Appendix G – MIS Population Trends

Monitoring and Evaluation Report

FY2008 through FY2014

for the

1993 George Washington National Forest
Land and Resource Management Plan

and

2004 Jefferson National Forest
Land and Resource Management Plan

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Introduction

Under the National Forest Management Act (NFMA) the Forest Service is charged with providing for a diversity of plant and animal communities consistent with overall multiple-use objectives. Management Indicator Species (MIS) are a planning tool used to accomplish this requirement (36 CFR 219.19 of 1982 Regulations). They are selected during forest planning "because their population changes are believed to indicate the effects of management activities" (36 CFR 219.19(a) (1)) on important elements of plant and animal diversity. They and their habitat needs are used to set management objectives and minimum management requirements, to focus effects analysis, and to monitor effects of Forest Plan implementation. The George Washington and Jefferson Forest Plans are designed to provide habitat conditions needed to maintain viable populations of all MIS, along with other species that use similar habitats.

Wildlife, fish, and plant species are managed in cooperation with the Virginia Department of Game and Inland Fisheries (VDGIF), Virginia Department of Conservation and Recreation – Division of Natural Heritage (VDCR-DNH), West Virginia Department of Natural Resources (WVDNR), and the Kentucky Department of Fish and Wildlife Resources (KDFWR). The respective states set policy for hunting and fishing regulations and law enforcement programs. The Forest Service manages fish and wildlife habitat conditions. This discussion focuses on the habitat conditions that support the wildlife populations that are managed by the States.

This report focuses on the effects of Forest Service management on the habitat conditions that support Management Indicator Species.

All cites to the 219 regulations are to the 1982 planning rule (September 30, 1982 (47 FR 43026)), and amended in part on June 24, 1983 (48 FR 29122), and on September 7, 1983 (48 FR 40383) in effect prior to November 9, 2000.

Identification of Management Indicator Species

1993 George Washington Plan Management Indicator Species

Table 1 shows the Management Indicator Species (MIS) for the 1993 Revised Land and Resource Management Plan of the George Washington National Forest (1993 GWNF Plan). The MIS can also be found in the 1993 GWNF Plan pages 2-8 and 2-9; and the GWNF FEIS, Appendix J). Each MIS has a relationship with a certain type of preferred habitat. The habitat preferred by the species is discussed under each species discussion.

Table 1. GWNF Plan Management Indicator Species (MIS)

Ecological Indicators	Threatened and Endangered Species	Demand Species
Cave Dwelling Bats	Indiana Bat	Black Bear *
Brown Headed Cowbird	Northern Flying Squirrel	Eastern Wild Turkey *
Worm-eating Warbler	Peregrine Falcon	White-tailed Deer *

Ecological Indicators	Threatened and Endangered Species	Demand Species
Ovenbird *	Bald Eagle	
Cow Knob Salamander	James Spinymussel	
Tiger Salamander	Shale Barren Rockcress	
Northern Flicker	Swamp Pink	
Pileated Woodpecker *	Northern Bulrush	
Native Brook (Wild) Trout*		
Sunfish Family (*Centrarchid*)		
Yellow Pine Community		
Old Growth Forest Types		

* Common MIS to the Revised 2004 Jefferson National Forest Plan

2004 Jefferson Plan Management Indicator Species

Table 2 shows the MIS for the 2004 Revised Land and Resource Management Plan for the Jefferson National Forest (2004 JNF Plan) The MIS can also be found in the 2004 JNF Plan Table 2-3, page 2-12. Six species are the same as those MIS identified for the GWNF. Each MIS has a relationship with a certain type of preferred habitat. The habitat preferred by the species is discussed under each species discussion.

Table 2. JNF Plan Management Indicator Species (MIS)

Biological Community Indicators	Threatened and Endangered Species	Special Habitat Indicators	Demand Species
Hooded Warbler	Peaks of Otter Salamander	Pileated Woodpecker *	Black Bear *
Scarlet Tanager		Ovenbird *	Eastern Wild Turkey *
Pine Warbler		Chestnut-sided Warbler	White-tailed Deer *
Eastern Towhee		Acadian Flycatcher	
Wild Trout *			

* Common MIS to the 1993 George Washington National Forest Plan

Trends in Forest Service Management Activities Associated with MIS Habitats

Table 3 through Table 6 display historic trends in key management activities across the Forests.

Table 3. Management Activities Trend on GWNF Only

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1976	N/A	26.6	N/A	N/A	0	N/A
1977	N/A	16.9	N/A	N/A	0	N/A
1978	N/A	18.2	N/A	N/A	0	N/A
1979	N/A	17.3	N/A	N/A	0	11
1980	N/A	25.7	N/A	N/A	0	16
1981	N/A	37.4	0	N/A	0	24
1982	N/A	29.8	115	N/A	0	N/A
1983	N/A	34.2	N/A	N/A	0	N/A
1984	N/A	36.4	117	N/A	0	N/A
1985	N/A	44.9	N/A	N/A	0	49.7
1986	N/A	32.2	189	N/A	0	36.6
1987	N/A	35.9	146	N/A	200	24.9
1988	3,966	40.5	40	N/A	8,395	24.6
1989	3,492	41.7	37	N/A	4,098	16.3
1990	3,265	33.6	1,092	N/A	8,121	2.3
1991	3,396	36.9	170	N/A	4,368	11.9
1992	4,082	38.2	970	1,338	2,198	7.8
1993	3,271	35.2	1,870	1,380	6,855	4.4
1994	2,993	37.2	795	1,860	4,735	3.8
1995	2,707	33.4	1,741	1,700	4,800	4.5
1996	1,964	27.4	1,339	1,230	2,015	6.17
1997	3,215	24.8	1,465	1,290	3,000 Research	2.7

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1998	1,449	24.0	6,564	1,382	3,000 Research	0.7
1999	1,284	21.7	5,523	1,710	0	3.2
2000	1,254	17.9	4,172	1,634	0	0.1
2001	1,162	15.8	3,135	1,434	3,695	2.8
2002	881	14.7	2,322	1,383	2,183	0.3
2003	789	13.0	7,188	1,585	0	0.0
2004	780	17.4	7,103	1,510	0	1.0
2005	1,176	15.6	9,349	1,217	0	0.0
2006	824	11.7	5,180	1,467	0	0.5
2007	732	10.8	3,335	1,603	0	0.2
2008	611	**	9,457	1,649	0	0.0
2009	803	11.2	6,716	1,182	0	0.0
2010	606	9.2	10,579	1,288	0	0.0
2011	695	10.5	171	1,134	0	2.6
2012	336	7.6	11,301	985	0	0.0
2013	602	8.7	12,418	1,603	0	0.0
2014	368	9.1	11,608	1,604	0	0.0

N/A: Information Not Available

* Management activities include active grazing and mowing

** Reporting method changed and reported only by administrative forest, not proclaimed forest.

Volume Harvested utilizes 0.66 conversion factor from cubic feet for comparison with previous years.

Table 4. Management Activities Trend on JNF Only

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1976	N/A	16.8	N/A	N/A	0	N/A
1977	N/A	8.8	N/A	N/A	0	N/A

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1978	N/A	6.8	N/A	N/A	0	N/A
1979	N/A	14.5	N/A	N/A	0	20
1980	N/A	15.1	N/A	N/A	0	21
1981	N/A	17.3	N/A	N/A	0	26
1982	N/A	17.1	N/A	N/A	0	N/A
1983	N/A	21.8	N/A	N/A	0	N/A
1984	N/A	21.2	N/A	N/A	0	40.1
1985	N/A	28.0	N/A	N/A	0	33.1
1986	2,854	30.6	466	N/A	0	23.9
1987	2,498	25.7	983	N/A	0	18.1
1988	2,945	28.7	935	N/A	16,334	18.7
1989	1,850	21.2	1,232	N/A	13,818	7.2
1990	1,897	28.9	1,718	N/A	0	3.0
1991	2,699	32.5	1,411	N/A	0	8.5
1992	2,023	19.1	963	9,198	343	4.8
1993	2,397	25.4	1,245	9,240	0	7.7
1994	2,438	20.1	1,233	9,720	0	2.6
1995	1,715	22.3	1,353	9,560	0	1.3
1996	1,218	17.7	775	9,089	0	1.25
1997	1,682	9.4	2,323	9,149	0	1.0
1998	1,293	11.3	5,310	9,241	0	0.6
1999	942	14.8	2,462	9,570	0	0.0
2000	1,115	9.6	994	9,494	0	0.0
2001	795	7.3	2,715	9,294	643	0.0
2002	332	4.3	3,228	9,243	2,706	0.0
2003	226	3.8	3,207	9,445	0	0.2
2004	244	4.1	6,516	6,415	0	1.0

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
2005	407	5.8	6,323	4,692	239	1.4
2006	172	4	1,496	4,835	158	3.7
2007	480	9	7,178	9,345	5,540	1.6
2008	555	**	10,652	9,336	8,505	0.0
2009	361	6	5,967	9,298	15,356	0.0
2010	451	10	10,412	9,404	0	0.0
2011	511	8.5	675	9,062	0	1.1
2012	233	4.2	3,619	8,914	0	0.0
2013	208	4.5	7,357	9,560	0	0.0
2014	199	3.75	9,202	9,532	0	0.0

N/A: Information Not Available

* Management activities include active grazing and mowing

** Reporting method changed and reported only by administrative forest, not proclaimed forest.

Volume Harvested utilizes 0.66 conversion factor from cubic feet for comparison with previous years.

Table 5. Combined Management Activities Trend Across Both Forests

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1976	N/A	43.4	N/A	N/A	0	N/A
1977	N/A	25.7	N/A	N/A	0	N/A
1978	N/A	25.0	N/A	N/A	0	N/A
1979	N/A	31.8	N/A	N/A	0	31
1980	N/A	40.8	N/A	N/A	0	37
1981	N/A	54.7	N/A	N/A	0	40
1982	N/A	46.9	N/A	N/A	0	N/A
1983	N/A	56.0	N/A	N/A	0	N/A

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
1984	N/A	57.6	N/A	N/A	0	N/A
1985	N/A	72.9	N/A	N/A	0	82.8
1986	N/A	62.8	655	N/A	0	60.5
1987	N/A	61.6	1,129	N/A	200	43.0
1988	6,911	69.2	975	N/A	24,729	43.3
1989	5,342	62.9	1,269	N/A	17,916	23.5
1990	5,162	62.5	2,810	N/A	8,121	5.3
1991	6,095	69.4	1,581	N/A	4,368	20.4
1992	6,105	57.3	1,933	10,536	2,541	12.6
1993	5,668	60.6	3,115	10,620	6,855	12.1
1994	5,431	57.3	2,028	11,580	4,735	6.4
1995	4,422	55.7	3,094	11,260	4,800	5.8
1996	3,182	45.1	2,114	10,319	2,015	7.42
1997	4,897	34.2	3,788	10,439	3,000 Research	3.7
1998	2,742	35.3	11,874	10,623	3,000 Research	1.3
1999	2,226	36.5	7,985	11,280	0	3.2
2000	2,369	27.5	5,136	11,128	0	0.1
2001	1,957	23.1	5850	10,728	4,338	2.8
2002	1,213	19.0	5550	10,626	4,889	0.3
2003	1,015	16.9	10,395	11,030	0	0.2
2004	1,024	21.5	13,619	7,925	0	2.0
2005	1,583	21.4	15,672	5,909	239	1.4
2006	996	15.7	6,676	6,302	158	4.2
2007	1,212	19.8	10,053	10,948	5,540	1.8
2008	1,166	21.3	19,775	10,985	8,505	0.0
2009	1,164	17.2	15,483	10,480	15,356	0.0
2010	1,057	19.2	20,586	10,692	0	0.0

Year	Timber Harvest (Acres)	Timber Cut (Million Bd. Ft.)	Prescribed Burning (Acres)	Permanent Grassland/ Shrubland Maintenance* (Acres)	Gypsy Moth Aerial Spraying (Acres)	Road Construction (Miles)
2011	1,206	19	1,372	10,196	0	3.7
2012	569	11.8	15,437	9,899	0	0.0
2013	810	13.2	19,775	11,163	0	0.0
2014	567	12.85	22,081	11,136	0	0.0

N/A: Information Not Available

* Management activities include active grazing and mowing

Volume Harvested utilizes 0.66 conversion factor from cubic feet for comparison with previous years.

Forested Age Class Distribution Trend

Management Indicator Species are monitored on the George Washington and Jefferson National Forests (GWJNF or Forests) through the use of both population data and habitat data. An evaluation of the trends in population data for each MIS is presented later in this document. Habitat condition is one of the primary factors influencing population levels for these species; and Table 6 displays the trends in forest age class, a key habitat parameter. Note that the change in total acreage on both Forests between 2007 and 2014 is due to a change in the dataset and the way that the acreage is calculated, not because of the sale or exchange of NFS lands.

Table 6. Age Class Distribution for All Forested Land 1989, 2007, and 2014

	Age	1989	%	2007	%	2014	%
Jefferson NF	0-10	26,269	3.9%	2,146	0.3%	2,932	0.4%
	11-20	25,682	3.8%	12,322	1.7%	3,659	0.5%
	21-30	13,122	1.9%	17,253	2.4%	17,650	2.5%
	31-40	6,967	1%	26,349	3.7%	16,227	2.3%
	41-50	29,840	4.4%	10,622	1.5%	23,561	3.4%
	51-60	121,277	17.9%	8,352	1.2%	9,632	1.4%
	61-70	173,584	25.6%	39,544	5.5%	12,305	1.8%
	71-80	115,851	17.1%	148,865	20.8%	57,753	8.2%
	81-90	55,392	8.3%	176,672	24.7%	157,205	22.4%
	91-100	29,911	4.4%	115,216	16.1%	163,525	23.3%

	Age	1989	%	2007	%	2014	%
	101-110	43,927	6.5%	51,595	7.2%	92,416	13.2%
	111-120	17,835	2.6%	26,551	3.7%	45,069	6.4%
	121-130	9,499	1.4%	48,507	6.8%	33,418	4.8%
	131-140	4,860	0.7%	17,983	2.5%	38,421	5.5%
	141-150+	3,149	0.5%	14,726	2.1%	27,069	3.9%
	Total	**677,165**	**100%**	**716,703**	**100%**	**700,842**	**100.0%**
George Washington NF	0-10	44,367	4.3%	7,576	0.7%	7,793	0.7%
	11-20	32,524	3.1%	27,124	2.6%	14,323	1.4%
	21-30	22,987	2.2%	26,705	2.6%	29,142	2.8%
	31-40	3,309	0.3%	40,328	3.9%	26,641	2.6%
	41-50	5,490	0.5%	11,503	1.1%	40,304	3.9%
	51-60	31,822	3.1%	3,681	0.4%	6,255	0.6%
	61-70	101,660	9.8%	8,332	0.8%	3,989	0.4%
	71-80	214,257	20.7%	44,620	4.3%	13,000	1.2%
	81-90	218,002	21.1%	133,311	12.8%	55,084	5.3%
	91-100	115,456	11.2%	228,543	21.9%	156,022	15.0%
	101-110	79,291	7.7%	203,317	19.5%	226,638	21.8%
	111-120	63,294	6.1%	90,055	8.6%	181,114	17.4%
	121-130	33,702	3.3%	75,189	7.2%	78,875	7.6%
	131-140	26,012	2.5%	55,786	5.3%	72,018	6.9%
	141-150+	42,546	4.1%	88,445	8.5%	129,095	12.4%
	Total	**1,034,719**	**100%**	**1,044,515**	**100%**	**1,040,293**	**100.0%**
Combined GWJNFs	0-10	70,636	4.1%	9,722	0.6%	10,725	0.6%
	11-20	58,206	3.4%	39,446	2.2%	17,982	1.0%
	21-30	36,109	2.1%	43,958	2.5%	46,792	2.7%
	31-40	10,276	0.6%	66,677	3.8%	42,868	2.5%
	41-50	35,330	2.1%	22,125	1.3%	63,865	3.7%

Age	1989	%	2007	%	2014	%
51-60	153,099	8.9%	12,033	0.7%	15,887	0.9%
61-70	275,244	16.1%	47,876	2.7%	16,294	0.9%
71-80	330,108	19.3%	193,485	11%	70,753	4.1%
81-90	273,394	16%	309,983	17.6%	212,289	12.2%
91-100	145,367	8.5%	343,759	19.5%	319,547	18.4%
101-110	123,218	7.2%	254,912	14.5%	319,054	18.3%
111-120	81,129	4.7%	116,606	6.6%	226,183	13.0%
121-130	43,201	2.5%	123,696	7%	112,293	6.4%
131-140	30,872	1.8%	73,769	4.2%	110,439	6.3%
141-150+	45,695	2.7%	103,171	5.9%	156,164	9.0%
Total	**1,711,884**	**100%**	**1,761,218**	**100%**	**1,741,135**	**100.0%**

Monitoring and Evaluation of Management Indicator Species

Management Indicator Species are monitored on the Forests through use of both population and habitat data. Habitat condition is one of the primary factors influencing population levels for these species; therefore, an assessment of trends in key habitat parameters also is important. In this section, population and habitat data for each MIS is discussed, with the Forest' data combined for MIS in common. Important differences in population trends or numbers between the Forests are highlighted where they occur.

Ecological, Biological Community, or Special Habitat Indicators

State wildlife agencies do not monitor populations of most ecological indicators. For avian species, population trend data available from the Breeding Bird Survey (BBS) Program (administered by the U.S. Geological Survey (USGS) Patuxent Wildlife Research Center) and from the GWJNF's avian point count monitoring program, part of the Southern Region's avian point count monitoring program. Analysis of the BBS data has been conducted for the years 1966 through 2004. The avian point count monitoring program has been active since 1994 on the GWNF and since 1997 on the JNF. In 2004 804 point counts were completed across the GWJNF. When reviewing and comparing the BBS data and the avian point count data, an important distinction is that BBS data is presented as the average number of birds seen or heard per route, while the GWJNF point count data is presented as average number of birds' seen/heard per point per year. In addition, BBS trend data is available at the state level and regional level, while the avian point count data is specific to the GWJNF's.

Cave Dwelling Bats

Reason For Selection

Cave dwelling bats are designated as an MIS in the 1993 GWNF Plan. Cave dwelling bats were selected because they are dependent on relatively undisturbed caves, a habitat element important for maintaining the wide array of animal diversity on the Forest. Populations of cave dwelling bats are believed to reflect effectiveness of measures to protect these habitats (i.e. caves) from disturbance (primarily human-induced). The Indiana bat was individually selected because it is a federally listed endangered species and there is direct interest in its population levels based on the fact that it is generally a woodland and forest dwelling bat during the non-hibernation months that may be affected in during some management activities. There are also non-cave dwelling bats, such as the red bat, but they are wide ranging temperate migrants and mostly common species that typically utilize hardwood forests of various ages for roosting and foraging.

Cave dwelling bats use the relatively constant temperature and humidity of caves to meet specific seasonal habitat requirements. Depending on the bat species, caves may be used as hibernacula, roosts, and/or maternity sites during some or all seasons of the year. All bats monitored use caves for hibernating, although some may also be found in man-made structures such as mines, culverts, barns, outbuildings and house attics.

Bat species known to occur in caves on or near the GWNF include: big brown bat, northern long-eared bat, eastern small-footed bat, little brown bat, eastern pipistrelle (tri-colored bat), Virginia big-eared bat, and Indiana bat. Some species such as tri-colored bats, gray bats, and Virginia big-eared bats use caves year round. Others, such as the big brown bat and Indiana bat use caves only from late fall to early spring (while in hibernation), and then spend summer days under the bark of trees or in buildings, foraging at night.

Bats are especially sensitive to disturbance during winter hibernation. For this reason, protection of caves and the area surrounding cave entrances is extremely important. Less is known about bat life history outside caves during the spring, summer, and fall months. Future research and study findings on feeding and migration habits of bats will likely further refine management techniques and procedures. Until then, protection of caves and the immediate above-ground area around cave entrances is essential.

For purposes of this analysis, the fundamental relationship between bats and their winter habitat is that the cave environment (temperature, humidity, darkness) must remain stable and free from human disturbance. The cave's environment is most likely to be influenced by management activities associated with allowing public use (spelunking) of caves, especially during winter, and by surface disturbances near the cave that could change the relatively constant environmental conditions within the cave. Surface disturbances include activities that may drastically alter vegetative cover and water flow such as road construction, mining, or indiscriminant timber harvesting.

For spring, summer, and fall, another key relationship between bats and their habitat is the need for an available food source (GWNF FEIS, page J-10). Available food sources (insects, consisting primarily of beetles and moths) during the spring, summer, and fall are most likely to be negatively influenced by management activities associated with aerial pesticide applications to treat gypsy moth defoliations.

Plan Habitat Objectives

It is estimated the minimum population for this guild (as a group) is 40% of the 1982 - 1990 forest average (as determined from sampling the two most populated bat caves in Bath and Augusta Counties, Va.) (GWNF FEIS, page J-14). Thus, the 1993 GWNF Plan identifies a minimum population of 390 bats (GWNF FEIS, page J-14). Specific to the Indiana bat, habitat objectives are presented in a Forest Plan amendment dated March 12, 1998. While these objectives were adopted for conservation and recovery of the Indiana bat on the Forest as a result of formal consultation with the U.S. Fish and Wildlife Service (USFWS), they benefit all other cave dwelling bats as well. The objectives are presented as standards in the Plan Amendment and they provide for: cave gating to prevent human disturbance, cave and buffer area land acquisition (on a willing seller basis), eliminating or limiting types of disturbances near caves/roost sites/maternity sites, timber activities to leave all shagbark hickories and a minimum of six snag or cavity trees per acre >9" dbh, at least 60% of all forest types to be maintained over 70 years of age and a minimum of 40% acreage of CISC Forest Types #53 (white oak-red oak-hickory) and #56 (yellow poplar-white oak-red oak) to be maintained at an age >80 years old, encouraging prescribed burning to provide for open understory foraging corridors, and creating drinking water sources for bats in areas greater than 0.6 miles from open water (Indiana bat EA, page 1-83 and DN page 1-6).

Description of Monitoring Method

For all cave dwelling bats, population counts by species are conducted in hibernacula during January &/or February every other year (odd # years in VA, some even # years in WV). These surveys are conducted by and in cooperation with the USFWS, VDGIF, and West Virginia Department of Natural Resources. Based on the Biological Opinion (BO) received from the USFWS as a result of formal consultation in 1997 and subsequently included in the 1998 Forest Plan Amendment, three monitoring items are required for the Indiana bat: 1) the total number of acres of potential bat habitat removed or disturbed as the result of management activities (excluding prescribed burn acreage) (Acres disturbed cannot exceed 4,500 annually or 22,500 over a five year period), 2) the amount of forest type acreage over certain age classes across the Forest (minimum of 60% all forest types over 70 years of age and a minimum of 40% forest type #53 and # 56 greater than 80 years old), and 3) the number of Indiana bats "taken" (i.e. killed) shall not be more than 10 annually.

Habitat Trend

The number of caves on the GWNF is finite. In Virginia there are over 3,200 caves with more than 97% on private land according to the Cave & Karst Program of VDCR-DNH. Currently there are 41 caves known to occur on the JNF and 42 on the GWNF (83 total). Not all caves on NFS land are suitable for bats and fewer still are suitable for certain bat species. The Forest Service is looking for opportunities to acquire or assist with management of caves adjacent to NFS land. Work is still underway to acquire an important bat hibernacula cave entrance and surrounding acreage in Wise County, Virginia. In 1999 this cave was gated with the assistance of the USFWS, VDGIF, The Nature Conservancy (TNC), and Bat Conservation International (BCI). In 2000 Mountain Grove Saltpeter Cave in Bath County was gated. Therefore, while the trend in cave numbers on the Forest is stable, that number may increase through acquisition of known caves and discovery of new caves. The trend for habitat conditions surrounding cave entrances is that of an aging ("maturing") late successional forest. This trend is due to the fact that forested acreage surrounding cave entrances is protected from forest management disturbance. At the same time food sources (i.e. insects) are experiencing population fluctuations and shifts in species diversity

associated with an aging forest and limited management activities. These trends in forest age and management activities are displayed in Table 3 thru Table 6.

Population Trend

Table 7 through Table 11 displays trends in cave dwelling bats on the GWNF by bat species and year monitored. These numbers are the result of winter surveys conducted in four caves that occur on (Mountain Grove Saltpeter Cave and Starr Chapel Cave) or near (Clark's Cave and Hupman's Saltpeter Cave) the GWNF. Personnel of the Non-game & Endangered Species Section of the VDGIF and VDCR-DNH, in cooperation with the Forest Service, conduct these surveys. These surveys are not conducted every year in order to minimize disturbance to the bats. Most caves were surveyed in January or February of 2013 with the next survey scheduled for 2015.

The drop in Indiana bats at Hupman's Cave from 1996 to 2001 could be because the bats were hibernating in a different section of the cave from where they had seen them in the past (2003 and 2005 Personal Communication between Steve Croy and Rick Reynolds). The cave is complex with many levels and passages, not all of which are accessible. The bats may have moved due to some disturbance earlier in the winter or a difference in internal cave temperatures due to a colder/warmer fall/winter. While caves are generally the most static of environments, airflow and temperatures can change as a result of surface openings or internal passages forming or closing. This would result in temperature/humidity changes that would force bats to seek optimal hibernating conditions elsewhere in the cave. VDGIF was not concerned about large drop from previous counts, especially with other bat species in the cave showing stable to increasing trends. Before the drop seen in 2001 for Indiana bats could be completely investigated, access to the cave was restricted until 2011 and by that time white nose syndrome (WNS) was well established in Virginia's caves and bat numbers plummeted as populations were decimated by this highly infectious fungal disease caused by *Pseudogymnoascus destructans*. WNS was first seen in a New York cave during the winter of 2006-2007. This newly discovered, cold-loving fungus, likely introduced from Europe by international spelunkers, has spread south during the past several years and was first confirmed in Virginia and West Virginia during the winter of 2008-2009 with additional spread and caves now contaminated. To date well over 1-million bats have been killed by this fungus which irritates bats during hibernation causing them to wake and use precious fat reserves. The bats then starve and or freeze when they attempt to fly and leave the cave in search of food during the midst of winter conditions.

Just prior to WNS becoming established in Virginia during the winter of 2008-2009 bat counts in three caves totaled 6,444. Bat counts in caves for combined years 2013 & 2014, were estimated at 367 individuals in four caves, a 94% decrease in five years. Declines have varied by bat species with some species not affected by WNS infection such as big brown bats and Virginia big-eared bats showing little decline while most species of *Myotis* showing drastic declines such as the little brown bat which has declined by 99%. Results of these surveys suggest that prior to WNS establishment there was a continuing overall stable to increasing trend for cave dwelling bat populations on the GWNF, and after WNS infection a dramatic decrease. Fluctuations are seen in year-to-year numbers for a given species and for the total cave count due to one or several factors such as differences in fall and winter weather from year-to-year causing bats to move to new cave locations or change their positions within a cave to a location on the cave wall or ceiling where they cannot be easily counted or even missed entirely. Other causes for differences between years include normal population fluctuations, observer bias, differences in cave survey techniques, and cave inaccessibility due to deep snow or ice preventing access during the survey period. However the dramatic and persistent decreases seen after 2009 are due solely to mortality caused by WNS. The decreases seen on the Forest are similar to those experienced wherever WNS has become established.

Table 7. Bat Population Trend in Clark's Cave

Bat Species	1990	1992	1994	1995	1999	2001	2003	2005	2007	2009	2011	2013
Big Brown Bat	3	10	1	0	4	12	1	6	8	4	1	1
Eastern small-footed Bat	0	0	0	0	0	0	0	0	0	2	1	0
Little Brown Bat	202	742	255	200	309	463	541	612	658	241	62	20
Northern Long-eared Bat	0	1	0	0	0	0	0	0	0	0	0	0
Indiana Bat	22		20		1	47	47	50	49	48	64	77
Tri-color Bat	27	210	18	4	36	216	98	196	377	159	335	34
Total	**254**	**963**	**294**	**204**	**350**	**738**	**687**	**864**	**1,092**	**454**	**463**	**132**

Table 8. Bat Population Trend in Hupman's Saltpetre Cave

Bat Species	1990	1991	1992	1994	1996	2001	2003	2005	2007	2009	2011	2013
Big Brown Bat	128	174	58	34	29	18	10	34	*	*	8	3
Eastern small-footed Bat	56	55	64	27	22	44	37	32	*	*	6	27
Little Brown Bat	1,360	3,082	3,342	4,571	2,750	2,611	3,564	3,168	*	*	732	54
Northern Long-eared Bat	2	1	0	0	0	0	2	0	*	*	0	0
Indiana Bat	26	0	220	300	225	5	4	0	*	*	3	0
Tri-color Bat	149	319	272	172	217	240	128	101	*	*	73	9
Total	**1,721**	**3,631**	**3,956**	**5,104**	**3,243**	**2,918**	**3,745**	**3,335**	*****	*****	**822**	**93**

* = cave not surveyed (private land access issues)

Table 9. Bat Population Trend in Mountain Grove Saltpetre Cave

Bat Species	1990	1992	1994	1998	2001	2003	2005	2007	2009	2011	2013	2014
Big Brown Bat	9	27	22	29	24	*	*	*	*	*	*	26
Eastern small-footed Bat	1	5	5	2	8	*	*	*	*	*	*	1
Little Brown Bat	10	3	19	36	0	*	*	*	*	*	*	1
Indiana Bat	5	23	1	2	2	*	*	*	*	*	*	0
Tri-color Bat	27	34	81	51	52	*	*	*	*	*	*	3
Total	**52**	**92**	**128**	**120**	**86**	*	*	*	*	*	*	**31**

* = not surveyed due to snow cover and inaccessibility

Table 10. Bat Population Trend in Starr Chapel Cave

Bat Species	1990	1992	1994	1995	1997	1999	2001	2003	2005	2007	2009	2011	2013
Big Brown Bat	4	18	16	15	9	10	13	9	9	19	14	15	15
Eastern small-footed Bat	3	11	7	8	12	21	22	13	12	29	21	29	15
Little Brown Bat	718	1,292	1,407	1,393	1,552	1,689	1,872	1,727	1,695	1,652	1,672	472	12
Northern Long-eared Bat	0	1	3	4	3	13	28	13	9	2	1	1	0
Indiana Bat	37	38	42	60	54	55	47	67	57	68	61	74	54
Tri-color Bat	34	326	146	95	73	128	264	111	115	247	128	142	14
Unknown													1
Total	**796**	**1,686**	**1,621**	**1,575**	**1,703**	**1,916**	**2,246**	**1,940**	**1,897**	**2,017**	**1,897**	**734**	**111**

The endangered Indiana bat has received much attention over the past several decades. The Forest completed formal consultation with the USFWS and was issued a Biological Opinion for the Indiana bat in September 1997. The 1993 GWNF Plan was amended in March 1998 and the JNF Plan was revised in January 2004 to include new prescriptions, standards and guidelines as conservation measures specifically for the Indiana bat. Table 11 displays the results of surveys for the Indiana bat. The trend for the Indiana bat from 1959 to 1998 in 9 caves shows a decline from the 1960's through the 1980's and a stable to slow increase during the 1990's to present for western Virginia.

Table 11. Indiana Bat Populations Within Hibernacula On or Near the GWJNF

Winter Survey Year	Starr Chapel Cave	Mt. Grove Cave	Clarks Cave	Hupman's Saltpetre Cave	Shires Cave	Kelly Cave	Rocky Hollow Cave	Newberry-Bane Cave	Patton Cave (WV)
1960	600								
1962	600								
1970							1,200		
1972	35								
1974	30								
1978	2						750		
1979	1								
1980	0								
1981		0							3
1982	16	0							
1983	29								
1984							647		
1985	30						270		
1986		0	21			1		90	
1987	5		52						
1988			31	0	13				0
1989	36				13				
1990	37	5	22	26	3			120	
1991	23			0			202		
1992	38	23	0	220				100	
1993	31	0			20	18	241	107	
1994	42	1	20	300					

Winter Survey Year	Starr Chapel Cave	Mt. Grove Cave	Clarks Cave	Hupman's Saltpetre Cave	Shires Cave	Kelly Cave	Rocky Hollow Cave	Newberry-Bane Cave	Patton Cave (WV)
1995	60							110	
1996			0	225	27				
1997	54					10 *			
1998		2							17
1999	55		1		23	10		120	
2000								235	8
2001		2		5	36	3	166		
2002									10
2003	67		47	4	19	9	325	189	
2004									8
2005	57		50	0	33	0 **	156	237	
2006									6
2007	68		49		16		170	232	
2008									
2009	61		48		23	1	130	208	
2010									8
2011	74		64	3	1	1	266	146	
2012	92		63	1					
2013	54		77		4		192	48	2
2014		0							

Blank cells = no survey done that winter.

* Incomplete survey of Kelly Cave was done in 1997

** 2005 number of "0" likely due to gate vandalism and subsequent human disturbance.

The recent threat of WNS has not affected Indiana bats as greatly as other species in the genus *Myotis*. Counts have decreased slightly in some caves while being higher in others. Research is ongoing into the difference in mortality rates seen in the various species of *Myotis*, but are unknown at this point.

Commercial wind power development has rapidly expanded across the Appalachians. Multiple sites have been developed in West Virginia and one site is close to being constructed in Virginia north of Eagle Rock in Botetourt County on private land. Bats are often killed during wind tower operations when they fly into the lower pressure area surrounding the trailing edge of spinning blades and suffer extreme barotrauma where decompression causes

capillaries in the lungs to explode. Bats are most affected during periods of fall migration when they often follow ridgetops and come into contact with wind towers built along those same ridgetops.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Populations of cave dwelling bats reflect more than management of caves and NFS land since they forage widely and some species migrate. For cave dwelling bats the trend prior the WNS in population numbers (stable to slowly increasing) reflect habitat conditions (an aging forest and cave stability) subject to management activities designed to maintain and/or enhance bat habitat (cave gating and foraging habitat enhancement through prescribed burning and modified timber harvest techniques). In order to prevent spread of WNS fungus by spelunkers on boots and equipment plus prevent human disturbance during the winter hibernation period, those caves on NFS land that have bat populations are gated and locked year-round. Management activities are designed to enhance habitat for bats near hibernacula. Rocky Hollow Cave was gated in 1999 and Mountain Grove Saltpetre in 2000 to prevent unauthorized use. All caves on NFS land used by endangered bat species have now been gated to prevent human disturbance, however there continues to be problems with cave gate vandalism and unauthorized entrance. Gates have been repaired and law enforcement efforts are increasing in order to try and eliminate this population threat. No aerial pesticide applications have occurred near any cave to treat gypsy moth defoliations, so there was no effect on food sources (i.e. insects) for the bat.

Long-term effects of WNS are still unknown at this time, but with the drastic drop in population numbers range-wide some species such as the northern long-eared bat have been listed as threatened by the U.S. Fish and Wildlife Service with others like the little brown bat and tri-color bat now under consideration for listing. It's likely that Indiana bats will be further affected by WNS and those cumulative effects will likely exceed the positive habitat actions now occurring with Forest Plan implementation.

Cumulative effects of wind power development is unknown and those effects have taken place outside of the GWJNF. Any potential affects at the Forest level will be addressed in project level analysis if and when the Forest receives a proposal for construction.

For the Indiana bat, since the Biological Opinion of 1997 and the 1993 GWNF Plan Amendment of 1998, the amount of acreage removed or disturbed has not exceeded 4,500 in any year nor have the percent of forest types by age been below the required level. In all cases the totals and percentages are far below the allowed amounts of take. Table 12 displays the trend in disturbance to vegetation and Table 13 displays the trend towards meeting 1993 GWNF Plan direction.

Table 12. Trend in "Take", as expressed by acres of disturbance to vegetation in Indiana Bat habitat

Year (fiscal)	Timber Harvest GWNF	Timber Harvest JNF	Total Timber Harvested	Road Const.	Rx Burn Line Const.	Rx Burn Acreage	Recreation Develop.	Wildlife Opening Develop.	Special Use Develop.	Total "Take" Acreage for Year	Allowed Acreage of "Take" per BO	"Take" Acres Not Used but Allowed
1998*	1,449	1,293	2,742	3.15	15.8	N/A	40	7.5	5.8	2,814	4,500	1,686
1999*	1,284	942	2,226	3.2	10.2	N/A	23	9.0	15.5	2,287	4,500	2,213
2000*	1,254	1,115	2,369	0.1	12.7	N/A	11	14.4	12.3	2,420	4,500	2,081
2001*	1,162	795	1,957	2.8	13.8	N/A	15	12.5	7.1	2,008	4,500	2,492
2002*	881	332	1,213	0.3	15.1	N/A	10.5	8.0	4.2	1,251	4,500	3,249
2003*	789	226	1,015	0.2	12.3	N/A	6.2	10.1	8.3	1,052	4,500	3,448
2004 (GWNF)	780		1,024	1.5	3.4	N/A	0.3	4.4	4.6	1,038	4,500	3,462
2004 (JNF)		244		1.5	3.8	6,516	0.4	2.5	2.2	6,770	16,800	10,030
2005 (GWNF)	1,176		1,583	0	6.9		46	0.1	1.2	1,646	4,500	2,855
2005 (JNF)		407			5.2	6,782	2.5	0	0.6	7,197	16,800	9,603
2006 (GWNF)	824		1,216	0.5	4.3		0.6	0	0	1,226	4,500	3,274
2006 (JNF)		392			4.8	1,762	0	0	0	2,159	16,800	14,641
2007 (GWNF)	732		1,212	0.2	5.1		4.4	0	1.5	1,237	4,500	3,263
2007 (JNF)		480			4.7	7,120	7.4	0	2	7,614	16,800	9,186

Year (fiscal)	Timber Harvest GWNF	Timber Harvest JNF	Total Timber Harvested	Road Const.	Rx Burn Line Const.	Rx Burn Acreage	Recreation Develop.	Wildlife Opening Develop.	Special Use Develop.	Total "Take" Acreage for Year	Allowed Acreage of "Take" per BO	"Take" Acres Not Used but Allowed
2008 (GWNF)	611		1,166	0	2.9		0.4	0	0.3	615	4,500	3,885
2008 (JNF)		555			0.6	10,574	0.1	0	4.8	11,135	16,800	5,666
2009 (GWNF)	833		1,194	0	2.1		0.4	6.8	0	1,237	4,500	3,263
2009 (JNF)		361		0	0.5	6,087	33.3	0	0	6,482	16,800	10,318
2010 (GWNF)	606		1,057		1.8		0.6	0	0.6	1,062	4,500	3,439
2010 (JNF)		451			1.1	10,434	0.4	0	0	10,887	16,800	5,914
2011 (GWNF)	651		1,149		0.3		3.5	7	2	1,176	4,500	3,324
2011 (JNF)		498		7.2	0	825	1.9	0	5.5	1,338	16,800	15,462
2012 (GWNF)	323		556		2.7		3.5	0	0.6	576	4,500	3,924
2012 (JNF)		233		7.2	0.8	4,148	0	0	5	4,394	16,800	12,406
2013 (GWNF)	711		919	4.1	1.2		0.5	10	13	964	4,500	3,536
2013 (JNF)		208		1.9	2.7	7,357	2.3	1	7.8	7,581	16,800	9,219

Year (fiscal)	Timber Harvest GWNF	Timber Harvest JNF	Total Timber Harvested	Road Const.	Rx Burn Line Const.	Rx Burn Acreage	Recreation Develop.	Wildlife Opening Develop.	Special Use Develop.	Total "Take" Acreage for Year	Allowed Acreage of "Take" per BO	"Take" Acres Not Used but Allowed
2014 (GWNF)	368		567		3.1	11,608	0	5	5	590	23,513	22,923
2014 (JNF)		199			1.9	10,473	1	4	3	10,682	16,800	6,118

* acres for both GWNF & JNF unless column Title indicates otherwise.

