews (Good et al. 2005; Ford 2011; NMFS 2011a), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Salmon of this ESU return to the Columbia River from mid-October to November and spawning occurs from early November to late December. Adults spawn in the lower reaches of rivers, digging redds along the edges of the mainstem and in tributaries or side channels. Some spawning sites are located in areas where geothermally-warmed groundwater or mainstem flow upwells through the gravel. Chum salmon fry emigrate to estuaries from March through May shortly after emergence. Like ocean-type Chinook salmon, juvenile chum salmon rear in estuaries for weeks to months before beginning their long-distance oceanic migration, primarily from February to June. The period of estuarine residence is a critical life history phase and plays a major role in determining the size of the subsequent adult run back to freshwater. Chum salmon remain in the North Pacific and Bering Sea for 2 to 6 years, with most adults returning to the Columbia River as 4-year-olds.

Historically, the ESU was composed of 17 populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Of these populations, 15 of them (six in Oregon and nine in Washington) are so depleted that either their baseline probability of persistence is low or they are extirpated or nearly so. An extensive 2000 survey in Oregon streams supports that chum salmon are extirpated from the Oregon portion of this ESU. Over the last century, Columbia River chum salmon returns have collapsed from hundreds of thousands to just a few thousand a year. Only two populations (Grays River and the Lower Gorge) with any significant spawning remain today, both in Washington. The estimated size of the Lower Gorge population is at 400 to 500 individuals, down from a historical level of greater than 8,900. A significant increase in spawner abundance occurred in 2001 and 2002 to around 10,000 adults. However, spawner surveys indicate the abundance again decreased to low levels during 2003 through 2008 though the spawner surveys may underestimate abundance because the proportion of tributary and mainstem spawning differ between years and the surveys do not include spawners in the Columbia River mainstem. In the 1980s, estimates of the Grays River population ranged from 331 to 812 individuals. However, the population increased in 2002 to as many as 10,000 individuals. Based on data for number of spawners by river mile, this increase continued through 2003 and 2004. However, fish abundance fell again to less than 5,000 fish during the years 2005 through 2008.

NOAA Fisheries listed Columbia River chum salmon as threatened on March 25, 1999 (64 FR 14508) and reaffirmed their status on June 28, 2005 (71 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; and overharvest. Much of the historical spatial structure has been lost on both the population and the ESU levels by extirpation (or near-extirpation) of many local stocks and the widespread loss of estuary habitats. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations, both of which have long- and short-term productivity trends at or below replacement. Limited distribution also increases risk to the ESU from local disturbances. Although hatchery production of chum salmon has been limited and hatchery effects on diversity are thought to have been fairly small, diversity has been reduced at the ESU level because of presumed extirpations and the low abundance in the remaining populations (fewer than 100 spawners by year for most populations). Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries originally designated critical habitat for Columbia River chum salmon on February 16, 2000 (65 FR 7764); critical habitat was re-designated on September 2, 2005 (70 FR 52630). Designated critical habitat includes areas in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Lower Cowlitz, and Lower Columbia subbasin and river corridor. Primary constituent elements for this ESU include freshwater spawning sites, rearing sites, and migration corridors; estuarine areas; near shore marine areas; and offshore marine areas. Limited information exists on the quality of essential habitat characteristics for this ESU. However, it is apparent that migration corridors have been significantly impacted by dams obstructing adult migration and access to historic spawning locations. Water quality and cover for estuary areas and freshwater rearing sites have decreased in quality to the extent the primary constituent elements are not likely to maintain their intended function to conserve the species. A status review or viability assessment described this species as stable.

## Hood Canal Summer-run chum salmon

The Hood Canal summer-run chum salmon ESU includes all naturally spawned populations in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. Eight artificial propagation programs are included in the ESU, however on June 26, 2013, NOAA Fisheries proposed to change the number of artificial propagation programs included in the ESU to four (78 FR 38270). We used information available in status reviews (Good et al. 2005; NMFS 2011e), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Salmon of this ESU enter natal rivers from late August until October (Washington Department of Fisheries and Wildlife and Western Washington Treaty Indian Tribes 1993) and spawning occurs from mid-September through mid-October. Adults spawn in low gradient, lower mainstem reaches of natal streams, typically in center channel areas due to the low flows encountered in the late summer and early fall and fry emerge between January and May. After hatching, fry move rapidly downstream to subestuarine habitats where they rear for an average of 23 days before entering the ocean. Summer-run chum salmon have a longer incubation time than fall-run chum salmon in the same streams. Consequently, offspring of summer-run chum salmon have lower average weight and less lipid content than offspring of fall-run chum salmon. Thus, prey availability during their early life history is important for fry survival. Most adult salmon of this ESU return from the ocean to spawn as three- and four-year old fish.

Historically, this ESU consisted of two independent populations (the Strait of Juan de Fuca and Hood Canal populations) that, together, contained an estimated 16 stocks (Sands et al. 2007). Of the 16 historic stocks, seven are considered extirpated, primarily from the eastern side of Hood Canal. Of the extant Strait of Juan de Fuca stocks, three spawn in rivers and streams entering the eastern Strait of Juan de Fuca and Admiralty Inlet. The Hood Canal population consists of six extant stocks within the Hood Canal watershed. Hood Canal summer-run chum salmon are part of an extensive rebuilding program developed and implemented in 1992 by state and tribal co-managers. The largest supplemental program occurs at the Big Quilcene River fish hatchery.

Reintroduction programs occur in Big Beef (Hood Canal population) and Chimacum (Strait of Juan de Fuca population) creeks. Adult returns for some of the HC summer-run chum salmon stocks showed modest improvements in 2000, with upward trends continuing in 2001 and 2002. The recent five-year mean abundance is variable among stocks, ranging from one fish to nearly 4,500 fish. Productivity in the last 5-year period (2005-2009) has been low, especially compared to the high productivity observed during the 5-10 previous years (1994-2004).

NOAA Fisheries listed Hood Canal summer-run chum salmon as threatened on March 25, 1999 (64 FR 14508), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; overharvest; and artificial propagation. Much of the historical spatial structure and connectivity has been lost on both the population and the ESU levels by extirpation of many local stocks and the widespread loss of estuary and lower floodplain habitats. Long-term trends in productivity are above replacement only for the Quilcene and Union River stocks; however, most stocks remain depressed. The overall trend in spawning abundance is stable (meaning adults are replacing themselves) for the Hood Canal population (all natural spawners and natural-origin only spawners) and for the Strait of Juan de Fuca population (all natural spawners). Only the Strait of Juan de Fuca population's natural-origin only spawners shows a significant positive trend. Estimates of the fraction of naturally spawning hatchery fish exceed 60 percent for some stocks, which indicates that reintroduction programs are supplementing the numbers of total fish spawning naturally in streams. There is also concern the Quilcene hatchery stock has high rates of straying and may represent a risk to historical population structure and diversity. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Hood Canal summer-run chum salmon on September 2, 2005 (70 FR 52630). Designated critical habitat includes the Skokomish River, Hood Canal subbasin, which includes the Hamma and Dosewallips rivers and others, the Puget Sound subbasin, Dungeness/Elwha subbasin, and nearshore marine areas of Hood Canal and the Strait of Juan de Fuca. This includes a narrow nearshore zone within several Navy security and restricted zones and approximately eight miles of habitat that was unoccupied at the designation (including Finch, Anderson and Chimacum creeks), but has been reseeded. Primary constituent elements for this ESU are as described for Columbia River chum salmon. Freshwater spawning sites are degraded by excessive fine sediment in the gravel and the rearing sites are degraded by loss of access to sloughs in the estuary and nearshore areas and excessive predation. Low flow in several rivers also adversely affects most primary constituent elements. In estuarine areas, both migration corridors and rearing sites for juveniles are impaired by loss of functional floodplain areas necessary for growth and development of juvenile chum salmon. These degraded conditions likely maintain low population abundances across the ESU. A status review or viability assessment described this species as improving.

## Coho salmon - *Oncorhynchus kisutch*

The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan.

Coho salmon exhibit a stream-type life history. Most coho salmon enter rivers between September and February. In many systems, coho salmon wait to enter until fall rainstorms have provided the river with sufficiently strong flows and depth. Coho salmon spawn from November to January, and occasionally into February and March. Some spawning occurs in third-order streams, but most spawning activity occurs in fourth- and fifth-order streams with gradients of 3 percent or less. After fry emerge in spring, they disperse upstream and downstream to establish and defend territories with weak water currents such as backwaters and shallow areas near stream banks. Juveniles rear in these areas during the spring and summer. In early fall juveniles move to river margins, backwater, and pools. During winter juveniles typically reduce feeding activity and growth rates slow down or stop. By March of their second spring, juveniles feed heavily on insects and crustaceans and grow rapidly before smoltification and outmigration (Olegario 2006). Coho salmon smolts usually spend a short time (one to three days) in the estuary with little feeding (Thorpe 1994; Miller and Sadro 2003). After entering the ocean, immature coho salmon initially remain in nearshore waters close to the parent stream. North American coho salmon will migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. During this migration, juvenile coho salmon occur in both coastal and offshore waters.

Along the Oregon/California coast, coho salmon primarily return to rivers to spawn as three-year olds, having spent approximately 18 months rearing in freshwater and 18 months in salt water. In some streams, a smaller proportion of males may return as two-year olds. The presence of two-year old males can allow for substantial genetic exchange between brood years. The rather fixed three-year life cycle exhibited by female coho salmon limits demographic interactions between brood years. This makes coho salmon more vulnerable to environmental perturbations than other salmonids that exhibit overlapping generations, such as, the loss of a coho salmon brood year in a stream is less likely than for other Pacific salmon to be reestablished by females from other brood years. All coho salmon are semelparous and anadromous.

Coho salmon feed on various prey organisms depending upon life stage and size. While at sea, coho salmon eat fish including herring, sand lance, sticklebacks, sardines, shrimp and surf smelt. While in estuaries and in freshwater coho salmon are significant predators of Chinook, pink, and chum salmon, as well as aquatic and terrestrial insects. Smaller fish, such as fry, eat chironomids, plecoptera and other larval insects, and typically use visual cues to find their prey.

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NOAA Fisheries amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

## Central California coast Coho salmon

The central California coast coho salmon ESU includes all naturally spawned populations of coho salmon from Punta Gorda in northern California south to and including the San Lorenzo River in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. The ESU also includes four artificial propagation programs. We used information available in status reviews (Weitkamp et al. 1995; Good et al. 2005; NMFS 2011f; Spence and Williams 2011), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-central California coast Recovery Domain" (Bjorkstedt et al. 2005), listing documents (60 FR 38011; 61 FR 56138; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Both run and spawn timing of coho salmon in this region are late (both peaking in January) northern populations, with little time spent in freshwater between river entry and spawning. Spawning runs coincide with the brief peaks of river flow during the fall and winter. Most juveniles of this ESU undergo smoltification and start their seaward migration one year after emergence from the redd. Juveniles spending two winters in freshwater have, however, been observed in at least one coastal stream within the range of the ESU. Smolt outmigration peaks in April and May (Shapovalov and Taft 1954). In general, coho salmon within California exhibit a three-year life cycle. However, two-year old males commonly occur in some streams.

The ESU consisted historically of 11 functionally independent populations and a larger number of dependent populations. One of the two historically independent populations in the Santa Cruz Mountains (south of the Golden Gate Bridge) is extirpated. Coho salmon are considered effectively extirpated from the San Francisco Bay. The Russian River population, once the largest and most dominant source population in the ESU, is now at high risk of extinction because of low abundance and failed productivity. The Lost Coast to Navarro Point to the north contains most coho salmon remaining in the ESU.

Limited information exists on abundance of coho salmon for this ESU. About 200,000 to 500,000 coho salmon were produced statewide in the 1940s. This escapement declined to about 99,000 by the 1960s with approximately 56,000 (56 percent) originating from streams within this ESU. The estimated number of coho salmon produced within the ESU in the late 1980s had further declined to 6,160 (46 percent of the estimated statewide production). Additionally, information on the abundance and productivity trends for the naturally spawning component of this ESU is limited. There are no long-term time series of spawner abundance for individual river systems. Returns increased in 2001 in streams within the northern portion of the ESU; however, returns in 2006/07 and 2007/08 were low (McFarlane et al. 2008) and about 500 fish returned in 2010 across the entire range. Hatchery raised smolt have been released infrequently but occasionally in large numbers in rivers throughout the ESU. Releases have included transfer of stocks within California and between California and other Pacific states as well as smolt raised from eggs collected from native stocks.

NOAA Fisheries listed the central California coast coho salmon ESU as threatened on October 31, 1996 (61 FR 56138) and later reclassified their status as endangered on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; urbanization; stream channelization; damming; wetland loss; overharvest; artificial propagation; and prolonged drought and poor ocean conditions. ESU spatial structure has been substantially modified due to lack of viable source populations and loss of dependent populations. Limited information exists on abundance for central California coast coho salmon; therefore, the best data available are presence-absence surveys used as a proxy for abundance changes. As of the 1996 listing, coho salmon occurred in 47 percent of streams (62) and were considered extirpated from 53 percent (71) of streams that historically harbored coho salmon within the ESU (Brown et al. 1994). Later reviews have concluded the number of occupied streams relative to historic has not changed and may have declined. Additionally, the low rates of return from 2006 to 2010 suggest that all three year classes are faring poorly across the species' range. Though hatchery salmon have been released, genetic studies show little homogenization of populations (transfer of stocks between basins) has had little effect on the geographic genetic structure of the ESU (SCWA 2002). Salmon in this ESU likely have considerable diversity in local adaptations given the ESU spans a large latitudinal diversity in geology and ecoregions, and include both coastal and inland river basins. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for central California coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes accessible reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and the San Lorenzo River (inclusive) in California. Critical habitat for this species also includes two streams entering San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek. Specific primary constituent elements were not designated in the critical habitat final rule; instead five "essential habitat" categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The "essential features" that characterize these sites include adequate 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover or shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. NMFS (2008a) evaluated the condition of each habitat feature at its current condition relative to its role and function in conserving the species. Assessing the habitat showed a distinct trend of increasing degradation in quality and quantity of all essential features as the habitat progresses south through the species range, with the area from the Lost Coast to the Navarro Point supporting the most favorable habitats and the Santa Cruz Mountains supporting the least. However, habitat of all populations is degraded in terms of spawning and incubation substrate, and juvenile rearing habitat. Elevated water temperatures occur in many streams across the entire ESU. A status review or viability assessment described this species as "no change".

## Lower Columbia River Coho salmon

The lower Columbia River coho salmon ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Oregon and Washington, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, Washington; and the Willamette River to Willamette Falls, Oregon. This ESU includes 25 artificial propagation programs, however on June 26, 2013, NOAA Fisheries proposed the number of artificial propagation programs included in the ESU be changed to 23 (78 FR 38270). We used information available in status reviews (Johnson et al. 1991; Good et al. 2005; Ford 2011; NMFS 2011a), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), "Viability status of Oregon salmon and steelhead populations in the Willamette and lower Columbia basins (McElhany et al. 2007), listing documents (70 FR 37160; 78 FR 2725), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Most of the Lower Columbia River coho salmon are of hatchery origin. Hatchery runs are managed for two distinct runs: early-returning and late-returning. Early-returning coho salmon return to the Columbia River in mid-August and to spawning tributaries in early September, with peak spawning from mid- October to early November. Late-returning coho salmon return from late September through December and enter spawning tributaries from October through January. Most late-returning spawning occurs from November through January. Fry emerge from redds during a three-week period between early March and late July. Juveniles rear in freshwater for a year and smolt outmigration occurs from April through June with a peak in May. Juvenile coho are present in the Columbia River estuary from March to August. In general, salmon of this ESU return to freshwater as three-year-olds. Analysis of run timing of coho salmon suggests the Clackamas River population is composed of one late returning population and one early returning population. The late-returning population is believed to be descended from the native Clackamas River population and the early-returning population is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River basin. The naturally produced coho salmon return to spawn between December and March.

The ESU historically consisted of 24 independent populations. The vast majority (over 90 percent) of these are either extirpated or nearly so. Of the 24 populations, only two have significant natural production: the Sandy and Clackamas Rivers. Wild coho salmon reappeared in two additional basins (Scappoose and Clatskanie) after a 10-year period during the 1980s and 1990s when they were largely absent. Before 1900, the Columbia River had an estimated annual run of more than 600,000 adults with about 400,000 spawning in the lower Columbia River. By the 1950s, the estimated number of coho salmon returning to the Columbia River had decreased to 25,000 adults (about five percent of historic levels). Massive hatchery releases since 1960 have increased the Columbia River run size. Between 1980 and 1989, the run varied from 138,000 adults to a historic high of 1,553,000 adults. However, only a small portion of these spawned naturally, and available information indicates the naturally produced portion has continuously declined since the 1950s. The current number of naturally spawning fish during October and late November ranges from 3,000 to 5,500 fish. Most of these are of hatchery origin. The 1996 to 1999 geometric mean for the late run in the Clackamas River, the only-run which is considered consisting mainly of native coho salmon, was 35 fish. Both long- and short-term trends and median population growth rate for the natural origin (late-run) portion of the Clackamas River coho salmon are negative but with large confidence intervals. The short-term trend for the Sandy River population is close to 1, indicating a relatively stable population during the years 1990 to

2002. The long-term trend for this same population shows the population has been decreasing (trend = 0.54) and there is a 43 percent probability the median population growth rate was less than one.

NOAA Fisheries listed Lower Columbia River coho salmon as threatened on June 28, 2005 (70 FR 37160). Lower Columbia River coho salmon have been and continue to be affected by habitat degradation, hydropower impacts, harvest, and hatchery production. Out of the 24 populations that make up this ESU, 21 are considered to have a low probability of persisting for the next 100 years, and none is considered viable. The low persistence probability for most Lower Columbia River coho salmon populations is related to low abundance and productivity, loss of spatial structure, and reduced diversity. Though data quality has been poor because of inadequate spawning surveys and, until recently, the presence of unmarked hatchery-origin spawners, most populations are believed to have low abundance of natural-origin spawners (50 fish or fewer). The spatial structure of some populations is constrained by migration barriers (such as tributary dams) and development in lowland areas. Low abundance, past stock transfers, other legacy hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among coho salmon populations. It is likely that hatchery effects have also decreased population productivity. The poor baseline population status of coho salmon reflects long-term trends: natural-origin coho salmon in the Columbia Basin have been in decline for the last 50 years. Based on these factors, this ESU would likely have low resilience to additional perturbations.

NOAA Fisheries proposed critical habitat designation of approximately 2,288 miles of freshwater and estuarine habitat in Oregon and Washington on January 14, 2013 (78 FR 2725). A final designation has not been made.  A status review or viability assessment described this species as stable / improving.

## Southern Oregon/Northern California Coast Coho salmon

The Southern Oregon/Northern California Coast coho salmon ESU consists of all naturally spawning populations of coho salmon that reside below long-term, naturally impassible barriers in streams between Punta Gorda, California and Cape Blanco, Oregon. This ESU also includes three artificial propagation programs. We used information available in status reviews (Good et al. 2005; NMFS 2011h; Williams et al. 2011), the draft recovery plan (NMFS 2012b), listing documents (62 FR 24588; 70 FR 37160), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

In this ESU, river entry occurs earlier in the north and later in the south. In Oregon, salmon of this ESU enter rivers in September or October; south of the Klamath River Basin to the Mattole River, California salmon entry occurs in November and December; and river entry occurs from mid-December to mid-February in rivers farther south. Because coho salmon enter rivers late and spawn late south of the Mattole River, they spend much less time in the river before spawning compared to populations farther north. Juveniles emerge from the gravel in spring, and typically spend a summer and winter in freshwater before migrating to the ocean as smolts in their second spring. coho salmon adults spawn at age three, spending about a year and a half in the ocean.

Data on population abundance and trends are limited for this ESU. Historical point estimates of coho salmon abundance for the early 1960s and mid-1980s suggest that California statewide coho spawning escapement in the 1940s ranged between 200,000 and 500,000 fish. Numbers declined to about 100,000 fish by the mid-1960s with about 43 percent originating from this ESU. In 1994, Brown et al. estimated that about 7,000 wild and naturalized coho salmon were produced in the California portion of this ESU. Though long-term data on salmon abundance are rare, the available monitoring data indicate that spawner abundance has declined for populations in this ESU. The Shasta River population has declined in abundance by almost 50 percent from one generation to the next. Two partial counts from Prairie Creek, a tributary of Redwood Creek, and

Freshwater Creek, a tributary of Humboldt Bay show negative trends, and data from the Rogue River basin also show recent negative trends. Estimates from Huntley Park in the Rogue River basin show a strong return year of approximately 25,000 spawners in 2004, followed by a decline to 2,566 fish in 2009. The 12-year average estimated wild adult coho salmon in the Rogue River basin between 1998 and 2009 (excluding 2008)7 is 8,050 fish. Based on extrapolations from cannery pack, the Rogue River had an estimated adult coho salmon abundance of 114,000 in the late 1800s (Meengs and Lackey 2005).

NOAA Fisheries listed the Southern Oregon/Northern California coast coho salmon as threatened on May 7, 1997 (62 FR 24588) and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed because of habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; road building; urbanization; stream channelization; damming; wetland loss; beaver trapping, water withdrawals; overharvest; drought; flooding; poor ocean conditions and El Niño; and artificial propagation. Though distribution has been reduced and fragmented within the ESU, extant populations can still be found in all major river basins within the ESU. Presence-absence data indicate a disproportionate loss of southern populations compared to the northern portion of the ESU. Though long-term data on salmon abundance are scarce, the available monitoring data indicate that spawner abundance has declined for populations in this ESU. Many populations have been extirpated, are near extirpation, or are severely depressed. Based on available data, the draft recovery plan (NMFS 2012b) concluded that this ESU is at high risk of extinction and is not viable. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Southern Oregon/Northern California Coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes all accessible river reaches between Cape Blanco, Oregon, and Punta Gorda, California and consists of the water, substrate, and river reaches (including off-channel habitats) in specified areas. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Specific primary constituent elements were not designated in the critical habitat final rule; instead five "essential habitat" categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The "essential features" that characterize these sites include adequate: 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover or shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. Critical habitat designated for this ESU is of good quality in northern coastal streams. Spawning essential habitats have been degraded throughout the ESU by logging activities that have increased fine particles in spawning gravel. Rearing essential habitats have been degraded in many inland watersheds from the loss of riparian vegetation resulting in unsuitably high water temperatures. Rearing and juvenile migration essential habitat quality has been reduced from the disconnection of floodplains and off-channel habitat in low gradient reaches of streams, consequently reducing winter rearing capacity. A status review or viability assessment described this species as "no change".

## Oregon Coast Coho salmon

The Oregon Coast coho salmon ESU includes all naturally spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco (63 FR 42587). One hatchery population, the Cow Creek hatchery coho salmon, is considered part of the ESU. We used information available in the status review (Good et al. 2005), "Scientific conclusions of the status review for Oregon coast coho salmon (Oncorhynchus kisutch)" (Stout et al. 2012).

"Identification of historical populations of coho salmon (Oncorhynchus kisutch) in the Oregon Coast Evolutionarily Significant Unit" (Lawson et al. 2007), listing documents (63 FR 42587; 73 FR 7816), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

In general, adults begin to migrate into rivers at the first fall freshet, usually in late October or early November, though there is some variation in run timing among watersheds. A delay in rain can delay river entry. Some coho may spend up to two months in freshwater before spawning. Spawning usually occurs from November through January and may continue into February. Juveniles emerge from the gravel in spring and typically spend a summer and winter in freshwater before migrating to the ocean as smolts, usually in April or May of their second spring. Timing varies between years, among river systems, and based on small-scale habitat variability. Salmon in this ESU exhibit a three-year life cycle, though two- year-old males commonly occur in some streams and on average make up 20 percent of spawning males.

Lawson et al. (2007) considered the ESU to have historically consisted of 13 functionally independent populations and eight potentially dependent populations. Historical escapement in the 10 largest basins has been estimated to about 2.4 to 2.9 million spawners. The estimated median population of native spawners during the years 1990 to 1999 was 46,291 (min. 21,139, max. 82,661) spawners. After 1999, total ESU abundance increased. A median of 186,769 native spawners was estimated for the period 2000 through 2012 (min. 66,271, max. 356,243) (Oregon Department of Fish and Wildlife 2013). The encouraging increases in spawner abundance in 2000–2002 were preceded by three consecutive brood years (the 1994–1996 brood years returning in 1997–1999, respectively) exhibiting recruitment failure. As of the 2005 status report, these three years of recruitment failure were the only such instances observed in the abundance time series since 1950. The increases in natural spawner abundance from 2000-2002 increases were primarily observed in populations in the northern portion of the ESU. Despite the increase in spawner abundance in 2000–2002, the long-term trends in ESU productivity remained negative because of the low abundances observed during the 1990s. Recent data indicate the total abundance of natural spawners in the Oregon coast coho salmon ESU again steadily decreased until 2007 with an estimated spawner abundance of 66,271 fish or approximately 25 percent of the 2002 peak abundance (258,418 spawners) (Oregon Department of Fish and Wildlife 2013). Thus, recruitment failed during the five years from 2002 through 2007. Abundance increased each year from 179,686 native spawners in 2008 to the highest recorded abundance of native spawners in the time series: 356,243 native spawners in 2012; however, abundance in 2012 was estimated at 99,142 native spawners, indicating another recruitment failure.

NOAA Fisheries listed the Oregon coast coho salmon as a threatened species on February 11, 2008 (73 FR 7816). The ESU was listed because its biological status had not improved since NOAA Fisheries January 19, 2006 determination the ESU's listing was not warranted (71 FR 3033) and current efforts being made to protect the species did not provide sufficient certainty of implementation or effectiveness to mitigate the assessed extinction risk. Current coho salmon coastal distribution has not changed markedly compared to historical distribution; however, river alterations and habitat destruction have significantly modified use and distribution within several river basins. Genetic diversity has been reduced by legacy effects of freshwater and tidal habitat loss, low spawner returns within the past 20 years, and past high levels of hatchery releases; however, with recent reductions in hatchery releases, diversity should improve. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Oregon Coast coho salmon on February 11, 2008 (73 FR 7816). The designation includes 72 of 80 watersheds within the range of the ESU, totals approximately 6,600 stream miles, and includes all or portions of the Nehalem, Nestucca/Trask, Yaquina, Alsea, Umpqua, and Coquille basins. Primary constituent elements include: spawning sites with water and substrate quantity to support spawning, incubation, and larval development; freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth, foraging, behavioral development (predator avoidance, competition), and mobility; freshwater migratory corridors free of obstruction with adequate water quantity and quality conditions; and estuarine, nearshore and offshore areas free of obstruction with adequate water quantity, quality and salinity conditions that support physiological transitions between fresh- and saltwater, predator avoidance, foraging and other life history behaviors.

Physical and biological features vary widely throughout the critical habitat area designated for the ESU; many watersheds have been heavily altered and support low quality primary constituent elements, while habitat in other watersheds have sufficient quality for supporting the conservation purpose of designated critical habitat. In many watersheds, fine sediment into spawning gravel, created from timber harvest and forestry related activities, agriculture, and grazing, affects the spawning sites. These activities have also diminished the channels' rearing and overwintering capacity by reducing large woody debris in stream channels, removing riparian vegetation, disconnecting floodplains from stream channels, and changing the quantity and dynamics of stream flows. Freshwater rearing sites have been degraded by elevated water temperatures in 29 of the watersheds within the Nehalem, North Umpqua, and the inland watersheds of the Umpqua subbasins. Contaminants from agriculture and urban areas affect water quality in low-lying areas in the Umpqua subbasin, and in coastal watersheds within the Siletz/Yaquina, Siltcoos, and Coos subbasins. Reductions in water quality have been observed in 12 watersheds because of contaminants and excessive nutrition. Throughout the ESU, culverts and road crossings restrict passage, affecting migration corridors. A status review or viability assessment described this species as improving.

## *Sockeye salmon* - *Oncorhynchus nerka*

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately. However, because listed sockeye salmon species are indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in the status review (Good et al. 2005), various listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Sockeye salmon occur in the North Pacific and Arctic oceans and associated freshwater systems. In North America, the species ranges north from the Klamath River in California to Bathurst Inlet in the Canadian Arctic. In Asia sockeye salmon range from northern Hokkaido in Japan north to the Anadyr River in Siberia. The largest populations occur north of the Columbia River.

Most sockeye salmon exhibit a lake-type life history (they spawn and rear in or near lakes), though some salmon exhibit a river-type life history. Spawning occurs in late summer and fall, but timing can vary among populations. In lakes, salmon commonly spawn along "beaches" where underground seepage provides fresh oxygenated water. Incubation is part of water temperature but lasts between 100 to 200 days (Burgner 1991). Sockeye salmon fry primarily rear in lakes; river-emerged and stream-emerged fry migrate into lakes to rear. Juvenile sockeye salmon rear in lakes from one to three years after emergence, though some river-spawned salmon may migrate to sea in their first year. Juvenile sockeye salmon feeding behaviors change as they transition through life stages after emergence to the time of smoltification. In the early fry stage from spring to early summer, juveniles forage exclusively in the warmer littoral (shoreline) zone where they depend mostly on fly larvae and pupae, copepods, and water fleas. In summer, very young sockeye salmon move from the littoral habitat to a pelagic (open water) existence where they feed on larger zooplankton; however, flies may still make up a substantial portion of their diet. Older and larger fish may also prey on fish larvae.

Distribution in lakes and prey preference is a dynamic process that changes daily and yearly depending on many reasons, including: water temperature; prey abundance; presence of predators and competitors; and size of the juvenile. Peak emigration to the ocean occurs in mid-April to early May in southern sockeye populations (less than 52ºN latitude) and as late as early July in northern populations (62ºN latitude) (Burgner 1991). Adult sockeye salmon return to their natal lakes to spawn after spending one to four years at sea. The diet of adult salmon consists of amphipods, copepods, squid, and other fish.

Certain populations of Oncorhynchus nerka become resident in the lake environment and are referred to as "kokanee". Kokanee and sockeye often co-occur in many interior lakes, where access to the sea is possible but energetically costly; kokanee are rarely found in coastal lakes, where the migration to sea is short and energetic costs are minimal. At times, a single population will result in both the anadromous and freshwater life history form. Both sockeye and kokanee are semelparous.

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NOAA Fisheries amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

### Ozette Lake sockeye salmon

The Ozette Lake sockeye salmon ESU includes all naturally spawned anadromous populations of sockeye salmon that migrate into and rear in Ozette Lake, Ozette River, Coal Creek, and other tributaries flowing into Ozette Lake, near the northwest tip of the Olympic Peninsula in Olympic National Park, Washington. Composed of only one population, the Ozette Lake sockeye salmon ESU consists of five spawning aggregations or subpopulations, grouped according to their spawning locations: Umbrella and Crooked creeks, Big Rive, and Olsen's and Allen's beaches. Two artificial populations are also considered part of this ESU. Sockeye salmon stock reared at the Makah Tribe's Umbrella Creek Hatchery were included in the ESU but were not considered essential for recovery of the ESU. However, after the hatchery fish return and spawn in the wild, their progeny we consider them listed under the ESA. We used information available in status reviews (Good et al. 2005; NMFS 2011g), the recovery plan (NMFS 2009b), "Viability Criteria for the Lake Ozette Sockeye Salmon Evolutionarily Significant Unit" (Rawson et al. 2009), listing documents (63 FR 11750, 64 FR 14528), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Salmon of this ESU enter Ozette Lake through the Ozette River from April to early August and they delay spawning is until late October to February. Spawning occurs primarily in lakeshore upwelling areas of the lake, though minor spawning may occur below the lake in the Ozette River or its tributary, Coal Creek. Native sockeye salmon do not presently spawn in tributary streams to Ozette Lake, though spawning may have occurred there historically. Hatchery salmon, however, do spawn in the Ozette Lake tributaries of Umbrella Creek and Big River. Fry in Ozette Lake and the tributaries emerge from late-February through May and disperse to open areas of the lake to rear. Juveniles rear for one year in the lake and emigrate seaward in their second spring. At emigration, smolts are relatively large, averaging 4 ½ to 5 inches in length. Most adult salmon of this ESU return from the ocean to spawn as four-year old fish. Ozette Lake also supports a population of kokanee which is not listed under the ESA.

The Ozette Lake sockeye salmon ESU is composed of one historical population with multiple spawning aggregations. Historically at least four beaches in the lake were used for spawning; today only two beach spawning locations, Allen's and Olsen's beaches, are used. The historical abundance of Ozette Lake sockeye salmon is poorly documented but may have been as high as 50,000 individuals (Blum, 1988). Declines began to be reported in the 1920s. Escapement estimates (run size minus broodstock take) from 1996 to 2006 are variable and range from a low of 1,404 individuals in 1997 to a high of 6,461 individuals in 2004, with a median of approximately 3,800 sockeye per year (geometric mean: 3,353). No statistical estimation of trends for this ESU are reported. However, comparing four year averages (to include four brood years in the average because the species primarily spawn as four-year olds) shows an increase during the period 2000 to 2006. For return years 1996 to 1999 the run size averaged 2,460 sockeye salmon; for years 2000 to 2003 the run size averaged just over 4,420 fish; and for years 2004 to 2006, the average abundance estimate was 4,167 sockeye. The supplemental hatchery program began with out-of-basin stocks and make up an average of 10 percent of the run. The proportion of beach spawners originating from the hatchery is unknown, but it is likely that straying is low. Based on estimates of habitat carrying capacity, a viable sockeye salmon population in the Lake Ozette watershed would range between 35,500 to 121,000 spawners.

NOAA Fisheries listed the Ozette Lake sockeye salmon ESU as threatened on March 25, 1999 (64 FR 14528) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging; road building; predation; invasive plant species; and overharvest. Ozette Lake sockeye salmon have not been commercially harvested since 1982 and only minimally harvested by the Makah Tribe since 1982 (0 to 84 fish per year); there are also no known marine area harvest impacts to fish of this ESU. Overall abundance is substantially below historical levels and it is not known if this decrease in abundance is a result of fewer spawning aggregations, lower abundances at each aggregation, or a combination of both factors. The proportion of beach spawners is assumed to be low; therefore, hatchery originated fish are not believed to have had a major effect on the genetics of the naturally spawned population. However, Ozette Lake sockeye have a relatively low genetic diversity compared to other O. nerka populations examined in Washington State (Crewson et al. 2001). Genetic differences do occur between age cohorts, but as different age groups do not spawn with each other, the population may be more vulnerable to significant reductions in population structure due to catastrophic events or unfavorable conditions affecting one year class. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Ozette Lake sockeye salmon on September 2, 2005 (70 FR 52630). It encompasses areas within the Hoh/Quillayute subbasin, Ozette Lake, and the Ozette Lake watershed. The entire occupied habitat for this ESU is within the single watershed for Ozette Lake. Primary constituent elements identified for Lake Ozette sockeye salmon are areas for spawning, freshwater rearing and migration, estuarine areas free of obstruction, nearshore marine areas free of obstructions, and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, and adequate passage conditions. Spawning habitat has been affected by loss of tributary spawning areas and exposure of much of the available beach spawning habitat due to low water levels in summer. Further, native and non-native vegetation as well as sediment have reduced the quantity and suitability of beaches for spawning. Freshwater rearing sites are degraded by excessive predation and competition with introduced non-native species, and by loss of tributary rearing habitat. Migration corridors may be adversely affected by high water temperatures and low water flows in summer which causes a thermal block to migration (La Riviere 1991). A status review or viability assessment described this species as stable.

## Snake River sockeye salmon

The Snake River sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. Redfish Lake is located in the Salmon River basin, a subbasin within the larger Snake River basin. We used information available in status reviews (Gustafson et al. 1997; Good et al. 2005; NMFS 2011c), listing documents (58 FR 68543, 70 FR 37160), and previously issued biological opinions (notably NMFS 2008b and NMFS 2012a) to summarize the status of the species.

Snake River sockeye salmon are unique compared to other sockeye salmon populations. Sockeye salmon returning to Redfish Lake travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 ft.) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn et al. 1968). Salmon of this ESU are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1,870 ft., Okanagon at 912 ft.) and occupy different ecoregions.

No natural origin anadromous adults have returned since 1998 and the species is currently entirely supported by adults produced through a captive propagation program. Historically, salmon of this ESU entered the Columbia River system in June and July and arrived at Redfish Lake between August and September. Spawning occurred in lakeshore gravel and generally peaked in October. Fry emerged in the spring (generally April and May) then migrated to open waters of the lake to feed. Juvenile sockeye remained in the lake for one to three years before migrating through the Snake and Columbia Rivers to the ocean. While pre-dam reports indicate that sockeye salmon smolts migrate in May and June, passive integrated transponder (PIT) -tagged sockeye smolts from Redfish Lake pass Lower Granite Dam from mid-May to mid-July. Adult anadromous sockeye spent two or three years in the open ocean before returning to Redfish Lake to spawn. A resident form of Snake River sockeye salmon also occurs in Redfish Lake. The residuals are nonanadromous (they complete their entire life cycle in freshwater); however, studies have shown that some ocean migrating juveniles are progeny of resident females (Rieman et al. 1994). The resident salmon spawn at the same time and in the same location as anadromous sockeye salmon.

The only extant sockeye salmon population in the Snake River basin at the time of listing occurred in Redfish Lake. Other lakes in the Salmon River basin that historically supported sockeye salmon include Alturas Lake above Redfish Lake which was extirpated in the early 1900s as a result of irrigation diversions, though residual sockeye may still exist in the lake. From 1955 to 1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented re-entry of anadromous sockeye salmon (Chapman and Witty 1993). Other historic sockeye salmon populations within the Snake River basin now considered extinct include Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho), and Warm Lake (South Fork Salmon River drainage, Idaho).

Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn et al. 1968). In 1985, 1986, and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir. Only 18 natural origin sockeye salmon have returned to the Stanley Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005, a total of 345 captive brood adults that had migrated to the ocean returned to the Stanley Basin. Recent years have seen an increase in returns to over 600 in 2008 and more than 700 returning adults in 2009.

NOAA Fisheries listed Snake River sockeye salmon as endangered on November 20, 1991 (56 FR 58619) and reaffirmed their status on June 28, 2005 (70 FR 37160). Subsequent to the 1991 listing, the residual form of sockeye residing in Redfish Lake was identified and in 1993, NOAA Fisheries determined that residual sockeye salmon in Redfish Lake was part of the ESU. The ESU was listed due to habitat loss and degradation from the combined effects of damming and hydropower development; overexploitation; fisheries management practices; and poor ocean conditions. Recent annual abundances of natural origin sockeye salmon in the Stanley Basin have been extremely low. This species is currently entirely supported by adults produced through the captive propagation program. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3 percent (Hebdon et al. 2004). Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

NOAA Fisheries designated critical habitat for Snake River sockeye salmon on December 28, 1993 (58 FR 68543). It encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to salmon of this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Specific Primary constituent elements were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The “essential features” that characterize these sites include substrate/spawning gravel; water quality, quantity, temperature, velocity; cover/shelter; food; riparian vegetation; space; and safe passage conditions. The quality and quantity of rearing and juvenile migration essential habitats have been reduced from activities such as tilling, water withdrawals, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. These activities disrupt access to foraging areas, increase the amount of fines in the steam substrate that support production of aquatic insects, and reduce instream cover. Adult and juvenile migration essential habitat is affected by four dams in the Snake River basin that obstructs migration and increases mortality of downstream migrating juveniles. Water quality impairments in designated critical habitat include inputs from fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, acids, petroleum products, animal and human sewage, dust suppressants (such as magnesium chloride), radionuclides, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments from the headwaters of the Salmon River to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges.  A status review or viability assessment described this species as improving.

### *Steelhead trout - Oncorhynchus mykiss*

We discuss the distribution, life history, population dynamics, status, and critical habitats of the eleven species (here we use the word “species” to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed steelhead trout species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across DPSs. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), various salmon ESU listing documents, and biological opinions (notably NMFS 2012a) to summarize the status of the species.

Steelhead is the common name of the anadromous form of Oncorhynchus mykiss. They are a Pacific salmonid with freshwater habitats that include streams extending from northwestern Mexico to Alaska in North America to the Kamchatka peninsula in Russia. Non-anadromous Oncorhynchus mykiss do not migrate to the ocean and remain in freshwater all their lives. These fish are commonly called rainbow trout.

Though steelhead have a longer run time than other Pacific salmonids and do not tend to travel in large schools, they can be divided into two basic run-types: the stream-maturing type (summer steelhead) and the ocean-maturing type (winter steelhead). Summer steelhead enter freshwater as sexually immature adults between May and October (Busby et al., 1996; T.E. Nickelson et al., 1992) and hold in cool, deep pools during summer and fall before moving to spawning sites as mature adults in January and February (Barnhart, 1986; T.E. Nickelson, et al., 1992). Winter steelhead return to freshwater between November and April as sexually mature adults and spawn shortly after river entry (Busby, et al., 1996; T.E. Nickelson, et al. 1992). Steelhead typically spawn in small tributaries rather than large, mainstem rivers and spawning distribution often overlaps with coho salmon, though steelhead tend to prefer higher gradients (generally two to seven percent, but up to 12 percent or more) and their distributions tend to extend further upstream than coho salmon. Summer steelhead commonly spawn higher in a watershed than do winter steelhead, sometimes even using ephemeral streams from which juveniles are forced to emigrate as flows diminish. Fry usually inhabit shallow water along banks and stream margins of streams (T.E. Nickelson et al. 1992) and move to faster flowing water such as riffles as they grow. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (T.E. Nickelson et al. 1992). In Oregon and California, steelhead may enter estuaries where sand bars create low salinity lagoons. Migration of juvenile steelhead to these lagoons occurs throughout the year but is concentrated in the late spring/early summer and in the late fall/early winter periods (Shapovalov & Taft, 1954; Zedonis, 1992). Juveniles rear in freshwater for one to four years, then smolt and migrate to the ocean in March and April (Barnhart, 1986). Steelheads typically reside in marine waters for two or three years before returning to their natal streams to spawn as four or five-year olds. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby, et al., 1996). Females spawn more than once more commonly than males, but rarely more than twice before dying (T.E. Nickelson, et al., 1992). Iteroparity is also more common among southern steelhead populations than northern populations (Busby, et al., 1996).

Steelhead feed on a variety of prey organisms depending upon life stage, season, and prey availability. In freshwater juveniles feed on common aquatic stream insects such as caddisflies, mayflies, and stoneflies but also other insects (especially chironomid pupae), zooplankton, and benthic organisms (Merz, 2002; Pert, 1987). Older juveniles sometimes prey on emerging fry, other fish larvae, crayfish, and even small mammals, though these are not a major food source (Merz, 2002). The diet of adult oceanic steelhead is comprised primarily of fish and squid (Light 1985; Burgner et al. 1992).

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NOAA Fisheries amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the Protective Regulations for Threatened Salmonid Species section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed before release into the wild.

NOAA Fisheries designated critical habitat for all but one of the listed steelhead DPSs on September 2, 2005 (70 FR 52488). Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At the time of designation, primary constituent elements are identified and include sites necessary to support one or more steelhead life stage(s). Primary constituent elements in steelhead designated habitat include freshwater spawning and rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat section for each listed DPS below identifies the areas included as part of the designation and discusses the current status of critical habitat.

## Central California coast steelhead

The Central California Coast steelhead DPS includes all naturally spawned populations of steelhead in coastal streams from the Russian River to Aptos Creek; the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; and tributary streams to Suisun Marsh including Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough (commonly referred to as Red Top Creek). The DPS does not include the Sacramento-San Joaquin River Basin of the California Central Valley. Two artificial propagation programs are considered to be part of the DPS: Don Clausen Fish Hatchery, and Kingfisher Flat Hatchery/Scott Creek (Monterey Bay Salmon and Trout Project). We used information available in status reviews (Good et al. 2005; NMFS 2011j), the recovery outline (NMFS 2007a), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain" (Bjorkstedt et al. 2005), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

The DPS, like those to the south, is entirely composed of winter-run fish. Adults return to the Russian River and migrate upstream from December to April. Most spawning occurs from January to April. Smolts emigrate between March and May (Hayes et al. 2004; Shapovalov and Taft 1954), typically at one to four years of age, though recent studies indicate that growth rates in Soquel Creek likely prevent juveniles from undergoing smoltification until age two (Sogard et al. 2009).

The Central California Coast steelhead DPS consisted of nine historic functionally independent populations and 23 potentially independent populations. Of the historic functionally independent populations, at least two are extirpated and most of the remaining populations are nearly extirpated. Historically, the entire central California coast steelhead DPS may have consisted of an average runs size of 94,000 adults in the early 1960s. Information on current steelhead populations in the DPS consists of anecdotal, sporadic surveys that are limited to only smaller portions of watersheds. Though it is not possible to calculate long-term trends for individual watersheds or the entire DPS, the limited data that do exist indicate that abundance has declined for all populations sampled compared to historical data. Current runs in the basins that originally contained the two largest steelhead populations for the DPS, the San Lorenzo and the Russian Rivers, both have been estimated at less than 15 percent of their abundances compared to 30 years earlier. The interior Russian River winter-run steelhead has the largest runs with an estimate of an average of over 1,000 spawners.

