

LASSEN VOLCANIC NATIONAL PARK

A SUMMARY OF RESOURCE MANAGEMENT ACTIVITIES

FOR 2009

Division of Natural Resources Management
Lassen Volcanic National Park



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National Park Service
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BUFFLEHEAD DUCK MONITORING

INTRODUCTION

The Bufflehead Duck (*Bucephala albeola*) is California's rarest boreal duck species. The Bufflehead nests almost exclusively in cavities excavated by Northern Flickers (*Colaptes auratus*) and occasionally in those excavated by Pileated Woodpeckers (*Dryocopus pileatus*) (Cornell Laboratory of Ornithology 2008). A small, isolated breeding population occurs in Northeastern California, the majority of which is located within Lassen Volcanic National Park (LVNP) and Lassen National Forest (LNF). The nearest breeding population occurs a substantial distance away in central Oregon, Idaho, and Wyoming. The largest concentration of breeding buffleheads worldwide is found in Central British Columbia.

In an eight-year study of the distribution, density, population trends, and habitat usage of buffleheads in California, Airola (1987) raised concerns over the viability of the Lassen population because of its small size, remoteness from other breeding populations and several land-use factors which may lead to loss or degradation of habitat. These land-use factors were fish stocking, loss of nest snags near lake shorelines, and high recreation use. Of the 151 lakes surveyed within the study area, 21 broods and 82 adults were found. Airola developed models that estimated the total California breeding population at 59-65 pairs, with McCoy Flat reservoir in LNF contributing 20% of the state's population.

PROJECT HISTORY

In 1997, LVNP and LNF biologists agreed to establish an interagency monitoring effort to survey buffleheads over park and forest lands to determine if any changes had occurred in the population over the 11-year period since Airola completed his study. In addition, both agencies were interested in long-term monitoring of Bufflehead Duck population trends. These efforts are important because: 1) these two land holdings contain the vast majority of the breeding habitat for this species in California, and 2) much of this land, at least on LNF, is subject to land-use practices which may jeopardize the breeding success of the species.

During the first year of monitoring in 1997, twenty-six lakes were surveyed within LVNP. Broods were found on eight of these lakes, and another seven lakes had adult ducks but no broods. Combining all 218 ponds and lakes surveyed over the study area (LVNP and LNF lands) a total of 71 broods and 374 young were observed. Preliminary analysis of first year data seem to corroborate the findings of Airola that fish stocking and lakeshore disturbance can result in decreased bufflehead use and productivity on otherwise useable lakes (Rickman 1997). Using the 1997 data and estimation models developed by Airola, a total of 119-130 pairs and 95-104 broods were estimated to occur within the state. During a nine year period of surveys on LNF, Hog and McCoy Reservoirs have contributed 46% of the observed adults, 39% of the broods and 45% of

the young, despite having been dry or nearly dry for two of the survey years (Rickman 2006).

OBJECTIVES

The objective of this survey effort is to track population trends by monitoring Bufflehead Duck adults and young at lakes within LVNP. Additionally, data is being collected that will help describe site conditions at each lake, including the presence of fish and identification of potential human-caused disturbances.

METHODS

As many lakes as possible are surveyed each year. However, priority is given to fifty baseline lakes selected for long-term monitoring in 2003. These lakes have been prioritized for survey, in case limits on staff time preclude more extensive surveys. Forty of the fifty lakes were selected because brood production had been observed at these sites one or more times during the first six years of survey (1997-2002). Ten additional lakes were randomly selected, to detect potential increases in the number of breeding sites.

In 2009, Bufflehead Duck brood surveys were conducted between June 15 and August 10. Surveys were conducted by walking the perimeter of the lakes and recording numbers of adults with and without broods and the number of young in each brood. Sex of adult birds was noted. Because males in full basic plumage, adult females, and first-year birds of both sexes usually cannot be distinguished, birds greater than age 1 year were recorded as “age and sex unknown”, except females with broods and a few males in adult alternate plumage. Clutches with more than 12 young are thought to represent either the results of dump nesting or brood amalgamation (Rickman 2001). Therefore, the total number of young within an observed group is divided by 12 to estimate the number of contributing broods. Other data collected at each lake included: presence of fish, type and extent of recreational use, and a notation of other disturbances. Field data were recorded on standard survey forms and archived in the Natural Resource Management Division office. Data were entered into an Excel spreadsheet.

Volunteers contribute significantly to the survey efforts on both park lands and national forest lands. Volunteers from the California Waterfowl Association (CWA) surveyed numerous lakes on LNF in 2009.

RESULTS IN LASSEN VOLCANIC NATIONAL PARK

One hundred and nine lakes were surveyed in LVNP during 2009. Buffleheads were observed at 32 of the lakes surveyed. Twenty-one of the lakes supported broods and a total of 24 broods were observed (Figure 1). A total of 42 adults and 114 young were observed.

RESULTS OF INTERAGENCY SURVEYS

Two of the three ranger districts within Lassen National Forest are surveyed for Bufflehead Ducks: Eagle Lake Ranger District (ELRD) and Almanor Ranger District (ALRD). A total of 524 lakes and ponds were surveyed on LVNP and LNP lands in 2009. Broods were observed at 78 of the 524 site surveyed, and a total of 358 young counted. Refer to Table 1 for a summary of the interagency survey results.

Totals by agency in 2009 were:

Entity:	Number of Lakes Surveyed	Number of Lakes with Broods	Total Number of Broods	Total Number of Young
LVNP	109	21	24	114
ELRD	70	6	10	43
CWA	277	41	46	164
ALRD	68	10	10	37

Table 1. Bufflehead Duck Brood Surveys, 1997-2009, Lassen Volcanic National Park and Lassen National Forest

Year	Number of Lakes Surveyed	# of Lakes with Broods	Number of Broods	Number of Young
1997	218	43	71	374
1998	179	36	79	510
1999	198	46	105	651
2000	181	36	82	506
2001	348	43	46	203
2002	309	47	78	437
2003	351	42	76	297
2004	350	60	101	521
2005	399	57	110	490
2006	472	54	110	620
2007	385	50	85	434
2008	445	54	66	307
2009	524	78	90	358

FUTURE DIRECTION

The park will continue this joint project with Lassen National Forest as part of the park's long-term monitoring program.

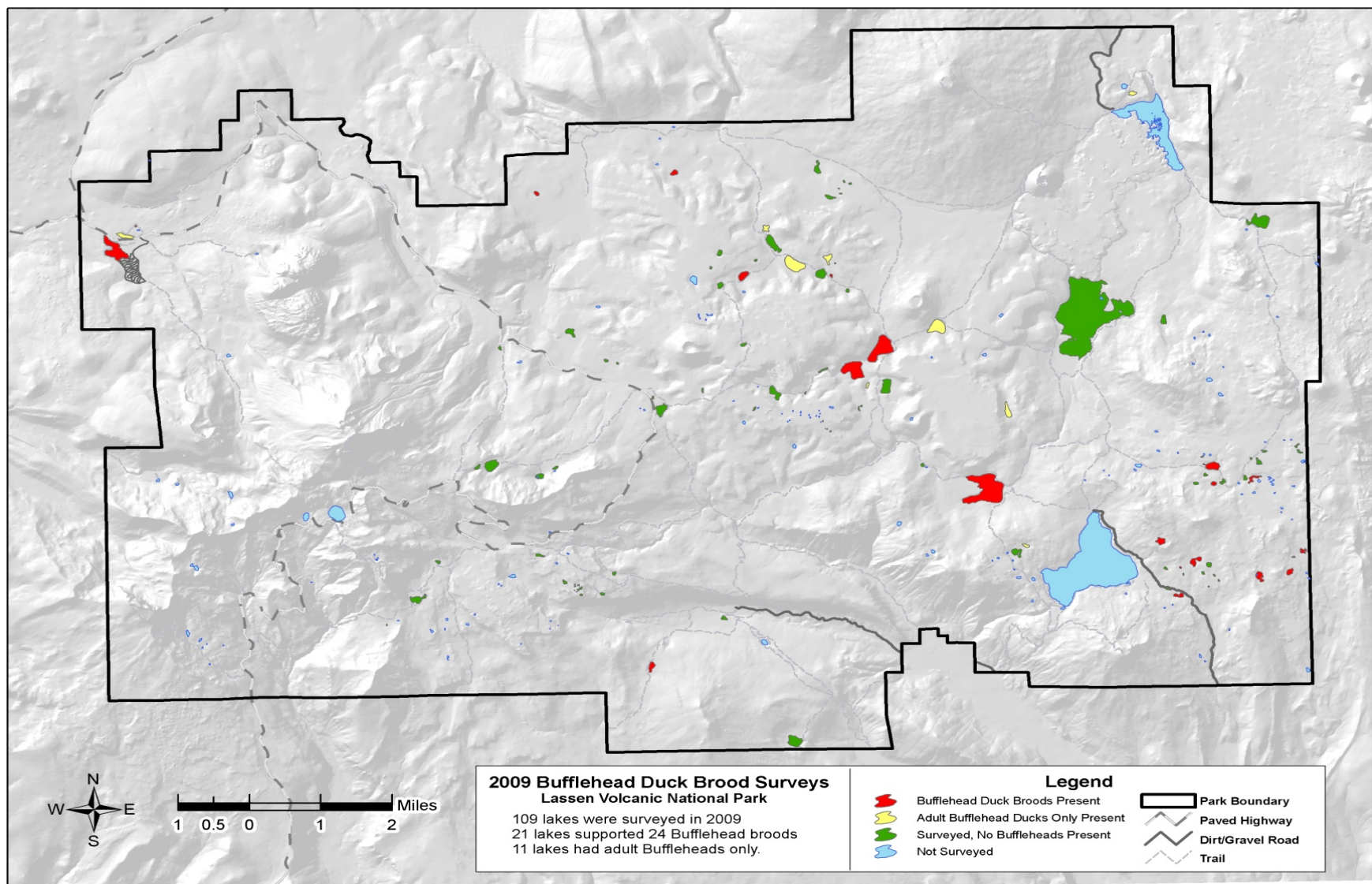


Figure 1. Map of 2009 Bufflehead Surveys

PEREGRINE FALCON MONITORING

INTRODUCTION

The American Peregrine Falcon (*Falco peregrinus anatum*), once a common resident throughout much of California, began rapidly declining about the mid-part of the 20th century. The chief factor responsible for this decline was the biochemical impact of organochlorine pesticide residues (primarily DDT), but habitat degradation throughout the falcon's range also played a large role. Documentation of these alarming trends not only in California populations but throughout the species range prompted the United States Fish and Wildlife Service (USFWS) in 1970 to list the American Peregrine Falcon as Federally endangered.