The Total "Take" Acreage by Year for the GWNF covering years 2004 thru 2013 represent the total acres for both the JNF and the GWNF, since that is how the 4,500 acres of allowable take was developed in the 1997 BO. Biological Opinions currently in effect are 1-13-2004 for the JNF and 6-12-2013 (modified per FWS letter on 4-21-2014) for the GWNF.

From 1998 to 2003 acreages are for both GWNF & JNF since both Forests were under the 1997 BO from the USFWS. Starting in January 2004 the JNF had a new BO issued by the USFWS as part of the Forest Plan Revision process. The 1997 BO for the GWNF remains in effect. Biggest change was that the 2004 BO for the JNF includes acres that are prescribed burned whereas the 1997 BO only included those acres disturbed as a result of control line construction. However, in both BO's the USFWS acknowledges that vegetation changes resulting from prescribed burning (open understory & overstory with increased number of snags) is beneficial for Indiana bats and that long-term gains in habitat quality offset short-term negative effects such as smoke, loss of some snags and trees with exfoliating bark, and possible injury to bats should they be in the area.

Table 13. Trend in Indiana Bat Habitat Meeting Conditions Required by USFWS Biological Opinion

Year of CISC/GIS Data	CISC/GIS Total Forest Acres	> 60% of All Forest Types > 70 Years Old (Acres/Percent)	Total 53/56 Forest Acres	>40% of 53/56 Forest Types > 80 Years Old (Acres/Percent)
3/12/98 *	1,707,112	1,300,681 / 76.2	701,925	352,250 / 50.2
4/1/99	1,743,546	1,358,995 / 77.9	720,382	388,094 / 53.9
3/16/00	1,742,489	1,369,028 / 78.6	720,777	397,646 / 55.2
5/31/02	1,747,991	1,425,660 / 81.6	724,438	442,888 / 61.1
3/29/04	1,721,795 **	1,440,357 / 83.6	716,235	459,077 / 64.1
6/30/05	1,753,505	1,481,318 / 84.4	731,079	479,646 / 65.6
4/22/07	1,761,218	1,519,381 / 86.3	743,688	517,837 / 69.6
5/13/14	1,741,135 ***	1,526,722 / 87.7	712,342 ***	576,696 / 80.9

* Indiana Bat EA dated 3/12/98, page 32.

** 22,769 acres not included in GIS age class report

*** Reduction in acres from 2007 is due to change in FSVeg dataset and acreage calculations by forest-types.

The number of Indiana bats "taken" (i.e. killed) has been 0 each year from 1998 thru 2014 since no dead or injured bats have been seen during or following any management activity.

Bat populations reflect more than cave management, or even National Forest land management, as some species migrate widely. Cave protection measures appear adequate to protect this portion of the species life history and therefore National Forest management is contributing, to the extent possible, to maintain species viability. While there is uncertainty about some bat population levels range-wide in North America, the bat populations on the Forest are expected to remain relatively stable or increase in the near future, dependent on effects of WNS.

The GWNF is within the east-central portion of the range of the Indiana bat in eastern North America. While its winter distribution is limited to a few select caves, the summer distribution is widespread and potentially covers the entire Forest. This species is inherently rare and not well distributed across the Forest at some times of the year, yet potentially Forest-wide at others. Current management of prescribed fire & woodland restoration provides for ecological habitat conditions capable to maintain bat populations, when concentrated at wintering

caves, as well as when dispersed during summer months. Overall, ecological conditions on the Forest are sufficient to contribute to species viability (persistence over time). Range-wide population numbers of the Indiana bat shows a slow and hopefully steady increase and the Forest Service is contributing to its viability and following the recovery plan from the USFWS.

Recommendation

No change needed in current Plan direction for bats is recommended at this time. WNS is an untreatable condition and the disease will run its course with bat populations adjusting accordingly. Work should continue with state, federal, and private cooperators plus monitoring and maintenance of cave gates along with Regional Forester closures and increased law enforcement to the fullest extent possible.

Cow Knob Salamander

Reason For Selection

The Cow Knob salamander (*Plethodon punctatus*) was selected because of viability concerns stemming from its naturally limited distribution. It is a Forest Service sensitive species and is only known to occur on Shenandoah Mountain along the Virginia - West Virginia state line. Nearly all of the global range of this salamander is located on land administered by the U.S. Forest Service. As with other members of the genus *Plethodon*, they are terrestrial, breathe through their skin, and do not require water to breed. They prefer late successional forest habitat with a loose rocky substrate. This species is a slow recolonizer of disturbed ground and is confined to older age class (late successional) forests (Terwilliger, 1991).

For purposes of this evaluation, the fundamental relationship between the Cow Knob salamander and its habitat is that it prefers late successional habitat on Shenandoah Mountain, such as that associated with old growth forests. The amount and distribution of old growth/late successional forests on Shenandoah Mountain are most likely to be influenced by management activities associated with timber harvesting techniques conducted to regenerate stands. The amount and distribution is not affected by prescribed burning since this management activity is carried out under specific parameters and techniques that burn only the understory in hardwoods while occasionally burning the overstory in pine dominated stands.

Plan Habitat Objectives

The 1993 GWNF Plan recognized the significance of the Cow Knob salamander by establishing the Shenandoah Crest Special Interest Area - Biologic. This 43,000-acre area on the crest of Shenandoah Mountain above 3,000 ft. elevation encompasses most of the known range of the salamander. Special Biological Areas (Management Area 4) are managed to “protect and/or enhance their outstanding natural biological values” (1993 GWNF Plan, page 3-6). Thus, it provides for those ecological conditions to maintain the salamander considering its limited distribution and abundance. By providing this habitat, the minimum population objective is estimated at 10 core populations throughout its range consisting of a minimum of 1,000 individuals per population (GWNF FEIS, Appendix J, page J-14).

Description of Monitoring Method

The emphasis has been on locating new populations and better defining habitat needs (see below). Since 1988 the Forest has supported and participated in studies to better define the distribution, abundance, habitat needs, and effects of management activities on the Cow Knob salamander (Buhlmann and Mitchell 1988, Buhlmann et al. 1998, Mitchell 1996, Tucker, Pauley, and Mitchell 1997). In 1992 a prelisting conservation plan was developed for this species with the cooperation of the USFWS, West Virginia Department of Natural Resources, Virginia Division of Natural Heritage, Virginia Department of Game and Inland Fisheries. Based on this conservation plan, a Conservation Agreement was signed by the USFWS and the U.S. Forest Service in 1994. Under the Conservation Agreement the Cow Knob salamander would not need to be listed as endangered or threatened under the Endangered Species Act provided the U.S. Forest Service follows certain management guidelines. The main guideline is allowing old growth conditions to develop and continue within the majority of the salamander's range on NFS land.

Habitat Trend

Since the Shenandoah Mountain Special Interest Area - Biologic is managed to minimize disturbance, the habitat trend is toward more suitable conditions (i.e. late successional, old-growth forest) for the Cow Knob salamander.

Population Trend

During 1995 and 1996 a total of 49 sites with habitat characteristics indicating a possibility of the presence of Cow Knob salamanders on Shenandoah Mountain were surveyed and Cow Knob salamanders were found at 22 of those sites (Tucker, Pauley, and Mitchell 1997). In addition to distribution and abundance information, this study also collected information such as leaf litter moisture, cover object preference, reproductive biology, and prey items. Due to concern about the effects of the loss of hemlock stands because of the hemlock wooly adelgid, 22 hemlock stands were surveyed in 1996. Cow Knob salamanders were found at 6 of the sites, all under rocks, at elevations ranging from 2,950 ft. to 3,620 ft. The results of this study indicate that the impact of the loss of hemlock on the salamander will probably be slight because Cow Knob salamanders occur in greater abundance in hardwood (oak dominated) sites.

Table 14. Trend in Cow Knob Salamanders Captured and Recaptured On Shenandoah Mountain

Year	Location	Number Captured	Number Recaptured
1987 & 1988	North Mountain	0	0
1987 to 1988	Various	19 found on 3 of 7 sites	0
1988	Briery Branch Gap to High Knob to Hall Spring	Occurrence documented, but not enumerated	0
1988	Little Bald Knob	16	3 from 1987
1996	Various	9 found on 6 of 22 sites	0
2003	VA and WV monitoring sites	311	91

Year	Location	Number Captured	Number Recaptured
2008-2014	Monitoring not conducted, but surveys were conducted.	Field surveys indicate that in some sites the lower elevational limit is around 2,000 ft.	

In 2002 William Flint, a graduate student at James Madison University, began studying the Cow Knob salamander for his Master's thesis with financial support from the Forests (Flint, 2004). His work included three parts; 1) effects of roads on population abundance and condition, 2) population monitoring, and 3) range and distribution. This research is contained in his thesis "Ecology and Conservation of the Cow Knob salamander, Plethodon punctatus" and is summarized here.

Effects of Roads on Population Abundance and Condition

Salamander abundance increased as distance from the road increased. However, in Flint's study the numbers of salamanders increased more rapidly upslope from the road as opposed to downslope, in spite of the habitat appearing better downslope. The reason for this was unclear, but pollutants, runoff, and silt are discussed as possible causes.

Population Monitoring

Long-term monitoring stations were established at two sites on the George Washington National Forest, one in Virginia and one in West Virginia. These sites were surveyed during the entire active season of the Cow Knob salamander (April – October). At the West Virginia site a total of 223 individuals were counted. At the Virginia site 88 individuals were counted. Flint also measured the condition of the animals by comparing snout-vent lengths and body mass. He found the animals in West Virginia to be in better condition than those in Virginia. Flint accounts for the difference between the sites being due to higher rainfall and better habitat conditions at the West Virginia site.

Range and Distribution Study

Flint compiled all known distribution data for the Cow Knob salamander and attempted to determine its exact distribution. He created a map using the known data and located potential areas for undiscovered populations, potentially inaccurate records, and potential range boundaries. Field surveys extended the range of the Cow Knob salamander 6.5 kilometers south along the ridge of Shenandoah Mountain and suggest that Hardscrabble Knob represents the southernmost limit of the range.

The majority of the Cow Knob salamander's habitat is in the Shenandoah Crest Special Interest Area-Biologic and is being managed to allow old-growth forest conditions to develop. Over time the habitat is improving for this species as the forest matures. Analysis results suggest an overall stable trend for Cow Knob salamander populations on the GWNF.

In 2008 several field surveys were conducted. An organized search of the Signal Knob area and south was done to follow up on Billy Flint's earlier work. Billy Flint, JMU, and Fred Huber, U.S. Forest Service conducted separate field surveys that located Cow Knob salamanders as low as 2,200 ft. and 2,063 ft. in elevation. These elevations are quite a bit lower that previously recorded records and were seen in areas of north facing ravines which are likely cooler and more moist than other sites within this salamander's range.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Management in the Shenandoah Mountain Special Interest Area - Biologic consists generally of dispersed recreation and prescribed burning. The habitat trend is one of an aging forest that benefits Cow Knob salamanders and should lead to a stable or increasing population. Because habitat conditions are stable to improving, the Cow Knob salamander will remain viable on the Forest; however, due to the naturally limited range of this species it will remain vulnerable to unexpected events possibly causing population decline.

Almost the entire range of the Cow Knob salamander is on the GWNF. It's inherently rare and thus not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the salamander population considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to provide for species viability (persistence over time).

Recommendation

Continue conducting field surveys, and coordinating with cooperators to conduct field surveys, to better refine the range, elevation limits, and habitat needs of the Cow Knob salamander

Eastern Tiger Salamander

Reason For Selection

The tiger salamander (*Ambystoma tigrinum tigrinum*) was selected because it is a locally rare species, whose limited range on the Forest is cause for concern about local viability. The Maple Flats area, a sinkhole pond complex on the GWNF, is the only known location of the tiger salamander on the Forest. This population is naturally disjunct from its global range and contains a self-sustaining salamander population. The 1993 GWNF Plan designates the Maple Flats area as a Special Biological Area. The tiger salamander's habitat (seasonally dry, fishless natural ponds, and surrounding forest) may be influenced by management activities.

Photo 1. Eastern tiger salamander (*Ambystoma tigrinum tigrinum*)

For purposes of this analysis, the fundamental relationship between the tiger salamander and its habitat is that it requires sinkhole ponds and associated uplands. The amount and distribution of sinkhole ponds in this Special Biological Area are most likely to be influenced by beaver activity, or off site management that would influence the hydrology of the area. Other factors that could affect the water quality, terrestrial habitat, or biotic interactions include acid deposition, illegal fish stocking, illegal ATV use, maintenance of wildlife openings, timber management, and control activities associated with insects and disease.

Plan Habitat Objectives

The habitat for the eastern tiger salamander is protected within the Maple Flats Special Biological Area. Special Biological Areas (Management Area 4) are managed to "protect and/or enhance their outstanding natural biological values" (1993 GWNF Plan, p. 3-6). This would include minimizing disturbance of the natural community and hydrologic regimes.

Description of Monitoring Method

The 1993 GWNF Plan indicates the monitoring techniques for the tiger salamander are mark-recapture and plot surveys measured every two years. The Forest has been intensively studying the tiger salamander populations at Maple Flats in cooperation with researchers at the University of Virginia, Dr. Joe Mitchell, and others (Buhlmann 1987, 1997, Buhlmann and Mitchell 1998, Mitchell 1996, 1997, 1998, 2000). In 1996 we began using passive integrated transponder (PIT) tags as a technique to identify individual salamanders. PIT tags are tiny electronic devices that are inserted subcutaneously and contain a unique identifying number that is read using a scanner.

Habitat Trend

Monitoring trips in 1997 revealed that fish (bluegill and bass) had been introduced into one sinkhole pond raising the concern that these fish would eliminate tiger salamanders from that location. The water level had been high for several years enabling the fish to survive and grow. In late 1997 and early 1998 the water level dropped in that pond and all fish apparently died. Adult tiger salamanders and egg masses were observed in this pond in 1999. Monitoring in 2000 showed that, for the whole Maple Flats Sinkhole Complex, the habitat is stable; however, there is a continuing problem with illegal ATV use in the area. In addition, water quality trends for the mountains of Virginia show an increase in acidity related to atmospheric acid deposition. At low pH levels amphibians cannot reproduce.

Population Trend

Between 1996 and 1998 112 salamanders were tagged and released. In 1999, 69 were tagged. The increase in individuals tagged was due to increased time spent in the field and improved methods of capturing tiger salamanders. Ten salamanders captured in 1999 were recaptures from previous years. One salamander had been tagged in 1996 and recaptured in 1997 in the same pond. In 1999, this salamander was captured twice in a different pond. Data collected are beginning to provide information on how long tiger salamanders live and how mobile they are. In addition to adult tiger salamanders being tagged, they are measured for length and mass, and sex is determined. Egg masses are counted, and larval salamanders are captured for mass and length measurements. In 1999 drift fences were installed at three ponds as part of a University of Virginia cooperative study. During the winter of 1999-2000 very accurate counts of the tiger salamanders entering and leaving the three ponds were possible. Water chemistry of potential tiger salamander ponds has been sampled to develop a baseline from which to determine whether the ponds are undergoing acidification (Downey, Douglas, and Wirtz 1996). In 2001 the Virginia Herpetological Society conducted its spring survey in the Love's Run Pond Complex 5 miles west of Maple Flats. At one pond five larval tiger salamanders were dip-netted and released. This was the first time tiger salamanders were proven to occur outside the Maple Flats Sinkhole Pond Complex in the Big Levels area. In 2003 the pond was revisited, but it was dry.

Table 17 shows the trends in numbers of salamanders. Data from the above surveys for 2000 are still being analyzed, and initial figures show that 1458 tiger salamanders were caught at the three ponds with drift fences. From 2001 to 2003 the numbers of salamanders caught at the drift-fenced ponds varied: 405 in 2001, 138 in 2002, and 1053 in 2003. This variation is most likely the result of the severe drought in 2001 and 2002 (Church 2003). In addition, field surveys in the winter of 1999-2000 discovered tiger salamander egg masses and larvae at two previously unknown sites in the Maple Flats area (Church and Huber, unpublished data 2000). The more intensive survey methodology has increased the number of animals observed, and the number of known locations. Analysis results suggest a stable to increasing trend for tiger salamander populations on the GWNF.

Table 15. Trend in Tiger Salamanders Captured and Recaptured at Big Levels

Year	Number Captured	Number Recaptured
1996	45	0
1997	53	3
1998	14	0
1999	69	10
2000	1,458 (336 adult, 1,122 metamorph)	Data Not Analyzed
2001	405 (194 adult, 211 metamorph)	Data Not Analyzed
2002	138 (138 adult, 0 metamorph)	Data Not Analyzed
2003	1,053 (140 adult, 913 metamorph)	Data Not Analyzed
2004-2014	No new data collected	

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

In the past, it was thought that the delineation of the Maple Flats Special Biological Area containing the eastern tiger salamander appears to have encompassed much, if not all, habitat used by this species on the GWNF. Since the last Monitoring and Evaluation Report, 2005, new populations of eastern tiger salamanders have been found on and off the Forest. Dawn Kirk, Forest Fisheries Biologist and Fred Huber, Forest Botanist located tiger salamanders to the west of Maple Flats in a number of ponds in an arc around the base of the Big Levels massif. Tiger salamanders were observed at Grassy Pond, Loves Run Ponds, and Pines Chapel Pond. Tiger salamanders have also been observed in a sinkhole pond on State land in the same arc, and in a pond on private land near Stuarts Draft. Observations made since this species was discovered on the Forest indicate that this species is still present at all locations where previously found. . As new information on population trends and habitat use surface, management activities will be adjusted to protect the eastern tiger salamander where they occur on the Forest. Forest Service management activities are having no effect on the eastern tiger salamander since all sinkhole ponds in the Maple Flats area are avoided and buffered from management activities. Illegal ATV use is a continuing problem at Maple Flats and especially at Pine Chapel Pond. Illegal ATV use has the potential to directly impact this species along with federally listed plant species and their habitat. The 1999-2002 Monitoring and Evaluation Report suggested increased law enforcement efforts. Forest Service law enforcement has

apprehended several illegal ATV users in the Maple Flats area and they were successfully prosecuted in court. In 2001, the district placed boulders to restrict illegal ATV activity.

Salamander populations are expected to remain relatively stable or increase in the near future. The GWNF contains several populations of the eastern tiger salamander that are disjunct from its almost contiguous Atlantic coastal and Midwest distribution. This species is therefore inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the salamander population considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to provide for viability (persistence over time) of this disjunct population.

Recommendation

It is recommended that the area below the Big Levels Massif, where the sinkhole ponds occur, be designated a Special Biological Area. Continue law enforcement efforts to decrease illegal ATV use at Maple Flats and Pines Chapel Ponds to protect tiger salamanders. Continue monitoring.

Brook Trout and Wild Trout

Photo 2. Wild brook trout young-of-year from St. Mary's River, Augusta County, VA

Reason For Selection

Trout were selected as a Management Indicator Species (MIS) because they are commonly fished and are therefore in demand, and because they are associated with streams that have high water quality.

Brook trout (*Salvelinus fontinalis*), specifically, were chosen for the GWNF because that is the species indigenous to the Forest. Wild trout (brook, rainbow, and brown) were chosen for the JNF because many of the trout streams on the JNF support wild rainbow (*Oncorhynchus mykiss*) or brown trout (*Salmo trutta*) populations in addition to the native brook trout. Wild trout are an MIS for both Monitoring Question 5 (*What is the status and trend in aquatic habitat conditions in relationship to aquatic communities?*) and Monitoring Question 8 (*What are the trends for demand species and their use?*) in the 2004 JNF Plan. Trout are indicative of cold-water streams, good water quality and sedimentation rates that are in equilibrium with the watershed. MIS population trends and changes are analyzed for resident fish rather than hatchery reared fish, since many stocked streams are not suitable for year-round survival or recruitment of a self-sustaining trout population.

The fundamental relationship between trout and their habitat is that they need cold water and the water must be of good quality. The amount and distribution of cold water habitat and water quality is most likely to be influenced by management activities that have the potential to raise stream temperature, affect water chemistry, and introduce sediment into the streams.

Plan Habitat Objectives

The water temperature objective in the 1993 GWNF Plan (page 3-95) is for a maximum summer water temperature of 69º F. Additional objectives for cold-water habitat described in the 1993 GWNF Plan (page 3-93) include 125 to 300 pieces of large woody debris (LWD) per mile, and between 35% and 65% pool habitat. The 2004 JNF Plan objective for LWD is to have a minimum of approximately 200 pieces per stream mile (page 2-6). The minimum population is considered to be five pounds of trout per acre (or 5.6 kilograms per hectare) in flowing waters (GWNF FEIS, Appendix J, page J-7, JNF FEIS, page 3-155). Plan objectives are to maintain sedimentation rates that are in equilibrium with the watershed and do not alter biological communities as measured using EPA's Rapid Bio-assessment, Protocol II (EPA 1989).

Description of Monitoring Method

Monitoring includes the assessment of the physical and chemical stream habitat, biological integrity using benthic macroinvertebrates, and direct measurement of trout biomass. Trout are directly monitored through fish shocking using the 3-pass depletion method, and measuring biomass in kilograms per hectare is the monitoring method, because this is the method used by the VDGIF to determine biomass of trout within running waters. VDGIF started monitoring Virginia's trout streams in the mid-1970's. Since that time they have developed a monitoring program that involves electroshocking specific reaches every 2 years on streams selected to represent the diverse range of geologic conditions found in the mountains of Virginia. The habitat and macroinvertebrate monitoring methods are discussed below or in the Aquatics and Water Quality section of this report.

Habitat Trend

There is an estimated 1,601 miles of cold-water streams on the GWJNF, although, wild trout are not found in all of those cold-water miles. Trout habitat is a combination of the physical and chemical components of the stream ecosystem. Trout and all stream habitats are maintained and improved through deliberate protection and management of the riparian areas on the GWJNF.

Large Woody Debris, Aquatic Organism Passage, and Physical Habitat

See the discussion of large woody debris monitoring and aquatic organism passage in the Aquatics and Water Quality section of this report. Across all Ranger Districts, large woody debris was deliberately added to many streams that did not meet the DFC, and many road crossings have been replaced and made passible. In addition, efforts were made in the North River, to return a highly modified stream channel to a more natural condition. Past hydrological modifications of the North River include bank armoring with rock gabions and channelization to protect the road from frequent floods. These modifications resulted in a wide, shallow channel that lacks fisheries habitat complexity. Under a project spanning 2005-2015, rock vanes (j-hooks) and cross vanes, and other structures made of natural materials were placed in the stream channel to consolidate streamflow, create pools, and increase sinuosity; with the goal of maintaining surface summer flow connecting pools to increase habitat for wild brook trout and other stream organisms. Over nine construction seasons, 68 in-stream structures were installed. Non-functional rock gabions blocking the natural floodplain were also removed. Monitoring revealed that both types of structures (j-hooks and cross vanes) were able to maintain pools with an average depth of 1.2 meters. Mean bankfull pool width varied by structure type, with j-hook pool bankfull at 13.8 meters and cross vane pool bankfull at 8.1 meters (Finger 2013). This would be expected, since the cross vane controls bankfull elevation on both streambanks, while j-hooks only control one side.

Additional monitoring of the North River restoration section was done in 2014 by the FS Southern Research Station Center for Aquatic Technology Transfer. Stream habitat conditions were classified and inventoried in 2002 (June 24-25) and 2005 (June 20-30) prior to stream habitat modifications, as well as post modifications in 2014 (August 19-20) using the basin-wide visual estimation technique (BVET) (Dolloff et. al 1993). Using the pre modification inventory, and a “control” unmodified section (Section E Lower), as a comparison, there was an increase in total pool area and number of pools in the modified river Section E Upper in the 2014 survey (Krause and Roghair 2015). The restoration structures appear to be the cause of Section E Upper doubling the amount of pool habitat area, as well as pool habitat unit count, between 2005 and 2014, while remaining almost the same in Section E Lower. These structures have increased the amount of pool habitat available for brook trout, and fish monitoring has shown an increase in trout within the restoration sections.

Water Quality

Water quality has been systematically monitored on Forest streams since 1987. As expected, the general water quality of any given stream is strongly tied to the underlying geology coupled with prevailing air quality. The collected data has been used to determine trends and changes in stream water composition, and to develop a model for projecting the future status of native trout streams. A 1998 report (Bulger et al. 1998) found that of the study streams in non-limestone geology, 50 percent are “non-acidic.” An estimated 20 percent are extremely sensitive to further acidification. Another 24 percent experience regular episodic acidification at levels harmful to brook trout and other aquatic species. The remaining 6 percent of streams are “chronically acidic” and cannot host populations of brook trout or any other fish species. Modeling conducted by the Southern Appalachian Mountain Initiative (SAMI) and reported in their 2002 publication on acid deposition showed that even with the sulfate deposition declining considerably, as new air regulations are implemented, stream recovery will be slow or non-existent over the next 100 years. Chronically acidic streams may improve slightly and be only episodically acidic by 2100, but they will still be marginal for brook trout (see Figure 1).

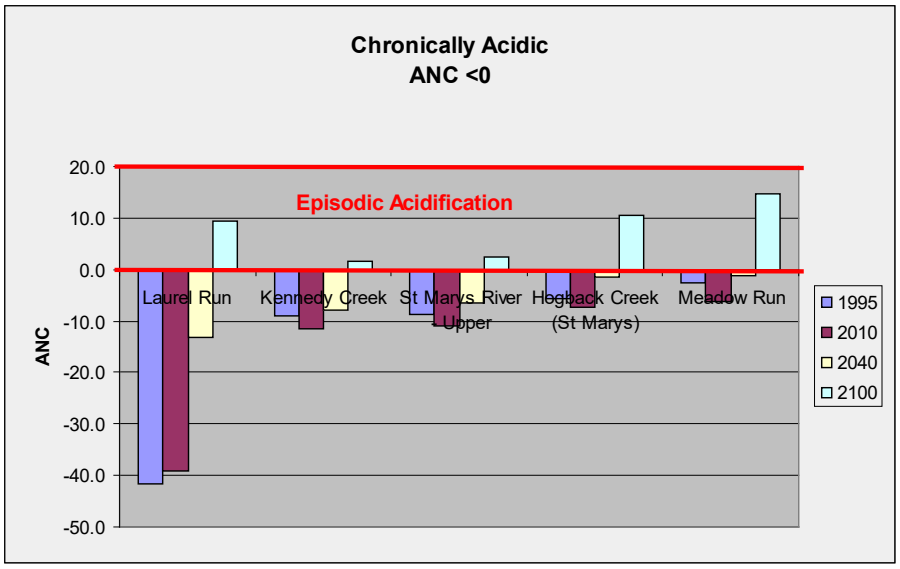

Figure 1. SAMI modeling results for selected streams

However, when Miller (2011) analyzed state-wide water chemistry data from the Virginia Trout Stream Sensitivity Study from 1987, 2000, and 2010, little improvement was noted between the 1987 and 2000 surveys, but there was clear improvement in water quality between the 2000 and 2010 surveys. The study found that 77 percent of the sampled streams in 2010 were suitable for brook trout reproduction. The 1987 and 2000 surveys showed that only 55 percent and 56 percent, respectively, were suitable for brook trout reproduction. The rate of stream recovery was significantly correlated with elevation, with lower elevation sites showing faster recovery. In addition, some sites were still getting worse.

The improvement is attributed to the Clean Air Act Amendments of 1990 that imposed strict regulations on emissions from coal-fired power plants, as well as improvements to technologies that reduce emissions from power plants, automobiles and other machinery. Between 1990 and 2009, sulfur dioxide emissions from coal-fired power plants declined by 64 percent. Dominion Virginia Power, as a notable example, removes 95 percent of the sulfur dioxide emissions from its largest coal-fired power plant, located at Mount Storm, W.Va., which is upwind of Virginia's mountains and Shenandoah National Park.

An analysis of water samples taken on the Forest since 1987 shows a similar mix of trends, with evidence of trends in ANC and pH at roughly 20% of sites (Smith and Voshell 2013). A little over half of the trends in pH are decreasing (getting more acidic), while more than half of the trends in sulfates (SO42-) were significant and increasing. If SO42- continues to increase in streams and there are decreases in atmospheric SO42- then this may indicate that soils are saturated with SO42- and any new deposition is moving directly into the soil water solution. Interestingly, the majority of ANC trends indicate increasing levels of ANC, however the results include some streams that are limed.

Site specific monitoring of stream water chemistry was conducted following a wildfire that burned through an entire watershed. North Branch Simpson Creek has a 1,837 acre watershed within the Rich Hole Wilderness Area. In April of 2012, ninety-five percent of the understory was burned to the forest floor with about five percent single and group torching. Quarterly VTSSS water samples from the stream since 1987 provided a baseline, while post-fire storm samples were collected to look at fire effects. Although soil alkalinity increased due to ash in the

burned area, water chemistry showed no corresponding increase in ANC or turbidity from soil erosion (Downey & Haraldstadt 2013). The severe and extensive wildfire within the Wilderness watershed did not affect water quality or stream habitat.

Population Trend

There are 10 trout streams that have been monitored extensively for trout biomass between 1976 and 2014 by the VDGIF and GWJNF (see Figure 2). These streams are used to elucidate trends in native brook trout and naturalized (wild) rainbow and brown trout populations across the Forest (see Table 16).

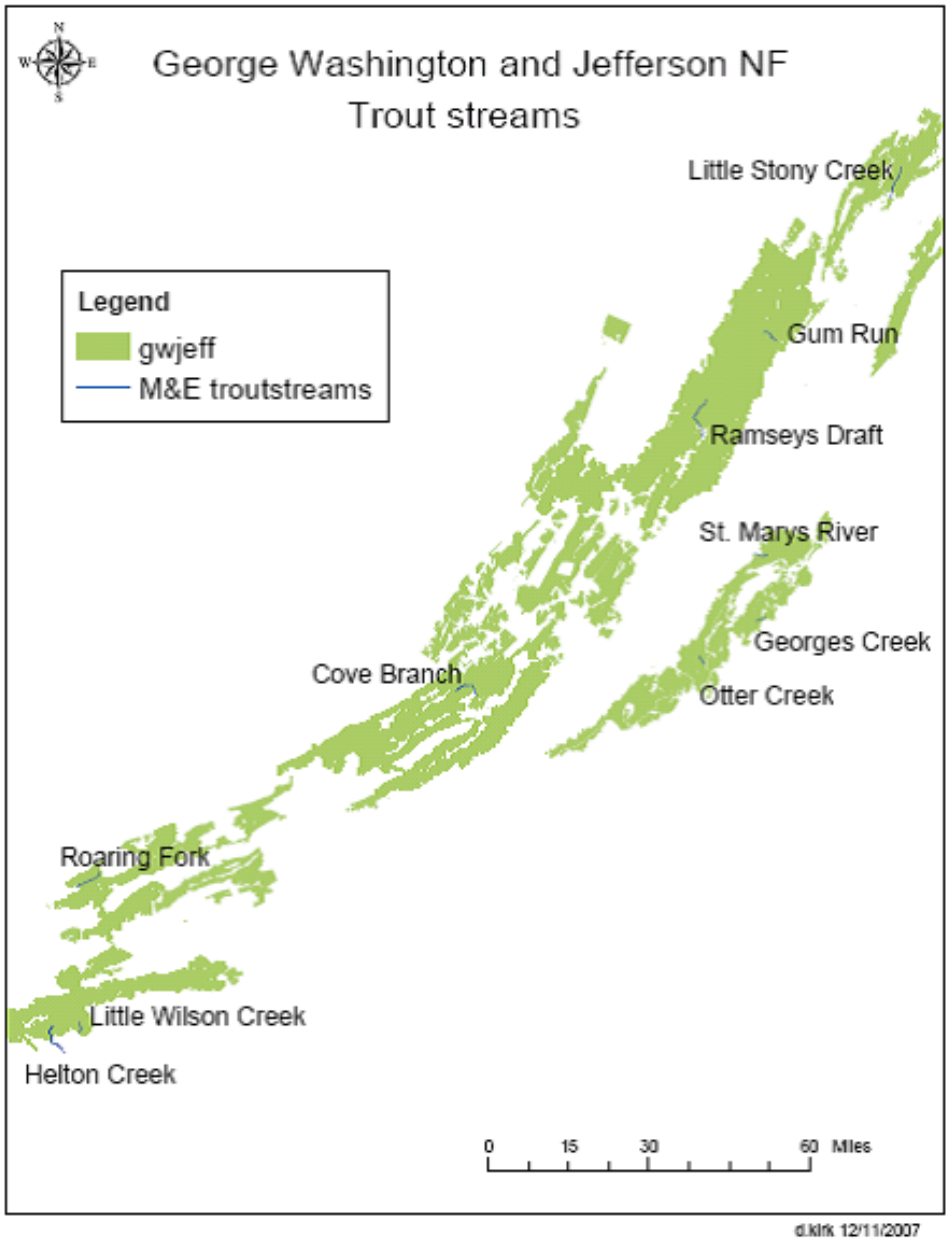

Figure 2. Location of selected trout streams on National Forest

Table 16. Wild Trout Biomass from Selected Streams in kilograms/hectare

Year	Cove Branch (bt)*	Gum Run (mean) (bt)*	Little Wilson (bt/rt) *	Roaring Fork (bt)*	Helton (bt/rt) *	Little Stony (bt)*	St.Marys (mean) (bt)*	Ramsey's Draft (upper) (bt)*	Georges (bt)*	Otter (bt)*
1974				bt						
1975						bt				
1976		bt					bt/rt/bn	bt	bt	
1977	bt				bt / rt					
1978			0 / 20.1						bt	
1983			0 / 0							
1984				bt				bt		bt
1985			bt							bt
1986							6.4			
1987									18.0	
1988					bt / rt	12.1	6.2			
1989	30.5					6.9			51.0	15.5
1990	66.9		14 / 15		80 / 17	17.6	17.1	75.7	73.0	12.25
1991	50.9			bt		32.6				
1992	22.6		11.4 / 8		52 / 12	14.6	17.1	46.9	81.0	12.25
1993	20.2					15.4				
1994	16.5	44.1	19 / 8.7	0.0	60 / 37	13.3	7.9	42.0	65.0	10.00
1995	15.8	19.1				9.8				
1996	25.2	22.0	26 / 11	0.0	39 / 59	6.5	8.0	81.0	30.0	5.0
1998	20.5	67.1				27.4	22.1	45.4	121.0	
1999							27.9			
2000	7.0	10.8		21.0	14 / 2	39.5	36.5	78.0	92.3	0.0
2001							31.8			
2002	10.6	30.6	19.2 / 5.2	7.3	36 / 30	29.0	25.2	71.5	122.7	0.0
2003							19.0			
2004	14.3	77.02	30.4 / 2.7	13.3	82 / 7.3	22.2	13.4		59.3	1.2

Year	Cove Branch (bt)*	Gum Run (mean) (bt)*	Little Wilson (bt/rt) *	Roaring Fork (bt)*	Helton (bt/rt) *	Little Stony (bt)*	St.Marys (mean) (bt)*	Ramsey's Draft (upper) (bt)*	Georges (bt)*	Otter (bt)*
2005							15.1			
2006	15.1	87.0	34.5 / 9.6	39.1	65.8 / 9.8	34.3	16.9	58.3	85.8	2.3
2007							16.0			
2008	11.5	46.0	56.1 / 0	33.1	83.2 / 14.4	25.7	12.7	50.6	47.1	5.1
2009							11.4			
2010	6.4	0.0	48.7 / 2	28.6	52.8 / 11.3	19.3	13.6	27.3	93.0	0.0
2011							11.9			
2012	8.5	26.2				19.3	14.8	55.5		
2013							13.2			
2014	24.0	96.1	14.4 / 0	23.1	39.3 / 7.2	17.8	27.5	53.0	59.4	

* "bt" denotes brook trout, "rt" denotes rainbow trout, and "bn" denotes brown trout. Where these initials are found in a tabular cell, only presence was noted; biomass was not calculated.

Note: to convert from kilograms/hectare to lbs./acre, multiply by .8923

Trout population trends can be broken into several categories, discussed below, that are strongly related to water quality.

Good water quality, circum-neutral pH (non-acidic)

Where native brook trout are the only trout species in the stream, their populations generally fluctuate. Brook trout numbers from year to year are naturally variable and tend to respond to climatic extremes such as droughts or floods (i.e. Georges Creek, Otter Creek, see Figure 3). As an example, the lack of brook trout found in Otter Creek in 2000 and 2002 reflects the extreme drought that occurred during 1999-2002, and the subsequent drying up of the stream during the summer months. Approximately 70 wild brook trout of various sizes were stocked in Otter Creek in 2003, a non-drought year. Brook trout were found again in Otter Creek from 2004 through 2008, but not in 2010, following another drought-year.

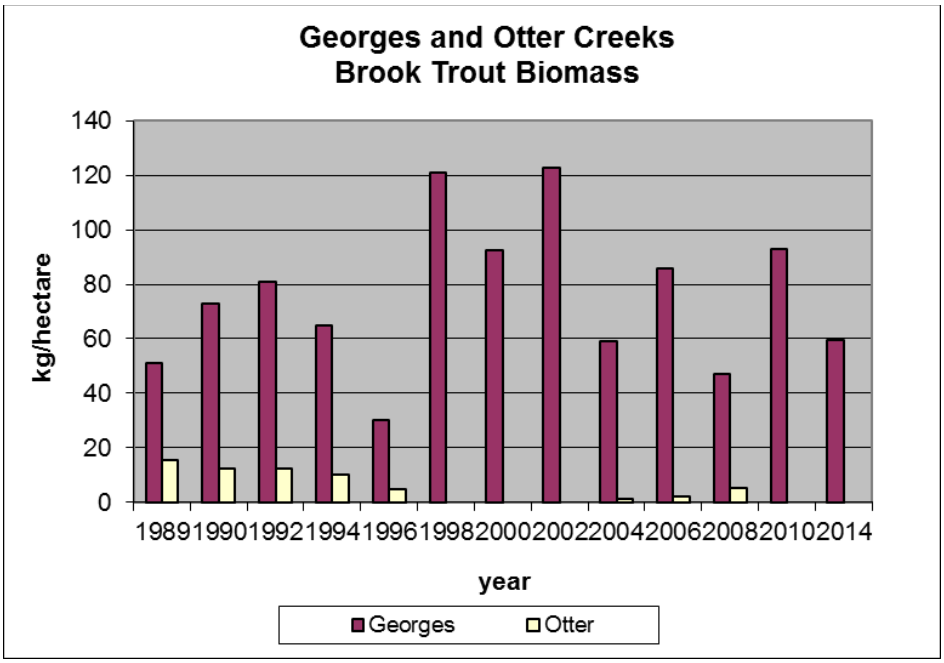

Figure 3. Brook Trout Biomass in Georges Creek and Otter Creek, 1989 to 2014 (Data from G. Palmer, VDGIF 2015).