NOAA Fisheries listed the Central California Coast steelhead as threatened on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of sedimentation and channel restructuring due to floods. Spatial structure has been reduced throughout the DPS. Impassible dams have cut off substantial portions of habitat in some basins and it is estimated that 22 percent of the DPS's historical habitat has been lost behind (primarily man-made) barriers, including significant portions of the upper Russian River. Long-term population sustainability is extremely low for the southern populations in the Santa Cruz Mountains and in the San Francisco Bay, and declines in juvenile southern populations are consistent with the more general estimates of declining abundance in the region. The interior Russian River population may be able to be sustained over the long-term, but hatchery management has eroded the population's genetic diversity. Though the information for individual populations is limited, available information strongly suggests that no population is viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the Central California coast steelhead DPS includes the Russian River watershed, coastal watersheds in Marin County, streams within the San Francisco Bay, and coastal watersheds in the Santa Cruz Mountains, southeast to Aptos Creek. Freshwater spawning sites have reduced quality throughout the critical habitat; sediment fines in spawning gravel have reduced the ability of the substrate to provide well oxygenated and clean water to eggs and alevins. Forage sites have been degraded in some areas where high proportions of fines in bottom substrate limit the production of aquatic stream insects adapted to high velocity water. Elevated water temperatures and impaired water quality have further reduced the quality, quantity, and function of rearing sites within most streams. These impacts have diminished the ability of designated critical habitat to conserve the Central California Coast steelhead. A recent status review or viability assessment described this species as “no change”.

### California Central Valley steelhead

The California Central Valley steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. The DPS also includes two artificial propagation programs: the Coleman National Fish Hatchery and Feather River Hatchery. We used information available in status reviews (Good et al. 2005, NMFS 2011i), the draft recovery plan (NMFS 2009a), listing documents (69 FR 33102; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Members of this DPS have the longest freshwater migration of any population of winter steelhead. Adults return to freshwater essentially continuously from July to May, with peaks in September and February. Spawning occurs from December to April, with peaks from January to March (McEwan and Jackson 1996). Spawning occurs in small streams and tributaries directly downstream of dams. Juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurs in spring, with a much smaller peak in fall. Emigrating juveniles use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean; some may use tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods before their final emigration to the sea (Hallock et al. 1961).

The California Central Valley steelhead DPS may have consisted of 81 historical and independent populations (Lindley et al. 2006). Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries. Until recently, steelhead were considered extirpated from the San Joaquin River system; in 2004, a total of 12 steelhead smolts were collected in monitoring trawls at the Mossdale station in the lower San Joaquin River (California Department of Fish and Game, unpublished data). Historically, annual steelhead run size for this ESU may have approached one to two million adults. By the early 1960s, the run size had declined to about 40,000 adults (McEwan 2001). Steelhead were counted at the Red Bluff Diversion Dam until 1993; counts declined from an average of 11,187 from 1967 to 1977 to an average of approximately 2,000 through the early 1990s. Estimated total annual run size for the entire Sacramento-San Joaquin system was no more than 10,000 adults during the early 1990s (D. McEwan & Jackson, 1996; D. R. McEwan, 2001). Based on catch ratios at Chipps Island in the Delta and using generous survival assumptions, the average number of steelhead females spawning naturally in the entire Central Valley during the years 1980 to 2000 was estimated at approximately 3,600.

NOAA Fisheries listed the California Central Valley steelhead DPS as threatened on March 19, 1998, and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the loss of most historical spawning and rearing habitat above impassable dams, restriction of natural production areas, the apparent continuing decline in abundance, and lack of monitoring efforts to assess the

DPS's abundance and trends. The DPS's present distribution has been greatly reduced: about 80 percent of historic habitat has been lost behind dams and about 38 percent of habitat patches that supported independent populations are no longer accessible to steelhead (Lindley et al. 2006). Though previously thought to be extirpated from these areas, populations may exist in Big Chico and Butte Creeks and steelhead have also been observed in Clear Creek and Stanislaus River (Demko and Cramer 2000). A few wild steelhead are produced in the American and Feather Rivers. Though annual monitoring data for calculating trends are lacking, available data indicate the DPS has had a significant long-term downward trend in abundance. The losses of populations and reductions in abundance have reduced genetic diversity in the DPS. Hatchery-origin fish have also compromised the genetic diversity of the majority of the spawning runs. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the California Central Valley steelhead DPS encompasses about 2,300 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisan Bay estuarine complex and includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the lower San Joaquin River to the confluence with the Merced River, including its tributaries, and the waterways of the Delta. The critical habitat is degraded and does not provide the conservation value necessary for species recovery. In addition, the Sacramento-San Joaquin River Delta provides very little function necessary for juvenile steelhead rearing and smoltification. Spawning sites are subject to variations in flows and temperatures, particularly over the summer months. The rearing habitat is degraded by channelized, leveed, and riprapped river reaches, and sloughs common in the Sacramento-San Joaquin system. These areas typically have low habitat complexity, low abundance of food organisms, offer little protection from fish or avian predators, and commonly have elevated temperatures. The current conditions of migration corridors are substantially degraded. Both migration corridors and rearing sites have reduced water quality from several contaminants introduced by dense urbanization and agriculture along the mainstems and in the Delta. In the Sacramento River, the migration corridor for both juveniles and adults is obstructed by the Red Bluff Diversion Dam gates from May 15 through September 15. The migration corridors are also obstructed by complex channel configuration making it difficult for fish to migrate successfully to the western Delta and the ocean. State and federal pumps and associated fish facilities alter flows in the Delta and impede and obstruct a functioning migration corridor. Estuarine areas in the Delta are affected by contaminants from agricultural and urban runoff and release of wastewater treatment plants effluent. However, some complex, productive habitats with floodplains remain in the system and flood bypasses (Yolo and Sutter bypasses).  A status review or viability assessment described this species as "no change".

## Lower Columbia River steelhead

The Lower Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington, and the Willamette and Hood Rivers, Oregon. The DPS also includes seven hatchery populations. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011a; Ford 2011), recovery plans (LCFRB 2010; Oregon Department of Fish and Wildlife 2010; NMFS 2013a), listing documents (61 FR 41541, 63 FR 13347, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

The Lower Columbia River steelhead DPS includes populations of summer- and winter-run steelhead. Summer-run steelhead return sexually immature to the Columbia River from May to October and spend several months in freshwater before spawning between February and April. Winter-run steelhead enter freshwater from December to May at sexual maturity. Peak spawning occurs from April to May. Where both races spawn in the same stream, summer-run steelhead tend to spawn at higher elevations than winter-run steelhead. Fry emerge from March to July, with peaks between April and May. Steelhead smolts generally migrate at ages ranging from one to four years, but most smolt after two years in freshwater. Emigration of both summer- and winter-run steelhead generally occurs from March to June, with peak migration in April to May. Both winter- and summer-run adults normally return to freshwater after two years in the ocean.

The Lower Columbia River steelhead had 17 historically independent winter-run steelhead populations and six independent summer-run steelhead populations (McElhany et al., 2003; J. Myers, et al., 2006). All historic populations are considered extant. All populations declined from 1980 to 2000, with sharp declines beginning in 1995. Historical counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) suggest the population probably exceeded 20,000 fish. During the 1990s, fish abundance dropped to 1,000 to 2,000 fish. Recent abundance estimates of natural-origin spawners range from extirpation of some populations above impassable barriers to over 700 fishes in the Kalama and Sandy winter-run populations. Several the populations have a substantial fraction of hatchery-origin spawners in spawning areas. Many of the long-and short-term trends in abundance of individual populations are negative.

NOAA Fisheries listed Lower Columbia River steelhead as threatened on March 19, 1998 (63 FR 13347) and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of genetic introgression from hatchery stocks. Spatial structure remains relatively high for most populations (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Except in the North Fork Lewis subbasin, where dams have impeded access to historical spawning habitat, most summer-run steelhead populations continue to have access to historical production areas in forested, mid- to-high-elevation subbasins that remain largely intact. Most populations of winter-run steelhead have maintained their spatial structure, though many of these habitats no longer support significant production (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Out of the 23 populations in this DPS, 16 are considered to have a low or very low probability of persisting over the next 100 years, and six populations have a moderate probability of persistence (LCFRB 2010, Oregon Department of Fish and Wildlife 2010). Only the summer-run Wind population is considered viable. The low to very low baseline persistence probabilities of most Lower Columbia River steelhead populations reflects low abundance and productivity. In addition, it is likely that genetic and life history diversity has been reduced as a result of pervasive hatchery effects and population bottlenecks. Although current Lower Columbia River steelhead populations are depressed compared to historical levels and long-term trends show declines, many populations are substantially healthier than their salmon counterparts, typically because of better habitat conditions in core steelhead production areas (LCFRB 2010a). Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Designated critical habitat for the Lower Columbia River steelhead DPS includes the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette. The Lower Columbia River corridor is also included in the designated critical habitat. Critical habitat is affected by reduced quality of rearing habitat and juvenile migration corridors within the lower portion and alluvial valleys of many watersheds. Contaminants from agriculture further affect both water quality and food production in these degraded reaches of tributaries and in the mainstem Columbia River. Several dams affect adult migration by obstructing the migration corridor. Watersheds which consist of a large proportion of Federal lands (for example, the Sandy River watershed) have relatively healthy riparian corridors that support attributes of the rearing sites such as cover, forage, and suitable water quality. A status review or viability assessment described this species as stable.

## Middle Columbia River steelhead

The Middle Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams from above the Wind River, Washington, and the Hood Rivers, Oregon and upstream to, and including, the Yakima River, Washington, excluding Oncorhynchus mykiss from the Snake River Basin. The DPS also includes seven artificial propagation programs. Steelhead from the Snake River basin (described in Section 6.7) are not included in this DPS. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011k; Ford 2011), the recovery plan (NMFS 2009c), listing documents (63 FR 11798, 64 FR 14517, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Middle Columbia River steelhead populations are mostly of the summer-run type, with the exception of inland winter-run steelhead that occur in the Klickitat River and Fifteenmile Creek. Adult summer-run steelhead enter freshwater from June through August and adults may spend up to a year in freshwater before spawning. The majority of juveniles smolt and immigrate to the ocean as two-year olds. About equal numbers of adults in the DPS return to freshwater after spending one or two years in the ocean; however, summer-run steelhead in Klickitat River have a life cycle more like Lower Columbia River steelhead where most of returning adults have spent two years in the ocean.

The Interior Columbia Technical Review Team identified 16 extant populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, Walla Walla and Umatilla Rivers, and Yakima River) and one extant unaffiliated population (Rock Creek) (Interior Columbia Technical Review Team 2003). There are three extirpated populations: two in the Cascades Eastern Slope major population group and one in the Walla Walla and Umatilla Rivers major population group. Historic run estimates for the Yakima River indicate that annual species abundance may have exceeded 300,000 returning adults. The 10-year geometric mean for each population ranges from a low of 85 fish (Upper Yakima River) to 1,800 fish (Lower Mainstem John Day). The 10-year average proportion of hatchery-origin spawners ranges from two percent (Walla Walla Mainstem) to 39 percent (Eastside Deschutes); the majority of populations have a hatchery proportion of spawners between six to eight percent. Fifteenmile Creek has no hatchery-origin spawners.

NOAA Fisheries listed Middle Columbia River steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their threatened status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as impacts from artificial propagation. NOAA Fisheries considers spatial structure and diversity of the DPS to be at moderate risk. Relative to the brood cycle just before listing (1992 to 1996 spawning year), current brood cycle (five-year geometric mean) natural abundance is substantially higher (more than twice) for seven of the populations, lower for three, and at similar levels for four populations. Three populations have insufficient data to calculate long-term trends. Short-term trends are positive for all but three populations. Viability ratings for the 17 populations are: four viable, seven maintained, one highly variable, and five high risk. Impacts from Tribal fisheries targeting Chinook salmon continue to harvest approximately five percent of summer-run steelhead in the Middle Columbia, Upper Columbia, and Snake River Basins per year. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Designated critical habitat for the Middle Columbia River steelhead DPS includes the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. The current condition of Middle Columbia River critical habitat is moderately degraded. Quality of juvenile rearing sites and migration corridors has been reduced in several watersheds and in the mainstem Columbia River by contaminants from agriculture that affect both water quality and food production. Loss of riparian vegetation from grazing has resulted in high water temperatures in the John Day basin. Reduced quality of rearing sites has diminished its contribution to the conservation value necessary for the recovery of the species. Several dams affect adult migration by obstructing the migration corridor. A status review or viability assessment described this species as stable / improving.

## Northern California steelhead

The Northern California steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in California coastal river basins from Redwood Creek southward to, but not including, the Russian River. The DPS also includes two artificial propagation programs: the Yeager Creek Hatchery and the North Fork Gualala River Hatchery (Gualala River Steelhead Project). We used information available in status reviews (Busby et al. 2006, Good et al. 2005; NMFS 2011j), the recovery outline (NMFS 2007b), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California Coast Recovery Domain" (Spence et al. 2008), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2008a and 2012a) to summarize the status of the species.

This DPS includes both winter- and summer-run steelhead. In the Mad and Eel Rivers, immature steelhead may return to freshwater as "half-pounders" after spending only two to four months in the ocean. Generally, a half-pounder will overwinter in freshwater and return to the ocean in the following spring. Juvenile out-migration appears more closely associated with size than age; though juveniles generally, throughout their range in California, spend two years in freshwater. Smoltification occurs when they are between 14 to 21 centimeters in length.

Historically, this DPS encompassed 42 independent populations of winter-run steelhead (19 functionally independent and 23 potentially independent) and 10 independent populations of summer-run steelhead. All historic populations of winter-run salmon are extant. Of the 10 summer-run steelhead populations, four are extant and six are assumed to be either extirpated or extremely depressed. Long-term data sets are limited for the Northern California steelhead. Prior to 1960, estimates of abundance specific to this DPS were available from dam counts. Cape Horn Dam in the upper Eel River reported annual average numbers of adults as 4,400 in the 1930s); Benbow Dam in the South Fork Eel River reported annual averages of 19,000 in the 1940s; and the Sweasey Dam in the Mad River reported annual averages of 3,800 in the 1940s. Estimates of steelhead spawning populations for many rivers in this DPS totaled 198,000 by the mid-1960s. For winter-run populations that have had recent counts, returns have not exceeded more than a few hundred fish, with the exception of a portion of the Gualala River population (counts of adult steelhead have averaged 1,915 fish) and at the Mad River Hatchery (average of 2,300 adults). The only summer-run steelhead population with a comprehensive time series of abundance is the Middle Fork Eel River, which has been monitored since the mid-1960s. Counts have averaged 780 fish over the period of record and 609 fish in the past 16 years. Both short-term and long-term trends are negative, though not significantly.

NOAA Fisheries listed Northern California steelhead as threatened on June 7, 2000 (65 FR 36074) and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of the introduction of a salmonid predator, the Sacramento pikeminnow (formerly known as Sacramento squawfish

[Ptychocheilus grandis], and concern about the influence of hatchery stocks on native fish (genetic introgression and ecological interactions). Overall, spatial structure of the DPS is relatively intact and all diversity strata appear to be represented by extant populations. However, spatial structure and distribution within most watersheds has been adversely affected by barriers and high water temperatures. The scarcity of time series of abundance at the population level spanning more than a few years hinders assessment of the DPS's status; population level estimates of abundance are available for four of the 42 winter-run populations and for one of the 10 summer-run populations. Trend information from the available datasets suggests a mixture of patterns, with slightly more populations showing declines than increases, though few of these trends are statistically significant. Where population level estimates of abundance are available, only the Middle Fork Eel River summer-run populations are considered to have a low-risk of extinction. The remaining populations for which adult abundance has been estimated appear to be at either moderate- or high-risk of extinction. Although surveys within the summer-run steelhead watersheds do not encompass all available summer habitats, the chronically low numbers observed during surveys suggest that those populations are likely at high risk of extinction. The high number of hatchery fish in the Mad River basin, coupled with uncertainty regarding relative abundances of hatchery and wild spawners is also of concern. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the Northern California steelhead DPS includes the following CALWATER hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, and the Mendocino Coast. The total area of critical habitat includes about 3,000 miles of stream habitat and about 25 square miles of estuarine habitat, mostly within Humboldt Bay. The current condition of designated critical habitat is moderately degraded. Portions of the rearing habitat, especially the interior Eel River, are affected by elevated temperatures from riparian vegetation removal. Spawning habitat attributes (the quality of substrate that supports spawning, incubation, and larval development) have been generally degraded throughout designated critical habitat by silt and sediment fines. The adult migration corridor function has been reduced by bridges and culverts that restrict access to tributaries in many watersheds, especially in watersheds with forest road construction. A status review or viability assessment described this species as "no change".

## Puget Sound steelhead

This Puget Sound DPS includes all naturally-spawned anadromous winter-run and summer-run steelhead in the river basins of Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. The DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). Hatchery production of steelhead is widespread throughout the DPS, but only two artificial propagation programs are included in the DPS. On June 26, 2013, NOAA Fisheries proposed to change the number of artificial propagation programs included in the DPS to six (78 FR 38270). We used information available in status reviews (NMFS 2005, NMFS 2007c, Ford 2011, NMFS 2011e), the recovery outline (NMFS 2013b), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

The Puget Sound steelhead DPS contains both winter-run and summer-run steelhead but is dominated by winter-run fish. Adult winter-run steelhead generally return to Puget Sound tributaries from December to April. Spawning occurs from January to mid-June and peaks from mid-April through May. Less information exists for summer-run steelhead as their smaller run size and higher altitude headwater holding areas have not been conducive for monitoring. Based on information from four streams, adult run time occurs from mid-April to October with a higher concentration from July to September. The majority of juveniles reside in the river system for two years with a minority migrating to the ocean as one or three-year olds. Smoltification and seaward migration occur from April to mid-May. Puget Sound steelhead spend one to three years in the ocean before returning to freshwater (Busby, et al., 1996). Due to the protection of the fjord-like marine environment of Puget Sound, juveniles and adults may hold there during emigration and immigration.

Fifty-three populations of steelhead have been identified in this DPS, of which 37 are winter-run. In the early 1980s, run size for this DPS was calculated at about 100,000 winter-run fish and 20,000 summer-run fish. Available data for calculating abundance and trends are not comprehensive for the DPS, primarily represent winter-run steelhead populations, and date from 1985. Since 1985 Puget Sound winter-run steelhead abundance has shown a widespread declining trend over much of the DPS. Four of the 16 winter-run populations evaluated exhibit estimates of long-term population positive growth rates, only one significantly. Thirteen winter-run steelhead populations have sufficient data to determine recent annual abundances (2005 to 2009). Of the 13 populations, two have geometric mean abundances greater than 4,500 fish annually. The remaining populations have low geometric mean abundances; none exceeds 1,000 fish annually and only two populations exceed 500 fish annually.

NOAA Fisheries listed Puget Sound steelhead as threatened on May 11, 2007 (72 FR 26722). Factors contributing to the listing of this DPS include habitat loss and degradation from damming, agricultural practices, and urbanization; historic overexploitation; predation; poor oceanic and climatic conditions; and impacts from artificial propagation. Spatial structure, complexity, and connectivity have been reduced throughout the DPS. Most populations of steelhead in Puget Sound have declining estimates of mean population growth rates (typically 3 to 10 percent annually) and extinction risk within 100 years for most populations is estimated to be moderate to high. Effects of hatchery fish on the natural populations remain unknown. Based on these factors, this DPS would likely have a low resilience to additional perturbations. A status review or viability assessment described this species as stable / declining.

## Snake River steelhead

The Snake River basin steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. Six artificial propagation programs are also included in the DPS. We used information available in status reviews (Good et al. 2005, NMFS 2011c; Ford 2011), listing documents (62 FR 43937, 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Snake River basin steelhead are generally classified as summer-run fish. They return to the Columbia River from late June to October and spawn the following spring (March to May). Two life history patterns are recognized within the DPS, primarily based on ocean age and adult size upon return: A-run and B-run. A-run steelhead are typically smaller, have shorter freshwater and ocean residences (generally one year in the ocean), and begin their up-river migration earlier in the year. B-run steelhead are larger, spend more time in freshwater and the ocean (generally two years in ocean), and appear to start upstream migration later in the year. Snake River basin steelhead smoltification usually occurs at two to three years of age.

The Interior Columbia Technical Review Team identified six historical major population groups in the Snake River steelhead DPS: Clearwater River, Salmon River, Grande Ronde River, Imnaha River, Lower Snake River, and Hells Canyon Tributaries. The Hells Canyon population is now extirpated; construction of Hells Canyon Dam blocked passage of upstream of the dam. The five extant major population groups support 24 extant independent populations (Interior Columbia Technical Review Team 2008). Population data are lacking for the Snake River steelhead DPS. Annual return estimates are limited to counts of the aggregate return (both A-run and B-run steelhead) over Lower Granite Dam, estimates for two populations in the

Grande Ronde major population group, and index area or weir counts for portions of several other populations. The recent geometric five-year mean abundance (2003 to 2008) for Lower Granite Dam was 18,847 natural-origin returning adults. This natural origin return average represented 10 percent of total returns (of both natural and artificial origin fish) over Lower Granite Dam. The previous five-year geometric mean abundance (1997 to 2001) was 10,693 natural-origin returning adults and represented 13 percent of total returns. The five-year periods for the two Grande Ronde populations for which population-level abundance data series are available are the same as above. The recent five-year geometric mean abundance of natural origin steelhead for the Joseph Creek population was 1,925 fish compared to 2,134 fish for the previous five-year period. These returns are made up entirely of natural origin fish. The recent five-year geometric mean abundance of natural origin steelhead for the Upper Grande Ronde River was 1,425 fish compared to 1,332 fish for the previous five-year period. The returns represent 99 and 76 percent of total returns, respectively.

NOAA Fisheries listed Snake River Basin steelhead as threatened on August 18, 1997 (62 FR 43937) and re-affirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), and, more specifically, widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The level of natural production in the two populations with full data series and one of the index areas is encouraging, but the status of most populations in the DPS remains highly uncertain. The DPS is not currently considered to be viable due to high risk population ratings, uncertainty about the viability status of many populations, and overall lack of population data. A great deal of uncertainty remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the Snake River Basin steelhead DPS includes the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grand Ronde River, Wallowa River, Lower Grand Ronde, Lower Snake/Tucannon, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon, South Fork Salmon, Lower Salmon, Little Salmon, Upper and Lower Selway, Lochsa, Middle and South Fork Clearwater, and the Clearwater subbasins, and the Lower Snake/Columbia River corridor. The current condition of critical habitat designated for Snake River basin steelhead is moderately degraded. Critical habitat is affected by reduced quality of juvenile rearing habitat and migration corridors within many watersheds. Contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Loss of riparian vegetation to grazing has resulted in high water temperatures in the John Day basin. These factors have substantially reduced the rearing habitat's contribution to the conservation value necessary for species recovery. Several dams affect adult migration by obstructing the migration corridor. A status review or viability assessment described this species as stable / improving.

## South-Central California Coast steelhead

The South-central California coast steelhead DPS includes all naturally spawned steelhead populations in streams from the Pajaro River watershed (inclusive) to, but not including, the Santa Maria River, (71 FR 5248) in northern Santa Barbara County, California. There are no artificially propagated steelhead stocks within the range of the DPS. We used information available in status reviews (Busby et al. 1996, Good et al. 2005; NMFS 2011l, Williams et al. 2011), the recovery plan (NMFS 2013c), "Steelhead of the South-central/Southern California coast: population characterization for recovery planning" (Boughton et al. 2006), "Viability criteria for steelhead of the South-central and Southern California Coast" (Boughton et al. 2007), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a and 2013d) to summarize the status of the species.

NOAA Fisheries recognizes two life-history types of winter-run steelhead in the South-central California coast DPS: fluvial-anadromous and lagoon-anadromous. Freshwater resident steelhead (rainbow trout) are not included in the DPS. Fluvial-anadromous fish spend one or two summers (occasionally more) in freshwater streams as juveniles, then smolt and migrate to the ocean, using the estuary only for acclimation to saltwater and as a migration corridor (and occasionally for spring feeding). Lagoon-anadromous fish spend either their first or second summer as juveniles in a seasonal lagoon at the mouth of a stream. Adults of both winter-run types spend two to three years in the ocean before returning to freshwater.

The steelhead populations in this region have declined dramatically from estimated annual runs totaling 27,000 adults near the turn of the 19th century to approximately 4,740 adults in 1965, with a large degree of inter-annual variability. These run-size estimates are based on information from only five major watersheds in the northern portion of the DPS. Run-size estimates from coastal and inland watersheds south of the Big Sur have not been estimated or recorded. Only one population in the DPS has sufficient data to compute a trend for adult escapement, the Carmel River above San Clemente Dam. This population experienced a decline of 22 percent per year from 1963 to 1993 and an average five-year adult count of 16 adult spawners. The most recent counts (2012 to 2013) in the Carmel River indicate 452 adults at the San Clemente Dam and 204 adults at the Los Padres Dam.

NOAA Fisheries listed South-Central California Coast steelhead as threatened August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concerns about genetic effects from widespread stocking of rainbow trout. The DPS consists of 12 discrete sub-populations which represent localized groups of interbreeding individuals. None of these sub-populations are considered to be viable. Most of the sub-populations are characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. Though steelhead are present in most streams in the DPS, their populations are small, fragmented, and unstable, or more vulnerable to stochastic events. In addition, severe habitat degradation and the compromised genetic integrity of some populations pose a serious risk to the survival and recovery of the DPS. The DPS is in danger of extinction. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the South-Central California coast steelhead DPS includes the following CALWATER hydrological units: Pajaro River, Carmel River, Santa Lucia, Salinas River and Estero Bay. Migration corridors and rearing sitess are degraded throughout designated critical habitat by elevated stream temperatures and contaminants from urban and agricultural areas. Estuarine areas are impacted due to breaching, removal of structures, and contaminants. A status review or viability assessment described this species as "no change".

### Southern California steelhead

The Southern California Steelhead DPS includes all naturally spawned populations of steelhead in streams from the Santa Maria River, San Luis Obispo County, California (inclusive) to the U.S.-Mexico Border (62 FR 43937; 67 FR 21586). No artificially propagated steelhead stocks are currently recognized within the range of the DPS; however, two artificial propagation programs, the Don Clausen Fish Hatchery and the

Kingfisher Flat Hatchery (Monterey Bay Salmon and Trout Project) have been proposed for inclusion in the DPS, as they were inadvertently omitted from the original listing (78 FR 38270). We used information available in status reviews (Busby et al. 1996, Good et al. 2005; NMFS 2011m, Williams et al. 2011), the recovery plan (NMFS 2012c), "Contraction of the southern range limit for anadromous Oncorhynchus mykiss" (Boughton et al. 2005), listing documents (62 FR 43937; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a and 2013e) to summarize the status of the species.

Life history of the Southern California Steelhead is similar to that of the South-Central California Coast steelhead.

Population dynamics Limited information exists for Southern California steelhead runs. Run coastal and inland watersheds south of the Los Angeles Watershed have generally not been estimated or recorded and no long term (greater than 20 years) run-size estimates are available for any of the populations. Based on combined estimates for only four major watersheds in the northern portion of the DPS, steelhead runs declined from estimated historic levels of 32,000 to 46,000 adults to less than 500 adults in 1996. More recent counts from various monitoring locations in the DPS have reported very small runs of less than 10 fish, with the exception of a monitoring location in Santa Ynez River that reported 16 adults in 2008.

NOAA Fisheries listed the Southern California steelhead as endangered on August 18, 1997 (62 FR 43937) and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concern about the widespread, dramatic declines in abundance relative to historical levels. Construction of dams and a corresponding increase in water temperatures have excluded steelhead distribution in many watersheds throughout southern California. Streams in southern California containing steelhead have declined over the last decade, with a southward proportional increase in loss of populations. Consequently, the DPS has experienced a contraction of its southern range. This range contraction affects the DPS's ability to maintain genetic and life history diversity for adaptation to environmental change. The 2005 status review concluded the chief causes for the DPS's decline include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants. The most recent status review indicates these threats are essentially unchanged and the species remains in danger of extinction. Based on these factors, this DPS would likely have a very low resilience to additional perturbations.

Designated critical habitat for the Southern California steelhead DPS includes the following CALWATER hydrological units: Santa Maria River, Santa Ynez, South Coast, Ventura River, Santa Clara Calleguas, Santa Monica Bay, Callequas and San Juan hydrological units. All primary constituent elements have been affected by degraded water quality by pollutants from densely populated areas and agriculture within the DPS. Elevated water temperatures impact rearing sites and juvenile migration corridors in all river basins and estuaries. Rearing and spawning sites have been affected throughout the DPS by water management or reduction in water quantity. Spawning sites have been affected by the combination of erosive geology features and land management activities that have resulted in excessive fines in spawning gravel of most rivers. A status review or viability assessment described this species as "no change".

## Upper Columbia River steelhead

The Upper Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River basin upstream from the Yakima River, Washington, to the U.S.-Canada border. The DPS also includes six artificial propagation programs.

We used information available in status reviews (Good et al. 2005, NMFS 2011n; Ford 2011), the recovery plan (Upper Columbia Salmon Recovery Board 2007), listing documents (62 FR 43937; 71 FR 834; 74 FR 42605), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

All Upper Columbia River steelhead are summer-run fish. Adults return in the late summer and early fall. Most adults migrate quickly to their natal tributaries, though a portion of returning adults overwinter in mainstem reservoirs, beyond upper-mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the year following river entry. Juvenile steelhead spend one to seven years rearing in freshwater before migrating to sea. Smolt emigrate primarily at ages two and three, though some smolts in the DPS have been reported at ages up to seven. Most adult steelhead return to freshwater after one or two years in the ocean.

The Upper Columbia River steelhead consists of five historic independent populations, four of which are extant (Wenatchee, Entiat, Methow, and Okanogan) and one that is functionally extinct (Crab Creek). Two additional major population groups likely existed prior to the construction of Grand Coulee and Chief Joseph dams. No direct counts of adult steelhead in the DPS are available before dam construction. Estimates of spawning escapement for all four extant populations are available through the 2008/2009 cycle year, along with preliminary estimates of the aggregate counts over Priest Rapids Dam for the 2009/2010 cycle year. The most recent five-year geometric mean abundance (2005 to 2009) of natural origin fish ranges from 116 to 819 adults in the four populations and is 3,604 adults for the aggregate count. These abundances represent nine to 47 percent of total spawner abundances (natural origin and hatchery origin). The most recent 5-year average of percent of natural origin fish for the aggregate count is 19 percent.

NOAA Fisheries originally listed Upper Columbia River steelhead as endangered on August 18, 1997 (62 FR 43937). NOAA Fisheries changed the listing to threatened on January 5, 2006 (71 FR 834). After litigation resulting in a change in the DPS' status to endangered and then again to threatened. On August 24, 2009, NOAA Fisheries reaffirmed the species' status as threatened (74 FR 42605). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of extremely low estimates of adult replacement ratios, habitat degradation, juvenile and adult mortality in the hydrosystem, unfavorable marine and freshwater environmental conditions, overharvest, and genetic homogenization from composite broodstock collections. Though steelhead in the DPS must pass over several dams to access spawning areas, three of the four populations are rated as low risk for spatial structure. The proportions of hatchery-origin returns in natural spawning areas remain extremely high across the DPS and continue to be a major concern. Though there has been an increase in abundance and productivity for all populations, the improvements have been minor, and none of the populations meet recovery criteria. All populations remain at high risk of extinction and the DPS, as a whole, is not viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

Designated critical habitat for the Upper Columbia River steelhead DPS includes the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. Currently, designated critical habitat is moderately degraded. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development. The water quality and food production features of juvenile rearing sites and migration corridors in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect adult migration by obstructing the migration corridor. A status review or viability assessment described this species as improving.

## Upper Willamette River steelhead

The Upper Willamette River (UWR) steelhead DPS includes all naturally spawned winter-run steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). No artificially propagated populations are included in the DPS. Hatchery summer-run steelhead occur in the Willamette Basin, but they are an out-of-basin population and not included in the DPS. We used information available in status reviews (Busby et al. 1996; Good et al. 2005, NMFS 2011d; Ford et al. 2011), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), listing documents (64 FR 14517; 71 FR 834), and previously issued biological opinions (notably NMFS 2012a) to summarize the status of the species.

Native steelhead in the Upper Willamette are late-migrating winter-run fish. Steelhead enter freshwater in January and February (Howell et al. 1985), but do not ascend to spawning areas until late March or April, later than other winter-run steelhead. Spawning occurs from April to June. The majority of juveniles smolt and emigrate after two years. Peak smolt emigration past Willamette Falls occurs from early April to early June, with a peak in early- to mid-May (Howell et al. 1985). Smolts generally migrate through the Columbia River via Multnomah Channel rather than the mouth of the Willamette River. Most adults return to fresh water after spending two years in the ocean.

Four basins on the east side of the Willamette River historically supported independent steelhead populations, all of which remain extant. There is intermittent spawning and rearing in tributaries on the west side of the Willamette River, but these areas are not considered to be independent populations. Because native winter-run steelhead also return outside of the DPS boundaries, Willamette Falls counts represent the best estimate for the DPS abundance. The average number of steelhead passing Willamette Falls in the 1990s was less than 5,000 fish. The number increased to over 10,000 fish in 2001 and 2002. The geometric and arithmetic mean number of steelhead passing Willamette Falls for the period 1998 to 2001 were 5,819 and 6,795 fish, respectively. More recent abundances have declined. The total abundance of steelhead at Willamette Falls in 2008 was 4,915 adults. In 2009, the abundance was 2,110 fish.

NOAA Fisheries originally listed Upper Willamette steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of damming, water diversions, poor ocean conditions and overharvest. Though access to historical spawning grounds has been lost behind dams, the DPS remains spatially well-distributed. Three populations are considered to be in the moderate to high risk category for spatial structure and one is in the low risk category. The DPS continues to demonstrate an overall low abundance pattern. The elimination of winter-run hatchery releases reduces threats from artificial propagation, but non-native summer steelhead hatchery releases are still a concern. Human population growth within the Willamette Basin continues to be a significant risk factor for the populations. This DPS remains at a moderate risk of extinction. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

Designated critical habitat for the Upper Willamette River steelhead DPS includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River and specific stream reaches in the sub-basins: Upper Willamette, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Yamhill, Tualatin, and Lower Willamette. Designated critical habitat is currently degraded. The water quality and food production features of juvenile rearing sites and migration corridors in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect the adult migration by obstructing the migration corridor. A status review or viability assessment described this species as declining.

## *Pacific Eulalchon - Thaleichthys Pacificus*

The southern population of Pacific eulachon was listed as threatened on March 18, 2010 (75 FR 13012). Eulachon are small smelt native to eastern North Pacific waters from the Bering Sea to Monterey Bay, California, or from 61º N to 31º N (Eschmeyer et al. 1983; 1944; Hay and McCarter 2000; Minckley et al. 1986). Eulachon that spawn in rivers south of the Nass River of British Columbia to the Mad River of California comprise the southern population of Pacific eulachon. This species is designated based upon timing of runs and genetic distinctions (Beacham et al. 2005; Hart and McHugh 1944; Hay and McCarter 2000; McLean et al. 1999; McLean and Taylor 2001).

Adult eulachon are found in coastal and offshore marine habitats (Allen and Smith 1988; Hay and McCarter 2000; Willson et al. 2006). Larval and post larval eulachon prey upon phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, worm larvae, and other eulachon larvae until they reach adult size (WDFW and ODFW 2001). The primary prey of adult eulachon are copepods and euphausiids, malacostracans and cumaceans (Barraclough 1964; Drake and Wilson 1991; Hay and McCarter 2000; Smith and Saalfeld 1955; Sturdevant et al. 1999).

Although primarily marine, eulachon return to freshwater to spawn. Adult eulachon have been observed in several rivers along the west coast (Emmett et al. 1991; Jennings 1996; Larson and Belchik 2000; Minckley et al. 1986; Moyle 1976; Musick et al. 2000; Odemar 1964; WDFW and ODFW 2001; Wright 1999). For the southern population of Pacific eulachon, most spawning is believed to occur in the Columbia River and its tributaries as well as in other Oregonian and Washingtonian rivers (Emmett et al. 1991; Musick et al. 2000; WDFW and ODFW 2001). Eulachon take less time to mature and generally spawn earlier in southern portions of their range than do eulachon from more northerly rivers (Clarke et al. 2007).

Spawning is strongly influenced by water temperatures, so the timing of spawning depends upon the river system involved (Willson et al. 2006). In the Columbia River and further south, spawning occurs from late January to March, although river entry occurs as early as December (Hay and McCarter 2000). Further north, the peak of eulachon runs in Washington State is from February through March while Alaskan runs occur in May and river entry may extend into June (Hay and McCarter 2000). Females lay eggs over sand, course gravel or rocky substrate. Eggs attach to gravel or sand and incubate for 30 to 40 days after which larvae drift to estuaries and coastal marine waters (Wydoski and Whitney 1979a).

Eulachon generally die following spawning (Scott and Crossman 1973). The maximum known lifespan is 9 years of age, but 20 to 30 percent of individuals live to 4 years and most individuals survive to 3 years of age, although spawning has been noted as early as 2 years of age (Barrett et al. 1984; Hay and McCarter 2000; Hugg 1996; WDFW and ODFW 2001; Wydoski and Whitney 1979b). The age distribution of spawners varies between river and from year-to-year (Willson et al. 2006).

The southern population of Pacific eulachon was listed as threatened on March 18, 2010 (75 FR 13012). It is considered to be at moderate risk of extinction throughout its range because of a variety of factors, including predation, commercial and recreational fishing pressure (directed and bycatch), and loss of habitat. Further population decline is anticipated to continue as a result of climate change and bycatch in commercial fisheries. However, because of their fecundity, eulachon are assumed to have the ability to recover quickly if given the opportunity (Bailey and Houde 1989). A status review or viability assessment described this species as stable / improving.

Eulachon formerly experienced widespread, abundant runs and have been a staple of Native American diets for centuries along the northwest coast. However, such runs that were formerly present in several California rivers as late as the 1960s and 1970s (Klamath River, Mad River and Redwood Creek) no longer occur (Larson and Belchik 2000). This decline likely began in the 1970s and continued until, in 1988 and 1989, the last reported sizeable run occurred in the Klamath River and no fish were found in 1996, although a moderate run was noted in 1999 (Larson and Belchik 2000; Moyle 2002). Eulachon have not been identified in the Mad River and Redwood Creek since the mid-1990s (Moyle 2002).

Critical habitat has been designated for the southern population of Pacific eulachon (76 FR 65323). The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 km (335 miles) of habitat. The physical or biological features essential to the conservation of the DPS include:

1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.
2. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.
3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter, 2000; WDFW and ODFW, 2001), unidentified malacostracans (Sturdevant, 1999), cumaceans (Smith and Saalfeld, 1955) mysids, barnacle larvae, and worm larvae (WDFW and ODFW, 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

### *Green sturgeon* - *Acipenser mediosteris*

Green sturgeon has been listed as two separate DPSs, with the Southern DPS listed as threatened (71 FR 17757; April 7, 2006). The Southern DPS consists of populations south of the Eel River (Humboldt, CA), coastal and Central Valley populations, and the spawning population in the Sacramento River, CA. On June 2, 2010, NOAA Fisheries issued a 4(d) Rule for the Southern DPS, applying certain take prohibitions (75 FR 30714).

Green sturgeon occur in coastal Pacific waters from San Francisco Bay to Canada. The Southern DPS of green sturgeon includes populations south of (and exclusive of) the Eel River (Adams et al. 2007). We used information available in the 2002 Status Review and 2005 Status Review Update (GSSR 2002, 2005), and the proposed and final listing rules (70 FR 17836; 71 FR 17757) to summarize the status of the species, as follows.

As members of the family Acipenseridae, green sturgeon share similar reproductive strategies and life history patterns with other sturgeon species; see discussion for shortnose sturgeon above. The Sacramento River is the location of the single, known spawning population for the green sturgeon Southern DPS (Adams et al.

2007). Green sturgeon have relatively large eggs compared to other sturgeon species (4.34mm) and grow rapidly, reaching 66mm in three weeks. Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Little is known specifically about green sturgeon foraging habits; generally, adults feed upon invertebrates like shrimp, mollusks, amphipods and even small fish, while juveniles eat opossum shrimp and amphipods. Juvenile green sturgeon spend 1-3 years in freshwater, disperse widely in the ocean, and return to freshwater as adults to spawn (about age 15 for males, age 17 for females).

Trend data for green sturgeon is severely limited. Available information comes from two predominant sources, fisheries and tagging. Only three data sets were considered useful for the population time series analyses by NOAA Fisheries biological review team: the Klamath Yurok Tribal fishery catch, a San Pablo sport fishery tag returns, and Columbia River commercial landings. Using San Pablo sport fishery tag recovery data, the California Department of Fish and Game produced a population time series estimate for the southern DPS. San Pablo data suggest that green sturgeon abundance may be increasing, but the data showed no significant trend. The data set is not particularly convincing, however, as it suffers from inconsistent effort and because it is unclear whether summer concentrations of green sturgeon provide a strong indicator of population performance. Although there is not sufficient information available to estimate the current population size of southern green sturgeon, catch of juveniles during state and federal salvage operations in the Sacramento delta are low in comparison to catch levels before the mid-1980s.

The 5 Year Status Review for the Southern DPS was initiated in 2012 (77 FR 64959). Loss of spawning habitat and bycatch in the white sturgeon commercial fishery are two major causes for the species decline. Current threats to the Southern DPS include reduction in spawning habitat (mostly from impoundments), entrainment by water projects, contaminants, incidental bycatch and poaching. Given the small population size, the species' life history traits (slow to reach sexual maturity), and that the threats to the population are likely to continue into the future, we conclude that the Southern DPS is not resilient to further perturbations.

Green sturgeon critical habitat for the Southern DPS was designated on October 9, 2009 (74 FR 52300), including coastal U.S. marine waters within 60 fathoms deep from Monterey Bay, CA to Cape Flattery, WA, including the Strait of Juan de Fuca, and numerous coastal rivers and estuaries: see the Final Rule for a complete description (74 FR 52300). Food resources were identified as a primary constituent element. A status review or viability assessment described this species as "no change".

### *Gulf sturgeon - Acipenser oxyrinchus desotoi*

Historically, Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Sporadic occurrences were recorded as far west as the Rio Grande River in Texas and Mexico, and to Florida Bay in the east. Their present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi respectively, east to the Suwannee River in Florida. Based on current data, populations continue to reproduce in seven river systems (Pearl, Pascagoula, Escambia, Yellow/Blackwater, Choctawhatchee, Apalachicola, and Suwannee rivers). In addition to the seven spawning riverine populations, Gulf sturgeon are also known to inhabit the Mississippi, Mobile, and Ochlocknee rivers.

Because Gulf sturgeon spawn in the rivers in which they were born, a breeding population can be defined as the individuals natal to a particular river, and abundance is calculated as the number of individuals within that breeding population. Given the variety of survey methods and gears used to estimate abundance both within and across rivers, coupled with surveys regularly targeting only particular geographic areas within a river (a summer holding area), it is difficult to assess Gulf sturgeon abundance at both riverine and species scale. Some gears and surveys target specific age-classes, and some estimates include only a portion of the population. Therefore, surveys over time within and across rivers are not easily comparable.

Currently, seven rivers are known to support reproducing populations of Gulf sturgeon. No population estimate has been made that would satisfy the recovery criteria of evaluating a change from baseline within statistically valid limits over a three to five year period or an assessment to determine if the average rate of natural recruitment is at least equal to the average mortality rate over a 12-year period. The demographic recovery criteria in the 1995 Recovery Plan relied upon catch-unit-effort (CPUE) data, which has proven too variable to serve as a practical monitoring metric. Demographic parameters estimated from mark-recapture studies appear better suited for this purpose. Using the mark-recapture data, general estimates of population size can be calculated. Although variable, most populations appear relatively stable with a few exceptions. The number of Gulf sturgeon in the Escambia River system may have recently declined due to hurricane impacts, and the Suwannee River population appears to be slowly increasing. Due to lack of research since Hurricanes Ivan and Katrina, no data are available to determine the current size of the Gulf sturgeon populations within the Pearl and Pascagoula Rivers.

Given the variety in methods, Gulf sturgeon population estimates are relatively imprecise, with more than half of the confidence intervals reported exceeding 65 percent of the value reported in the third column. This is perhaps owing to the low capture/recapture probabilities associated with sampling this species, which was estimated to be less than 10 percent using closed-system models by Zehfuss et al. (1999), although another researcher argues that recapture rates for Gulf sturgeon are consistently high (K. Sulak, USGS, peer review comments on draft of this document). Although the trends may not be statistically significant, these surveys indicate a roughly stable or a slowly increasing trend in number of individuals.