Once a species is Federally listed, the Endangered Species Act strives not only to prevent the species from becoming extinct, but ultimately to restore these species to the point where they no longer require legal protection. To this end, the USFWS is required to develop and implement formal Recovery Plans to help guide restoration efforts. The fundamental components of a recovery plan include range-wide inventories of species abundance and distribution, and monitoring to track population trends.

In 1999, due to population recovery criteria being met, the American Peregrine Falcon was removed from the Federal list of Endangered and Threatened Wildlife. It currently retains endangered status by the State of California.

Though periodic sightings of this species in the park have been made over the past few decades (LVNP Species Observations Database), and nesting has been confirmed outside the park boundary (Grinnell and Miller 1944), the park's scant records have never shown peregrine falcons to nest inside the park. A scientific study conducted in the park (Baldrige et al. 1980), though not successful in detecting nesting Peregrine Falcons, identified potential nesting sites and recommended a strategy for monitoring these sites.

PROJECT HISTORY

In 1980, a study was initiated by the Cooperative Park Studies Unit in Davis to determine the extent of the use of the park by endangered raptors, including Peregrine Falcon (Baldrige et al. 1980). Thirty-six priority cliff sites were located, described, photographed, and mapped for their potential to support Peregrine Falcon nesting. Data analysis showed that none of the 36 cliff sites held excellent potential as a Peregrine Falcon nesting location. However, two sites were rated as having good potential, three sites were rated as suitable, and four sites were rated as having marginal potential. The remaining 27 potential sites, after closer examination, were considered unsuitable for nesting.

Though no Peregrine Falcon nesting was observed at any of these locations during subsequent surveys in summer 1980, one Peregrine Falcon was observed near Lassen

Peak well after the nesting season. Results led the authors to believe that 1) potential Peregrine Falcon nest sites in the park are below optimum, and that most are generally unsuitable, and 2) presence of Peregrine Falcon in the park is probably mostly due to upslope post-breeding movement in response of prey availability.

Nevertheless, because five sites (those rated as having good or suitable potential) could conceivably support nesting Peregrine Falcons in some years, the report recommended that the park annually monitor these sites using methods similar to those employed in this study. Nest site monitoring was begun in 1997 and has continued annually at high priority sites.

METHODS

An observer experienced in Peregrine Falcon monitoring conducted all surveys from designated (and mapped) observation posts. A spotting scope and binoculars were used to scan all potential nesting sites. Results of surveys including Peregrine Falcon sightings and any signs and indications of nesting activities were recorded in detailed journal format, which is stored in Resource Management files. Timing and duration of surveys was based on knowledge of the species' nesting habits, local climate conditions, and consultation with biologists conducting Peregrine Falcon surveys on lower elevation lands surrounding the park.

RESULTS

From fieldwork accomplished during 1999 and 2000, it was determined that: 1) 2009 field efforts would be concentrated on two priority sites that appeared to promise the best results, and 2) locating Peregrine Falcons while they were still on the nest would require beginning the surveys in mid to late May. The two sites chosen were Northwest Blue Lake Canyon, and Raker Peak.

Northwest Blue Lake Canyon

This nest cliff was surveyed on May 21st of 2009. This cliff was surveyed from 10:15 until 13:00 with no peregrine falcons seen or heard. The cliff was surveyed again on May 28th from approximately 11:00 until 13:30 with one peregrine falcon heard calling and seen briefly flying along the cliff and then disappeared around 12:00. No peregrine falcons were seen or heard for the rest of this survey. Due to time and personnel constraints, this area was not surveyed again in 2009. The reproductive status of this territory is unknown for 2009.

Raker Peak

This area was surveyed by using a spotting scope and binoculars to view the cliff and surrounding areas. The area was surveyed twice in 2009, on May 21 and May 28. No indication of Peregrine Falcon presence was observed on either of these visits.

Visitor Reports

There were two observations of Peregrine Falcons reported by park visitors in 2009. There was one peregrine falcon observed at Ridge Lakes on July 16th and one peregrine falcon observed at the top of Brokeoff Mountain on August 3rd. These observations did not include behavior or description details.

FUTURE DIRECTION

We plan to continue implementing Peregrine Falcon monitoring at the high priority sites in Blue Lake Canyon and Raker Peak for 2010. We will continue to collaborate and share information with Forest Service biologists conducting falcon monitoring on properties adjacent to LVNP.

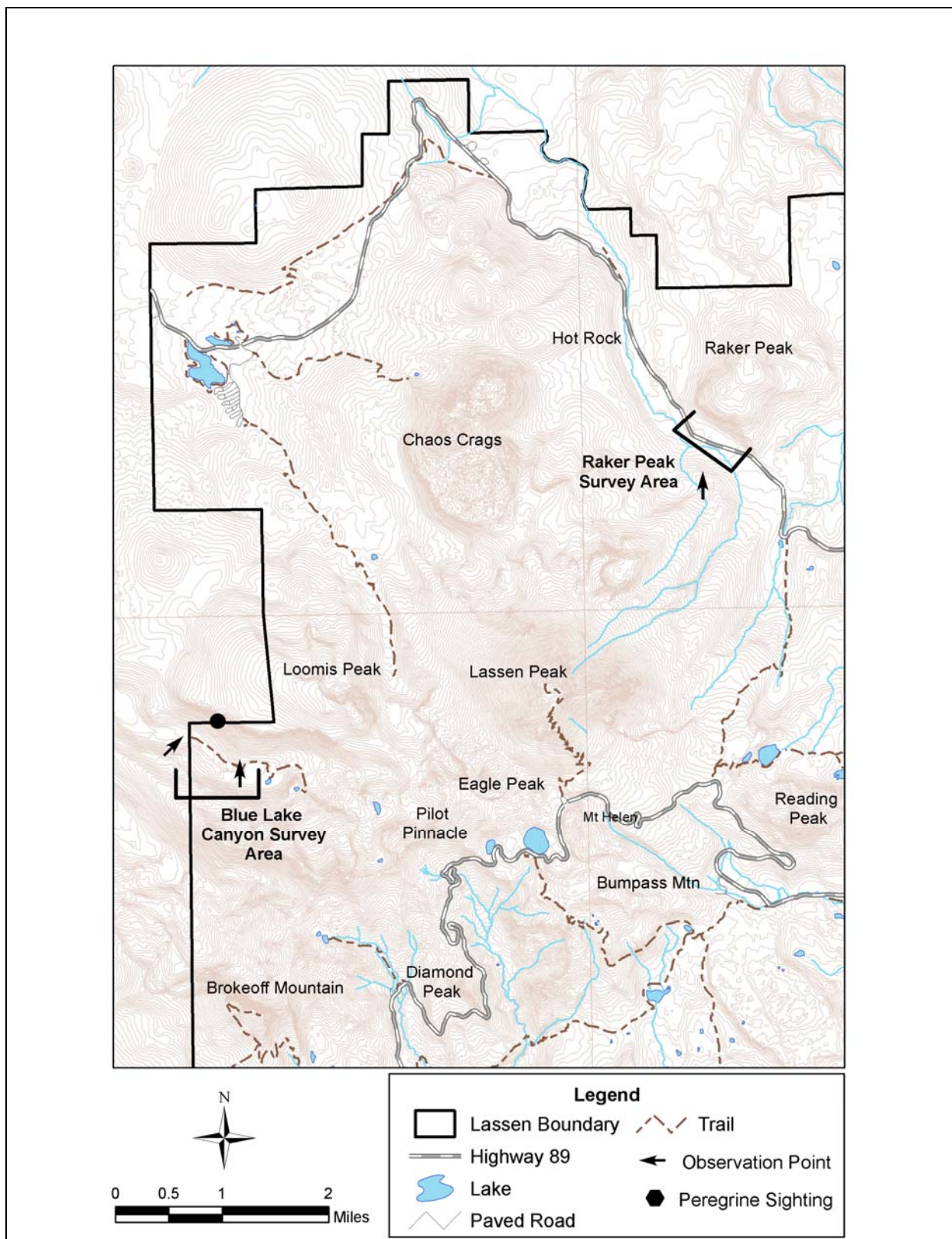


Figure 2. Peregrine Falcon Survey Sites

BALD EAGLE NEST MONITORING

INTRODUCTION

Though no historical information exists on Bald Eagle (*Haliaeetus leucocephalus*) population size in California, it is widely thought that this species formerly occupied a widespread range and was quite abundant throughout the western states. After World War II, the Bald Eagle population declined rapidly in California and throughout all other parts of its range. This was caused primarily by DDT contamination which caused severe nesting failure in this species. Another factor contributing to its decline was degradation of breeding and wintering habitats. In 1967 the United States Fish and Wildlife Service (USFWS) listed the Bald Eagle as Federally endangered, followed by the State of California which listed the species as endangered in 1971. By the late 1960s and early 1970s, fewer than 30 nesting pairs remained in California, all in the northern part of the state (Jurek 1990).