Where brook trout and wild rainbow trout are found in the same stream with good water quality, there is competition between rainbow trout and brook trout, resulting in rainbow trout occupying lower reaches of the stream and brook trout occupying upper reaches of the stream. In some of the streams sampled that fit this category, there are middle reaches where both species are found (see Figure 4). Rainbow trout adults are found in moderate numbers, while brook trout numbers fluctuate from moderately high, to low with a large percentage of young fish in the sample.

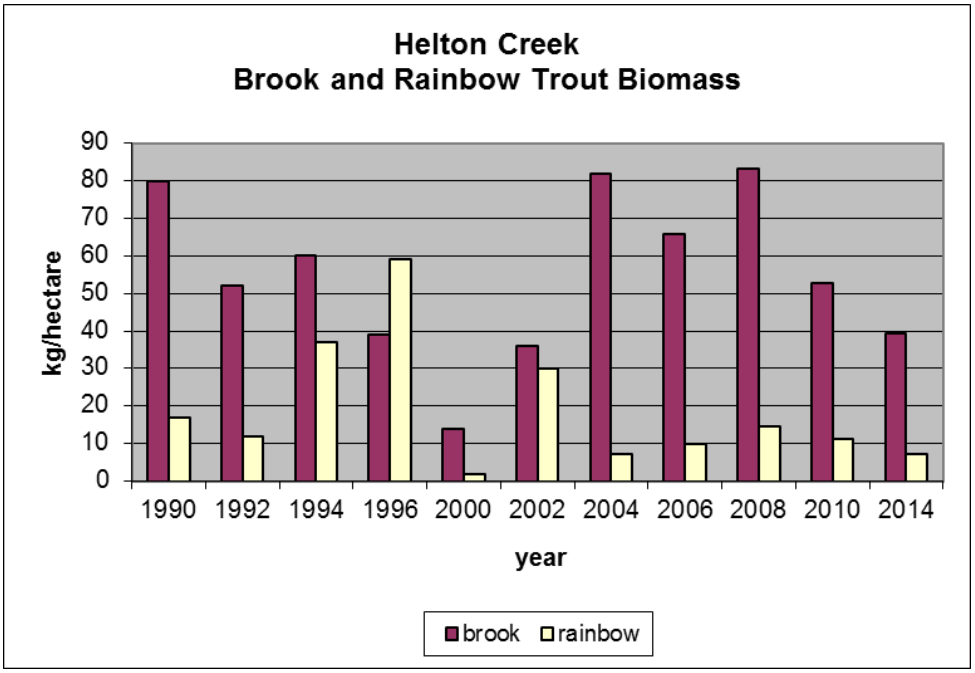

Figure 4. Brook Trout and Rainbow Trout Biomass for Helton Creek, 1990 to 2014 (Data from S. Owens, VDGIF 2015).

A small number of streams on the Forest have stream conditions suitable to support reproducing brown trout. These populations fluctuate in response to natural events.

Water quality with low acid neutralizing capacity (ANC) and variable pH (acid sensitive)

Because brook trout are fairly acid-tolerant, native brook trout populations in these streams are similar to the populations found in non-acidic streams, except the fish have an additional extreme to contend with in the form of acid pulses, or periods of flow with low pH, generally associated with storm events in the winter or spring.

Where rainbow trout are present, their populations are declining, and brook trout populations are expanding. This category of stream seems to be reverting from wild rainbow back to brook trout (e.g., Little Wilson Creek, see Figure 5).

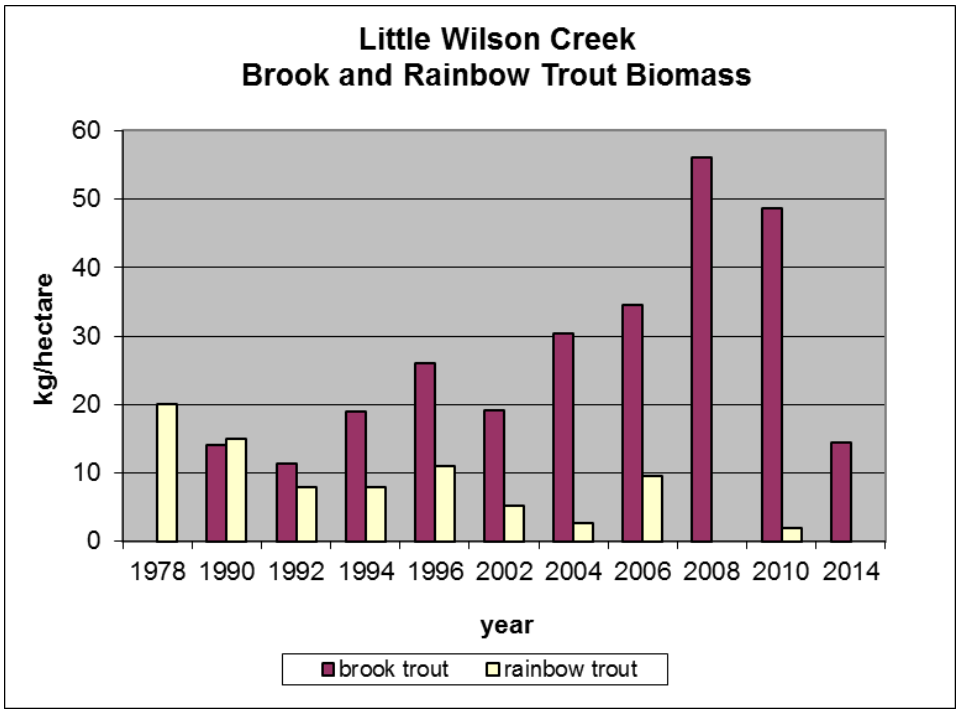

Figure 5. Brook and Rainbow Trout Biomass of Little Wilson Creek, 1978 to 2014 (Data from S. Owens, VDGIF 2015).

Water quality with no ANC and low pH (acidified)

If streams in this category once harbored rainbow trout, they are now gone. Brook trout numbers are low. The population is chiefly made of older fish, and there is generally low recruitment. Some of these streams have had all fish extirpated. An example would be Roaring Fork prior to 1999. Several years of no spring floods carrying acidic pulses gave brook trout a chance to re-colonize the upper reaches of Roaring Fork. Brook trout are among the most acid tolerant fish and have somewhat recovered in the past few years in this stream (see Figure 6).

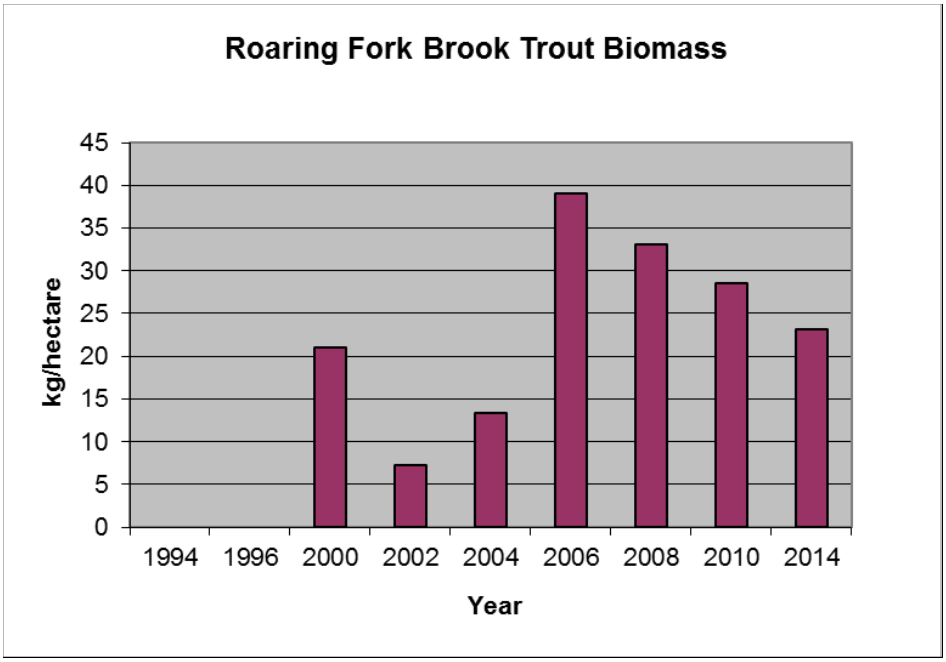

Figure 6. Brook Trout Biomass of Roaring Fork, 1994 to 20014

(Data from S. Owens, VDGIF 2015).

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Several chronically acidic streams on the Forest have been treated with high-grade limestone sand (see Table 17). Brook trout populations in these streams have increased dramatically following treatment. If population trends continue upward for several years, relatively stable populations can be maintained through periodic liming. If the stream is not re-limed, brook trout numbers will return to their pre-liming condition within 5 to 8 years. Thus, Forest Service management activities such as liming (e.g., Little Stony Creek, Fridley Gap (Hudy et al, 1999), and St. Mary's; see Figures 7 & 8) and watershed restoration are increasing brook trout populations within selected watersheds. Since brook trout are among the most acid-tolerant of native fish, they are the last species to disappear from acidic waters, and an overall declining trend will be seen when streams gradually move from episodically acidic to chronically acidic.

Table 17. Streams and lakes limed on the GWJNF, 1989 - 2014

Stream	County	Year
Burns Creek (right fork)	Wise	2001
Burns Creek (left fork)	Wise	2002
Cedar Creek	Shenandoah	1990, 1997
Laurel Run	Shenandoah	1993, 1994, 1997, 2000, 2003, 2006, 2011
Little Passage Creek	Shenandoah	1997, 2000, 2003, 2006, 2009, 2012
Little Stony Creek	Shenandoah	1989, 1990,1991, 1998, 2001, 2004, 2007, 2010, 2014
Mill Creek	Shenandoah	1990, 1998, 2001, 2004, 2007, 2010, 2014
Mountain Run	Rockingham	1993,1997, 1999, 2002, 2005, 2008, 2013
Pitt Springs	Page	2011
St. Mary's River & 5 tribs	Augusta	1999
St. Mary's River & 6 tribs	Augusta	2005, 2013
Trout Pond Run	Hampshire, WV	1995, 1996, 1997, 1998, 1999

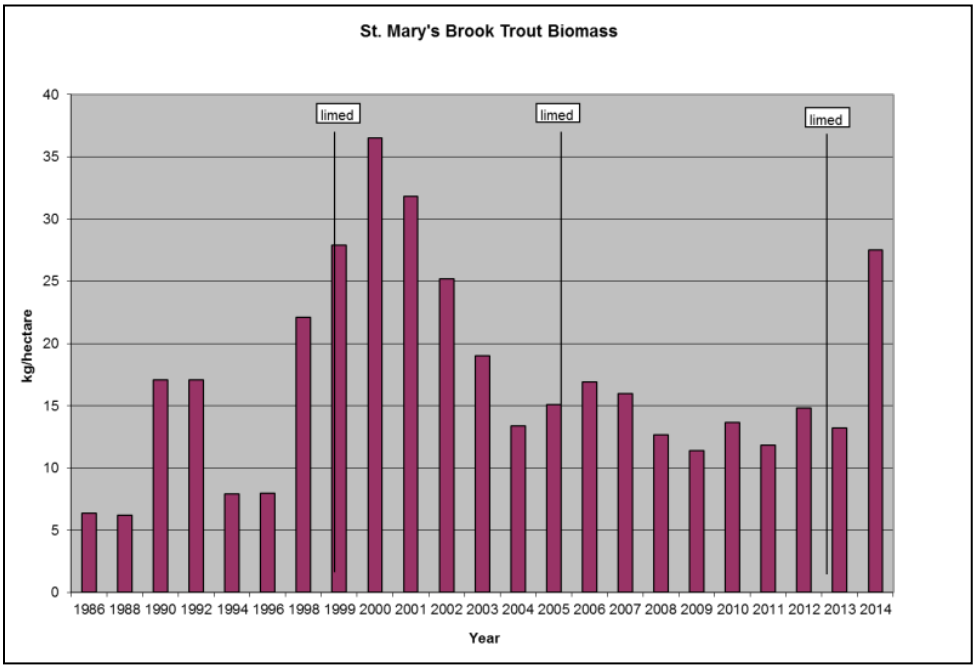

Figure 7. St. Mary's River Brook Trout Biomass Before and After Liming Treatment, 1986 to 2014

(Data from S. Reeser, VDGIF 2015).

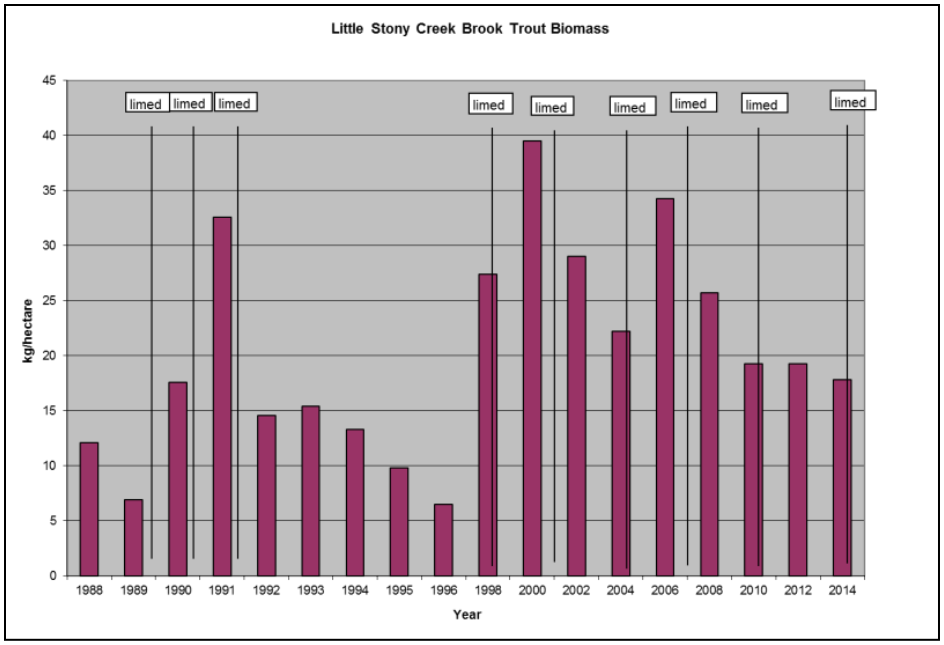

Figure 8. Little Stony Creek Brook Trout Biomass Before and After Liming Treatment, 1988 to 2014

(Data from S. Reeser, VDGIF 2015).

As shown in Table 16, populations of wild trout tend to fluctuate greatly over time. These findings do not necessarily suggest negative impacts to those streams from management activities, but rather that trout numbers are often highly variable due to natural occurrences (drought, floods, high temperatures, etc.). Hakala (2000) showed that low flows related to drought conditions, overpowered other mechanisms that could potentially influence juvenile trout abundance (i.e. fine sediment), and that adult trout abundance was principally a function of stream discharge. He also showed that the critical fine sediment size for brook trout in his study is between 0.063 mm and 1.0 mm, and that fine sediment (<0.063mm) should not exceed 0.6-1.0% of spawning substrate, or negative population effects may be incurred. Documented sediment shifts from extreme events (VDOT road construction) that result in altered Rosgen channel types have involved median particle sizes (D50) much larger (i.e. D50 shift from 78 mm to 52 mm) than those that have been scientifically linked to biological effects (FY 97/98 Monitoring and Evaluation Report, GWJNF). Therefore, although extreme channel-altering events may be significant enough to change the stream morphology and hydrology, they may not necessarily affect stream biota in the short term.

Based on the monitoring analysis of macroinvertebrates as found in the Aquatics and Water Quality section of this report, management activities are not having a negative effect on stream biota or habitat; and in some cases, management activities are improving them. Management of the riparian area for shade, large woody debris recruitment, erosion control, and water retention is beneficial to trout populations and habitat.

Recent discussions on the effects of climate change on trout habitat have identified the possibility of less flow and warmer water in the summer and flashier intense flow in the winter (Trout Unlimited 2007). Actions that could mitigate the resulting changes to stream channels include 1) protecting riparian zones which would maximize shading, provide bank integrity and a source for large wood, and 2) allow natural processes such as meandering

channels and development of wetlands (including beavers) to increase groundwater recharge and provide refuge during extreme droughts or floods. Through Forest Plan emphasis on riparian structure and function, the Forest has already laid the groundwork for addressing this issue in the future.

The trout is a game fish that is harvested throughout Virginia and West Virginia, and therefore, viability is not a concern. Overall, viability is sustained for trout on the GWJNF. Trout populations are expected to remain relatively stable in the near future. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation

No change in direction for trout is recommended. Continue monitoring.

Sunfish Family

Photo 3. Smallmouth bass (*Micropterus dolomieu*)

Reason For Selection

The Sunfish family was selected as an MIS for the GWNF because it includes species whose habitats may be influenced by management activities and members of this family include popular game fish. This is not an MIS for the JNF. Largemouth bass (*Micropterus salmoides*) and smallmouth bass (*Micropterus dolomieu*) were selected as representatives of this group for the GWNF because they are highly desired by the public for angling recreation, and VDGIF monitors their populations. The members of the sunfish family are used as indicators of recreational fishing opportunities associated with warm water streams, small impoundments, and large impoundments (such as Lake Moomaw).

The fundamental relationship between sunfish and their habitat is that the water must be of good quality and there should be adequate structural habitat for spawning and cover. The amount and distribution of warm water quality

is most likely to be influenced by management activities associated with timber sales, dumping sewage (after treatment) into lakes from nearby developed recreation sites, dredging operations to remove sediment buildup, and repairing or reconstructing spillways.

Plan Habitat Objectives

The water temperature objective in the 1993 GWNF Plan (Page 3-93) for cool to warm water habitat requires maintaining a water temperature regime within 2 degrees Fahrenheit of ambient water temperature, dissolved oxygen values greater than 7.0 parts per million, and sedimentation rates that are in equilibrium with the watershed. For the GWNF, the minimum population for sunfish is considered to be 15 pounds per acre (16.81 kg/ha) in cool/warm water streams, lakes, and ponds (GWNF FEIS, Appendix J, page J-7).

Description of Monitoring Method

Fish shocking of population as measured in catch per unit effort (#/hour) will be the monitoring method, because calculation of catch per unit effort is the method used by the VDGIF in monitoring fish within large rivers and reservoirs.

Habitat Trend

The GWJNF has approximately 981 miles of warm-water stream habitat and approximately 3,000 acres of warm-water lake habitat. Much of the warm water stream habitat on the Forest is within a mosaic of private ownership. Off-Forest non-point source pollutants from agriculture and urban runoff continue to be a problem. Acid deposition is not an immediate problem for most warm-water streams on NFS lands because they are often found in the valley bottoms where the geology is rich in limestone or other carbonate-bearing rock. As small impoundments within the Forest age, underwater structural habitat diversity (generally, trees and shrubs) that may have been present at time of lake or pond development is decaying and needs to be replaced in order to maintain a healthy, self-sustaining warm water fish population. There are no new impoundments planned in the near future.

The habitat trend for a large impoundment on the Forest, such as Lake Moomaw, is centered on the continued addition and maintenance of structural habitat as older structures decays. Water quality remains good, yet is dependent on the water quality that feeds the lake.

Population Trend

Recruitment (ability of the fish to successfully reproduce) is generally good, but growth is slow due to the relatively infertile nature of most of the Forest's warmwater lake habitat. Data for this analysis was taken from VDGIF electroshocking surveys of warmwater habitat on the Forest. A representative of two warmwater habitat types on the GWNF are discussed below.

Warmwater Streams[*]

The South Fork Shenandoah River has been used as a representative of warm water streams in the M&E reports since 1997. Fish kills have been occurring since 2004-2007 in the entire North Fork Shenandoah, South Fork Shenandoah, Main stem Shenandoah River, and main tributaries of the South Fork Shenandoah River (North River, Middle River, South River). In 2007 fish kills occurred in the Cowpasture River and Upper James River from Lick Run downstream to Lynchburg.

The main kills were seen in the spring of the year from March-June. There have been some kills involving suckers in November and December in the Main stem Shenandoah River. Fish affected are primarily smallmouth bass, redbreast sunfish, and rock bass. Small numbers of white suckers, northern hogsuckers, largemouth bass, chubs, fallfish, and a few bullhead catfish have also been affected. A few additional species have been reported by anglers.

Symptoms may include physical problems, however, some dead fish have no visual external problems. Dying or stressed fish sometimes are covered in a heavy layer of mucus, have "blotched" coloration, are extremely dark in color, have external patches of fungus or protozoans on them that appear to be fuzzy-like cotton, bloody spots under the scales, or open bloody lesions caused by bacteria. Some fish may be lethargic and found swimming near the surface, while others may be acting normally and are even caught by anglers.

The summer of 2015 illustrated the remarkable ability of a smallmouth bass population to rebound following a fish mortality event. The rebound, although not fully, was contributed to successful year of spawning in 2010. The most recent mortality event occurred in the spring of 2014 when a few anglers and concerned citizens reported small numbers of dead and diseased smallmouth bass in the Shenandoah River. DGIF verified that there were a relatively high percentage (30%) of smallmouth bass and redbreast sunfish with lesions and other abnormalities on the South Fork Shenandoah River from Port Republic to Front Royal. DGIF also sampled throughout the North Fork Shenandoah River and observed fish with the same abnormalities, but the percentage was slightly lower.

Impacts from the 2014 mortality/disease events in the Shenandoah River watershed were fairly heavy for that spring and summer. However, DGIF sampled the fish community in the fall of 2014 and found an abundance of 9 to 11 inch smallmouth bass and a lot of very young bass as well. Based on the most recent 2015 fall sampling, the 9 to 11 inch group of smallmouth grew to 11 to 13 inches during the summer of 2015 and barring any disease outbreaks in 2016 the fish are expected to reach the 13 to 15 inch range by August of 2016. Additionally, a successful spawning year in 2012 will bring another group of 9 to 11 inch smallmouth bass for anglers to enjoy in 2016. Better days are ahead for bass anglers in the Shenandoah River basin.

It is common for a few fish in a population to exhibit some type of abnormality such as lesions, dark patches of skin, raised bumps, loss of scales, split/eroded fins or discolored/eroded gills. Historically in the Shenandoah River watershed when 20% or more of the fish in a population are exhibiting one or multiple abnormalities of this type it becomes more of a concern. Chronic spring-time fish mortality and disease events have occurred in the Shenandoah River over the last decade, and were present in the upper James River from 2007-2010. These episodes have not been uniform in location or severity. Adult smallmouth bass, redbreast sunfish and rock bass

[*] data from S. Reeser, VDGIF, 2016 https://www.dgif.virginia.gov/fishing/fish-kill/

have been the primary fish affected. However, several additional species have also been inflicted. Affected fish typically exhibit open sores or "lesions" on the sides of their bodies and some dead and dying fish have no visibly external abnormalities.

Determining the cause of these mortality/disease events has proven to be extremely difficult. Scientists have and continue to conduct in-depth studies on fish health, pathogens, water quality, contaminant exposure and toxins released by bacteria (blue-green algae). Current studies are focusing on endocrine disrupters, bacterial toxins (blue-green algae), and water quality impacts. The fact that these events have occurred in multiple watersheds that differ in many ways has added to the complexity of understanding the primary cause.

Fish health investigations to date have included: histopathology, parasitology, bacteriology, virology, and blood and liver analysis. This information has been collected from the affected rivers, and also from a few "reference" rivers where these mortality/disease events have not been occurring. Fish health samples have been analyzed by several Universities, the United States Fish and Wildlife Service's Northeast Fish Health Lab, and the United States Geological Society's Eastern Fish Health Lab. While researchers have collected a plethora of fish health data, linking the disease and mortality episodes to a single cause has been elusive. Detailed research findings are described in the Virginia Tech University final report *Investigation Into Smallmouth Bass Mortality in Virginia's Rivers* (Orth et al. 2009).

From the research and monitoring conducted to date, there has not been any conclusive evidence that water quality variables or chemical contaminants are directly responsible for these fish mortality/disease events. Contaminant levels were measured in the rivers affected as well as a few rivers where these fish mortality/disease events are not occurring. Contaminant levels were measured at both base-flow and during runoff events. However it must be noted that not every possible chemical compound was measured, and that the toxic concentration to fish of many chemical compounds are unknown. It is also not well understood how some chemical compounds could "interact" with one another and become toxic to fish. More research is needed in this area to determine if multiple stressors may be occurring at the same time to impact the health of these fish. Detailed findings from water quality and contaminant monitoring projects can be obtained from the Virginia Department of Environmental Quality's Valley Region Office.

During the spring of 2015 VDGIF began collecting smallmouth bass livers throughout the South Fork Shenandoah River to test for microcystin presence. Microcystin exists in the aquatic environment when blue-green algae (cyanobacteria) are present. Blue-green algae toxins have been shown to be lethal to fish, humans, livestock and pets. Most blue-green algae thrive in aquatic systems with a high ratio of phosphorus to nitrogen and appropriate flow and temperature. Given favorable environmental factors blue-green algae may displace non-toxic algae. When water temperatures increase certain blue-green algae begin to die-off. This causes the cell wall of the algae to burst and release toxins into the water column. Again, this is probably not the root cause of the fish mortality events. However, coupled with other stressors it may be one of the major factors contributing to these events. In 2015 smallmouth bass liver microcystin levels were relatively low. There were also very few fish with lesions and little to no reports of fish mortality events. VDGIF plans to collect samples each spring until another fish mortality event occurs to determine if there is a spike of microcystin levels in smallmouth bass livers.

In the past DGIF and USGS focused on a particular biological pathogen as a possible cause of the disease/mortality episodes. Smallmouth bass, redbreast sunfish and rock bass were collected before, during and after the April/May mortality period from different rivers and analyzed for the presence of pathogenic bacteria from 2008 to 2012. The pathogenic bacterium *Aeromonas salmonicida* was present and typically the most

abundant on fish sampled during the fish kill period. This bacterium was not present on fish in the Maury River during the fish kill period and there have not been any fish kill issues or reports in the Maury River of this type. *A. salmonicida* was not present on fish before or after the fish kill period. Although this bacterium is present and has the ability to greatly impact fish health we are not aware of why it may be impacting the fish population. *A. salmonicida* is present in multiple aquatic systems around the world. The simple presence usually doesn't cause such impacts on bass and sunfish populations. It most commonly causes disease in trout and salmon. Environmental factors such as temperature, flow and eutrophication may also play a role in its ability to flourish. The bacteria is considered a "cold-water" fish pathogen since it cannot survive water temperatures > 74° F. USGS researchers have identified that coldwater tributaries entering the river and large springs upwelling in the river are "reservoirs" of this bacteria where it can survive year-round. *A. salmonicida* is a very virulent bacterium that may influence populations with only its presence. However, if any additional environmental, behavioral or chemical stress is added to the population while *A. salmonicida* is present in the river then it would have a higher probability of having a detrimental impact on the population. Although it seems *A. salmonicida* may be a major contributor to the mortality/disease events we now ask, why has it only impacted the fishery during the last decade and what may be stressing the population to let *A. salmonicida* thrive?

While scientists conclude that they may never be able to determine where specifically this bacteria came from nor when it may have been introduced into these rivers, learning more about this pathogen could lead to understanding the root cause of the problem. Additional questions that researchers hope to answer concerning this bacterium include:

1. Are fish becoming more resistant to the bacteria over time?
2. Do certain environmental parameters influence the virulence of the bacteria?
3. Are there other stressors such as blue-green algae toxins or endocrine disruptors that are impacting the immune system of fish which allows *A. salmonicida* to impact the population?

Reservoirs[†]

Lake Moomaw has been used as the GWNF reservoir example in the M&E report since 1997. Lake Moomaw is a 2,530 acre impoundment located in Bath and Alleghany Counties, Virginia. Gathright Dam was authorized by the U. S. Congress in 1946 and completed by the U. S. Army Corps of Engineers in 1981. Operation and maintenance of the recreation area was transferred to the U. S. Forest Service in July, 1982. The reservoir was constructed for downstream water quality augmentation, flood control, and recreation. Recreational pool level is at 1,582 feet above sea level and there is over 43 miles of shoreline. Lake Moomaw is surrounded by the 13,482 acre Gathright Wildlife Management Area and thousands of acres owned by the U. S. Forest Service. The lake's unique intake tower consists of nine portals, designed to release water at any level from 12 – 87 feet below recreation pool. This allows for maximizing optimum temperature and flow regimes in Jackson River below Gathright Dam. The average depth of the reservoir is 80 feet, with the maximum depth at 150 feet near the dam.

Lake Moomaw's geographic location and its operational procedure lends itself to thermal stratification in the summer. As much as 60,000 acre-feet of coldwater fisheries habitat is available in later summer for species such as brown and rainbow trout. Coldwater habitat varies annually depending on flow into the lake and downstream release loads. In summer 1993, the Corps of Engineers changed the way they released water out of the

[†] data from S. Reeser, VDGIF, 2015

impoundment during summer/early fall. The Corps is required to provide 210C.water at Covington, 30 km downstream of Gathright Dam, throughout this period. Currently, water from the epilimnion is mixed with cold, anoxic water from the hypolimnion, meeting downstream temperature requirements and preserving summer trout habitat in the lake. Alewives, the primary forage base, also thrive in the lake's two-story environment. Trout are the only sport fish that are stocked annually.

Changes in the physical habitat have focused primarily on black bass populations. Warmwater fish species such as black bass, black crappie, rock bass, sunfish, chain pickerel, channel catfish, and yellow perch reproduce and grow in the flats, drop-offs, brush, and standing timber afforded to them along the lake's shoreline. Common carp found their way into the reservoir through bait introductions in the late 1990's. Artificial habitat such as tire reefs, artificial grass, cedar tree shelters, crappie stakes, pallet structures, log cribs, hinge trees, brush/tree piles, concrete structures, and PVC attractors have been deployed at various times in Lake Moomaw since 1981. Prior to impoundment, the Corps of Engineers left 40 hectares of standing timber in several coves and a few boulder piles in deep sections of the lower lake. Hundreds of stumps were also left along the shoreline, providing exceptional cover/nesting habitat for channel catfish. Addition of physical habitat has been accomplished jointly by DGIF, USFS, and local angling clubs. An inventory of past projects is maintained by USFS at the Warm Springs Ranger District office. A lake management plan was also jointly developed by DGIF and USFS in 1993.

Black bass relative abundance is estimated with annual nighttime electrofishing surveys conducted at established stations throughout the lake. Additional black bass (particularly smallmouth bass) data are periodically sampled with fall/winter daytime horizontal gill net sets. Black crappie have been periodically targeted with spring or fall trap net sets, but no permanent sampling protocol has been established for this species. Channel catfish, yellow perch, and chain pickerel are collected incidentally with gill nets and by electrofishing.

Fishing regulations were set years ago and have changed little in the past decade. Black bass regulations have remained unchanged since 1982, with an aggregate (smallmouth and largemouth bass) of five per day, 12 inches or larger. Fifty sunfish of any size can be creeled daily and 25 each of rock bass and black crappie of any size can be taken daily. Five chain pickerel daily of any size and 20 channel catfish of any size can be harvested daily. There is no size or creel limit on yellow perch or common carp.

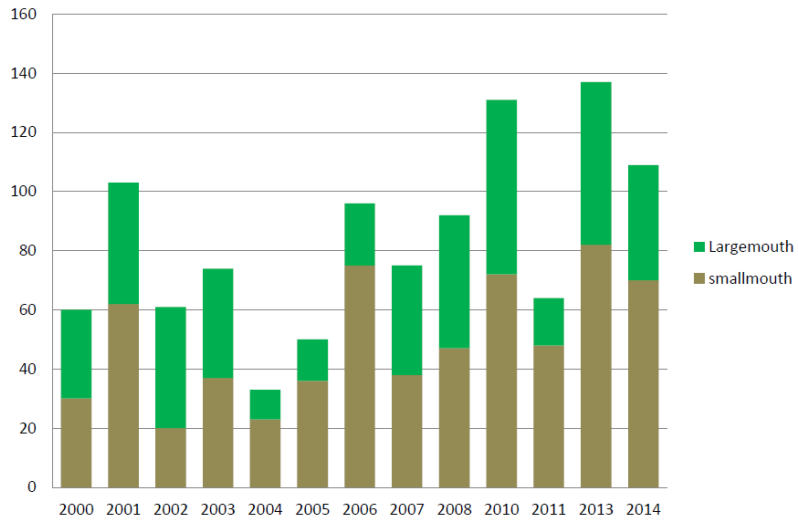

Figure 9. Black Bass Relative Abundance at Lake Moomaw (catch per hour of electrofishing)

In summary, the black bass fishery at Lake Moomaw is representative of a western Virginia impoundment. Bass densities (see Figure 9) and growth are very good for smallmouth bass, and moderate for largemouth bass. Sunfish are plentiful and large redears and bluegill are creeled from deep, shady cover. Yellow perch have established themselves as a favorite quarry in early spring for those looking for excellent table fare. The state record yellow perch was creeled from Lake Moomaw. Black crappie are moderately abundant and can be found in the one-pound size range in woody cover. Large chain pickerel are active in early spring and trophy channel catfish are scattered throughout the lake.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Although the addition and maintenance of underwater structures in Forest reservoirs is necessary for healthy self-sustaining warm water fish populations, these populations are heavily manipulated through fishing regulations and harvest pressure. Forest Service activities, such as the creation of structures in reservoirs, are beneficial to members of the sunfish family. River centrarchid populations are currently controlled by water quality and disease unrelated to Forest management activities.

Sunfish are game fish that are harvested throughout Virginia and West Virginia; and, therefore, viability of these populations is not a concern. Overall, numbers and distribution of sunfish species on the GWNF is sufficient to support viable populations and sustained recreational use. Sunfish populations are expected to remain relatively stable in the near future. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation

Recommend dropping sunfish as an MIS. If sunfish continue to be used as an MIS, we suggest developing a MVP based on catch per unit effort (CPUE) rather than biomass, since biomass is rarely monitored within reservoirs on the Forest. To get a true fish biomass estimate of these habitats would take a rotenone or other lethal sampling method.

Yellow Pine Community

Reason For Selection

The Yellow Pine Forest Community (combined forest types dominated by yellow pine tree species) was selected in the 1993 GWNF Plan because it is an important element of plant and animal diversity and is a fire-dependent habitat type (GWNF FEIS, page J-12) that may be influenced by management activities. This forest community type consists of pitch (*Pinus rigida*), table mountain (*Pinus pungens*), Virginia (*Pinus virginiana*), and shortleaf pine (*Pinus echinata*) forests. This community is dependent on recurrent fire for maintenance and regeneration.

The yellow pine community is an aggregate of forest types that are dominated by “hard” pine (often called yellow pine) species that occur in the mid-Appalachians. In the Forest FSVeg inventory this community is made up of four pine dominated forest types (pitch pine, table mountain pine, shortleaf pine, and Virginia pine) and four pine-oak forest types where pine species dominate the overstory (pitch pine - oak, table mountain pine - oak, shortleaf pine - oak, and Virginia pine - oak).

The yellow pine community is typically found on south to southwest facing ridges and slopes. These areas are well drained and receive maximum solar radiation, and are exposed to prevailing winds making them more prone to desiccation and are hence drier. While pines dominate the overstory, ericaceous shrubs (in the heath plant family *Ericaceae*) such as mountain laurel, blueberry, huckleberry, teaberry, azaleas, wintergreen, fetterbush, maleberry, minniebush, and trailing arbutus dominate the understory. These shrubs often have waxy leaf coatings and most are evergreen. This combination of dry, windy site conditions, and the volatile chemical nature of resinous pines and waxy/oily shrubs, which retain their foliage year-round, make them conducive to burn. In fact, most occurrences of this community are maintained by fire and must be disturbed periodically in this way to regenerate and maintain a structure of an open mid-story with a shrub/grass understory and patchy overstory. Without fire this community will become dominated by hardwoods (oaks) or white pine (which is a "soft" pine) and the openness of typical yellow pine stands will be lost as it closes in with thick understory and mid-story vegetation. Many plant species that occur in this community are also adapted to fire for seed release and flowering. The cones of table mountain pines open and release their seeds when exposed to high heat. Blueberries and huckleberries are stimulated to rapid growth from underground stems (rhizomes) and subsequent flowering once top killed by fire. Therefore the species composition and vertical structure relies on the periodic disturbance of fire.

For purposes of this analysis, the amount and distribution of the yellow pine community is most likely to be influenced by topographic settings (south to west facing slopes) and those management activities associated with fire management. Other events that affect this MIS include episodes of bark beetle infestations and suppression of wildland fire occurrences.

Plan Habitat Objectives Related to the Yellow Pine Community

The 1993 GWNF Plan objective is "Maintaining biological diversity on the Forest is a major goal …". Habitat objectives are "…to conserve specific elements of biodiversity and restore others where needed" (1993 GWNF Plan, page 2-1). Thus maintaining and restoring the spatial and structural attributes of the yellow pine community is a 1993 GWNF Plan habitat objective. Likewise, a prescribed burning program objective is to improve fire-dependent ecosystems (1993 GWNF Plan, page 2-32).

Description of Monitoring Method

Monitoring of the yellow pine community looks at the FSVeg forest-wide database, forest health reports from the Southeast Forest Experiment Station, number of acres prescribed burned annually, and data collected from vegetation plots established in yellow pine community occurrences. Prior to the development of the FSVeg database, the Forest used data from the Southern Region's CISC (Continuous Inventory of Stand Condition) database.

Habitat Trend for the Yellow Pine Community

To track the yellow pine community we used the GWNF FSVeg database and Forest Inventory data on forest types and acres. Table 18 shows the trend in acres by forest type for yellow pines on the GWNF since 1993 utilizing FSVeg. Table 19 shows the trend in acres by pine forest types from the forest survey data done by the Southeastern Forest Experiment Station.

Table 18. Yellow Pine Community acreage trend across the GWNF

Forest Type (FSVeg #)	1993	1997	1999	2000	2004	2005	2010
Shortleaf Pine (32)	1,590	1,550	1,484	1,547	1,553	1,536	1,556
Virginia Pine (33)	14,408	14,600	14,195	14,167	14,313	13,689	13,985
Pitch Pine (38)	28,084	27,430	27,864	27,832	27,366	27,689	27,582
Table Mountain Pine (39)	13,650	13,510	13,663	13,688	13,419	13,340	13,356
Shortleaf Pine - Oak (12)	1,050	1,190	1,065	1,065	1,175	1,065	1,196
Pitch Pine - Oak (15)	31,871	32,270	31,758	31,681	31,288	32,353	32,440
Virginia Pine - Oak (16)	18,706	17,930	18,449	18,448	17,839	18,900	18,705
Table Mtn. Pine - Oak (20)	15,129	14,810	15,288	15,297	14,885	15,629	15,489
Total acres	**124,488**	**123,290**	**123,766**	**123,725**	**121,838**	**124,201**	**124,309**

Table 19. Yellow Pine Community acreage trend from Forest Survey Data across the GWJNF in Virginia

Forest Type	Virginia Mountain Region *	1977	1986	1992	2001
Virginia Pine	Northern Mt.	17,857	12,649	8,966	3,521
	Southern Mt.	N/A	4,227	4,204	4,763
Pitch Pine	Northern Mt.	39,188	30,496	26,818	28,673
	Southern Mt.	4,738	3,772	3,773	5,631
Table Mt. Pine	Northern Mt.	16,718	25,555	29,627	22,894
	Southern Mt.	5,494	12,767	7,924	4,575
Subtotal Pines	**All Regions**	**66,138**	**91,452**	**83,304**	**72,058**

* Separate Reports: Table 10 of Forest Statistics for National Forest land only for the Northern and Southern Regions of Virginia, 1977, 1986, 1992, and 2001.