All of the dams noted in the listing rule continue to block passage of Gulf sturgeon to historical spawning habitats and thus either reduce the amount of available spawning habitat or entirely impede access to it. Since Gulf sturgeon were listed, several new dams have been proposed on rivers that support Gulf sturgeon. Effects of these dams on Gulf sturgeon and their habitat continues to be investigated as well as potential mitigating factors, including assessing the effects of dam operations, on downstream habitats.

On Sept 30, 1991 (56 FR 49653), Gulf sturgeon were listed as threatened under the Endangered Species Act after their population was greatly reduced or eliminated throughout much of their range because of overfishing, dam construction, and habitat degradation. NOAA Fisheries and the U.S. Fish and Wildlife Service jointly manage and protect Gulf sturgeon. On March 19, 2003 (68 FR 13370 13495), critical habitat for Gulf sturgeon was designated. A status review or viability assessment described this species as improving.

### *Atlantic sturgeon – Acipenser oxyrinchus*

The historical and current range of Atlantic sturgeon includes major estuaries and river systems from Canada to Florida. While still found throughout their historical range, Atlantic sturgeon spawning is known to occur in only 22 of 38 historical spawning rivers.

Atlantic sturgeon was listed under the ESA on February 6, 2012 (50 CFR 224.101) as five distinct population segments. A distinct population segment is the smallest division of a species permitted to be protected under the ESA. Atlantic sturgeon that hatch out in Gulf of Maine rivers are listed as threatened, and those that hatch out in other U.S. rivers are listed as endangered. Atlantic sturgeon are not protected in Canada. On August 17, 2017, NOAA Fisheries designated areas in each of the distinct population segments of Atlantic sturgeon as critical habitat. NOAA Fisheries designated these areas because they protect spawning locations, rearing areas, water quality, and water quantity necessary for Atlantic sturgeon survival.

The three major threats to Atlantic sturgeon are habitat degradation, habitat impediments, and vessel strikes. Atlantic sturgeon habitat can be disrupted or lost because of various human activities, such as dredging, dams, water withdrawals, saltwater intrusion (often caused by groundwater pumping from freshwater wells or drought), chemical contamination of sediments in rearing areas, and other development. Sturgeon need hard bottom substrates in freshwater reaches for spawning, so any activity that destroys those locations directly (dredging) or indirectly (sedimentation or saltwater intrusion) would affect Atlantic sturgeon habitat. To support all life stages, Atlantic sturgeon also require sufficient water quantities and water qualities sufficient to support all life stages, which are often impacted by the activities above.

Locks and dams on the Cape Fear River, North Carolina; the Santee-Cooper rivers, South Carolina; Savannah River, South Carolina/Georgia and the Connecticut River, Connecticut, impede access to upstream spawning habitat. Recent dam removal projects on the Penobscot River, Maine and Rappahannock River, Virginia, have increased accessibility to upstream habitats.

Atlantic sturgeon can be struck by the blades of a propeller as a boat is passing or struck by the boat itself. The risk of injury and mortality can be high in areas with high ship traffic, including the Hudson, Delaware, and James rivers. They are struck and killed by large commercial vessels as well as smaller vessels such as recreational vessels. We do not know how many sturgeons are struck by vessels and survive their injuries. A status review or viability assessment described this species as declining.

### *Shortnose Sturgeon - Acipenser brevirostrum*

Historically, shortnose sturgeon were found in the coastal rivers along the East Coast of North America—from the Saint John River in New Brunswick, Canada, to the St. Johns River in Florida, and perhaps as far south as the Indian River in Florida. Currently, shortnose sturgeon can be found in 41 bays and rivers along the East Coast, but their distribution across this range is broken up, with a large gap of about 250 miles separating the northern and mid-Atlantic metapopulations from the southern metapopulation. Because of this distance between the shortnose sturgeon in mid-Atlantic/northern metapopulations and the southern metapopulation, adults from the two areas may never meet to breed.

In the southern metapopulation, shortnose sturgeon are currently found in the Great Pee Dee, Waccamaw, Edisto, Cooper, Santee, Altamaha, Ogeechee, and Savannah rivers. They may also be found in the Black, Sampit, Ashley, Roanoke, and Cape Fear rivers, as well as Albemarle Sound and Pamlico Sound. Shortnose sturgeon used to be considered extinct in the Satilla, St. Marys, and the St. Johns rivers, but were recently found again in both the Satilla and St. Marys rivers. A single specimen was found in the St. Johns River by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002 and 2003.

In the northern and mid-Atlantic metapopulations, shortnose sturgeon are currently found in the Saint John (Canada), Penobscot, Kennebec, Androscoggin, Piscataqua, Merrimack, Connecticut, Hudson, Delaware, and Potomac rivers. They have also been frequently spotted opportunistically foraging and transiting in the St. George, Medomak, Damariscotta, Sheepscot, Saco, Deerfield, East, and Susquehanna rivers. On rare occasions, they have been seen in the Narraguagus, Presumpscot, Westfield, Housatonic, Schuylkill, Rappahannock, and James rivers.

There are also two dam-locked populations of shortnose sturgeon that have been trapped upstream of these dams since their construction. Populations can be found above the Holyoke Dam on the Connecticut River, and the Pinopolis, Wilson, and St. Stephens dams on the Santee and Cooper rivers in South Carolina. Shortnose sturgeon can also be found trapped above the dams on the Santee-Cooper system in Lake Moultrie and Lake Marion, as well as the Congaree and Wateree rivers.

The historical range of shortnose sturgeon included major estuaries (areas where rivers meet the sea) and river systems from Canada to Florida. No estimate of the historical population size of shortnose sturgeon is available. While the shortnose sturgeon were rarely the target of a commercial fishery, they were often was taken incidentally in the commercial fishery for Atlantic sturgeon. In the 1950s, sturgeon fisheries declined on the East Coast, which resulted in a lack of records of shortnose sturgeon. This led the Fish and Wildlife Service to conclude that the fish had been eliminated from the rivers in its historic range (except the Hudson River) and was in danger of extinction because of pollution and overfishing, both directly and incidentally.

Currently, shortnose sturgeon are found in 41 rivers and bays along the East Coast, spawning in 19 of those rivers and comprising three "metapopulations," or reproductively isolated groups. These three metapopulations include the Carolinian Province (southern metapopulation), Virginian Province (mid-Atlantic metapopulation), and Acadian Province (northern metapopulation). A status review or viability assessment described this species as declining.

### *Steller Sea Lion - Eumetopias jubatus*

The Steller sea lion was listed as a threatened species under the ESA on November 26, 1990 (55 FR 49204). In 1997, NOAA Fisheries reclassified Steller sea lions as two DPSs based on genetic studies and other information (62 FR 24345); at that time the eastern DPS was listed as threatened and the western DPS was listed as endangered. On November 4, 2013, the eastern DPS was removed from the endangered species list (78 FR 66139). Steller sea lions obtain 100 percent of their diet from the marine environment but depend on terrestrial environments for rookeries (birthing areas) and haulouts (non-birthing resting and loafing areas).

Rookeries occur on gently sloping terrestrial surfaces that are protected from waves but adjacent to marine waters. Sites used as rookeries in the breeding season may also be used as haulouts during other times of year. Critical habitat was designated on August 27, 1993, based on the location of terrestrial rookery and haulout sites, spatial extent of foraging trips, and prey availability (58 FR 45269). Currently, NOAA Fisheries has identified two rookeries and seven haulouts as critical habitat within the Chugach National Forest (50 CFR 226.202). A recent status review or viability assessment showed this species as stable or declining.

### *Beluga whale (Cook Inlet DPS) - Delphinapterus leucas*

In 2000, NOAA Fisheries designated the Cook Inlet beluga whale population as a Candidate Species under the ESA and as depleted under the MMPA. In 2008, the Cook Inlet beluga Distinct Population Segment (DPS) was listed as Endangered under the ESA. The Cook Inlet DPS of beluga whale was listed as Endangered on 13 April 2011 (50 CFR 224.101). A recent status review or viability assessment showed this species as declining.

Cook Inlet beluga whales predominately share the upper and middle portions of Cook Inlet with Alaska's human population center (Anchorage), transportation hub, and largest concentration of industrial activity. Generally, belugas spend the ice-free months in upper Cook Inlet, gathering in discrete, high-use areas with plenty of fish. Breeding and calving typically occur during this gathering period.

After the anadromous fish runs end in late fall and ice begins to form in the upper inlet, belugas begin to disperse into smaller groups, and some head south to the deeper waters of the middle and lower portions of Cook Inlet in winter.

### *Fin Whale - Balaenoptera physalus*

The fin whale was listed as an endangered species under the ESCA on December 2, 1970 (35 FR 18319) and continued to be listed as endangered following passage of the ESA. In the North Pacific, fin whales preferred prey is euphausiids and large copepods, followed by schooling fish such as herring, walleye pollock, and capelin. There is no recent status review or viability assessment.

## *Sperm Whale - Physeter macrocephalus*

The sperm whale was listed as an endangered species under the ESA on December 2, 1970 (35 FR 18319) and continued to be listed as endangered following passage of the ESA. In general sperm whales are considered a pelagic species and are usually found in waters 600 meters or deeper and are uncommon in waters less than 300 meters in near-shore waters. There is no recent status review or viability assessment.

## *Humpback Whale (Mexico DPS) - Megaptera novaeangliae*

The humpback whale was listed as endangered under the Endangered Species Conservation Act (ESCA) on December 2, 1970 (35 FR 18319). Congress replaced the ESCA with the ESA in 1973, and humpback whales continued to be listed as endangered. NMFS recently conducted a global status review and changed the status of humpback whales under the ESA. Under this final rule, the Mexico DPS (distinct population segment, which includes a small portion of humpback whales found in Southeast Alaska) is listed as threatened, and the Hawaii DPS (which includes the majority of humpback whales found in Southeast Alaska) is not listed (81 FR 66260; September 8, 2016). Critical habitat has not been designated for Mexico DPS humpback whales. A recent status review or viability assessment showed this species as stable.

## *Southern Resident Killer Whale - Orcinus orca*

Killer whales (or orcas) are distributed worldwide, but populations are isolated by region and ecotype (different morphology, ecology, and behavior). Southern Resident killer whales occur in the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait during the spring, summer and fall. During the winter, they move to coastal waters primarily off Oregon, Washington, California, and British Columbia. The DPS was listed as endangered under the ESA on November 18, 2005 (70 FR 69903).

According to the NOAA Fisheries website; scientists estimate the minimum historical population size of Southern Residents in the eastern North Pacific was about 140 animals. Following a live-capture fishery in the 1960s for use in marine mammal parks, 71 animals remained in 1974. Although there was some growth in the population in the 1970s and 1980s, with a peak of 98 animals in 1995, the population experienced a decline of almost 20 percent in the late 1990s, leaving 80 whales in 2001. The population census at the end of 2016 counted only 78 whales, and several deaths in 2017 brought the total of this struggling population to 76. In 2003, NOAA Fisheries began a research and conservation program with congressional funding to address the dwindling population.

Critical habitat was designated on 29 November 2006 (71 FR 69054 69070). The physical and biological features identified in the rule include (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging. Area 1. Core Summer Area - Bordered to the North and West by the U.S. / Canadian border, Area 1 includes the waters surrounding the San Juan Islands, the U.S. portion of the Southern Strait of Georgia, and areas directly offshore of Skagit and Whatcom counties. Prey species, one of the primary constituent elements, are present in Area 1. Runs of salmon passing through Area 1 include Chinook, chum, coho, pink, and sockeye salmon. Occurrence of Southern Residents in Area 1 coincides with concentrations of salmon. Southern

Resident killer whales have been sighted in Area 1 during every month of the year, but sightings are more consistent and concentrated in the summer months of June through August.

Area 2. Puget Sound - south from Deception Pass Bridge, entrance to Admiralty Inlet, Hood Canal Bridge. Southern Resident killer whale occurrence in Area 2 has been correlated with fall salmon runs, a prey related primary constituent element. Southern Resident killer whales have been sighted in parts of Area 2 in all seasons despite limited search effort. The presence of Southern Residents in Area 2 is intermittent, with the smallest number of sightings in May-July. There are different sighting patterns in Area 2 for the three pods.

In the most southern portion of Area 2, south of Tacoma Narrows Bridge, there have been only a small number of Southern Resident sightings from October-January, with one additional sighting in April.

Area 3. Strait of Juan de Fuca - Deception Pass Bridge, San Juan and Skagit County lines to the northeast, entrance to Admiralty Inlet to the southeast, U.S./Canadian border to the north, Bonilla Point/Tatoosh Island line to the West. All pods regularly use the Strait of Juan de Fuca for passage from Areas 1 and 2 to outside waters in the Pacific Ocean.

Area 3 is predominantly a passage used to access outer coastal water feeding grounds, including Swiftsure and La Perouse Banks, off Tofino, British Columbia, and off Westport, as well as other areas with unknown usage, such as the coast of northern California. The presence of migrating salmonids in the Strait of Juan de Fuca suggests that feeding might occur during times the whales are transiting.

However, the whales are not known to spend long periods in localized areas in the Strait. Sightings of the Southern Residents in Area 3 are limited, particularly on the U.S. side of the international boundary, as there is little observation effort in the area, particularly to the west toward the Bonilla Point/Tatoosh Island line. Even with a small number of actual sightings, we can infer that the whales are using this corridor, and the passage feature is present in Area 3 based on the inland and coastal sightings of whales. The Strait of Juan de Fuca is not the only transit corridor between inland waters and coastal British Columbia, and the whales occasionally use the Strait of Georgia and Johnstone Strait in Canadian waters as an alternate route.

A recent status review or viability assessment showed this species as declining.

## *Marine Reptiles*

ESA-listed sea turtles and their designated critical habitat can be present in the coastal waters adjacent to National Forest System lands in four states including, California, Oregon, Washington, and Alaska, but primarily in Forest Service Region 5. FS Region 8 in the southeast portion of the country also may have sea turtles associated with National Forest System lands in North Carolina, Georgia and Florida. Sea turtle species include green, loggerhead, Kemp's and Olive ridley, Hawksbill, and leatherback turtles.

Few recent status review or viability assessment exist for these species.

### Green sea turtle- Chelonia mydas

The species was listed Threatened on 6 May 2016. Critical habitat was designated on September 2, 1998 (63 FR 46693). Adult and juvenile green turtles are generally found nearshore as well as in bays and lagoons, on reefs, and especially in areas with seagrass beds. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found in inshore and nearshore waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico. Important feeding areas in Florida include the Indian River Lagoon, the Florida Keys, Florida Bay, Homosassa, Crystal River, Cedar Key, and St. Joseph Bay. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south.

Green turtle nest counts in peninsular Florida have increased eightyfold since nest counts began in 1989 (Florida Fish and Wildlife Conservation Commission, 2020).

## Leatherback sea turtle - Dermochelys coriacea

The species was listed Endangered on 2 June 1970. Critical habitat was designated on the U.S. West Coast on February 27, 2012 (50 CFR 226). Leatherbacks occur in the Atlantic, Pacific, and Indian Oceans. They occupy U.S. waters in the West Pacific, East Pacific, and Northwest Atlantic.

Pacific Leatherbacks: Western Pacific leatherbacks feed off the Pacific Coast of North America, and migrate across the Pacific to nest in Malaysia, Indonesia, Papua New Guinea, and the Solomon Islands. Eastern Pacific leatherbacks, on the other hand, nest along the Pacific coast of the Americas in Mexico and Costa Rica. Western Pacific leatherbacks engage in one of the greatest migrations of any air-breathing marine animal, swimming from tropical nesting beaches in the western Pacific (primarily Papua Barat, Indonesia, Papua New Guinea, and the Solomon Islands) to foraging grounds in the eastern North Pacific. The nearly 7000-mile trans-Pacific journey through the waters of multiple Pacific nations and international water requires 10 to 12 months to complete. The Eastern Pacific leatherback subpopulation nests along the Pacific coast of the Americas from Mexico to Ecuador, and marine habitats extend from the coastline westward. This subpopulation is genetically distinct from all other leatherback subpopulations, despite having some areas of overlap with the Western Pacific subpopulation.

Atlantic Leatherbacks: Globally, the most important nesting beach for leatherbacks lies in the eastern Atlantic in Gabon, Africa. The largest nesting population in the western Atlantic is in French Guiana. Within the United States, the majority of nesting colonies are in the Caribbean, in Puerto Rico and the Virgin Islands, with some nesting in southeast Florida as well. Atlantic leatherbacks are distributed as far north as British Columbia, Newfoundland, and the British Isles, and as far south as Australia, Cape of Good Hope, and Argentina. Leatherback nest counts on core index beaches in Florida show an increase since 1989, but the nest count was slightly lower compared to the number counted during the 2009-2015 period (Florida Fish and Wildlife Conservation Commission, 2020).

Atlantic Canada supports one of the largest seasonal foraging populations of leatherbacks in the Atlantic. In the Atlantic, nesting female leatherbacks tagged on beaches in French Guiana have been tracked, using satellite transmitters, to the west coast of North America as far north as Newfoundland. Leatherbacks have also been satellite tagged at sea on foraging grounds off Nova Scotia and have been tracked from there to nesting beaches in the Caribbean.

## Loggerhead sea turtle- Caretta caretta

The species was listed Endangered on 28 July 1978. Critical habitat was designated on July 10, 2014 (79 FR 39755). Loggerheads are found throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Nine Distinct Population Segments of loggerhead sea turtles are listed under the Endangered Species Act. In the Atlantic, the loggerhead turtle's range extends from Newfoundland to as far south as Argentina. They are the most abundant species of sea turtle found in U.S. coastal waters of the Atlantic Ocean. During the summer, nesting occurs primarily in the subtropics. Although the major nesting concentrations in the U.S. are found from North Carolina through southwest Florida, minimal nesting occurs outside of this range westward to Texas and northward to Virginia. Adult loggerheads make extensive migrations between foraging areas and nesting beaches. During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern United States and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and the Yucatán Peninsula, Mexico.

In the eastern Pacific, loggerheads have been reported in waters as far north as Alaska, and as far south as Chile. In the United States, occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The west coast of Mexico, including the Baja Peninsula, provides critically important developmental habitats for North Pacific juvenile loggerheads which nest only in Japan. Annual loggerhead nest counts between 1989 and 2020 on index beaches in peninsular Florida show a stable to increasing trend (Florida Fish and Wildlife Conservation Commission, 2020).

## Olive ridley sea turtle- Lepidochelys olivacea

The species was listed Threatened on 28 July 1978. The olive ridley is mainly a pelagic (open ocean) sea turtle, but has been known to inhabit coastal areas, including bays and estuaries. Olive ridleys mostly breed annually and have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, back to pelagic foraging. Olive ridleys are globally distributed in the tropical regions of the Atlantic, Pacific, and Indian Oceans. In the Atlantic Ocean, they are found along the coasts of West Africa and South America. In the Eastern Pacific, they occur from Southern California to Northern Chile. In the wider Caribbean Region and Mexico, their abundance has increased since 2008 (Berzins & Parathoen, 2019), but too few data are available to confirm a declining trend in abundance that has been described in the eastern Pacific.

## Hawksbill sea turtle - Eretmocheleys imbricata

Hawksbill turtles use different habitats at different stages of their life cycle, but they are most commonly found in healthy coral reefs. In the Eastern Pacific, hawksbills also inhabit mangrove estuaries. Juvenile turtles are believed to occupy the pelagic zone (the open sea), taking shelter in floating algal mats and drift lines of flotsam and jetsam. After a few years in the pelagic zone, small juveniles migrate to shallower coastal feeding grounds, including their preferred coral reef habitats.

The ledges and caves of coral reefs provide shelter for resting hawksbills during the day and at night. Hawksbills are known to rest in the same spot night after night. Hawksbills are also found around rock formations and high energy shoals, which are sand bars in shallow water. These places are very good sites for sponge growth. The turtles are also known to live in mangroves in bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent.

In the U.S. Atlantic territories, hawksbills are most common in Puerto Rico and the U.S. Virgin Islands. In the continental U.S., hawksbills are found primarily in Florida and Texas, though they have sometimes been found in each of the Gulf States and on the east coast as far north as Massachusetts. In Florida, hawksbills live in the reefs off Palm Beach, Broward, Miami-Dade, and Monroe Counties. Most sightings involve post-hatchlings and juveniles. These small turtles are believed to come from nesting beaches in Mexico.

Along the Pacific Rim, hawksbills sometimes nest in the southern part of the Baja peninsula. Sightings of juveniles and young adults foraging along the coast occur more regularly. Small nesting populations exist along the Eastern Pacific coast of the Americas from Mexico to Ecuador. The 5-year status review indicated the 63 out of 88 monitoring sites showed declining abundance (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 2013).

## Kemp’s Ridley sea turtle – Lepidochelys kempii

Kemp's ridleys are distributed throughout the Gulf of Mexico and U.S. Atlantic seaboard, from Florida to New England. Adult Kemp's primarily occupy nearshore coastal (neritic) habitats which typically contain muddy or sandy bottoms where their preferred prey are found. Depending on their breeding strategy, male Kemp's ridleys appear to occupy many different areas within the Gulf of Mexico. Some males migrate annually between feeding and breeding grounds, yet others may not migrate at all, mating with females encountered at their feeding grounds or near nesting beaches. Female Kemp's ridleys have been tracked migrating to and from nesting beaches in Mexico and south Texas. Females leave breeding and nesting areas and migrate to foraging areas ranging from the Yucatán Peninsula to southern Florida. Some females take up residence in specific foraging grounds for months at a time and return to the same foraging grounds in subsequent years. Nesting also occurs in Veracruz, Mexico, and in Texas, but on a much smaller scale. Occasional nesting has been documented in North Carolina, South Carolina, and Florida. The 5-Year Review by the regulatory agencies concluded that Kemp's Ridley sea turtle are stable or declining based on available information (National Marine Fisheries Service and U.S. Fish and Wildlife Service, 2015).

# Environmental Baseline

The environmental baseline for this consultation provides the backdrop for evaluating the effects of the action on listed resources under NOAA Fisheries jurisdiction. The environmental baseline includes the past and present impacts of all state, Federal or private actions and other human activities in the action area (50 CFR 402.02). New information is presented for the Alaska Region because it was not part of the original consultation.

The environmental baseline for this consultation was divided into 4 broad geographic regions: the Alaska Region, Pacific Northwest Region, the Southwest Region, and a combination of two NOAA Fisheries - defined regions; the Southeast Atlantic and Gulf Coast Regions. In some instances, regions were further subdivided into recovery domains, that are relevant to NOAA Fisheries trust resources.

Baseline characteristic common to all ecoregions: All species described in this BA are likely to be threatened by the direct and indirect effects of climate change. Climate change is projected to have substantial direct effects on individuals, populations, species, and the community structure and function of marine, coastal, and terrestrial ecosystems in the foreseeable future (IPCC, 2002) (IPCC, 2013) (McCarty, 2001) (Parry, Canziani, Palutikof, van der Linden, & Hanson, 2007). Increasing atmospheric temperatures have already contributed to changes in the quality of freshwater, coastal, and marine ecosystems and have contributed to the decline of populations of endangered and threatened species (Karl, Melillo, & Peterson, 2009) (Littell, Elsner, Whitely Binder, & Snover, 2009) (Mantua, Hare, Zhang, Wallace, & Francis, 1997).

Warming water temperatures attributed to climate change can have significant effects on survival, reproduction, and growth rates of aquatic organisms (Staudinger, Grimm, & Staudt, 2012). From 1906-2006, global surface temperatures have risen 0.74º C and continue to rise at an accelerating pace; 11 of the 12 warmest years on record since 1850 have occurred since 1995 (Poloczanska, Limpus, & Hays, 2009). The direct effects of climate change include increases in atmospheric temperatures, decreases in sea ice, and changes in sea surface temperatures, patterns of precipitation, and sea level. For example, warmer water temperatures have been identified as a factor in the decline and disappearance of mussel and barnacle beds in the Northwest (Harley, 2011).

Changes in temperature and precipitation projected over the next few decades are projected to decrease snow pack, affect stream flow and water quality throughout the Pacific Northwest region (Knowles, Dettinger, & Cayan, 2006) (Mote, Hamlet, & Salathe, 2008) (Rauscher, Pal, Diffenbaugh, & Benedetti, 2008) (Stewart, Cayan, & Dettinger, 2004). Warmer temperatures are expected to reduce snow accumulation and increase stream flows during the winter, cause spring snowmelt to occur earlier in the year causing spring stream flows to peak earlier in the year, and reduced summer stream flows in rivers that depend on snow melt (most rivers in the Pacific Northwest depend on snow melt).

As a result of these changes, seasonal stream flow timing will likely shift significantly in sensitive watersheds (Littell et al. 2009). Increased extremes in river flow (periods of flooding and low flow) can alternatively disrupt and fill in spawning habitat that salmon and sturgeon rely upon (ISAB, 2007). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, 47 percent would be negatively affected, and 21 percent would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats (Macleod, 2009). About one third of the current habitat for either the endangered or threatened Northwest salmon species will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded (Littell et al. 2009). As summer temperatures increase, juvenile salmon are expected to experience reduced growth rates, impaired smoltification and greater vulnerability to predators.

As a result of these changes, seasonal stream flow timing will likely shift significantly in sensitive watersheds (Littell et al. 2009). Increased extremes in river flow (periods of flooding and low flow) can alternatively disrupt and fill in spawning habitat that sturgeon rely upon (ISAB, 2007). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, 47 percent would be negatively affected, and 21 percent would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats (Macleod, 2009). About one third of the current habitat for either the endangered or threatened Northwest salmon species will no longer be suitable for them by the end of this century as key temperature thresholds are exceeded (Littell et al. 2009). As summer temperatures increase, juvenile salmon are expected to experience reduced growth rates, impaired smoltification and greater vulnerability to predators.

## *Alaska Region*

The Alaska Region occupies the rugged, mountainous coast of the northeast Pacific Ocean. The maze of fjords and islands, streams and mountains characterizing the Region support a wide array of vegetation types ranging from vast wetlands to luxuriant temperate rainforests to magnificent alpine ecosystems. There are two national forests in the Alaska Region; the Tongass National Forest and the Chugach National Forest. However, the two forests are the largest national forests in the Country. The Chugach surrounds Prince William Sound and is near Anchorage, Alaska's largest city. The Tongass National Forest includes the islands and mainland of southeastern Alaska and surrounds the towns of Ketchikan, Sitka, Juneau, Petersburg, Wrangell, Yakutat and Skagway.

### Natural History

Compared with other areas of the North American continent, Alaska formed in the recent geologic past. Until 200 million years ago, western North America terminated at the Rocky Mountains, 120 miles further inland than the current shoreline, until the addition of the Yukon-Tanana Terrane. Aside from the interior of Alaska, a different schist belt may underlie the Brooks Range and is known from deep boreholes in the vicinity of Prudhoe Bay, reaching greenschist and blueschist on the sequence of metamorphic facies. Precambrian metasedimentary gneiss is found in the Kigluaik Mountains on the Seward Peninsula, while in southeast Alaska, additional Precambrian rocks underlie Prince of Wales Island.

The southeast region of Alaska, along the Alexander Archipelago, near the Tongass National Forest, is dominated by a mid-latitude oceanic climate in the south, an oceanic, marine sub-polar climate in the central region around Juneau, and a subarctic climate to the far northwest and the interior highlands of the archipelago. Southeast Alaska is also the only region in Alaska where the average daytime high temperature is above freezing during the winter months. The area tends to be a graveyard for North Pacific storms and has the highest precipitation in Alaska. At low elevations winter precipitation may fall as rain or snow; and the lowlands are covered with temperate rain forest. Higher elevations nourish glaciers reaching tidewater.

The climate in south central Alaska, along the coast near the Chugach-St Elias Mountains, and near the Chugach National Forest, is mild by Alaskan standards. This is due in large part to its proximity to the coast. While it does not get nearly as much rain as the southeast of Alaska, it does get more snow, although days tend to be clearer here. It is a subarctic climate due to its short, cool summers. There are frequent, strong southeast winds known as the Knik wind in the vicinity of Palmer, especially in the winter months.

**Table BA-15. Select rivers within the Chugach and Tongass National Forest vicinity.**

| Watershed | Length (miles [approx.) | Basin Size ($mi^2$) |
|---|---|---|
| Stikine River | 380 | 20,000 |
| Copper River | 290 | 24,000 |
| Susitna River | 313 | 20,000 |

## Human Activities and Their Impacts

### *Land Use-Chugach National Forest*

The Chugach National Forest is composed of large, functional, intact ecosystems spread across coastal and inland landscapes located in close proximity to half the population of Alaska. Nearly 99 percent of the national forest is managed to allow natural ecological processes to occur with limited human influence and consistent with the Roadless Area Conservation Rule of 2001.

The landscape is divided into three distinct areas, identified as the Kenai Peninsula, Prince William Sound, and Copper River Delta geographic regions:

- The Kenai Peninsula geographic area is managed to accommodate high levels of human use, while maintaining its natural appearing character. The Seward, Sterling and Portage highway corridors (0.75 miles either side of the highways) and other road corridors contain developed recreation sites and provide access points for a variety of dispersed recreational activities.
- The lands within Prince William Sound are managed primarily to maintain the wild character of this area. Human access remains almost exclusively by boat or aircraft with the exception of the road accessed portals of Whittier and Valdez. Most of the remaining lands maintain their natural characteristics while providing accommodation to human visitors.
- The Copper River Delta lands are managed primarily for the conservation of fish and wildlife. Most of the area remains in its natural state with the exception of the road corridor extending from Cordova. The unique ecological role of the Copper River Delta in providing habitat to waterfowl, terns, shorebirds and migratory birds, wildlife, and fish is maintained.

The boundary of the Chugach National Forest encompasses 9.6 million acres of lands and waters including the entirety of Prince William Sound (USFS 2019b). The Chugach National Forest manages 5.4 million acres (86 percent) of the uplands, which includes the majority of the mainland surrounding Prince William Sound, and most of the islands as well. The State-managed marine waters of Prince William Sound support a variety of commercial and recreational uses year-round, and serve as a key part of Alaska's transportation system. Commercial marine traffic is substantial, and includes international cruise ships, oil tankers, container ships, barges, commercial and sport fishing vessels, intra and interstate ferry vessels, water taxis and tour boats. Prince William Sound also experiences both concentrated and dispersed recreational and subsistence use using a variety of motorized and non-motorized watercraft, including fishing and sailing boats, kayaks and personal watercraft.

The majority of all vegetation or habitat management and other ground disturbing activities are conducted within the Kenai Peninsula Geographic Area in close proximity to the existing road system. A few additional habitat restoration projects are planned or being conducted within the Copper River Delta Geographic Area. Most of these management activities are designed to reduce wildland fuel hazards in proximity to human use areas, restore native vegetative communities, stream or wetland habitats, improve water quality, or enhance habitat for selected fish and wildlife species. Due to the nature and limited scope of vegetation and ground disturbing activities, and their concentration at inland locations, these management actions have very little influence on ecological conditions of coastal and marine habitats within the action area.

The only NFS lands used by Steller sea lions are rookery and haulout sites located on gradually sloping ocean shorelines protected from waves. Two rookeries and seven haulouts located on lands managed bythe Chugach National Forest have been identified by NMFS as critical habitat (50 CFR 226.202). These critical habitat sites are protected from human disturbance by federal regulations establishing a 3,000 foot buffer inland and vertically from the sites. These sites also include a 20 nm marine buffer subject to specific fishery regulations. Steller sea lions use other haulout sites on the Forest but usually in smaller numbers or with less regularity.

The rich State-managed marine waters of Prince William Sound adjacent to the Chugach National Forest serve as important feeding habitat for humpback whales (Teerlink et al. 2015), Steller sea lions, and many other marine dependent species. While fin whales also use Prince William Sound, reported sightings are much less frequent than for humpbacks. The upper reaches of Cook Inlet provide year-round habitat for beluga whales, and the tributary waters of Twentymile River provide important seasonal foraging habitat. The upstream extent of beluga use of the Twentymile River is unknown, but they have been documented regularly at least 1000 feet upstream of the railroad bridge.

### *Land Use-Tongass National Forest*

Encompassing approximately 17 million acres, the Tongass National Forest is the largest administrative unit in the National Forest System, in the nation's largest State. The Tongass is a naturally fragmented patchwork of temperate rainforest bordered by muskeg, alpine meadow, rock, water, and ice distributed across 22,000 islands and a narrow strip of mainland encompassing nearly all of Southeast Alaska.

Ecological Factors – Unlike many NFS lands in the contiguous 48 States, the Tongass National Forest does not have a long history of intense multiple-use management (USFS 2020). Compared to other forests and regions, the Tongass has relatively few threatened, endangered, proposed, and sensitive (TEPS) species. Management activities that have affected overall ecosystem health are tied predominantly to intensive roading and timber harvest that has occurred within the past few decades.

The Tongass National Forest comprises the majority of the northern Pacific coast ecoregion. This ecoregion occupies a narrow (160 km wide) coastal band extending from the southern portion of the Alexander Archipelago to Prince William Sound and eastern Kodiak Island. Containing more than one fourth of the world's coastal temperate rainforests, this ecoregion is one of the most pristine temperate rainforest and shoreline ecosystems in the world (Ricketts and others 1999).

### *Hydromodification Projects*

Few of the rivers within the area surrounding the National Forests in Alaska and no rivers within the forests have been modified by significant dams, water diversions and drainage systems.

While hydropower has occurred and still do exist on the Tongass, the effects of this activities is far less than the effects of these activities throughout the rest of the United States.

### *Mining*

The name of the Copper River, within the Chugach National Forest, comes from the abundant copper deposits along the upper river that were used by Alaska Native population and then later by settlers from the Russian Empire and the United States. Extraction of the copper resources was problematic due to navigation difficulties at the river's mouth. The construction of the Copper River and Northwestern Railway from Cordova through the upper river valley from 1908 to 1911 allowed widespread extraction of the mineral resources, in particular from the Kennecott Mine, discovered in 1898. The mine was abandoned in 1938 and is now a ghost town tourist attraction and historic district maintained by the National Park Service.

The Ross-Adams Mine Site (Site) is a former uranium mine located in the Tongass National Forest near the southern end of Prince of Wales Island, Alaska. The Ross-Adams Mine was mined by open pit and then later by underground operations intermittently between 1957 and 1971 by several different mining companies. The USDA Forest Service is the lead agency for the Site cleanup process. Otherwise, mining still occurs on the Tongass NF, but the effects are minimal.

### *Artificial Propagation*

There are at least 18 salmon hatcheries along the along the coast and islands of the Tongass National Forest. There are another 14 in the vicinity of Anchorage and Cook Inlet, but few that are closer to the Chugach National Forest.

### *Commercial and Recreational Fishing*

Most of the commercial landings in the region are groundfish, Dungeness crab, shrimp, and salmon. Many of the same species are sought by Tribal fisheries, and by charter, and recreational anglers. Nets and trolling are used in commercial and Tribal fisheries, whereas recreational anglers typically use hook and line, and may fish from boat, river bank, and docks. Entanglement of marine mammals in fishing gear is not uncommon and can lead to mortality or serious injury.

## The Risk of Fire in the Region

In the southeastern Alaska coastal forest, lightning caused wildland fire is not ecologically significant (Skorkowsky 2020). The majority of the fires are human caused. Over 100 inches of rainfall occur in coastal areas each year make natural ignitions and fires over 100 acres near the national forest unlikely.

# *Pacific Northwest Region*

This region encompasses Washington, Oregon, Idaho, and includes parts of Nevada, Montana, Wyoming, Alaska and British Columbia. The region is ecologically diverse, encompassing northern marine lowland forests, mountain forests, alpine meadows and Northern desert habitat. In this section we focus on five recovery domains that characterize the region, including; interior Columbia River, Willamette/Lower Columbia, Puget Sound, and Oregon Coast, and Southern Oregon/Northern California Coast.

## Interior Columbia River and Willamette/ Columbia Recovery Domains

### Natural History

The Columbia River is the most notable river, the largest river in the Pacific Northwest, and the fourth largest river in terms of average discharge the United States drains an area over 258,000 square miles (making it the sixth largest in terms of drainage area). Major tributaries include the Snake, Willamette, Salmon, Flathead, and Yakima rivers; smaller rivers include the Owyhee, Grande Ronde, Clearwater, Spokane, Methow, Cowlitz and the John Day Rivers. The Snake River is the largest tributary at more than 1,000 miles long; its headwaters originating in Yellowstone National Park, Wyoming. The second largest tributary is the Willamette River in Oregon (Kammerer 1990; Hinck et al. 2004).

The climate within the basin is a mix of arid, dry summers, cold winters, and maritime air masses entering from the west. It is not uncommon for air temperatures in the Rocky Mountains to dip below zero in mid-winter, but summer air temperatures can reach more than 100 degrees Farenheit in the middle basin.

The river and estuary were once home to more than 200 distinct runs of Pacific salmon and steelhead, and represented adaptation to the local environment within a tributary or segment of a river. Salmonids within the basin include Chinook, chum, coho, sockeye salmon, steelhead and redband trout, bull trout, and cutthroat trout. Other fish species within the basin include sturgeon, eulachon, lamprey, and sculpin (Wydoski and Whitney 1979).

### Human Activities and Their Impacts

#### Land Use

More than 50 percent of the United States' portion of the Columbia River Basin is in federal ownership (most of which occurs in high desert and mountain areas), 39 percent is in private land ownership (most of which occurs in river valleys and plateaus), and the remainder is divided among tribes, state, and local governments (Hinck et al. 2004).

The interior Columbia Basin has been altered substantially by humans causing dramatic changes and declines in many native fish populations. In general, the basin supports a variety of mixed uses. Predominant human uses include logging, agriculture, ranching, hydroelectric power generation, mining, fishing and a variety of recreational activities, and urban uses.

#### Hydromodification Projects

More than 400 dams exist in the basin ranging from mega dams that store large amounts of water to small diversion dams for irrigation. Every major tributary of the Columbia except the Salmon River is totally or partially regulated by dams and diversions. More than 150 dams are major hydroelectric projects of which 18 dams are located on mainstem Columbia River and its major tributary, the Snake River. The federal Columbia River Power System encompasses the operations of 14 major dams and reservoirs on the Columbia and Snake rivers, operated as a coordinated system. The Army Corps of Engineers operates nine of 10 major federal projects on the Columbia and Snake rivers, and Dworshak, Libby and Albeni Falls dams. The Bureau of Reclamation operates Grand Coulee and Hungry Horse dams. These federal projects are a major source of power in the region, and provide flood control, navigation, recreation, fish and wildlife, municipal and industrial water supply, and irrigation benefits.

Development of the Pacific Northwest regional hydroelectric power system, dating to the early twentieth century, has had profound effects on the ecosystems of the Columbia River Basin (ISG 1996). These effects have been especially adverse to the survival of anadromous salmonids.

#### Artificial Propagation

There are several artificial propagation programs for salmon production within the Columbia River Basin, many of which were instituted under federal law to ameliorate the effects of lost natural production of salmon within the basin from the dams on fishing. The hatcheries are operated by federal, state, and tribal managers. For more than 100 years, hatcheries in the Pacific Northwest have been used to produce fish for harvest and replace natural production lost to dam construction, and have only minimally been used to protect and rebuild naturally produced salmonid population (Sacramento River winter Chinook salmon). In 1987, 95 percent of the coho salmon, 70 percent of the spring Chinook salmon, 80 percent of the summer Chinook salmon, 50 percent of the fall Chinook salmon, and 70 percent of the steelhead returning to the Columbia River Basin originated in hatcheries (CBFWA 1990). More recent estimates suggest that almost half of the total number of smolts produced in the basin come from hatcheries (Mann et al. 2005).

The impact of artificial propagation on the total production of Pacific salmon and steelhead has been extensive (Hard et al. 1992). Hatchery practices, among other factors, are a contributing factor to the 90 percent reduction in natural coho salmon runs in the lower Columbia River of the past 30 years (Flagg et al. 1995).

#### Mining

Many of the streams and river reaches in the basin are impaired from mining and several abandoned and former mining sites are designated as superfund cleanup areas. According to the U.S. Bureau of Mines, there are about 14,000 inactive or abandoned mines within the Columbia River Basin of which nearly 200 pose a potential hazard to the environment (Quigley 1997 in Hinck et al. 2004).

### *Commercial, Recreational, and Subsistence Fishing*

Archeological records indicate that indigenous people caught salmon in the Columbia River more than 7,000 years ago. One of the most well-known tribal fishing sites within the basin was located near Celilo Falls, an area submerged by The Dalles Dam in 1957 and the slackwater created behind it. Celilo Falls, was the economic and cultural hub of Native Americans in the region and the oldest continuously inhabited settlement in North America (Deitrich, 1995). Salmon fishing increased with better fishing methods and preservation techniques, such as drying and smoking, such that harvest substantially increased in the mid-1800s with canning techniques. Harvest techniques also changed over time, from early use of hand-held spears and dip nets, to river boats that used seines and gill-nets, eventually, transitioning to large ocean-going vessels with trolling gear and nets and the harvest of Columbia River salmon and steelhead off the waters of the entire west coast, from California to Alaska (Mann et al. 2005).

## Puget Sound Recovery Domain

### *Natural History*

The Puget Sound watershed is defined by the crest lines of the Olympia Mountain Range (and the Olympic Peninsula) to the west and the Cascade Mountain Range to the east. As the second largest estuary in the United States, Puget Sound has about 1,330 miles of shoreline, extends from the mouth of the Strait of Juan de Fuca east, including the San Juan Islands and south to Olympia, and is fed by more than 10,000 rivers and streams.

Major rivers draining to Puget Sound from the Cascade Mountains include the Skagit River, the Snohomish River, the Nooksack River, the Puyallup/Green River, and the Lake Washington/Cedar River watershed. Major rivers from the Olympic Mountains include the Hamma, the Duckabush, the Quilcene, and the Skokomish rivers. Numerous other smaller rivers drain to the Sound, many of which are significant producers of salmonids despite their small size.

The Puget Sound basin is home to more than 200 fish species, representing more than 50 families; more than 140 mammals, of which less than a third are marine mammals. Salmonids within the region include Coho salmon, Chinook salmon, sockeye salmon and kokanee, chum salmon, pink salmon, steelhead and rainbow trout, coastal cutthroat trout, bull trout, and Dolly Varden (Wydoski and Whitney 1979). At present over 40 species in the region are listed as threatened and endangered under the ESA.

### *Human Activities and Their Impacts*

#### Land Use

Land use in the Puget Sound lowland is composed of agricultural areas (including forests for timber production), urban areas (industrial and residential use), and rural areas (low density residential with some agricultural activity). In the 1930s, all of Western Washington contained about 15.5 million acres of "harvestable" forest land and by 2004 the total acreage was nearly half that surveyed more than 70 years earlier (PSAT 2010). Forest cover in Puget Sound alone was about 5.4 million acres in the early 1990s and about a decade later the region had lost another 200,000 acres of forest cover with some watersheds losing more than half the total forested acreage. The most intensive loss of forest cover has occurred in the State's Urban Growth Boundary, which encompasses specific parts of the Puget Lowland; in this area forest cover declined by 11.1 percent between 1991 and 1999 (Ruckelshaus and McClure 2007). Projected land cover changes indicate that trends are likely to continue over the next several decades with population changes—coniferous forests are projected to decline as urban uses increase.

#### Hydromodification Projects

More than 20 dams occur within the region's rivers and overlap with the distribution of salmonids, and a number of basins contain water withdrawal projects or small impoundments that can impede migrating salmon. The resultant impact of these and land use changes (forest cover loss and impervious surface increases) has been a significant modification in the seasonal flow patterns of area rivers and streams, and the volume and quality of water delivered to Puget Sound waters. Several rivers have been hydro modified by other means including levees and revetments, and bank hardening for erosion control, and agriculture uses.

#### Mining

Mining has a long history in the State of Washington, and in 2004 the state was ranked 13th nationally in total nonfuel mineral production value and 17th in coal production (Palmisano et al. 1993; NMA 2007). Metal mining for all metals (for example, zinc, copper, lead, silver, and gold) peaked in the State between 1940 and 1970 (Palmisano et al. 1993). Today, construction sand and gravel, Portland cement and crushed stone are the predominant materials mined. Where sand and gravel is mined from riverbeds (gravel bars and floodplains) it may result in changes in channel elevations. Puget and patterns, instream sediment loads, and seriously alter instream habitat.

#### Commercial and Recreational Fishing

Most of the commercial landings in the region are groundfish, Dungeness crab, shrimp, and salmon. Many of the same species are sought by Tribal fisheries, and by charter, and recreational anglers. Nets and trolling are used in commercial and Tribal fisheries, whereas recreational anglers typically use hook and line, and may fish from boat, river bank, and docks. Entanglement of marine mammals in fishing gear is not uncommon and can lead to mortality or serious injury.