Fortunately, the last 30 years have seen a remarkable turnaround in population numbers and occupied sites for the Bald Eagle. Protection of nesting areas, restrictions on use of DDT and other pesticides, and wildlife management projects designed to enhance bald eagle populations have all played significant roles. By 1994, the number of occupied territories in California had increased from 30 to 116. Likewise, the wintering population had stabilized to around 1,000 birds. Annual productivity for the species has been considered good during the last decade, with slightly more than one young being produced per occupied territory. Partly because much progress has been made toward meeting most of the population recovery criteria specified in the Pacific Bald Eagle Recovery Plan (Jurek 1995), the USFWS recently officially reclassified the Bald Eagle to threatened.

Since 1980, Lassen Volcanic National Park (LVNP) has actively participated in a multi-agency program of annual breeding season surveys. This program, which is managed by the California Department of Fish and Game (CDFG), has provided a relatively thorough statewide coverage of the status of breeding Bald Eagles.

PROJECT HISTORY

The current Bald Eagle monitoring effort has been in place for more than 20 years and stems from written management recommendations provided by a 1980 study of endangered raptors in the park (Baldrige et al. 1980). The purpose of that study was to document the distribution of endangered raptors (Bald Eagle and Peregrine Falcon) in LVNP, determine if these species nested in the park, and implement a monitoring system for these species which could be continued by park personnel. Significant findings of Baldrige's study were: 1) the discovery of the first active Bald Eagle nest in the park, at Snag Lake, 2) the recognition that the Snag Lake nest is probably the highest in elevation of any in the state, and 3) the acknowledgment that LVNP has extremely marginal Bald Eagle nesting habitat because of scarce food supplies and relatively harsh climates during the nesting season. Therefore, the park can support at

most one resident breeding pair, in addition to one other foraging pair which nests outside the park, and a few wandering juveniles.

The nest that was used in 2000 blew down during the winter or spring of 2001. No new nest has been located since 2000. Adult Bald Eagles have been observed in the Butte Lake, Snag Lake, and Cluster Lake areas since 2000.

METHODS

Two observation posts are used to make on-ground surveys of the nest tree during the breeding/fledging season. The principal post is located one half mile west/northwest of the nest, and the secondary post is located east/northeast near the southwest edge of Snag Lake. Observation posts and nest trees have been mapped using a GPS device. Observations generally occur approximately once per week from early June until young Bald Eagles fledge (sometimes as late as early August), or until it is determined that no young are present. Observations are taken using a 20-45 power spotting scope and binoculars. In addition to time spent at the observation posts, observations are made of the entire Snag Lake region from trails along the lakeshore and prominent points affording adequate views of the lake. In years of nesting success, detailed records are kept of adult foraging behavior, foods obtained, adult and nestling interactions, and alternate nest building and nest repairing activities. Data are recorded on standard CDFG eagle monitoring forms and submitted to State offices in Sacramento.

RESULTS

In 2009, Resource Management staff searched for bald eagles at Snag Lake and was successful in locating one nest along the SW shore in the same vicinity as the 2000 nest on 6-18-09. On 6-17, Resource Management staff hiked into Snag Lake in the late afternoon to camp that night and look for Bald Eagles. The crew camped along the eastern shore and used a spotting scope to observe the western shore where the previous nest was located. That afternoon a juvenile Bald Eagle was also observed flying over the lake and then perched along the eastern shore. This juvenile appeared to be 1½ to 2 ½ years old by plumage characteristics (McCollough, 1989). One adult bald eagle was also observed perched in the trees above the west shore of the lake and disappeared just after sunset. On the morning of 6-18, the juvenile was observed along the eastern shore again and both adults were observed flying over the lake. At mid morning the nest was located by watching one of the adults fly to the nest where 2 juveniles were observed. This nest is the same nest that was found in 2003 and surveyed from 2003 to 2005 with no bald eagles observed and thought to be historic. The nest was surveyed again in mid July and the two young were still in the nest. In mid August the nest was surveyed again and both young were out of the nest and flying.

Bald Eagles were also observed by park staff at Manzanita Lake in 2009. There were two sighting reports turned in by park staff for Manzanita Lake. One reported seeing one adult being chased by an “unidentifiable, medium sized raptor” and the other

reported seeing one adult Bald Eagle land in a tree near Manzanita Creek. These Eagles nest outside the park but use Manzanita Lake for foraging.

Bald Eagle nesting success at the Snag Lake site has been verified in 12 of the 31 years of nest monitoring (Table 2). Although no nest was found in 2007 or 2008, one juvenile was observed both years inferring nesting success for these years as well.

FUTURE DIRECTION

Nest site monitoring will continue indefinitely at the Snag Lake nest site. Any additional nest sites located within the park will be monitored using established protocol.

Table 2. Snag Lake Bald Eagle Nest History, LVNP

Year	Hatched, (Fledged)	Mode of Survey	Comment
1979	unknown, (1)	Foot	No nest located
1980	No	Aircraft, foot	1 nest located
1981	No	Aircraft	No nest located
1982	No	Foot	No nest located, late thaw
1983	2, (1)	Foot	1 nest located, late thaw
1984	2, (1)	Foot	Same tree as previous year
1985	?	---	Not surveyed
1986	?, (1)	Foot	2 nests found, 1 gone by end of year
1987	2, (1)	Foot	Alternate nest rebuilt, then collapsed; Remains of eaglet found; Snag Fire in Aug-Sept.
1988	No	Foot	Evidence of spring nest-building
1989	No	Foot	Nest used in '83 and '84 fully intact
1990	No	Foot	No evidence of nesting or territorial behavior
1991	No	Foot	No evidence of nesting or territorial behavior
1992	1, (1)	Foot	Same nest as used in '83 and '84
1993	1, (1)	Foot	Same nest as used in '83 and '84
1994	?	--	Not surveyed
1995	No	Foot	Heavy winter snow, late thaw
1996	1, (1)	Foot	
1997	1, (1)	Foot	
1998	No	Foot	El Nino winter; evidence of spring nest- building
1999	1,(1)	Foot	Probably same nest as used in 1996/7
2000	1,(1)	Foot	Same nest as used in 1999
2001	No	Foot	No nest located
2002	Unknown	Foot	No nest located
2003	Unknown	Foot	One nest located (historic nest)
2004	Unknown	Foot	One historic nest located - no activity
2005	Unknown	Foot	One historic nest located - no activity
2006	Unknown	Foot	Status unknown
2007	Unknown	Foot	Status unknown (1 young suspected)
2008	Unknown	Foot	Status unknown (1 young suspected)
2009	2(2)	Foot	Historic nest found in 03 used in 09

SONGBIRD MONITORING – DRAKESBAD MIST-NETTING

INTRODUCTION

In the past few decades, much concern has been raised about the sharp and widespread population declines of songbirds. In the early 1990s, the Partners in Flight (PIF) program began an attempt to enlist a concerted effort among academic, government, and private sector scientists and managers to understand the causes of, and then reverse, songbird declines. Through this program, many important underlying causes of declines have been identified, followed by successful strategies to protect songbirds and their habitats. The National Park Service has contributed an active role in the PIF program since its inception.

The Lassen region is critical to efforts to protect declining songbirds. The area supports diverse bird communities including half of the PIF-listed Species of Conservation Priority and all the species listed by the Sierra Nevada Ecosystem Project Report as declining or likely declining (Graber 1996). Neotropical migrants are an especially important avian group which are presently well-represented in the Lassen region, but continue to show alarming declines elsewhere.

Constant-effort mist-netting data collected during the breeding season provides an annual index of abundance, productivity, and survivorship (DeSante and Geupel 1987). Data can indicate whether populations are sources (reproductive success is sufficient to balance mortality) or sinks (mortality exceeds local production of young), and whether existing conditions are capable of supporting breeding populations (Nur and Geupel 1993).

PROJECT HISTORY

From 1997-1999, Lassen Volcanic National Park (LVNP), Lassen National Forest (LNF), and the Point Reyes Bird Observatory (PRBO) conducted a 3-year study of the songbird communities in selected areas of the park and the forest. The purpose of this project was to evaluate the health of existing bird populations, identify areas important to sensitive and declining species, and provide recommendations to enhance declining populations. All data collected during these efforts were done so in accordance with standard methodologies and were contributed to national monitoring programs including Monitoring Avian Productivity and Survivorship (MAPS) and Breeding Biology Research and Monitoring Database (BBIRD).

During all years of the project, intensive training in standard methodologies (especially constant-effort mist-netting and point-counting) was provided to LVNP and LNF field staff by PRBO ornithologists to facilitate continuation of the project beyond the 3-year pilot period. At the conclusion of the study in 1999, the Drakesbad mist-netting station was converted to a permanent MAPS station as part of the park's long-term monitoring program. This year marked the thirteenth consecutive year of constant-effort mist-netting at Drakesbad.

METHODS

Mist-netting procedures were conducted according to the protocols described in Ralph et al. (1993). See Table 3 for a summary of days of operation. Nets were located approximately 50 meters apart and were operated during the breeding season approximately once every 10 days (Figure 4). Nets were opened 15 minutes after local sunrise, checked every 30 to 40 minutes, and operated for five hours. Birds captured were removed from the nets and processed immediately on-site. Each bird captured (except hummingbirds and game birds) received a U.S. Fish and Wildlife Service band for permanent identification and to allow estimates of survival from subsequent recaptures. Age, sex, skull ossification, breeding condition, fat score, molt, flight feather wear and fade, wing length and weight of each bird were recorded as described by Pyle (1997). All data are stored in FOXPRO databases and analysis programs developed by PRBO.