Based on FSVeg information the number of acres of yellow pine forest types across the GWNF has been slightly decreasing to stable over the past 20 years. The changes may be greater than indicated due to the inventory technique used in FSVeg coupled with recent ongoing natural changes in those eight forest types that are not reflected in these acreage figures. For at least the past two decades FSVeg has only been updated on those lands considered suitable for timber production as allocated in the 1993 GWNF Plan. Yellow pine dominated forest types are generally considered unsuitable for timber production and are therefore not consistently inventoried.

Additionally, in the early to mid-2000's pine bark beetles (a native insect) infesting many yellow pine stands to epidemic proportions and have caused extensive pine mortality in the overstory. More than 85% of the yellow pine stands on the GWNF are over 80 years old. As these stands age and are stressed from ingrowth of other trees

they become more susceptible to bark beetle infestations. This combined with the lack of fire occurrences in these stands (both wildfire and prescribed fire), where no more than 3% has burned over the past 15 years, has led to increased stress from competition with non-yellow pine tree species in the understory and has led to a rapidly increasing pine overstory mortality and ever-increasing fuel loads. These pine dominated stands require periodic fire for regeneration since the effects of burning result in opening the canopy to increased sunlight on the forest floor, killing thin-barked fire intolerant / shade tolerant trees that compete with pine seedlings, and in the case with table-mountain pine, heat from a fire opens serotinous cones allowing for seed release and dissemination. The lack of fire coupled with beetle activity accounts for what is likely a downward trend in the number of acres (quantity) and in stand condition (quality) of this management indicator.

2011 Forest survey data reveals decreasing trends for total pine over the past 25 years, likely due to southern pine beetle infestations, with the most serious declines suffered by table mountain pine.

Population Trend for the Yellow Pine Community

See previous paragraph on habitat trend as a function of total acreage.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Agency management activities are limited to prescribed burning and managing fire within these forest types. Control or suppression of pine bark beetles, by means other than timber salvage harvesting, has not been done due to prohibitive costs and negative impacts to other associated animal species. While the acres of prescribed burning have increased in recent years (see trend in management activities presented earlier at the beginning of this report, Table 5), the number of acres burned that have been targeted at restoring the yellow pine community have not kept up with the downward decline in total number of acres and regeneration of yellow pine trees. Thus while current Forest Service management activities are attempting to increase the Yellow Pine Community in some areas, not enough prescribed burning and management of wildfires for resource benefit is occurring forest-wide and the overall decreasing trend in habitat quality and total acreage is likely to continue.

Overall, viability of species dependent on the Yellow Pine Community is a concern on the GWNF. Amount of yellow pine acreage is expected to continue to decrease in the near future.

Recommendation

Implement prescribed fire and fire managed for resource benefits in those areas with a yellow pine component. Continue partnerships and cooperative work with state, federal and organizations such as The Nature Conservancy in efforts like the Virginia Prescribed Fire Council and Fire Learning Networks (FLN) plus the Consortium of Appalachian Fire Managers and Scientists (CAFMS). Implement inventory and analysis methods that more accurately identify yellow pine acreage to focus fire management efforts and monitor resulting conditions on the Forest.

Old Growth Forest Types

Reason For Selection

Old growth forests were selected as a management indicator in the 1993 GWNF Plan because they are important elements of plant and animal diversity and a social issue. These late successional (i.e. "mature") forest conditions may be influenced by management activities and are biological communities (GWNF FEIS, page J-12). There are 10 old growth forest type groups on the GWNF. They consist of: 1) northern hardwood forests, 2) conifer (hemlock, white pine, red spruce) and northern hardwood forests, 3) mixed mesophytic forests, 4) hardwood wetland forests, 5) dry-mesic oak forests, 6) dry and xeric oak woodlands and savannas, 7) xeric pine and pine-oak forests and woodlands, 8) dry and dry-mesic oak-pine forests, 9) eastern riverfront forests, and 10) rocky, thin-soiled excessively drained cedar woodlands. These groups represent aggregations of similar forest types in conditions that are necessary for species requiring mature forests.

For purposes of this analysis, the amount and distribution of old growth forest types is most likely to be influenced by management activities associated with timber harvesting. Natural disturbances, such as strong winds, large accumulations of ice, native insects/disease, fire (including prescribed fire), and landslides, also affect old growth forest conditions, but they are regarded as being with the natural range of variability for forest successional dynamics. Old growth is a management indicator only for the GWNF. (NOTE: No plant or animal species in the Appalachians are known to require old growth forest conditions exclusively i.e. are "old growth obligates" for their survival or continued existence.) Mature forests are considered to be those forests that are in the later stages of succession and are generally synonymous with old growth. Old growth forests are distinguished by old-age trees and related structural attributes within the forest stand. The stand age at which old growth develops varies according to forest type (determined by dominant tree species) and reflects climate, site conditions (bedrock geology, soil type, aspect, moisture regime, elevation), and disturbance regime. A discussion on old growth as it relates to the GWNF is found in FEIS Appendix H and 1993 GWNF Plan pages 2-3 to 2-6. Additional information is contained in the document, "Guidance for Conserving and Restoring Old-Growth Forest Communities on National Forests in the Southern Region, Forestry Report R8-FR 62" and "Information About Old Growth for Selected Forest Type Groups in the Eastern United States, General Technical Report NC-197."

Plan Habitat Objectives Related to Old Growth Forests

For the GWNF, to maintain old growth forest type conditions, a minimum of 2.5% of the forest should be in old growth (defined as hardwood stands older than 200 years old) (GWNF FEIS, Appendix J, page J-5). This would amount to approximately 26,075 acres on the GWNF (1,042,999 total forested acres). Additional discussion and objectives for all forest types are outlined on pages 2-3 to 2-6 of the 1993 GWNF Plan and Appendix H of the GWNF FEIS.

Description of Monitoring Method

The FSVeg data set maintained by the Forest will be used to measure acres of each old growth forest type.

Habitat Trend for Old Growth Forests

Table 22 displays trends for this management indicator as acres by year and Old Growth Forest Type (OGFT). Acreage figures for 1993 differ from those presented in the 1993 GWNF Plan and EIS. The data set from which those numbers were derived in 1993 no longer exists due to computer system conversions implemented since 1993. The number of acres presented here are from the current FSVeg data set. The only management that has occurred in any old growth forest acres since 1993 that would alter stand age and structure is timber harvest, and most of that has occurred in OGFT 21. All other OGFT acres identified in 1993 still exist. The number of acres reaching the minimum age to be considered old growth is increasing annually as the forest ages. Forest-wide the forest is aging and the number of acres in earlier successional stages is decreasing. Based on these acreage figures the amount of old growth is steadily increasing on the Forest.

Table 20. Old Growth acreage trend across the GWNF

Old Growth Forest Type Groups*	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
01 - Northern Hardwood Forests	369	1,047	1,141	1,141	1,255	1,356	1,412	1,482	1,546	1,619
02 - Conifer & North. Hardwood Forests										
2a-Hemlock-North. Hardwood Subgroup	1,412	1412	1412	1412	1412	1412	1412	1593	1633	1633
2b-Wh. Pine-North. Hardwood Subgroup	9	9	9	28	28	28	28	28	28	28
2c-Spruce-North. Hardwood Subgroup	71	71	71	71	71	71	71	71	71	71
05 - Mixed Mesophytic Forests	1,619	3,866	4,009	4,009	4,312	4,906	5,322	5,675	5,822	5,925
10 - Hardwood Wetland Forests	78	0	0	0	0	0	0	0	0	0
21 - Dry-mesic Oak Forests	118,974	122,484	126,367	129,659	134,127	151,360	155,505	161,113	164,884	170,532
22 - Dry and Xeric Oak Woodlands	80	85	85	85	85	271	271	271	312	331
24 - Xeric pine & Pine-oak Forests	110,011	111,821	112,589	113,602	114,672	115,297	116,042	116,456	116,846	117,239
25 - Dry & Dry-mesic Oak-pine Forests	7,819	8,198	8,465	9,246	9,684	10,943	11,276	11,873	12,192	13,085
28 - Eastern Riverfront Forests	25	25	25	25	25	25	25	25	25	25
37 – Rocky, Thin-soil Conifer Wood.	0	0	0	0	0	0	0	0	0	0
Total acres	**249,372**	**249,018**	**254,173**	**259,278**	**265,671**	**285,669**	**291,364**	**298,587**	**303,359**	**310,488**

* Names and associated identification numbers are from Forestry Report R8-FR 62. One OGFT group still has no acreage that meets the minimum age criteria. That type is the rocky, thin-soiled, excessively drained conifer woodland that is found over limestone bedrock and dominated by eastern red cedar. Very few acres of that type exist on the GWNF and no management activity is occurring in those acres that would affect stand age.

Population Trend for Old Growth Forests

Measurement by "population" is not applicable as old growth is a forest successional stage and habitat condition measured in acres, not individual species. The trend in old growth as measured in acres is one of steady increase; from 249,372 acres in 2005 to 310,488 acres in 2014.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

As specified in the 1993 GWNF Plan with regards to management activities in old age stands, timber harvesting can only occur within the Dry Mesic Oak Type (OGFT #21), as all other stands meeting the minimum age in other groups were classified during the Forest Plan revision process as unsuitable for timber production. Timber harvesting on unsuitable timberland has not been done on the GWNF. Timber harvesting of any old growth Dry Mesic Oak stands is disclosed in site-specific environmental analyses. While some individual old age stands of the Dry Mesic Oak type have been lost due to timber harvest during the past 20 years (<2,000 acres), the total acreage of stands meeting the minimum age within the that group continues to increase. From 1993 to 2014 there was an increase of 100,116 acres from 70,416 acres to 170,532 acres, almost a 150% increase. Thus, timber harvesting is not significantly limiting the old growth forest conditions on the GWNF, and in particular OGFT #21.

Very few acres have reached 200 years old since most of the Forest was cutover prior to entering federal ownership in the 1910s to 1930s. It will take another 50 to 60 years before a significant amount of 200 year-old stands are found on the Forest. According to data from FSVeg there exists approximately 129,095 acres forest types greater than 141 years of age on the GWNF (1,040,293 total forested acres in Age Class Report for 2014). For stands greater than 200 years old there exists 12,118 acres (1.2%). Therefore 116,977 acres is between 141 and 200 years of age. However, an important point is that the age at which old growth conditions develop varies by forest type and is not simply 200 years old for all forest types. The acreage by OGFT displayed in the table takes this into account where some types (mostly pine/conifer dominated) develop old growth conditions at 80 to 130 years of age. This is why the acreage figures for these types are greater. More information on old growth designation is presented in Appendix H of the 1993 GWNF Plan EIS.

Fire is a natural disturbance process common to most OGFTs (but is very limited in northern hardwoods, spruce/fir, and riverfront forests). Thus, the increased use of prescribed fire is not affecting the overall amount of old growth measured by tree age across the Forest, but instead is restoring and maintaining that condition in a species composition and structure more typical of the fire regime these forests experienced prior to active fire suppression (~1930's) which is likely more important ecologically than simply tree age of the oldest cohort.

Overall, acreage of old growth forest types on the GWNF is increasing as the forest continues to increase in age. Old growth acreages of each forest type are expected to continue to steadily increase over time.

Recommendation

No change in direction for old growth is recommended. Continue monitoring.

Northern Flicker

Photo 4. Northern flicker (*Colaptes auratus*)

Reason For Selection

The northern (common) flicker (*Colaptes auratus*) was selected as a MIS in the 1993 GWNF Plan to represent effects of management on cavity nesters for the GWNF, but also an indicator of open woodland habitat (both deciduous and coniferous (GWNF 1993 FEIS, Appendix page J-12).

Plan Habitat Objectives

For the GWNF to maintain habitat for the flicker, a minimum of one percent of the forest should be in early successional stages of ages 1 through 12 (GWNF 1993 FEIS, Appendix J, page J-5). For the JNF, a minimum of 3,900 acres should be in an early successional stage (JNF FEIS, Appendix B, page B-32). Likewise two standing dead snags per acre within harvest units need to be provided when possible (JNF FEIS, Appendix B, page B-32, as amended by FEIS on Vegetation Management in the Appalachian Mountains).

Minimum flicker populations are defined as one bird per square mile (GWNF FEIS, Appendix J, page J-14) or about 1,650 birds forest-wide. The JNF should provide a minimum population of 500 birds (JNF FEIS, Appendix B, page B-32).

Description of Monitoring Method

The USGS breeding bird surveys will be used. GWJNF's avian point counts will be used in addition to BBS.

Habitat Trend

See age-class distribution Table 6 and management activities in Tables 3-5.

Population Trend

USGS Breeding Bird Survey data indicates an initial decline followed by a lower but overall stable trend in northern flickers in the Appalachian Region (Figure 10). USFS Avian Monitoring data indicates an overall stable trend for northern flickers on the GWJNF (Figure 11).

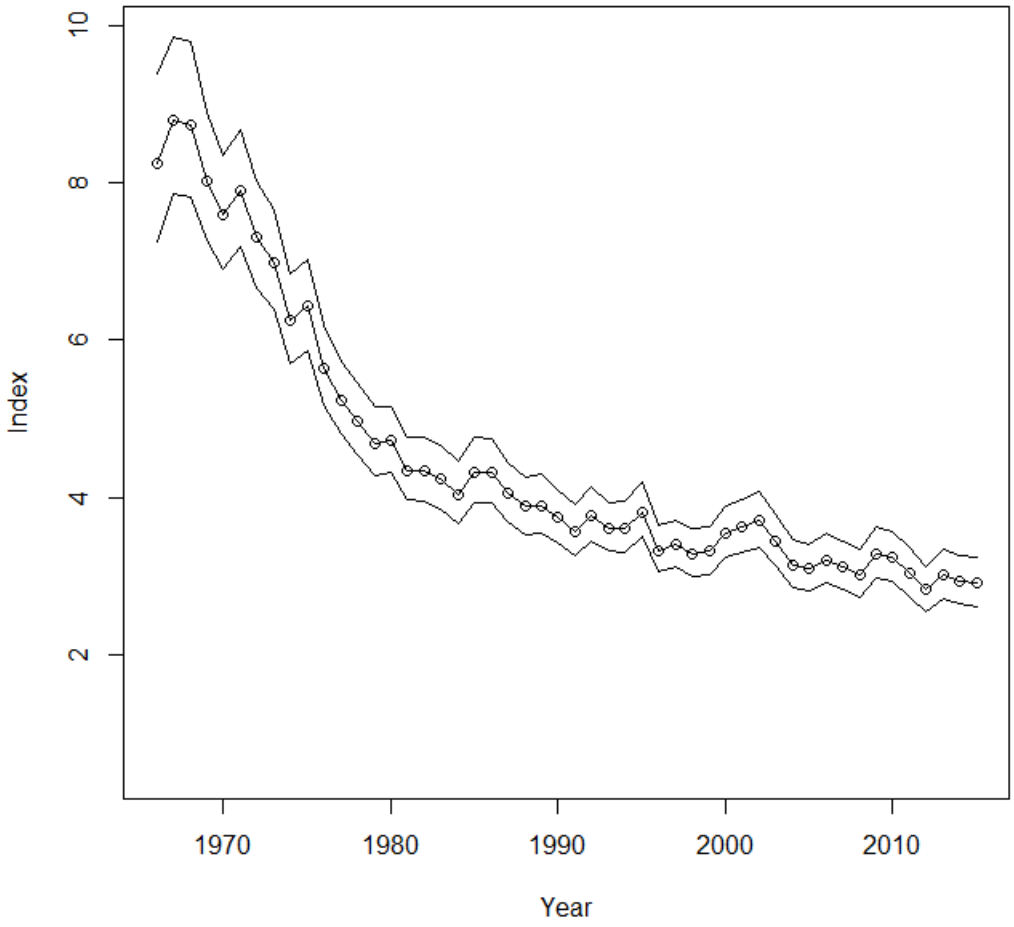

Figure 10. Trend In USGS BBS Data Of Northern Flickers across the Appalachian Region 1996 to 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

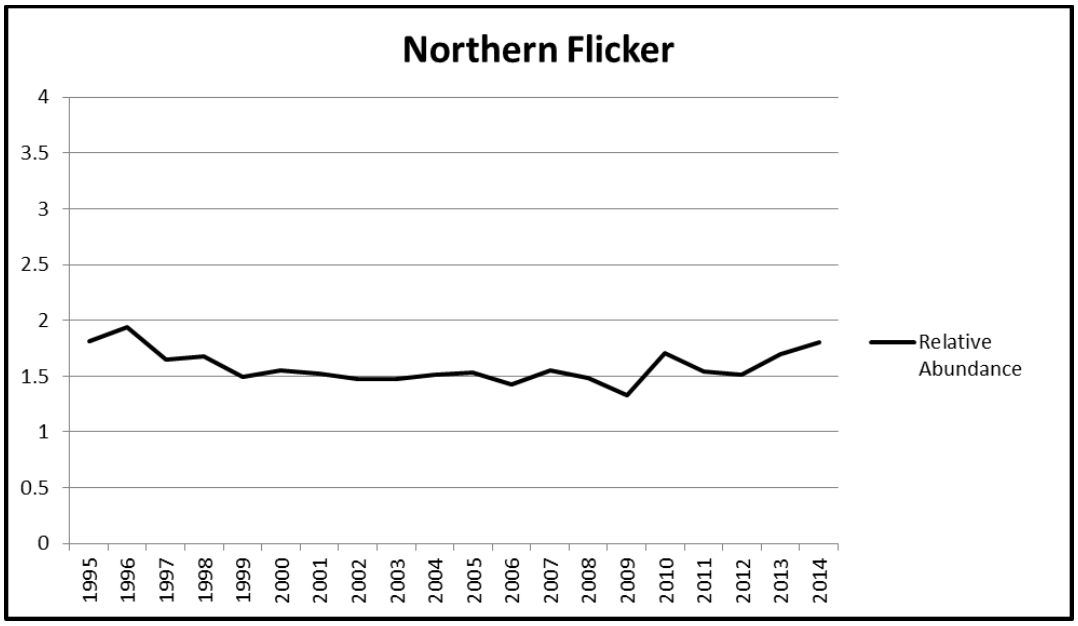

Figure 11. Trend In BBS Data Of Northern Flickers across the Appalachian Region 1996 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Northern flicker prefers open woodland habitat and ecotone habitat between forested and patches of early successional woody or grassy/shrubby habitat (Hamel 1992). It requires large-sized (over 12" DBH) snags and living trees for excavating nest cavities. Northern flickers have exhibited significant continental population declines in the last couple of decades, mirroring an overall trend of decline of disturbance-dependent bird species associated with open habitats in eastern North America (Vickery 1992, Askins 2000, Hunter et al. 2001). A significantly greater proportion of bird species exhibiting steep population declines are associated with disturbance-mediated habitats than in forested or generalist habitat types (Brawn et al. 2001). Forty percent of all North American species associated with some type of disturbance-mediated habitat (grassland, shrub-scrub, open woodlands) have been significantly decreasing in population since 1966 (Brawn et al. 2001). Combined with research highlighting the importance of early successional woody habitat for post-breeding and migratory stop-over needs of forest-interior migratory bird species in a larger landscape of mature forest (see sections on ovenbirds and worm-eating warblers and hooded warblers), the role of early successional habitat in largely mature, forested landscapes and the need to restore/maintain disturbance regimes creating such habitats is of vital importance in conservation planning (Brawn et al. 2001, Hunter et al. 2001).

Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities has effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 5). All of these activities, in addition to natural disturbances and continued maturation of the forest, should provide patches of early successional woody habitat, as well as restoring and maintaining open oak, oak/pine, and pine woodlands, which would benefit northern flickers.

Based on the results of monitoring data and habitat evaluation, northern flickers exhibit variable but overall stable population trends on the GWJNF's, and a stable trend across the Appalachian Region. Northern flickers have an abundance and distribution across the Forests that should provide for their persistence into the foreseeable future.

Recommendation

No change in direction for flickers is recommended. Continue monitoring.

Brown-headed Cowbird

Photo 5. Brown-headed cowbird (*Molothrus ater*)

Reason For Selection

Brown-headed cowbird (*Molothrus ater*) was selected to represent possible effects of fragmentation across the landscape (GWNF FEIS, page J-10). This species inhabits open agricultural lands, but will fly into nearby forested areas to lay their eggs in other bird's nests (nest parasite), and is thus considered an indicator of edge habitat effects (GWNF FEIS, page 3-172). With over 100 species of birds known to be parasitized by brown-headed cowbirds, many forest interior birds exhibit lower reproductive success near forest edges, in part due to increased brood parasitism by the cowbird (Thompson, 1992).

Numbers of cowbirds and rates of parasitism vary with distance from edges. In an extensively forested area of Wisconsin, for example, percent of parasitized nests declined from 65% within 99 meters of an edge to less than 18% at > 300 meters (Temple, 1988).

In landscapes characterized as mostly forested, recent research suggests very little change in cowbird populations from increased edge (e.g. from timber harvesting). Work in the Missouri Ozark Forests (Thompson et al., 1992) compared areas managed with clear-cutting to areas with no recent timber harvest or disturbance. Brown-headed cowbirds occurred in similar numbers in both of these areas.

For purposes of this analysis, the fundamental relationship between cowbirds and its habitat is that it prefers to parasitize nests in the edges of open areas such as pastures (where it feeds) that fragment the forested landscape.

Plan Habitat Objectives

Since this species is a nest parasite, our objective is to minimize the number of cowbirds. Due to its increased abundance and detrimental effects on other bird species, it will be monitored not primarily to insure viability, but to gauge effects on other species.

Description of Monitoring Method

The USGS breeding bird surveys will be used. GWJNF's avian point counts will be used in addition to BBS.

Habitat Trend

Table 23 displays the trend in the amount and distribution of open areas potentially used by cowbirds.

Table 21. Trend in open area acreage across both Forests

	GWNF			JNF		
Year *	Non-forest Land	Total NFS Land	Percent Non-forest of Total NFS	Non-forest Land	Total NFS Land	Percent Non-forest of Total NFS
1985	9,719* (6,847)**	1,055,525	0.9 (0.6)	7,151* (6,800)**	690,258	1.0 (1.0)
2014	9,734* (6,978)**	1,064,379	0.9 (0.7)	7,187* (6,778)**	716,960	1.0 (0.9)

* Includes Water data from planning records from both National Forests

** Excludes Water

Population Trend

USGS BBS data indicates a steady downward trend in brown-headed cowbird numbers in the Appalachian Region (Figure 12). USFS Avian Monitoring data also indicates a declining trend for brown-headed cowbirds on the GWJNFs (Figure 13).

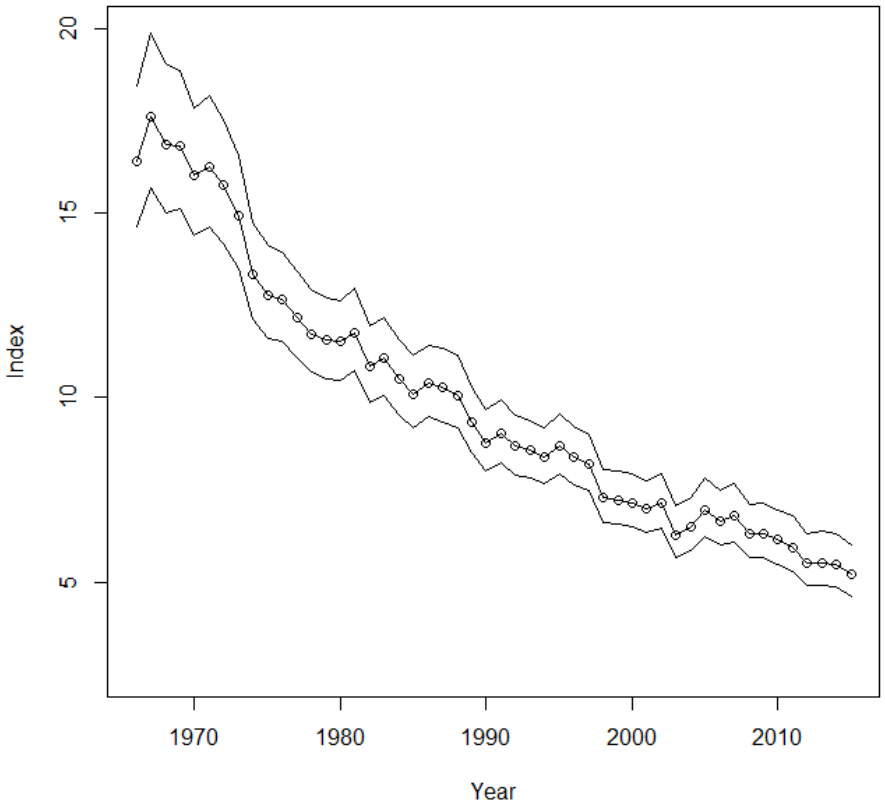

Figure 12. Trend In BBS Data Of Brown-Headed Cowbirds Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

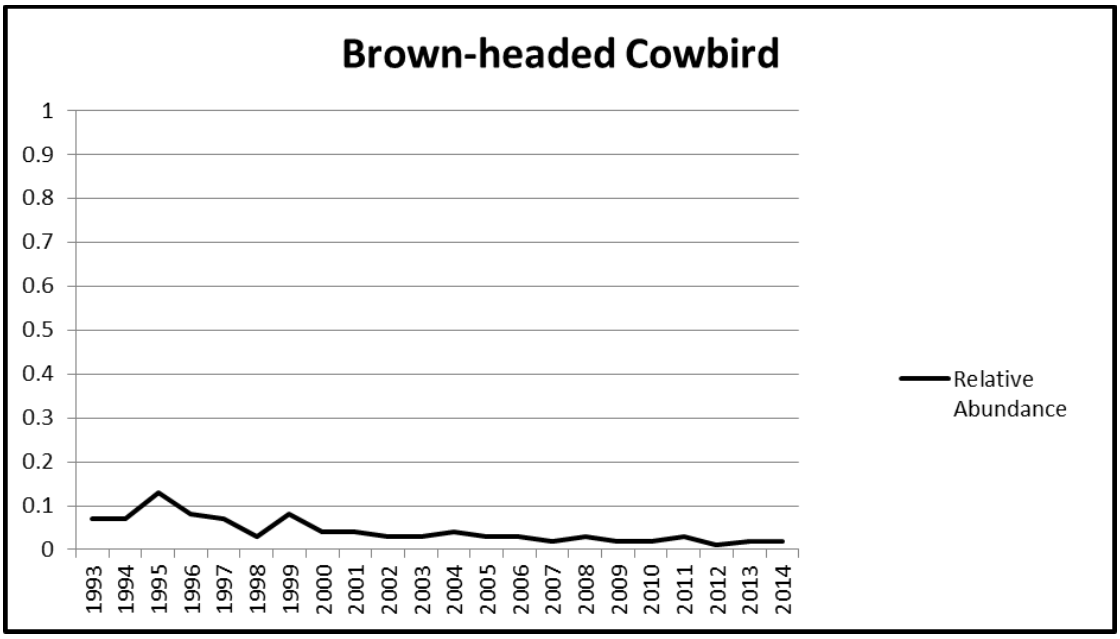

Figure 13. Trend in USFS Avian Point Count Data of brown-headed cowbirds across the GWJNFs, 1994 to 2014. Source: Southern Region Avian Monitoring Database.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Relatively low numbers documented by point count data and the downward trend by BBS data suggests the minimal amount of forest fragmentation (both existing and that created by management activities) across the GWJNF is not sufficient to support significant populations of cowbirds. Additionally, patch size of interior forest on the GWJNF appears not be readily penetrated by cowbirds searching for nests to parasitize. Thus, management activities appear to not be creating habitat to support significant increases in cowbird populations.

The overall forest on the GWJNF's continues to mature. Patches of varying sizes of early successional woody and grassy/shrubby habitat are inherent in older forest stand dynamics, and are created as a result of natural disturbance regimes such as ice storms, fire, tornados, and insect infestations and active management activities such as forest harvest, grassy/shrubby openings, and prescribed fire. Yet, these patches are generally small in size. Recent research has indicated that in a landscape that is mostly forested (>70%), early successional habitat that is not permanent does not have the negative effects on forest interior species documented in landscapes characterized by small, isolated forest patches (Braun et al. 2001, Hunter et al 2001).

Overall, viability of this species in the area surrounding the GWJNF is not in question. NFS land likely contributes marginally to area populations. Those birds found on NFS land are primarily composed of birds coming from surrounding private agricultural land in search of nest parasitism opportunities. Cowbird occurrences are expected to continue to decrease in the near future as the landscape becomes more forested.

Recommendation

No change in direction for cowbirds is recommended. Continue monitoring.

Pileated Woodpecker

Photo 6. Pileated woodpecker (*Dryocopus pileatus*)

Reason For Selection

The pileated woodpecker (*Dryocopus pileatus*) was selected because trends in presence and abundance of this species across the forest will help indicate the effectiveness of management in maintaining desired conditions relative to abundance of snags (GWNF FEIS, Appendix page J-12 and JNF FEIS, Appendix page D-3). It is the MIS for Monitoring Question 4 (*How well are key terrestrial habitat attributes being provided?*) in the 2004 JNF Plan.

Plan Habitat Objectives

The 1993 GWNF Plan specifies a minimum of 2.5% of the forest should be in an old growth condition (GWNF FEIS, Appendix J, page J-5). The 2004 JNF Plan specifies maintaining 84,000 acres of mixed mesophytic forest communities, sustaining 75% in a mid- to late- successional condition and 78,000 acres in nine community types in an old growth or late-successional condition (2004 JNF Plan, page 2-12).

Description of Monitoring Method

USGS Breeding Bird Surveys (BBS) data and GWJNF avian point count data are used.

Habitat Trend

See trend in old growth at Table 20. Table 6 shows that 88.6% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure.

Population Trend

USGS BBS data indicates an increasing trend of pileated woodpeckers in the Appalachian Region (Figure 14). USFS Avian Monitoring data indicates a stable trend for pileated woodpeckers on the GWJNFs (Figure 15).

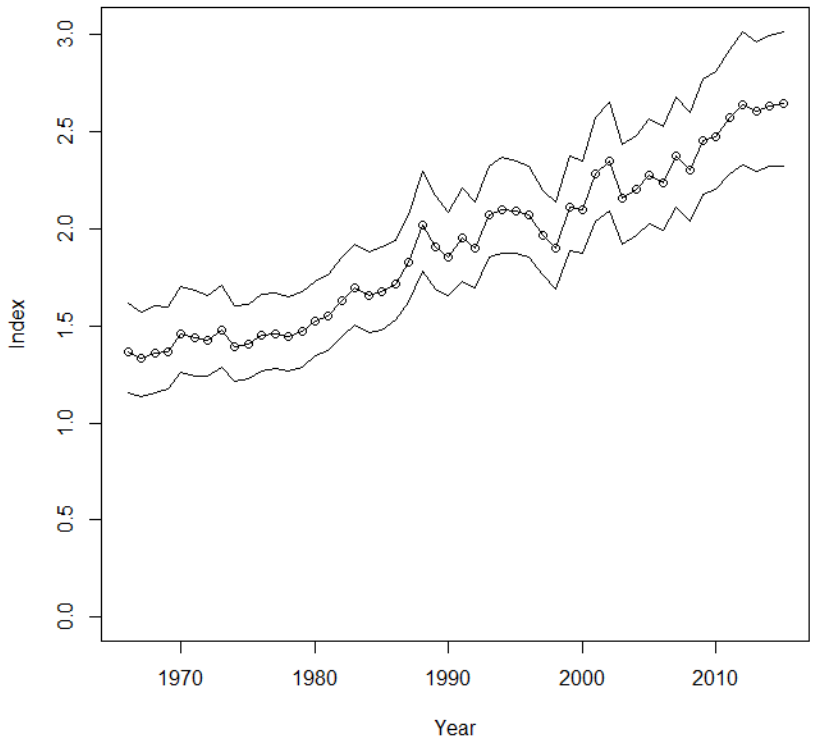

Figure 14. Trend In BBS Data Of Pileated Woodpeckers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

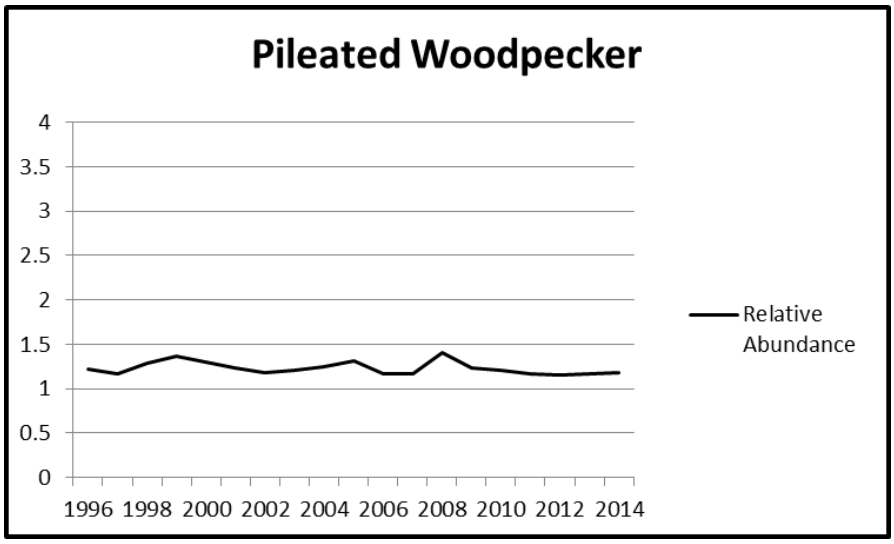

Figure 15. Trend in USFS Avian Point Count Data of Pileated Woodpeckers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Pileated woodpecker was selected as an indicator of the presence of mature forests with dead or dying trees at least 20" in diameter, in which the birds excavate their nest cavities. Pileated woodpeckers generally prefer mature forests near riparian areas (Hamel 1992). This species is a primary cavity nester/excavator, requiring large snags for nesting cavities and large dead trees for feeding. Generally, this species requires trees greater than 15 inches DBH for cavities, but prefers trees greater than 20 inches DBH. Nests may occur in a variety of trees including oak, hickory, maple, hemlock, and pine. The maintenance of older age forests, in relatively un-fragmented blocks, will provide optimum pileated woodpecker habitat. Aging forests should provide adequate snag numbers for all cavity-nesting species. The amount of older aged forest, along with its large snag component, continues to increase across the Forest and so should continue to provide habitat for this woodpecker.

Based on the results of monitoring data and habitat evaluation, this species is showing stable population trends on the GWJNF's and increasing trends across the Appalachian Region. Pileated woodpeckers have the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation

No change in direction for the pileated woodpecker is recommended. Continue monitoring.

Ovenbird and Worm-eating Warbler

Photo 7. Ovenbird (*Seiurus aurocapillus*)

Photo 8. Worm-eating warbler (*Helmitheros vermivorus*)

Reason For Selection:

Ovenbird (*Seiurus aurocapillus*) is an MIS on the GWJNF. It is one of four MIS for Monitoring Question 3 (*Are key successional stage habitats being provided?*) in the 2004 JNF Plan.

Worm-eating warbler (*Helmitheros vermivorus*) is an MIS only on the GWNF. Ovenbird and Worm-eating warbler were selected because trends in presence and abundance of these species in mature deciduous forests will be used to help indicate the effectiveness of management in maintaining desired condition relative to forest interior habitats (GWNF FEIS, page J-12 and 2004 JNF Plan, pg. 5-4).

Plan Habitat Objectives

The minimum population objective is one pair of breeding birds per square mile (GWNF FEIS, Appendix J, J-14) or about 1,625 birds Forest-wide. For the For the JNF, maintain 84,000 acres of mixed mesophytic forest communities, sustaining 75% in a mid- to late- successional condition and 78,000 acres in nine community types in an old growth or late-successional condition (2004 JNF Plan, page 2-12).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are also used in addition to BBS.

Habitat Trend

See trend in old growth at Table 20. Table 6 shows that 88.6% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure.

Population Trend

USGS BBS data indicates an increasing trend of ovenbirds in the Appalachian Region (Figure 16). USFS Avian Monitoring data indicates a stable to increasing trend for ovenbirds on the GWJNFs (Figure 17).

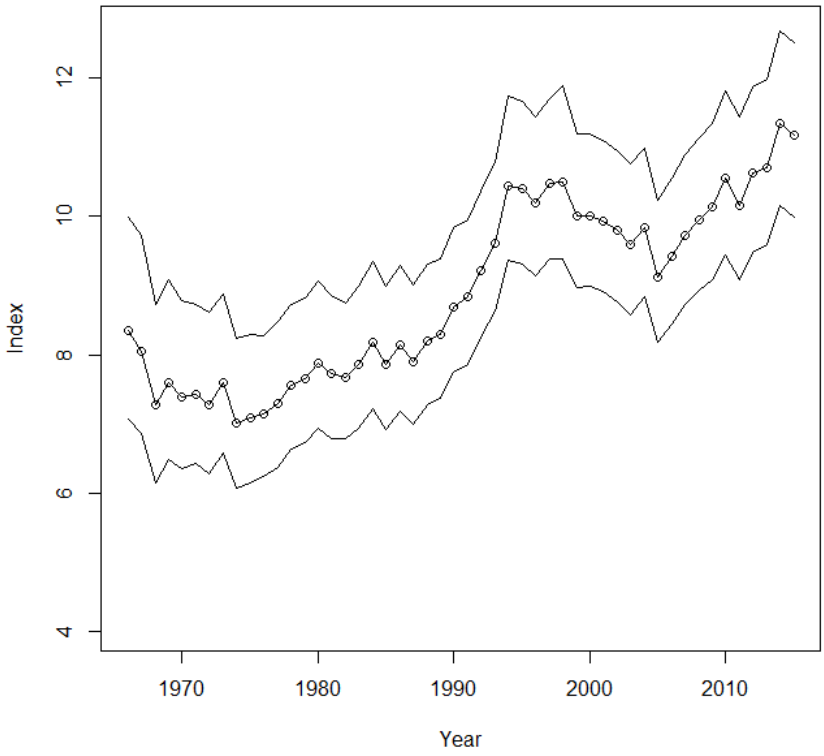

Figure 16. Trend In BBS Data Of Ovenbirds Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

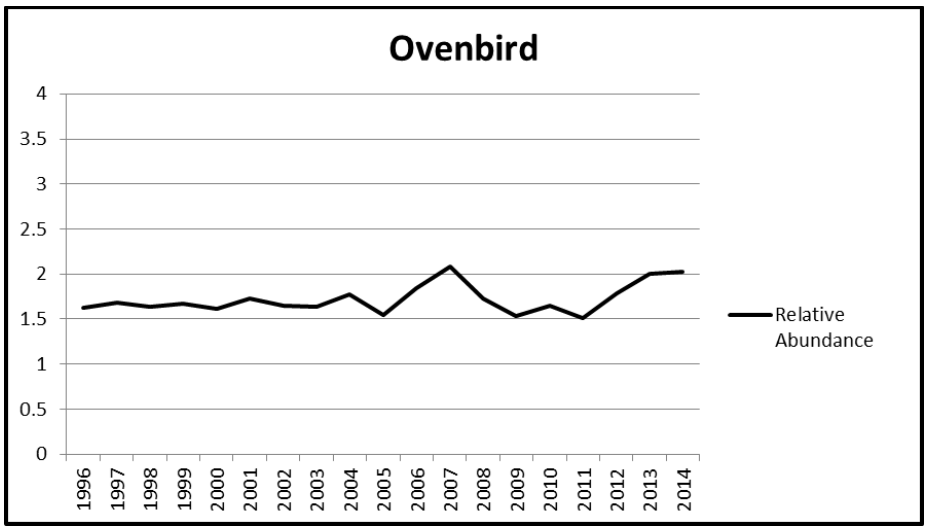

Figure 17. Trend in USFS Avian Point Count Data of Ovenbirds across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

The worm-eating warbler is also a MIS only on the GWNF. USGS BBS data indicates a stable trend of worm-eating warblers in the Appalachian Region (Figure 18). USFS Avian Monitoring data indicates a stable trend for worm-eating warblers on the GWJNFs (Figure 19).