## Oregon Coast and Southern Oregon/Northern California Coast Recovery Domains

This area encompasses two recovery domains originating in the Oregon and Northern California Coast Mountains --the Coast Range ecoregion where elevations range from sea level to about 4,000 feet. More than 15 watersheds drain the region's steep slopes including the Umpqua, Alsea, Yaquina, Nehalem, and Eel Rivers. Numerous other small to moderately sized streams dot the coastline. Many of the basins in this region are relatively small—the Umpqua River drains a basin of 4,685 sq. miles and is a little over 110 miles long and the Nehalem River drains a basin of 855 sq. miles and is almost 120 miles long—yet represent some of the most biologically diverse basins in the Pacific Northwest (Johnson 1999; Kagan et al. 1999; Carter and Resh 2005).

The region is part of a coastal, temperate rainforest system, and is characterized by moderate maritime climate marked by long wet seasons with short dry seasons and mild to cool year-round temperatures. Average annual precipitation ranges from about 60 inches to more than 180 inches, much of which falls as rain, and supports a rich temperate forest. Vegetation is characterized by giant coniferous forests of Sitka spruce, western hemlock, Douglas fir, western red cedar, and red alder and black cottonwood.

### *Human Activities and Their Impacts*

#### Land Use

The rugged topography of the Oregon and Northern California Coastal Range has limited the development of dense population centers. For instance, the Nehalem River and the Umpqua River basins consist of less than 1 percent urban land uses. Most basins in this region have long been managed for timber production, and are still dominated by forestlands. Approximately 92 percent of the Nehalem River basin is forested, with only 4 percent considered agricultural. Similarly, in the Umpqua River basin about 86 percent is forested land, 5 percent agriculture and 0.5 percent are considered urban lands—with about half the basin under federal management (Carter and Resh 2005).

#### Hydromodification Projects

Compared to other areas in the greater Northwest Region, the coastal region has fewer dams and several rivers remain free flowing. The Umpqua River is fragmented by 64 dams, the fewest number of dams on any large river basin in Oregon (Carter and Resh 2005).

In the past, temporary splash dams were constructed throughout the region to transport logs out of mountainous reaches. The general practice involved building a temporary dam in the creek adjacent to the area being logged, the pond was filled with logs and when the dam broke the floodwater would carry the logs to downstream reaches where they could be rafted and moved to market or downstream mills. Thousands of splash dams were constructed across the Northwest in the late 1800s and early 1900s. While the dams typically only temporarily blocked salmon habitat, in some cases they remained long enough to wipe out entire runs, the effects of the channel scouring and loss of channel complexity resulted in the long term loss of salmon habitat (NRC 1996).

#### Mining

Oregon is ranked 35th nationally in total nonfuel mineral production value in 2004. For mining in Washington State, see Puget Sound Recovery Domain above.

#### Commercial and Recreational Fishing

Most of the commercial landings in the region are groundfish, Dungeness crab, shrimp, and salmon. Many of the same species are sought by Tribal fisheries, and by charter, and recreational anglers. Nets and trolling are used in commercial and Tribal fisheries, whereas recreational anglers typically use hook and line, and may fish from boat, river bank, and docks. Entanglement of marine mammals in fishing gear is not uncommon and can lead to mortality or serious injury.

### The Risk of Fire in the Region

Peak fire season in the Pacific Northwest Region occurs between April and October. Based on a review of more than 80,000 wildfires, Malamud et al. (2005) calculated the wildfire recurrence interval for large fires (larger than 2,471 acres (10 km2)) in the marine mountain ecoregion that encompasses the Coastal Basins and Puget Sound, as ranging between every 63 to 137 years. Whereas, wildfire recurrence interval for large fires (greater than 2,471 acres (10 km2)) in the Columbia River watershed, which also covers the more arid Temperate Dessert, Temperate Steppe, and Temperate Steppe Mountain ecoregions, is more frequent—ranging from every 8 to 18 years in the Temperate Dessert, every 14 to 30 years in the Temperate Steppe ecoregion, and every 26 to 46 years in the Temperate Steppe Mountain ecoregion (Malamud et al. 2005).

## *Southwest Region*

The basins described in this section are encompassed by the state of California and southern Oregon. Essentially, this region encompasses all Pacific Coast rivers south of Cape Blanco, Oregon, through California and into southern California. The Cape Blanco area marks a major biogeographic boundary and has been identified by NMFS as a DPS/ESU boundary for Chinook and Coho salmon, and steelhead on the basis of strong genetic, life history, ecological and habitat differences north and south of this landmark. Major rivers contained in this grouping of watersheds are the Sacramento, San Joaquin, Salinas, Eel, Russian, Santa Ana and Santa Margarita Rivers.

#### Natural History

The physiographic regions covered by the basins discussed herein include: (a) the Cascade-Sierra Nevada Mountains province, which extends beyond this region as we have defined it and continue north into British Columbia, (b) the Pacific Border province, and (c) the Lower California province (Carter and Resh 2005). The broader ecoregions division, as defined by Bailey (1995) is the Mediterranean Division.

This region is the most geologically young and tectonically active region in North America. The Coast Range Mountains are folded and faulted formations, with a variety of soil types and nutrients that influence the hydrology and biology of the individual basins (Carter and Resh 2005). The region also covers the Klamath Mountains and the Sierra Nevada.

The climate is defined by hot dry summers and wet, mild winters, with precipitation generally decreasing in southern latitudes although precipitation is strongly influenced by topography and generally increases with elevation. Annual precipitation varies from less than 10 inches to more than 50 inches in the region. This likely increases the variability in the annual composition of the fish assemblies in the region.

### Human Activities and Their Impacts

Land use is dominated by forest in northern basins, and grass, shrub land, and urban uses dominate in southern basins (Carter and Resh 2005, displayed in Table 5). Overall, the most developed watersheds are the Santa Ana, Russian, and Santa Margarita rivers. About 50 percent of coastal subbasin of the Santa Ana watershed is dominated by urban land uses where the population density is about 1,500 people per square mile and the most densely populated portion of the basin is near the city of Santa Ana where density reaches 20,000 people per square mile.

In many basins, agriculture is the major water user and the major source of water pollution to surface waters. In 1990 nearly 95 percent of the water diverted from the San Joaquin River was diverted for agriculture, and 1.5 percent diverted for livestock (Carter and Resh 2005). A study conducted by USGS in the mid-1990s on water quality within San Joaquin River basin detected 49 pesticides in the mainstem and three subbasins--22 pesticides were detected in 20 percent of the samples and concentrations of seven exceeded water quality standards (Dubrovsky et al. 1998). Water chemistry in the Salinas River is strongly influenced by intensive agriculture—water hardness, alkalinity, nutrients (including nitrogen and phosphorus based fertilizers) and conductivity are high in areas where agricultural uses predominate.

#### Mining

Famous for the gold rush of the mid 1800s, California has a long history of mining. In 2004, California ranked top in the nation for nonfuel mineral production with 8.23 percent of the total production (NMA 2007). Today, gold with silver and iron ore comprise only 1 percent of the production value. Primary minerals include construction sand and gravel, cement, boron and crushed stone. California is the only state to produce boron, rare-earth metals and asbestos (NMA 2007).

#### Hydromodification Projects

Several of the rivers within the area have been modified by dams, water diversions and drainage systems for agriculture and drinking water, and some of the most drastic channelization projects within the nation. In all, there are about 1,400 dams within the State of California, more than 5,000 miles of levees, and more than 140 aqueducts (Mount 1995 in Carter and Resh 2005). While about 75 percent of the runoff occurs in basins in the northern half of the State, 80 percent of the water demand is in the southern half of the State. Two water diversion projects meet these demands—the federal Central Valley Project and the California State Water Project.

Both the Sacramento River and the San Joaquin River are heavily modified, each with hundreds of dams. The Rogue, Russian, and Santa Ana rivers each have more than 50 dams, and the Eel, Salinas, and the Klamath Rivers have between 14 and 24 dams. The Santa Margarita considered one the last free flowing rivers in coastal southern California has 9 dams in its watershed. All major tributaries of the San Joaquin River are impounded at least once and most have multiple dams or diversions.

#### Commercial and Recreational Fishing

The region is home to many commercial fisheries. The largest in terms of total landings in 2006 were northern anchovy, Pacific sardine, Chinook salmon, sablefish, Dover sole, Pacific whiting, squid, red sea urchin, and Dungeness crab (CDFG 2007).

### The Risk of Fire in the Region

Peak fire season in the Southwest Coast Region occurs between April and October. Based on a review of more than 80,000 wildfires, Malamud *et al.* (2005) calculated the wildfire recurrence interval for large fires (greater than 2,471 acres (10 $km^2$)) in the Mediterranean and Mediterranean Mountain ecoregions that encompasses most of this region, as every year to 3 years in the lowland or Mediterranean ecoregion, and less frequently in the Mediterranean Mountains – approximately every 9 to 17 years.

## *Southeast Atlantic Region, and Gulf Coast Region*

### Land Use-Southeast Atlantic Region

This region encompasses two NMFS-defined regions. The states along the Southeast United States from South Carolina to Florida (including parts of Georgia) make up the first NMFS Region and the Gulf of Mexico coast and states from Florida to Texas, and Louisiana to Canada are the second NMFS Region; both combined for the purpose of this analysis.

The southeast Atlantic region is ecologically diverse, encompassing broad ecoregions—according to Bailey's (1995) Description of the Ecoregions of the United States this region encompasses the hot continental and the hot continental mountains divisions —these ecoregions can be further subdivided into provinces based on vegetation (Bailey 1995). The hot continental region of the southeast coast and adjacent forested areas are characterized by its winter deciduous forest dominated by tall broadleaf trees, moderately leached soils rich in humus (Inceptisols, Ultisols, and Alfisols), and rainfall totals that decrease with distance from the ocean (Bailey 1995).

Most of the Southeast Atlantic Coast Region is contained within the subtropical ecoregion and is characterized by a humid subtropical climate with particularly high humidity during summer months, and warm mild winters. Soils are strongly leached and rich in oxides of iron and aluminum (Bailey 1995). The subtropical ecoregion is forested, largely by second growth forests of longleaf, loblolly, and slash pines, with inland areas dominated by deciduous trees. Rainfall varies between 40-64 inches, increasing as you move south towards Florida.

There are 22 major river systems that generally flow in a south easterly direction to the Atlantic Coast. The diverse geology and climate create variety in biological productivity and hydrology. Substrates in the northern rivers consist of cobbles and gravels and tend to have higher gradients. Streams in the southern Atlantic have lower gradients and more sand and silt substrates. More detail on rivers of the South east can be found in 2011 NMFS Biological Opinion (NMFS 2011).

#### *Hydromodification Projects*

In the Southeastern United States, the dams are used as agricultural diversions, flood control and recreation, but the amount of agricultural and urban runoff that collects behind the dams causes water quality problems. Some dams are being removed which should improve access to historic habitat. Widespread stream alteration and degradation of habitat quality affect listed species abundance.

### The Risk of Fire in the Region

Peak fire season in the south eastern United States occurs between October and June. Based on a review of more than 80,000 wildfires, Malamud et al. (2005) calculated the wildfire recurrence interval for large fires (greater than 2,471 acres (10 km2)) in the Subtropical ecoregion that encompasses most of this region, as 19 years to 47 years, and more or less frequently in the Subtropical Mountains – approximately every 11 to 53 years. Of the total land area in the southeast region (greater than 4,000,000 square miles), the USFS manages less than one percent (16,571 square miles).

### Land Use-Gulf Coast Region

The Gulf coast region encompasses states and Canadian provinces with rivers that drain into the Mississippi River. Almost 2/3 of the continental United States drains to the Gulf of Mexico through the Mississippi River. The Gulf is roughly 800 nautical miles wide and is connected with the Atlantic Ocean. Other than the Mississippi, more than ten major river basins flow through to the Gulf including the Atchafalaya, Mobile, Red, Brazos, Colorado, and Rio Grande Rivers several. We will briefly discuss the general ecology of the area, river habitat quality and past and current human activities and their impacts on the area.

Due to the enormity of the drainages in this region, several ecoregions are encompassed in this region including the subtropical, the tropical/subtropical steppe, hot continental and mountain segments, temperate steppe, and the prairie ecoregions (Bailey 1995). Most of the region is within the subtropical ecoregion (division) and is characterized by a humid subtropical climate with particularly high humidity during summer months and warm mild winters. Rainfall is moderate to heavy with annual averages of about 40 inches in the north, decreasing slightly in the central portion of the region, and increasing to 64 inches in southern Florida.

Land use is dominated by forest in the basins east of the Mississippi, whereas grass/shrub and rangeland use dominate in basins west of the Mississippi. The Mississippi also appears to be a divide between the less developed eastern basins, and the increasingly urbanized western basins.

#### Mining

Mining occurs throughout the region. Mining along the eastern Gulf of Mexico coast is primarily for clay, sand, limestone, phosphate, and peat. There are also some sulfide mines upstream on the Apalachicola River and gravel mines in the Escambia River.

#### Hydromodification Projects

Several of the rivers within the area have been modified by dams, impoundments for navigation, levees, and drainage systems. Some rivers on both the eastern and western portion of the Gulf (including the Mississippi River) have been heavily hydromodified—fragmented by hydroelectric power plants and navigational dams, channels have been deepened, straightened, and contained within levees. For instance, there are 13 dams on the mainstem Chattahoochee and three on the Flint River, but there are no major dams on the Apalachicola River. There are 36 major dams in the Mobile River watershed, and the Trinity River watershed is also highly fragmented with 21 major dams throughout the watershed.

#### Commercial and Recreational Fishing

There is an extensive commercial fishery in the Gulf of Mexico. Fishermen fish with gillnets, trawls, paired trawls, and cast nets. Recreational fishermen are allowed to use hand lines, rod and reels, spears, and cast nets. This gear poses a risk to gulf sturgeon as a potential bycatch species. Gulf of Mexico fishing regulations require special gear to release turtles and smalltooth sawfish.

Impacts that affect Atlantic and shortnose sturgeon in south east coastal rivers include mining, impoundments, pollution, stream habitat loss, and commercial fisheries. Mining occurs throughout the region, and non-fuel mineral production from states in the region is some of the highest in the nation. Mines release toxins materials that negatively impact fish and fish living around the dredge tailings have elevated levels of mercury and selenium in tissues.

Bycatch of shortnose sturgeon in gillnets and purse seines account for 2 percent of the catch. A large percentage of the bycatch results from the shrimp fishery which also impacts sea turtles.

### The Risk of Fire in the Region

Peak fire season in the Gulf Region is similar to the Southeast Region. The recurrence interval for large fires in the forests east of the Mississippi River are up to 47 years while the two most arid regions, the tropical/subtropical steppe region and the prairie ecoregions (Texas portions of the Gulf Region) every 17 years.

# Effects Analysis

Current Forest Service lists of species and designated critical habitat known and suspected to occur on or near National Forest System lands were used to determine species to consider. This analysis addresses 45 Endangered Species Act-listed NOAA Fisheries managed species, two candidate species, and 36 designated critical habitats (Table BA-14). Species specific information including listing packages, recovery plans, critical habitat designations, range distribution, habitat, threats, five-year reviews and viability assessments, NatureServe, NOAA.gov and any petitions, as available for each species were reviewed. Because of the programmatic nature of the proposed action, the analysis was conducted at the scale of a species' distribution, population segments, or nationwide as appropriate. The analysis is qualitative and is applied to all species within a group (anadromous fish, marine reptiles, marine mammals) or subgroup (salmon, steelhead, eulachon, sturgeon, manatee, sea lion, whales, etc.).The National Effects Screen (Table BA-13) uses the size and location of species populations and critical habitat, past retardant use and land base affected by retardant, and presence of avoidance areas to help standardize determinations.

This analysis is organized as follows: Information about the potential for retardant to enter into waterways via intrusions, spills, drift, or runoff is provided to give context to the potential for species to come into contact with retardant chemicals. Next, information from the Ecological Risk Assessment (Auxilio Management Services 2020) is described and used to help determine the potential for effects to aquatic species based on the combination of chemical toxicity and potential for chemical to enter waterways. The potential effects to species and critical habitat, including due to toxicity, habitat alterations, prey changes, and disturbance, are then described in general terms.

## *Entry of Retardant Chemical into Waterways*

Intrusions into aquatic species habitat may result from accidental or intended drops of mixed retardant into avoidance areas. Avoidance area maps help ensure that retardant drops on National Forest System lands are not made within waterways or threatened, endangered, proposed or candidate species habitat. Aerial retardant drops are not allowed in mapped avoidance areas for threatened, endangered, proposed, candidate or sensitive species or in waterways. This national direction is mandatory and would be implemented except in cases where human life or public safety is threatened and retardant use within avoidance areas could be reasonably expected to alleviate that threat. (USDA Forest Service 2011b) (FSM 5100-2020-1 Policy 5130.3; USDA Forest Service 2011). Between 2012 and 2019 there were 89 intrusions that occurred as a result of using the exceptions.

Operations protocols also reduce the potential for intrusions. For example, pilots fly "dry runs" over retardant drop areas prior to the application, to orient themselves with the location of avoidance areas relative to the target area. Implementation guidance included as part of aircraft operations protocols provide pilots with instructions about when to stop applying retardant when approaching and departing avoidance areas. Pilots will adjust methods based on airspeed and weather to avoid application over avoidance areas.

Over time, multiple fires and repeated intrusions in the exact same location with the same ESA-listed species are unlikely, however, repeat intrusions into habitat of ESA-listed species do occur. The situation arose for Snake River spring/summer Chinook, Snake River Sockeye, and Snake River steelhead habitat, over the course of 8 years, where there were multiple intrusions into the overlapping critical habitat of these three species during six fires between 2012 and 2019.

Between 2012 and 2019 there were 459 reported intrusions in a total of 56,868 retardant drops, for an intrusion rate of 0.8 percent (Table BA-5). Maps showing the locations of intrusions into threatened, endangered, proposed and candidate species habitat are found in Appendix C. One hundred of those intrusions (0.2 percent) were into Aquatic threatened, endangered, proposed and candidate species avoidance areas for Fish and Wildlife Service and NOAA Fisheries managed species (Table BA-5). Twenty-four (0.04 percent) of those intrusions were into mapped avoidance areas of NOAA Fisheries managed species. Based on these intrusion rates, the probability of an intrusion in the future into aquatic threatened, endangered, proposed and candidate species will remain low (near one percent).

Thickeners in retardant mixtures are designed to increase viscosity (i.e. thickness) and thereby prevent breakup of the mixture into smaller droplets as it falls from the aircraft. Retardant mixtures on the Qualified Products List must meet requirements for minimum viscosity in order to optimize retardant delivery to the target area and improve its ability to stick to fuels (vegetation). This also reduces the potential for drift of the mixture outside of the target area.

Surface runoff can occur when retardant moves from an upslope area into a waterway. Thickeners and surfactants added to retardant mixtures increase adhesion of chemicals to vegetation and reduce the risk of runoff. Only one product currently in use carries a risk of runoff into waterways, and that risk is only in certain ecoregions (see Risk Assessment section below).

Spills of retardant into threatened, endangered, proposed and candidate species habitat are unlikely. Air tanker bases are located generally off NFS lands and far from aquatic species habitat and operate with protocols for cleaning and containment that minimize risk of retardant reaching areas off the tanker base. Thus, there are no effects to threatened, endangered, proposed and candidate species from mixing and loading retardant at airtanker bases.

Mobile retardant bases (portable mixing system) are used to mix and load helicopters near the incident site and are often on National Forest System lands. To prevent accidental spill of concentrate or mixed product from a mobile retardant base into a waterbody, a spill containment system is required as well as and contracts include environmental controls such as:

- The Mobile Retardant Base site will be located greater than 300-feet from any water source.
- The contractor and Agency Representative at the incident will jointly develop a Site Spill Containment Plan
- The retardant contractor will be responsible for removal and disposal of chemical residue and chemical spills created in the retardant mixing area or due to accident or negligence of retardant personnel. All cleanup and disposal will be accomplished in accordance with state and federal environmental standards.
- All wash-down water generated from cleaning aircraft and ramp surfaces shall be the ordering Agency’s responsibility for disposal.

- All chemical spills into waterways or other identified avoidance areas will be reported to the Incident Commander, through the on-site agency representative and to the Contracting Officer or representative within 24 hours of the time of the spill. Information regarding fire chemical intrusions can be found at https://www.fs.fed.us/managing-land/fire/chemicals.
- The Contractor shall possess an environmental plan. The plan will be approved by the Government and shall be maintained with the mobile retardant base at all times when operating.

Between 2012 and 2019, there was one spill at a mobile retardant base on the Sunrise incident on the Lolo National Forest in 2017 when improper procedure allowed retardant to flow over ground into a mapped avoidance area adjacent bull trout habitat, but not into the water. There is also one instance since 2000 of concentrate entering water during transport. Based on the two occurrences of a spill and the number of drops by helicopters from mobile retardant bases (estimated at 14,216 drops) used in the monitoring period, the expected frequency of intrusions from mobile retardant bases in the future is very low (0.01 percent). Although the likelihood of accidental spills is extremely small, if it were to occur there would be effects to individual threatened, endangered, proposed and candidate species.

## *Risk Assessment*

The Long-Term Retardant Specification (5100-304, USDA Forest Service 2020c) requires risk assessments prior to a retardant's placement on the Qualified Products List. An ecological risk assessment (Auxilio Management Services, 2020) was prepared for aerial fire retardants on the Qualified Products List as of August 5, 2020. This risk assessment evaluates the toxicological effects associated with chemical exposure. The risk assessment follows the United States Environmental Protection Agency's Guidelines for Ecological Risk Assessment (EPA 1998). This section summarizes the methodology and results of the assessment.

The risk assessment compares published toxicity data with anticipated environmental chemical concentrations. The assessment included all retardant formulations currently on the Qualified Products list. Each retardant formulation was screened for individual ingredients that were moderately toxic, as defined by the Environmental Protection Agency (2012), to representative aquatic species. Moderately toxic ingredients have toxicity greater than or equal to a lethal median concentration ($LC_{50}$) of 10 mg/L for aquatic organisms. Representative aquatic species included rainbow trout (coldwater fish), water flea (aquatic invertebrate), and tadpoles of frogs or toads (aquatic stages of amphibians). Assessment was also made of the risk to freshwater mussels of ammonia exposure originating from aerial retardant runoff.

The assessment looked at the potential concentrations of the retardant ingredients described above that would result from contaminated runoff or as a result of a retardant drop or accidental spill directly into a stream. Concentrations of chemicals that could occur in streams because of these events were estimated by environmental fate and transport modelling, using the Groundwater Loading Effects of Agricultural Management Systems (GLEAMS) (Knisel and Davis 2000) model. Because inputs of the model vary based on geographic area, the model was run for fifteen ecoregions (Bailey 1995) representative of areas where retardants are applied (Appendix F). In order to estimate a range of effects, estimates were made for two different stream sizes: a small (6,400-acre) drainage with a 12 cubic-feet-per-second streamflow and a larger (147,200-acre) drainage basin with a 350 cubic-feet-per-second streamflow.

Potential risks were assessed following the Environmental Protection Agency Office of Pesticides Program methodology, which characterizes risk as the ratio of the exposure level (chemical concentration in water) to the hazard level (chemical toxicity to representative species). Where risks are identified, they can be interpreted to mean the identified exposure level could be associated with risk of mortality to individual organisms. For this assessment, if the modeled concentration in water exceeds one twentieth of the median lethal concentration ($LC_{50}$) for an individual aquatic species, then there is an assumed risk of effects to the survival, growth, or reproduction of individuals of that species. The risks of adverse effects vary by representative species, type of event (i.e. runoff or direct drop or spill into waterway), and bioregion, and are summarized here.

A risk of effects to individuals was predicted for aquatic invertebrates in small streams receiving runoff from land where the retardant Fortress FR-100 was applied to fuels (vegetation) in six ecoregions during fire-fighting activities. These ecoregions include the western portions of Oregon and Washington (Pacific Lowland Mixed Forest and Cascade Mixed Forest-Coniferous Forest-Alpine Meadow Provinces), parts of Louisiana (Lower Mississippi Riverine Forest Province) and Texas and eastern New Mexico (Southern Plateau and Plains Dry Steppe and Shrub Province), the southeast coast from Louisiana to Delaware (Other Coastal Plain Mixed Forest Province), and a portion of interior Alaska (Yukon Intermontane Plateaus Tayga Province). Fortress FR-100 was also predicted to pose a runoff risk in small streams to rainbow trout along the southeast coast (Other Coastal Plain Mixed Forest Province). There were no risks of runoff-related exposure from any of the other products assessed. For freshwater mussels, runoff from retardant-treated areas is not expected to result in water concentrations of ammonia that would pose a risk.

Each retardant assessed posed a risk to one or more aquatic species if retardant is dropped into the stream of a small drainage at the application rates normally used for wildland fire fighting on National Forest System lands. The potential risks to individual species are specific to ecoregion. Appendix F includes a map and description of Bailey's ecoregion for reference. Table BA-16 displays the ecoregions where risks were identified, with ecoregions listed by their identifier number. One retardant, Phos-Chek® LCE20-Fx, poses a risk to daphnia (aquatic invertebrates), in ecoregions 131, 232, and M262, if that retardant is dropped into the stream of a large drainage.

**Table BA-16. Ecoregions where risks to aquatic species from accidental application of mixed (diluted) retardant to a small stream are indicated.**

| Retardant | Tadpole | Daphnia | Rainbow trout |
|---|---|---|---|
| Phos-Chek® MVP-Fx | 131, 232, M262 | 131, 212, 232, M242, M262 | 131, 212, 232, M242, M262, 315, 342 |
| Phos-Chek® MVP-F | 131, 232, M262 | none | 131, 232, M262 |
| Phos-Chek® 259-Fx | none | 212, 232, M242, 315, 342 | 131, 212, M212, 231, 232, 234, 242, M242, 342, M262, M313, 315, M331, M332 |
| Phos-Chek® LC-95A-Fx | none | 212, M242, 232, 131, M262 | M313, M331, M332, 242, 234, M212, 231, 342, 315, 212, M242, 232, 131, M262 |
| Phos-Chek® LC-95A-F | none | none | 131, 212, 232, M242, M262, 315, 342 |
| Phos-Chek® LC-95A-R | none | none | 131, 212, 232, M242, M262, |

| | | | |
|---|---|---|---|
| | | | 315, 342 |
| Phos-Chek® LC-95W | none | none | 131, 212, 232, M242, M262, 315, 342 |
| Phos-Chek® LCE20-Fx | none | 131, 212, M212, 231, 232, 234, 242 M242, M262, M313, 315, 331, M331, M332, 342 | 131, 212, 232, M242, M262 |
| Fortress® FR-100[1] | none | 131, 232, M262 | none |

The risk assessment evaluated the potential for impacts from persistent aquatic exposure to ammonia from the retardant salts because some aquatic species could be limited to habitats, such as ponds, where water movement is limited and therefore exposure would be longer term. In water, the balance of un-ionized ammonia ($NH_3$) to ionized ammonia ($NH_4$+) is dependent on pH. Using a conservative estimate that all ammonia would be present in the more toxic un-ionized form, the risk assessment determined that Phos-Chek® 259-Fx and Phos-Chek® LCE20-Fx pose potential risks of effects to bivalves resulting from long-term exposure.

In the case of an accidental spill of retardant concentrate or mixed tank directly to the stream, the risk assessment determined risk to all species groups from all retardant chemicals in both small and large drainages.

## *Potential Effects Associated with the Proposed Action*

Impacts to listed species from the proposed action can occur at an individual or population level. Effects may include impacts to the survival, growth, or reproduction of aquatic organisms, including such things as:

- Direct mortality,
- Increases or decreases in growth,
- Changes in reproductive behavior,
- Reduced number of eggs produced, fertilized, or hatched,
- Developmental abnormalities, including behavioral deficits, or physical deformities,
- Reduced ability for osmoregulation or ability to adapt to saline environments,
- Reduced ability to tolerate shifts in other environmental variables (temperature, dissolved oxygen etc.),
- Increased susceptibility to disease,
- Increased susceptibility to predation,
- Changes in migratory behavior.

Effects may also include impacts to habitat, including such things as:

- Changes in availability of prey or food,
- Changes in riparian vegetation, such as disrupting or accelerating the growth of riparian vegetation,

- Damage to trees resulting in broken treetops that fall into habitat, and
- Disturbance from low flying aircraft noise.

These effects can be grouped into three categories: effects from chemical toxicity, effects to habitat including available food, and disturbance effects.

The risk assessment (Auxilio Management Services 2020) looks at the potential for effects from chemical toxicity. It uses the median lethal concentration ($LC_{50}$) of retardant products, as displayed in Table BA-1. In 2013, Phos-Chek® LC-95A and 259-F were included in a study of toxicity of retardants to ocean- and stream-going Chinook salmon and their potential to recover before seawater entry (Dietrich, Myers, Strickland, Van Gaest, & Arkoosh, 2013). The authors found similar $LC_{50}$ values for these two retardants. The study also showed reduced survival of Chinook from exposure to sublethal concentrations (227 mg/L for LC-95A and 103 mg/L for 295-F) during their transition from freshwater rearing environments to sea water. This study provides information as to the ability of parr and smolts to survive during their transition to sea water.

Sub-lethal effects of chemical toxicity are those effects that do not result in direct mortality, but that could impact the overall health and fitness of individuals within a population of aquatic species. These effects may include impacts to individual physiology or behavior that lead to impacts on individual survival, growth or reproduction. There are no studies that specifically address the impact of retardants in this manner.

Studies have documented a short-term (one year) reduction in species richness in areas treated with retardant. This effect was more pronounced in riparian corridors than in other habitat. Vegetation changes in the riparian corridor could contribute to changes in stream characteristics such as water temperature, sedimentation rates, or other factors that could alter the way aquatic species are able to use those habitats. Fire retardant chemicals could also impact algal populations through direct mortality or, alternately, through increased algal production due to fertilization or changes in solar radiation related to changes in riparian vegetation. Changes in vegetation could also contribute to changes in availability of prey species.

The integrity of the aquatic food chain is an essential biological requirement for salmonids, marine mammals, and reptiles, and the possibility exists that retardant applications could alter productivity and aquatic systems. Retardant chemicals could impact prey species through direct mortality of prey, changes in prey distribution and availability, or ingestion by aquatic species of prey that have been exposed to chemicals.

The risk assessment (Auxilio Management Services 2020) found that the analyzed retardants would have low toxicity to prey species. Of the means by which retardant could enter aquatic environments (direct application/intrusion, surface runoff, and accidental spills), an accidental spill would have the greatest potential to impact prey species because of the amount of chemical that a spill could introduce into the water. As discussed earlier, however, the absence of a spill between 2012 and 2019, and the low likelihood that a spill will occur in the future make the risk of spill effects on the food chain very low.

Overall, the risk of riparian vegetation and prey base changes and effects on threatened, endangered, proposed, and candidate species is low because, as described above, intrusions are rare and toxic conditions are of short duration. Multiple intrusions into the same waterbody would likely need to occur before long term effects to prey availability become apparent. As discussed previously, intrusions rarely occur in the same location. While the risk of spills and intrusions occurring is very low, studies indicate when they occur habitat characteristics ould change and impacts to prey species could occur. Therefore, there is a **low probability** that aerial fire retardant would cause indirect effects to NOAA Fisheries Endangered Species Act listed resources by causing changes in riparian or aquatic habitat or prey availability.

A low, fast drop of a large load (2,500 gallons) of aerially applied fire retardant could negatively affect habitat by breaking off treetops or vegetation or cause direct mortality. Fire retardant drops could negatively affect components of species spawning activities and rearing habitat by direct hit. However, direct mortality did not occur from 2012 to 2019 and the probability of broken treetops and direct mortality occurring in the future, and taking individual listed aquatic species, or damaging habitat and making an area less productive is **discountable**.

Disturbance from low-flying aircraft is not a concern for most species addressed in this biological assessment because water mutes aircraft noise. This activity can stress some species of marine mammals or displace them to areas of less suitable habitat. Although short in duration, this activity may cause a change in behavior for a species that may be present or within the vicinity of the fire retardant drop. Disturbance by low flying aircraft may affect an area up to ½-mile from a breeding or haul out site, depending on the species and location. Stellar's sea lion may be impacted by aircraft disturbance. As additional protection, Forest Service operations would avoid approaching within air zones 3,000 feet above the terrestrial zone of each major Stellar Sea Lion rookery and major haul out under terms of the Marine Mammal Protection Act. These avoidance areas and adherence to standard operating procedures would make risks to Stellar's sea lion **discountable**.

### *Analysis of Effects to NOAA Fisheries Managed Species*

Table BA-5 summarizes the retardant intrusions on all National Forest System lands. Table BA-17 summarizes intrusion data on forests where NOAA Fisheries managed species occur. Between the years 2012-2019, there were 24 intrusions of aerial fire retardant into habitats occupied by nine NOAA Fisheries managed species; all intrusions were in designated critical habitat. Out of 23,281 drops of retardant in NOAA Fisheries managed species habitat nationwide, the rate of intrusions was 0.1 percent (Table BA-17). Five of the intrusions into avoidance areas resulted in "take" of NOAA Fisheries managed species when retardant was dropped directly into water. More than one intrusion occurred in the avoidance area of five NOAA Fisheries species during the eight year monitoring period, including multiple intrusions in Snake River steelhead, sockeye, and spring/summer Chinook habitat over the course of six fires (Table BA-18).

**Table BA-17. Summary of intrusion reports by year on Forest Service units with species under the jurisdiction of NOAA Fisheries for the years 2012-2019**

| Year | Number of fires with intrusions | Number of intrusion reports on FS lands[5] | Number of intrusions into water | Number of intrusions into water buffer only | Number of intrusions into waters with species under the jurisdiction of NOAA Fisheries | Number of accidental intrusions | Number of exception intrusions | Total number of fires | Total retardant used (gallons) in year | Estimated numbers of drops delivered by aircraft (gallons retardant/1800) | Percent of fires with intrusions (%) | Total intrusions divided by estimated drops (%) | Total intrusions into water divided by estimated drops (%) | Total intrusions into NOAA Fisheries species water divided by estimated drops (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 20 | 43 | 17 | 24 | 2 | 33 | 10 | 2253 | 3,968,980 | 2205 | 0.89 | 1.95 | 0.77 | 0.09 |
| 2013 | 14 | 27 | 13 | 13 | 2 | 22 | 5 | 2926 | 2,687,877 | 1493 | 0.48 | 1.81 | 0.87 | 0.13 |
| 2014 | 21 | 25 | 17 | 7 | 2 | 22 | 3 | 2919 | 6,178,904 | 3433 | 0.72 | 0.73 | 0.50 | 0.06 |
| 2015 | 21 | 37 | 27 | 10 | 3 | 31 | 6 | 2715 | 4,642,483 | 2579 | 0.77 | 1.43 | 1.05 | 0.12 |
| 2016 | 18 | 45 | 19 | 18 | 3 | 34 | 11 | 1614 | 10,154,237 | 5641 | 1.12 | 0.80 | 0.34 | 0.05 |
| 2017 | 14 | 23 | 15 | 6 | 2 | 20 | 3 | 2510 | 5,578,950 | 3099 | 0.56 | 0.74 | 0.48 | 0.06 |
| 2018 | 22 | 51 | 28 | 22 | 8 | 46 | 5 | 1588 | 6,898,852 | 3833 | 1.39 | 1.33 | 0.73 | 0.21 |
| 2019 | 8 | 10 | 8 | 1 | 2 | 7 | 3 | 2081 | 1,794,786 | 997 | 0.38 | 1.02 | 0.80 | 0.20 |
| Total | 138 | 261 | 144 | 101 | 24 | 215 | 46 | 18606 | 41,905,069 | 23281 | 0.74 | 1.12 | 0.62 | 0.10 |

[5] *1 An intrusion report refers to each location where retardant enters the avoidance area. An intrusion can consist of a single retardant drop or multiple. The location is defined by the reported latitude and longitude.*

The rate of intrusions in NOAA Fisheries species habitat in the future will likely remain the same, which is 0.1 percent (range 0.5 to 0.21 percent) of all drops. Locations of intrusions from 2012 to 2019 are shown on maps in Appendix C. The following is a summary of observations from monitoring specific intrusion events, and considerations regarding intrusion monitoring.

- There has been no observed mortality of NOAA Fisheries listed fish to date. After a fire, a resource specialist uses the spill calculator (Spill Calculator) to determine the distance of stream to survey for effects from an intrusion. Between 2012 and 2019, surveys were conducted between one hour and seven days after an intrusion occurred. Survey methods (walking the stream length after an intrusion occurs) could miss some fish mortality, but it is notable that none was observed. In some cases, fish were observed swimming at an intrusion site 14 hours post application. Due to safety concerns from active fire, some post-intrusion surveys were not conducted.
- One individual mortality (rainbow trout) was observed in an intrusion in Colorado in 2012 and resource staff were unsure if retardant intrusion caused the death. In 2017, the Lolo National Forest experienced a severe fire season and as a result of extensive retardant use on fires on this forest, 14 intrusions occurred into mapped avoidance areas with 13 directly into water. Observers documented fish mortality after three of the intrusions. An interagency fish crew (Montana Fish Wildlife and Parks and Lolo National Forest) monitored sites post intrusion, and conducted backpack electrofishing, eDNA, and aquatic insect collections within and upstream of the affected stream segments of five different streams. Fish mortality was documented (bull trout), either from retardant drops and/or effects from high intensity fire within the riparian area.
- Surveys at some intrusion sites have observed live fish and macro-invertebrates at 24 hours post intrusion event up to 14 days post event.
- Water quality monitoring is difficult to implement in a timely fashion after an intrusion due to the volatility of ammonia, and delays traveling to intrusion sites because of safety concerns (ongoing fire and suppression activities).
- It is important to note that an intrusion reported on one fire event may impact more than one species. For instance, the intrusion event on the Road 210 Fire in 2013 in Idaho was one retardant drop into a waterway that had habitat for three NOAA Fisheries Endangered Species Act listed species.

Details are provided in Table BA-18 on NOAA Fisheries listed species affected by fires between 2012 and 2019, organized by Recovery Domain. The two most common retardants involved in intrusions were Phos-Chek® MVP-Fx and LC95A-R, with the former used most often in the Pacific Southwest Region. MVP-Fx is the least toxic of the two types (Auxilio Management Services 2020).

**Table BA-18. Summary of intrusions of aerial application of fire retardant by the Forest Service in areas with NOAA Endangered Species Act listed species and/or Designated Critical Habitat from 2012 to 2019 by recovery domain (derived from on-line intrusion reporting). There were no intrusions into NOAA Fisheries Endangered Species Act listed Marine Mammal, or Sea Turtle habitat. Regions or Recovery Domains without intrusions are not included. (T= threatened, E = endangered)**

| Region / Recovery Domain (Forest Service Unit) | ESA Status | List of Aerial Application of Fire Retardant Intrusions and Description - NOAA Fisheries ESA-Listed Species and/or Designated Critical Habitat (DCH) |
|---|---|---|
| **Pacific Northwest Region and Intermountain Region** | | |
| **Interior Columbia Recovery Domain** | | |
| Middle Columbia River Steelhead – (Columbia River Gorge National Recreation Area, and Deschutes, Gifford-Pinchot, Malhuer, Mt. Baker-Snoqualamie, Mt. Hood, Ochoco, Okanagon-Wenatchee, Olympic, Umatilla, and Wallowa-Whitman National Forests) | T | *2015 Aug 16, Canyon Creek Complex Malheur National Forest, Pine Creek* – ten gallons of retardant in buffer; stream surveyed no dead fish; retardant drop site upstream 2,000’ from DCH. Retardant Type: Phos-Chek® LC-95A-R |
| | | *2015 Aug 31, OR-MAF 015292 Malheur NF* – ten gallons of retardant in buffer; Overholt Creek surveyed from drop site downstream two miles; juveniles and fry observed length of survey, no dead fish or macro invertebrates found. Retardant Type: Phos-Chek® LC-95A-R |
| | | *2012 Aug 30 Parish Cabin Fire Malheur NF* – 320 gallons of retardant in buffer; intermittent unnamed stream; surveyed area retardant drop site 2,500’ upstream of DCH, no retardant in channel. Retardant Type: Phos-Chek® LC-95A-R |
| Snake River Fall-run Chinook Salmon – (Columbia River Gorge National Recreation Area, and Umatilla, Wallowa-Whitman, and Payette National Forests) | T | no intrusions reported |
| Snake River Spring/Summer-run Chinook Salmon – (Columbia River Gorge National Recreation Area, and Umatilla, Wallowa-Whitman, Boise, Challis, Payette, Salmon, and Sawtooth National Forests) | T | *2019 August 6. And August 9, Nethker Fire, Payette NF* – unknown amount of retardant resulted in spotty coverage in avoidance area and riparian vegetation. 600x150-foot and 300x600-foot area. |
| | | *2016 Aug 7, Dry Creek Fire Sawtooth National Recreation Area – Park Creek* – two intrusions on same stream; 6 gallons of retardant in buffer; estimate retardant travelled 4,700’; DCH, no observed Chinook but positive eDNA; stream surveys and monitoring after intrusions downstream 6,000 feet and 4,000 feet, no observed dead fish or macroinvertebrates; report with water quality results available. Retardant Type: Phos-Chek® LC-95A-F |
| | | *2016 July 3, Buck Fire Boise NF – West Fork Bearskin Creek* – 1,054 gallons of retardant in buffer, estimate retardant travel 4,000 feet; DCH, ~ 3.5 miles upstream of Chinook presence; stream surveyed no dead fish; report with water quality results available. Retardant Type: Phos-Chek® LC-95A-R |
| | | *2014 July 4, Hell Roaring Fire Sawtooth NRA –unnamed very small stream*; 2.5 gallons of retardant in buffer, stream surveyed, DCH distant downstream. Retardant Type: Phos-Chek® LC-95A-R. |

| | | |
|---|---|---|
| | | *2013 July 22, Thunder City Fire, Payette NF - unnamed headwater spring* – less than one gallon of retardant in buffer; stream surveyed no dead fish or aquatic invertebrates. Retardant Type: Phos-Chek® LC-95A-R. |
| | | *2013 July 23, Road 210 Fire, Sawtooth NF* - estimate retardant travelled 4,700'; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17. 2016 |
| Snake River Sockeye Salmon– (Columbia River Gorge National Recreation Area, and Umatilla, Wallowa-Whitman, Dixie, Payette, Salmon and Sawtooth National Forests) | E | *2013 July 23, Road 210 Fire, Sawtooth NF* - estimate retardant travelled 4,700'; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17. 2016 |
| Snake River Steelhead – (Columbia River Gorge National Recreation Area, and Umatilla, Wallowa-Whitman, Boise, Challis, Payette, Salmon and Sawtooth National Forests) | T | *2019 August 6. And August 9, Nethker Fire, Payette NF* – unknown amount of retardant resulted in spotty coverage in avoidance area and riparian vegetation. 600x150-foot and 300x600-foot area. |
| | | *2016 July 3, Buck Fire Boise NF – West Fork Bearskin Creek* – 1,054 gallons of retardant in buffer, estimate retardant travelled 4,000 feet; no DCH or fish present; ~ 1.0 miles upstream of juvenile rainbow/steelhead presence; stream surveyed no dead fish; report with water quality results available. Retardant Type: Phos-Chek® LC-95A-R. |
| | | *2016 Aug 7, Dry Creek Fire Sawtooth National Recreation Area – Park Creek* – two intrusions on same stream; 6 gallons of retardant in buffer; estimate retardant travelled 4,700'; DCH, observed juvenile rainbow/steelhead; stream surveys and monitoring after intrusions downstream 6,000 feet and 4,000 feet, no observed dead fish or macroinvertebrates; report with water quality results available. Retardant Type: Phos-Chek® LC-95A-F |
| | | *2014 July 4, Hell Roaring Fire Sawtooth NRA –unnamed very small stream;* 2.5 gallons of retardant in buffer; stream surveyed, DCH distant downstream. Retardant Type: Phos-Chek® LC-95A-R. |
| | | *2013 July 22, Thunder City Fire, Payette NF - unnamed headwater spring* – less than one gallon of retardant in buffer; stream surveyed no dead fish or aquatic invertebrates. Retardant Type: Phos-Chek® LC-95A-R. |
| | | *2013 July 23, Road 210 Fire, Sawtooth NF* - estimate retardant travelled 4,700'; stream surveyed 7 miles downstream of drop; no dead fish found; initiated consultation; BO WCR-2015-1976 May 17. 2016 |
| Upper Columbia River Spring-run Chinook Salmon – (Columbia River Gorge National Recreation Area and Okanagon-Wenatchee National Forest) | E | no intrusions reported |

| | | |
|---|---|---|
| Upper Columbia River Steelhead – (Columbia River Gorge National Recreation Area and Okanagon-Wenatchee National Forest) | T | *2014 July 30, Carlton Complex Fire, Okanogan-Wenatchee* NF – NF Gold Creek – 300 gallons in buffer and 60 gallons in stream; estimate 0.3 miles of stream impacted; steelhead and DCH; surveyed and found live fish and invertebrates, and no dead fish. Retardant Type: Phos-Chek® LC-95A-R |
| **Pacific Southwest Region** | | |
| Southern Oregon/Northern California Coast Recovery Domain | | |
| Southern OR/Northern CA Coasts Coho Salmon – (Rogue River – Siskiyou, Klamath, Mendocino, Shasta-Trinity and Six Rivers National Forest) | T | *2018 Nachez Fire - Rogue River- Siskiyou NF;* 2400 gallons into occupied Coho habitat and DCH. No dead fish observed. Retardant Type: Phos-Chek® MVP-Fx.<br>*2018 Kerlin Fire – Shasta-Trinity NF;* 15000 gallons into DCH for Coho salmon, no take observed. No dead fish observed. Retardant Type: Phos-Chek® MVP-Fx.<br>*2018 Petersburg Fire – Klamath NF;* unknown amount of retardant was applied to Coho DCH. Retardant Type: Phos-Chek® MVP-Fx. |
| | | *2017 Salmon-August Fire – Klamath NF;* 2100 gallons into DCH, no take observed. Retardant Type: Phos-Chek® MVP-Fx. |
| | | *2014 July 9, Happy Camp Fire, Klamath NF – Klamath River at Kuntz Creek*; 300 gallons in buffer and edge of stream; DCH, occupied Coho habitat 2.3 miles downstream; surveyed and found no dead fish. Retardant Type: Phos-Chek® MVP-F. |
| | | *2015 Sept 19, South Complex Fire Shasta-Trinity NF –* unnamed tributary to Eltapon Creek; 800 gallons in buffer; occupied Coho and DCH 2 miles downstream. Phos-Chek® MVP-Fx was the retardant type. Retardant Type: Phos-Chek® MVP-Fx. |
| North-Central California Coast Recovery Domain | | |
| Upper Klamath/Trinity River Chinook salmon – (Klamath, Shasta-Trinity, and Six Rivers National Forest) | C | no intrusions reported |
| California Coastal Chinook Salmon – (Mendocino and Six Rivers National Forest) | T | no intrusions reported |
| Central California Coastal Coho Salmon – (Lassen and Mendocino National Forest) | E | *2018, Ranch Fire – Mendocino NF* – 1000 gallons into DCH and occupied Coho stream. No dead fish observed. Retardant Type: Phos-Chek® MVP-Fx. |
| Central California Coastal Steelhead – (Mendocino National Forest) | T | no intrusions reported |
| Northern California Steelhead – (Mendocino and Six Rivers National Forest) | T | *2018, Ranch Fire – Mendocino NF* – 1000 gallons into DCH and occupied steelhead stream. Retardant Type: Phos-Chek® MVP-Fx. |

| | | |
|---|---|---|
| Central Valley Recovery Domain | | |
| California Central Valley Steelhead – (Eldorado, Lassen, Mendocino, and Shasta-Trinity National Forests) | T | *2016 Sept 30, Potato Fire Lassen NF* - intermittent un-named channel; DCH; 500 gallons of retardant in buffer; channel surveyed, no water and no fish. Phos-Chek® MVP-Fx was the retardant type. Retardant Type: Phos-Chek® MVP-Fx. |
| Central Valley Spring-run Chinook Salmon – (Eldorado, Lassen, Mendocino and Shasta-Trinity National Forests) | T | *2016 Sept 30, Potato Fire Lassen NF* - intermittent un-named channel; DCH; 500 gallons of retardant in buffer; channel surveyed, no water and no fish. Phos-Chek® MVP-Fx was the retardant type. Retardant Type: Phos-Chek® MVP-Fx. |
| Sacramento River Winter-run Chinook Salmon – (Mendocino National Forest) | E | no intrusions reported |
| South-Central /Southern California Coast Recovery Domain | | |
| South-Central /Southern California Coast steelhead – (Los Padres National Forest) | T | no intrusions reported |
| Southern California Steelhead – (Cleveland National Forest) | E | *2017 December 18, Thomas Fire Los Padres NF* – direct application into known occurrence and DCH, estimated 500-1000 gallons of retardant into 85 foot width of stream, onsite surveys and water quality samples obtained 12 days post intrusion. Live fish observed swimming above and below the intrusion site. Water quality sampling results for macro invertebrates and ammonia concentration still pending from the Forest Service. Retardant Type: Phos-Chek® MVP-Fx. |

## *Cumulative Effects*

Cumulative effects are defined in 50 CFR 402.02 as "those effects of future State, local, tribal, or private activities, not involving federal activities that are reasonably certain to occur within the action area of the federal action subject to consultation." Effects from state, local, tribal, and private actions on or near public lands could affect fish and other aquatic organisms discussed in this biological assessment, although the size, magnitude and potential for adverse effects may differ due to differences in management practices and scale of actions. Because aquatic habitats that occur on public lands often extend onto land under other ownership, non-federal activities could occur within the action area for aquatic species and would have the potential to be additive to Forest Service aerial fire retardant activities. Non-federal, or state and private activities that could have impacts to Endangered Species Act listed aquatic species within the watersheds adjacent to National Forest System lands include aerial delivery of retardant, use of salt mixtures for deicing or dust abatement, and use of fertilizers for agriculture

States, local townships and tribes use aerial fire retardant and use may increase based on human population growth trends and the impacts of that trend (increasing amount of wildland-urban interface, climate change). Re-application of retardant to specific locations is unlikely because past fires tend to reduce fuel loads for some period of time. Where retardant is used on federal and non-federal land within the same watershed, greater distance between those areas could reduce the potential for cumulative impacts in any specific portion of the watershed used by an Endangered Species Act listed species for a specific portion of its life cycle. Risk of cumulative effects would be reduced when interagency coordination occurs on the use of aerial fire retardant, avoidance area mapping, establishing trigger points that restrict the use of retardants within watersheds where fire retardant has caused adverse effects, and annual coordination. Nevertheless, there remains the low likelihood of cumulative effects from aerial retardant use on non-federal lands that adjoin or occur in the same watersheds where retardant is used on federal lands.