Table 3. Summary of Breeding Season Net Results from 1997-2009 at Drakesbad

Year	Days of Operation		Total Net Hrs.	No. of Captures ¹			Birds/ 100 Net Hrs.	Number of Species
	Total	Range		B	U	R		
1997	6	6/16-8/1	315	169	39	39	78.41	20
1998	4	7/7-8/4	200	127	23	37	93.5	24
1999	7	6/8-8/5	336	147	38	72	76.5	23
2000	7	6/5-8/3	247	143	39	46	92.3	27
2001	7	6/7-8/9	313.5	190	59	56	97.4	27
2002	7	6/4-8/6	350	217	21	71	88.3	24
2003	7	6/5-8/7	349.5	199	25	66	83.0	31
2004	7	6/3-8/5	350	217	43	58	90.8	30
2005	7	6/10-8/4	335	171	13	64	74.0	26
2006	7	6/7-8/3	350	301	50	53	115.4	31
2007	7	6/7-8/2	350	226	52	70	99.4	30
2008	7	6/5-8/7	350	179	38	61	79.4	30
2009	7	6/7-8/7	350	305	46	80	123.1	29

¹ B = BANDED, U = UNBANDED, R = RECAPTURE

RESULTS

The national average for number of individuals captured per 100 net hours, from 410 MAPS stations, was 37.2 in 1996 (DeSante et al. 1998). Drakesbad consistently has capture rates well above the national average. Productivity indices (juvenile to adult ratio) by species are presented in Table 4. These results indicate high productivity (defined here as ratios ≥ 0.30) for many breeding species, in particular several riparian species such as Neotropical migrants MacGillivray's Warbler (*Oporornis tolmiei*) and Wilson's Warbler (*Wilsonia pusilla*), in addition to Song Sparrow (*Melospiza melodia*) (Figure 3). This is noteworthy because two of these species, Wilson's Warbler (*W. pusilla*) and Song Sparrow (*M. melodia*), are showing marked declines throughout their ranges and are both listed by PIF as Species of Concern.

Survivorship analysis for Drakesbad was conducted in 2004 by PRBO. For Wilson's Warbler (*W. pusilla*) the survival rate was 33% for females and 68% for males (Gardali et al. 2004). The MAPS N.W. region estimate for this species was 45% (Gardali et al. 2004). For Song Sparrow (*M. melodia*) the survival rate was 49% for females and 57% for males (Gardali et al. 2004). The MAPS N.W. region estimate for this species was 47% (Gardali et al. 2004). MacGillivray's Warbler (*O. tolmiei*) had a survival rate of 42% for females and 48% for males (Gardali et al. 2004). The MAPS Northwest Region estimate for this species is 49%. It is interesting to note the difference between male and female survival rates for all three species. Female survival rates are lower than male survival rates for all three species. It is hypothesized that this is due to the stress levels endured by females that take on the majority of the effort during the breeding season in terms of egg production and incubation (Gardali et al. 2004). This data suggests that with the relatively high survival rates for these species, Drakesbad is high quality habitat.

Data continue to show the importance of the Drakesbad area for dispersing hatch year birds, such as Orange-crowned Warbler (*Vermivora celata*) and Rufous Hummingbird (*Selasphorus rufus*). Neither of these species breeds at Drakesbad but dispersing juveniles use the area to forage. In 2009, 35 hatch year Rufous Hummingbirds and 99 hatch-year Orange-crowned Warblers were captured. Fourteen after-hatch-year Orange-crowned Warblers were also captured in 2009 as well as three after-hatch-year Rufous Hummingbirds.

Between-year recapture has revealed important data on site fidelity and longevity. One male Warbling Vireo was recaptured in 2009 that were originally banded in 2002 and was aged as an after-hatch-year bird when originally banded. This would mean this bird is at least eight years old. One Song Sparrow and one Lincoln's Sparrow were recaptured in 2009 that were originally banded in 2005 and aged as after-second-year, indicating that these birds were at least five years old. One Orange-crowned Warbler was recaptured in 2009 that was originally captured as a juvenile in 2005, indicating this bird was four years old. One Wilson's Warbler was recaptured in 2009 that was originally captured in 2005 and aged as after-second-year, indicating that this bird is at least six years old. Another Wilson's Warbler was recaptured in 2009 that was originally banded in 2006 and aged as after-second year, indicating this bird is at least four years old. All other birds recaptured in 2009 were originally banded in 2007, 2008 or 2009.

No new species were recorded in 2009.

FUTURE DIRECTION

Long-term data collection from the Drakesbad station will continue indefinitely as a part of the park's developing inventory and monitoring program. Implementation of the Monitoring Concept Plan that was developed in 2000 will guide the park in planning comprehensive, long-term programs for monitoring bird populations (Humble et al. 2001). This plan recommended that the park combine mist-net data collection with relative abundance monitoring — using Variable Circular Plot (VCP) point counts — of bird populations in other areas of the park. In addition, recommendations were made to consider the establishment of 1 to 2 more mist-netting stations. This approach is in accordance with direction from the NPS Inventory and Monitoring program which states “the most effective and useful avian

monitoring programs will be those that incorporate multiple, complementary approaches — population distribution and trend monitoring through Variable Circular Plot Points Counts, and determination of vital rates through constant-effort mist-netting” (Fancy and Sauer 2000).

The Lassen National Forest plans to continue operating the Gurnsey Creek mist-net station, companion station to Drakesbad during 1997-2009. Resulting datasets will add greater resolution and value to Drakesbad data.

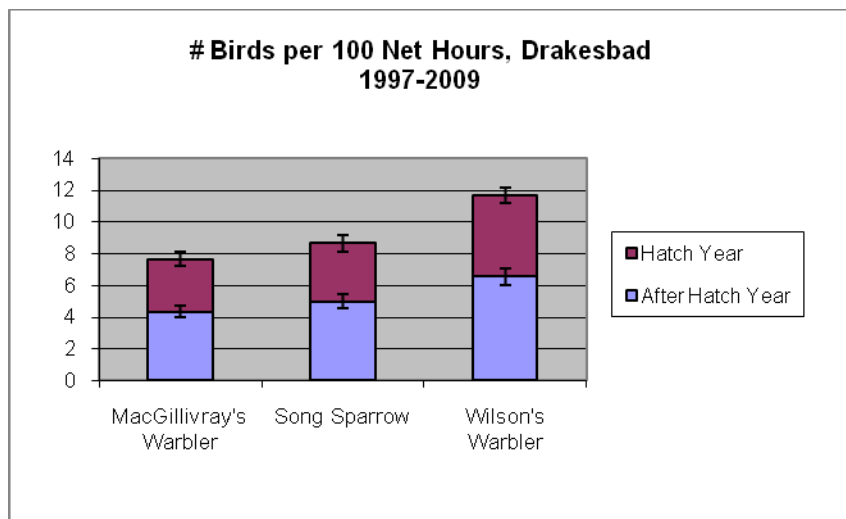


Figure 3. Average Productivity as Expressed in Ratios of Hatch-Year to After Hatch-Year Birds for Three Species at Drakesbad, Lassen Volcanic National Park