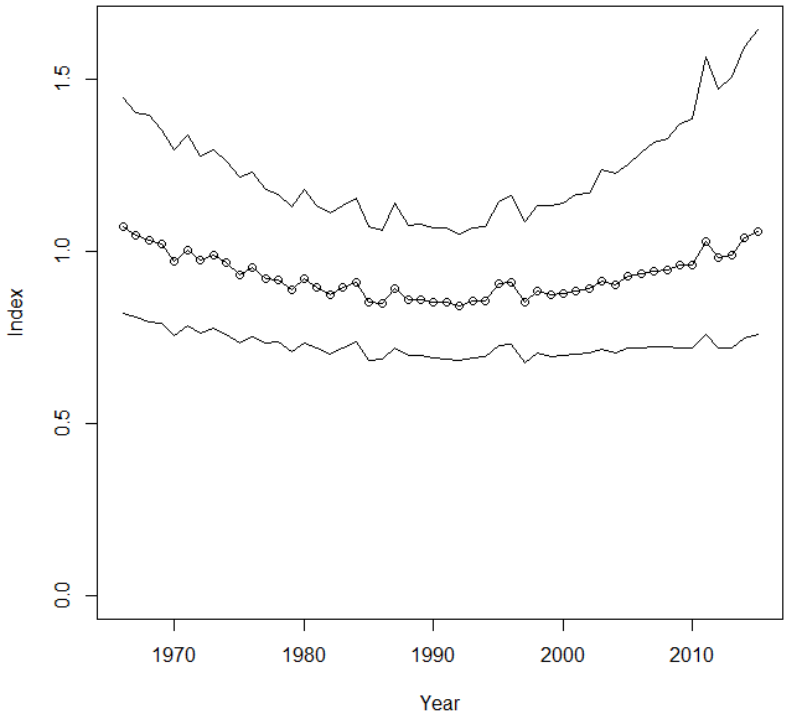

Figure 18. Trend In BBS Data Of Worm-eating Warblers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

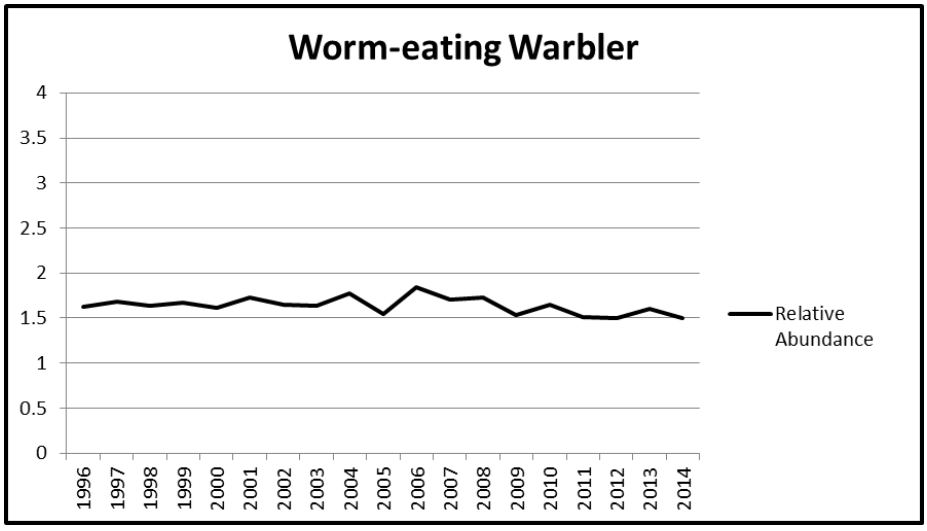

Figure 19. Trend in USFS Avian Point Count Data of Worm-eating Warblers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Ovenbirds breed in upland deciduous or mixed deciduous/pine forests with a moderately dense understory. They nest on the ground and build a covered nest from leaf litter. (Robbins, et al. 1989). Worm-eating warblers also prefer deciduous or deciduous/pine forests to breed, but they require a denser, evergreen understory. They also nest on the ground in the leaf litter. Both require large patches of mature forest for nesting (Robbins et al. 1989). While the need for large patches of mature forested habitat has been well documented for many migratory birds species, including ovenbirds and worm-eating warblers, evidence is mounting that early successional habitats are also important for these same species during the critical time period just after breeding and during migration (Anders et al. 1996 and 1998, Vega Rivera et al. 1998 and 1999, Pagen et al. 2000, and Hunter et al. 2001). Recent research has documented that adult and fledgling ovenbirds and worm-eating warblers (as well as many other mature forest bird species such as wood thrushes, red-eyed vireos, Kentucky warblers, black-and-white warblers, and hooded warblers) move from their nesting habitats in mature forests to areas characterized by dense, woody vegetation, abundant insect availability, and the presence of ripe fruits (Anders et al. 1998, Vega Rivera et al. 1998, 1999). These areas provide 'safe havens' for molting, abundant food for the buildup of fat reserves for migration, and protection from predators. Habitats supporting this kind of vegetation include open oak, oak/pine, and pine woodlands, patches of early successional habitat resulting from insect infestation and natural disturbance such as ice storms, patches of early successional habitat where the overstory had been thinned or harvested in some way (modified shelterwood, clear cut, high-grading), areas of second growth scrub/deciduous saplings located along forest borders and old fields, and mature riparian forests with a dense understory (Anders et al 1998, Vega Rivera et al. 1998, 1999). Several studies have also documented the need for patches of early successional woody habitat within a largely forested landscape to provide abundant food resources and protective cover for migratory bird species during migration (Kilgo et al. 1999, Suthers et al. 2000, Hunter et al. 2001). These studies strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), to provide the habitat requirements needed by migratory birds such as ovenbirds and worm-eating warbler during all of their life stages here in North America.

Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). These activities, in addition to natural disturbances and continued maturation of the forest, should provide patches of early successional woody habitat, as well as restoring and maintaining open oak, oak/pine, and pine woodlands. Combined with the maintenance of over 80% of forested acres in mature forest condition, the GWJNF's should be able to provide the mosaic of forest types and ages recommended by research for migratory birds such as ovenbirds and worm-eating warblers during the life history stages (breeding, post-breeding, migration) that they utilize GWJNF's lands.

Based on the results of monitoring data and habitat evaluation, these two species exhibit stable to increasing population trends on the GWJNF's as well as state-wide and region-wide, and have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for either the ovenbird or warbler is recommended. Continue monitoring.

Hooded Warbler

Photo 9. Hooded warbler (*Wilsonia citrina*)

Reason For Selection

The hooded warbler (*Wilsonia citrina*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in mature mesic deciduous forests will help indicate the effectiveness of management in providing dense understory and mid-story structure within these forest communities (2004 JNF Plan, pg. 5-4). It is one of three MIS for Monitoring Question 2 (*Are landscape and stand level composition, structure, and function of major forest communities within desirable ranges of variability?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the JNF, implement 400- 600 acres of habitat improvement per year to increase structural diversity for migratory birds in mid to late successional mixed mesophytic, northern hardwood, mesic oak forests, or xeric oak and oak-pine woodlands and maintain 84,000 acres of mixed mesophytic forest communities, sustaining 75% in a mid- to late- successional condition and at least 50% in the late-successional condition by the end of the planning period. (2004 JNF Plan, pp. 2-12, 2-13, and 2-24).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

See trend in old growth at Table 20. Table 6 shows that 88.6% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure. Table 4 shows the acreage of timber harvest and prescribed fire on the JNF.

Population Trend

USGS BBS data indicates an increasing trend of hooded warblers in the Appalachian Region (Figure 20). USFS Avian Monitoring data indicates a stable trend for hooded warblers on the GWJNFs (Figure 21).

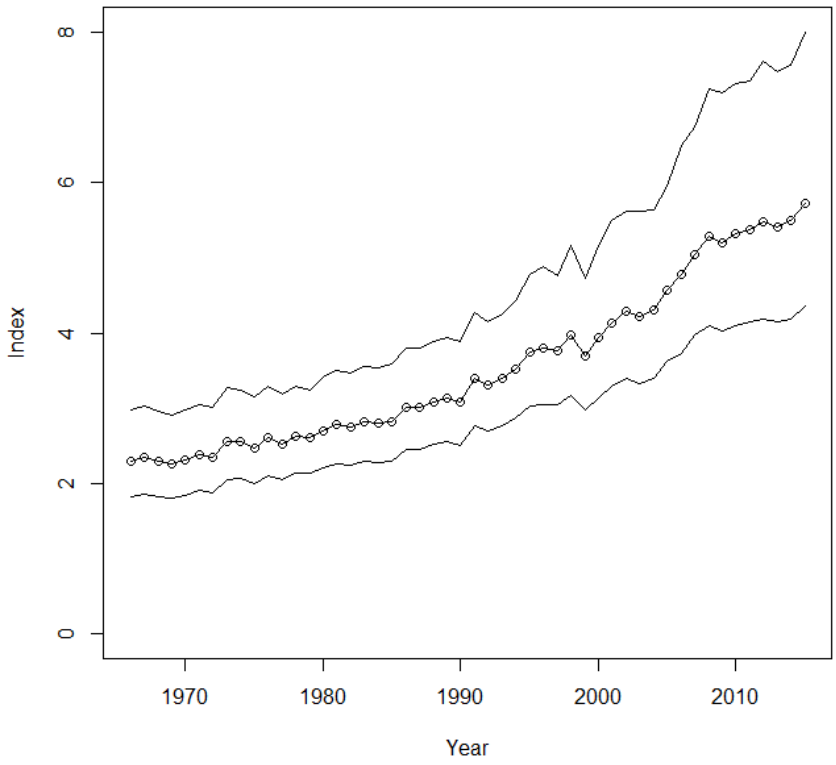

Figure 20. Trend In BBS Data Of Hooded Warblers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

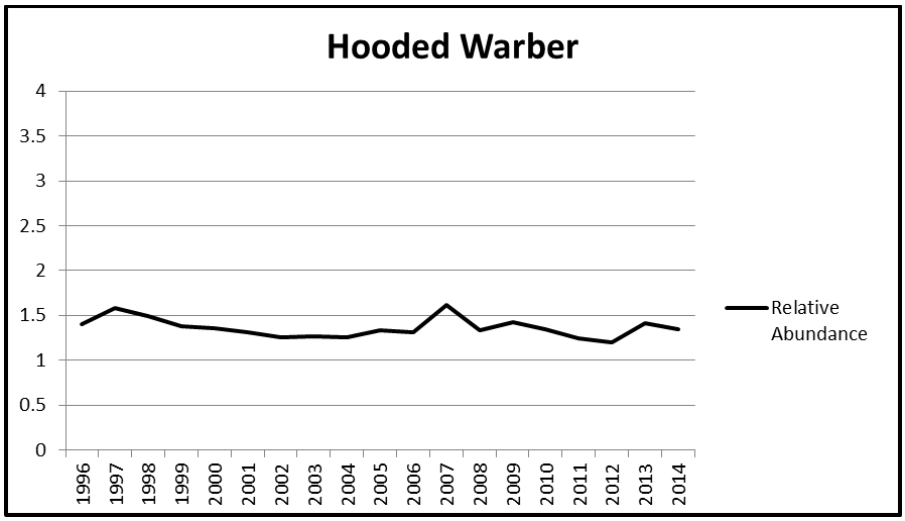

Figure 21. Trend in USFS Avian Point Count Data of Hooded Warblers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Hooded warblers occur in deciduous, mixed deciduous/coniferous forest types, near or in riparian areas (Hamel 1992, Robbins et al. 1989). Hooded warblers are associated with canopy gaps and other small patches of dense woody vegetation in an otherwise mature forest (Robbins et al. 1989, Hunter et al. 2001). After breeding, both fledglings and adults move to areas characterized by dense, woody vegetation, abundant insect availability, and the presence of ripe fruits (Morton 1990, Evans Ogden and Stutchbury 1997, Anders et al. 1998, Vega Rivera et al. 1998, 1999). These areas provide 'safe havens' for molting, abundant food for the buildup of fat reserves for migration, and protection from predators. Habitats supporting this kind of vegetation include open oak, oak/pine, and pine woodlands, patches of early successional habitat resulting from insect infestation and natural disturbance such as ice storms, patches of early successional habitat where the overstory had been thinned or harvested in some way (modified shelterwood, clear cut, high-grading), areas of second growth scrub/deciduous saplings located along forest borders and old fields, and mature riparian forests with a dense understory (Anders et al 1998, Vega Rivera et al. 1998, 1999). The 2004 JNF Plan selected hooded warbler because trends in presence and abundance of this species in mature mesic deciduous forests will help indicate the effectiveness of management in providing dense understory and mid-story structure within these forest communities. Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities has effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 7). All of these activities, in addition to natural disturbances and continued maturation of the forest, should provide patches of early successional woody habitat, permanent grassland/shrubland habitat, as well as restoring and maintaining open oak, oak/pine, and pine woodlands). Recent studies strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), as well as mature riparian forest, to provide the habitat requirements needed by migratory birds during all of their life stages

here in North America, including the hooded warbler (Kilgo et al. 1999, Suthers et al. 2000, Hunter et al. 2001)(see also discussion under ovenbird and worm-eating warbler). Combined with the maintenance of over 80% of forested acres in mature forest condition, the GWJNF's should be able to provide the mosaic of forest types and ages recommended by research for migratory birds such as hooded warbler during the life history stages (breeding, post-breeding, migration) that they utilize GWJNF's lands. With overall stable population trends of hooded warbler on the GWJNF's and stable to increasing trends at the Appalachian Regional level, hooded warblers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for the hooded warbler. Continue monitoring.

Scarlet Tanager

Photo 10. Scarlet tanager (*Piranga olivacea*)

Reason For Selection

The scarlet tanager (*Piranga olivacea*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in mid- and late-successional oak and oak-pine forests will help indicate the effectiveness of management in maintaining desired conditions in these forest communities (2004 JNF Plan, pg. 5-4). It is one of three MIS for Monitoring Question 2 (*Are landscape and stand level composition, structure, and function of major forest communities within desirable ranges of variability?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the JNF, implement habitat improvement treatments to increase structural diversity for migratory birds in mid to late successional xeric oak and oak-pine woodlands, maintain existing dry-mesic oak, dry and dry-mesic oak-pine, dry and xeric oak forest communities through a combination of timber harvest, prescribed burning and wildland fire use across 28,000 acres per decade (2004 JNF Plan, pp. 2-12, 2-13, and 2-24).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

See trend in old growth at Table 20. Table 6 shows that 88% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure. Table 4 shows the acreage of timber harvest and prescribed fire on the JNF.

Population Trend

USGS BBS data indicates a variable but overall stable trend of scarlet tanagers in the Appalachian Region (Figure 22). USFS Avian Monitoring data also indicates a stable trend for scarlet tanager on the GWJNFs (Figure 23).

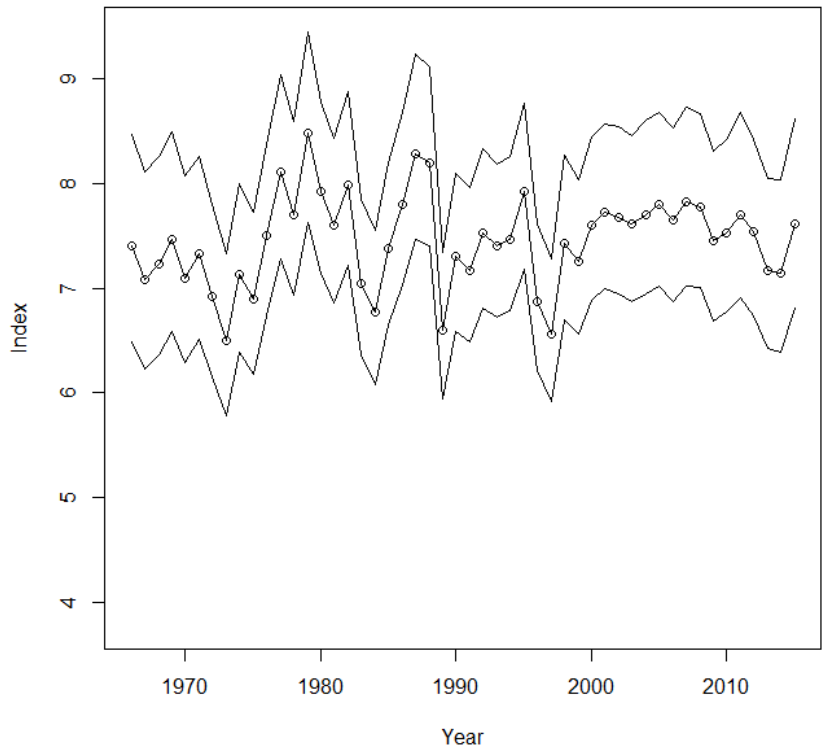

Figure 22. Trend In BBS Data Of Scarlet Tanagers Warblers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

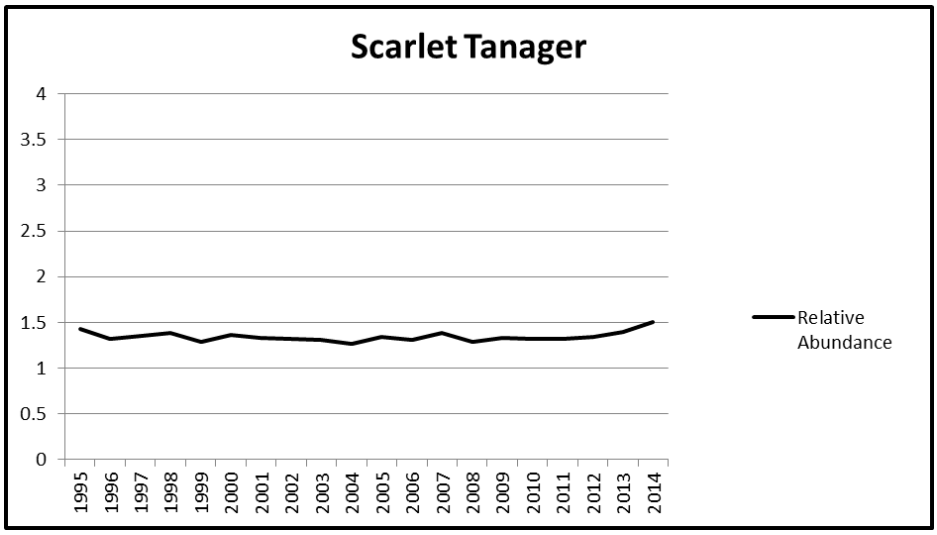

Figure 23. Trend in USFS Avian Point Count Data of Scarlet Tanagers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Scarlet tanagers occur in deciduous, mixed deciduous/coniferous and coniferous forest types in the Appalachian region (Rosenburg et al. 1999). In the Appalachian region, research has indicated that scarlet tanagers do not show area sensitivity in moderately or heavily forested landscapes (Rosenburg et al. 1999). The 2004 JNF Plan selected scarlet tanager because trends in presence and abundance of this species in mid- and late-successional oak and oak-pine forests will help indicate the effectiveness of management in maintaining desired conditions in these forest communities (2004 JNF Plan, pg. 5-4). Table 6 shows that 88% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure. Table 4 shows the acreage of timber harvest is staying at around 1,000 acres/year and prescribed fire is increasing in acreage on the Forest, which is within parameters of habitat objectives stated in the 2004 JNF Plan. Recent research strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), as well as mature riparian forest, to provide the habitat requirements needed by migratory birds during all of their life stages here in North America, including the scarlet tanager (Kilgo et al. 1999, Suthers et al. 2000, Hunter et al. 2001)(see also discussion under ovenbird and worm-eating warbler). Combined with the maintenance of over 80% of forested acres in mature forest condition, the GWJNF's should be able to provide the mosaic of forest types and ages recommended by research for migratory birds such as scarlet tanagers during the life history stages (breeding, post-breeding, migration) that they utilize GWJNF's lands. With overall stable to increasing population trends of scarlet tanagers on the GWJNF's and across the Appalachian Region, scarlet tanagers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for the scarlet tanager. Continue monitoring.

Pine Warbler

Photo 11. Pine warbler (*Dendroica pinus*)

Reason For Selection

The pine warbler (*Dendroica pinus*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in mature pine forest will help indicate effectiveness of management at maintaining these communities on the landscape (2004 JNF Plan, pg. 5-4). It is one of three MIS for Monitoring Question 2 (*Are landscape and stand level composition, structure, and function of major forest communities within desirable ranges of variability?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the revised JNF, restore 1,300 acres of open woodland and grassland complexes within the xeric pine and pine-oak forest and woodland community over the planning period, including table mountain pine. Maintain 41,500 acres of xeric pine and pine-oak forest and woodland community, sustaining 10-12% in an early/late successional woodland condition by the end of the planning period. Maintain a prescribed burn cycle of 4-12 years in dry and xeric oak forest, woodlands, and savannas and xeric pine and pine-oak forest and woodland communities (2004 JNF Plan, pp. 2-12, 2-24, and 2-28).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

See trend in yellow pine at Table 18 and Table 19. Table 4 shows the acreage of prescribed fire on the JNF

Population Trend

USGS BBS data indicates a variable but overall stable trend of pine warblers in the Appalachian Region (Figure 24). USFS Avian Monitoring data also indicates a stable trend for pine warblers on the GWJNFs (Figure 25).

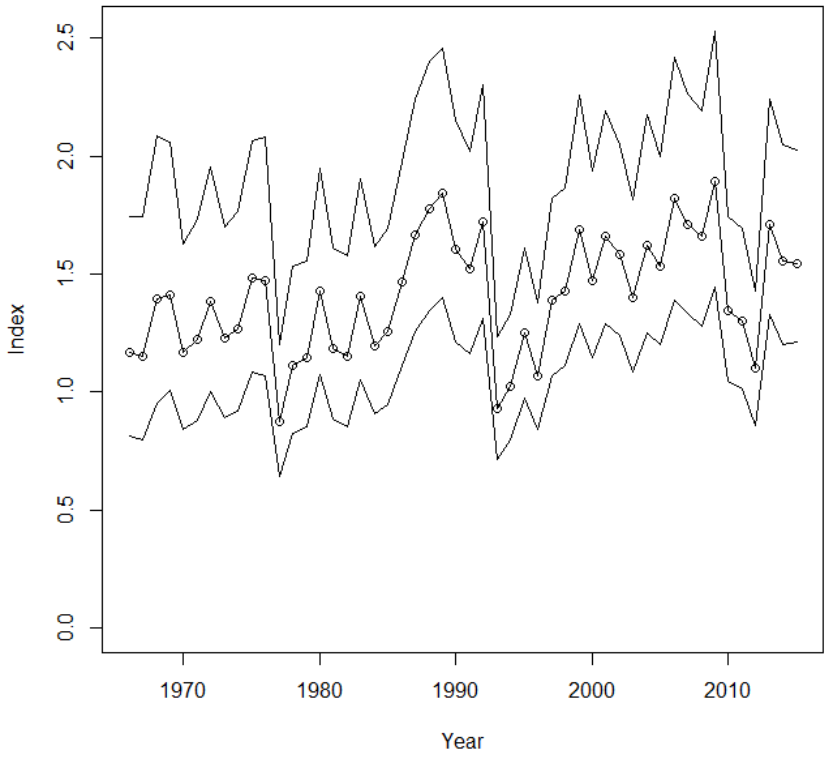

Figure 24. Trend In BBS Data Of Pine Warblers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

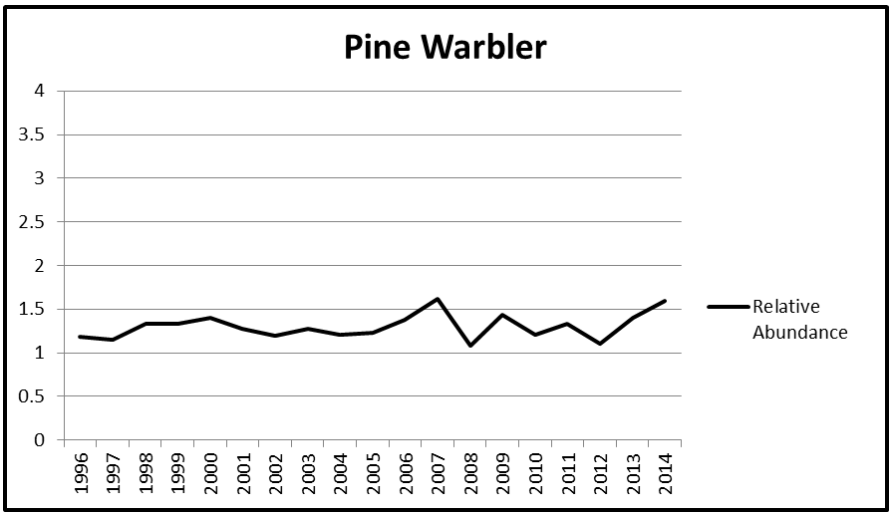

Figure 25. Trend in USFS Avian Point Count Data of Pine Warblers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Pine warblers occur in mid- to late-successional pine and pine/oak forest types throughout its range (Hamel 1992). It is rarely found in pure hardwood forest types. Pine warblers are temperate migrants in the Appalachians, shifting to the Piedmont and Coastal Plain during the winter months. They are mainly insectivorous during the breeding season, but shift to insects, berries, and small seeds the rest of the year. The 2004 JNF Plan selected pine warbler because trends in presence and abundance of this species in mature pine forest will help indicate effectiveness of management at maintaining these communities on the landscape (2004 JNF Plan, pg. 5-4). The yellow pine community (see section in this document) shows declining trends across the Forest. However, prescribed fire acreage on the Forest is increasing (See Table 5). As yet, population trends of pine warbler appear to be stable on the GWJNF's and across the Appalachian region, indicating an abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for the pine warbler. Continue monitoring.

Eastern Towhee

Photo 12. Eastern towhee (*Pipilo erythrophthalmus*)

Reason For Selection

The eastern towhee (*Pipilo erythrophthalmus*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in early-successional forests will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). It is one of four MIS for Monitoring Question 3 (*Are key successional stage habitats being provided?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the JNF, restore 1,300 acres of open woodland and grassland complexes within the xeric pine and pine-oak forest and woodland community over the planning period, including table mountain pine. Maintain 41,500 acres of xeric pine and pine-oak forest and woodland community, sustaining 10-12% in an early/late successional woodland condition by the end of the planning period. Maintain a prescribed burn cycle of 4-12 years in dry and xeric oak forest, woodlands, and savannas and xeric pine and pine-oak forest and woodland communities (2004 JNF Plan, pp. 2-12, 2-24, and 2-28).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

See trend in yellow pine at Table 18 and Table 19. Table 4 shows the acreage of timber harvest and prescribed fire on the JNF.

Population Trend

USGS BBS data indicates a steady decline until the 1990s, then an overall stable trend of eastern towhees in the Appalachian Region (Figure 26). USFS Avian Monitoring data also indicates a stable trend for eastern towhee from the 1990s to 2014 on the GWJNFs (Figure 27).

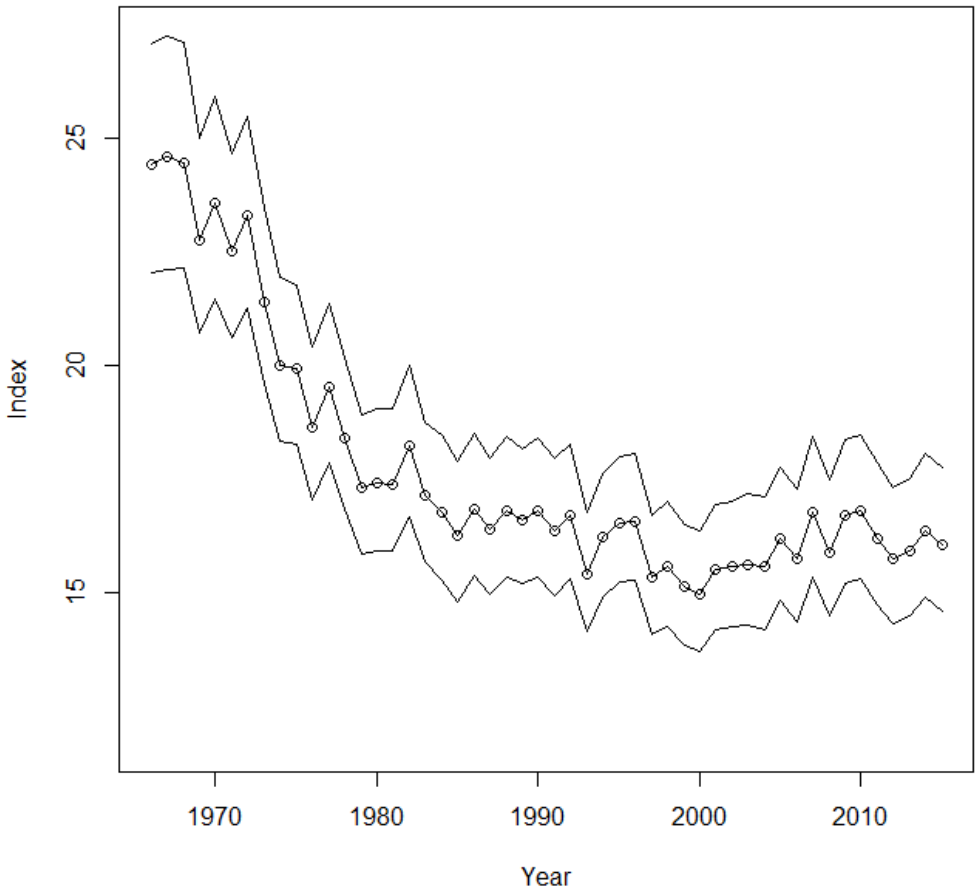

Figure 26. Trend In BBS Data Of Eastern Towhees Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

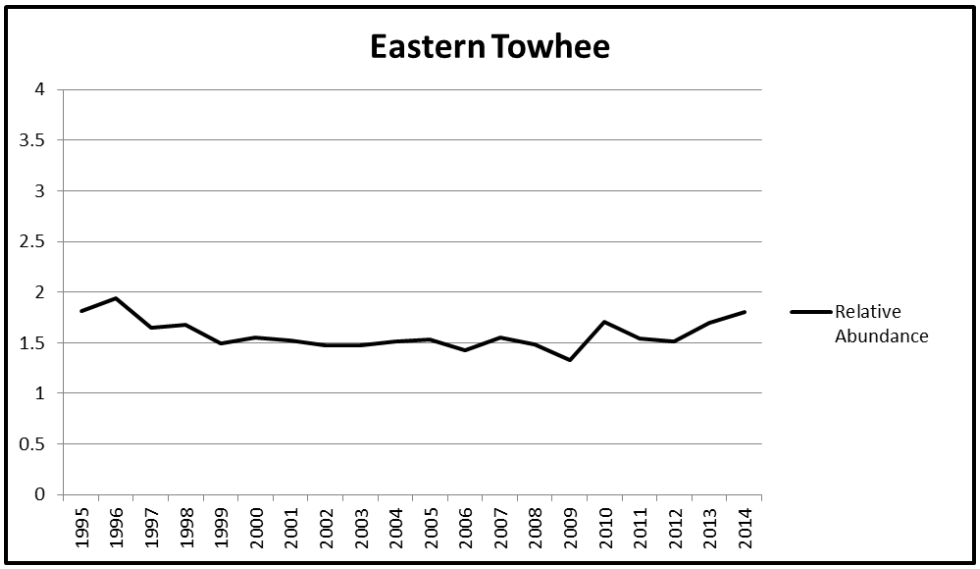

Figure 27. Trend in USFS Avian Point Count Data of Eastern Towhees across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Eastern Towhees inhabit early successional habitat associated with dense second growth, dense vegetation associated with open woodlands, and forest edge habitat (Hamel 1992) (Hunter et al. 2001). Eastern towhees have exhibited significant continental population declines in the last couple of decades, mirroring an overall trend of decline of disturbance-dependent bird species associated with open habitats in eastern North America (Vickery 1992, Askins 2000, Hunter et al. 2001). A significantly greater proportion of bird species exhibiting steep population declines are associated with disturbance-mediated habitats than in forested or generalist habitat types (Brawn et al. 2001). Forty percent of all North American species associated with some type of disturbance-mediated habitat (grassland, shrub-scrub, open woodlands) have been significantly decreasing in population since 1966 (Brawn et al. 2001). Combined with recent research highlighting the importance of early successional woody habitat for post-breeding and migratory stop-over needs of forest-interior migratory bird species in a larger landscape of mature forest (see sections on ovenbirds and worm-eating warblers and hooded warblers), the role of early successional habitat in largely mature, forested landscapes and the need to restore/maintain disturbance regimes creating such habitats is of vital importance in conservation planning (Brawn et al. 2001, Hunter et al. 2001). The 2004 JNF Plan selected eastern towhee because trends in presence and abundance of this species in early-successional forests will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). Table 4 shows the acreage of timber harvest is staying at around 1,000 acres/year and prescribed fire is increasing in acreage to about 16,0000 acres/year on the Forest, which is within parameters of habitat objectives stated in the 2004 JNF Plan. The yellow pine community, however, shows decreasing trends (see section in this document). Based on the results of monitoring data, eastern towhees show a stable population trend on the GWNF, as well as across the Appalachian Region, indicating an abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for the eastern towhee. Continue monitoring.

Acadian flycatcher

Photo 13. Acadian flycatcher (*Empidonax virescens*)

Reason For Selection

The Acadian flycatcher (*Empidonax virescens*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in mature riparian forests will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). It is one of four MIS for Monitoring Question 3 (*Are key successional stage habitats being provided?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the JNF, manage and restore riparian ecosystems, to protect and enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components with the corridor (2004 JNF Plan, pp. 2-6, 2-12, 3-179).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

Riparian habitat is associated with all forest types on the GWJNF's. Table 6 shows that 88% of the forested acres on the GWJNF's are in a mid- to late-successional age class structure. Table 4 shows the acreage of timber harvest and prescribed fire on the JNF.

Population Trend

USGS BBS data indicates a declining trend of Acadian flycatchers in the Appalachian Region (Figure 28). USFS Avian Monitoring data also indicates an overall stable trend for Acadian flycatchers on the GWJNFs (Figure 29).

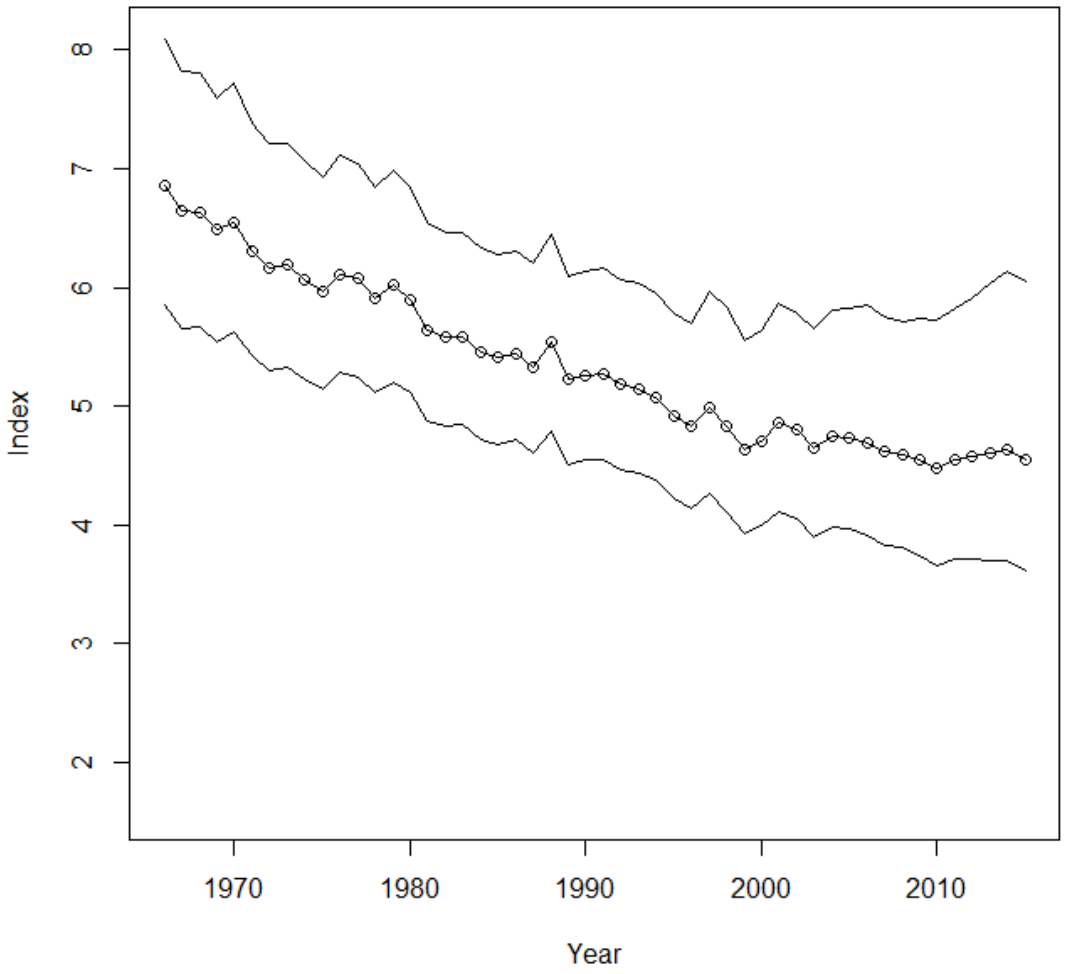

Figure 28. Trend In BBS Data Of Acadian Flycatchers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

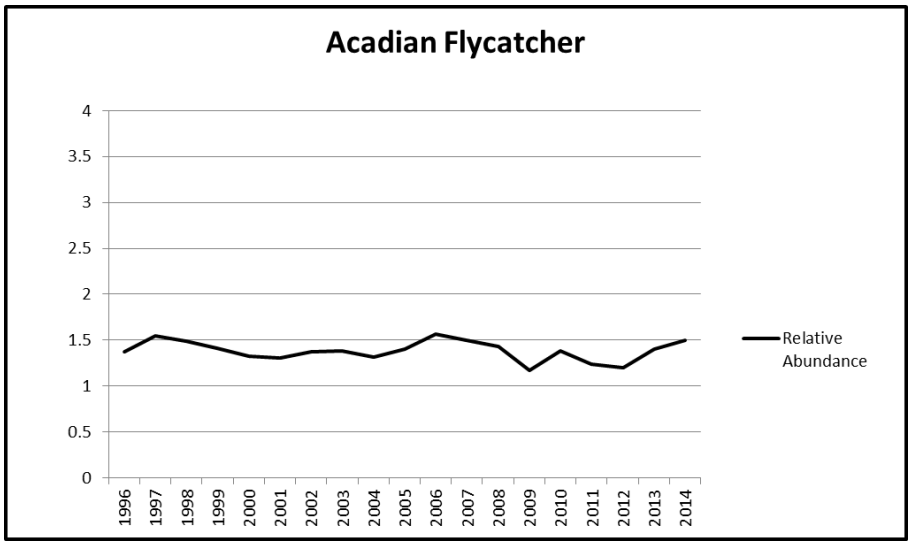

Figure 29. Trend in USFS Avian Point Count Data of Acadian Flycatchers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Acadian flycatchers occur in deciduous, mixed deciduous/coniferous forest types, in riparian areas (Hamel 1992). Acadian flycatchers are often associated with closed overstory canopies and open understories. After breeding, Acadian flycatchers utilize open scrub and early successional woody habitat during migration (NatureServe 2005). The 2004 JNF Plan selected Acadian flycatchers because trends in presence and abundance of this species in mature riparian forests will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). Both GWNF and JNF Plans have strong protection standards for riparian areas throughout the Forests (1993 GWNF Plan 3-146 through 3-148, 2004 JNF Plan 2-7 through 2-9). Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities has effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 7). Recent studies strongly recommend conservation strategies that maintain large tracts of mature forest, within which there is a mosaic of different forest types and ages (early and mid-successional forest stands), as well as mature riparian forest, to provide the habitat requirements needed by migratory birds during all of their life stages here in North America, including the Acadian flycatcher (Kilgo et al. 1999, Suthers et al. 2000, Hunter et al. 2001)(see also discussion under ovenbird and worm-eating warbler). Combined with the maintenance of over 80% of forested acres in mature forest condition, the GWJNF's should be able to provide the mosaic of forest types and ages recommended by research for migratory birds such as Acadian flycatchers during the life history stages (breeding, post-breeding, migration) that they utilize GWJNF's lands. With overall stable population trends of Acadian flycatcher on the GWJNF's, Acadian flycatchers have the abundance and distribution across the Forests that will provide for their persistence into the foreseeable future. Though such trends are not apparent on the GWJNF's, of concern are declining trends shown by USGS BBS data in populations of Acadian flycatcher throughout the Appalachian Region.