Aerial fire retardant is suspected to have cumulative effects when used with road deicing and dust abatement products. The application rate of road salts has increased since 1950, and recent evidence suggests that road salts have effects on aquatic communities (Van Meter et al. 2011, Van Meter and Swan 2014, Hintz et al. 2017, Jones et al. 2017, Schuler et al. 2017 in Schuler & Relyea, 2018). Magnesium chloride is used as a dust abatement and deicing agent on paved roads. Transportation agencies are increasingly seeking alternatives, such as magnesium chloride, to traditionally-used salts such as sodium chloride, in order to minimize the ecological effects of de-icing and dust abatement products (Schuler & Relyea, 2018). Although magnesium chloride appears to be less toxic to aquatic invertebrates than sodium chloride, road salts in general can cause changes in the composition of aquatic invertebrate and aquatic and riparian vegetation communities. These impacts could have cascading effects across trophic levels (Schuler & Relyea, 2018). Road salts are typically applied outside of fire season and in colder climates. Because deicers and retardant chemicals are used at different times of year and generally not in the same areas, cumulative effects are unlikely.

Dust abatement products are used on unpaved roads and may co-occur in watersheds inhabited by Endangered Species Act listed species and where aerial fire retardants could be used. Lignonsulfonates and calcium chloride are two of the most popular dust abatement products. These salts are sprayed directly on the unpaved road and work by soaking up water from the air, thus keeping the top level of soil damp enough to prevent it from turning into dust. While neither dust abatement product is likely to cause direct mortality, there may be synergistic effects between retardant and dust abatement products if they enter water at the same time of year. Both dust abatement and fire retardant contain ingredients that would lower pH and change the biotic community if they were to run off into streams. Vegetated strips between salted roadways and Endangered Species Act listed waterways, where they occur, reduce the likelihood of a cumulative effect with retardant, but a low likelihood of an adverse effect remains, especially in standing waterbodies where the salt may accumulate. NOAA Fisheries Endangered Species Act-listed resources generally do not occur in standing waterbodies.

Agriculture fertilizers applied on non-federal lands pose a risk of cumulative toxic effects to Endangered Species Act-listed resources when used in the same watersheds as aerial fire retardants on National Forest System lands. Fertilizers contain some of the same ingredients, such as ammonia ($NH_3$), and could have the same effect on the aquatic environment as fire retardant and could also lead toward eutrophication and cascading negative effects on NOAA Fisheries listed resources. While retardant application locations on National Forest System lands may be in the same watershed as agriculture lands with fertilizer, there is a low likelihood of cumulative toxic effects because deleterious conditions in National Forest System waters would probably be diluted sufficiently before combining with waters adjacent to agricultural lands. Nevertheless, cumulative negative effects on NOAA Fisheries resources might result from fertilizer use, but the risk is reduced by the distance between the two activities.

Overall, a low risk of adverse cumulative effects to NOAA Fisheries managed species exists from dust abatement, fertilizer use, and fire retardant use on non-federal lands. The products used for these activities contain some of the same (or similar) ingredients as retardant that when deposited in water could cause toxic effects and impacts to habitat and food webs. Cumulative effects of these actions could be greater for species confined to specific areas where the use of road chemicals or agricultural fertilizers might overlap or occur in close proximity. Species that use those areas for only part of their life history are less likely to encounter co-occurring effects. There are a wide variety of non-federal actions (e.g. pollution, harvest, recreational activities, etc.) that could have impacts to species addressed in this analysis but that cannot be addressed at this nationwide, programmatic scale.

## *Determinations*

At the programmatic level of this action, it isn't possible to predict the amount of aerial retardant that could reach water inhabited by listed species, nor is it possible to predict potential effects in any quantitative or specific way. Sublethal effects of fire retardant after an intrusion have not been thoroughly investigated. Site specific fate and transport modeling and water quality monitoring for effectiveness and verification of proposed design elements to be used has not been conducted. Consequently, after aerial fire retardant application to water on National Forest System lands, the toxicity retardant chemicals in the natural environment may be lower or higher than the 96-hour $LC_{50}$ values measured in a laboratory by Auxilio (2020). Factors found in the field environment may results in effects different in type or degree from those determined in a laboratory.

Risks to all species groups were identified for all retardant chemicals when an intrusion into water occurs. As shown in Table BA-5, data from 2012 to 2019 indicates the overall rate of intrusion into any avoidance area is 0.81 percent (459 intrusions out of 56,868 retardant drops). The likelihood of intrusion into water (n=248) was 0.44 percent. Table BA-17 displays intrusion data only on forests where NOAA Fisheries managed species occur. The overall intrusion rate on these forests is 1.12 percent (138 intrusions in 23,281 retardant drops). The intrusion rate into water was 0.62 percent, and into waters with NOAA Fisheries managed species was 0.1 percent. The likelihood of an intrusion impacted NOAA Fisheries managed species is very low. Direct effects from a spill of concentrate directly into water has the highest risk of lethal effects to all species groups (Auxilio Management Services 2020) but based on the previous record of one occurrence over a 20 year period, is not likely to occur.

Surface run off was identified as a risk to threatened and endangered aquatic insects when Fortress FR-100 is used in certain ecoregions, and a risk to coldwater fish in one ecoregion. Many of the ecoregions either do not include threatened and endangered aquatic insects, or retardant is not used or used only in low quantities.

Indirect effects from broken trees and noise from low flying aircraft would have a **discountable** effect. Following normal operating procedures for handling, transport, and use of these retardants would help minimize the risk from spills or intrusions. The procedures discussed include avoidance area maps, spill containment protocols, and flying “dry runs” over drop areas.

Fin, Sperm, and Humpback whales do not rely on a diet of anadromous salmonids, therefore, changes to prey for these species are not anticipated. Because the Chugach and Tongass National Forests currently do not use aerial fire retardants, nor would aerial retardants be used in the marine environment, use of aerially applied fire retardant would have **No Effect (NE)** on Cook inlet beluga, fin, sperm and humpback whale.

There are six threatened and endangered sea turtles in California, North Carolina, Georgia and Florida. Loggerhead, Green, Leatherback and Olive Ridley sea turtles have the potential to occur on a small beach area on a portion of the Monterey Ranger District, which is less than one percent of the forest land base, on the Los Padres National Forest in California (Krueger, personal communication April 2020). The Los Padres National Forest has high potential for aerial fire retardant use; Green, leatherback, loggerhead, hawksbill, and Kemp’s Ridley sea turtles may also come ashore on beaches from North Carolina to Florida on National Forest System lands where there is very little retardant use. There is a small potential for these species to be exposed to aerial retardant. Therefore, the use of aerial fire retardant may affect, but is not likely to adversely affect these sea turtles. Because the impact is on terrestrial habitat, not marine, this falls under Fish and Wildlife Service jurisdiction and will be included in the biological assessment for terrestrial species. Because retardant may be used in areas adjacent to beaches, **Mapped Avoidance Areas are *Required*** for all beach-shoreline areas on the Los Padres National Forest, in order to reduce the potential for effects from use of aerial retardant.

Because of the programmatic nature of the proposed action, it is not possible to forecast site-specific fire retardant needs. Nevertheless, as discussed in this biological assessment, mortality and sublethal effects could occur even if they have not been observed. Therefore, to be conservative and account for unknown risks, we will make likely to adversely affect determinations for species even when there is low certainty of effects occurring. Table BA-19 summarizes determinations and avoidance area mapping requirements of individual NOAA Fisheries managed species by NOAA Fisheries Region and Recovery Domain.

The aerial application of fire retardants **may effect and is likely to adversely affect** 23 NOAA Fisheries managed salmon and steelhead species, one eulachon species, and one sturgeon species as shown in Table BA-19. The reasons for these determinations are:

1. The National Forest System lands where these species occur have more than one retardant drop a year and the chance of an intrusion into water is greater than 0.1 percent (Aquatics Screen #3)
2. There is low risk of lethal effects to individuals or segments of populations.
3. There is a **low probability** of sub-lethal effects from riparian and prey base changes.

Aerially delivered fire retardant **may affect but is not likely to adversely** affect Atlantic, Gulf, and shortnose sturgeon, and the southern Distinct Population Segment of killer whales. The reasons for these determinations are:

1. Atlantic, Gulf, and shortnose sturgeon occur in or near the where there is no retardant use or retardant use is very low (National Forests of Florida and North Carolina) (Aquatics Screen 1). These fish

typically spawn in large, main stem rivers where retardant would be rapidly diluted and effects therefore reduced if an intrusion were to occur.

2. The southern distinct population segment of killer whale preys predominantly on salmon. Any individual salmon loss resulting from aerial retardant intrusions could reduce the prey availability for this species. The risk of this occurring is small, but not zero.

The use of aerially delivered fire retardant will have **No Effect** on Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Oregon coast coho salmon, Ozette Lake sockeye salmon, Puget Sound steelhead, Stellar sea lion, Hawksbill turtle, and Kemp's Ridley turtle. These species occur where fires do not occur (National Effects Screen #1) or where retardant use does not occur in their habitat (National Effects Screen #3).

For the candidate species Oregon coast spring-run Chinook and Upper Klamath-Trinity River Chinook salmon there is a potential of aerially applied retardant entering habitat during in intrusion, however it will **not jeopardize the continued existence** of these Evolutionarily Significant Units.

## Critical Habitat Determinations

The designation of large portions of the action area as critical habitat for one or more species requires the Forest Service to consult with the NOAA Fisheries on any action which is likely to result in a may affect determination. Of the possible physical or biological features listed in the proposed rule for NOAA Fisheries managed species with designated critical habitat, four of the most applicable physical or biological features that pertain to the National Forest System lands deemed essential to the conservation of NOAA Fisheries managed species are: 1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning; incubation and larval development. 2) Freshwater rearing sites with: water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. 3) Freshwater migration corridors free of obstruction and excessive predation with sufficient water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. , and 4) Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

As discussed in the indirect effects section, there is a discountable probability that retardant runoff could alter the water quality characteristics or vegetation changes waterbodies and lead toward prey base changes and a low probability of disturbance to critical habitat from aircraft or broken trees. All other physical and biological features would not be affected by retardant run off.

Water quality is the feature common to physical and biological features of critical habitat for many species that is most likely to be affected by an intrusion of aerial fire retardant. As discussed above, the rate of intrusion into water are predicted to occur at the same rate that they have in the past (0.62 percent on forests with NOAA Fisheries managed species) and would not likely alter the water chemistry in sufficient magnitude to cause mortality or indirect effects to populations. If there was an intrusion into water, water chemistry changes are likely. However, retardant toxicity would quickly dissipate in flowing water where most of the threatened, endangered proposed and candidate habitat exists. In flowing water, there would be localized toxic effects lasting a few hours, but these effects are not expected to have long term impacts to the designated habitat in the recovery domain of individual species. A higher risk is associated with standing waters where chemical concentrations would remain high and exposure prolonged, but NOAA Fisheries resources are usually not found in these habitats. Due to various procedures (avoidance areas, spill containment, and flight protocols, etc.), changes to physical and biological features of critical habitat, specifically water quality, and indirect effects to redds, spawning, rearing or migration areas are expected to have a low **probability**.

The proposed project is may affect or adversely modify designated Critical Habitat (LAA) for 23 species of salmon and steelhead as shown in Table BA-19, green sturgeon, and Pacific eulachon.

- Changes to physical and biological features are anticipated from intrusions to National Forest System lands with more than one retardant drop per year (Aquatics Screen #4).

For the Atlantic and Gulf sturgeon and the southern resident killer whale, the proposed project may affect but is not likely adversely modify designated Critical Habitat (NLAA).

- Critical Habitat is protected with avoidance area mapping and use of retardant would result in discountable or immeasurable changes to physical and biological features of critical habitat (Aquatic screen #2).

For Puget Sound chinook salmon, Hood Canal summer-run chum salmon, Oregon coast coho salmon, Ozette Lake sockeye salmon, Puget Sound steelhead, Stellar's sea lion, leatherback sea turtle and Hawksbill sea turtle, the project would have no effect (NE) on designated critical habitat.

- Species or habitat occurs on National Forest System lands where there are no fires, therefore no retardant use (National Screen #1 and #3).

A list of the individual Critical Habitat determinations based on NOAA Fisheries Region and Recovery Domain where they occur is found in Table BA-19.

## *Essential Fish Habitat*

The Magnuson-Stevens Act (MSA) of 1976 directs Regional Fishery Management Councils to identify Essential Fish Habitat (EFH) for commercial fish species of concern. Essential Fish Habitat includes those waters and substrate necessary to ensure the production needed to support a long-term sustainable fishery (properly functioning habitat conditions necessary for the long-term survival of the species through the full range of environmental variation). Essential Fish Habitat consists of those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity and includes all streams, lakes, ponds, wetlands, and other water bodies currently, or historically, accessible to salmon in the Eastern Pacific Ocean and supporting freshwater environments. Chinook salmon (Oncorhynchus tshawytscha) and Coho salmon (Oncorhynchus kisutch) are included under the Magnuson-Stevens Act -Essential Fish Habitat provisions (and overlap spring Chinook and coho salmon Critical Habitat). Spring Chinook and coho salmon occur in the action area in the Western United States. Evaluation of effects to Critical Habitat are the same for Essential Fish Habitat. The Project May Adversely Affect (MAA) the Essential Fish Habitat for 11 out of 12 species due to only possible impacts generated by Project Elements. The only species where there is No effect is the Puget Sound Chinook salmon because there is no aerial fire retardant use in the Essential Fish Habitat and the forests where the species occurs. For the remaining species, insignificant effects are expected, during the term of this project. See Table BA-19 and the above effects analysis to habitat indicators for each MSA species.

**Table BA-19. Species included in this BA, organized by NOAA Fisheries Regions/Recovery Domains, including effect determinations; species in bold were characterized as declining, or increased risk of extinction or listed as endangered during their Viability Assessment of Status Review. T = Threatened, E = Endangered**

| Species | Endangered Species Act (ESA) Status | Species Determination | Critical Habitat Determination | Essential Fish Habitat Determination | Status Review or Viability Summary | Avoidance Area Mapping | Notes |
|---|---|---|---|---|---|---|---|
| Alaska Region | | | | | | | |
| **Steller's Sea Lion (western DPS)** | **E** | **NE** | NE | None | **Stable/ Declining** | *Required for haul-out sites – 3,000 foot flight buffer* | *no retardant use on Chugach-Tongass NFs* |
| **Cook Inlet beluga whale** | **E** | **NE** | NE | None | **Declining** | *Marine-none required* | |
| **Fin whale** | **E** | **NE** | NE | None | **Unknown** | *Marine-none required* | |
| **Sperm whale** | **E** | **NE** | NE | None | **Unknown** | *Marine-none required* | |
| Humpback whale | T | NE | NE | None | Stable | *Marine-none required* | |
| Pacific Northwest Region | | | | | | | |
| Puget Sound Recovery Domain | | | | | | | |
| Hood Canal Summer-run Chum Salmon | T | NE | NE | None | Improving | *Required 300-ft buffer* | *no retardant use* |
| **Puget Sound Chinook Salmon** | **T** | **NE** | **NE** | **NE** | **Stable/ Declining** | *Required 300-ft buffer* | *no retardant use* |
| Puget Sound Steelhead | T | NE | NE | None | Stable | *Required 300-ft buffer* | *no retardant use* |
| Ozette Lake Sockeye Salmon | T | NE | NE | None | Stable | *Required 300-ft buffer* | *no retardant use* |
| **Killer whale** | **E** | **NLAA** | **NLAA** | **None** | **Declining** | *none* | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Interior Columbia Recovery Domain | | | | | | | |
| Middle Columbia River Steelhead | T | LAA | LAA | None | Stable/ Improving | *Required 300-ft buffer* | *low-high retardant use* |
| Snake River Fall-run Chinook Salmon | T | LAA | LAA | None | Improving | *Required 300-ft buffer* | *low-high retardant use* |
| Snake River Spring/Summer-run Chinook Salmon | T | LAA | LAA | MAA | Stable | *Required 300-ft buffer* | *low-high retardant use* |
| **Snake River Sockeye Salmon** | **E** | **LAA** | **LAA** | **None** | **Improving** | *Required 300-ft buffer* | *low-high retardant use* |
| Snake River Steelhead | T | LAA | LAA | None | Stable/ Improving | *Required 300-ft buffer* | *low-high retardant use* |
| **Upper Columbia River Spring-run Chinook Salmon** | **E** | **LAA** | **LAA** | **MAA** | **Stable** | *Required 300-ft buffer* | *low-high retardant use* |
| Upper Columbia River Steelhead | T | LAA | LAA | None | Improving | *Required 300-ft buffer* | *low-high retardant use* |
| Willamette/ Columbia Recovery Domain | | | | | | | |
| Columbia River Chum Salmon | T | LAA | LAA | None | Stable | *Required 300-ft buffer* | *Very low-low retardant use* |
| Lower Columbia River Chinook Salmon | T | LAA | None | None | Stable/ Improving | *Required 300-ft buffer* | *Very low-low retardant use* |
| Lower Columbia River Coho Salmon | T | LAA | LAA | MAA | Stable/ Improving | *Required 300-ft buffer* | *Very low-low retardant use* |
| Lower Columbia River Steelhead | T | LAA | LAA | None | Stable | *Required 300-ft buffer* | *Very low-low retardant use* |
| **Upper Willamette River spring-run Chinook Salmon** | **T** | **LAA** | **LAA** | **MAA** | **Declining** | *Required 300-ft buffer* | *Very low-low retardant use* |
| **Upper Willamette River Steelhead** | **T** | **LAA** | **LAA** | **None** | **Declining** | *Required 300-ft buffer* | *Very low-low retardant use* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pacific Eulachon (southern DPS) | T | LAA | LAA | None | Stable | *Required 300-ft buffer* | *Very low-low retardant use* |
| Oregon Coast Recovery Domain | | | | | | | |
| Oregon Coast Coho Salmon | T | LAA | NE | None | Improving | *Required 300-ft buffer* | *No use to high retardant use in this recovery domain* |
| Green sturgeon | T | LAA | LAA | None | No change | *Required 300-ft buffer* | *No use to high retardant use in this recovery domain* |
| Pacific eulachon (southern DPS) | T | LAA | LAA | None | Stable | *Required 300-ft buffer* | *No use to high retardant use in this recovery domain* |
| Southern Oregon/Northern California Coast Coho salmon | T | LAA | LAA | MAA | No change | *Required 300-ft buffer* | *No use to high retardant use in this recovery domain* |
| Oregon Coast spring-run Chinook salmon | Candidate | will not jeopardize the continued existence | LAA | MAA | Under review | *Required 300-ft buffer* | *No use to high retardant use in this recovery domain* |
| Southwest Region | | | | | | | |
| Southern Oregon/Northern California Coast Recovery Domain | | | | | | | |
| Southern Oregon/Northern California Coast Coho salmon | T | LAA | LAA | MAA | No change | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| Upper Klamath-Trinity River Chinook salmon | Candidate | will not jeopardize the continued existence | LAA | MAA | Under Review | *Required 300-ft buffer* | *high retardant use in this recovery domain* |

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|---|---|---|---|---|---|---|---|
| North-Central California Coast Recovery Domain | | | | | | | |
| California Coastal Chinook Salmon | T | LAA | LAA | MAA | No change | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| Central California Coast Coho Salmon | E | LAA | LAA | MAA | No change | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| Northern California Steelhead | T | LAA | LAA | None | No change | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| Central Valley Recovery Domain | | | | | | | |
| California Central Valley Steelhead | T | LAA | LAA | None | No change | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |
| Central Valley Spring-run Chinook Salmon | T | LAA | LAA | MAA | Decreased risk of extinction | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |
| **Sacramento River Winter-run Chinook Salmon** | **E** | **LAA** | **LAA** | **MAA** | **Increased risk of extinction** | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |
| Northern California steelhead | T | LAA | LAA | None | No change | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |
| Green Sturgeon (Southern DPS) | T | LAA | LAA | None | Stable | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Southern Oregon/Northern California Coast Coho salmon | T | LAA | LAA | MAA | No change | *Required 300-ft buffer* | *Mod-high retardant use in this recovery domain* |
| South-Central /Southern California Coast Recovery Domain | | | | | | | |
| South-Central /Southern California Coast steelhead | T | LAA | LAA | None | No change | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| **Southern California Steelhead** | **E** | **LAA** | **LAA** | **None** | **No change** | *Required 300-ft buffer* | *high retardant use in this recovery domain* |
| **Leatherback Sea Turtle** | **E** | **NLAA** | **NE** | **None** | **Declining** | *Required 300-ft buffer on beach - shoreline* | *high retardant use in this recovery domain* |
| **Olive Ridley Sea Turtle** | **T** | **NLAA** | **NE** | **None** | **Declining** | *Required 300-ft buffer on beach - shoreline* | *high retardant use in this recovery domain* |
| Green Sea Turtle; East Pacific DPS | T | NLAA | NE | None | No change | *Required 300-ft buffer on beach - shoreline* | *high retardant use in this recovery domain* |
| **Loggerhead Sea Turtle (North Pacific DPS)** | **E** | **NLAA** | **NE** | **None** | **Stable/Declining** | *Required 300-ft buffer on beach - shoreline* | *high retardant use in this recovery domain* |
| Northeast Atlantic/Southeast Atlantic/Gulf Coast Regions | | | | | | | |
| **Atlantic sturgeon** | **E** | **NLAA** | **NLAA** | **None** | **Declining** | *Required 300-ft buffer* | *No use to very low retardant use in this recovery* |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | *domain* |
| Gulf Sturgeon | T | NLAA | NLAA | None | Improving | *Required 300-ft buffer* | *No use to very low retardant use in this recovery domain* |
| **Shortnose sturgeon** | **E** | **NLAA** | **None** | **None** | **Declining** | *Required 300-ft buffer* | *No use to very low retardant use in this recovery domain* |
| **Leatherback Sea Turtle** | **E** | **NLAA** | **None** | **None** | **Insufficient data** | *Required 300-ft buffer on beach - shoreline* | *No use to very low retardant use in this recovery domain* |
| **Olive Ridley Sea Turtle** | **T** | **NLAA** | **NE** | **None** | **Insufficient data** | *Required 300-ft buffer on beach - shoreline* | *No use to very low retardant use in this recovery domain* |
| **Loggerhead Sea Turtle** | **E** | **NLAA** | **NE** | **None** | **Stable/declining** | *Required 300-ft buffer on beach - shoreline* | *No use to very low retardant use in this recovery domain* |
| **Hawksbill sea turtle** | **E** | **NE** | **NE** | **None** | **Insufficient data** | *Required 300-ft buffer on beach - shoreline* | *No use to very low retardant use in this recovery domain* |
| **Kemp’s Ridley sea turtle** | **E** | **NE** | **None** | **None** | **Stable/declining** | *Required 300-ft buffer on beach - shoreline* | *No use to very low retardant use in this recovery domain* |

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# Appendix A. Aerial Fire Retardant use by National Forest 2012 – 2019.

**Aerial Fire Retardant Use in Gallons by Forest Service Region and Forest by year for comparison purposes. Region 10 is omitted because no Aerial Fire Retardant was used prior to 2019.**

| FS Region | Forest | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Beaverhead-Deerlodge | 20,851 | 188,684 | 4,223 | 68,424 | 28,630 | 187,023 | 166,290 | 0 | 664,125 |
| 1 | Bitterroot | 54,617 | 0 | 7,841 | 32,475 | 371,385 | 16,533 | 85,372 | 14,364 | 582,587 |
| 1 | Custer Gallatin | 90,837 | 210,080 | 0 | 6,152 | 0 | 9,977 | 0 | 0 | 317,046 |
| 1 | Dakota Prairie grasslands | 4,500 | 0 | 0 | 0 | 0 | 5,977 | 0 | 0 | 10,477 |
| 1 | Flathead | 0 | 2,839 | 4,797 | 29,935 | 0 | 48,459 | 14,671 | 0 | 100,701 |
| 1 | Helena-Lewis and Clark | 67,189 | 0 | 0 | 172,988 | 35,862 | 442,939 | 12,547 | 571,150 | 1,302,675 |
| 1 | Idaho-Panhandle | 0 | 19,311 | 8,219 | 480,607 | 993 | 66,655 | 148,485 | 146,073 | 870,343 |
| 1 | Kootenai | 4,344 | 0 | 12,897 | 120,323 | 0 | 355,527 | 204,248 | 0 | 697,339 |
| 1 | Lolo | 112,335 | 281,377 | 283,259 | 58,372 | 521,550 | 3,758,272 | 9,939 | 8,547 | 5,033,651 |
| 1 | Nez Perce - Clearwater | 199,352 | 83,789 | 54,818 | 279,451 | 30,766 | 223,372 | 384,765 | 62,970 | 1,319,283 |
| | **Region 1 Subtotal** | **554,025** | **786,080** | **376,054** | **1,248,727** | **989,186** | **5,114,734** | **1,026,317** | **803,104** | **10,898,227** |
| 2 | Arapaho & Roosevelt | 84,784 | 9,058 | 0 | 3,591 | 0 | 15,627 | 108,759 | 0 | 221,819 |
| 2 | Bighorn | 700 | 0 | 0 | 2,791 | 28,540 | 1,421 | 0 | 0 | 33,452 |
| 2 | Black Hills | 127,189 | 3,800 | 0 | 0 | 140,995 | 17,107 | 0 | 0 | 289,091 |
| 2 | Grand Mesa Uncompahgre and Gunnison | 713 | 17,756 | 0 | 0 | 23,867 | 0 | 66,961 | 0 | 109,297 |
| 2 | Medicine Bow-Routt | 157,216 | 3,340 | 28,786 | 14,481 | 67,928 | 69,783 | 499,099 | 12,969 | 853,602 |
| 2 | Nebraska | 4,157 | 0 | 2,750 | 0 | 4,625 | 0 | 0 | 0 | 11,532 |
| 2 | Pike and San Isabel | 216,994 | 56,857 | 0 | 0 | 64,025 | 13,391 | 182,345 | 14,245 | 547,857 |
| 2 | Rio Grande | 0 | 4,935 | 0 | 0 | 0 | 0 | 65,962 | 102,974 | 173,871 |
| 2 | San Juan | 48,665 | 286,528 | 9,486 | 16,854 | 5,264 | 0 | 69,232 | 48,435 | 484,464 |
| 2 | Shoshone | 0 | 142,332 | 0 | 26,128 | 343,438 | 11,842 | 0 | 0 | 523,740 |
| 2 | White River | 21,130 | 0 | 0 | 0 | 40,150 | 84,452 | 526,459 | 48,370 | 720,561 |
| | **Region 2 Subtotal** | **661,548** | **524,606** | **41,022** | **63,845** | **718,832** | **213,623** | **1,518,817** | **226,993** | **3,969,286** |
| 3 | Apache-Sitgreaves | 0 | 18,407 | 18,500 | 4,370 | 4,310 | 45,420 | 78,238 | 65,844 | 235,089 |
| 3 | Carson | 0 | 0 | 0 | 1,362 | 0 | 43,279 | 38,772 | 0 | 83,413 |
| 3 | Cibola | 108,582 | 200,343 | 2,137 | 0 | 500,837 | 2,052 | 0 | 0 | 813,951 |
| 3 | Coconino | 25,345 | 19,987 | 81,116 | 0 | 12,280 | 0 | 84,296 | 314,064 | 537,088 |
| 3 | Coronado | 236,438 | 68,969 | 188,240 | 23,821 | 68,471 | 1,252,025 | 79,010 | 206,084 | 2,123,058 |

| FS Region | Forest | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | Gila | 206,185 | 156,915 | 173,540 | 0 | 91,668 | 0 | 180,124 | 30,347 | 838,779 |
| 3 | Kaibab | 12,948 | 0 | 0 | 3,532 | 40,208 | 9,598 | 0 | 43,892 | 110,178 |
| 3 | Lincoln | 216,444 | 0 | 26,055 | 0 | 14,728 | 0 | 109,718 | 160,768 | 527,713 |
| 3 | Prescott | 320,346 | 334,543 | 0 | 7,779 | 1,375 | 959,782 | 0 | 424,477 | 2,048,302 |
| 3 | Santa Fe | 16,106 | 21,698 | 264,306 | 0 | 8,508 | 259,311 | 40,261 | 0 | 610,190 |
| 3 | Tonto | 501,837 | 35,618 | 29,129 | 70,681 | 90,275 | 488,913 | 33,147 | 1,305,614 | 2,555,214 |
| | **Region 3 Subtotal** | **1,644,231** | **856,480** | **783,023** | **111,545** | **832,660** | **3,060,380** | **643,566** | **2,551,090** | **10,482,975** |
| 4 | Ashley | 2,035 | 31,699 | 4,897 | 5,030 | 0 | 0 | 19,654 | 0 | 63,315 |
| 4 | Boise | 630,736 | 385,593 | 287,171 | 124,918 | 1,089,698 | 66,089 | 75,068 | 51,487 | 2,710,760 |
| 4 | Bridger-Teton | 77,851 | 79,363 | 0 | 6,086 | 7,141 | 14,092 | 1,100,133 | 0 | 1,284,666 |
| 4 | Caribou-Targhee | 27,763 | 23,657 | 0 | 0 | 18,494 | 16,683 | 26,800 | 0 | 113,397 |
| 4 | Dixie | 182,173 | 19,835 | 24,391 | 168,588 | 583,796 | 16,114 | 331,493 | 0 | 1,326,390 |
| 4 | Fishlake | 9,067 | 6,154 | 25,128 | 0 | 139,992 | 79,195 | 83,146 | 7,500 | 350,182 |
| 4 | Humboldt-Toiyabe | 81,403 | 799,092 | 54,814 | 234,992 | 86,261 | 255,766 | 596,232 | 61,295 | 2,169,855 |
| 4 | Manti-La Sal | 9,746 | 8,648 | 2,064 | 0 | 12,670 | 0 | 298,164 | 0 | 331,292 |
| 4 | Payette | 304,989 | 268,147 | 54,757 | 304,646 | 0 | 30,263 | 370,691 | 241,225 | 1,574,718 |
| 4 | Salmon-Challis | 52,612 | 311,565 | 0 | 118,422 | 102,871 | 0 | 81,821 | 123,823 | 791,114 |
| 4 | Sawtooth | 119,189 | 199,869 | 38,243 | 2,200 | 238,515 | 52,796 | 98,712 | 0 | 749,524 |
| 4 | Uinta-Wasatch-Cache | 26,195 | 9,159 | 15,488 | 10,100 | 1,024,192 | 257,837 | 1,296,433 | 126,015 | 2,765,419 |
| | **Region 4 Subtotal** | **1,523,759** | **2,142,781** | **506,953** | **974,982** | **3,303,630** | **788,835** | **4,378,347** | **611,345** | **14,230,632** |
| 5 | Angeles | 358,218 | 907,453 | 148,018 | 218,247 | 1,621,384 | 342,508 | 65,107 | 116,947 | 3,777,882 |
| 5 | Cleveland | 1,043 | 239,170 | 241,003 | 67,462 | 101,229 | 159,044 | 1,522,212 | 3,000 | 2,334,163 |
| 5 | Eldorado | 5,376 | 55,405 | 1,105,366 | 25,421 | 194,707 | 21,764 | 0 | 8,164 | 1,416,203 |
| 5 | Inyo | 4,932 | 9,492 | 11,782 | 168,052 | 462,918 | 14,760 | 102,148 | 115,896 | 889,980 |
| 5 | Klamath | 182,180 | 33,907 | 2,341,430 | 50,657 | 636,081 | 681,512 | 48,346 | 143,901 | 4,118,014 |
| 5 | LTBMU | 0 | 0 | 2,075 | 0 | 0 | 0 | 0 | 0 | 2,075 |
| 5 | Lassen | 0 | 87,592 | 224,816 | 21,114 | 31,439 | 31,363 | 181,911 | 21,281 | 599,516 |
| 5 | Los Padres | 220,384 | 235,634 | 11,203 | 210,562 | 6,632,898 | 1,477,974 | 249,234 | 249,704 | 9,287,593 |
| 5 | Mendocino | 356,023 | 22,695 | 0 | 130,430 | 11,451 | 126,102 | 80,432 | 14,815 | 741,948 |
| 5 | Modoc | 137,124 | 51,180 | 51,563 | 207,322 | 23,754 | 958,958 | 188,321 | 309,629 | 1,927,851 |

| FS Region | Forest | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | Plumas | 419,923 | 41,570 | 31,030 | 19,497 | 99,658 | 545,196 | 93,451 | 588,186 | 1,838,511 |
| 5 | San Bernadino | 108,385 | 1,525,494 | 25,408 | 1,232,004 | 1,317,829 | 581,269 | 1,102,662 | 69,929 | 5,962,980 |
| 5 | Sequoia | 331,930 | 248,003 | 832,343 | 16,101 | 1,118,843 | 1,086,137 | 112,685 | 27,784 | 3,773,826 |
| 5 | Shasta-Trinity | 865,256 | 88,481 | 146,878 | 928,595 | 31,293 | 321,838 | 938,581 | 146,936 | 3,467,858 |
| 5 | Sierra | 91,029 | 907,801 | 287,050 | 3,216,123 | 197,207 | 793,597 | 1,167,893 | 20,706 | 6,681,406 |
| 5 | Six Rivers | 7,979 | 191,723 | 40,092 | 605,784 | 16,712 | 533,570 | 0 | 17,028 | 1,412,888 |
| 5 | Stanislaus | 140,511 | 2,183,081 | 4,159 | 0 | 84,514 | 26,688 | 216,060 | 0 | 2,655,013 |
| 5 | Tahoe | 0 | 585,842 | 28,087 | 0 | 2,923 | 13,718 | 162,341 | 2,962 | 795,873 |
|  | **Region 5 Subtotal** | **3,230,293** | **7,414,523** | **5,532,303** | **7,117,371** | **12,584,840** | **7,715,998** | **6,231,384** | **1,856,868** | **51,683,580** |
| 6 | Columbia River Gorge | 0 | 0 | 6,208 | 0 | 0 | 11,040 | 0 | 0 | 17,248 |
| 6 | Colville | 0 | 0 | 0 | 425,944 | 0 | 0 | 5,974 | 2,989 | 434,907 |
| 6 | Deschutes and Ochoco | 59,416 | 132,497 | 106,479 | 110,256 | 19,651 | 644,931 | 147,399 | 74,211 | 1,294,840 |
| 6 | Fremont-Winema | 85,370 | 29,406 | 40,143 | 11,440 | 26,587 | 212,854 | 33,206 | 6,655 | 445,661 |
| 6 | Gifford Pinchot | 201,080 | 0 | 0 | 3,500 | 0 | 0 | 0 | 0 | 204,580 |
| 6 | Malheur | 39,212 | 61,501 | 92,607 | 506,507 | 13,625 | 25,433 | 9,058 | 198,882 | 946,825 |
| 6 | Mt Hood | 0 | 0 | 34,040 | 52,330 | 0 | 8,380 | 5,469 | 0 | 100,219 |
| 6 | Okanagon-Wenatchee | 360,529 | 76,555 | 634,222 | 278,649 | 103,493 | 19,555 | 1,322,191 | 180,761 | 2,975,955 |
| 6 | Rogue River-Siskiyou | 0 | 14,983 | 447,512 | 114,342 | 0 | 580,642 | 804,424 | 50,543 | 2,012,446 |
| 6 | Umatilla | 475 | 58,957 | 92,633 | 295,523 | 14,856 | 27,425 | 82,067 | 135,423 | 707,359 |
| 6 | Umpqua | 0 | 72,053 | 2,216 | 92,537 | 0 | 97,033 | 155,978 | 0 | 419,817 |
| 6 | Wallowa-Whitman | 180,976 | 47,926 | 118,230 | 144,189 | 281,573 | 293,149 | 0 | 32,094 | 1,098,137 |
| 6 | Willamette | 0 | 0 | 74,589 | 6,400 | 0 | 65,463 | 9,000 | 2,976 | 158,428 |
|  | **Region 6 Subtotal** | **927,058** | **493,878** | **1,648,879** | **2,041,617** | **459,785** | **1,985,905** | **2,574,766** | **684,534** | **10,816,422** |
| 8 | Chattahoochee-Oconee | 0 | 0 | 0 | 0 | 17,420 | 0 | 0 | 0 | 17,420 |
| 8 | Cherokee | 0 | 0 | 0 | 0 | 19,954 | 0 | 0 | 0 | 19,954 |
| 8 | NF in Florida | 0 | 0 | 0 | 0 | 0 | 64,098 | 0 | 35,562 | 99,660 |
| 8 | NF in Texas | 0 | 0 | 0 | 11,200 | 0 | 0 | 0 | 0 | 11,200 |
| 8 | North Carolina | 0 | 0 | 0 | 0 | 19,583 | 0 | 0 | 0 | 19,583 |
|  | **Region 8 Subtotal** | **0** | **0** | **0** | **11,200** | **56,957** | **64,098** | **0** | **35,562** | **167,817** |
| 9 | Chippewa | 0 | 0 | 8,000 | 0 | 2,196 | 0 | 600 | 0 | 10,796 |

| FS Region | Forest | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Mark Twain | 0 | 0 | 0 | 15,154 | 0 | 0 | 3,016 | 0 | 18,170 |
| 9 | Superior | 0 | 0 | 0 | 10,496 | 73,630 | 0 | 0 | 0 | 84,126 |
| | **Region 9 Subtotal** | **0** | **0** | **8,000** | **25,650** | **75,826** | **0** | **3,616** | **0** | **113,092** |
| | **GRAND TOTAL** | **8,540,914** | **12,218,348** | **8,896,234** | **11,594,937** | **19,021,716** | **18,943,573** | **16,376,813** | **6,769,496** | **102,362,031** |

# Appendix B. Consultation Re-initiation Framework.

**DRAFT**
**Aerial Fire Retardant Product Development**
**and**
**Relnitiation of Consultation Requirements with**
**National Oceanic and Atmospheric Administration – National Marine Fisheries Service**
**and Fish and Wildlife Service**

**Purpose:** The purpose of this document is to provide a decision framework for the Forest Service (FS) and National Oceanic and Atmospheric Administration-National Marine Fisheries Service (NOAA) and Fish and Wildlife Service (FWS) to develop standard operating procedures for when new aerial fire retardant formulations are developed and qualified for use by the FS. The decision(s) to be made and subsequent standard operating procedures developed includes:

1. When new retardants fit within the framework and they can be added to the Qualified Products List,
2. but those outside of the framework will require a reinitiated consultation to broaden the framework.

These decisions apply **only** to new product development; all other actions as described within the proposed action within the biological assessment and opinion, including the rates of delivery, will remain unchanged.

**Contents within this document include:**

- Reinitiation language and analysis parameters for the determination of effects within the BOs
- FS proposed chemical constituent limits for new product development consistent with retardants previously evaluated within Biological Assessments (BA) and Opinions.
- Diagram of process
- FS evaluation and qualification process of new fire retardant chemicals
- Appendices include: Forest Service Wildland Fire Chemical Program and Process, and chemical profiles for major components of long-term retardants on the Forest Service Qualified Products list for retardants

**Reinitiation Language**

The following section provides the reinitiation language in BA and BO and serves as the base line in development of level of reinitiation required before new aerial fire retardants are approved for use in firefighting activities on National Forest System lands.