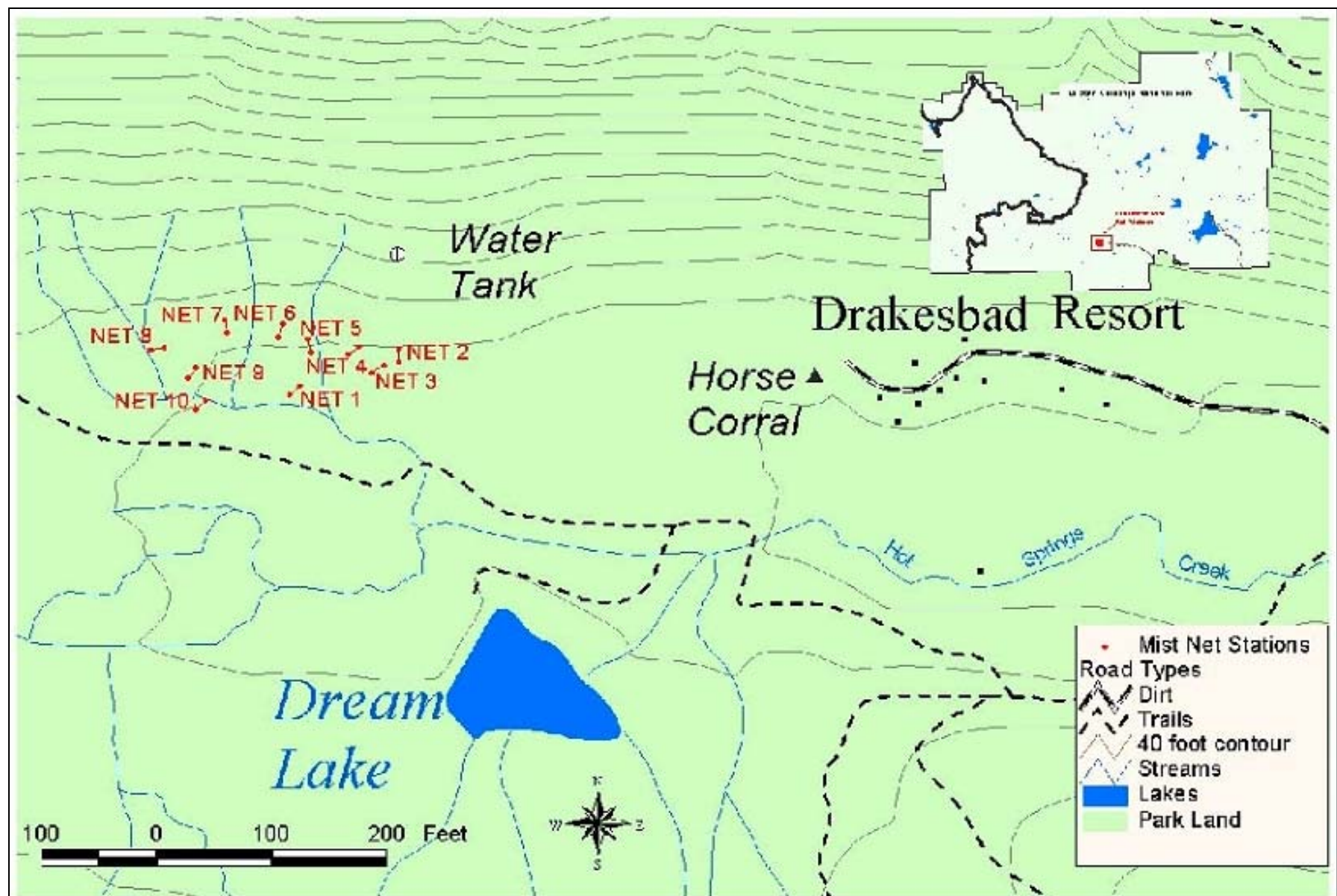


Figure 4. Drakesbad Mist Net Station

Table 4. Species and Age Class of Birds Banded at Drakesbad, 1997-2009

Species	1997			1998			1999			2000			2001			2002			2003		
	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio
American Dipper	0	0		0	0		0	0		1	0		0	0		0	0		0	0	
American Robin	0	1	0.00	0	3	0.00	2	5	0.40	0	5	0.00	0	1	0.00	0	2	0.00	0	4	0.00
Allen's Hummingbird	0	0		0	0		0	0		1	0		0	0		0	0		0	1	0.00
Anna's Hummingbird	2	1	2.00	2	0		0	0		0	0		1	0		0	0				
Audubon's Warbler	0	1	0.00	0	3	0.00	0	7	0.00	0	4	0.00	3	8	0.37	0	5	0.00	0	4	0.00
Brewer's Blackbird	0	0		0	1	0.00	0	0		0	0		0	0		0	0		0	0	
Brewer's Sparrow	0	0		0	0		0	0		1	0		0	0		0	0		0	0	
Brown Creeper	0	0		0	0		0	0		0	1	0.00	3	0		0	0		0	3	0.00
Calliope Hummingbird	0	0		0	0		0	0		3	0		2	1	2.00	0	0		0	0	
Cassin's Finch	0	0		0	1	0.00	0	4	0.00	0	1	0.00	0	0		0	1	1.00	1	12	0.08
Cassin's Vireo	2	0		0	0		1	0		0	0		0	0		1	1	1.0	2	0	
Common Snipe	0	0		0	0		0	0		0	0		0	0		0	0		U	U	
Dusky Flycatcher	0	0		0	0		0	0		1	0		3	0		0	0		0	1	0.00
Evening Grosbeak	0	11	0.00	0	8	0.00	0	3	0.00	1	0		0	4	0.00	0	13	0.00	0	9	0.00
Golden-crowned Kinglet	0	0		0	0		0	0		0	0		1	1	1.0	0	0		0	0	
Hairy Woodpecker	0	0		0	1	0.00	0	1	0.00	0	0		0	0		0	1	0.00	0	0	
Hammond's Flycatcher	2	0		0	0		4	0		1	0		1	0		1	0		1	0	
Hermit Thrush	0	0		0	1	0.00	0	0		0	0		0	0		0	0		0	0	
Hermit Warbler	0	0		0	0		0	2	0.00	2	0		0	0		2	0		0	1	0.00
House Wren	0	0		0	0		2	0		1	0		0	0		0	0		0	0	
Lazuli Bunting	0	0		0	0		0	0		0	0		0	2	0.00	0	0		0	0	
Lincoln's Sparrow	2	3	0.67	2	3	.067	1	4	0.25	2	2	1.0	0	1	0.00	2	6	0.33	0	5	0.00
MacGillivray's Warbler	14	11	1.27	3	9	0.33	5	16	0.31	14	8	1.75	17	12	1.42	12	21	0.57	10	8	1.25
Mountain Chickadee	0	0		0	1	0.00	0	2	0.00	0	1	0.00	2	0		0	0		0	2	0.00
Nashville Warbler	1	0		3	0		0	2	0.00	1	1	1.00	0	0		1	2	0.50	0	2	0.00
Olive-sided Flycatcher	0	0		0	0		0	0		0	0		0	0		0	0		0	1	0.00
Orange-crowned Warbler	39	2	19.5	25	2	12.5	28	1	28.0	28	6	4.67	37	9	4.11	35	11	3.18	27	11	2.45
Oregon Junco	1	0		0	3	0.00	0	4	0.00	1	4	0.25	3	0		0	2	0.00	0	0	
Pine Siskin	0	0		0	1	0.00	0	1	0.00	0	2	0.00	0	2	0.00	0	0		0	1	0.00
Purple Finch	0	0		0	0		0	0		0	0		2	1	2.00	0	0		0	0	
Red-breasted Nuthatch	0	0		0	0		0	0		0	0		0	0		0	0		0	1	0.00
Red-breasted Sapsucker	0	0		1	0		2	1	2.00	0	0		1	2	0.50	3	2	1.5	0	2	0.000
Red-shafted Flicker	0	1	0.00	0	0		0	0		0	0		0	0		0	0		0	0	
Red-winged Blackbird	0	1	0.00	0	1	0.00	0	0		0	2	0.00	0	2	0.00	0	1	0.00	0	1	0.00
Rufous Hummingbird	27	9	3.00	19	1	19.0	37	1	37.0	29	6	4.83	39	16	2.44	20	1	20.0	22	0	
Song Sparrow	17	12	1.42	4	17	0.24	5	18	0.28	16	13	1.23	13	16	0.81	8	22	0.36	6	19	0.31
Tree Swallow	0	0		0	0		0	0		0	0		0	0		0	0		0	1	0.00
Warbling Vireo	1	8	0.13	0	1	0.00	0	7	0.00	1	4	0.25	1	10	0.10	0	8	0.00	0	3	0.00
Western Tanager	0	0		0	3	0.00	1	4	0.25	0	2	0.00	0	6	0.00	0	3	0.00	0	3	0.00
Western Wood-Pewee	0	2	0.00	0	3	0.00	0	6	0.00	0	0		0	4	0.00	1	1	1.0	0	6	0.00
Willow Flycatcher	0	1	0.00	0	1	0.00	0	0		0	0		0	3	0.00	0	1	0.00	0	0	
Wilson's Warbler	22	13	1.69	12	21	0.57	9	19	0.47	16	17	0.94	20	16	1.25	6	28	0.21	22	21	1.05
Yellow Warbler	1	0		0	0		0	0		2	0		1	3	0.33	1	4	0.25	1	6	0.17
Totals	131	77		71	85		97	108		122	79		150	120		93	136		92	128	

U=unknown age.

Table 4 (cont). Species and Age Class of Birds Banded at Drakesbad, 1997-2009.