Recommendation

No change in direction for the Acadian flycatcher. Continue monitoring.

Chestnut-sided Warbler

Photo 14. Chestnut-sided warbler (*Dendroica pensylvanica*)

Reason For Selection

The chestnut-sided warbler (*Dendroica pensylvanica*) was selected in the 2004 JNF Plan because trends in presence and abundance of this species in areas that provide high elevation early-successional habitats will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). It is one of four MIS for Monitoring Question 3 (*Are key successional stage habitats being provided?*) in the 2004 JNF Plan.

Plan Habitat Objectives

For the JNF, restore and maintain approximately 2,500 acres above 2,800 feet elevation in early successional habitats to provide habitat for high-elevation, early successional migratory bird species over the planning period (2004 JNF Plan, pp. 2-12, 2-13).

Description of Monitoring Method

The USGS Breeding Bird Surveys (BBS) are used. GWJNF avian point counts are used in addition to BBS.

Habitat Trend

See trend in early successional habitat at Table 6. Table 4 shows the acreage of timber harvest and prescribed fire on the JNF.

Population Trend

USGS BBS data indicates a variable but overall stable trend of Chestnut-sided warblers in the Appalachian Region (Figure 30). USFS Avian Monitoring data also indicates a variable but overall stable trend for chestnut-sided warblers on the GWJNFs (Figure 31).

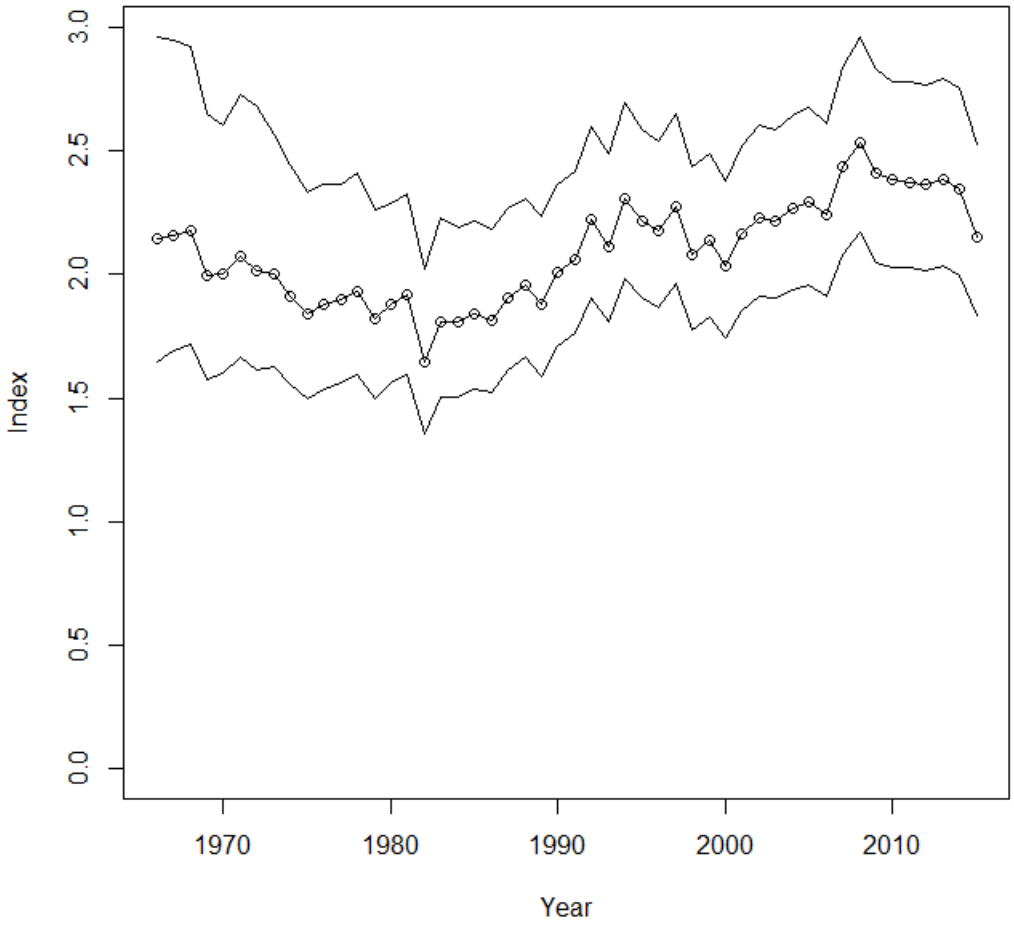

Figure 30. Trend In BBS Data Of Chestnut-sided Warblers Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

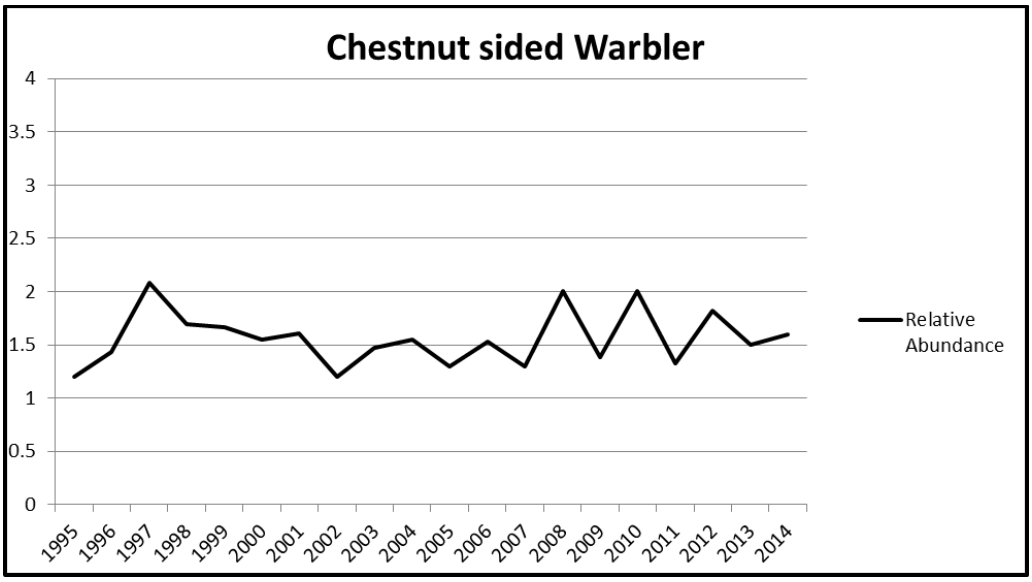

Figure 31. Trend in USFS Avian Point Count Data of Chestnut-sided Warblers across the GWJNFs, 1994 to 2014.

Source: Southern Region Avian Monitoring Database

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Chestnut-sided warblers are associated with larger patches (e.g. greater than 12 acres) of early successional woodlands, mountain laurel thickets, and forest edge habitat above 2,000 feet (Hamel 1992, Hunter et al. 2001). Chestnut-sided warblers have exhibited significant continental population declines in the last couple of decades, mirroring an overall trend of decline of disturbance-dependent bird species associated with open habitats in eastern North America (Vickery 1992, Askins 2000, Hunter et al. 2001). A significantly greater proportion of bird species exhibiting steep population declines are associated with disturbance-mediated habitats than in forested or generalist habitat types (Brawn et al. 2001). Forty percent of all North American species associated with some type of disturbance-mediated habitat (grassland, shrub-scrub, open woodlands) have been significantly decreasing in population since 1966 (Brawn et al. 2001). Combined with recent research highlighting the importance of early successional woody habitat for post-breeding and migratory stop-over needs of forest-interior migratory bird species in a larger landscape of mature forest (see sections on ovenbirds, worm-eating warblers, and hooded warblers), the role of early successional habitat in largely mature, forested landscapes and the need to restore/maintain disturbance regimes creating such habitats is of vital importance in conservation planning (Brawn et al. 2001, Hunter et al. 2001).

The 2004 JNF Plan selected chestnut-sided warbler because trends in presence and abundance of this species in early-successional forests will be used to help indicate the effectiveness of management in achieving desired conditions within these habitats (2004 JNF Plan, pg. 5-4). Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities has effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 7). Based on the results of monitoring data, this species shows a stable population trend on the

GWNF, and in the Appalachian region, with an abundance and distribution across the Forests that will provide for their persistence into the foreseeable future.

Recommendation

No change in direction for the chestnut-sided warbler. Continue monitoring.

Threatened and Endangered Species

Indiana Bat

See discussion under Section dealing with "Cave Dwelling Bats".

Virginia Northern Flying Squirrel

Photo 15. Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*)

Reason For Selection

The Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) (VNFS) was listed as endangered in 1985 and delisted in 2008 by the USFWS. This squirrel was selected for the 1993 GWNF Plan because it was a federally endangered species and therefore there is direct interest in its population status. The species occurs in high-elevation forests in the southern Appalachians, being restricted to mature red spruce/northern hardwood areas (Laurel Fork) on the GWNF. Virginia northern flying squirrel is not listed as an MIS for the 2004 JNF Plan.

For purposes of this analysis, the fundamental relationship between the squirrel and its habitat is that it prefers mature red spruce and northern hardwoods, typically associated with the spruce-northern hardwood old growth forest type group. The spruce forest type is to be protected (GWNF 1993 FEIS, page J-19). See earlier discussion of old growth.

Plan Habitat Objectives

A specific habitat objective related to mature red spruce and northern hardwoods to achieve minimum populations for the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) is stated in the 1993 GWNF Plan. That objective states "…stands that contain a red spruce component are managed to increase the red spruce component. In such an instance, the activities must comply with the Recovery Plan for the Virginia northern flying squirrel" (GWNF 1993 Plan, Common Standard #244, page 3-150).

Furthermore, the 1993 GWNF Plan recognized the significance of the Laurel Fork area by designating it as a Special Management Area (1993 GWNF Plan, page 3-109). This 10,000 acre area encompasses most of the

known range of the squirrel on the GWNF. In Laurel Fork, the Plan's objective is to maintain and, where appropriate, enhance habitat for this unique species west of Laurel Fork stream (1993 GWNF Plan page 3-110).

Description of Monitoring Method

Since 1985, the Laurel Fork area has been monitored for VNFS using a combination of presence/absence surveys with nest box checks and live capture/recapture methods (J. Pagels unpublished data; Reynolds et al. 1999).

Habitat Trend

The habitat is stable to increasing. See trend in spruce-northern hardwood old growth forest type group in Table 20.

Population Trend

At the time the 1993 GWNF Plan was signed, monitoring efforts estimated fewer than 20 individuals in the Laurel Fork Area (USFS 2011). Despite repeated monitoring efforts for over twenty years, very few VNFS have been captured. During a 10 year mark/recapture study on two sites in Laurel Fork (1986-1996), only one squirrel was captured in 10 years on site one, and 3-6 captured in four of 10 years on site two (Reynolds et al. 1999). Despite a low capture rate throughout the years, VNFS have been shown to persist in the Laurel Fork area with the most recent capture in 2004 (J. Pagels unpublished data). Three sites in Laurel Fork on the Forest have now been documented to have VNFS, as well as two sites on private land in Highland County, one adjacent to Forest land in Laurel Fork (Rick Reynolds, VDGIF and Marek Smith, TNC, pers. comm., 2012). The USFWS acknowledges known inadequacies in current monitoring techniques for VNFS to prove or disprove presence of the VNFS (USFWS 2001, 2006). The current Recovery Plan for VNFS, as amended, encourages the assumption of presence in suitable habitat, because the squirrels are less likely to use nest boxes or enter traps in good quality habitat due to the abundance of natural den sites and preferred foods in these areas (USFWS 2001). Analysis results suggest a low but overall stable trend for northern flying squirrel populations on both the GWNF and JNF.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

This species is inherently rare and not naturally well distributed across the Forest due to its dependence on the spruce-fir/northern hardwood ecotone. The spruce forest and its ecotone with northern hardwood forests is the only habitat for this species in the Appalachian Region. Approximately 6,268 acres of mixed spruce and northern hardwood habitat occurs in the Laurel Fork area on the Forest, in Highland County, Virginia.

Squirrel populations are expected to remain relatively stable in the near future. The GWNF encompasses a single population of the Virginia northern flying squirrel that is part of a larger population found in the Allegheny Mountains of West Virginia. Current management provides for ecological conditions capable to maintain the flying squirrel population considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to provide for viability (persistence over time) of this disjunct population.

Recommendation

No change in direction for northern flying squirrels is recommended. Continue monitoring habitat in Laurel Fork.

Blackside Dace

Photo 16. Blackside dace (*Phoxinus cumberlandensis*)

Photo courtesy of Conservation Fisheries

The blackside dace (*Phoxinus cumberlandensis*) was selected as a monitoring item because it is a federally threatened aquatic species; therefore, its population status is of direct interest (2004 JNF Plan, page 2-6). Its habitat is directly affected by water quality and land use changes, with it being sensitive to temperature, conductivity, stream size and gradient, and siltation (Black et al. 2013b, McAbee et al. 2013).

For purposes of this analysis, the fundamental relationship between the blackside dace and its habitat is water quality and the streambed substrate where it lives. Water quality, in streams with their watersheds on NFS land, is most likely to be negatively influenced by management activities that have the potential to introduce sediment into the streams. Water quality in blackside dace streams on private lands near the Forest is most likely to be influenced by gas/oil well exploration, human development, inadequate sewage treatment, coal mining, agricultural activities and point-source discharges (Black et al. 2013b).

Plan Habitat Objectives

Plan objectives are to maintain sedimentation rates that are in equilibrium with the watershed and to not alter biological communities as measured using EPA's Rapid Bio-assessment, Protocol II (EPA 1989). The application of riparian area and soil and water Plan standards and guidelines will protect downstream aquatic habitat, where occurrences and suitable habitats for the blackside dace are found. In addition, the GWJNF developed a Federally Listed Fish and Mussel Conservation Plan with the USFWS that is applied in 6th level HUC watersheds that contain a federally listed fish or mussel species.

Description of Monitoring Method

Monitoring Question #7 in the JNF Plan (page E-4) queries the population status of the blackside dace with the method of collection being to "follow the recovery plan".

1) Were requirements outlined in federal species recovery plans implemented? For this species the recovery plan (USFWS 1988) lists the following tasks relating to the Forest Service:

    a. Continue to utilize existing legislation and regulations to protect species.
    b. Provide long-term protection of essential habitats through acquisition, registry, management agreements, etc.
    c. Seek support from landowners, local governments, and agencies.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, through project review and implementation, and through cooperative agreements and memoranda of understanding.

Habitat Trend and Population Trend

The blackside dace was listed as threatened in 1987 (Biggins 1987). They inhabit cool, small, upland streams with moderate flow. The fish is generally associated with undercut banks and large rocks, and it is usually found within well-vegetated watersheds with intact riparian areas. Blackside dace feed on algae, diatoms, and small invertebrates. Spawning occurs in May over the nests of other fish in gravel run areas.

Historically, the blackside dace likely inhabited many of the small, moderate gradient cool water streams in the upper Cumberland River system in Kentucky and Tennessee. This species was found in 43 streams (78 reaches) in that river system from 2003-2006 (Black et al. 2013a). Since 1999, the blackside dace was found in 8 streams in the South Fork Cumberland River drainage in Kentucky and Tennessee (Bivens et al. 2013). The species is known from the Butler Tract, on the JNF in the Poor Fork of the Cumberland River drainage, Kentucky (Scott 2006). In addition, blackside dace specimens collected earlier from Cox Creek, Virginia were confirmed in 2001. This is significant, since Cox Creek is a tributary to the North Fork of the Powell River making this the first record within the Upper Tennessee River drainage (Strange and Skelton 2003). Since then, it has been collected from approximately 8 sites in the North Fork Powell River system (Jones Creek and Cox Creek) and 2 sites in the Upper Clinch River system (McGhee and Staunton Creek) (Skelton 2013). These new occurrences are adjacent to the Forest, and it is expected that nearby tributaries also contain blackside dace. Genetics work conducted on the Tennessee drainage blackside dace populations concluded that they are recent introductions of this fish, probably by bait bucket (Strange and Skelton 2003, Skelton 2013). From this recent work it can be concluded that the distribution and abundance of blackside dace are only partially known, and that more work is needed to better understand the full extent of the dace's distributional range. The remote location and small size of many streams offer the possibility that additional populations will be discovered, while unauthorized introductions by humans into new watersheds warrant more attention.

A recent special publication of the Southeastern Naturalist dedicated to the blackside dace summarized the current knowledge of the fish and several common themes emerged from the collection. First and foremost, is that human-induced impacts are still occurring, including, but not limited to: changes associated with extraction of natural resources, construction of road crossings, channelization of streams, and alteration of riparian zones.

McAbee et al. (2013), Bivens et al. (2013), and Black et al. (2013b) noted empirical evidence and expert opinion regarding impacts of coal mining on stream water quality. Mattingly and Black (2013) observed degradation of four stream habitat variables at sites adjacent to active logging operations. Papoulias and Velasco (2013) detailed the water quality changes and fish-tissue damage caused by hydraulic fracturing-fluid releases associated with development of natural gas wells. Finally, Eisenhour and Floyd (2013) and Floyd et al. (2013) discussed effects of perched culverts, stream channelization, and poorly maintained riparian zones. A non-anthropogenic impact was described by Compton et al. (2013), who chronicled the collapse of a blackside dace population where beavers had altered the stream hydrology and ecology.

Another theme within the publication is that many populations occur at undesirably low densities and, therefore are vulnerable to local extinction (Black et al. 2013a). This theme points to the importance of unimpeded passage and movement of dace between streams and reaches. Detar and Mattingly (2013) observed both sedentary and mobile individuals in study populations, the movement of which enhance short and long term viability. The negative consequences of stream obstructions were detailed in case studies by Eisenhour and Floyd (2013), Floyd et al. (2013), and Compton et al. (2013) in which perched culverts and beaver dams led to fish-community changes and blackside dace declines. A related theme, the integrity of the stream community should be maintained, points to the importance of ecological interactions between blackside dace and other species. Mattingly and Black (2013) examined the vital role of other minnow species that create spawning microhabitat for blackside dace, while Rakes et al. (2013) evaluated the role of milt from other species inducing blackside dace spawning behavior. In addition, habitat changes leading to invasion by other species or purposeful introductions could negatively affect blackside dace, for example competition from Southern redbelly dace, and predation by redbreast sunfish (Compton et al. 2013, Floyd et al. 2013).

Successful spawning and captive propagation of blackside dace will support the ongoing recovery efforts for this threatened species (Raikes et al. 2013). From 2011-2013, Conservation Fisheries Inc. (CFI) collected and propagated blackside dace to provide fish for toxicology testing and to support a USFWS grow-out and educational display. All broodstock have been retained at CFI for 2013 production efforts (Conservation Fisheries, 2014).

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Working cooperatively with State biologists, university experts, and the US Fish and Wildlife Service, the Forest developed a pro-active conservation plan for federally listed fish and mussels in 2004. The standards and guidelines in the plan are implemented in 6th level HUC watersheds that contain listed fish or mussel species. The following watersheds on the Forest are covered by the Federally Listed Mussel and Fish Conservation Plan and contain the blackside dace.

Table 22. 6th Level HUC Watersheds on the Forest with Blackside Dace

6th Level HUC	Watershed Name
051301010301	Bad Branch-Poor Fork Cumberland River
060102060202	Reed Creek-North Fork Powell River
060102050602	Little Stony Creek-Clinch River

The decline of this species is linked to siltation from coal mining and other ground disturbing activities, water quality degradation including acid mine drainage, impoundments, and residential development. Competition with the introduced Southern redbelly dace may have displaced blackside dace from the warmer waters within its range. For populations of blackside dace on or near the Forest, the potential management influences include: sedimentation, mineral development, and altered flow. The Surface Mining Control and Reclamation Act of 1977 prohibits surface (strip) mining of coal on the Forest. Residential development is prohibited on the Forest. Forest-wide and riparian standards will protect the blackside dace and its habitat from sediment released during management activities and mineral development. Instream flow needs will be quantified and maintained to protect aquatic organisms when new water use authorizations are proposed.

The Forest will manage and protect populations and historical habitats of blackside dace. Protection and active management will be implemented where the species is on the Forest. Protection, monitoring, and augmentation will be the primary recovery objectives. Actions will be taken in order to identify additional suitable habitat and restore fish to areas on the Forest where appropriate.

Recommendation

No change in direction for the blackside dace is recommended. Continue cooperation with monitoring and surveys.

James Spinymussel

Photo 17. James spinymussels from Little Oregon Creek, Craig County

Photo courtesy of Brian Watson, VDGIF

Reason For Selection

The James spinymussel (*Pleurobema collina*) was selected as an MIS because it is a federally endangered aquatic species; therefore, its population status is of direct interest. Its habitat is directly affected by water quality with it being sensitive to siltation (GWNF FEIS, page J-19).

For purposes of this analysis, the fundamental relationship between the spinymussel and its habitat is water quality and the streambed substrate where it lives. Water quality, in streams with their watersheds on NFS land, is most likely to be negatively influenced by management activities that have the potential to introduce sediment into the streams. Water quality in streams draining private lands near the Forest is most likely to be influenced by agricultural activities and point-source discharges.

Plan Habitat Objectives

Plan objectives are to maintain sedimentation rates that are in equilibrium with the watershed and to not alter biological communities as measured using EPA's Rapid Bio-assessment, Protocol II (EPA 1989). The application of riparian area and soil and water Plan standards and guidelines will protect downstream aquatic habitat, where historic and current occurrences and suitable habitats for the spinymussel are found. In addition, the GWJNF developed a Federally Listed Fish and Mussel Conservation Plan with the USFWS that is applied in 6th level HUC watersheds that contain a federally listed fish or mussel species.

Description of Monitoring Method

Chapter 5 of the GWNF FEIS lists the following two monitoring questions that apply to all federally listed threatened and endangered species. In addition, monitoring Question #7 in the JNF Plan (page E-4) queries the population status of the James spinymussel with the method of collection being to "follow the recovery plan".

1) Were requirements outlined in federal species recovery plans implemented? For this species the recovery plan (USFWS, 1990) lists the following tasks relating to the Forest Service:

    a. Conduct surveys.
    b. Continue to utilize existing legislation and regulations to protect species.
    c. Provide long-term protection of essential habitats through acquisition, registry, management agreements, etc.
    d. Seek support from landowners, local governments, and agencies.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, through project review and implementation, and through cooperative agreements and memoranda of understanding.

2) Is habitat for all existing threatened and endangered species being maintained or improved with no unwarranted habitat alterations/degradations happening?

This question is answered using qualitative and quantitative field surveys that are conducted by snorkeling along transects in potential or known habitat, in addition to biological monitoring using benthic macroinvertebrates.

Habitat Trend

The James spinymussel was federally listed as endangered in 1988 (USDI Fish and Wildlife Service 1990). Historically, this species was apparently throughout the James River above Richmond, in the Rivanna River, and in ecologically suitable areas in all the major upstream tributaries (Clarke and Neves 1984). The species remained widespread through the mid-1960's, but now appears extirpated from 90% of the historic range. Since 1990, James spinymussel populations have been found in three tributaries to the Dan River in Virginia and North Carolina, which is outside of the species' range known at the time of listing.

This species is found in slow to moderate currents over stable sand and cobble substrates with or without boulders, pebbles, or silt (Clarke and Neves 1984). Hove and Neves (1994) found James spinymussels in 1.5 to 20 m wide second and third order streams at water depths of 0.3 to 2 m. Seven fish hosts, all in the family *Cyprinidae*, have been identified (Hove 1990): bluehead chub, rosyside dace, blacknose dace, mountain redbelly dace, rosefin shiner, satinfin shiner, and stoneroller. Freshwater mussels are filter feeders taking organic detritus, diatoms, phytoplankton, and zooplankton from the water column. The following excerpt from Hove and Neves (1994) states the current thinking on threats:

"There are several anthropogenic and natural threats to the James spinymussel's continued existence. Nearly all the riparian lands bordering streams with the James spinymussel are privately owned. With more intensive use of the land, it is probable that water quality and habitat suitability will deteriorate. At present, the most detrimental activities include road construction, cattle grazing, and feed lots that often introduce excessive silt and nutrients into the stream."

The introduced Asian clam is also considered to be a threat to the James spinymussel and is beginning to invade several sites (Hove and Neves 1994).

Loss and fragmentation of spinymussel habitat on larger rivers has slowed since no major impoundments are currently proposed or being built. The fish hosts found on the Forest are not endangered, threatened, sensitive, or locally rare, therefore they are not thought to be a limiting factor. Water quality as related to acid deposition is reducing the calcium carbonate found in some streams that are not well buffered. Sediment loading seems to be the current major threat to populations of this species and is continuing to occur on private land.

Population Trend

Occurrences of the James spinymussel near the Forest include Potts Creek, Craig Creek, Pedlar River, Cowpasture River, Bullpasture River, Mill Creek, and there are historic records from the James and Calfpasture Rivers. In the Craig Creek watershed, the species is stable due to population(s) in Johns, Dicks, and Little Oregon creeks (near the JNF). The species appears to be extirpated in Potts Creek or at such low numbers that detection is extremely difficult. In the Cowpasture River watershed, population status in the Cowpasture and Bullpasture is uncertain with the population in Mill Creek stable (see Table 6, Watson 2014). Propagation and release of James spinymussels within known populations has been a focus of the Virginia Department of Game and Inland

Fisheries and the US Fish & Wildlife Service. In addition, these agencies are conducting mark-recapture surveys in several streams (Dicks, Johns, Little Oregon, Mill Creek, Craig Creek) to determine population size.

Table 23. Location and Status of James spinymussel Populations in the James River Watershed

Tributary	County/State	Status
Bullpasture River	Highland/VA	Unknown
Calfpasture River	Rockbridge/VA	Extirpated?
Catawba Creek	Botetourt/VA	Extirpated?
Cowpasture River	Bath & Alleghany/VA	Stable?
Mill Creek	Bath/VA	Stable
Craig Creek	Craig/VA	Declining
Dicks Creek	Craig/VA	Stable to increasing
James River mainstem	Various	Extirpated
Johns Creek	Craig/VA	Stable
Little Oregon Creek	Craig/VA	Stable to increasing
Patterson Creek	Botetourt/VA	Extirpated?
Pedlar River	Amherst/VA	Stable
Potts Creek	Monroe/WV	Stable
Potts Creek	Craig & Alleghany/VA	Extirpated?
Upper Potts Creek	Monroe/WV	Stable?

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

This species is inherently rare and not naturally well distributed across the Forest due to its historic distribution (restricted to the James River drainage) and the limited amount of suitable habitat on the Forest. Despite extensive searches, no occurrences of the spinymussel have been located on the Forest (Watson 2014). The 14 miles of potential habitat modeled for this species in the Ecological Sustainability Analysis for the 2015 GWNF Plan Revision (2012) assumes all of the river mileage is suitable substrate, which is not probable; in all of the watersheds with spinymussels near the Forest, the occurrences are all on private land. The James spinymussel does occur both upstream and downstream from the Forest. Current Forest management provides for water quantity and quality that contributes to the persistence of mussel populations. The main avenues for the Forest to aid in this species recovery are through land acquisition, assisting in augmentation efforts, and working with landowners to protect streams and streamside habitat. Several isolated reaches of habitat on the Forest could provide sites for augmentation if the substrate were suitable. Working cooperatively with State biologists, university experts, and the US Fish and Wildlife Service, the Forest developed a pro-active conservation plan for federally listed fish and mussels in 2004. The standards and guidelines in the plan are implemented in 6th level

HUC watersheds that contain listed fish or mussel species. The watersheds listed below in Table 24. are covered by the Federally Listed Mussel and Fish Conservation Plan.

Table 24. Federally Listed Mussel and Fish Conservation Plan watersheds

6th Level HUC	Watershed Name
020802010403	Mill Branch-Potts Creek
020802010404	Cast Steel Run-Potts Creek
020802010405	Hays Creek-Potts Creek
020802010601	Wolfe Draft-Cowpasture River *
020802010602	Shaws Fork *
020802010603	Benson Run-Cowpasture River *
020802010701	Scotchtown Draft-Cowpasture River
020802010702	Dry Run *
020802010703	Thompson Creek-Cowpasture River *
020802010801	Mill Creek-Cowpasture River *
020802010803	Simpson Creek-Cowpasture River
020802011201	Rolands Run Branch-Craig Creek
020802011202	Barbours Creek *
020802011205	Roaring Run-Craig Creek
020802011302	Town Branch-Catawba Creek
020802020104	Hamilton Branch *
020802020105	Fridley Branch-Calfpasture River *
020802020106	Cabin Creek-Mill Creek
020802020108	Guys Run-Calfpasture River *
020802020506	Poague Run-Maury River *
020802030201	Lynchburg Reservoir-Pedlar River
020802030202	Browns Creek-Pedlar River
020802030203	Horsley Creek-Pedlar River

* No spinymussel occurrence in this watershed, but is found in downstream HUC(s)

Overall, viability remains a concern for the James spinymussel on the GWNF, yet management has little ability to affect its overall viability. Factors outside the authority of this agency affect the viability of the James spinymussel. Since it does not occur on the National Forest, the main avenues for the Forest to aid in this species recovery are through educating and working with landowners to protect streams and streamside habitat, and assisting efforts to identify additional suitable habitat and restore these species to historical habitats as appropriate. In some cases, acquisition of lands within the Forest's Proclamation Boundary may also be part of recovery actions

Recommendation

No change in direction for the James spinymussel is recommended. Continue monitoring and surveys.

Peaks of Otter Salamander

Photo 18. Peaks of Otter salamander (*Plethodon hubrichti*)

Reason For Selection

"Trends in populations of this species will be used to indicate effectiveness of management activities designed specifically to meet conservation objectives for this species" (2004 JNF Plan, page 5-6). The Peaks of Otter salamander (*Plethodon hubrichti*) was selected because of viability concerns stemming from its naturally limited distribution. It is the MIS for Monitoring Question 7 (*What are the status and trends of federally listed species and species with viability concerns on the forest?*) in the 2004 JNF Plan.

It is a Forest Service sensitive species and is only known to occur in Bedford, Botetourt, and Rockbridge Counties, VA. Nearly all of the global range of this salamander is located on land administered by the U.S. Forest Service. As with other members of the genus *Plethodon*, they are terrestrial, breathe through their skin, and do not require water to breed. They prefer mature Appalachian hardwood forests with closed canopies, deep moist soil, and abundant cover objects.

A pre-listing conservation plan was developed for this species with the cooperation of the USFWS, Blue Ridge Parkway, Virginia Division of Natural Heritage, and Virginia Department of Game and Inland Fisheries. Based on

this conservation plan, a Conservation Agreement was signed by the USFWS, the Blue Ridge Parkway, and the U.S. Forest Service in 1997. Under the Conservation Agreement the Peaks of Otter salamander would not need to be listed as endangered or threatened under the Endangered Species Act provided the U.S. Forest Service follows certain management guidelines. The main guideline is allowing mature hardwood forest conditions to develop and continue within the majority of the salamander's range on NFS land.

For purposes of this evaluation, the fundamental relationship between the Peaks of Otter salamander and its habitat is that it prefers habitat associated with mature hardwood forests. The amount and distribution mature hardwood forests in this species' range are most likely to be influenced by management activities associated with timber harvesting.

Plan Habitat Objectives

The 2004 JNF Plan recognized the significance of the Peaks of Otter salamander by establishing management prescription 8.E.2 – Peaks of Otter Salamander Habitat Conservation Areas (2004 JNF Plan page 3-129). This management prescription is allocated to approximately 7,700 acres of the Glenwood Ranger District. These acres are divided into a primary conservation area (2,400 acres) unsuitable for timber production (8.E.2a) and a secondary conservation area (5,300 acres) suitable for timber production (8.E.2b). The emphasis in the Peaks of Otter salamander primary habitat conservation area (8.E.2a) is maintenance and enhancement of the salamander's habitat, including connectivity of unaltered or enhanced habitat. The emphasis for the Peaks of Otter salamander secondary habitat conservation area (8.E.2b) is maintenance of Peaks of Otter salamander habitat to assure its continued existence on the JNF while also providing habitat for other species and maintenance and enhancement of the health of oak forest communities through vegetation management. Research and monitoring to determine the effects of multiple use management on the Peaks of Otter salamander are an important component of this prescription.

Management prescription 8.E.2 is part of the larger Peaks of Otter salamander Habitat Conservation Area (about 20,700 acres) which includes Blue Ridge Parkway lands and Forest Service lands in management prescription 1A (Designated Wilderness), 4A (Appalachian Trail), 4K1 (North Creek Special Area), 5B (Designated Communication Sites), and 12A (Remote Backcountry Recreation – Few Open Roads). All of these prescriptions contain the following Standard: "Within the Peaks of Otter salamander habitat conservation area, activities must comply with the Habitat Conservation Agreement for the Peaks of Otter salamander."

Thus, the 2004 JNF Plan provides for those ecological conditions to maintain the salamander considering its limited distribution and abundance.

Description of Monitoring Method

Since 1993 the Forest has supported and participated in studies to better understand the effects of timber harvest on Peaks of Otter salamander populations since vegetation management is the main activity that will occur in the secondary habitat conservation area. A key study is that being conducted by Sattler and Reichenbach (see below). This study uses three treatments (control, shelterwood harvest, and clear-cut), with four replicates for each treatment. At each of these 12 sites one 5x5 m plot was established. These plots were sampled 8 times a year at night when conditions are suitable for salamanders to be surface active. Numbers of surface active salamanders

are recorded. The Forest may continue to use these plots for long-term monitoring at the completion of this particular study.

Habitat Trend

Since the signing of the pre-listing conservation plan in 1997 there has been one vegetation management activity carried out within the secondary habitat conservation area to date. In February 1998 an ice storm caused severe damage to trees within a certain elevation and aspect on the Glenwood Ranger District including an area within the Peaks of Otter salamander habitat conservation area. In the worst hit areas the forest canopy was considerably reduced. U.S. Forest Service plant pathologists recommended salvage operations to remove trees that had lost 50% or more of their crowns because they were unlikely to survive. In the summer 2009 the Parkers Gap Salvage Sale took place. Prior to the timber sale, David Marsh (2010), herpetologist at Washington and Lee University, collected population data in the area to be harvested as well in adjacent unharvested areas. Marsh found that:

> Our results were most consistent with the following scenario: *P. hubrichti* declines moderately following shelterwood harvest, with most of the declines farther out into the harvested zone. Although our study covered only 5 years post-harvest, salamander numbers are expected to increase again as forest begins to re-grow. The exact time to full recovery of the salamander population cannot be predicted from a short-term study such as this. Our results differ somewhat from Sattler and Reichenbach (1998) in that they found no detectable declines in *P. hubrichti* abundance in shelterwood harvests. The differences between our study and theirs could be due to site-specific differences or to differences in the size of the harvest units (1 ha. in their study versus 6 ha in ours). This latter possibility is consistent with our finding that most of the declines were concentrated towards the center of the logged unit. Overall, the effects of shelterwood logging that we observed for *P. hubrichti* were about average compared to other studies of the effects of partial canopy removal on salamanders of the genus *Plethodon* (Tilghman et al. 2012).
>
> Our study suggests that the effects of shelterwood logging in Parker's Gap are largely consistent with expectations (i.e. moderate reductions with eventual recovery as long as the site is not re-harvested too quickly). If these results are indeed somewhat general, small-scale shelterwood harvests could be a sustainable part of the management strategy for *P. hubrichti* in the Secondary Conservation Area. However, our results suggest that caution should be taken with respect to larger timber harvests within the area. Because effects of harvesting appeared stronger as one moved further into the harvest zone, the negative consequences of larger harvests might be substantially greater than those that have been previously observed in smaller harvest units.

Population Trend

The Forest funded two studies of the effects of timber harvesting on Peaks of Otter salamanders:

1. Mitchell, et al. 1996. A two year study of recent clear-cuts, older clear-cuts, recent shelterwood cuts, and mature sites. No significant differences were seen in salamander abundance among the sites. Recent clear-cuts did support consistently fewer salamanders than the other sites. They concluded that timber harvesting practices do not eliminate this species, but may diminish population size and diet quality.

2. Sattler, P. and N. Riechenbach (2007). 1993 to 2005. A long-term study of pre and post-timbering population levels. Three treatments, (control, shelterwood cut, and clear-cut), each with four replications, were assessed to determine the long-term effects of the harvest methods. Population data were collected prior to timber harvest and periodically afterward. The data are presented in the following Table 25 (the numbers represent the averages of the replication average):

Table 25. Trend in Peaks of Otter Salamanders Following Timber Harvest

Year	Control	Shelterwood	Clear-cut
1993	6.9	4.4	4.5
1994	8.6	2.4	2.6
1995	7.6	4.7	1.4
1997	6.2	3.6	1
1999	5.1	4.1	2.7
2001	4.7	4.1	2.2
2005	8.6	7.2	2.4

Reichenbach and Sattler concluded that clear-cuts had a "significant and long-lasting impact" with steep declines in salamander numbers in the first two years, some recovery after five years, but after twelve years the numbers stabilized at about half the pre-timbering levels. Shelterwood cuts, by contrast, did not show any significant long-term impacts. They attribute this to the similarity between the shelterwood sites and the reference sites with regard to canopy closure and leaf litter versus the clear-cut sites. Canopy closure results in shade to control temperature and maintain higher humidity levels, while the leaf litter provides refuge and food sources. These results are consistent with and, in fact, confirm, the direction the Forest has taken to protect populations of Peaks of Otter salamanders.