*FS Proposed Action and Reinitiation Language for Aerially Applied Fire Retardant*

As provided for 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 take is exceeded,

(2) New information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered,

(3) The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered, or

(4) A new species is listed, or critical habitat is designated that may be affected by the action.

If the FS proposes any changes to the USDA FS Specification 5100-304 Long-Term Retardant, Wildland Firefighting, (current version 304d, January 7, 2020) that affect the evaluation thresholds for toxicity on species, consultation will occur. The FS will inform both regulatory agencies of any changes to the specification if additional ingredients are added to the unacceptable ingredients section, or other changes that do not directly affect the formulations of retardant concentrates.

*Analysis Parameters and NOAA Reinitiation Language*

The language in Table 1 describes the analysis parameters of fire chemicals consulted on and reinitiation requirements language associated with the decisions within the BO (NOTE: THIS WILL CHANGE WITH THE NEW 2021 ANALYSIS and BO. Table 2 provides the ammonia and phosphate concentrations applied at typical application rates of currently approved retardants and analyzed within the BA and BO.

**Table 1. NOAA Fisheries Analysis Parameters and Reinitiation Language**

| **NOAA Aerial Fire Retardant Component** | **NOAA Re- Initiation Language** |
|---|---|
| The fire retardant component factor was based on the following retardant constituents (NOAA BO pg 103):<br>• 85% Water<br>• 10% ammonium phosphate or magnesium chloride<br>• 5% additives (gums, colorants, corrosion inhibitors)<br>• No sodium ferrocyanide<br>• | This concludes formal consultation on the USFS' National Fire Retardant Programmatic Consultation. 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) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (2) 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 (3) a new species is listed or critical habitat designated that may be affected by the action. For each species, one misapplication is authorized at the programmatic level. As proposed by the USFS in their action, an intrusion event will initiate a consultation with the local NOAA Fisheries office responsible for the species affected. If it is found that Pacific eulachon migration overlaps with fire season or that Columbia River chum salmon are adversely affected by long-term fire retardant applications, this programmatic consultation should be reinitiated. In the event USFS would authorize, fund, or carry out fire retardant drops or other fire suppression activities that may affect resources in a manner or to an extent not considered in this Opinion, USFS must reinitiate consultation to |

| | |
|---|---|
| | compensate for information that was not available for consideration during this consultation (NOAA BO pg 184). |

| Table 2. Nutrients Delivered at Specified Coverage Levels | | | | |
|---|---|---|---|---|
| Ammonia and Phosphate concentrations | | | | |
| Retardant | 4 GPC Coverage Level | | 8 GPC Coverage Level | |
| | lbs $NH_3/ft^2$ | lbs $P_2O_5/ft^2$ | lbs $NH_3/ft^2$ | lbs $P_2O_5/ft^2$ |
| Phos-Chek LC-95A-R | 0.0095 | 0.0301 | 0.0190 | 0.0602 |
| Phos-Chek LC-95A-Fx | 0.0095 | 0.0273 | 0.0191 | 0.0546 |
| Phos-Chek LC-95-W | 0.0095 | 0.0276 | 0.0191 | 0.0553 |
| Phos-Chek MVP-Fx | 0.0053 | 0.0199 | 0.0105 | 0.0399 |
| Phos-Chek 259-Fx | 0.0070 | 0.0203 | 0.0140 | 0.0406 |
| Phos-Chek LCE20-Fx | 0.0073 | 0.0208 | 0.0147 | 0.0415 |
| Magnesium and Chloride concentrations | | | | |
| | lbs $Mg/ft^2$ | lbs $Cl^-/ft^2$ | lbs $Mg/ft^2$ | lbs $Cl^-/ft^2$ |
| Fortress FR-100 | 0.0093 | 0.0270 | 0.0185 | 0.0541 |

### Composition of Retardants Currently Approved and Limits for New Retardants to be Included within Bounds of Existing Biological Opinion

Aerially delivered fire retardants are either a liquid concentrate or a dry concentrate. Water is added to each, diluting the products, prior to loading onto an airtanker. Various combinations of di-ammonium phosphate, mono-ammonium phosphate, ammonium polyphosphate (11-37-0), or magnesium chloride retardant salts have previously been or currently are contained in qualified retardant products that have been consulted on. Products containing ammonium sulfate, which was added to the unacceptable ingredients list (USDA Forest Service 2020), are not considered in this discussion. In addition to salts, retardants may include thickeners, coloring agents, and performance ingredients (corrosion inhibitors, stabilizers, anti-caking agents, flow conditioners, etc.).

Fire retardant composition is described by percent of ingredient in the mixed product. Composition of retardant salts has ranged from nine to 20 percent of mixed products. Mono-ammonium phosphate and di-ammonium phosphate salts are commonly combined in the same product. Di-ammonium polyphosphate and ammonium polyphosphate are used individually. The amount (percent) of thickener in the mixed product ranges from 0.2 to 0.8 percent. Types of thickener and percent of total mixed product in previously approved products include: guar (0.4 to 0.8 percent), xanthan (0.2 to 0.7 percent) and clay (0.3 to 0.5 percent). Coloring agents range from 0.1 to 0.3 percent of the total mixed product and include iron oxide, or fugitive (fading) colorant. Performance ingredients have comprised 0.1 to 0.8 percent of the mixed products.

Aerially delivered retardant is provided at specific coverage levels, expressed as gallons per 100 square feet (GPC), depending on the fuel types present and conditions present. The amount of retardant salt delivered is dependent on the coverage level. The range of chemicals, in pounds per square foot, that would be delivered in a retardant drop at 8 gallons per 100 square feet coverage level for the retardants previously or currently approved are displayed in second column in Table 3:

Table 3: Range and upper limits in pounds per square foot (lbs/$ft^2$) of allowable chemicals when applied at a coverage level of 8 gallons per 100 square feet of mixed product.

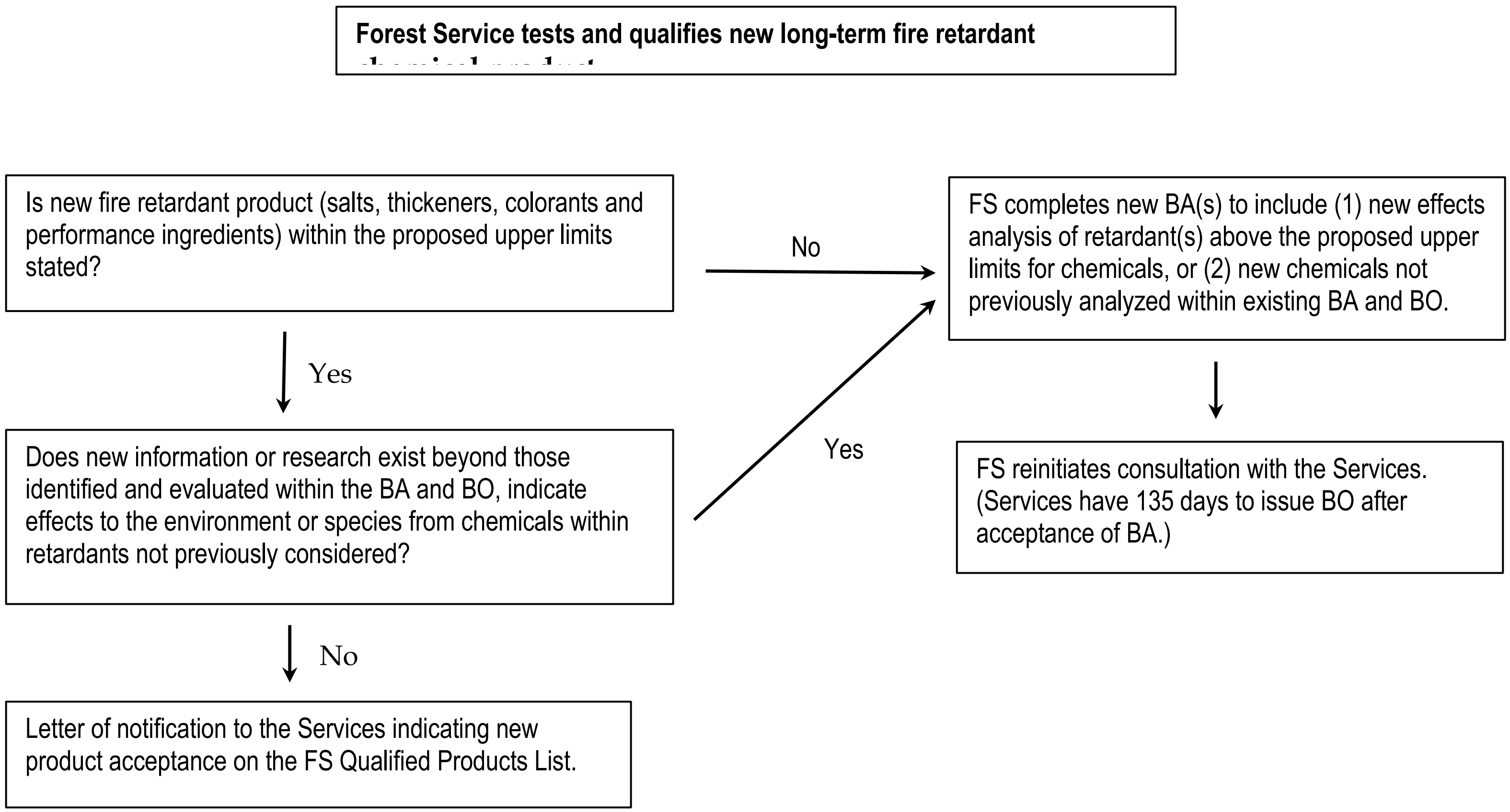
| Chemical | Range from previously or currently approved retardants | Proposed upper limit when delivered at 8 GPC |
|---|---|---|
| Ammonia ($NH_3$) | 0.0105 – 0.0191 lbs/$ft^2$ | ≤ 0.02 lbs/$ft^2$ |
| Phosphate ($P_2O_5$) | 0.0399 – 0.0602 lbs/$ft^2$ | ≤ 0.07 lbs/$ft^2$ |
| Magnesium (Mg) | 0.0185 lbs/$ft^2$ | ≤ 0.02 lbs/$ft^2$ |
| Chloride (Cl) | 0.0541 lbs/$ft^2$ | ≤ 0.06 lbs/$ft^2$ |

The Forest Service proposes that the previously approved concentrations of ammonia, phosphate, magnesium, or chloride when delivered at 8 gallons per 100 square feet and displayed in Table 3 (third column) be used to establish the upper limit of retardant salts that can be included in newly developed retardants without the need for re-initiation of consultation. Upper limit values provided reflect small increases in constituent levels compared to existing values to allow for minor modifications in formulations as needed by the manufacturer without the need to re-initiate consultation. For any new formulation the toxicity levels must not exceed those of currently approved products. In addition, the maximum extent and duration of effects from new products cannot exceed effects of products already considered in order to be approved without reinitiation.

The Forest Service also proposes establishing the limits of thickeners (guar, xanthan, clay), coloring agents (iron oxide, fugitive) and performance ingredients based on the concentrations found in products that have been previously approved and consulted on. The proposed upper limits are:

- 1 percent thickener (guar, xanthan, and/or clay)
- 0.5 percent colorant (iron oxide and/or fugitive)
- 1.5 percent performance ingredients

## Reinitiation process for new long-term fire retardant chemical



## How FS Qualifies New Aerial Fire Retardant

The following section provides information on how the FS evaluates and qualifies new and modified fire retardants. The information presented here is the same as what was submitted to the services with the consultation(s) and is provided here for clarity.

Since fire retardant is another tool for fire managers to utilize, it is imperative that any product used meets stringent requirements in order to ensure safety is met for people, the environment and equipment.

Retardant formulations in use today are primarily inorganic fertilizers, the active compound being ammonium polyphosphates (USDA Forest Service Specification 5100-304d Long-Term Retardant, Wildland firefighting, January 7, 2020, Appendix A https://www.fs.fed.us/rm/fire/wfcs/documents/5100-304d_LTR_Final%20Draft_010720.pdf. Although retardant is approximately 85 percent water, the ammonia salt compounds constitute about 60 to 90 percent of the remainder of the product. The other ingredients include thickeners, such as guar gum; suspending agents, such as clay; dyes; and corrosion inhibitors (Johnson and Sanders 1977; Pattle Delamore Partners 1996). Corrosion inhibitors are added and required to minimize the deterioration of retardant tank structures and aircraft. Acceptable corrosion inhibitors do not include sodium ferrocyanide (previously shown to have toxic effects to aquatic species and aquatic environments) or any of the other chemicals included in the list of prohibited chemicals which have been shown to have adverse effects on people or the environment.

### History

A full understanding about how retardant chemical components interacted with various elements of the environment was generally lacking during early use of the materials (pre-1990s). Over the past two decades, wildland firefighting agencies have conducted more monitoring and review of the environmental and safety aspects of retardant use (Auxilio August 2020 revised, Labat Environmental December 2013, Labat Environmental April 2007, Labat March 2003, Labat-Anderson Incorporated July 1996, Labat-Anderson Incorporated August 1994a, Carmichael 1992, Finger 1997, Krehbiel 1992, Van Meter and Hardy 1975).

The CERC report (Little and Calfee 2000) spurred a review of procedures used by the FS, Bureau of Land Management (BLM), National Park Service (NPS), and Fish and Wildlife Service (FWS) during aerial firefighting. As a result of these studies, the Guidelines for Aerial Delivery of Retardant or Foam near Waterways (U.S. Forest Service et al. 2000) were established as interim guidelines in April 2000. Due to the potential increased toxicity, the FS has not accepted for evaluation, contract or purchased retardants that contain sodium ferrocyanide since 2005 (U.S. Forest Service 2000, 2002). The FS discontinued the use of retardants containing sodium ferrocyanide beginning with the 2007 fire season.

Besides the ongoing work with outside agencies and environmental entities, the FS Wildland Fire Chemicals program includes a specification review and revision process. This is applied to all categories of wildland fire chemicals. The current specification was established in 2020.

### Evaluation Process

The evaluation process for any product is funded by the company that is seeking to have a product on the Qualified Products List (QPL). The FS does not use any wildland fire chemical that is not listed on the QPL. A product must meet all requirements of FS 5100-304 to become qualified. The initial request from a company or manufacturer for the FS to evaluate a product results in a review of the formulas' ingredients and quantity used to prepare the product. The submitted paperwork from the company shall include:

- Each ingredient, quantity and supply source in the formulation
- Copies of the Safety Data Sheets (SDS) for the product and for each ingredient used to prepare the retardant.

This is done to assure the product does not contain ingredients meeting the criteria for Chemicals of Concern (which is checked against our list of unacceptable ingredients as contained in the specification section 3.4.2, National Toxicology Program (NTP) Annual Report of Carcinogens, International Agency for Research on Cancer (IARC) Monographs for Potential Carcinogens, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) List of Extremely Hazardous Substances and Their Threshold Planning Quantities) in order to determine if there are any ingredients that could pose a threat to either the environment or human populations. If this review identifies an ingredient of potential concern, and the supplier wants to proceed with the evaluation, a risk assessment is conducted by a third party before proceeding with a full evaluation.

The specification includes requirements for effectiveness, safety and environmental protection, materials protection, stability, and physical properties. The FS developed unique test methods or identified standard test methods for each requirement in the evaluation process.

The FS establishes formal national retardant contracts in order to ensure that only products on the QPL are purchased and applied to National Forest System lands. The QPL and retardant contracts are also used by other Federal land management agencies through their authorities and policies.

**Conclusion**

Fire retardant manufacturers are continuing to develop retardant formulations that perform effectively and submit products to the FS for evaluation and testing. Often new formulations (which may be identified by the same or new product names but are always identified by a unique formulation identification number) have only very minor changes in constituents, while some may be completely different. The FS performs rigorous testing of these products prior to placing these products on the Qualified Product List (QPL). To summarize:

- FS does not make or develop the products, private industry does.
- FS does test to the specification, not just a spot check.
- If a product does not meet all the requirements, it is not added to QPL.
- Prohibited ingredients and mammalian and aquatic toxicity testing are included in the Long-Term Retardant Specification.
- Listed ingredients trigger additional study.
- Specification requirements are not optional

The intent of this document is to provide a framework and agreement of protocols between the FS and NOAA for the need for reinitiation of consultation when new products are developed, submitted to the FS for evaluation, qualified for use and placed on the QPL.

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**USDA Forest Service.** 2002. Letter dated October 4, 2002, from Jerry T. Williams, Director of Fire and Aviation management, US Forest Service, Washington Office, to Fire-Trol Holdings, LLC, regarding the use of sodium ferrocyanide.

**Van Meter, W.P. and Charles E. Hardy**. 1975. Predicting effects on fish of fire retardants in streams. Res. Pap. INT-166. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 16 p.

## Appendix A.  Forest Service Wildland Fire Chemical Program and Process

Please see Nationwide Aerial Application of Fire Retardant FEIS Appendix L : https://www.fs.usda.gov/managing-land/fire/chemicals

**And**

**https://www.fs.fed.us/rm/fire/wfcs/index.php**

## Appendix B.

Chemical profiles for these same ingredients containing toxicity and ecological effects are presented below with the dates of evaluation.  Please contact **https://www.fs.fed.us/rm/fire/wfcs/index.php** to inquire if profiles have been updated.

Material Safety Data Sheets (MSDS) components of long-term retardants on the Forest Service Qualified Products can we found at:   **https://www.fs.fed.us/rm/fire/wfcs/sds.php**

**NOTE: This appendix contains information determined to be proprietary and confidential.  This appendix has been removed.  The chemical profiles are considered in the risk assessment process as described in the biological assessment.**

# Appendix C. Intrusion Location Maps

Maps are located on a thumb drive.

# Appendix D. Intrusion Data

See attached file

# Appendix E. Implementation Guide

note: Appendices removed from this document to save space. Full copy available at website link in biological assessment.

United States
Department of
Agriculture
Forest Service
Fire and Aviation Management
Washington, DC

# Implementation Guide for Aerial Application of Fire Retardant

**May 2019**

*What's new in this edition? See page 3*

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**Cover photo** by Kreig Rasmussen, Fishlake National Forest, 2005.

## Changes and Updates for this Edition

The following items are changes or edits made to the June 2016 edition of the guide:

- The new aerial application of fire retardants website is now located on the US forest Service/Interagency Wildland Fire chemicals Policy and Guidance webpage:
  - Interagency Wildland Fire Chemicals Policy and Guidance
  - This site contains tools and documents to assist in the required reporting for use of aerial and ground application of fire chemicals.

- The US Forest Service Wildland Fire Chemicals website is located at:
  - Wildland Fire Chemicals
  - This website provides additional information on wildland fire chemicals.

- **An updated Spill Calculator** has been developed to assist in determining impacts of a direct application to water for affected area for aquatic species. The calculator is ready for beta testing. This spill calculator and accompanying user guide is found at:
  - USGS Spill Calculator

- For specifics related to other fire chemicals and reporting requirements, please refer to the Interagency Policy for Aerial and Ground Delivery of Wildland Fire Chemicals Near Waterways and Other Avoidance Areas (Red Book, Chapter 12), accessed from the NIFC website: National Interagency Fire Center Interagency Guides

- **Avoidance Area Mapping Changes:**
  - Recent consultations have increased buffers for certain species (West Coast Region NOAA Fisheries 2017 interim direction and 2019 BO) or added new buffer areas due to changes in critical habitat or newly-listed species (2018 FWS BO).
  - **These updated maps are in the 2019 AFR mapping database.**
  - It is recommended to check with Regional TES species coordinators on any changes that may have occurred to avoidance area maps due to supplemental consultations.
    - **Certain FS Regions have removed some dry intermittent streams (DIS) from avoidance area maps: (R3, R5 and R6) in agreement with FWS and NOAA Fisheries.**
    - For questions concerning drops in dry intermittent streams, call Laura Conway, Natural Resource Specialist at 406-329-3956 (work) or 406-802-4317 (cell).

  - Updating of the national TEPCS mapped avoidance area layer in the FS Enterprise Data Warehouse will only occur from November 1 – March 31. For updates outside of this window, or assistance with avoidance area mapping, please contact **Carl Albury, Remote Sensing Specialist, GTAC** at carl.albury@usda.gov.
    - Aerial Application of Fire Retardant Mapping Sharepoint is the link to the FS Sharepoint site for data updates for maps.

- ***New Information Comments***:

- Changes to direction as a result of supplemental ESA consultations are shown in certain sections as ***New Information Comments***:
    - Avoidance Area Mapping and
    - Reporting of Misapplications
- These comments will supply the reference to any forest, regional or national supplemental consultations which resulted in changes to the 2011 BO and ROD for ESA listed species.

- ***IMPORTANT NOTE TEXT BOXES***:

| |
|---|
| ***In 2017, a Five Year Review Report was completed for Compliance with the EIS/ROD and the FWS/NOAA Fisheries BOs. Information provided in these text boxes emphasizes specific requirements or direction from the 5 year Compliance Report findings. It is important to ensure these items are being implemented when using aerially applied fire retardants on national forest system lands.*** |

For assistance in misapplication reporting, please contact:

- Laura Conway, Natural Resource Specialist, at laura.conway@usda.gov 406-329-3596 (work) or 406-802-4317 (cell)
- Shirley Zylstra, Program Leader at shirley.zylstra@usda.gov

## Table of Contents

# Acronyms

| | |
|---|---|
| AFR | Aerial Fire Retardant |
| BA | Biological Assessment |
| BE | Biological Evaluation |
| BO | Biological Opinion |
| EDW | Enterprise Data Warehouse – Forest Service |
| EIS | Environmental Impact Statement |
| ESA | Endangered Species Act |
| FAM | Fire and Aviation Management |
| FMO | Fire Management Officer |
| FS | United States Forest Service |
| FWS | Fish and Wildlife Service – Department of Interior |
| GDB | Geodatabase |
| GIS | Geographic Information System |
| GTAC | USFS Geospatial Technology and Applications Center |
| IA | Initial Attack |
| IC | Incident Commander |
| ITS | Incidental Take Statement |
| NIFC | National Interagency Fire Center |
| NFS | National Forest System |
| NHD | National Hydrography Dataset |
| NOAA | National Oceanic and Atmospheric Administration |
| NTDP | National Technology and Development Program - Missoula |
| READ/REAF | Resource Advisor/ Resource Advisor - Fireline |
| ROD | Record of Decision |
| SDE | Spatial Database Engine |
| SHPO | State Historic Preservation Officer |
| TEPCS | Threatened, Endangered, Proposed, Candidate, Sensitive |
| TES | Threatened and Endangered Species |
| USGS | U.S. Geological Survey |
| WFDSS | WildFire Decision Support System |
| WildCAD | Wildland Fire Computer Aided Dispatch |
| WFCMR | Wildland Fire Chemicals Misapplication Reporting Database |
| WFCS | Wildland Fire Chemical Systems (USFS, Missoula Technology and Development Center) |
| WO | Washington Office |

# Chapter 1. Introduction

On December 13, 2011, U.S. Forest Service Chief Tom Tidwell signed a Record of Decision (ROD) for the Environmental Impact Statement (EIS) establishing new direction for the use of fire retardant applied from aircraft to manage wildfires on National Forest System (NFS) lands. This direction approves the use of aerially applied fire retardant and implements an adaptive management approach that protects resources and continues to improve the documentation of retardant effects through reporting, monitoring and application coordination.

> ***Aerial retardant drops are not allowed in mapped avoidance areas for certain threatened, endangered, proposed, candidate or sensitive (TEPCS) species or in waterways on NFS lands.***
>
> ***This national direction is mandatory for the US Forest Service (FS), and will be implemented, except in cases where human life or public safety is threatened and retardant use within avoidance areas could be reasonably expected to alleviate that threat.***

When an application occurs inside avoidance areas for any reason, it will be reported, assessed for impacts, monitored and remediated as necessary. The direction also provides greater protection for cultural resources including historic properties, traditional cultural resources, and sacred sites through closer coordination with states and Tribes.

> ***This direction and guidelines do not require helicopter or air tanker pilots to fly in a manner that endangers their aircraft or other aircraft or structures or that compromises the safety of ground personnel or the public.***

This direction also includes procedures developed by the Forest Service, United States Geological Survey (USGS), Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration (NOAA) Fisheries for monitoring and reporting if aerially-applied fire retardant impacts certain species or habitat. National level programmatic consultation with FWS and NOAA Fisheries as directed by Section 7(a)(2)of the Endangered Species Act (ESA) ) [16 U.S.C. 1531 *et seq.*] was completed for species and designated critical habitats in 2011 for the EIS/ROD, with supplemental consultations for newly listed species since 2011, or in certain cases, when incidental take has been exceeded. The ROD accepted the terms and conditions of the Biological Opinions (BO) rendered by the Services and outlined re-initiation triggers. For additional information about ESA or missions of these two regulatory agencies (FWS, NOAA Fisheries) please see the Glossary.

The ROD direction also includes Aircraft Operation Guidance, Avoidance Area Mapping Requirements, Annual Coordination/Training, Reporting and Monitoring Requirements, and modifications resulting from ESA Section 7 Consultation.

**Nothing in this decision changes the way aerially applied fire retardant is used outside of the mapped avoidance areas.**

All other fire suppression tactics are still available with avoidance areas, including ground activities and foams and water enhancers. For specifics related to other fire chemicals and reporting requirements, please refer to the Interagency Policy for Aerial and Ground Delivery of Wildland Fire Chemicals Near Waterways and Other Avoidance Areas (Red Book, Chapter 12), accessed from the NIFC website:

National Interagency Fire Center Interagency Guides

It's important to remember that firefighter and public safety continues to be Forest Service's number one priority. To review the final decision and all documents related to this direction see:

Interagency Wildland Fire Chemicals Policy and Guidance.

## Objective of the Guide

The objective of this guide is to provide a 'one-stop resource' for forests and regions to obtain all the information necessary to implement the Aerial Fire Retardant (AFR) Guidelines as directed in the 2011 EIS/ROD and any changes from supplemental ESA consultations. This guide consists of direction for personnel such as pilots, Fire Management Officer's (FMO's), Incident Commander's (IC's), Resource Advisors (READs), or others involved in the use aerial fire retardant. Reporting and monitoring requirements at the local and national level, avoidance area mapping requirements, data management, coordination and re-initiation of consultation with regulatory agencies, and reporting and monitoring funding are also included.

The format of this guide is presented as direction by the following categories:

- **Avoidance Areas Direction and National Mapping Process**. This section provides the process of development of avoidance areas, national direction associated with use of aerial fire retardant in these areas, where avoidance maps can be found and how maps are updated.

- **Pilot Direction.** This section provides specific direction to pilots when approaching mapped avoidance areas and describes methods to ensure compliance with the new direction.

- **Fire Operations.** This section includes an introduction to this direction in comparison to previous direction and provides direction for preseason planning, fire suppression activities, and tactics associated with the use of aerial fire retardant.

- **Resource Specialists**. This section provides information related to the role and function of resource specialists, including READS, direction associated with mapped avoidance areas, and the process of re-initiation of consultation with regulatory agencies if needed**.**

- **Misapplication Reporting and Monitoring Process.** This section provides direction and reporting requirements in the event of a misapplication into an avoidance area; information regarding funding sources for these activities is also provided.

- **Five Percent (5%) Assessment and Reporting Process.** This section describes the purpose, direction and reporting requirements associated with this assessment. Methodologies and flow charts are provided to assist in completion.

- **Seasonal and Annual Training Requirements.** This section outlines specific seasonal requirements such as processes that need to be completed prior to fire season, during and post-fire season by resource. Additionally this section provides a list of annual training requirements and information regarding funding codes.

- **Data and Upward Reporting Requirements.** Documentation, data collection and reporting requirements and funding codes are provided within this section.

- **Questions and Answers.** This section consists of a compiled list of most commonly asked questions and associated answers encountered by the team developing this direction and implementation strategy during the development of the ROD.

# Chapter 2. Avoidance Area Mapping Process and Direction

## Process

The Forest Service used the following protocols to generate a standardized, national map template of mapped avoidance areas:

- Use FWS and NOAA Fisheries-designated critical habitat layers when available.
- Use the National Hydrography Dataset (NHD) for mapping water bodies to create hydrographic avoidance areas.
- Use FWS, NOAA Fisheries, and Forest Service species population and designated critical habitat information for occupied sites.

At this time all national forests and grasslands that have affected TEPCS species have completed this mapping. These protocols will be used for annual updates and are specified in further detail below.

Aerial retardant avoidance areas have been identified and maps developed to protect resources. Beginning March 2013, all avoidance maps have been georeferenced. Avoidance area maps can be found at local FS offices or at the link provided at the following website:

Interagency Wildland Fire Chemicals Policy and Guidance

Users may access all maps on the public NIFC server at:

Retardant Avoidance Area Maps FTP site

- This site is updated annually by the Geospatial Technology and Applications Center (GTAC). If changes to TEPCS mapped avoidance areas are completed by individual forests and Geographic Information System (GIS) data uploaded to the FS T drive as described in *Updates of TEPCS Data*, below, national-level retardant avoidance data will be automatically updated as described in *Raw Data Availability*.
- New maps for these updates will need to be retained by the local forests and changes as associated with implementation of a new area will need to be coordinated at the local level.
- Updating of the national TEPCS mapped avoidance area layer in the FS Enterprise Data Warehouse will only occur from November 1 – March 31. For updates outside of this window, or assistance with avoidance area mapping, please contact
  **Carl Albury, Remote Sensing Specialist, GTAC** at carl.albury@usda.gov. This is the Sharepoint site describing GIS data and mapping update requirements:
    - Aerial Application of Fire Retardant Mapping Sharepoint

## Avoidance Areas

Mapped Avoidance Areas include the following:

### Aquatic/Hydrographic Avoidance Areas

Waterways shall be avoided and are given a minimum of a 300-foot buffer, including perennial streams, intermittent streams, lakes, ponds, identified springs, reservoirs, and vernal pools, etc.

Buffer areas may be increased based on local conditions in coordination with the FWS and NOAA Fisheries local offices.

***New Information –*** The new NOAA Fisheries West Coast Region BO and Terms and Conditions make permanent the 2017 and 2018 600' buffers on specific streams in Region 4 and Region 6, and in Region 5 adds 600' buffers on stream segments on the southern California coast with highly vulnerable steelhead populations with less than 20 miles in length of occupied habitat.

### Terrestrial Avoidance Areas

Terrestrial Avoidance Areas may be used to avoid impacts on a) one or more federally listed threatened, endangered, or proposed plant or animal species or critical habitat where aerial application of fire retardant may affect habitat and/or populations; or b) any Forest Service terrestrial sensitive or candidate species where aerial application of fire retardant may result in a trend toward federal listing under ESA or a loss of viability on the planning unit.

### Cultural Resources, including Historic Properties, Traditional Cultural Resources, and Sacred Sites

Although not mapped for protection, cultural resources, including historic properties, traditional cultural resources, and sacred sites will be given case-by-case consideration when ordering the aerial application of fire retardant. As necessary, incident commanders will consider the effects of aerial applications on known or suspected historic properties, any identified traditional cultural resources, and sacred sites. The Forest Service intends to use cultural resources specialists, archaeologists, and tribal liaisons to assist in the Forest Service's consideration of effects and alternatives for protection.

## Direction for Avoidance Area Mapping

The Forest Service will annually coordinate with local FWS and NOAA Fisheries offices to ensure that the mapped avoidance areas on National Forest System (NFS) lands incorporate the most up-to-date information.

***Each unit must keep a record of these meetings with date, participants (and agency), notes, etc.***

The Forest Service will coordinate with aviation managers and pilots on avoidance area mapping and aircraft operational direction and will provide reporting direction to all fire personnel with suppression responsibilities in the event they discover a misapplication in an avoidance area. Chapters 3-6 and 8 of this guide provide specific guidance for each resource area.

- Each Forest Supervisor will be responsible for maintaining and updating the avoidance area maps for the applicable National Forest System land area.
    - It is recommended a list be kept of all personnel/offices/cooperators receiving maps and date maps are received
    - It is recommended a list be kept of any changes made to maps and date of distribution of changes

- Avoidance maps can be updated or adjusted for TEPCS species or designated critical habitats which may also include waterways and their corresponding buffered areas by Forest Supervisors in consultation with local FWS or NOAA Fisheries offices as necessary.
- Mapping changes are allowed if they do not create additional adverse effects than what was analyzed in the Biological Assessments (BA) or change the analysis conducted or determinations made in the BOs. Refer to Chapter 4-Resource Specialists, Process for Addendums to the National Programmatic Consultations.
- Terrestrial and waterway avoidance areas are mapped using the best current information and can be updated as better data becomes available. As this information changes or is updated, the maps are adjusted by the process defined in this chapter of the implementation guide.
- For the purposes of mapping hydrographic avoidance areas, all waterways (using the USGS NHD) were used as a base layer and were given 300' or more (species specific) buffers.
- For the analysis of effects for consultation with the FWS and NOAA Fisheries, hydrographic avoidance areas included perennial and intermittent/ephemeral streams, lakes, and ponds, whether or not they contain aquatic life.
- Avoidance maps can be updated by Forest Supervisors for candidate and listed sensitive species, or cultural sites, based on the best current information.

## Updating Avoidance Maps and Data

There are four components for updating the retardant avoidance areas' GIS layers and associated hardcopy maps:

1) Updates of terrestrial TEPCS avoidance information,
2) Updates of hydrographic avoidance information,
3) Annual quad and large-area pdf avoidance map updates, and
4) Provision of data to facilitate forest unit and partner requirements.

All components are intended to address both forest and national requirements and to satisfy formal aerial fire retardant avoidance ROD guidelines.

### Updates of TEPCS Data

This section describes the process for forests or regions to update their TEPCS retardant avoidance information at any time. Using their 2011 and onward TEPCS retardant avoidance data as a starting point, national forests or regions have the ability to reassess their information and provide updates as conditions warrant (ex. changes in Federal listings; revised impact on TEPCS species from aerial retardant meeting requirements identified in this handbook; annual updates).

  - GIS data format requirements are provided on the Aerial Fire Retardant Avoidance Mapping Sharepoint site: [Aerial Application of Fire Retardant Mapping Sharepoint]

Any national forest that may apply aerial fire retardant must submit a single ArcGIS v10.x File Geodatabase (please do not use ArcGIS Pro) containing up to four separate Feature Classes to the T Drive location specified in step *(2)* below.

The Geodatabase may contain one feature class for each Threatened, Endangered, and/or Sensitive (including Candidate and Proposed) species trending toward federal listing, representing terrestrial depiction of areas of fire retardant avoidance.

Each Feature Class record must have an attribute indicating its forest code as shown in the FS Unit Name Standards at the EDW Data Source Sharepoint site at Unit Schema and Library Names. Further, after performing step *(3d)* below, a single merged and dissolved Feature Class, called FireRetardantEIS_Dissolved needs to be created. Once uploaded to the FS T drive location specified below, automated routines at the FS Enterprise Data Warehouse (EDW) check existing GIS layers on a daily basis from November 1 until March 31 for any data updates (based on forest code) and will update the national GIS TEPCS retardant avoidance layer sitting at the FS EDW Default SDE: S_USA.AerialFireRetardantAvoidance.

Existing internal and external map services, as well as web maps pointing to this national layer will be automatically updated accordingly. In this manner, any TEPCS data revisions by any forest or region will be available to all FS and external partners within a brief time period (most likely within a day to a few days between November and March). Note that hydrographic updates are not currently automated in the Data Warehouse.

The specific interim update process follows. New or revised TEPCS information submitted in the process outlined below will be used to create annually-updated fire retardant avoidance pdf maps, associated component datasets, and map services.

1. Each national forest that uses aerial fire retardant must follow the process in this handbook to analyze areas of TEPCS species that would be negatively affected by application of aerial fire retardant.
    a. The national forest shall create GIS layers resulting from (#1) above and upload to the USFS T: Drive at Fire Retardant EIS files

2. If there is existing data, overwrite the appropriate file. However; ensure that any existing features / feature classes that need to be maintained are integrated into the revised Geodatabase.

3. These TEPCS GIS layers must be in the following GIS file format, specified below and available in template form at Aerial Application of Fire Retardant Mapping Sharepoint.
    a. Data must be in a single ArcGIS v10 File Geodatabase named S_R*xx*_*FFF* _FireRetardantEIS.gdb where '*xx*' is the two-digit region identifier and '*FFF*' is the 2-6 character forest abbreviation. Follow the FS Unit Name Standards given on theEDW Data Source Sharepoint site at Unit Schema and Library Names.

b. Each File Geodatabase must contain up to three single Feature Classes (four for 2013-2015, explained below in (e)), each depicting geospatially valid polygons of land where aerial fire retardant is to be avoided, as named below:
   i. Threatened Species: FireRetardantEIS_Threatened
   ii. Endangered Species: FireRetardantEIS_Endangered
   iii. Sensitive Species, Candidate, or Pending trending toward federal listing: FireRetardantEIS_Sensitive
   iv. FireRetardantEIS_Dissolved (created in step (e))
c. If the forest does not have specific avoidance of a particular species type (T, E, or S), that feature class may be left out.
d. Each Feature Class shall follow these guidelines:
   i. Can be in any projection
   ii. Contain full FGDC metadata
   iii. Contain polygons only
   iv. Contain valid geometry (must undergo Repair Geometry)
   v. Follow the file format template provided at: Aerial Application of Fire Retardant Mapping Sharepoint
   vi. Each record must contain a valid Forest Code attribute called UnitID matching its national forest. These forest codes must be in 4-character text format *RRFF* where *RR* is the 2-digit region identifier and *FF* is the 2-digit forest identifier.
   vii. Clip data to FS administrative boundaries, per EIS guidelines.
e. The final processing step is to combine any revised T, E, or S data into a single v10 Feature Class.
   i. The new feature class, called FireRetardantEIS_Dissolve, will fix many issues that have prevented smooth implementation of updated data within the EDW.
   ii. Using the Arc Toolbox, simply perform a Merge on your input T, E, and/or S layers.
   iii. Then using the Arc Toolbox, perform a Dissolve based on UnitID on the result in (ii). Name this new result FireRetardantEIS_Dissolve and perform a Repair Geometry.
   iv. The end result is that in the Geodatabase you upload, there will be a single Feature Class for any T, E, or S layers, plus a single feature class with everything merged & dissolved together.
f. Ensure a local copy of all data is maintained.

4. The Forest Service staff member uploading each File Geodatabase shall send an email notifying the GTAC that a new file is available.
   a. Notify **Carl Albury** (carl.albury@usda.gov ).

5. Each time a national forest or region submits an updated or new File Geodatabase, EDW will process the new information (daily or within a few days from November 1 until March 31, assuming all file requirements are met), recompile, and republish the national terrestrial aerial fire retardant avoidance layer at the EDW Default SDE: S_USA.AerialFireRetardantAvoidance.

## Updates of Aquatic/Hydrographic Avoidance Data

This section describes the process for forests or regions to update their hydrographic/aquatic retardant avoidance information. The 2011 EIS Record of Decision confirmed the need for avoidance of aerial fire retardant within at least 300 feet of a water feature (stream, lake, etc). Therefore, to maintain the national standard, the original 2012 retardant avoidance quad pdf maps used the USGS National Hydrographic Dataset (NHD) as a starting point for display of water features and buffered these features by 300 feet and integrated them accordingly during quad map production. The maps displayed water bodies and perennial streams with a different symbology from intermittent/ephemeral streams. Due to observed inaccuracies of NHD, a feature revision process specifically for aerial fire retardant avoidance data has been established. For latest information on this process, see the aerial fire retardant avoidance mapping Sharepoint site at: Aerial Application of Fire Retardant Mapping Sharepoint

For these hydrographic updates, the forest/region must provide revised geospatial data for their entire planning area and theme (water bodies and/or streams) if they need to modify any features. In other words, if the forest/region determines that a single water feature needs to be modified (spatially, attributes, deleted, etc), they must start with the entire dataset as guided below, modify that feature, and resubmit the entire new Geodatabase/feature class. This new data will then become the hydrographic avoidance layer used to update the formal avoidance pdf maps.

Revised hydrographic information submitted in the process outlined below will be used to create annually-updated fire retardant avoidance pdf maps, associated component datasets, and map services.

1. The process for creating revised hydrographic avoidance features is as follows:
    a. Download high-resolution NHD geospatial data from EDW available in EDW's Default SDE as regional datasets:
        i. S_R*xx*_Hydrography where '*xx*' is the region identifier
            1. NHDFlowline feature class: Streams/Rivers Polylines
            2. NHDWaterbody feature class: Water bodies Polygons
            3. NHDArea feature class: Water area Polygons
                a. Note that incorporation of NHD Area polygons is available starting 2016. If a forest or region deems it appropriate to use these features, they should be merged with the Water body feature class as appropriate and therefore submitted as a single combined FireRetardantEIS_Waterbodies feature class as discussed in this section.
        ii. Forests/Regions only need to resubmit data for feature classes they wish to be modified for display on avoidance quad maps. EG. If water bodies' avoidance are unchanged from the full NHD Waterbody feature class, they need not be resubmitted here.
        iii. Note if a region or forest has previously revised their hydrographic avoidance, they should begin the update process with data they submitted most recently.
    b. Create a local copy of this base data for editing.

c. For either/both feature class(es) where updating is required, modify the hydrographic features locally as necessary to better represent potential areas of water to be avoided. Ensure that re-initiation of consultation with the regulatory agencies at the local level is completed (Refer to Chapter 5 on re-initiation of consultation). Do not modify any hydrographic avoidance without contacting your TES staff member.
d. Maintain the FCODE attribute to ensure that these features are symbolized properly.
e. Buffer the resultant data by 300 feet. If this is to be modified, again ensure that re-initiation of consultation is achieved.
f. Clip the resultant data to FS administrative boundaries.
g. Repair Geometry sufficiently to ensure geometry of dataset is valid.
h. Upload final dataset as described in (2) below and ensure (2) through (5) are completed.

2. The national forest or region shall upload their new hydrographic layers to the USFS T: Drive at Fire Retardant EIS files

3. If there is existing data, overwrite the appropriate file. Any new feature classes submitted will completely replace any existing hydrographic avoidance data and will not be augmented with other hydrographic avoidance data.

4. These GIS layers shall be in the following GIS file format, specified below and latest format information available at Aerial Application of Fire Retardant Mapping Sharepoint
   a. Data must be in a single ArcGIS v10 File Geodatabase named S_R*xx*_*FFF* _FireRetardantEIS_Hydro.gdb where '*xx*' is the two-digit region identifier and '*FFF*' is the 2-6 character forest abbreviation following the FS Unit Name Standards given on the EDW Data Source Sharepoint Site at Unit Schema and Library Names. If uploading as an entire region, name the file S_R*xx*_FireRetardantEIS_Hydro.gdb.
   b. Each File Geodatabase may contain up to two single Feature Classes, each depicting geospatially valid polygons of water where aerial fire retardant is to be avoided, as named below. If the forest/region does not have any hydrographic features to change from the original high-resolution NHD, that Feature Class may be omitted and hydrographic avoidance information will default to all NHD features buffered by 300 ft.
      i. Hydrographic stream/river features: FireRetardantEIS_Streams
      ii. Hydrographic water bodies: FireRetardantEIS_Waterbodies
   c. Each Feature Class shall follow these guidelines:
      i. Specify attributes showing whether the feature is a water body, perennial stream, or intermittent/ephemeral stream, essentially maintaining the FCODE and FTYPE attributes of the river/stream NHD information. Any features without these attributes will be assumed to be perennial water bodies. The GTAC mapping team needs these attributes in order to properly display hydrographic features during production of annual pdf avoidance maps.
      ii. Data may be in any projection
      iii. Data shall contain full FGDC metadata
      iv. Data shall consist of polygons only

v. Data shall have valid geometry (undergo Repair Geometry sufficiently to ensure it is valid)

5. The Forest Service staff member uploading each file shall send an email to **Carl Albury** (carl.albury@usda.gov), notifying the GTAC that a new file is available.

## Annual Updates of Georeferenced Avoidance Quad and Forest-wide Pdf Maps

Annual avoidance map updates will be coordinated by the FS GTAC using updated TEPCS and hydrographic GIS inputs from GIS staff working with their Resource Specialists within each national forest or region. Annually, each forest or region with TEPCS species that may be affected by the application of aerial fire retardant must provide updated GIS information as necessary to support map revisions. These layers must follow specified data format requirements identified previously in this chapter and the associated Sharepoint site given below. Upon meeting the deadline for updated avoidance information (specified in the most recent letter from the Deputy Chief), GTAC will compile all local or regional TEPCS and hydrographic data and integrate them to create digital retardant avoidance Pdf's for each national forest where retardant is used.

These maps will be provided at the NIFC FTP server at: Retardant Avoidance Area Maps in digital Georeferenced Pdf format and may be printed as hardcopy booklets or used otherwise.