Species	2004			2005			2006			2007			2008			2009			
	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	HY	AHY	Ratio	
American Dipper	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	
American Robin	0	3	0.00	0	1	0.00	1	2	0.50	0	2	0	1	1	1.00	0	3	0.00	
Allen's Hummingbird	0	0		0	0		0	0		0	0	0	0	0	0	0	0	0.00	
Anna's Hummingbird	1	0	0.00	0	0		11	2	5.50	0	0	0	0	1	0.00	1	1	0.00	
Audubon's Warbler	4	6	0.67	0	2	0.00	0	1	0.00	3	0	0.00	0	6	0.00	0	3	0.00	
Black-headed Grosbeak	0	0		1	0		1	3	0.33	0	2	0	0	0	0	0	0	0.00	
Brewer's Blackbird	0	0		0	0		0	1	0.00	0	0	0	0	0	0	0	0	0.00	
Brewer's Sparrow	0	0		0	0		0	0		0	0	0	0	0	0	0	0	0.00	
Brown-headed Cowbird	0	0		0	0		0	1	0.00	0	0	0	0	0	0	0	0	0.00	
Brown Creeper	0	0		0	0		2	1	2.00	1	0	0.00	1	0	0.00	0	2	0.00	
Calliope Hummingbird	5	0	0.00	1	0		0	1	0.00	1	0	0.00	4	0	0.00	1	0	0.00	
Cassin's Finch	2	4	0.50	0	0		0	8	0.00	0	4	0.00	0	3	0.00	0	7	0.00	
Cassin's Vireo	1	0	0.00	0	1	0.00	0	0		0	0	0	0	1	0.00	1	1	1.00	
Dusky Flycatcher	0	1	0.00	0	0		0	1	0.00	1	0	0.00	0	1	0.00	1	0	0.00	
Evening Grosbeak	6	13	0.46	0	1	0.00	0	15	0.00	1	7	0.14	0	1	0.00	0	11	0.00	
Golden-crowned Kinglet	0	0		0	0		0	0		1	0	0.00	0	0	0.00	0	0	0.00	
Hairy Woodpecker	0	1	0.00	0	0		0	0		0	1	0.00	0	4	0.00	0	0	0.00	
Hammond's Flycatcher	0	0		2	0		3	1	3.00	2	0	0.00	0	0	0.00	4	0	0.00	
Hermit Thrush	0	0		0	0		0	0		0	0	0.00	0	1	0.00	0	0	0.00	
Hermit Warbler	1	1	1.00	0	0		1	0	0.00	2	0	0.00	0	0	0.00	0	0	0.00	
House Wren	0	0		0	0		1	0	0.00	1	0	0.00	0	0	0.00	0	1	0.00	
Lawrence's Goldfinch	1	0	0.00	0	0		0	0		0	0	0.00	0	0	0.00	0	0	0.00	
Lazuli Bunting	5	1	5.00	0	1	0.00	0	3	0.00	0	2	0.00	0	1	0.00	2	3	0.67	
Lincoln's Sparrow	2	4	0.50	4	8	0.50	4	2	2.00	3	2	1.50	0	2	0.00	2	5	0.40	
MacGillivray's. Warbler	12	19	0.63	6	14	0.50	20	18	1.11	5	8	0.63	8	18	0.44	13	21	0.62	
Mountain Chickadee	0	0		1	1	1.00	0	1	0.00	0	0	0.00	1	0	0.00	1	3	0.33	
Nashville Warbler	5	2	2.50	2	1	2.00	9	2	4.50	0	1	0.00	3	3	1.00	3	10	0.30	
Olive-sided Flycatcher	0	0		0	2	0.00	0	1	0.00	0	1	0.00	0	1	0.00	0	0	0.00	
Orange-crowned Warbler	43	7	6.14	31	6	5.17	102	6	17.0	55	14	3.93	42	4	10.5	99	14	7.07	
Oregon Junco	0	1	0.00	1	1	1.00	4	4	1.00	4	2	2.00	1	1	0.00	2	0	0.00	
Pine Siskin	2	8	0.25	0	0		0	0		0	3	0.00	0	0	0.00	0	0	0.00	
Purple Finch	0	0		1	1	1.00	0	0		0	0		0	0	0.00	0	0	0.00	
Red-breasted Nuthatch	1	0	0.00	0	0		0	0		1	0	0.00	0	0	0.00	1	0	0.00	
Red-breasted Sapsucker	1	6	0.17	0	1	0.00	0	1	0.00	0	2	0.00	2	1	2.00	0	2	0.00	
Red-shafted Flicker	0	0	0.00	0	0		0	0		0	0		U	U		0	0	0.00	
Red-winged Blackbird	0	0	0.00	0	0		0	0		0	0		0	1	0.00	0	1	0.00	
Rufous Humminbird	36	0	0.00	8	4	2.00	36	0	0.00	48	3	16.0	27	4	6.75	35	3	11.7	
Song Sparrow	12	9	1.33	5	12	.417	9	13	0.69	20	16	1.25	21	11	1.90	17	25	0.68	
Spotted Sandpiper	U	U	0	0	0		0	0		0	0		0	0	0.00	0	0	0.00	
Swainson's Thrush	0	0		0	1	0.00	0	0		0	0		0	0	0.00	0	0	0.00	
Townsend's Solitaire	0	0		0	1	0.00	0	0		0	0		0	0	0.00	0	0	0.00	
Warbling Vireo	2	2	1.00	0	12	0.00	0	4	0.00	1	6	0.17	1	13	0.77	1	20	0.05	
Western Tanager	0	0		0	7	0.00	1	5	0.20	1	4	0.25	0	3	0.00	0	4	0.00	
Western-Wood Peewee	0	5	0.00	0	6	0.00	1	10	0.10	1	3	0.33	0	5	0.00	0	1	0.00	
Willow Flycatcher	0	3	0.00	0	0		0	2	0.00	0	4	0.00	0	3	0.00	0	0	0.00	
Wilson's Warbler	14	22	0.64	13	29	.448	20	21	0.95	22	28	0.78	10	11	0.91	25	23	1.09	
Yellow Warbler	4	6	0.67	3	10	0.300	1	1	1.00	2	8	0.25	3	2	1.5	5	6	0.83	
Totals	160	124		79	122		227	131		176	123		125	103		214	170		

SONGBIRD MONITORING – BREEDING BIRD SURVEY

INTRODUCTION

In the 1960s concern began to be raised about the harmful effects of habitat degradation on the nation's songbird populations (Carson 1962). Unfortunately, because no long-term regional or continental data were available for most bird species, ornithologists were unable to accurately quantify these perceived declines. Consequently, in the mid-1960s the Patuxent Environmental Science Center (now a part of the USGS, Biological Resource Division) developed the Breeding Bird Survey (BBS) program, a volunteer-staffed effort to obtain continental population data on breeding birds. Today, the BBS has nearly 4000 established survey transects in the US and Canada and has become an important source of long-term population data for all birds at continental, regional and local scales.

As with any sound ecological monitoring program, the main strengths of the program are that it is systematic, range wide, and has been in operation for multiple decades. However, one drawback of BBS data is that it provides no explanation for cause of population trends. Other techniques such as constant-effort mist-netting or nest searches must be used to assist in identifying the cause of trends.

Despite the program's shortcomings, the BBS is still recognized as a valuable source of information for scientific research and is used by government agencies to establish management priorities. In recent years, the Sierra Nevada Ecosystems Project (SNEP) relied heavily upon BBS data to provide Congress with a status report of Sierra Nevada ecosystems (Graber 1996). During the course of SNEP, 17 BBS transects were analyzed. Among other findings, 18 species of landbirds were discovered to be declining or likely declining. The report also concluded that because of the many years of systematic data derived from Sierra Nevada routes, breeding landbirds were the most useful group of vertebrates to monitor as an indicator of vertebrate health in the Sierra Nevada.

New analysis techniques have increased the value of the BBS program to a wider range of resource managers and researchers. Because individual BBS routes have been recently linked by computer to specific geographic points, relative abundance data can be used to show temporal and geographical patterns of songbird decline (Figure 5). Because of the natural variation of bird populations and sampling error from imperfect BBS methods, the most precise estimates resulting from these data are those covering large spatial scales (continental or regional). These new analysis techniques more readily identify at-risk species to avian researchers who can then undertake studies to determine causes for declines.

PROJECT HISTORY

In 1972, the "Lassen Park" transect (Route 008) was established. Twenty-seven observation stations were located within the park's boundaries and 23 stations were located within Lassen National Forest (LNF). In 1990, the route was modified because highway noise from State Highway 44 was unacceptably influencing bird detection rates at

several observation stations along the highway. The new transect — renamed “Chaos Crater” (Route 308) — maintained the identical 27 observation stations as Route 008 within the park, but observation stations formerly occurring along the highway on LNF were redistributed to quieter locations (Figure 6).

Biologist Ron Schlorff of the California Department of Fish and Game conducted censuses on Route 008 from 1972 to 1989 and on Route 308 from 1990 to 1998. In 1999, park Resources Management assumed responsibility for managing Route 308.

Route 308 was not run in 1992, 1995, and 1998 because of inclement weather.

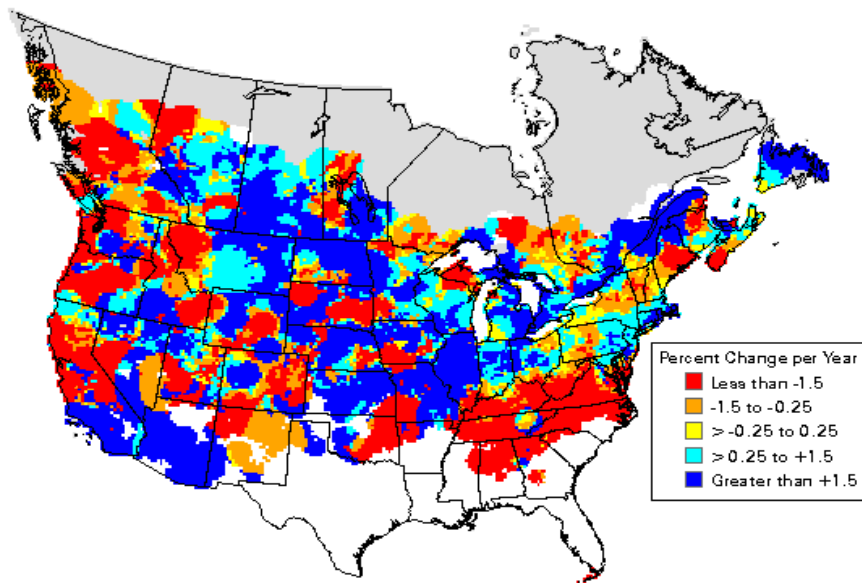


Figure 5. BBS Trend Map for Yellow Warbler, 1966-2003

METHODS

Following national protocols, Breeding Bird Surveys are conducted in the park once annually during the peak of the nesting season, primarily during June. The transect is 24.5 miles long, with 50 observation stations located at ½ mile intervals along the route. A three-minute point count is conducted at each station, during which the observer records all birds heard or seen within a quarter mile of the station. A single observer collects the data, although other observers may be present to record data or provide transportation between stations. Observers must be able to identify all birds breeding in their area by sight and sound.

RESULTS

In 2009, the route was run on July 01. A total of 325 individuals representing 37 species were observed in 2009. Audubon's Warbler (*Dendroica coronata*) was the most numerous species followed by Mountain Chickadee (*Parus gambeli*), with 52 and 41 individuals observed, respectively (Table 5). Oregon Junco was the third highest count with 27 individuals observed. There were no new species observed in 2009 although there were 11 unidentified flycatchers, four unidentified woodpeckers and one unidentified Accipiter hawk. The unidentified flycatchers were either Hammond's or Dusky Flycatchers which have similar plumage and song and are difficult to tell apart. If there was a question about the species it was marked down as unknown. The four unidentified woodpeckers and one Accipiter were flying through the forest and could not be reliably identified to species.

FUTURE DIRECTION

The park will continue to operate the Chaos Crater Route (#308) indefinitely to contribute data to this long-term national monitoring effort. Data from the BBS will help support and corroborate data collected from other avian monitoring programs within the park and surrounding National Forest lands.