The majority of the Peaks of Otter salamander's habitat is in the Peaks of Otter Salamander Habitat Conservation Area and is being managed to allow mature forest conditions to develop. Over time the habitat is improving for this species as the forest matures. Analysis results suggest an overall stable trend for Peaks of Otter salamander populations on the JNF.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Management in the Peaks of Otter Salamander Habitat Conservation Area consists generally of dispersed recreation and vegetation management. The habitat trend is one of an aging forest that benefits Peaks of Otter salamanders and should lead to a stable or increasing population. The 2004 JNF Plan limits the acreage that may be harvested over time, places restrictions on harvest methods and implementation, and calls for monitoring to determine the effects of vegetation management on the Peaks of Otter salamander. Because habitat conditions are stable to improving, the Peaks of Otter salamander will remain viable on the Forest; however, due to the naturally limited range of this species it will remain vulnerable to unexpected outside events possibly causing population decline (e.g. global climate change, introduced diseases).

Almost the entire range of the Peaks of Otter salamander is on the JNF. It is inherently rare and thus not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the salamander population considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to provide for species viability (persistence over time).

Recommendation

No change in direction for the Peaks of Otter salamander is recommended. Continue monitoring the effects of management activities.

Shale Barren Rockcress

Reason For Selection

Photo 19. Shale barren rockcress habitat

Shale barren rockcress (*Arabis serotina*) was selected because it is an endangered species. It was listed as endangered on August 8, 1989. This species is endemic to mid-Appalachian shale barrens in a small region of Virginia and West Virginia. The shale barren rockcress was selected because it is a federally endangered shale barren endemic species and therefore there is direct interest in its population status and trend (GWNF FEIS, page J-19).

For purposes of this analysis, the fundamental relationship between the shale barren rockcress and its habitat is the geologic structure and bedrock where it lives. The amount and distribution of this species is most likely to be influenced by management activities associated with authorizing the collection of common variety mineral materials by the private sector, road construction, the creation of shale pits for use in surfacing State or NFS roads, by herbicide applications associated with road maintenance or gypsy moth defoliation control, increased canopy closure (fire suppression?), deer browsing or activities that could encourage the spread of invasive plant species.

Plan Habitat Objectives

The 1993 GWNF Plan allocated most of the habitat that supports shale barren rockcress on the Forest as Wilderness or Special Biological Areas. Wilderness Areas (Management Area 8) are managed to “maintain or achieve a naturally functioning ecosystem” (GWNF FEIS, p. 3-35). Special Biological Areas (Management Area 4) are managed to “protect and/or enhance their outstanding natural biological values” (GWNF FEIS, p. 3-6). In addition “No herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant. Buffers are clearly marked before treatment so applicators

can easily see and avoid them" (GWNF FEIS, Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136].

Description of Monitoring Method

Chapter 5 of the GWNF FEIS lists two monitoring questions that apply to all federally listed threatened and endangered species:

1) Were requirements outlined in federal species recovery plans implemented? For this species the recovery plan (USFWS, 1991) lists the following tasks relating to the Forest Service:

    a. Preserve habitat on public lands.
    b. Enforce regulatory authorities to protect populations/habitat.
    c. Implement and evaluate the monitoring program.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

2) Is habitat for all existing threatened and endangered species being maintained or improved with no unwarranted habitat alterations/degradations happening? This question is answered using qualitative field surveys.

Habitat Trend

Habitat where shale barren rockcress occurs is protected either by designation as a Special Biological Area or during the project-level Biological Evaluations prior to project decision and implementation. Habitat for this species on the Forest is stable. Habitat has not changed since the 2000 report except through natural processes.

Population Trend

In 1993 there were 17 known occurrences of shale barren rockcress on the Forest. The GWJNF's focus since this species was listed has been to attempt to locate additional populations and further define its range on the Forest. From 1994 to 1998 agency personnel worked cooperatively with the Virginia Division of Natural Heritage and the USFWS to inventory shale barrens on the Forest (Belden, Ludwig, and Van Alstine 1999). The Virginia Division of Natural Heritage identified 809 potential shale barrens from aerial photographs. Of these, 188 were examined for rare species. The inventory resulted in 27 new occurrences of shale barren rockcress, bringing the total known sites on the Forest (in Virginia) to 37. This number does not include two sites where shale barren rockcress was known to occur recently, but could not be found in 1994.

In 2004 the West Virginia Department of Natural Resources discovered a new population of shale barren rockcress at the Little Fork North Shale Barren bringing the total occurrences on the Forest from the 77 reported by the West Virginia Natural Heritage Program in 2000 to 78. Habitat has not changed since the 2004 report except through natural processes. In 2005 West Virginia Department of Natural Resources (WVDNR) reported a new record on the Forest north of Sugar Grove U.S. Naval Radio Station. Tom Wieboldt from Virginia Tech, Forest Service personnel, and Va. Natural Heritage personnel found five plants in 2007 at a new location on a

shale barren near the Cowpasture River, upstream from the community of Griffith VA. The current total of known rockcress locations on the Forest is now 80.

Of the 80 occurrences, 17 were known in 1993 when the 1993 GWNF Plan took effect, so there has been an increase of 63 occurrences. The number of individual plants in shale barren rockcress populations is known to fluctuate greatly from year to year, so the inability to find plants in a given year is not necessarily indicative of loss of a population (Jarrett, et al. 1996). Overall, given that habitat is stable and protected and field studies have located new populations, shale barren rockcress populations appear stable on the GWNF.

Reflecting this trend, in 2003 the West Virginia Department of Natural Resources changed the rank for shale barren rockcress from S1 (1 to 5 occurrences) to S2 (6 to 20 occurrences). In 2012 the Forest conducted a prescribed burn on Heavener Mountain which included the shale woodlands that support shale barren rock cress. Per USFWS instruction the plants were excluded from the burn. 2014 monitoring of the burn site revealed about 40 shale barren rock cress plants as the far eastern end of the burn block where no plants had been seen before. The presence of many robust plants in an area that received fairly intense fire behavior argues for fire as a natural factor in the life history of this plant and fire may be a key element in maintaining populations and habitat. Table 26 below shows the results of counting or estimating the number of rosettes and bolting plants of shale barren rockcress in the shale barrens on the GWNF in Pendleton County, WV.

The number of individual plants in shale barren rockcress populations are known to fluctuate greatly from year to year, so the inability to find plants in a given year is not necessarily indicative of loss of a population (Jarrett, et al. 1996). Overall, given that habitat is stable and protected and field studies located new populations, shale barren rockcress populations appear stable on the GWNF.

Table 26. Shale barren rockcress on the GWNF Shale Barrens in Pendleton County, WV 2000 - 2010

Site		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Brandywine	Rosettes	677	659		1,552		949		132			742
	Bolts	188	42		148		38		164			306
Little Fork North	Rosettes					15						45
	Bolts					37						17
Brushy Knob	Rosettes		62					32				
	Bolts		7					69				
Dunkle Knob	Rosettes		1					57				

Site		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Bolts		7					235				
Heavner Mt	Rosettes					385		265		568		343
	Bolts					308		177		65		266
Road Run Trib	Rosettes		84					84				
	Bolts		11					7				
	Bolts		80									
Sugar Run	Rosettes			24					9			
	Bolts			7					15			
Swamp Run	Rosettes		17					35				
	Bolts		1					14				
Thompson	Rosettes	5					3					2
	Bolts	1					0					1
Whetmiller Knob	Rosettes		105					31				
	Bolts		9					11				

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Habitat for this species is stable on the Forest. There are possible threats to shale barren communities from invasive native and exotic species. Populations appear stable, but since they naturally tend to fluctuate greatly from year to year this is uncertain. Potential habitat is being inventoried and continues to reveal new populations that will be protected. Management activities are having no effect on the habitat that contains the shale barren

rockcress and thus are having no effect on the rockcress, however, the role of fire in the maintenance of populations and habitat should be explored.

Overall, viability is being maintained through identification and protection of occurrences, however, viability is still of concern due to the naturally limited distribution of this species. Shale barren rockcress populations are expected to remain relatively stable in the near future.

The GWNF encompasses several populations of the endemic shale barren rockcress that are in the core of its limited distribution in the Northern Ridge and Valley Section of the mid-Appalachians. This species is inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain the shale barren rockcress populations considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to maintain viability (persistence over time) of populations on national forest land.

Recommendation

No change in direction for shale barren rockcress is recommended. Continue monitoring.

Swamp Pink

Reason For Selection

The swamp pink (*Helonias bullata*) was selected because it is a federally threatened species and therefore its populations are of direct interest (GWNF FEIS, page J-19). It was listed as threatened on October 11, 1988. It occurs on the GWNF in Augusta County in the Maple Flats/Big Levels area south of Stuarts Draft, VA.

For purposes of this analysis, the fundamental relationship between the swamp pink and its habitat is that it needs wetland conditions to live. The amount and distribution of wetlands is most likely to be influenced by management activities associated with land exchanges involving isolated federal parcels that are better utilized for economic development in the private sector, by authorized recreational or other group public use where people could trample the plant, by pond construction that could flood wetlands or modify hydrology, by herbicide applications associated with road maintenance, or by gypsy moth defoliation.

Photo 20. Swamp pink (*Helonias bullata*)

Plan Habitat Objectives

The majority of the habitat that supports swamp pink on the Forest is located in Wilderness or Special Biological Areas. Wilderness Areas (Management Area 8) are managed to “maintain or achieve a

naturally functioning ecosystem" (GWNF FEIS, p. 3-35). Special Biological Areas (Management Area 4) are managed to "protect and/or enhance their outstanding natural biological values" (GWNF FEIS, p. 3-6). The 1993 GWNF Plan also states that "No herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant. Buffers are clearly marked before treatment so applicators can easily see and avoid them" (GWNF FEIS, Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136]. In 1993 there were 16 known occurrences of swamp pink on the Forest. The Forest's objective is to not lose any existing occurrences and to inventory to locate new populations that will be protected.

Description of Monitoring Method

Chapter 5 of the GWNF FEIS lists two monitoring questions that apply to all federally listed threatened and endangered species:

1) Were requirements outlined in federal species recovery plans implemented? For this species the recovery plan (USFWS, 1991b) lists the following tasks relating to the Forest Service:

    a. Develop and maintain conservation plans.
    b. Identify and implement management techniques.
    c. Enforce protective regulations.
    d. Investigate population dynamics.
    e. Monitor threats to existing sites.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

2) Is habitat for all existing threatened and endangered species being maintained or improved with no unwarranted habitat alterations/degradations happening? This question is answered using qualitative field surveys.

Habitat Trend

There has been annual qualitative monitoring of two sites. One site, a sinkhole pond, has had beavers raising the water level. Due to a concern that the raised water level would negatively impact the swamp pink in the vicinity of the pond, efforts have been made to eliminate the beaver and control the water level. In the fall of 1999 the water level in the sinkhole pond rose, perhaps due to heavy hurricane rains. The level did not fall after the rain subsided and it was found that the beavers had raised their dam, possibly in response to water flowing rapidly out of the pond. The USFWS were contacted for guidance. They did not feel action by the Forest Service was required. However, in 2002 the Forest Service installed a pipe through the beaver dam to lower the water to the level typically observed over the past few decades. This was in response to public concern for the swamp pink and for other rare plants. Recent monitoring has failed to locate swamp pink plants at this site. It is possible that the beaver induced inundation has altered the site beyond the ability of swamp pink to adjust. A site in the St. Mary's Wilderness exists in a seep along a trail. This site has been monitored for several years, with no apparent negative impacts to the swamp pink, in spite of the fact that hikers have placed logs across the seep area. In1997 field surveys in the area located several hundred to a thousand additional plants. In 2004 another large population of possibly several thousand plants was discovered in St. Mary's Wilderness near and unnamed tributary. An

exact count was not possible because of autumn leaf fall, but one will be conducted in 2005. Because the majority of the Forest's swamp pink habitat is in Wilderness or Special Biological Areas it is being conserved and protected from potentially damaging activities. Basically, natural processes are operating in these areas. The habitat trend for this species is stable or increasing.

Population Trend

The population of swamp pink on the National Forest is large, dispersed over a ten-mile area, and well protected. At the time of the 1993 GWNF Plan there were 16 known occurrences (according to Virginia Division of Natural Heritage information) with perhaps 15,000 plants. Since that time four more locations have been discovered, including one that contains more than one thousand plants. With the possible exception of the beaver activity mentioned above there has been no loss of population occurrences since the 1993 GWNF Plan was adopted in 1993 or since the species was listed under the Endangered Species Act in 1988. The population trend is stable to increasing for swamp pink on the GWNF.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Habitat appears to be stable on the Forest and known occurrences and populations are protected. Occurrences appear to be stable with no loss of occurrences observed. Field surveys have revealed new occurrences, some quite large. Management activities do not appear to be having adverse effects on populations of swamp pink.

Overall, swamp pink occur in enough locations and in high enough numbers that their persistence on the Forest seems likely; however, viability remains a concern due to the limited nature of required habitats. Swamp pink populations are expected to remain stable or increase.

The GWNF encompasses a population of swamp pink that is part of a disjunct distribution in eastern North America from New Jersey south to North Carolina and Georgia. It's inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain swamp pink populations on the Forest considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to provide for distribution and abundance of the species that will provide for population viability (persistence over time).

Recommendation

No change in direction for swamp pink is recommended. Continue monitoring.

Northeastern Bulrush

Reason For Selection

Northeastern bulrush (*Scirpus ancistrochaetus*) was selected because it is a federally endangered species associated with wetlands, and therefore its populations are of direct interest (GWNF FEIS, page J-19). It was listed as endangered on June 6, 1991.

For purposes of this analysis, the fundamental relationship between the bulrush and its habitat is that it needs wetland conditions to live. The amount and distribution of wetlands is most likely to be influenced by management activities associated with land exchanges involving isolated federal parcels that are better utilized for economic development in the private sector, by authorized recreational or other group public use where people could trample the plant, by pond construction that could flood wetlands or modify hydrology, by herbicide applications associated with road maintenance, or by gypsy moth defoliation.

Plan Habitat Objectives

The 1993 GWNF Plan designates the Potts Mountain site and the Maple Springs site as Special Biological Areas. Special Biological Areas (Management Area 4) are managed to "protect and/or enhance their outstanding natural biological values" (GWNF FEIS, p. 3-6). Specific habitat objectives for the bulrush are clearly articulated in the 1993 GWNF Plan. "No herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant. Buffers are clearly marked before treatment so applicators can easily see and avoid them" (GWNF FEIS, Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136]. In 1993 there were two occurrences of northeastern bulrush on the Forest, although subsequent information makes one of those occurrences suspect.

The 1993 Recovery Plan describes four extant populations in Virginia that are all on private land and are threatened by off-road vehicles and possible development. These populations occur in two types of ponds in the Northern Ridge and Valley section: 1) shallow, oligotrophic sinkhole ponds over sandstone which overlies limestone, or 2) sandstone depression ponds on mountain ridges that are not formed by the subsidence of underlying material. At the time of the 1993 GWNF Plan there were 2 possible occurrences on the Forest. One of the populations is on a 40-acre tract on Potts Mountain that was acquired by the U.S. Forest Service in 1995. This site is managed as a Special Biological Area. The other is in the Maple Springs Special Biological Area, however, the record of collection there has not been verified and it is doubtful northeastern bulrush occurs here. As of August 1996, inventories by Virginia Division of Natural Heritage (VDNH) discovered a new occurrence (Morning Knob). An additional site is in West Virginia at Pond Run Pond on the Forest.

Description of Monitoring Method

Chapter 5 of the GWNF FEIS lists two monitoring questions that apply to all federally listed threatened and endangered species:

1) Were requirements outlined in federal species recovery plans implemented? For this species the recovery plan (USFWS, 1992) lists the following tasks relating to the Forest Service:

    a. Identify essential habitat.
    b. Secure permanent protection for known populations.
    c. Resurvey sites thought to have suitable habitat
    d. Identify potentially suitable habitat for additional surveys
    e. Survey potential sites for species presence.
    f. Monitor 10 other representative populations for general population and habitat information.
    g. Verify, monitor, and protect any additional populations.
    h. Identify historical and potential habitat suitable for reintroductions.

These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

2) Is habitat for all existing threatened and endangered species being maintained or improved with no unwarranted habitat alterations/degradations happening? This question is answered using qualitative field surveys. In 1999 photo monitoring was begun and will continue annually.

Habitat Trend

Potts Mountain

The Potts Mountain population has been qualitatively monitored annually since 1990. A designated off-highway vehicle (OHV) trail/road runs near the pond. There has been concern that users of such vehicles might drive them through the pond as they have at other locations. The monitoring found that in June of 2001 at least one OHV had driven toward the pond. The tire tracks followed the drainage path from Potts Pond. The OHV did not enter the pond and there was no damage to the northeastern bulrush. In response to this activity large rocks were placed in the area where the OHV left the designated OHV road to prevent further incursions. In August of 2003 more damage in the same area was seen. Some of the rocks had been moved and, as in 2001, an OHV drove toward the pond following the pond drainage. In January of 2004 the OHV road was closed by the installation of a gate at the FDR 176 entrance. A sign was put up informing the public of the reason for the road closure. Before the road was opened for OHV use, 90 additional large rocks were put in place. In addition, the wilderness boundary has been remarked and there is a Forest Supervisor's order prohibiting vehicles from entering the Special Biological Community that supports the northeastern bulrush. This order includes signs placed along the road and around the Special Biological Community. The habitat is still intact and undisturbed and the bulrush is present in the pond. Area occupied by the bulrush has not changed since the Forest Service acquired the site.

Cast Steel Pond (Morning Knob)

Monitored 2007, no change in habitat except natural succession.

Maple Springs

This pond is protected as part of the Shenandoah Mountain Crest Special Biological Area. Northeastern bulrush had been reported at this site in 1970, but not confirmed until 2012 when the Forest Botanist and a VA Natural Heritage Ecologist relocated the population.

Pond Run Pond

Pond Run Pond is monitored by the West Virginia Department of Natural Resources. Their 2002 report to the Forest indicated concern about increasing canopy closure over the pond that may negatively affect the Northeastern bulrush. They also noted the possible hydrologic connection between Pond Run Pond and a bog uphill. A trail runs between the pond and the bog and may be interfering with the normal movement of water between the two areas. A field review by U.S. Forest Service, WV Division of Natural Resources, and U.S. Fish and Wildlife Service personnel was conducted on May 25, 2004. The decision was made to try daylighting the pond to slowly increase sunlight reaching the pond. A 6 inch diameter red maple on the south side of the pond was girdled. No evidence of damage from horses was seen. On September 24, 2004 WVDNR returned and noted

that the girdled red maple was alive and the wound had healed over. They suggest repeating the girdling and cutting deeper.

In 2009 a fence was constructed around the pond to keep out horses. Monitoring in 2010 showed a big increase in the number of culms that was likely caused by the opening of the canopy when the fence was constructed.

Population Trend

Table 29 shows the occurrences of bulrush. Since 1993, there has been no loss of occurrences on the Forest. An additional two occurrences were discovered as noted above. Analysis results suggest an overall stable trend for bulrush populations on the GWNF.

Table 27. Northeastern bulrush populations

Potts Mountain	Cast Steel Pond (Morning Knob)	Maple Springs	Pond Run Pond
No quantitative population data available	In 1994, 1,000+ culms	2012, 30+ culms observed	1996, 30 culms
			1997, 35 culms
			1998, 30 culms
		Habitat stable	1999, pond dry, no plants observed
	Habitat stable		2000, habitat possibly being impacted by horses
	2010, 219 culms (Cipollini and Cipollini)		2001, 6 clumps and 12 stems
Habitat stable			2002, 3 clumps and 14 stems
			2003, 3 clumps and 13 stems
2004, habitat stable			2004, no clumps, 14 plants had one or more fruiting culms prostrate and rooting
2010, 3,966 culms (Cipollini and Cipollini)			Canopy cover >90% we would like to slowly reduce that and see how the bulrush responds.
			2009 Canopy cover reduced by fence construction.
			2010, 300 culms (Cipollini and Cipollini)

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

The Potts Mountain habitat is stable and the population appears stable. The Morning Knob and Maple Springs habitats are stable. The Morning Knob population has not been monitored since 1996. The Maple Springs site is protected within a Special Biological Area, and in 2012 northeastern bulrush was confirmed at this site. Management activities are having no effect on populations of bulrush.

The GWNF encompasses several populations of the northeastern bulrush as part of a disjunct distribution in eastern North America from New England south to Virginia. It's inherently rare and not well distributed across the Forest. Current management provides for ecological conditions capable to maintain bulrush populations considering its limited distribution and abundance. Overall, ecological conditions are sufficient on the Forest to maintain population viability (persistence over time).

Recommendation

No change in direction for bulrush is recommended. Continue monitoring.

Virginia Spiraea

Reason For Selection

Virginia spiraea (*Spiraea virginiana*) was selected because it is a federally threatened species associated with rocky, flood scoured riverbanks, sandbars, flatrocks, or gravel bars, and therefore its populations are of direct interest (2004 JNF Plan, page 2-14). Virginia spiraea is a southern Appalachian endemic occurring in the southern Blue Ridge and Appalachian Plateau physiographic provinces. It was listed as threatened on June 15, 1990.

For purposes of this analysis, the fundamental relationship between Virginia spiraea and its habitat is that it needs flood scoured riverbanks. The flood scour creates suitable open conditions and removes competing vegetation. The amount and distribution of flood scoured riverbanks is most likely to be influenced by impoundments that reduce or eliminate the necessary flood scour events. Other potential threats are human disturbance of riverbank habitats and non-native invasive plant species.

Plan Habitat Objectives

The 2004 JNF Plan designates two the sites where Virginia spiraea occurs as either Special Biological Areas or Rare Communities. Special Biological Areas (Management Area 4D) are managed to "…serve as a network of core areas for conservation of significant elements of biological diversity." (2004 JNF Plan, p. 3-27). Rare Communities (Management Area 9F) are "…assemblages of plants and animals that occupy a small portion of the landscape, but contribute significantly to plant and animal diversity." (2004 JNF Plan p. 3-166). The Plan objective for Virginia spiraea is to maintain the current number of populations/occurrences through protection and maintenance of existing sites and surrounding habitat conditions (JNF Revised LRPM pp. 2-14 – 2-15), 2). To achieve this the 2004 JNF Plan directs the Forest Service to 1) maintain records of locations and conditions of Virginia spiraea populations, 2) control non-native invasive species that are negatively affecting this species, 3) not issue permits for collection except for approved scientific purposes. The Revised LRMP also states that "No

herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant, except where its use is necessary to control non-native invasive species affecting federally listed or sensitive species. Buffers are clearly marked before treatment so applicators can easily see and avoid them" (2004 JNF Plan p. 2-29., Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136]. In 2004 there were three occurrences of Virginia spiraea on the Forest.

The 1991 Recovery Plan describes four extant populations in Virginia that are on a combination of private, federal, and state lands. In 2002 an additional population was discovered on the JNF. At the time of the 2004 JNF Plan there were 3 occurrences on the Forest.

Description of Monitoring Method

Chapter 5 of the 2004 JNF Plan Monitoring Question 7 asks: What are the status and trends of federally listed species and species with viability concerns on the forest? This question is answered using qualitative and quantitative field surveys.

1) For this species the recovery plan (USFWS, 1991) lists the following tasks relating to the Forest Service:

    a. Identify and monitor threats to each existing population.
    b. Enforce laws protecting the species and/or its habitat.
    c. Conduct range-wide searches for additional populations.
    d. Conduct site-specific manipulation to maintain existing populations.
    e. Reintroduce the species within its historical range.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

Habitat Trend

At the time of the 2004 JNF Plan there were 3 occurrences believed to be on the Forest. They are the following:

Pound River

The 2004 JNF Plan states that Virginia spiraea occurs within the Pound River Rare Community boundary. Subsequent to the implementation of the Revised Plan it was discovered that the population was not in the Rare Community. The original report of this occurrence located it 0.25 km downstream from John H. Flannagan Reservoir on the Pound River. In fact it is 0.025 km downstream from the dam, putting it on private land. The Forest Service did own the land that the population is on, but exchanged the land with the U.S. Army Corps of Engineers in 1967.

Chimney Cliffs / Russell Fork

In 1995 there were three occurrences, two on Breaks Interstate Park and one on Forest Service land. The largest occurrence was on the Forest Service land, and consisted of 25-30 clumps in a 10 X 15 meter area. Vigorous vegetative reproduction was observed (Belden and Moorhead 1996). Belden and Moorhead also state that this occurrence appears to have about the same number of clumps as seen by Ogle in 1987.

Guest River Gorge

In 1993 a survey found 100 clumps of plants and more than 170 branches with seed were observed along an estimated 1.7 km of river. Vegetative reproduction was also noted (Ludwig, Belden, and Clampitt 1994).

On September 21, 24, and 25, 2007 Fred Huber, Mike Donahue, Jessica Bier of the Forest Service surveyed approximately 3 miles of the Guest River, beginning at the bridge near the tunnel and working downstream (Figure 32, Table 28). From areas 1-6, the search was primarily on the southern side of the river. Downstream of area 6, both sides of the river were searched. The recent drought allowed for access to all areas of the river which would be very difficult during normal water flow.

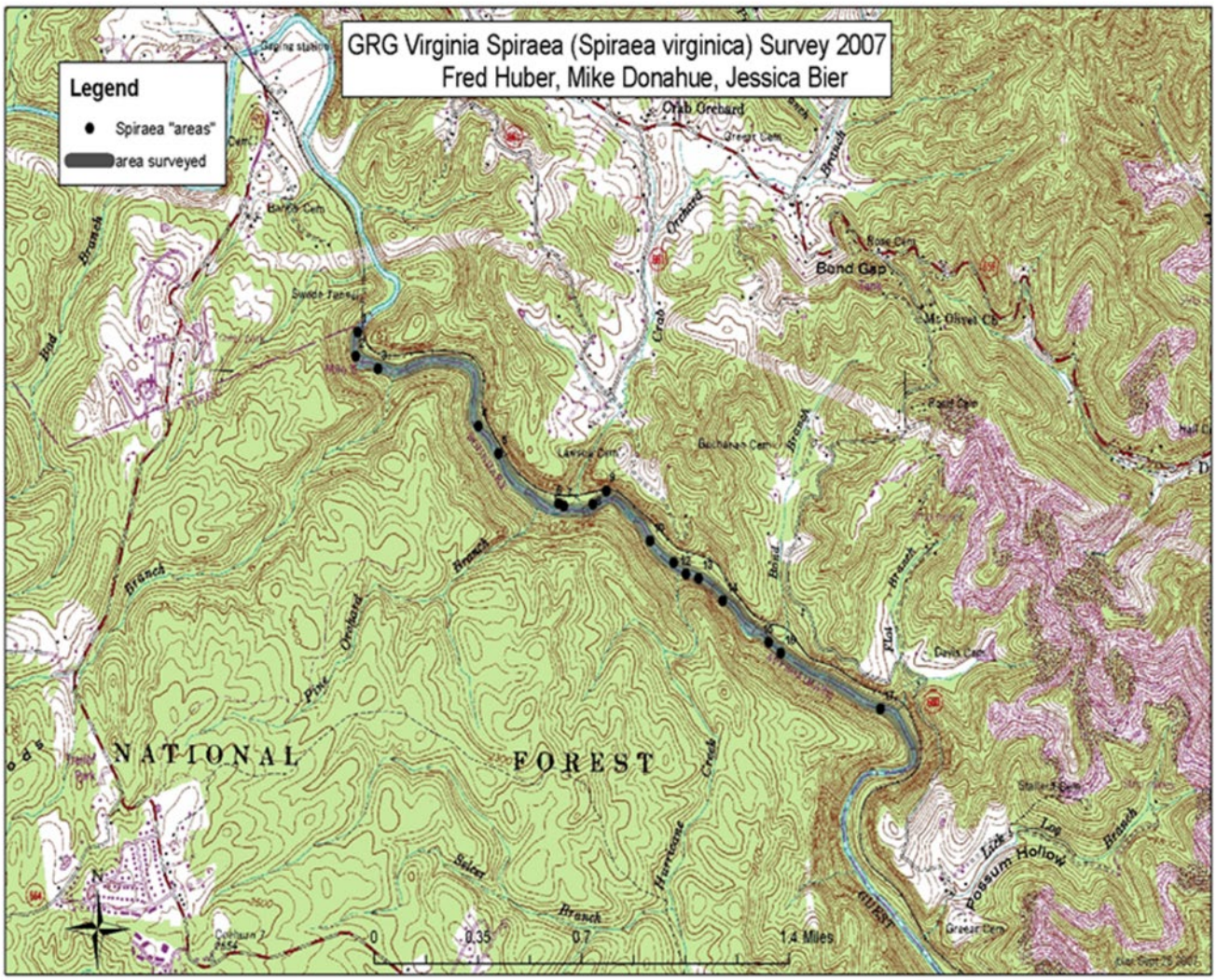

Figure 32. 2007 Virginia spiraea survey locations

Table 28. 2007 Virginia spiraea survey summary

Area	Location	Group	# stems*	Height avg./max	Cover m^{2*}	Reproduction	Exotics	Habitat/Comments
1	Around base of sycamore on island point 10 m downstream of bridge below tunnel	1	40	.6 / 1	.5	no	no	Around base/root system of sycamore on mid channel island with cobble substrate, recently browsed
2	75 m downriver from group 1 LHS	2	40	.6 / 1	.5	no	no	In crevices in mid channel rocks
3	On LHS across from rockhouse on RHS and sycamore growing in middle of river	3	—	—	—		—	Not located – possibly browsed – high beaver activity in the area
4	36 54 53.2 82 26 33.0	4	120	.3 / .5	1	no	no	Crevices in rocks mid channel rocks, right at bankfull level
	LHS 15 m downstream of Group 4	5	750	1.2 / 1.5	15	24 flower heads	no	In rock crevices at various heights above bankfull Flowerheads on largest plants
5	RHS50 m downstream of bench/trail to river 36 54 49.3 82 26 28.7	6	100	.9 / 1.4	5	no	no	Rock crevices, one clump more on the bank of river, most plants right at bankfull

Area	Location	Group	# stems*	Height avg./max	Cover m^{2*}	Reproduction	Exotics	Habitat/Comments
6	.85 mile past bridge on nose of island 36 54 41.7 82 26 17.9	7	20	.9 / 1.2	1	no	no	Base of rock on downstream side at bankfull
	30 m downstream on other end of island	8	150	.9 / 1.5	15	no	Polygonum cuspidatum	On island around sycamores among roots and cobble
	RHS	9	750	1/1.5	25	8 flower heads no seed	Polygonum cuspidatum R. multiflora	Exotics not an immediate threat, plants scattered along a 50 m stretch that becomes an island during high water
7	100 m downstream of group 9 RHS 36 54 42.0 82 26 14.0	10	20	1.5/2.0	1	no	no	.3 m above bankfull in between embedded cobble
8	RHS of main channel 36 54 42.3 82 26 07.7	11	250	1.25/1.75	5	no	2 flower heads 1 w/ seed set	Area is an island during high water
9	LHS 36 54 44.3 82 26 04.7	12	75	1/1.5	2	no	no	

Area	Location	Group	# stems*	Height avg./max	Cover m^{2*}	Reproduction	Exotics	Habitat/Comments
10	LHS	13	400	1/1.75	8	Yes	no	2 plants w/ many flowerheads, one with many seeds set, in cobble around sycamores on island along a 25 m stretch
	LHS 75 m downstream from 13	14	15	.75/2	.5	no	no	In between boulders, .3 m above bankfull
11	RHS 36 54 34.2 82 25 49.8	15	75	1.5/1	1	no	No R.multiflora nearby	Around large boulder, more sand deposited here than in other areas
12	RHS 36 54 32.6 82 25 47.0	16	150	.75/2	4	no	no	Around boulders, cobble, some sand deposits, .3-1 m above bankfull

* stem count and cover are rough estimates

The first ¼ mile of this stretch had been surveyed in 2003. The plants found at that time were relocated with the exception of one group of clumps that may have been taken out by beavers. There is a lot of beaver activity in the vicinity of Areas 1-3. The plants found in this area had been browsed recently and stems/sprouts were more diminutive than those downstream. Recent beaver activity was also observed around Area 17. Most of the plants along the 3 mile stretch show history of being browsed with larger diameter cut stumps still visible. Diameter of stumps was up to 4 cm – no live stems larger than 1 cm were seen.

With the exception of the first three areas, plants all appeared vigorous. Flowerheads were observed on 10-15 plants and seed had set in a few of these.

Stem counts and cover were roughly estimated. The total number of stems was ~4500. Total cover was 150 m2.

All of the plants were found growing in the river channel itself, 0-.5 m above estimated bankfull. Most were either in rock crevices or between cobble on "islands" that also support the growth of trees, primarily sycamores.

Observed introduced species included Silver grass (*Miscanthus sinensis*), Japanese knotweed (*Polygonum cuspidatum*), Japanese stiltgrass (*Microstegium vimineum*), Multiflora rose (*Rosa multiflora*), Chinese lespedeza (*Lespedeza cuneata*), and purple loosestrife (*Lythrum salicaria*). None of these species are an immediate threat to the Spiraea population. Herbicide treatment may be considered but it would be an ongoing project because of the numerous source populations found upriver. It is possible that the microhabitat characteristics of Spiraea will prevent direct competition with the above species. Future monitoring will be important to determine the level of threat from introduced species.

North Fork Pound River

In August 2002 Lois Boggs, Wildlife Biologist on the Clinch Ranger District, discovered a Virginia spiraea population along the North Fork Pound River. This population was not addressed in the 2004 Revised LRMP because it was found and documented too late in the plan revision process. In 2002 there were 3 to 4 large clumps and several scattered individuals. It is speculated that the North Fork of Pound reservoir has altered (reduced) the flood scour regime and competing vegetation may overwhelm the Virginia spiraea plants.

Population Trend

Since 2004, there has been no loss of occurrences on the Forest. One additional occurrence was discovered as noted above. Analysis results suggest an overall stable trend for Virginia spiraea populations on the JNF.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

The Chimney Cliffs / Russell Fork and Guest River population appear stable, however, non-native invasive species and beaver activity are potential threats. Control of invasive species is needed. The North Fork Pound site needs to be monitored and competing vegetation removed as necessary.

Summary

The JNF supports several populations of Virginia spiraea, a southern Appalachian endemic species. It's inherently rare and not well distributed across the Forest. Monitoring has shown that beavers and competing vegetation,

including non-native invasive plant species, may be having a negative effect on populations of Virginia spiraea on the JNF. Current management provides for ecological conditions capable of maintaining Virginia spiraea populations considering its limited distribution and abundance and past habitat alteration caused by impoundments. Overall, ecological conditions are sufficient on the Forest to maintain population viability (persistence over time).

Recommendation

The 2004 JNF Plan provides contradictory direction. On the one hand it states that all known locations of Virginia spiraea will be allocated as management prescription 4D, Special Biological Area designation. However, only part of the Guest River population is in the SBA, with the rest being in 2C3 Eligible Recreational River designation. The North Fork Pound River population is not addressed in the Revised LRMP and is in a management prescription 11 Riparian Corridors designation. It is recommended that consideration be given to including these two populations in SBAs.

The Chimney Cliffs/Russell Fork population is on land allocated to management prescription 9F Rare Communities. To make it consistent with the other populations and with Plan direction, it is recommended that the Chimney Cliffs/Russell Fork Rare Community Rare Community designation be change to Special Biological Area. The Pound River population was found to not occur on the national forest, in fact it was previously owned by the Forest Service, but exchanged to the U.S. Army Corps of Engineers (Corps).

No change in direction for Virginia spiraea is recommended. Continue monitoring populations and/or habitat as appropriate and take action to eliminate competing vegetation.

Virginia Roundleaf Birch

Reason For Selection

Virginia roundleaf birch (*Betula uber*) was selected because it is a federally threatened species that occurs in a very limited area near Cressy Creek in Virginia, and therefore its populations are of direct interest (2004 JNF Plan, page 2-14). The Virginia roundleaf birch was originally discovered in 1918 and not seen again until 1975 when a population of 40 trees was found. The only naturally occurring population of this tree is in Smyth County, Virginia along the floodplain of Cressy Creek in an open secondary forest. This birch is a sub-canopy tree growing in rocky debris that is strongly acidic and very permeable. The natural population is within a narrow strip of second-growth forest that includes many sweet and yellow birches. The band of forest is nearly surrounded by agricultural land. Twenty plantation populations, totaling 1,920 trees, were established on Forest Service land between 1984 and 1987. All introduced populations are on U.S. Forest Service lands within the Mount Rogers National Recreation Area (U.S. Fish and Wildlife Service 2016). This species was listed as endangered in 1978 and down-listed to threatened in 1995.

For purposes of this analysis, the fundamental relationship between Virginia roundleaf birch and its habitat is that Virginia roundleaf birch needs early successional habitat, like most birch species. This type of habitat is typically created by a disturbance event such as a fire, landslide, or flood. In the Cressy Creek drainage flooding is a logical disturbance event. In the past mining and agricultural activities in the area may have also provided suitable habitat

for seedling establishment. Birches don't produce abundant seed every year, so the combination of suitable disturbed habitat and a good seed year has to occur for Virginia roundleaf birch seedling establishment. The primary threats to this species are its extremely small range, small population size, and need for disturbance events. In the past, a threat was collection of small trees and seedlings after Virginia roundleaf birch was rediscovered and gained some notoriety.

Plan Habitat Objectives

The JNF Plan designates the site where Virginia roundleaf birch was known to occur naturally is designated a Special Biological Area. Special Biological Areas (Management Area 4D) are managed to "…serve as a network of core areas for conservation of significant elements of biological diversity." (2004 JNF Plan, p. 3-27). The Virginia roundleaf birch plantations occur in several Management Areas: 9.H Management, Maintenance, and Restoration, 7.B Scenic Corridors and Viewsheds, and 7.E.2 Dispersed Recreation Areas (Suitable Timberland).

The Plan objective for Virginia roundleaf birch is to increase the number of populations/occurrences with the assistance of reintroduction and propagation efforts (JNF Revised LRPM pp. 2-14 – 2-15). In addition, the 2004 JNF Plan Standards direct the Forest Service to 1) maintain records of locations and conditions of Virginia roundleaf birch populations, 2) control non-native invasive species that are negatively affecting this species, 3) not issue permits for collection except for approved scientific purposes. The Revised LRMP also states that "No herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant, except where its use is necessary to control non-native invasive species affecting federally listed or sensitive species. Buffers are clearly marked before treatment so applicators can easily see and avoid them" (2004 JNF Plan p. 2-29., Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136].

Description of Monitoring Method

Chapter 5 of the 2004 JNF Plan Monitoring Question 7 asks: What are the status and trends of federally listed species and species with viability concerns on the forest? This question is answered using qualitative and quantitative field surveys.