Further, GTAC will update the national aerial retardant avoidance GIS layers at the FS Enterprise Data Warehouse which will provide access of TEPCS and hydrographic retardant avoidance areas to personnel within the FS as well as to external partners. These geospatial layers can be used in web map applications such as Google Maps or ArcGIS Online, as well as other portable applications/platforms such as IPad, Avenza, etc. and desktop software such as ArcGIS, with details provided on the mapping Sharepoint site: Aerial Application of Fire Retardant Mapping Sharepoint

## Raw Data Availability

Data is currently available within the Forest Service intranet and internet to support the official record of decision from the 2011 EIS. Data components used in the creation of the official retardant avoidance PDF maps are:

- TEPCS retardant avoidance:
  - S_USA. AerialFireRetardantAvoidance -- standalone feature class in EDW SDE Default available to internal users
  - Forest Service Geodata Clearinghouse - Aerial Fire Retardant Avoidance -- Raw TEPCS and hydrographic GIS data available to internal/external users
  - Terrestrial Avoidance Areas -- map service available to internal/external users
  - Each national forest or region has archived data they submitted as well
- Hydrographic retardant avoidance:
  - S_R*XX*.AFRAA_Hydro – feature classes in EDW SDE Default available to FS staff, where *XX* is the 2-letter region identifier

- Forest Service Geodata Clearinghouse - Aerial Fire Retardant Avoidance -- Raw TEPCS and hydrographic GIS data available to internal/external users
- Hydrographic Avoidance Areas -- map service available to internal/external users
- Each national forest or region has archived revised hydrographic avoidance data they submitted as well

- USFS FS Topo Primary Base Series Maps:
  - Use data available to internal users located in the EDW Default SDE with the following naming convention:
    - S_USA.FSTopo_PBS_Cadastral
    - S_USA.FSTopo_PBS_Cultural
    - S_USA.FSTopo_PBS_Elevation
    - S_USA.FSTopo_PBS_Geodetic
    - S_USA.FSTopo_PBS_Hydrography
    - S_USA.FSTopo_PBS_Landform
    - S_USA.FSTopo_PBS_Text
    - S_USA.FSTopo_PBS_Transportation
  - Forest Service Geodata Clearinghouse - datasets -- search for FSTOPO datasets in this catalog. Raw GIS data available to internal / external users
  - Symbological definitions are available at Fire Retardant EIS files in the FSTopoTemplate.mxd
  - Use the FS_Topo Primary Base Series image server connection at GTAC Image Server for a raster background of topographic information or Forest Service Topo for a vector service.
  - Component FS Topo background datasets available to external partners at Forest Service Geodata Clearinghouse

- Hillshaded terrain raster dataset:
  - Use the image server connection at: GTAC Image Server for a raster hillshade.

- NHD National Hydrologic Dataset information (Base data, not formatted as retardant avoidance):
  - USGS National Hydrography -- High resolution NHD from USGS, available to internal / external users
  - Available in EDW's Default SDE to internal users as regional datasets:
    - S_R*xx*_Hydrography where '*xx*' is the region identifier
      - NHDFlowline feature class: Streams/Rivers Polylines
      - NHDWaterbody feature class: Water bodies Polygons

# Chapter 3. Pilot Direction

## Direction

Incident Commanders and pilots are required to avoid aerial application of fire retardant in avoidance areas for TEPCS species or within the 300-foot (or larger) buffers on either side of waterways.

When approaching an avoidance area mapped for terrestrial TEPCS species, waterway, or riparian vegetation visible to the pilot, the pilot will terminate the application of retardant approximately 300 feet (or larger) before reaching the mapped avoidance area or waterway. For example, a waterway has a 300’ buffer on either side of the edge of the waterway and the pilot would terminate the application of retardant prior to reaching the 300’ edge. In some cases the avoidance area along waterways may be larger than this standard 300’ distance. These are noted on the avoidance maps.

When crossing a mapped terrestrial avoidance area, waterway, or riparian vegetation, the pilot will wait one second before applying retardant. Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot or larger buffer or avoidance area.

> **These guidelines do not require helicopter or airtanker pilots to fly in a manner that endangers their aircraft or other aircraft or structures or that compromises the safety of ground personnel or the public.**

The Forest Service will coordinate with aviation managers and pilots on avoidance area mapping and aircraft operational direction and will provide reporting direction to all firefighting fire personnel with suppression responsibilities in the event they discover a misapplication in an avoidance area. Chapters 4, 5, 6 and 8 provide information and direction concerning fire operations, reporting a misapplication, and training.

**Medium/Heavy Airtankers, Single Engine Airtankers, and Helicopters:**

- Prior to fire retardant application, all pilots shall be briefed on the locations of all TEPCS species avoidance areas on the unit.  If actual briefing is not feasible, at a minimum the pilot will inquire as to avoidance areas and their locations if they do not have avoidance area maps or access to the locations electronically.

- Prior to aerial application of fire retardant, the pilot will make a “dry run” over the intended application area to identify avoidance areas and waterways in the vicinity of the wildland fire if possible.

- A pilot does not need to make additional “dry runs’ when applying multiple loads of retardant in the same general area of the fire.

- When approaching mapped avoidance areas for TEPCS species or waterways or riparian vegetation visible to the pilot, the pilot will terminate the application of retardant approximately 300 feet before reaching the mapped avoidance area or waterway.

- When crossing a mapped avoidance area or waterway, pilots will wait 1 (one) second after crossing the far border of a mapped avoidance area or waterway before applying retardant. For additional buffer widths, an additional second should be added.

- Pilots will make adjustments for airspeed and ambient conditions such as wind to avoid the application of retardant within the 300-foot or larger buffer zone, or mapped avoidance area in order to avoid drift into protected areas.

- Pilots shall be provided avoidance area maps at all briefings or in advance of fire chemical suppression missions, and attend required training to maintain necessary certifications to fly for the Forest Service fire program, which includes applying the operational guidelines herein.

### Flight Condition Guidelines

Aerial supervision personnel must carefully evaluate flight hazards and conditions (visibility, wind, thunder cells, turbulence, and terrain) to ensure that operations can be conducted in a safe and effective manner. Aerial application of fire retardant should only occur if the conditions support the use. Avoiding waterways, waterway buffers, and all other mapped avoidance areas is critical.

## Notification Process for Aerial Assets

Avoidance Area maps will be made available in a variety of formats, including hard copy maps, and electronic maps, to all Lead Plane, Aerial Supervision Module, Air Tactical Group Supervisor, and Initial Attack (IA) qualified Air Tankers, Helicopters, Fire Management Officers (FMO), Line Officers, Incident Commanders, and all resource specialists, such as wildlife biologists, fisheries biologists, botanists, and cultural resources specialists. Fire Management Officers can distribute as necessary to appropriate fire personnel.

All retardant avoidance area mapping information is in a GIS layer that can be overlaid into moving map applications and WildFire Decision Support System (WFDSS). These map products can be downloaded to GPS units that aviation assets could utilize with any technology they use in the airplane.

Interagency Dispatch Centers will have avoidance area maps available in WildCAD for the forests/units in their dispatch area. When aircraft are utilized and/or requested, the requesting dispatch center will review their retardant avoidance area maps and advise as to whether or not the fire is within, or adjacent to, an avoidance area.

This information will then be communicated to responding aircraft similar to how hazard information is currently communicated. Coordination should occur with the IC as well, if there is one on scene. If needed, the IC should request a local Resource Advisor (READ) in the event there are several avoidance areas within the vicinity of the incident.

As it is unreasonable to expect pilots to utilize a map book while simultaneously performing all of their other responsibilities, it is important that any avoidance areas that may be near or within the fire activity is passed along from the dispatch.

Aerial Supervision (Aerial Supervision Module, Air Tactical Group Supervisor or Lead Plane) personnel should communicate with pilots regarding the presence of avoidance areas and waterways that may be near the drop area. Communicating with ground resources on the fire is also critical to assist in the proper placement of the aerially delivered retardant outside of avoidance areas.

***When retardant is requested on a National Forest, there needs to be a trigger to advise aviation assets whether or not the fire location is within or adjacent to a mapped avoidance area. Theoretically, this initial trigger would come from dispatch to the Aerial Supervision Module, Air Tactical Group Supervisor, or lead plane. This may be specific communication (e.g. fire is in an avoidance area) or it may be general (e.g. fire could be near an avoidance area). Regardless, this information should trigger the Air Tactical Group Supervisor, Air Tanker, Lead Plane or Aerial Supervision Module to consult with the IC or their Retardant Avoidance Area Map Book to determine whether or not the fire is located in an avoidance area.***

***If dispatch is not able to communicate this information for whatever reason (e.g. overloaded with heavy initial attack) it is going to be incumbent on the IC and/or the Air Tactical Group Supervisor to determine whether or not the fire is within an avoidance area. If the Air Tactical Group Supervisor is overloaded and unable to consult his/her map book or digital map and there is no IC on the ground, then at the very least, a request to dispatch for clarification needs to occur. However, if there is a life or public safety threat, retardant should be considered if there is a "reasonable expectation that retardant will alleviate that threat."***

# Chapter 4. Fire Operations

## Introduction and Background Information

Firefighter and public safety is always the first and highest priority in fighting fires (FSM 5100). The introduction of increased restrictions on where aerial fire retardants (AFR) can be applied has the potential to introduce an unintended consequence to safety. Firefighting training, direction, and requirements are generally standardized across all Federal wildland firefighting agencies and most States. Implementing a more complex mapping system for ground and aerial resources only on Forest Service fires may lead to confusion and inconsistencies with partners and cooperators.

The Forest Service will continue using aerially delivered fire retardant while reducing impacts to federally listed species sufficiently to ensure that no species will be jeopardized by such use. The EIS establishes national avoidance area mapping standards and annual coordination between the Forest Service with FWS and NOAA Fisheries to ensure that avoidance areas and mitigations are reducing impacts to TEPCS species. The ROD/EIS only increases the avoidance areas for excluding retardant use across approximately 0.8 percent of NFS lands in addition to the 2000 Interagency Direction on the Use of Fire Chemical Near Waterways for protection of all waterways with a 300 foot buffer.

The EIS institutes more protective measures than previously identified for aquatic and terrestrial environments and other special habitats, including FS listed sensitive species, than past practices. It also established national requirements for protection of heritage, cultural, and tribal resources.

## National Requirements set forth within the ROD/EIS include:

- Updating the interagency policy for use of aerially delivered long-term retardant on NFS lands which is found in the Fire and Aviation Operations Standards (known as the "Red Book") Chapter 12, and includes all fire chemicals and all types of application: ground delivery, aerial delivery and foams and water enhancers/gels,
- Monitoring and reporting of five percent (5%) of all fires less than 300 acres in size during which aerially delivered retardant was used and aquatic or terrestrial avoidance areas exist to determine if any misapplications occurred that were not reported (see Chapter 7 - Assessment of Fires Less than 300 Acres),
- Additional reporting and monitoring requirements associated with AFR mapped avoidance areas (aquatic, terrestrial and potentially cultural and historic, etc),
- National mapping requirements that ensure consistency across regions,
- Annual training to all fire staff of the direction set forth within the ROD/EIS,
- Implementation of the terms and conditions and reasonable and prudent measures provided within the BOs from FWS and NOAA Fisheries.

## Exceptions for use in Waterways:

***The only exception to using aerial application of fire retardant on NFS lands into a waterway, 300' buffer on either side of a waterway (or larger in certain areas) or a mapped avoidance area on Forest Service fires is: for protection of human life and public safety only.[1]***

***Agency administrators need to establish clear direction and expectations for managing fires near mapped avoidance areas through the delegation-of-authority issued to Incident Commanders. Discussion of alternative tactics should take place on Forest Service units in advance of fire season as well as coordination with their cooperators to determine the best strategies for areas of potential high risk, such as the wildland–urban interface.***

***This national direction is mandatory and shall be implemented except in cases where human life or public safety is threatened and retardant use within avoidance areas could be reasonably expected to alleviate that threat.***

***In cases where the exception for human life and public safety is used, it is recommended to provide documentation to the misapplication report for the incident. An example of an exception letter is provided below.***

[1]- All other federal and some state agencies follow the "Exceptions for All Other Agencies and All Other Fire Chemicals" found in Chapter 12 of the Interagency Standards for Fire and Fire Aviation Operations (Red Book).

File code: 5100/2670 Date: XXXX

Subject: Exception for Use of Aerial Fire Retardant in Mapped Avoidance Area - XXX Fire

The XXX Fire started around XXXX hours on <date> in the vicinity of <general description>. The fire quickly grew in size and intensity due to dry fuels/moderately steep topography, and wind. The fire had the potential to threaten <describe threat to fire fighter and/or public safety>.

The <describe areas> are mapped avoidance areas for ESA listed species and or critical habitats (XXXX Quad):

- <provide list of species and/or critical habitat> •
- 

<Provide any other pertinent information>

<Describe why exception was used>

> Example: When Air Attack first arrived over the incident, knowing that there were mapped avoidance areas in the vicinity, and seeing the fire activity increasing and with a rapid rate of spread, requested from the Incident Commander <name> permission to drop in the avoidance area for fire fighter and public safety. The IC and <name of District/Unit> District Ranger <name>, in concurrence of Forest Supervisor <name>, made the decision to use aerial fire retardant in the avoidance area because fire fighter and public safety was threatened and the use of retardant alleviated that threat.

| | |
|---|---|
| *SIGNATURE* | *SIGNATURE* |
| <name> | <name> |
| <title – ex:Agency Administrator> | Incident Commander |

**Figure 1. Exception letter example**

## Implementation of the National Requirements for Fire Operations

### Pre-Season Planning

Preparedness: units with mapped avoidance areas shall include the additional reporting, tracking and monitoring requirements. These National requirements can be included in:

- check-lists,
- briefing materials,
- local training and refreshers,
- other unit - specific materials that are typically generated for sharing with any fire resources on the unit prior to their regular fire season.

Pre-season readiness reviews may also provide an opportunity to disseminate this direction and reporting requirements during:

- preplanned dispatch initial attack response strategies,
- local fire refresher training,
- cooperative fire protection agreements where other agencies provide protection on National Forest lands,
- any meetings where response to fires is a topic. These venues will provide direct means of communicating the intent of these guidelines and provide a standard practice of reviewing the maps annually to ensure personnel are aware of changes, as well as ensuring new employees on the units will be exposed to the material and requirements***.***
- ***Documentation of such coordination is recommended.***

Initial attack response cooperative agreements should be reviewed and discussed with the cooperating agency(s) to ensure they have the information specific to changes with aerially applied fire retardant and additional reporting requirements. Chapter 6 provides the misapplication reporting requirements.

> ***Training is a critical element for any resource supporting fires. Chapter 8 includes seasonal duties and annual training requirements.***

Aerial fire retardant mapped avoidance areas may include not only just waterway but additional areas associated with TEPCS species, designated critical habitats of those species, other resource areas of importance, cultural resource, traditional cultural property, or sacred sites. Units need to identify if aerially applied fire retardant is appropriate for protection of the resource or surrounding areas or if other suppression tactics should be used. This pre-work will assist any IC when a fire is threatening these areas.

Units should consider developing a pre-established briefing packet that includes general avoidance area map direction, cultural avoidance areas and information, misapplication reporting requirements, and contacts for local resource specialists in case of a misapplication. This packet should be provided to personnel responding to the incident.

## Fire Suppression Activities

Agency Administrators will include direction and expectations in their delegation of authority to the Incident Management Team IC if a fire has potential or already includes any avoidance area as identified through the EIS/ROD and Consultation. The initial briefing with the IC should cover areas that have been identified as potential for high risk for public (such as urban interface) and fire fighter safety that fall within or overlap with mapped avoidance areas. The exception to apply retardant may be invoked in these cases and awareness of this in advance is critical.

Incident Commanders and Agency Administrators need to ensure firefighting resources have general avoidance area maps and direction, cultural avoidance areas and information, misapplication reporting requirements, and contacts for local resource specialists in case of a misapplication.

For Initial Attack (IA) fires, it is critical for the avoidance area maps to be available to any fire resources that provide initial attack response including dispatchers. The potential to order the use of fire retardant to assist in the containment of an IA is strong, so forests with mapped avoidance areas should develop strategies and tactics in advance of fire starts. This level of preplanning and IA priorities for the dispatch of appropriate resources will minimize the potential for misapplications. See Chapter 3 Pilot Direction, Notification Process for Aerial Assets for more details.

The ROD includes language specific to aircraft operational guidance. Specific to the IC, the following is identified:

> **Whenever practical, as determined by the fire Incident Commander, the Forest Service will use water or other wildland fire chemical suppressants for direct attack or less toxic approved fire retardants in areas occupied by TEPCS species or their designated critical habitats. Some species and habitats require that only water be used to protect their habitat and populations; these habitats and populations have been mapped as avoidance areas.**

# Chapter 5. Resource Specialists

## Resource Specialists and Advisor (READ) Role

Resource specialists or qualified red-carded Resource Advisors (READs) or the Resource Advisor –Fireline (REAF) may consist of any FS specialist responsible for the protections of cultural resources, fish or aquatic resources, wildlife and plants or other terrestrial resources. READs/REAFs are usually assigned at the local National Forest level for support to fire incidents, but may also include regional specialists in the case of TEPCS species. A regional specialist may be involved with the annual reporting and coordination requirements with the FWS, NOAA Fisheries, State Historic Preservation Officer (SHPO), Tribal Historic Preservation Officers, State Fish and Wildlife agencies, or others as appropriate. Depending on the implementation task, whether it is misapplication reporting, updating avoidance maps, coordination with other agencies FWS/NOAA Fisheries, or monitoring requirements after a misapplication various resource specialists, qualified biologist or a READ on a fire may be involved.

Before fire season, it is recommended that hydrologists or Forest Hazardous Materials coordinators expected to work as a READ coordinate with their state water quality agency counterpart to discuss (and document) reporting required in the event of a retardant spill or retardant misapplication to water. In addition, become familiar with the latest state water quality requirements, any site specific areas with special water quality issues, and water intakes for municipal watersheds or domestic water supplies on the Forest or directly downstream.

The role resource specialists or READS, have within the ROD include:

**Aerial Retardant Misapplication Reporting and Monitoring**

Analysis of Impacts through Site Assessments

Follow-up monitoring as needed

Notifications with regulatory agencies and/or other regions and forests for wide ranging species and incidental take statement requirements

Re-initiation of consultation if needed

Implementation of restrictions if necessary

Implementation of appropriate mitigation measures, remediation, restoration and recovery actions

**Annual Coordination and Training**

With Regulatory Agencies: Update avoidance maps annually in cooperation with FWS and NOAA Fisheries to reflect changes during the year on additional species or changes made for designated critical habitat, either from new federal species, final or proposed listings or designated/proposed critical habitat, or changes to existing species occurrences

Include documentation of this annual coordination: date, participants, and agendas.

Ensure the most up to date maps reflecting avoidance areas are maintained.

**Figure 2. Resource Specialists Role within the Aerial Fire Retardant Delivery from Aircraft Direction**

## Implementation Guidance

The guidance below is general in nature, allowing for Regions and Forests to organize processes as it best suits their individual needs to meet the requirements in the ROD. For species evaluated within the FS Biological Assessments (BA's), it is suggested for wide ranging species or species that occur on multiple forests within a region that FS species leads or species coordinators be identified to ensure the Aerial Application of Fire Retardant Direction and Conservation Measures and Incidental Take Statements (ITS) are implemented.

The following is suggested as a method to determine species leads:

1) Use Forest Service Manual 2672.24a Exhibit 01-part for existing species listed up to around Jan 31, 1991.
2) For species not on this list, use the Region where the species predominately occurs.
3) For all other species, use the Region closest to FWS/NOAA Fisheries office lead.

The guidance follows:

- The FS, at the local level will coordinate with local FWS and/or NOAA Fisheries offices annually or as needed to ensure that any updates for retardant avoidance areas on NFS lands are mapped using the most up-to-date information.

- The FS, at the local level, will report any misapplication into an avoidance area and contact FWS and NOAA Fisheries if required. The ***Wildland Fire Chemical Misapplication Reporting Database*** (Appendix B) documents site specific impacts if any, and directs the resource specialist or READ for additional actions, e.g. reporting to FWS, NOAA Fisheries, or water quality monitoring requirements. This local level reporting, using this On-Line reporting tool captures all data for upward reporting to the National Offices of FWS and NOAA Fisheries, available at: Interagency Wildland Fire Chemicals Policy and Guidance.

- The FS at the local level will implement the terms and conditions and Incidental Take Statements issued within the BO's. Different scales of analysis for incidental take and different re-initiation requirements were given for aquatic species under the jurisdiction of NOAA Fisheries, compared to FWS species (refer to the BO's at Interagency Wildland Fire Chemicals Policy and Guidance.)

    - **For FWS species occurring within multiple Regions or Forests and where 'take' is tracked by forest, FS TES Regional Program Managers need to ensure 'take' is not exceeded and determine if re-initiation is necessary. For NOAA Fisheries species, FS TES Regional Program Managers need to ensure that 'take' is tracked and re-initiation is completed as appropriate for species.**

- The FS at the local level will implement any conservation measures or terms and conditions outlined within the FWS BO's for species specific requirements, in addition to completing any supplemental analysis or assessments to determine necessary mitigation measures, remediation actions monitoring needs, and whether re-initiation of formal consultation is needed.

***Depending on the severity of the adverse effect, a restriction on future aerial application of retardant may be necessary for the reported area.***

- The FS will implement mitigation measures for misapplications in avoidance areas if soil or vegetation and surrounding habitat within the waterway buffers are impacted, and implement erosion control measures to reduce retardant delivery from entering habitat during rain events.
    - These measures will follow revegetation and erosion control as outlined within the BAER guidance.
    - These measures are determined at the local level depending on local conditions and are associated with aquatic and riparian threatened and endangered species habitats.

- Due to the nature of cultural resources and sacred sites, direction for mapping, misapplication and reporting, and monitoring is provided within a separate section in Chapter 6, "Process of Reporting of Misapplication of Aerial Application of Fire Retardant for Cultural Resource, Traditional Cultural Property, or Sacred Sites".

## Re-initiation of Consultation for the National Programmatic BA with FWS/NOAA Fisheries

The National programmatic BA's and BO's are broad in scope. Within the take statements and the implementation direction provided above, notifications/discussions/emails/telephone conversations and consultations with FWS/NOAA Fisheries related to a specific misapplication frequently occurs. All of these types of local level communications are associated with, and take place as part of, the terms and conditions of the BO and the implementation of the ROD. These discussions and mini-consultations are not considered as national formal re-initiation of consultation.

Re-Initiation for the National Programmatic BO is provided in 50 CFR 402.16. Re-initiation 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:

- the amount or extent of take is exceeded;
- new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered**;**
- the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered; or
- a new species is listed or critical habitat is designated that may be affected by the action.

## Examples of Re-initiation for the National BO

### *Amount or Extent of Take is Exceeded:*

**Action:**

1. Species leads will be identified to track amount or extent of take at either the local or regional level.

2. If species is wide ranging and take occurs in one area, all other regions/forests where species occur will be notified (this process is captured within the reporting forms and associated databases).

3. If amount or extent of take is exceeded, FS species lead will re-initiate consultation with regulatory agency species lead, determine additional action items, complete the re-initiation consultation and send results to WO-FAM who will coordinate with the WO-TES Program Manager on amendment of the National BA as necessary.

### *New Information reveals effects of the Agency Action on Listed Species or Designated Critical habitat in a manner or to an extent not considered:*

The following items are examples of what may constitute new information:

- aerial fire retardant use on forests not previously considered within the analysis,
- aerial fire retardant use or new FS direction that would apply aerial fire retardant in amounts beyond analysis parameters within the BA, or
- species baseline conditions change that may not have been considered within the BA.

**Action:**

1. If aerial fire retardant is planned or occurs on forests not analyzed in the BA due to no previous or very little use of aerial fire retardant, local forests or regions must re-initiate consultation following similar analysis used within the BA, consult with local FWS offices, retain information locally and submit to WO-FAM who will coordinate with WO-TES Program Manager and amend the National BA as necessary.

2. Aerial fire retardant use by forest is tracked each year by Fire and Aviation Management (FAM), and annual reports of use are sent to the Director of FAM to forward to the Regulatory Agencies. Regional TES coordinators should determine if aerial fire retardant use is outside the bounds of analysis set forth in the BA (annual aerial fire retardant use by forest will be available via on-line database or annual report prepared by FAM).
   - Because the BA considered average aerial fire retardant use from the past 10 years by forest, considering if aerial fire retardant use is outside the bounds of analysis will likely be a process evaluated during the 5-year programmatic review.
   - However, if aerial fire retardant proves to be continually out of bounds of analysis earlier for specific forests, re-initiation may be appropriate.

3. If a species baseline condition changes resulting in actions not considered within the BA, (for instance a natural event that would eliminate a small endemic population) local staff will reinitiate consultation, determine additional action items, and complete re-initiation and retain information locally and submit to WO-FAM who will coordinate with the WO-TES Program Manager and amend the National BA as necessary.

### *The agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered:*

The development and approval of new fire retardant chemicals not previously evaluated within the BA may be classified as a potential effect to species or critical habitat not considered.

**Action:**

1. WO-FAM/NTDP has developed processes with both regulatory agencies when new retardant formulations are approved and placed on the qualified products list.
    a. For minor formulation changes where the effects of the action are not changed, re-initiation with FWS is not required. Supporting evidence of this finding will be provided to the FWS and they will evaluate these findings and informally concur.
    b. For NOAA Fisheries, new formulations using the same salt bases analyzed within the BO, that are less toxic than those already considered, do NOT require re-initiation.

2. For more complex formulation changes that have not previously been evaluated or alter the effects of the action, re-initiation triggers apply.

### *A new species is listed or critical habitat is designated that may be affected by the action.*

**Action:**

1. Re-initiation will occur at the either the local or regional level or
    - with FS species leads or RO/WO for wide ranging species.
2. Develop baseline information, tier to, or use similar screening protocols provided within the National BA.
3. Results of consultation will be retained locally and sent to WO-FAM who will coordinate with the WO-TES Program Manager to amend the National BA as necessary.

Example templates for completing National level re-initiation of consultation in addition to completed documents can be found in Appendix E and on the Pinyon SharePoint site, respectively:

**WO-FAM contacts:**

**Dave Haston, Branch Chief Equipment and Chemicals**, WO-FAM/NIFC; david.haston@usda.gov
**Shirley Zylstra, Program Leader**, Wildland Fire Chemical Systems, NTDP; shirley.zylstra@usda.gov
**Laura Conway, Natural Resource Specialist,** NTDP; laura.conway@usda.gov

**WO-TES contacts:**

**John Morse, National Threatened and Endangered Species Program Leader**, WO-WFWARP; john.morse2@usda.gov

## Local Level Changes That Do Not Trigger National Level Re-initiation

If there are minor changes at the local level, such as new species occurrences already considered within the BA's and BO's, or critical habitat adjustments, an addendum process will be used. These minor changes, which do not trigger the re-initiation actions at the national level described above, or make any changes in the effects analysis within the existing BA's and BO's are described below and will be tracked by the Regional level TEPCS species coordinators, retained at the local level or in cases with wide ranging species with the species lead.

The addendum process will be used for the following when:

1. There are additional species locations or minor additions or changes to critical habitat.

2. Updated or corrected information for a local national forest/grassland is relevant; for instance, change in mapping of avoidance areas due to local conditions:
    a. For water, NHD layer must be used as base layer but adjustments within this layer may be applied (e.g. intermittent/dry washes, diversions, or irrigation ditches),
    b. Changes in size or removal of current terrestrial avoidance areas to allow for protection of species or habitat with the use of aerial application of fire retardant due to change in conditions,
    c. Adjustments to the avoidance area mapping e.g. reduction of standard 300' buffer on intermittent streams, dry washes, diversions or irrigation ditches may occur if:
        i. There are no changes to species determinations as reported in the BO, and
        ii. Coordination with local FWS/NOAA Fisheries would need to occur to ensure concurrence of determination statements. A letter of concurrence would need to be provided by FWS/NOAA Fisheries.

3. There is a change in a determination for a species at the local level. For instance if a species was given a Likely to Adversely Affect determination nationally and the forest identifies additional pertinent information that may indicate a lesser effect, the local level must provide defensible rationale and analysis to support change from the national programmatic Biological Assessment and Biological Opinion and should follow assumptions and factors used in national programmatic processes.

## Process for Addendums to the National Biological Evaluations (BE) for Sensitive Species

If there are necessary changes at the national forest/grassland level based on local conditions, the units will address those changes with the process listed below. This action will result in addendums to National Programmatic BE's. All changes will be tracked at the local and regional level by TEPCS species coordinators. Any changes to the programmatic BE will be retained at the local or regional level.

The addendum process will be used for the following when:

1. There is a change in listing status from sensitive to candidate. If candidate species is elevated to proposed species, refer to re-initiation of consultation above (proposed species were considered within the formal consultation).
    a. If the species is limited to a single forest, then the local level should conduct a determination analysis using the national screening processes outlined in the resource specific BE's and FEIS as a coarse filter.
        i. For wildlife, use the Terrestrial Screening Process outlined in the FEIS, Appendix I - wildlife, on pages 328-338.
    b. If the species is wide-ranging, the analysis should be done at the regional office level using the screening process from the BE's and FEIS
        i. Coordinate with adjacent forests on appropriate level of analysis to conduct, and
        ii. Coordinate on appropriate buffers for protection by avoidance areas mapping.

2. There is an addition of a new sensitive species or habitat in need of protection from aerial fire retardant application.

**Refer to Chapter 2 for the process of updating avoidance area maps due to new species listings or changes in critical habitat.**

# Chapter 6. Reporting and Monitoring

## Process of Reporting of Aerially Delivered Fire Retardant into Mapped Avoidance Areas and Waterways

The Forest Service acknowledges that misapplications have occurred and likely will in the future due to weather, visibility, pilot error, topography, or other conditions. The Forest Service continues to report application of retardant into waterways or mapped avoidance areas as a result of invoking the exception for use or accidental misapplication; these processes are outlined in Figures 3 and 4. Figure 3 provides an overall flow chart of the components and Figure 4 breaks the reporting and monitoring needs separately. A process tracking sheet found in Appendix C provides an outline of how and where data is collected and submitted.

The Forest Service has developed reporting, monitoring, and assessment tools to streamline data gathering and provides forests/regions/national office a final product that standardizes and captures the required reporting and monitoring associated with this decision. The reporting tools (***Interagency Wildland Fire Chemicals Reporting Tools***) with instructions can be found in Appendix B as well as online at: Interagency Wildland Fire Chemicals Policy and Guidance. Refer to the online reporting tools/forms for the most current updated forms in the event that this handbook is delayed in updates. Online reporting tools/forms will be updated annually to reflect adjustments to required reporting and monitoring that may occur for individual species. Refer to Chapter 7 for specific information related to assessment of 5% of fires less than 300 acres in size.

***Due to the additional implementation activities required it is imperative the regions are diligent in meeting all reporting requirements within the timeframes established. For misapplication reports, assessments should be done as soon as possible during the incident but no later than 30 days after drops have occurred in order to determine impacts. For the 5 percent monitoring of fires less than 300 acres in size, the assessment should be done no later than 30 days after drops have occurred in order to determine impacts.***

***The Agency Administrator at the local level where the fire activity occurs needs to be kept abreast of any misapplications of aerially applied fire retardant that may have the potential for adverse impacts of species identified in the BOs.***

***There are a number of species specific Conservation Measures, Incidental Take Statements and Reasonable and Prudent Measures that are tied to the decision and are required as part of this action. For instance, 1) specific monitoring protocols and subsequent actions if adverse effects are identified must be implemented to comply with requirements of the decision, or 2) actions such as notification of other forests or regions if adverse effects are identified for wide ranging species. It is the responsibility of each region/ forest to be knowledgeable of these additional reporting and monitoring requirements. These requirements must be implemented and all reports and applicable monitoring completed and documented. Conservation Measures, Incidental Take Statements, and Reasonable and Prudent Measures can be found in the BO and the ROD.***

*Aerial Fire Retardant into Waterways or Mapped Avoidance Areas Flow Chart*

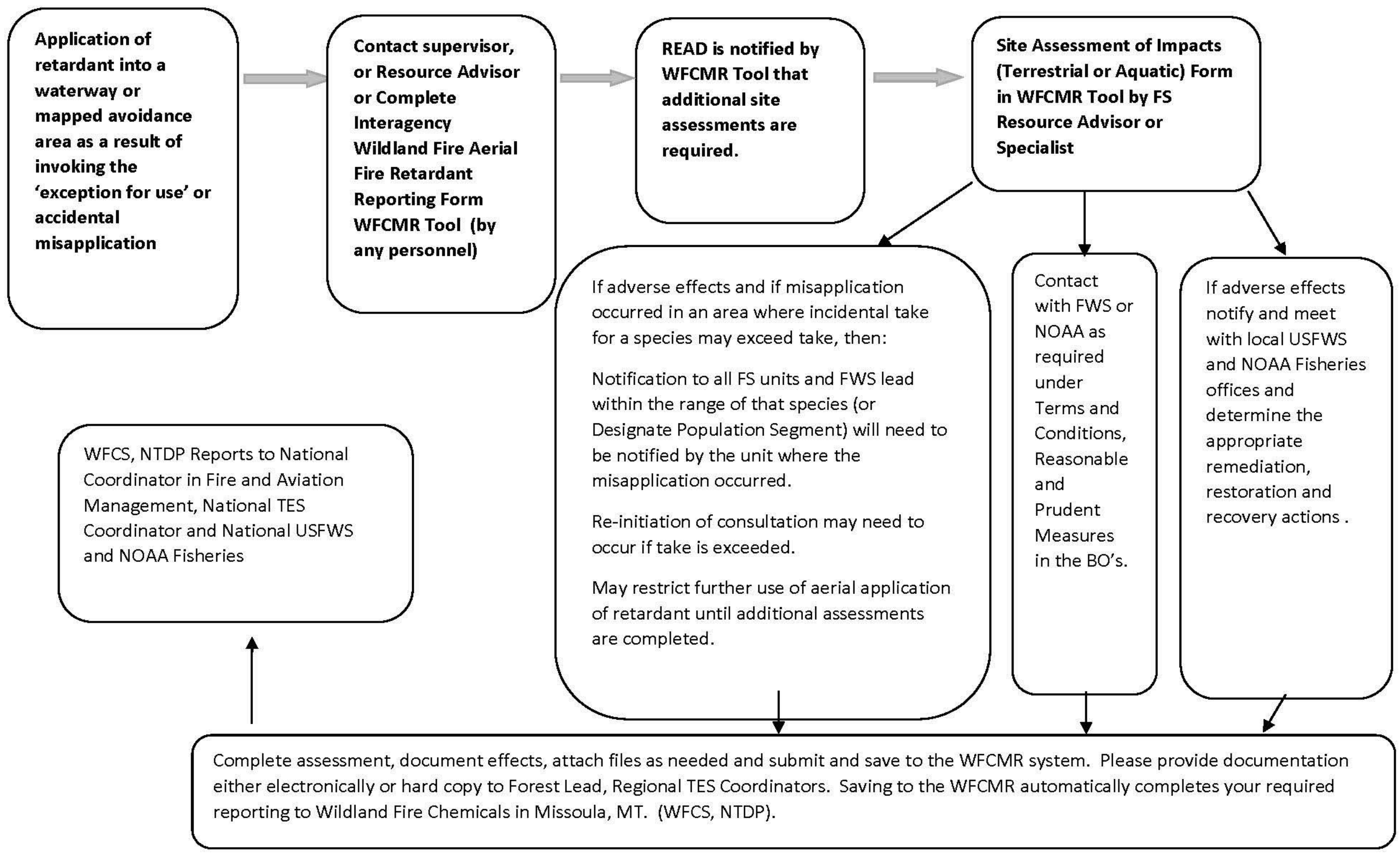



**Figure 3. Process map of steps to take in the event of a misapplication into a waterway or mapped avoidance area for TEPCS species. Cultural resources would follow a similar process with the appropriate SHPO/tribal entities.**

## *Re-initiation of Consultation for the National Programmatic BA with FWS/NOAA Fisheries*

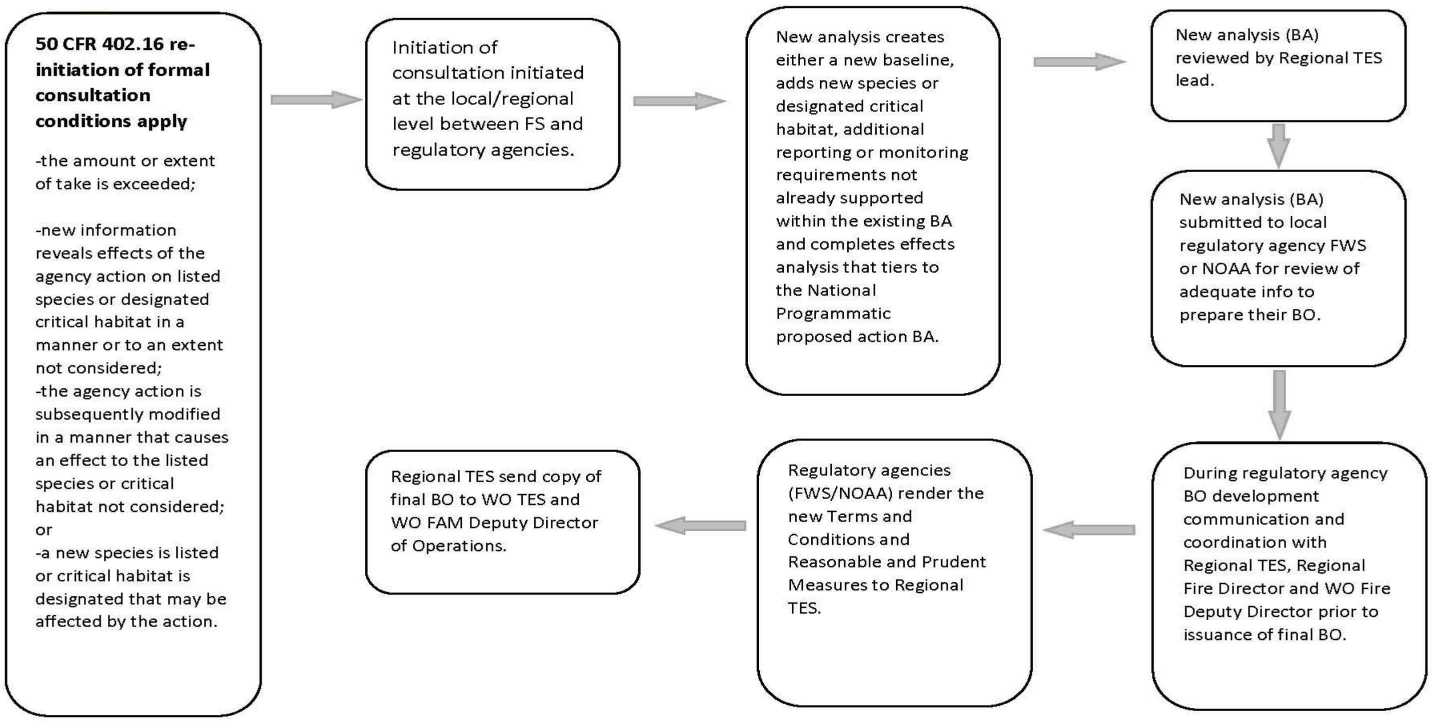



**Figure 4. Process map for re-initiation of National programmatic Biological Opinions**

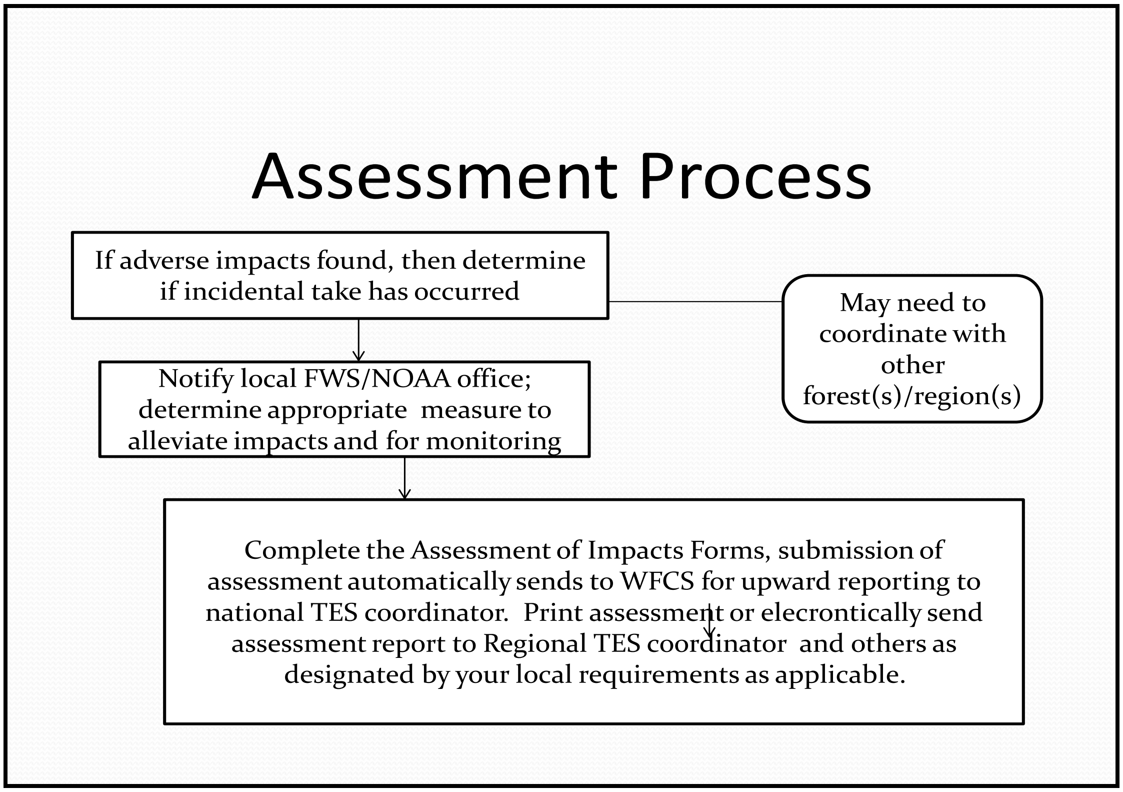



**Figure 5. Reporting and Assessment Processes for Fire Retardant applied into Waterways or Mapped Avoidance Areas.**

The implementation of monitoring establishes another level of training and the potential for additional resources, both personnel and funding, in order to mitigate the impacts of using retardant. Due to this, additional emphasis has been placed on the appropriate use of retardant in initial attack (IA) responses as well as large fires. It is important to remember that the tactics identified that will best meet the desired outcome drive which firefighting resources will be utilized, which can include the use of fire retardant.

## Reporting and Monitoring Direction

The following processes describe how reporting and monitoring will occur.

1. **Reporting of Misapplication of Aerial Application of Fire Retardant**
    a. Report occurrences at time of event during suppression activities to the Incident Commander, and FMO who will:
        i. Ensure the Interagency Wildland Fire Aerial Fire Retardant Misapplication Reporting Form is Completed (example of on-line form in Appendix B and On-line reporting tool – Wildland Fire Chemical Misapplication Reporting (WFCMR) database).

b. Notify the READ or local resource specialist, such as Forest Biologist or District level specialist to complete assessment of impacts.

   i. Site Assessment of Impacts Forms and Follow-up Monitoring Forms (example of on-line form in Appendix B and On-line reporting tool – WFCMR document impacts and ensure that species specific requirements are met).

   ii. This assessment of impacts to species or habitats; (completed by qualified biological resources personnel) documents if adverse impacts have occurred and is completed and submitted for annual reporting requirements.

   iii. NTDP compiles all misapplication reports and forwards to WO-FAM to complete annual reporting requirements to the regulatory agencies.

c. If adverse impacts are found, the local resource specialists, Ranger District biologist or Forest Biologist should:

   i. Determine if misapplication has occurred in area where the incidental take for a species may be at or exceed take, then:

      1. Notification to all FS units and FWS lead within the range of that species (or Designate Population Segment). This may also be accomplished by the FS species leads/coordinators for wide-ranging species,

      2. re-initiation of consultation may need to occur if take is exceeded,

      3. unit may need to restrict further use of aerial application of retardant at that time until a biological assessment is completed.

   ii. Notify and meet with local USFWS and NOAA Fisheries offices and determine the appropriate remediation, restoration and recovery actions.

**2. Scenarios: Aerial Application of Fire Retardant**

a. If a misapplication occurs <u>on</u> <u>National Forest System</u> (NFS) land, regardless of who is authorizing, funding, or carrying out the action, the Forest Service will evaluate effects of the fire retardant intrusion on listed species occurring on NFS lands and determine the need to reinitiate consultation with the regulatory services.

   Responsibility: Forest Service action and responsibility.