Figure 6. Breeding Bird Survey Route # 308

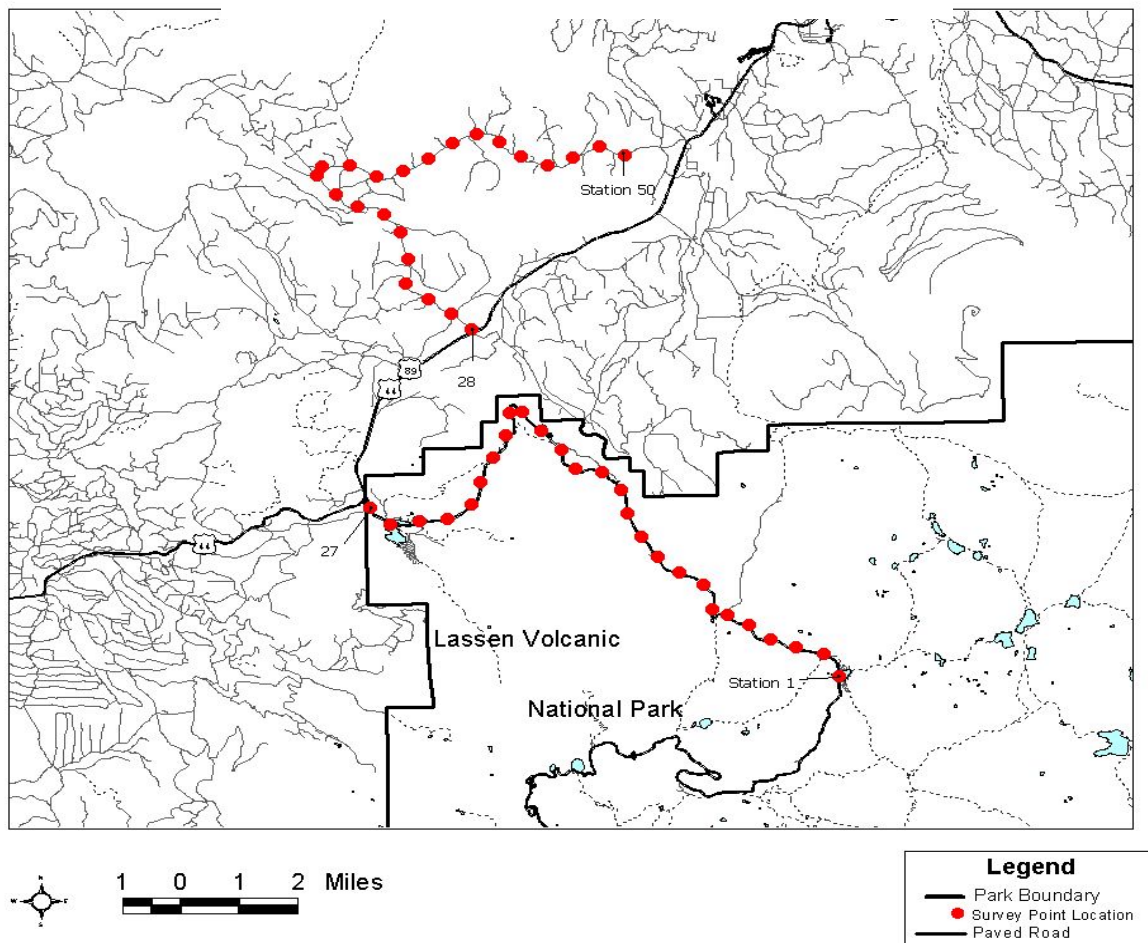


Figure 6. Breeding Bird Survey Route #308

Table 5. Breeding Bird Survey – Route Summary

RTE: 308 NAME: CHAOS CRATER STRATUM: 66 LAT-LONG: 4035-12133
STATE: CA

SPECIES	1990	1991	1993	1994	1996	1997	1999	2000	2001	2002	2003	2004	2005
American Coot	0	0	3	0	0	0	0	0	0	0	0	0	0
American Dipper	0	0	0	0	0	0	1	0	0	0	0	0	0
American Robin	46	30	40	28	28	37	12	13	10	10	6	7	14
Anna's Hummingbird	1	0	0	0	2	0	0	0	0	0	0	0	0
Audubon's Warbler	26	28	41	24	52	50	58	49	56	61	51	44	43
Band-tailed Pigeon	0	0	0	0	0	0	0	2	0	0	1	1	1
Bewick's Wren	0	0	0	2	1	0	0	0	0	0	0	0	0
Black-backed Woodpecker	0	3	0	0	3	0	1	0	2	0	0	0	0
Black-headed Grosbeak	1	1	0	4	0	0	0	0	0	0	0	0	0
Brewer's Blackbird	0	0	1	0	2	0	0	0	2	4	3	0	0
Brown Creeper	13	14	15	18	19	8	9	8	5	6	2	9	6
Brown-headed Cowbird	0	1	0	1	0	0	1	0	0	0	0	0	0
Canada Goose	0	0	0	0	0	0	0	0	0	0	0	0	2
Cassin's Finch	8	8	5	3	16	5	11	3	5	0	2	2	7
Chipping Sparrow	0	0	8	6	5	0	1	23	14	10	8	13	23
Clark's Nutcracker	13	4	2	0	2	0	3	0	0	3	0	0	0
Common Nighthawk	2	1	0	0	1	2	0	0	1	0	0	1	2
Common Raven	0	0	0	0	4	3	0	1	3	1	1	3	1
Dusky Flycatcher	5	3	8	6	2	0	21	9	7	5	8	9	7
Evening Grosbeak	1	0	1	1	0	2	1	13	11	9	15	19	3
Fox Sparrow	15	12	9	3	10	9	7	15	13	11	10	11	11
Golden-crowned Kinglet	5	3	2	2	13	13	9	17	21	15	5	9	11
Gray Flycatcher	0	0	0	2	0	0	0	0	0	0	0	0	0
Great Blue Heron	0	0	1	0	0	0	0	0	0	0	0	0	0
Green-tailed Towhee	0	1	9	1	0	1	2	1	1	0	0	0	0
Hairy Woodpecker	1	6	9	5	5	2	5	0	0	6	0	3	1
Hammond's Flycatcher	17	42	17	18	28	31	9	5	5	6	11	9	8
Hermit Thrush	12	15	17	12	22	12	9	4	5	5	8	2	9
Hermit Warbler	0	1	4	7	13	0	19	7	2	2	5	3	4
House Wren	0	0	0	1	0	0	0	0	0	0	0	0	0
Lincoln Sparrow	0	0	0	0	0	0	1	1	1	2	0	1	2
Macgillivray's Warbler	0	0	3	0	0	0	1	0	0	2	0	2	1
Mallard	0	0	2	3	0	1	0	0	1	0	0	0	1
Mountain Chickadee	67	74	75	79	95	87	55	38	32	38	46	35	46
Mountain Quail	0	3	4	3	3	2	0	0	0	0	3	0	1

TABLE 5 (continued)	1990	1991	1993	1994	1996	1997	1999	2000	2001	2002	2003	2004	2005
Mourning Dove	0	0	1	0	0	2	0	0	0	0	0	0	0
Nashville Warbler	0	0	0	0	0	0	5	0	3	0	5	0	6
Northern Goshawk	1	0	0	0	0	0	0	1	0	0	0	0	0
Olive-sided Flycatcher	16	12	10	9	27	20	7	8	4	4	3	2	4
Orange-crowned Warbler	1	1	0	0	0	0	0	1	0	0	2	0	0
Oregon Junco	36	32	37	42	67	41	26	26	21	31	22	32	23
Pacific-slope Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0	1
Pied-billed Grebe	0	0	0	1	0	0	0	0	0	0	0	0	0
Pileated Woodpecker	0	0	0	0	0	0	0	0	0	1	0	1	0
Pine Siskin	0	0	1	0	0	0	4	1	2	0	0	1	0
Pygmy Nuthatch	0	0	0	0	0	0	0	0	2	0	0	0	0
Red Crossbill	0	0	1	0	0	0	2	1	0	0	3	2	0
Red-breasted Nuthatch	50	43	23	39	59	50	49	11	12	17	17	22	14
Red-breasted Sapsucker	0	0	0	0	1	2	3	1	2	1	2	0	0
Red-shafted Flicker	4	3	8	1	4	8	1	6	7	3	1	1	3
Red-tailed Hawk	0	0	1	1	1	1	0	0	0	0	0	0	0
Red-winged Blackbird	0	0	0	1	3	1	0	1	1	0	0	2	0
Cassin's (Solitary) Vireo	0	0	0	4	4	1	3	0	4	0	0	1	1
Song Sparrow	0	0	2	1	0	0	0	0	0	0	2	1	1
Spotted Sandpiper	0	0	0	0	0	0	0	0	0	0	1	1	0
Spotted Towhee	0	3	2	1	0	0	3	0	2	0	0	1	5
Steller's Jay	13	8	14	5	37	17	13	7	7	12	10	18	9
Townsend's Solitaire	0	0	0	0	0	0	9	4	3	3	1	3	1
Tree Swallow	0	1	0	0	2	1	4	0	0	2	1	0	1
Turkey Vulture	0	0	1	0	0	1	2	0	0	0	0	0	0
Unidentified Hummingbird	0	0	0	0	0	1	0	1	0	0	0	0	0
Warbling Vireo	1	5	3	8	1	2	15	7	7	11	10	8	12
Western Screech-Owl	1	0	0	0	0	0	0	0	0	0	0	0	0
Western Tanager	3	6	1	3	4	3	17	21	18	27	25	20	19
Western Wood-Pewee	28	26	29	24	43	19	19	29	21	26	26	24	33
White-breasted Nuthatch	1	1	0	1	0	0	0	0	0	0	1	0	0
White-headed Woodpecker	0	0	2	2	1	1	4	1	6	1	2	6	1
White-throated Swift	0	0	0	0	0	1	0	0	0	0	0	0	0
Willow Flycatcher	0	0	0	0	1	0	0	0	0	0	0	0	0
Wilson's Warbler	0	0	0	0	0	0	2	1	0	0	0	0	0
Winter Wren	0	0	0	0	0	0	0	1	0	0	0	0	0
Wrentit	0	0	0	0	0	0	3	1	1	2	0	1	0
Yellow Warbler	1	8	2	3	5	5	1	3	2	1	2	1	1
TOTAL INDIV.	389	399	414	375	586	442	428	342	322	338	321	331	339
TOTAL SPECIES	29	32	39	39	37	35	42	38	39	33	36	39	39
DATE ROUTE RUN	06/23	06/15	07/03	06/25	06/21	06/19	06/19	06/26	06/25	06/27	6/28	6/29	7/02