1) For this species the revised recovery plan (USFWS, 1990) lists the following tasks relating to the Forest Service:

    a. Protect existing habitat.
    b. Monitor individuals in original population.
    c. Encourage natural regeneration.
    d. Maintain additional populations.
    e. Expand management zone.
    f. Consider purchase of private property
    g. Implement educational programs.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

Taxonomic Status

The taxonomy of Virginia roundleaf birch remains unsettled. When Ashe (1918) first described Virginia roundleaf birch, he considered it a variety of *Betula lenta*, sweet or black birch. In 1945 Fernald elevated it to full species status as *Betula uber*. McAllister and Ashburner (2004) suggested that, based on breeding behavior, *Betula uber* is actually a form of *Betula lenta*: *Betula lenta* forma *uber*. In 2005, Li, Shoup, and Chen published research on the genus *Betula* using nuclear ribosomal DNA and they found that *Betula lenta* and *Betula uber* form a clade and state that their results are consistent with those of Ashe (1918). The Flora of Virginia (2012) regards *Betula uber* as a variety of *Betula lenta*. Further genetic work is needed to definitively settle the issue, however, it increasing appears that what we are calling *Betula uber* is in fact a variety or form of *Betula lenta*.

Habitat Trend

The plantation sites need ground disturbance to create bare soil for seed germination and establishment.

Population Trend

Extensive searches since 1975 have failed to locate any additional naturally occurring populations. Of the original 1920 seedlings planted 950 remain. The trees in the plantations are maturing and no longer subject to damage by deer browsing and antler scraping. At the time of the 2004 JNF Plan there were 2 naturally occurring trees and 951 planted trees on Forest Service land. A 2008 survey counted 926 plantation trees remaining, a loss of 25 trees. On June 24, 2010, Tom Blevins USFS, Sumalee Hoskin, USFWS, and Fred Huber, USFS surveyed plots # 5, 8, 12, 17, 20 and 21 to assess the current conditions and plan additional management actions to improve the potential for natural regeneration in or near the plantations. No evidence of catkins or fruiting were observed.

Evaluation of Relationship of Habitat Trend, Population Trend

The habitat holds the key to the future of the Virginia roundleaf birch. The plantations must be managed to enhance the existing trees and to create bare ground suitable for seed germination and establishment.

Summary

The JNF supports nearly all individuals of Virginia roundleaf birch, outside of those in horticultural cultivation. This species is inherently rare and not well distributed across the Forest. Monitoring has shown that competing vegetation, nearby sweet birch trees, and lack of ground disturbance may be having a negative effect on populations of Virginia roundleaf birch on the JNF. Current management is not adequate to" increase the number of populations/occurrences with the assistance of reintroduction and propagation efforts". Ecological conditions are currently not sufficient on the Forest to maintain population viability (persistence over time).

Recommendation

No change in direction for Virginia roundleaf birch is recommended. Continue monitoring populations and/or habitat as appropriate. However, the Forest must take action to facilitate the successful establishment of seedlings. Recommend following the management actions outlined in the Virginia Round Leaf Birch Survey report (2010).

Small Whorled Pogonia

Reason For Selection

Small whorled pogonia (*Isotria medeoloides*) was selected because it is a federally threatened species associated with primarily second and third growth deciduous and mixed-deciduous/coniferous forests, and therefore its populations are of direct interest (2004 JNF Plan, page 2-14). Small whorled pogonia occurs in eastern North America from Ontario Canada to Georgia. It was listed as endangered in 1982 and revised to threatened in 1992.

For purposes of this analysis, the fundamental relationship between small whorled pogonia and its habitat is that small whorled pogonia needs second and third-growth forests, often with old roads or streams nearby. The forest habitat where small whorled pogonia is found is not rare, yet colonies are few. Site characteristics are variable, but sites are usually mesic, with sparse to moderate ground cover and a relatively open understory canopy. Habitat destruction from residential and commercial development is the primary threat to this species. Addition threats are plant collecting, herbivory, and recreational use.

Plan Habitat Objectives

The JNF Plan designates the sites where small whorled pogonia has been known to occur as Special Biological Areas. Special Biological Areas (Management Area 4D) are managed to "…serve as a network of core areas for conservation of significant elements of biological diversity." (2004 JNF Plan, p. 3-27). The Keokee Lake Site is in management prescription 4D Special Biological Areas. The Hannah Branch site is in management prescription 8C Black Bear Habitat.

The Plan objective small whorled pogonia is to maintain the current number of populations/occurrences through protection and maintenance of existing sites and surrounding habitat conditions (JNF Revised LRPM pp. 2-14 – 2-15), 2). To achieve this the 2004 JNF Plan directs the Forest Service to 1) maintain records of locations and conditions of small whorled pogonia populations, 2) control non-native invasive species that are negatively affecting this species, 3) not issue permits for collection except for approved scientific purposes. The Revised LRMP also states that "No herbicide is aerially applied within 300 feet, nor ground-applied within 60 feet, of any known threatened, endangered, proposed, or sensitive plant, except where its use is necessary to control non-native invasive species affecting federally listed or sensitive species. Buffers are clearly marked before treatment so applicators can easily see and avoid them" (2004 JNF Plan p. 2-29., Appendix J, page J-18 to J-21) [1993 GWNF Plan Standard #118, page 3-136]. In 2004 there were two occurrences of small whorled pogonia on the Forest.

At the time of the 2004 JNF Plan there was one occurrence on the Forest.

Description of Monitoring Method

Chapter 5 of the 2004 JNF Plan Monitoring Question 7 asks: What are the status and trends of federally listed species and species with viability concerns on the forest? This question is answered using qualitative and quantitative field surveys.

1) For this species the recovery plan (USFWS, 1992) lists the following tasks relating to the Forest Service:

    a. Coordinate among governmental agencies and conservation organizations in providing permanent protection.
    b. Use regulatory mechanisms in protecting *I. medeloides* habitat.
    c. Create displays for use at visitor information centers.

    These tasks may be accomplished through the Forest's planning process, including inventory and monitoring, and through project review and implementation.

Habitat Trend

Annual visits have shown that the habitat does not appear to have substantially changed from the time the plants were first observed until present.

Population Trend

At the time of the 2004 JNF Plan there was one occurrence believed to be on the Forest, a second population near Hannah Branch was found in 2006. A third occurrence was reported in 2014, but could not be relocated.

Small whorled pogonia populations are known to often dwindle and disappear after they are discovered. The reasons for this are unclear. Since many populations are near roads, streams or other openings in the forest it may be that canopy openings or some other disturbance events are necessary to stimulate growth above ground. Orchids in general may not appear above ground every year as they can maintain themselves underground through mycorrhizal associations.

Keokee Lake Site

A population of plants was discovered in 1994. Table 29, below, records yearly observations from 1994 to 2001 when plants were no longer observed at this site.

Table 29. Small whorled pogonia (*Isotria medeoloides*) population on the Clinch RD

Year	Total # of Plants	Tag # of Emerged Plants	Flowering Plants	Fruiting Plants	Aborted Flowers and Fruits	Comments
1994	6	Info Not Available	Info Not Available	3	Info Not Available	Plants were found late in season.
1995	8	1,3,4,5,6,7,8	4	1	3	One plant reproduced. Plants 7 and 8 were new plants. Plant #1 was the only one to reproduce.
1996	8	1,3,4,5,6,8,9	1	1	1	No reproduction took place. Plant #6 was browsed. Seven plants were sterile.
1997	8	1,2,3,4,5,6,8,9	2	2	1	Six plants were sterile. Plant #8 was the only one to reproduce.
1998	6	1,3,4,6,8,9	0	0	0	No reproduction took place. Plants 1 and 3 disappeared by 8/18/98. All plants were sterile.
1999	6	3,4,6,8,9,10	0	0	0	Plant #8 had a crimped stem. No reproduction took place. Plant 10 was a new individual located above and to the east of the existing population. All plants were sterile.
2000	2	1,4	0	0	0	No reproduction took place. All plants were sterile.
2001	2	1,4	0	0	0	Two plants emerged this year but one plant has disappeared as of 7/2/01. Plant #8 has not emerged in two years, it is suspected that this plant is dead. No reproduction took place. All plants were sterile.

Hannah Branch Site

A Virginia Division of Natural Heritage botanist discovered one plant growing near Hannah Branch in Craig County, VA in 2006. In 2007 Forest Service personnel visited the site and the original plant was found and another smaller plant was seen nearby. Since 2007 annual searches in the area no plants have been seen at this site.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Both sites where small whorled pogonia have been seen in the past continue to be monitored. These sites are managed to protect the habitat where small whorled pogonia has been found.

Summary

Several populations of small whorled pogonia have been observed on the JNF. Since they were first observed these populations/occurrences have disappeared. It is unclear why the plants have not been observed, but it is possible they may reappear in the future when environmental conditions are suitable for above ground growth. The Forest Service will continue to protect these sites from inappropriate activities in the hope that future research will reveal information about this species' biology that will allow us to actively manage it.

Recommendation

No change in direction is needed. Continue monitoring sites where plants have been observed in the past.

Peregrine Falcon

Reason For Selection

The peregrine falcon (*Falco peregrinius*) was selected because it was a federally threatened species. In 1999, the USFWS removed the peregrine falcon from the list of threatened and endangered wildlife due to recovery. This species is now a Sensitive species, whose habitat may be influenced by management activities. It requires a specialized nesting habitat (cliffs).

Plan Habitat Objectives

The habitat objective for this species is to maintain all known historic nest sites (eyries), with the hope that falcons will eventually nest on the Forest.

Description of Monitoring Method

The Forest Service has participated in periodic statewide surveys for peregrines since 1990, and individual and pairs of birds have been seen, but successful nesting has been confirmed on the GWJNFs (personal communication VDGIF 2014).

Habitat Trend

Cliffs are habitat created naturally over millions of years. No man-made cliffs have been made on the Forest through such activities as large cut banks as a result of road construction or reconstruction projects on the GWNF.

Population Trend

From 1988 through 1991, a total of 59 young peregrines were “hacked” onto the GWNF (hacking is a process whereby young raptors are trained to feed and to fly). The purpose of the hacking was to restore a breeding population of peregrines to the GWJNFs, as the birds often return to breed in the area where they fledged. None of the hacked birds returned to the GWJNFs to nest, although banding records show that several of these birds have shown up both north and south of Virginia. In 2005 and 2006, a pair of peregrines nested successfully in a remote section of Shenandoah National Park. In 2000, a nesting pair of peregrine falcons fledged two young in the vicinity of Lost River State Park, just over the state line in West Virginia. Peregrine falcons are not tracked by the USGS BBS survey in the state of Virginia, nor have we found them on any of our GWJNF avian point count sites to date.

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

The amount and distribution of isolated cliffs on the Forest are most likely to be influenced by management activities associated with allowing recreational climbing in and around cliff areas that were used as hack sites in the early and late 1980’s to release fledgling falcons. In addition, prescribed fire may enhance suitable habitat by controlling vegetation encroachment on suitable cliff areas (NatureServe 2009). If it were determined that falcons were nesting, or attempting to nest at either a historic or a new eyrie on either Forest, one of the first actions would be to close the area to rock climbing and to other activities that could potentially disturb the birds.

Based on the results of our monitoring and evaluation, ecological conditions on the Forest are sufficient to contribute to species viability (persistence over time).

Recommendation

No change in direction for peregrine falcons is recommended at this time.

Bald Eagle

Photo 21. Bald eagle (*Haliaeetus leucocephalus*)

Reason For Selection

The bald eagle (*Haliaeetus leucocephalus*) was selected by the 1993 GWNF Plan because it was a federally endangered species, and there is therefore direct interest in its populations. In 2007, the USFWS removed the bald eagle from the list of threatened and endangered wildlife due to recovery. This species is now considered to be a sensitive species on the Forest. The eagle is a species whose habitat may be influenced by management activities, and it's a non-game species of interest. It prefers large bodies of water adjacent to forested areas. The bald eagle is not a MIS for the 2004 JNF Plan. For purposes of this analysis, the fundamental relationship between the eagle and its habitat is that it needs riparian areas associated with medium-to-large-sized rivers or lakes for nesting and foraging (GWNF FEIS, page J-19). The amount and distribution of riparian area forests and nesting sites are most likely to be influenced by management activities associated with timber harvesting and allowing people to recreate near known nest sites.

Plan Habitat Objectives

The 1993 GWNF Plan's habitat objective is to protect known nest sites with a ½ mile "restricted management activity" buffer (See GWNF 1993 FEIS; pg. J-21 and 1993 GWNF Plan Standard #246; pg. 3-15).

Description of Monitoring Method

The USGS breeding bird surveys are used, along with eagle nest surveys.

Habitat Trend

See riparian area discussion elsewhere in this report associated with Acadian flycatcher and fish species such as brook and wild trout and sunfish. This includes riparian habitat associated with large-sized rivers, lakes, and ponds.

Population Trend

Bald eagles are now observed on the GWJNFs annually. Currently, active bald eagle nests are known on private land from all major river watersheds on the GWJNFs and on scattered locations on Forest Service land. Bald eagles have not been documented to date on the GWJNFs avian point counts. USGS BBS data indicates an increasing trend of Bald eagles in the Appalachian Region (Figure 33).

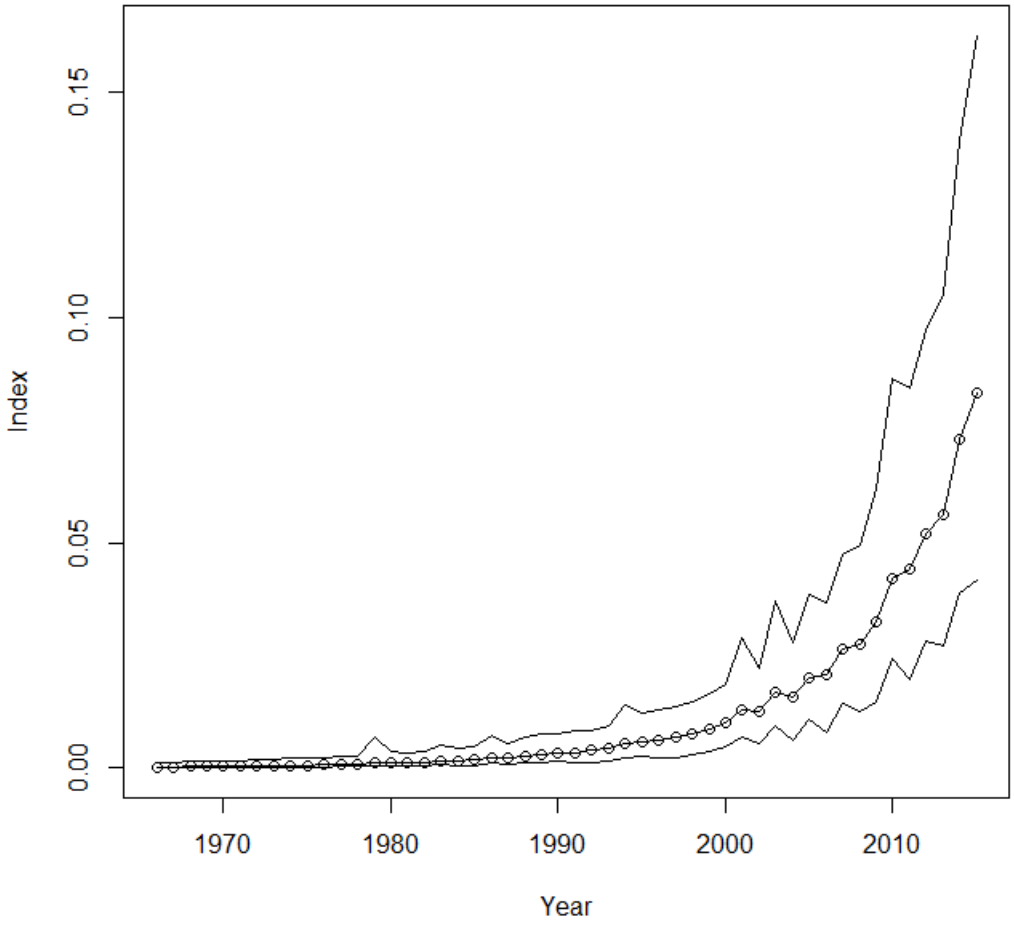

Figure 33. Trend In BBS Data Of Bald Eagle Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Suitable nesting and wintering habitat for bald eagles would be found along all major riparian areas in and adjacent to the GWJNFs, as well as natural lakes and impoundments. When nests are found, protection measures outlined by the USFWS are followed.

Based on the results of our monitoring and evaluation, ecological conditions on the Forest are sufficient to contribute to species viability (persistence over time).

Recommendation

No change in direction for bald eagle is recommended.

Demand Species

White-tailed Deer

Photo 22. White-tailed deer (*Odocoileus virginianus*)

Reason For Selection

The White-tailed Deer (*Odocoileus virginianus*) was selected because it is a species commonly hunted and its populations are of public interest. It's a species whose habitats may be influenced by management activities such as prescribed fire, permanent opening maintenance, and timber management activities (GWNF FEIS Appendix page J-12, 2004 JNF Plan FEIS page 3-134) and it is one of the MIS for Monitoring Question 8 (*What are the trends for demand species and their use?*) in the 2004 JNF Plan. White-tailed deer use a variety of habitat types (GWNF FEIS, Page 3-171). An important component of suitable habitat for white-tailed deer includes herbaceous and woody vegetation at or near ground level, and availability of hard mast, such as acorns.

Plan Habitat Objectives

For the GWNF, to maintain habitat for deer, approximately one percent of the forest should be in early successional stages of ages 1 through 12, while 10% should be hard mast bearing stands (in hardwood stands within age range from 40 to 120 years old) (GWNF FEIS, Appendix J, page J-5). For the JNF, a range of habitat objectives, management prescriptions, and desired conditions are identified to provide needed herbaceous and woody browse vegetation and hard mast (2004 JNF Plan, pg. 2-12).

Description of Monitoring Method

Hunter harvest information is reported by state wildlife agencies. For deer harvested on National Forest System (NFS) land, the VDGIF and the WVDNR use a sex, age, and kill models to generate population estimates. They also compare population trends from periodic spotlight counts.

Habitat Trend

Table 8 compares age class data or age class acres on NFS land.

Population Trend

Virginia

Current population reconstruction models indicate that Virginia's statewide deer population has been relatively stable over the past decade, fluctuating between 850,000 and 1,000,000 animals (VDGIF 2012). In Virginia, deer population trends were evaluated by examining the annual rate of change in the population index (i.e., antlered buck harvest per unit area) over the 10-year period from 2000-2010. An exponential regression ($y = aert$; where, y = population index, a = intercept, e = 2.718, r = instantaneous rate of change, and t = year) was used to determine trends in population. The annual rate of change ($R = er - 1$. The status of the deer population in each county was considered to be increasing or decreasing if the annual rate of change in the population index was >2.26% (either positive or negative) and the statistical significance level of the exponential regression model was $p < 0.10$ (r2 Value > 0.301). Annual rates of change that exceeded 2.26% represent a change of at least 25% in the population index over the decade (1.022610 = 1.25). Counties that displayed a rate of change between 0 and +2.26 were deemed to be stable. Overall on the GWJNF's in Virginia, 14 counties demonstrated stable population trends, and 9 counties demonstrated decreasing trends. Since 2000, VDGIF harvest data has suggested a more substantial decline across much of the GWJNF. In contrast, private land in the same counties ranges from stable to increasing trends (VDGIF 2013).

West Virginia

From 1945 through 2010, a total of 5,472,196 deer have been harvested in West Virginia, with 50% of the total recorded deer harvest during the period occurring in the last 15 years (WVDNR 2011). West Virginia estimates their current deer population as an index of antlered deer harvest. Estimated deer per square mile of land in West Virginia increased steadily from 1945 to 2001 to a peak of 43 deer/square mile, then declining from 2002 to 2010 to an estimated 25 deer/square mile or less (WVDNR 2011).

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Review of Table 6 (GWJNF age class distribution of all forested land) shows a decreasing percentage of early successional habitats across the GWJNF. However, review of Table 5 (Combined management activities trend across both forests) shows a marked increase in acres prescribed burned. Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year

total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities have effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 5). All of these activities, in addition to natural disturbances, should provide patches of early successional woody habitat, as well as restoring and maintaining open oak, oak/pine, and pine woodlands, which would benefit white-tail deer. The positive effects of prescribed fire on white-tailed deer browse and other habitat requirements is well documented (Brennan et al. 1998, DeBano et al. 1998). In addition, the continued maturation of forested acres across the GWJNF increases availability of hard mast.

Virginia's revised Deer Management Plan has an objective to stabilize and/or increase deer populations on public land in western Virginia (VDGIF 2007). West Virginia's Revised Deer Management Plan has an objective to maintain a healthy deer population at levels compatible with biological and sociological conditions, while providing a diversity of hunting opportunities and other associated recreational benefits (WVDNR 2011). Both revised Deer Management Plans recommend supporting habitat management objectives on public lands that manipulate vegetation for early successional wildlife and promote restoration, regeneration, and productivity of plant species important to wildlife, particularly those that provide diverse hard and soft mast (e.g., American chestnuts, acorns, grapes, and berries). This includes an increase in timber harvest and prescribed fire, that creates early successional woody and open woodlands habitat, and restoration and maintenance of grasslands and shrublands. Such habitat creation should be well dispersed across the otherwise mature forested landscape of the GWNF.

The white-tailed deer is a game animal that is harvested throughout Virginia and West Virginia; therefore, population viability is not a concern. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation:

No change in direction is recommended for deer. Continue monitoring.

Black Bear

Photo 23. Black bear (*Ursus americanus*)

Reason For Selection

The Black Bear (*Ursus americanus*) was selected because it is a species commonly hunted and its populations are of public interest. It's a species whose habitats may be influenced by management activities (GWNF FEIS Appendix page J-12, 2004 JNF Plan FEIS, page 3-134). It is one of the MIS for Monitoring Question 8 (*What are the trends for demand species and their use?*) in the 2004 JNF Plan.

Black Bear are an opportunistic species, thriving in a variety of habitat types. Important habitat elements are habitat remoteness, habitat diversity, den site availability, and availability of hard mast (GWNF 1993 FEIS, Appendix page J-12, 2004 JNF Plan FEIS, page 3.134). An important activity managers can undertake for black bear is access management (Lentz 1980, Carlock et al. 1983, Hamilton and Marchinton 1980, Miller 1975, Pelton 1980, Brody 1984). Access management does not refer to the prohibition of building or upgrading existing roads, but rather to their subsequent management. Roads themselves are not detrimental; it's the use of these roads by the public that affects black bear. Proper management of open road densities is critical to black bear populations.

For purposes of this analysis, the amount and distribution of remote habitat (assumed to be Semi-primitive non-motorized or Semi-primitive recreation opportunity areas) and old growth is most likely to be influenced by management activities associated with prohibiting or limiting public use of existing roads and timber management.

Plan Habitat Objectives

For the GWNF, to maintain old growth habitat for bear, a minimum of 2.5% of the forest should be in old growth (in hardwood stands older than 200 years old) (GWNF 1993 FEIS, Appendix J, page J-5). For the JNF, maintain approximately 252,000 acres under conditions where open road density is less than 0.8 miles per square mile, and off-road vehicle use is restricted throughout the years (Revised JNF Plan, page 2-13). Extrapolating the remoteness factor from the JNF and the old growth factor from the GWNF leads to the conclusion that, across the combined forests, a minimum of 2.5% of the Forest should be in hardwood old growth (hardwood stands older than 200 years old) and a minimum of 15.5 % (271,000 acres) should be remote.

Description of Monitoring Method

Hunter harvest information is reported by state wildlife agencies, including sex, age, and total harvest data for bear harvested on NFS land. No simple methods exist for estimating key demographic parameters (recruitment rates, mortality rates, population growth rates, density) to assess black bear population status over large areas. Definitive estimates of these parameters can only be obtained through expensive, site-specific research. As in other states, the Virginia Department of Game and Inland Fisheries uses a combination of indices derived from harvest, nuisance activity, age structure, and miscellaneous mortalities to monitor status of black bear population (Virginia Black Bear Status Report - 1998 Virginia Department of Game and Inland Fisheries). Only Virginia data is used under the assumption that trends are the same in Kentucky and West Virginia.

Habitat Trend

See trend in old growth at Table 20 in this report.

Population Trend

The black bears in western Virginia and eastern West Virginia belong to the largest contiguous bear population in the southeast and mid-Atlantic. Bear population status on the GWNF is monitored by the state agencies of Virginia and West Virginia and uses a combination of indices derived from harvest, age structure, nuisance activity, and miscellaneous mortalities (VDGIF 2013; WVDNR 2013). These indices, coupled with computer modeling, provide a current statewide population estimate of 16,000-17,000 bears in Virginia and 10,000-12,000 in West Virginia. While monitoring indices may provide rough estimates of bear population size, their primary values are to reflect population trends and relative densities. Multi-year harvest trends for both states have indicated significant increases since 1974. Since 2001, trends in harvest and population modeling suggest that the bear population throughout the area encompassing the GWNF has been increasing at about 9% annually (VDGIF 2013; WVDNR 2013).

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

Many factors are likely responsible for the increased bear populations on the GWJNF. The relative abundance and distribution of oak mast, primarily white oak, have a significant impact on bears in terms of natality, mortality, and movements (Pelton, 1989). The birth and survival of young bears are directly associated with oak mast crops. Increased movements associated with poor acorn crops often result in significantly increased mortality. The acres of older hardwood stands on the Forest have benefited bears through increased availability of den trees. In addition to older hardwood forests, bears also use a variety of other successional stages. Secondary foods (such as soft mast) can help buffer the effects of acorn shortages (Eiler, Wathen, and Pelton, 1989). Soft mast foods can be enhanced by forest management activities including prescribed burning and timber harvest (Wigley, 1993; Weaver, 2000). Important soft mast species—such as blackberries, blueberries, and huckleberries—often are more abundant in young forests.

The component of old trees as represented by a shift to more acres in the older age classes has been occurring (See Table 6). Increased acres of older hardwood stands, sustained hard mast production, and enhanced soft mast

production through forest management activities—such as prescribed burning and timber harvest—have contributed to improved black bear habitat on the Forest.

The black bear is a game animal that is harvested throughout Virginia and West Virginia; therefore, viability is not a concern. Overall, viability is well sustained for black bear on the GWJNF. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation

No change in direction is recommended for bear. Continue monitoring.

Wild Turkey

Photo 24. Wild turkey (*Meleagris gallopavo*)

Reason For Selection

The Wild Turkey (*Meleagris gallopavo*) was selected because it is a species commonly hunted and its population is of public interest. It is a species whose habitats may be influenced by management activities (GWNF FEIS Appendix page J-12, 2004 JNF Plan FEIS, page 3-138). It is one of the MIS for Monitoring Question 8 (*What are the trends for demand species and their use?*) in the 2004 JNF Plan.

Wild turkeys prefer mature forests with open understories and well-dispersed patches of early successional woody and grass/shrub vegetation. Freedom from frequent disturbance during nesting and brood rearing seasons is also important. Brood habitat is the most limiting factor to eastern turkey populations in the central Appalachians (J. Pack, West Virginia DNR, Pers. Comm.). Hens with broods use a variety of habitats: pastures, hay fields, wildlife clearings, powerline rights-of-way, natural glades, and savannas. Structure of vegetation is as important as ground vegetation types (Healy 1981). Ground cover should consist of sparse herbaceous vegetation that does not impede poult movements and produces maximum insect production, while providing protection from predators. In addition, open woodland and savannah habitats that have moderate herbaceous understory vegetation provide

brood habitat. Well-distributed water sources, especially in brood habitat are also beneficial to turkeys. Hard mast is an important winter food of the eastern turkey in the central Appalachians.

For purposes of this analysis, the fundamental relationship between wild turkey and its habitat is that it prefers mature forests with open understories and temporary or permanent open areas vegetated with grasses, forbs, and low woody fruit-producing plants. The amount and distribution of 1) patches of appropriate early successional habitat 2) open woodlands and savannahs, and 3) mature habitat that provides hard mast is most likely to be influenced by management activities associated with prescribed fire, active timber management, and creation of small wildlife openings.

Plan Habitat Goals and Objectives

For the GWNF 1993 Plan, a minimum of 10% should be hard mast bearing stands (in hardwood stands within age range from 40 to 120 years old) is identified (GWNF FEIS, Appendix J, page J-5). For the Revised JNF Plan, goals identified to manage forest ecosystems to maintain or restore composition, structure, and function within desired ranges of variability are identified as benefiting turkey (2004 JNF Plan, page 2-12).

Description of Monitoring Method

Hunter harvest information is reported by the VDGIF and the WVDNR, and includes sex, age, and total harvest data for turkey harvested on NFS land.

Habitat Trend

Maturing forests are of benefit to turkey habitat. Wild turkeys have an even greater dependence on hard mast than do deer, so the more mature forest is of more benefit to them. Also of great importance to turkeys is an interspersion of savanna-like areas with an herbaceous/shrubby understory, an open mid-story, and a partially open overstory. Other favored areas include small open patches or strips vegetated with grasses or other herbaceous species. These are used heavily, especially in spring, as “bugging” areas. With an increase in prescribed burning as noted in Table 5, the trend in wild turkey habitat is now increasing.

Population Trend

Wild turkey population trends are monitored by the Virginia Department of Game and Inland Fisheries (VDGIF) and West Virginia Division of Natural Resources (WVDNR). Population trends, in terms of harvest/square mile, vary over the years, but indicate an overall stable to increasing trend in counties with GWJNF lands. USGS BBS data indicates an increasing trend of Wild turkeys in the Appalachian Region (Figure 34).

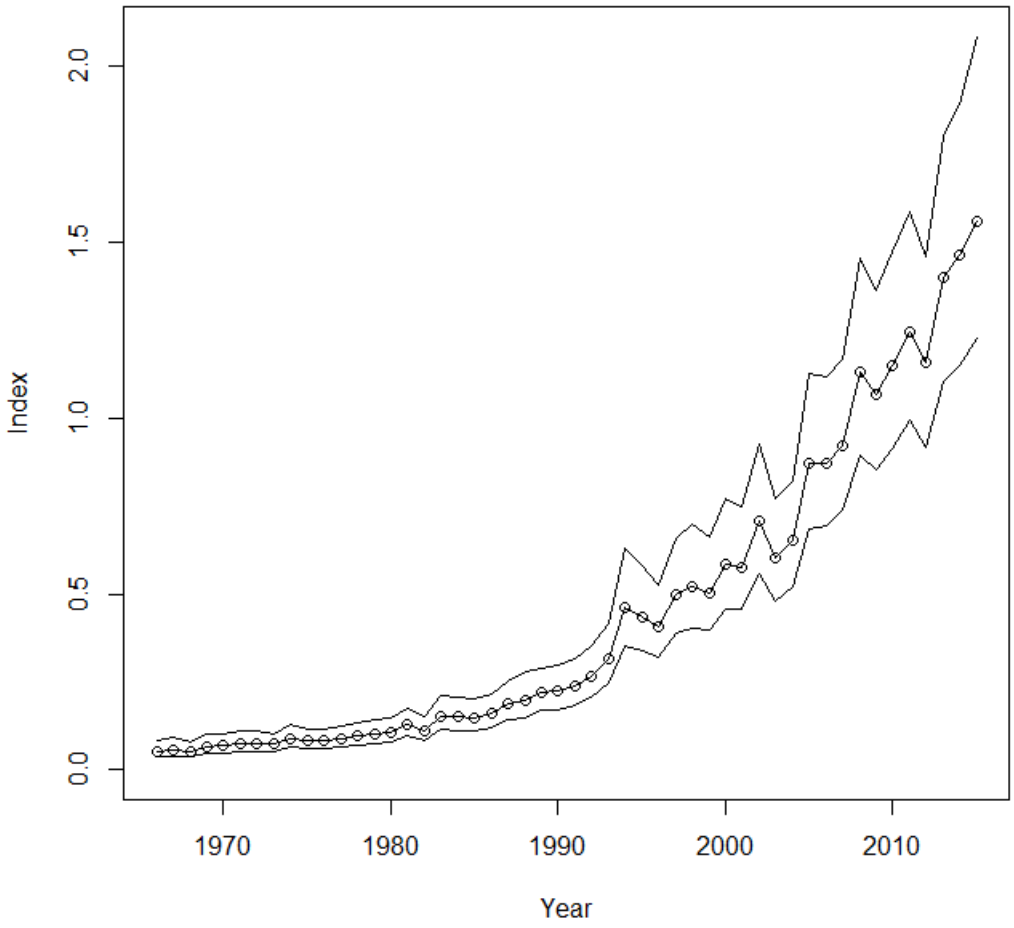

Figure 34. Trend In BBS Data Of Wild Turkey Across the Appalachian Region, 1966 To 2014.

Source: http://www.mbr-pwrc.usgs.gov/bbs/bbs.html

Evaluation of Relationship of Habitat Trend, Population Trend with Agency Activities

The forest across the GWJNF's continues to mature. Martin et al. (1951) and Dickson (1992) state acorns (hard mast) are the most important food for turkeys, especially in the winter and early spring months. As long as a high percentage of the forest remains in the optimum hard mast-producing age range (oaks 50-100 years old, generally), wild turkeys will be favored.

Wild turkeys use a wide range of habitats, with diversified habitats providing optimum conditions (Schroeder, 1985). This includes mature mast-producing stands during fall and winter, shrub-dominated stands for nesting, and herb-dominated communities, including agricultural clearings for brood rearing. Habitat conditions for wild turkey are enhanced by management activities such as prescribed burning and thinning (Hurst, 1978; Pack, Igo, and Taylor, 1988), and the development of herbaceous openings (Nenno and Lindzey, 1979; Healy and Nenno, 1983).

Based on the current age-class structure of forested land in the GWJNF's, 88% of all forest types are mature (71-150+ years) (See Table 6). Current active forest management in the last 10 years has created 10,725 acres of early successional habitat, or 0.6% of the total forested acres (Tables 3-5). Current prescribed burning has effected 1,372 to 22,081 acres per year, for a 10 year total of 160,525 acres or 9% of the total forested acres treated (Tables 3-5). Permanent grassland/shrubland maintenance activities has effected 5,900 to 11,163 acres per year, or 0.3% to 0.6% of the total GWJNF acres per year (Table 7). All of these activities, in addition to natural disturbances, should provide patches of early successional woody habitat, as well as restoring and maintaining open oak, oak/pine, and pine woodlands, which would benefit wild turkey.

The eastern wild turkey is a game animal that is harvested throughout Virginia and West Virginia; therefore, viability is not a concern. Overall, viability is well sustained for wild turkey on the GWJNF. Based on the results of our monitoring and evaluation, this species has the abundance and distribution across the Forests that will provide for its persistence into the foreseeable future.

Recommendation

No change in direction is recommended for turkey. Continue monitoring.

Viability of Forests' MIS

The overall goal is to conserve species with viability concerns through conserving their habitat. The concept of viability is making the assumption that all the species needs can be met on the National Forests. But the Forests are not "islands" and cannot be called upon to meet all needs for all MIS, especially wide-ranging species such as neo-tropical migrants, bald eagles, or the Indiana bat. Each individual species status and trend narratives articulated the rationale for selection of that species. Most MIS were not selected because of concerns over viability. Most MIS species were selected for other reasons (1982 36 CFR §219.19(1)(a)).

See Table 30. Viability is not a concern for most identified MIS because, based on rankings of the Natural Heritage Program's, MIS species are either "very common and demonstrably secure" (G5, S5) or "common and apparently secure" (G4, S4) throughout their "global" and "state" ranges. This is the case for 11 out of 23 identified MIS/MIS groups on the GWNF and for 8 out of 8 identified MIS/MIS groups for the JNF.

Table 30. Global and State Rankings for GWJNF's' MIS and Identification of Viability Concerns

Management Indicator Species	Global Ranking	Virginia Ranking	West Virginia Ranking	Species Viability Concerns (Yes or No)
Black bear	G5	S4	S5	No
Eastern Wild Turkey	G5	S5	S5	No
White-tailed Deer	G5	S5	S5	No
Brown Headed Cowbird	G5	S5	S4B S5N	No
Worm-eating Warbler	G5	S4	S5B	No
Ovenbird	G5	S5	S5B	No
Hooded warbler	G5	S5	S5B	No
Acadian flycatcher	G5	S5	S5B	No
Scarlet tanager	G5	S5	S5B	No
Pine warbler	G5	S5	S4B, S1N	No
Eastern towhee	G5	S5	S5B,S5N	No
Chestnut-sided warbler	G5	S4	S5B	No
Cow Knob Salamander	G3	S2	S1	Yes
Tiger Salamander	G5	S1	N/A	Yes
Common Flicker	G5	S5	S5B S5N	No
Pileated Woodpecker	G5	S5	S5	No
Native Brook Trout	G5	S4	S5	No
Wild Trout (Brook, Rainbow and Brown)	G5	S4	S5	No
Indiana Bat	G2	S1	S1	Yes
Virginia Northern Flying Squirrel	G5T2	S1	S2	Yes
Peregrine Falcon	G4	S1B/S2N	S2B S2N	Yes *
Bald Eagle	G5	S3S4B/S3S4N	S3B S3N	Yes *
James Spinymussel	G1	S1	S1	Yes
Shale Barren Rockcress	G2	S2	S2	Yes
Swamp Pink	G4	S1	N/A	Yes
Northeastern Bulrush	G3	S2	S1	Yes
Cave Dwelling Bat Group				

Management Indicator Species	Global Ranking	Virginia Ranking	West Virginia Ranking	Species Viability Concerns (Yes or No)
-Big Brown Bat	G5	S5	S5	No
-Little Brown Bat	G3	S1S3	S2	Yes
-Northern Long-eared Bat	G2G3	S2	S1S2	Yes
-Tri-color Bat (Pipistrelle)	G3	S1S3	S2	Yes
-Eastern Small-footed Bat	G1G3	S2	S1	Yes
Sunfish Family Group				
-Smallmouth Bass	G5	S5	S5	No
-Largemouth Bass	G5	S5	S5	No
-Redbreast Sunfish	G5	S5	S5	No
-Rock Bass	G5	S5	S5	No
-Black Crappie	G5	S5	S4	No
-Bluegill	G5	S5	S5	No
-Redear Sunfish	G5	SE	SE	No
Yellow Pine Community	NA	NA	NA	Yes
Old Growth Forest Types	NA	NA	NA	No

* Species has been federally delisted, so viability concerns on Forest are diminished.

Source: http://www.natureserve.org

Table 31. Heritage Ranking Codes Used in Preceding Table 30

Code	Code Description
G	Global Ranking
S	State Ranking
G1	Extremely Rare Throughout Entire Range Of Species (Occurrences 1-5)
S1	Extremely Rare Throughout The State (Occurrences 1-5)
G2	Very Rare Throughout Entire Range Of Species (Occurrences 6-20)
S2	Very Rare Throughout The State (Occurrences 6-20)
G3	Rare Or Uncommon Throughout The Entire Range Of Species (Occurrences 21-100)
S3	Rare Or Uncommon In The State (Occurrences 21-100)

Code	Code Description
G4	Common And Apparently Secure Throughout Range
S4	Common And Apparently Secure Throughout State
G5	Very Common And Demonstrably Secure Throughout Range
S5	Very Common And Demonstrably Secure Throughout State
GX	Believed Extinct With No Likelihood Of Rediscovery
SX	Believed Extirpated From State
SE	Exotic Species
GH	Historically Known Globally - Not Recently Verified (Within Past 15 Years)
SH	Historically Known From State - Not Recently Verified (Within Past 15 Years)
GU	Possibly Rare - Status Uncertain - More Data Needed
SU	Possibly Rare - Status Uncertain - More Data Needed
Q	Taxonomic Question
T	Signifies The Rank Of A Subspecies Or Variety
?	Rank Uncertain
N/A	Not Known To Occur In State
S*B S*N	B = Breeder, N = Non-breeder
NA	Not Applicable

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