   If it is determined there are downstream effects within a specified distance as determined within the BO's (e.g. the 6.2 mile buffer for NOAA Fisheries, or species specific areas as determined by FWS) the FS will work cooperatively with the agency administrator or landowner to evaluate effects of fire retardants and determine if further consultation is required due to federal regulations or state statutes.

b. If a misapplication occurs <u>off NFS land</u> (and is applied by any agency) but has the potential to affect NFS lands as a result of drift or water transport (as outlined within the action area as described by NOAA Fisheries and FWS (e.g. the 6.2 mile buffer for NOAA Fisheries, or species specific areas as determined by FWS) then the Forest

Service will cooperatively work with land owners (other federal agency, state or private) to evaluate effects of the fire retardant intrusion on listed species occurring on NFS lands and determine the need to reinitiate consultation with the Services.

Responsibility: The Forest Service monitors the potential for aerial fire retardant intrusions on fires that occur near FS lands and cooperatively coordinates with firefighting activities and agencies to determine if a misapplication has occurred. FS (Resource Specialist) participates with landowners to determine potential impact. If adverse effect triggers a re-initiation as described in the biological opinion (BO), FS takes the lead on re-initiation of consultation for specific species evaluated within the BO.

If during the evaluation of effects on these non-NFS lands, effects to listed species not affecting NFS lands and not considered within the BO are identified, immediate notification to the agency administrator for the fire and landowner will ensure for compliance with ESA or other states endangered species protection measures as provided in applicable state statutes.

Responsibility: Agency Administrator initiates emergency consultation procedures or other applicable state endangered species protection measures outlined in their statutes.

c. If a misapplication occurs off NFS land (and applied by any agency through the delegation of authority) and does not have the potential to affect NFS lands as a result of drift or water transport, and is outside the action area as defined by NOAA Fisheries, then the federal or state agency land owner will be responsible for determining whether there were adverse effects and initiate emergency consultation.

   Responsibility: Compliance with ESA and consultation is completed by the federal or state agency applying retardant through the delegation of authority and applicable agreement(s).

d. If a misapplication occurs on private land not within the 6.2 mile buffered area as described by NOAA Fisheries and there is no Federal involvement, then there will be no requirement for ESA Section 7 consultation.

   Responsibility: FS takes no action related to ESA section 7 consultations

3. **Follow-up Monitoring Process will:**

   a. Determine the amount of follow-up monitoring necessary as dictated by the extent of the impacts to species or habitat identified during assessment of the misapplication.
   b. Be conducted in coordination with local unit(s) of the Forest Service/USFWS/NOAA Fisheries/USGS offices and appropriate state agencies.
   c. Determine the type of recovery or restoration of species or habitats:

    i. may include salvage of species during BAER activities,
    ii. may supplement established captive breeding programs until specie can be re-introduced back into impacted area.

d. Additional assessment of cumulative effects for some species may need to be coordinated with certain agencies.
e. Determine the appropriate contingency measures for protection of TEPCS species from aerially applied fire retardant.
    i. If soil or vegetation and surrounding habitat within the waterway buffers are impacted, implement erosion control measures to reduce retardant delivery during rain events from entering habitat. Follow re-vegetation and erosion control guidance as outlined within BAER guidance.
f. Reported annually through forest and national TES species staff for coordination with other agencies.

## Monitoring Methodology

Numerous procedures and protocols exist for collection of data used to determine or predict the effects of aerial fire retardant on resources. For instance a 'spill calculator' developed by the USGS in cooperation with the Forest Service estimates the unintentional release of fire-suppressant chemicals into surface waters, which may result in adverse effects to aquatic biota, such as fish kills. The spreadsheet calculating tool provides a means of estimating the extent of impacted water, as well as the clearance rate as the product becomes diluted and is carried downstream. The calculations are based on the estimated amount of product released, the flow characteristics of the stream, and the toxicity of the fire-suppressant chemical.

The spill calculator can be found here:
ftp://ftpext.usgs.gov/pub/er/il/urbana/pjackson/Software/USFS_FRMC_v1.0.2.zip

For more information on this application and program contact NTDP Fire Chemicals Program Leader Wildland Fire Chemicals.

**Water Quality Monitoring:** Water quality monitoring is required for certain species as part of the Biological Opinion and development of these species standards are done at the local level in cooperation with the applicable regulatory agencies. Thus, water quality components listed on this form are not required unless they are tied to a specific Term and Condition or Reasonable and Prudent Measure associated with a species (ROD Appendices A and B and the Final FWS BO and NOAA BO). However, information collected at time of incident will further the knowledge base and future determination of potential impacts. Site specific conditions will drive the type or method of monitoring needed. Local resource staff should be consulted for specific method or need. The following sources may provide additional information useful for protocols:

- *Regional Developed protocols for water quality monitoring or non-native species monitoring. Check with regional TES species coordinator.*
- *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish - Second Edition* US Environmental Protection Agency
- *DRAFT - Sampling Protocol for Westslope Cutthroat Trout Oncorhynchus clarki lewisi in the Upper Missouri River Basin* Montana Fish, Wildlife and Parks Westslope Cutthroat Trout
- *State, Provincial, and Forest Service Standard Sampling Protocols - Water/Fish* Bonar Lab
- *USFS National Stream and Aquatic Ecology Center* National Stream and Aquatic Ecology Center

Collection of data associated with invasive species such as species name, density and infestation size, may provide a predictive tool in certain instances, for potential impact and recommended mitigation measures to prevent impacts to natural communities. Refer to local biologists and botanists for required or recommended data collection parameters and needs.

## Process of Reporting of Misapplication of Aerial Application of Fire Retardant for Cultural Resource, Traditional Cultural Property, or Sacred Sites

The definition of a misapplication on a historic property, traditional cultural property, or sacred site is when an aerial fire retardant application occurs on a previously identified resource (mapped avoidance area). The effects and any resolution of adverse effects in these cases are reportable as the result of a misapplication. If the cultural resource was not identified prior to the application, then it is not a "misapplication." These effects should be considered as suppression damages.

Agency personnel will complete the appropriate forms for misapplications and submit as directed. Due to the nature of cultural resources and sacred sites, ***no site-specific information about the location of the sites will be included in upward reporting.*** The WFCMR on-line reporting tool can be used to store and document information related to impacts. The reporting tool will hide all locational information (i.e. lat/longs) so that only the person who completes the form can view the actual location**. It is the forest's decision whether to use this tool. It is however, the forests' responsibility to ensure all local reporting is completed.**

If a retardant drop occurs on a cultural resource, traditional cultural property, or sacred site, **the site conditions will be assessed by a qualified archaeologist and reported to the appropriate consulting parties.** If adverse impacts are found, the local resource specialists, Ranger District archaeologist or Forest Archaeologist should:

- Notify the State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Officers or both, depending on the nature of the resources affected. Tribal notification and consultation is required if the affected resource is a sacred site or a location that is of cultural or religious importance to tribes.

- Determine the amount of follow-up monitoring necessary as dictated by the extent of the impacts to resource identified during assessment of the misapplication.

The purpose of consultation with these external parties is first, to determine if the application has had an adverse effect, and second, to determine what actions, if any, should be taken to mitigate or resolve the adverse effect. Depending on tribal perspectives, application may have no effect or no adverse effect; whereas SHPO perspectives may be very different. If, in consultation with appropriate tribal representatives, the effect is found to be adverse, the agency will consult with the tribe to determine an appropriate course of action to mitigate or resolve the adverse effect. If, in consultation with SHPO, the effect is found to be adverse, then the agency will follow standard procedures under 36CFR800 or National Historic Preservation Act programmatic agreements.

If disagreements arise between tribes and other consulting parties, then consultation shall engage the Advisory Council on Historic Preservation and seek Council guidance before taking any remedial action.

Existing monitoring and reporting tools/forms specific to the local unit will be updated, as needed, for use in the reporting and monitoring process and retained at the local level.

Records of the misapplication, the effects to the resource, the consultation process, and the resolution of adverse effects will be maintained by the local unit. Refer to Appendix B for additional information on reporting.

## Funding for Reporting and Monitoring and Mitigation Actions

During a fire if a misapplication is discovered and reported the incident job code (P-code) should be used for individuals' time in reporting and assessing the misapplication. If a monitoring plan is developed the fire unit will request a new job code (P-code) from their dispatch office or appropriate personnel. The naming convention for the job code will be the name of the fire with "FR Monitoring" as part of the name for the fire. For example, the fire's name was Willow Creek so the new P-Code's name will be Willow Creek FR Monitoring.

All monitoring and any mitigation costs will be charged to this code. If the monitoring and/or mitigation continues into the next fiscal year, the fire unit will need to request the specific P-code to be rolled over. The job code can be rolled over each fiscal year as needed in order to capture the total cost of the misapplication.

BAER plans will not include any monitoring or mitigation for specific misapplication needs.

# Chapter 7. Assessment of Fires Less than 300 Acres in Size -5% Assessment Process and Documentation Requirements

## Direction on 5% Assessment

In response to concerns that an application of aerially delivered fire retardant may occur in an identified avoidance area on smaller initial attack fires and on unstaffed fires, and thus be underreported, the Forest Service will ***annually assess 5 percent of all fires*** that are:

1. less than 300 acres in size (with a minimum of 1 fire per forest), and
2. where aerial fire retardant was used, and
3. mapped avoidance areas are present nearby (nearby is interpreted as having the potential for aerial fire retardant to be applied into the avoidance area either accidentally, from drift or exception to use).

> ***If your forest uses aerially delivered fire retardant on any size fire, you must complete annual 5% assessment reporting (See Figure 5). If the Forest does not have a fire meeting the less than 300 acres size, then a negative reply of 0 is to be entered into the 5% reporting.***
>
> ***Forests that do not use aerially delivered fire retardant in the calendar year, do not need to complete this assessment.***
>
> ***It is imperative that the FS comply with this assessment and reporting component for these smaller fires. By completing this action, results may eliminate this need in the future or provide additional important information to ensure species protection in the future.***

If misapplication into an avoidance area as described above occurs, the process described in the Reporting and Monitoring section applies. Forest Supervisors are responsible to ensure the 5% assessment is completed and documented and that all forms are submitted annually.

## Calculating or Estimating 5% Assessment

Prior to the onset of annual fire season and based on historical records of fire, aerial fire retardant use and presence of avoidance areas, estimate approximately how many initial attack fires (fires less than 300 acres) may call for aerial retardant.

Appendix C of the FEIS (pages 219-237) Interagency Wildland Fire Chemicals Policy and Guidance contains Fire and Retardant Use Information that may be used as a guide for coarsely estimating the amount of fires and retardant use by forest and region. For determining 5%, this is a minimum of 1 out of every 20 fires per forest where aerial fire retardant is used. These coarse estimates will give you an idea of when to initiate evaluations.

For example, a forest with low use (less than 10 drops per year) of aerial retardant should start with the first initial attack fire (less than 300 acres) where aerial fire retardant is used and avoidance area exists nearby. Higher use forests will need to ensure they are tracking the number of fires where aerial fire retardant is applied.

Again, it may be easier to conduct the assessment on one of the first fires with aerial fire retardant use, track the number of times aerial fire retardant is applied up to 20 then assess the next fire with aerial fire retardant use, rather than waiting until later into the season, in order to meet these requirements. For fires managed under a long-term strategy but are still less than 300 acres, determine if retardant was used near an avoidance area. Visit the site as soon as it is safe to do so.

Each unit should establish a process which includes identification of staff or personnel who will do the assessment, the timeframe they are to be conducted, the completion of forms and any follow-up needed based on the findings.

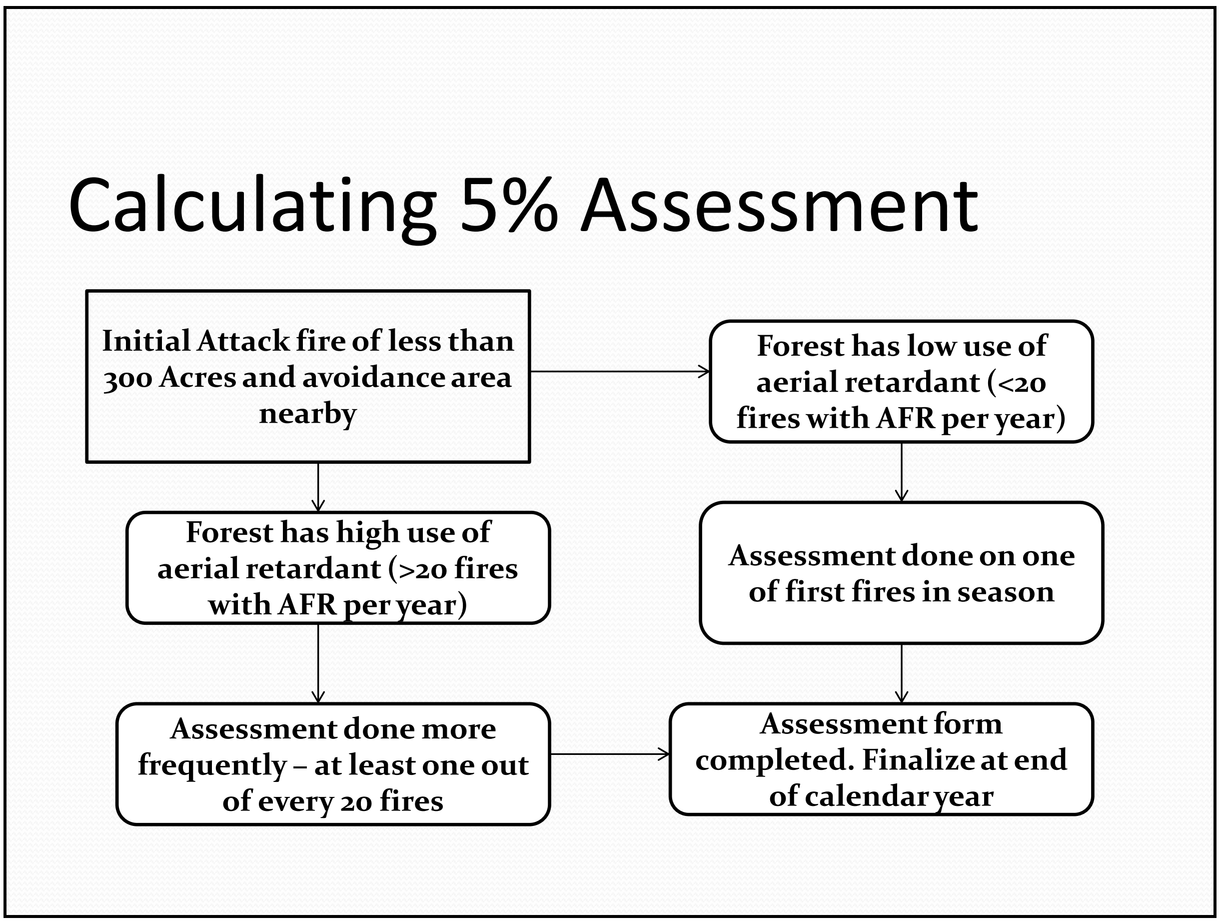
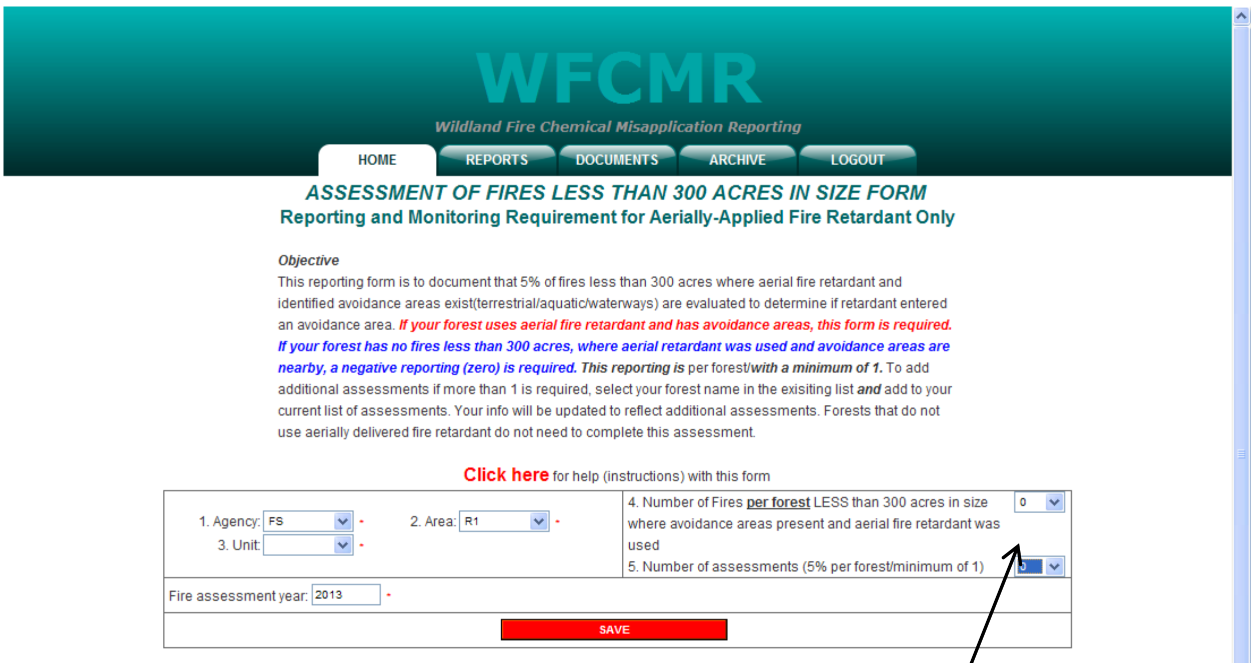



**Figure 6. Process for determining 5% and reporting.**

## Reporting Process and Reporting Tools/Forms for the 5% Assessment Aerial Fire Retardant

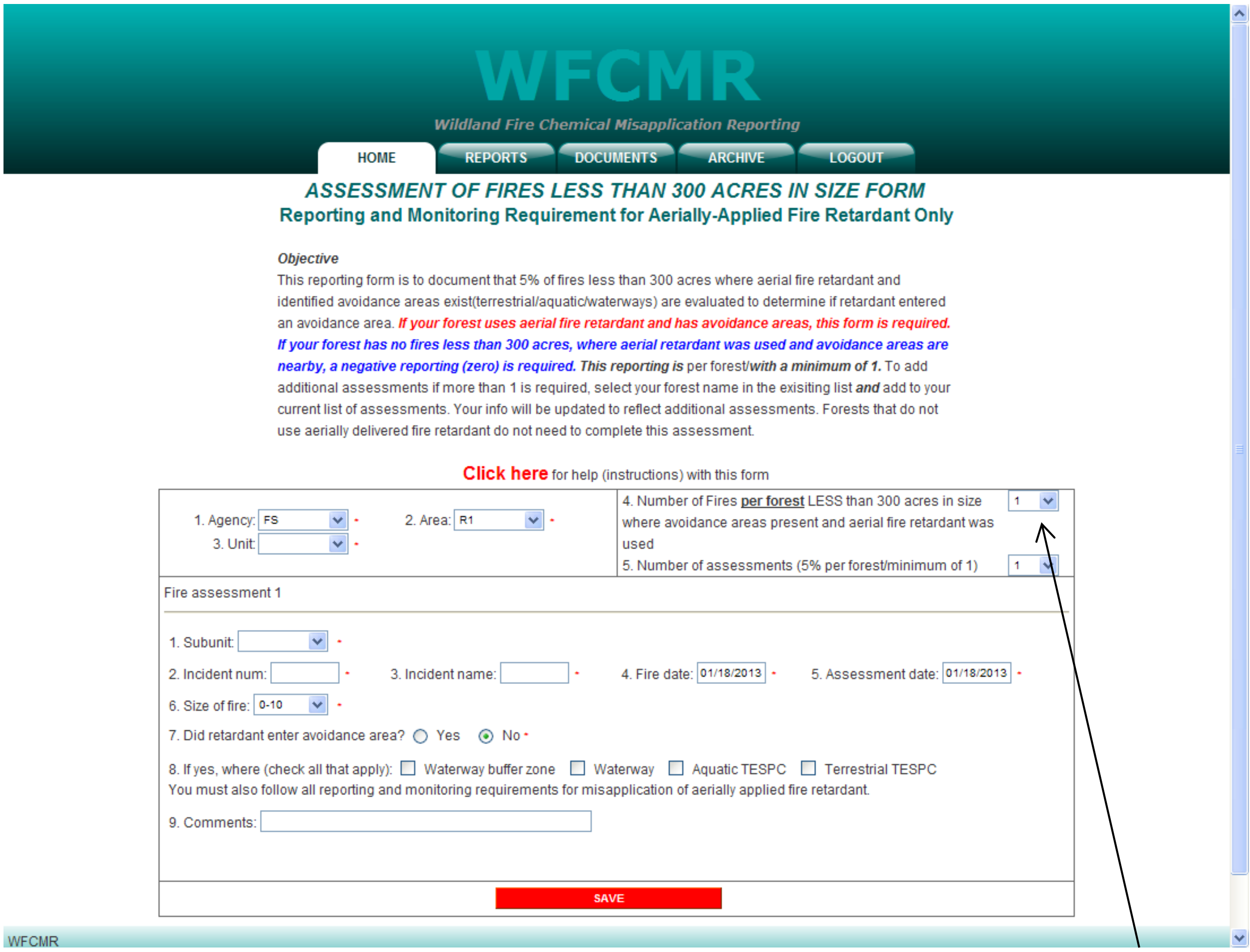
The Forest Service has developed on-line reporting forms to streamline data gathering and provide end-users a final product that captures all the required reporting and monitoring associated with this decision. The forms with instructions are located at: [Interagency Wildland Fire Chemicals Policy and Guidance]




If at the end of the calendar year, and after your forest has completed the tracking of these smaller fires, and

1. Your forest used aerial fire retardant, and
2. Your forest had no fires less than 300 acres in size where aerial fire retardant was used and mapped avoidance areas were nearby THEN you must submit this type of negative reporting for the year. Zero for number of fires, and Zero for the number of assessments. Nearby = any potential that aerial fire retardant could possibly enter an avoidance area either thru drift, or other.

**Figure 7. Reporting Tool Process for negative reporting.**


WFCMR

Wildland Fire Chemical Misapplication Reporting

HOME | REPORTS | DOCUMENTS | ARCHIVE | LOGOUT

ASSESSMENT OF FIRES LESS THAN 300 ACRES IN SIZE FORM

Reporting and Monitoring Requirement for Aerially-Applied Fire Retardant Only

*Objective*

This reporting form is to document that 5% of fires less than 300 acres where aerial fire retardant and identified avoidance areas exist(terrestrial/aquatic/waterways) are evaluated to determine if retardant entered an avoidance area. ***If your forest uses aerial fire retardant and has avoidance areas, this form is required.*** ***If your forest has no fires less than 300 acres, where aerial retardant was used and avoidance areas are nearby, a negative reporting (zero) is required.*** ***This reporting is*** per forest/***with a minimum of 1.*** To add additional assessments if more than 1 is required, select your forest name in the exisiting list ***and*** add to your current list of assessments. Your info will be updated to reflect additional assessments. Forests that do not use aerially delivered fire retardant do not need to complete this assessment.

**Click here** for help (instructions) with this form

1. Agency: FS · 2. Area: R1 · 3. Unit:

4. Number of Fires **per forest** LESS than 300 acres in size where avoidance areas present and aerial fire retardant was used: 1

5. Number of assessments (5% per forest/minimum of 1): 1

Fire assessment 1

1. Subunit:

2. Incident num: · 3. Incident name: · 4. Fire date: 01/18/2013 · 5. Assessment date: 01/18/2013

6. Size of fire: 0-10

7. Did retardant enter avoidance area? ○ Yes ◉ No

8. If yes, where (check all that apply): ☐ Waterway buffer zone ☐ Waterway ☐ Aquatic TESPC ☐ Terrestrial TESPC

You must also follow all reporting and monitoring requirements for misapplication of aerially applied fire retardant.

9. Comments:

SAVE

WFCMR

This form can be used at any time during the year to document monitoring of these smaller fires. As these types of fires are tracked you can update box #4 to reflect tracking. At the end of the calendar year, you must ensure that box #4 reflects the number of fires that fit into the category:

- <300 acres in size,
- aerial retardant application, and
- an avoidance area nearby

Only 5% of these fires are required to be assessed- this means if there are 20 or less fires that fit into the category as stated above, you must complete at least 1 assessment,

**Figure 8. Reporting Tool Process for assessments and tracking throughout the season.**

# Chapter 8. Seasonal Duties, Annual Training and Data Reporting Requirements

To assist in streamlining requirements within the implementation of the direction, the following list outlines pre-fire season, during fire season and post-fire season requirements, for training, coordination, and data reporting.

## Pre- Fire Season Requirements:

### Coordination

1. Annual Coordination meetings between:
    a. FS and cooperators.
    b. FS and regulatory agencies, and
    c. FS Fire Management, Line, and Resources.

2. Pilot Briefings
    a. At beginning of contract for exclusive use/pre-work meeting.

3. Resource Advisor review (in conjunction with avoidance mapping update completion)
    a. Updates to avoidance area mapping using most up-to-date information
    b. Changes in species lists, or critical habitat designations
    c. Before fire season, it is recommended that hydrologists or hazardous materials coordinators providing expertise or as a resource advisor, coordinate with their counterpart at their state water quality agency to discuss (and document) reporting required in the event of a retardant spill or retardant application to water. In addition, become familiar with the state's latest water quality requirements, any local areas with special water quality issues, and water intakes for municipal watersheds or domestic water supplies on Forest or directly downstream.

### Training for:

1. Forest Service Fire Management Personnel, Line Officers and Resource Specialists
    a. Reviewing the Aerial Application of Fire Retardant Direction will be conducted with Forest Service biologists/botanists, fire management personnel, anyone planning to act as a resource advisor and line officers. Fire management personnel should include Type 1-5 incident commanders (ICs), fire management officers (FMO), aviation managers, module leaders, or other personnel responsible for ordering the aerial delivery of fire retardant during a wildland fire incident.
    b. This annual review will include:
        i. Review of avoidance area maps,
        ii. Review of aircraft operational direction,
        iii. Review of reporting process for misapplications,

iv. Review of the tracking and reporting requirement of fires less than 300 acres in size, and
v. Review of the BA/BO and monitoring process for resource specialists.

2. Pilots
    a. annual review by aviation managers or appropriate personnel will brief pilots on:
        i. Aircraft operation direction.
        ii. Avoidance area maps - sets of avoidance area maps for each national forest will be available through the forest's aviation officer, at tanker bases, at helibases, at fire dispatch offices and with all appropriate cooperators.

### Data and Reporting

- Avoidance Area mapping updates completed by annual dates.
- Documentation of Annual Coordination Meetings as described above, Pilot briefings, and training

## During Fire Season Requirements:

### Coordination

1. Pilot Briefings:
    a. Aircraft operational direction as needed,
    b. If changes to Avoidance Area maps occur,
    c. If a new pilot is used on an incident,
    d. If changing area/locations to different region which may have different requirements.

2. In the event of a misapplication into an avoidance area, IC's ensure READs or resource specialists are contacted for assessment of effects (Site Assessment of Impacts Forms). If 'take' of a species occurs (as specified within the BO), and is wide ranging, other FS Regions and Forests must be notified immediately of the amount of 'take' and the incident must be reported to Regulatory agencies to ensure tracking of 'take' is implemented and determine if re-initiation of consultation is necessary

3. Avoidance Area Mapping updated as necessary. Coordination with Regulatory agencies and other FS personnel including other Regions as necessary (wide ranging species) for avoidance area mapping updates as needed, for instance:
    a. New listed species.
    b. Changes in critical habitat designation.
    c. Additional avoidance areas identified (closures from triggers or monitoring results).

4. Avoidance Area monitoring as needed.

5. Coordination and completion of all local level consultations with Regulatory agencies and submission of actions/determinations/addendums to the National BA and ROD.

6. Assessment of Fires Less than 300 Acres in Size during fire activity.

### Data and Reporting

1. Interagency Aerial Retardant Misapplication Form.
2. Site Assessment of Impacts Form(s).
3. Tracking and assessment of Fires Less than 300 Acres in Size during fire activity.
4. Documentation of all communication and coordination meetings with Regulatory agencies.

## Post- Fire Season Requirements:

### Coordination

**Forests/Regions**

1. Ensure completion of the Assessment of Fires less than 300 acres where aerial retardant was used and avoidance areas are nearby. Complete this annual assessment requirement no later than the end of the calendar year. Refer to Chapter 7 for instructions.

2. Ensure that all assessments documenting misapplication effects into avoidance areas are submitted.

3. Completion of monitoring. If longer term monitoring is required, ensure plans for upcoming years/needs are documented as such in comments section of assessment forms (it is the responsibility of the Forest to ensure local level monitoring requirements are completed).

**WO-FAM**

1. Data call to forests for reporting of all aerial retardant use on NFS Lands.

**NTDP-WFCS**

1. Completion and submittal of Summary Report of Misapplications into Avoidance Areas to National Office (WO-FAM, WO-TES).

## Chapter 9. Questions and Answers

The following list of Questions and Answers was developed from the various comments received from training sessions.

***Q: I am a pilot and I drop a load of retardant either in waterway, buffer, or other avoidance area. Will I be held accountable or liable because of the misapplication?***

**A.** The Forest Service recognizes that misapplications will occur and discussed this with the Regulatory agencies. You will not be held accountable or liable for a misapplication in an avoidance area or waterway (including buffer). Report any misapplication.

***Q: How do I know if I can apply aerial fire retardant within an intermittent stream?***

**A:** If a stream is classified as 'intermittent' on the NHD layer and:

- has visible WATER, the 300' waterway avoidance area is in place regardless if it is mapped or not - **no application of aerial fire retardant.** Guidance for pilots delivering retardant near a waterway is to terminate retardant application if riparian vegetation is visible when approaching a mapped avoidance area (may vary based on locale).
- has no water, yet remains as a resource protection avoidance area (TEPCS or other) **no application of aerial fire retardant**
- some regions have updated their avoidance area maps and removed intermittent streams, meaning that these are not avoidance areas and can have retardant applied without the need for reporting. However, if water is present, the area is then considered a waterway and must be avoided.
- **For forests with intermittent streams remaining on their avoidance area maps, if aerial fire retardant is applied, even if the stream is dry, it is still considered a reportable misapplication. Refer to Chapter 6 on how to update maps for areas such as these on your forest.**

***Q: What if the forest wants to add, remove or change the size and shape of an avoidance area?***

**A:** Avoidance area maps can be updated or adjusted for TEPCS species or designated critical habitats by Forest Supervisors in consultation with FWS or NOAA Fisheries as necessary. Mapping changes are allowed if they do not create additional adverse effects than what was analyzed in the Biological Assessments or change the analysis conducted or determinations made in the Biological Opinions. Refer to Chapter 4-Resource Specialists, Process for Addendums to the National Programmatic Consultation. Refer to Chapter 2 and Appendix A for detailed instructions for developing and uploading GIS layers to the national database.

***Q. Will I be held liable if I invoke the exception and species mortality occurs due to the aerial application of fire retardant?***

**A.** No, the incident commander has the authority to invoke the exception when human life or public safety is threatened and the use of fire retardant is reasonably expected to alleviate the situation. The exceptions should be documented and reported.

***Q: What do I do if there is a misapplication in an avoidance area?***

**A.** Here's the simple process for documenting a misapplication:

1. First, determine if it is safe to enter the area where the aerial application of fire retardant has occurred, the goal is to visit the site as soon as it is safe to do so and not later than 30 days after the misapplication.
2. Calculate the area (size of coverage in the avoidance area or waterway) with retardant and if possible, estimate the amount of coverage of retardant
3. Determine if the exception to protect public and/or fire fighter safety was used
4. If possible, document GPS location, time of event, and date of event
5. Complete the Reporting form found at https://www.fs.fed.us/managing-land/fire/chemicals
6. Contact the IC to inform them a report was complete, contact:
    a. the Resource Advisor assigned to the fire or local unit's Resource Advisor if they are not the one completing the report, or
    b. any agency administrator for the unit where the misapplication occurred

***Q: How soon after misapplication in an avoidance area do I need to submit the documentation?***

**A:** It is best to complete the report as soon as possible after it is found. The end of the shift or next day is preferred due to requirements to conduct biological assessment as soon as possible. The incident should be reported to the Incident Commander, Resource Advisor, or forest specialist, FMO or agency representative to complete all reporting and assessment of effects no later than 30 days after misapplication if safe to do so.

***Q: How do I know if we need to re-initiate consultation or provide an addendum to the BA/BO with the regulatory agencies?***

**A:** Refer to Chapter 5 - Resource Specialists, sections on Re-initiation of Consultation for the National BA, and Process for Addendums to the National BA.

***Q: How do we implement the 5% assessment of fires less than 300 acres where aerial fire retardant is applied and avoidance areas exist?***

**A:** Prior to onset of annual fire season and based on historical records of fire, aerial fire retardant use and presence of avoidance areas, estimate the number of IA fires (fires less than 300 acres) that may call for aerial retardant. For determining 5%, this is a minimum of 1 out of every 20 fires per forest where aerial fire retardant is used.

For example, a forest with low use (less than 10 drops per year) of aerial retardant should start with the first initial attack fire where aerial fire retardant is used and avoidance areas exist. Higher use forests will need to ensure they are tracking the number of fires where aerial fire retardant is applied. Again, it may be easier to conduct the assessment on one of the first fires with aerial fire retardant use, track the number of times aerial fire retardant is applied up to 20, and then assess the next fire with aerial fire retardant use, rather than waiting until later into the season, in order to meet these requirements. Forests that either do not have any avoidance areas or do not use aerially delivered fire retardant do not need to complete this assessment. Refer to Chapter 7.

***Q: Who is supposed to do the 5% assessment?***

**A:** The forest and district will need to determine what personnel to assign this work to for completion. In most cases, it will likely be someone from the fire staff. Units should establish (prior to fire season) their process for accomplishing this and include who will conduct the assessment, forms completion, and if a misapplication is discovered communicating the information to the resource specialist on the unit. See Chapter 7 for information and funding direction.

***Q: How do I document that we have met our annual obligation of coordinating with the regulatory agencies and how is this process completed?***

**A:** It is recommended that the Forest documents each meeting date, keeps a participant sign in sheet, and list of topics discussed on a form. The forests keeps the original, sends a copy to the local FWS, and/or NOAA and sends a copy to regional/national FS coordinators if requested.

It is also recommended that these meetings be done early in the pre-season or at the same time of year each year in coordination with both biological and fire resources together as much as possible.

***Q: Which job code do I bill to?***

***A:*** If a misapplication is discovered during the fire, individuals' involved in the reporting and assessment should charge their time to the fire's P-code. If monitoring and mitigation are required, the unit with the fire shall request a new code from Firecode. The fire name plus "FR Monitoring" will be the name of the P-code and all costs affiliated with the plan and work associated with the plan will be charged to this code.

## Glossary

Avoidance Areas – A protection area surrounding a listed species developed to mitigate or avoid possible impacts caused by an action; no-drop zone for aerial retardant use.

Biological Assessment – A document prepared for Fish and Wildlife Service Section 7 consultation process to determine whether a proposed activity under the authority of a Federal action agency is likely to adversely affect listed species, proposed species, or designated critical habitat.

Biological Opinion – A document prepared by the Fish and Wildlife Service that is the product of formal consultation, stating the opinion of the Fish and Wildlife Service on whether or not a Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Biological Evaluation – A document prepared by the Forest Service to review planned, funded, executed, or permitted programs and activities for possible effects on endangered, threatened, proposed, or sensitive species (FSM 2672.4)

Candidate species – Plants and animals that have been studied and that the Fish and Wildlife Service has concluded should be proposed for addition to the Federal endangered and threatened species list. These species have formerly been referred to as category 1 candidate species.

Consultation – A requirement of the Endangered Species Act that requires the action agency to enter into discussions with a regulatory agency regarding the potential effects of a project on federally listed threatened or endangered species; occurs when a project "may affect" any species. The agencies work together to mitigate or avoid impacts to the species.

Critical habitat – As defined and used in the Endangered Species Act, is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Cumulative Effects - Impacts on environments that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Determination – A decision made from analysis of impacts of an action on a species; either No Effect or May Affect, which are further analyzed into adverse or not adverse effects.

Endangered – Any species listed in the Federal Register as being in danger of extinction throughout all or a significant portion of its range.

Endangered Species Act (ESA) – A law passed in 1973 to conserve species of wildlife and plants determined by the Director of the Fish and Wildlife Service or the National Marine Fisheries to be endangered or threatened with extinction in all or a significant portion of its range. Among other measures, ESA requires all federal agencies to conserve these species and consult with the Fish and Wildlife Service or NOAA Fisheries on federal actions that may affect these species or their designated critical habitat. Section 7 of the Endangered Species Act (Act) [16 U.S.C. 1531 *et seq.*] outlines the procedures for Federal interagency cooperation to conserve Federally listed species and designated critical habitats. Section 7(a)(2) states that each Federal agency shall, in consultation with the Secretary, insure that any action they authorize, fund, or carry out is not likely to **jeopardize** the continued existence of a listed species or result in the destruction or **adverse modification** of designated critical habitat.

Erosion – The wearing away of the land surface by running water, wind, ice, gravity, or other geological activities; can be accelerated or intensified by human activities that reduce the stability of slopes or soils.

Federally Listed Species – Formally listed as a threatened or endangered species under the ESA. Designations are made by the Fish and Wildlife Service or National Marine Fisheries Service.

Habitat – The place where a population (e.g., human, animal, plant, microorganism) lives and its surroundings, both living and non-living.

IA – Initial Attack is the actions taken by the first resources to arrive at a wildfire or wildland fire use incident.

Intermittent Stream – A stream that carries water a considerable portion of the time, but that ceases to flow occasionally or seasonally because bed seepage and evapotranspiration exceed the available water supply.

Misapplication –The accidental aerial application of fire retardant into a waterway, within the 300-foot buffer (or more as designated by specific forests) or within an avoidance area. Or when resources are directed to apply fire retardant into a waterway, within the 300-foot buffer (or more as designated by specific forests), or within an avoidance area based on allowable exceptions or a transportation accident.

Perennial Stream – A stream that contains water at all times except during extreme drought.

Re-initiation Trigger – A report of misapplication, where there is an effect to threatened and endangered species, requires consultation with the forest/Fish and Wildlife Service/NOAA Fisheries to determine the appropriate restriction on use of future application in the area (species dependent).

Riparian – The area adjacent to a stream, waterbody or wetland- pertaining to areas of land directly influenced by water. Riparian areas usually have visible vegetative or physical characteristics reflecting this water influence. Streamsides, lake borders, or marshes are typical riparian areas.

Sensitive Species – Those plant and animal species identified by a [U.S. Forest Service] regional forester for which population viability is a concern, as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species existing distribution (FSM 2670.5).

Threatened – The classification provided to an animal or plant likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

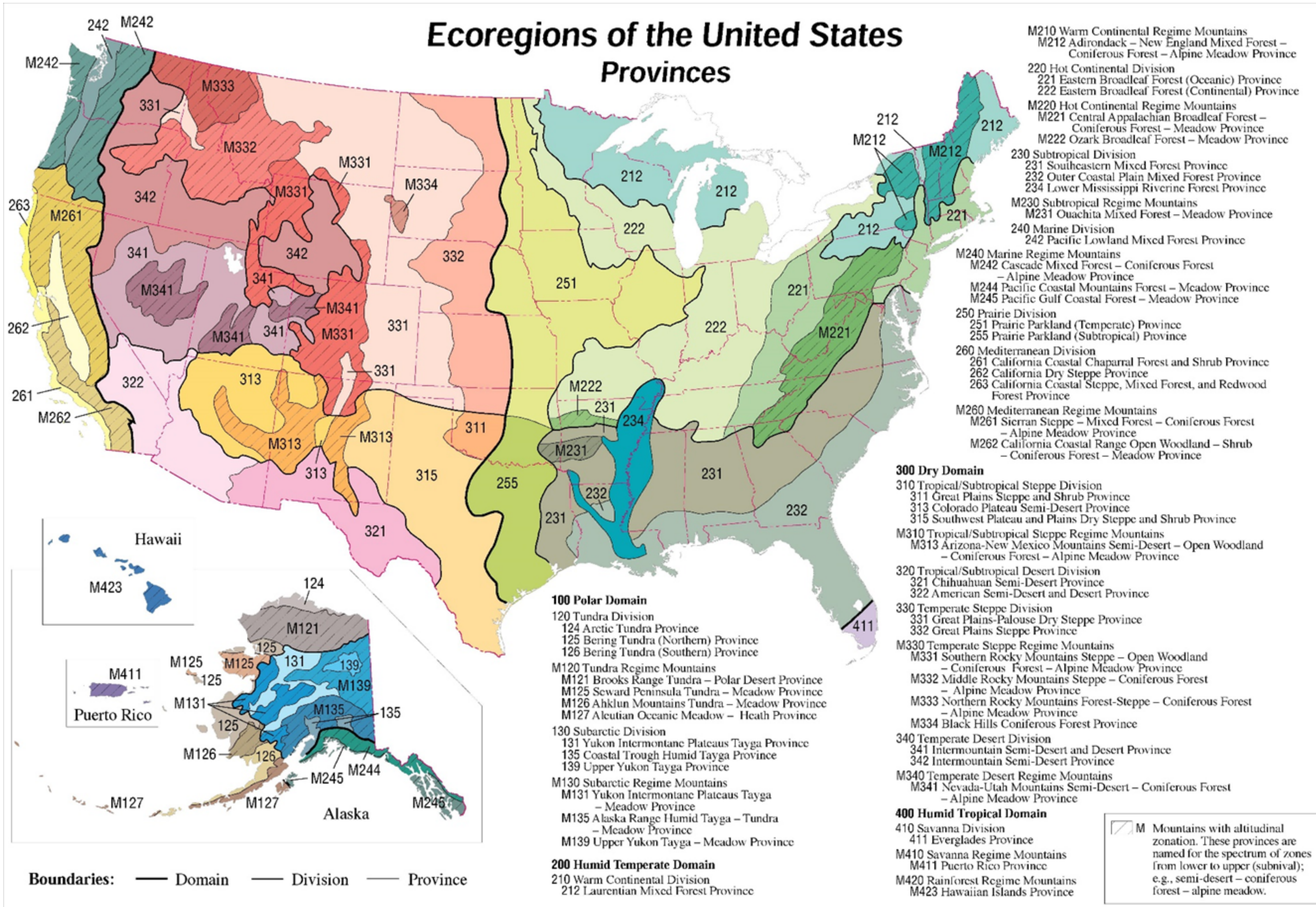
Water Quality – A term used to describe the chemical, physical, and biological characteristics of water,

Waterway – Any body of water including lakes, rivers, streams and ponds whether or not they contain aquatic life.

# Appendix F. Risk Assessment Ecoregions

| Ecoregion number | Ecoregion name | States that include ecoregion |
|---|---|---|
| 131 | Yukon Intermontane Plateaus Tayga Province | Alaska |
| 212 | Laurentian Mixed Forest Province | Minnesota, Michigan, Wisconsin |
| M212 | Adirondack – New England Mixed Forest – Coniferous Forest – Alpine Meadow Province | Maine, New Hampshire, Vermont, New York, Massachusetts |
| 231 | Southeastern Mixed Forest Province | Texas, Louisiana, Oklahoma, Arkansas, Mississippi, Tennessee, Alabama, Georgia, South Carolina, North Carolina, Virginia |
| 232 | Outer Coastal Plain Mixed Forest Province | Texas, Louisiana, Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware |
| 234 | Lower Mississippi Riverine Forest Province | Louisiana, Mississippi, Arkansas, Tennessee, Kentucky, Missouri |
| 242 | Pacific Lowland Mixed Forest Province | Oregon and Washington |
| M242 | Cascade Mixed Forest – Coniferous Forest – Alpine Meadow Province | Oregon and Washington |
| M262 | California Coastal Range Open Woodland – Shrub – Coniferous Forest – Meadow Province | California |
| M313 | Arizona – New Mexico Mountains Semi-Desert – Open Woodland – Coniferous Forest – Alpine Meadow Province | Arizona, New Mexico, Texas |
| 315 | Southwest Plateau and Plains Dry Steppe and Shrub Province | Texas and New Mexico |
| 331 | Great Plains-Palouse Dry Steppe Province | Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Oklahoma, New Mexico |
| M331 | Southern Rocky Mountains Steppe – Open Woodland – Coniferous Forest – Alpine Meadow Province | Montana, Wyoming, Idaho, Utah, Colorado, New Mexico |

| | | |
|---|---|---|
| M332 | Middle Rocky Mountain Steppe – Coniferous Forest – Alpine Meadow Province | Oregon, Washington, Idaho, Montana |
| 342 | Intermountain Semi-Desert Province | Oregon, Washington, California, Nevada, Idaho, Utah, Wyoming, Colorado |




*Source:* R.G. Bailey [Ecoregions of the United States, USDA Forest Service (scale 1:7,500,000, revised 1994)]