TABLE 5 (continued) BREEDING BIRD SURVEY - ROUTE SUMMARY REPORT

SPECIES	2006	2007	2008	2009
American Coot	0	0	0	0
American Dipper	0	0	0	0
American Robin	6	9	5	9
Anna's Hummingbird	0	0	0	0
Audubon's Warbler	36	38	41	52
Band-tailed Pigeon	1	1	5	0
Bewick's Wren	0	0	0	0
Black-backed Woodpecker	1	1	0	0
Black-headed Grosbeak	1	0	0	1
Brewer's Blackbird	0	0	0	2
Brown Creeper	1	3	4	2
Brown-headed Cowbird	0	0	1	0
Canada Goose	13	1	1	3
Cassin's Finch	4	6	4	2
Chipping Sparrow	10	12	11	18
Clark's Nutcracker	0	2	0	0
Common Nighthawk	0	0	2	2
Common Raven	4	0	1	3
Dusky Flycatcher	2	5	3	4
Evening Grosbeak	19	8	1	14
Fox Sparrow	5	8	5	5
Golden-crowned Kinglet	16	9	14	9
Gray Flycatcher	0	0	0	0
Great Blue Heron	0	0	0	0
Green-tailed Towhee	0	0	0	0
Hairy Woodpecker	2	5	2	3
Hammond's Flycatcher	6	5	2	8
Hermit Thrush	4	8	7	7
Hermit Warbler	0	5	0	0
House Wren	0	0	0	0
Lincoln Sparrow	2	2	2	1
Macgillivray's Warbler	0	0	0	0
Mallard	0	0	0	0
Mountain Chickadee	42	24	33	41
Mountain Quail	0	0	0	0
Mourning Dove	0	1	0	0
Nashville Warbler	0	1	0	0

TABLE 5 (continued) BREEDING BIRD SURVEY - ROUTE SUMMARY REPORT

SPECIES	2006	2007	2008	2009
Northern Goshawk	0	0	0	0
Olive-sided Flycatcher	0	0	3	3
Orange-crowned Warbler	0	0	0	0
Oregon Junco	27	23	30	27
Pacific-slope Flycatcher	0	0	0	0
Pied-billed Grebe	0	0	0	0
Pileated Woodpecker	0	0	1	0
Pine Siskin	0	1	0	1
Pygmy Nuthatch	0	0	0	0
Red Crossbill	0	2	0	0
Red-breasted Nuthatch	16	13	11	14
Red-breasted Sapsucker	1	1	2	1
Red-shafted Flicker	1	1	3	0
Red-tailed Hawk	0	0	0	0
Red-winged Blackbird	1	1	1	0
Cassin's (Solitary) Vireo	0	2	0	4
Song Sparrow	3	0	1	0
Spotted Sandpiper	1	0	0	0
Spotted Towhee	2	0	1	3
Steller's Jay	7	5	7	4
Townsend's Solitaire	2	4	3	4
Tree Swallow	0	0	0	0
Turkey Vulture	0	0	0	0
Unidentified Accipiter	0	0	0	1
Unidentified Flycatcher	3	6	8	11
Unidentified Hummingbird	1	0	0	0
Unidentified Woodpecker	0	2	4	4
Warbling Vireo	4	8	10	7
Western Screech-Owl	0	0	0	0
Western Tanager	15	19	12	21
Western Wood-Pewee	20	12	15	24
White-breasted Nuthatch	0	0	0	0
White-headed Woodpecker	1	1	2	4
White-throated Swift	0	0	0	0
Willow Flycatcher	0	0	0	0
Wilson's Warbler	0	0	1	3
Winter Wren	0	0	0	0
Wrentit	0	0	0	0
Yellow Warbler	1	4	0	3
TOTAL INDIV.	281	249	259	325
TOTAL SPECIES	36	36	37	37
DATE ROUTE RUN	7/11	6/21	7/08	7/01

SPOTTED OWL MONITORING

INTRODUCTION

The California Spotted Owl (*Strix occidentalis occidentalis*) is one of three subspecies of Spotted Owl occurring within the United States. The Mexican Spotted Owl (*Strix occidentalis lucida*) is found in the southwestern states and Mexico. The Northern Spotted Owl (*Strix occidentalis caurina*) occupies western Washington, Oregon and the coastal ranges of northern California, from the Oregon border to the San Francisco Bay area. The range of the California Spotted Owl includes the Cascade and Sierra Nevada mountains and portions of the Southern California Coast Range. Lassen Volcanic National Park (LVNP) is within the range of the California Spotted Owl, but not within the range of the Northern or Mexican Spotted Owls.

All three subspecies are associated with late seral habitat (Thomas et al. 1990). The California Spotted Owl occurs in habitat that has a mixture of tree sizes and usually at least two canopy layers, with some very large, old trees present (Verner et al. 1992). These old trees provide cavities which are used by the owls for nesting (Verner et al. 1992). Suitable California Spotted Owl habitat exists within LVNP.

The California Spotted Owl was petitioned for listing under the Endangered Species Act on October 12, 2000. The reason stated for the petition was habitat destruction due to logging, urban development, livestock grazing, mining, recreation, and road construction (USFWS 2000). The U.S. Fish and Wildlife Service (USFWS) made a determination on February 10, 2003 that the California Spotted Owl does not warrant protection under the Endangered Species Act at this time. This decision was based on the belief that current land management direction on Federal lands and commercial timberlands will increase nesting, roosting and foraging habitats for the California Spotted Owl. The California Spotted Owl is listed as a Sensitive species by the U.S. Forest Service and Bureau of Land Management (BLM).

PROJECT HISTORY

In 1988, a partial survey of suitable habitat within LVNP detected one pair and two individual California Spotted Owls (Fowler 1988). The pair was located near Kings Creek Falls. The two individuals were a female found near Grassy Swale and a male found near Snag Lake. In 1995, a formal survey of the entire park was attempted; however, the park-wide survey was not completed because heavy snow delayed the beginning of the monitoring period (DuBrau and Evasick 1995). Areas that were surveyed in 1995 included the Warner Valley and Butte Lake prescribed burn units. A new pair of Spotted Owls was located near Butte Lake. The Butte Lake pair was determined to be non-nesting in 1995. In 2002, the Forest Service's Pacific Southwest Forest and Range Experimental Station (PSW) located two new nests within the park while surveying national forest lands adjacent to the park boundary. One nest was located in the vicinity of Willow Lake and the other north of Prospect Peak. Both nests are monitored annually. Also in 2002, park staff initiated surveys in areas with scheduled fire management activities. FIREPRO funding is used for these inventories to protect Spotted Owl nest sites from fire management activities.

such as prescribed burning and mechanical thinning projects. One new pair and nest was found in 2002 during these surveys on the south side of Prospect Peak.

In 2005, LVNP received funding from the NPS Biological Resource Management Division (BRMD) to conduct a two year inventory of all suitable Spotted Owl habitat within the park in 2005 and 2006. Potential suitable habitat was delineated by vegetation mapping and Geographic Information System (GIS) analysis. Survey points were established in suitable habitat along roads and trails. Surveys were conducted in accordance with a protocol developed by the US Forest Service. Two new pairs of Spotted Owls were located during this two year survey in 2005 and both determined to be non-nesting that year. One is located near Craggs Campground and the other in Warner Valley. In 2006, the Craggs pair was located and determined to be non-nesting but the Warner Valley pair was not located during 4 survey visits to the area they inhabited in 2005. Since FIREPRO funding was not available in 2005 and 2006, proposed burn areas were incorporated into the park wide survey. No new pairs or nests were located in areas proposed for fire management activities.

METHODS

The surveys were conducted using protocols established by the U.S. Forest Service for Spotted Owl surveys within the Sierra Nevada. This allows for consistency in survey methods between agencies. According to the protocol, all suitable habitat must be surveyed six times. The surveys may be conducted in one year, or three times per year over a two year period (preferred). Most surveys were conducted at night, however, some cross-country surveys, considered too hazardous to walk at night, were surveyed during the day. Call points were established every one-quarter to one-half mile along roads and trails. An amplified caller was used to play Spotted Owl calls to elicit responses from territorial Spotted Owls. Each call point was surveyed for ten minutes.

If a Spotted Owl was detected during a survey, a daytime follow-up visit was conducted within 48 hours. The follow-up visit is a visual search of the area to locate an owl detected at night. If a Spotted Owl was found during the follow-up visit, a technique called mousing was used to determine nesting status. Mousing consists of placing a live mouse on the forest floor in plain sight of the owl. An owl will normally fly down and take the mouse. The owl will either eat the mouse or take it to a mate or nest. If an owl eats four or more mice it is determined to be non-nesting. If an owl takes at least one mouse to a nest or mate, pair status is confirmed. If the owl ignores the mouse for an hour the follow-up visit is complete with the results being inconclusive. Nesting status is confirmed if a female is detected on the nest, either member of the pair takes prey into the nest, or young are detected in the presence of one or both adults. If nesting was confirmed, a reproductive visit was conducted after June 1st to determine number of fledged young. All nests, non-nesting pairs and individual Spotted Owl locations were mapped using global positioning system (GPS).

Great Horned Owls (*Bubo virginianus*) and Northern Goshawks (*Accipiter gentilis*) are known predators of spotted owls, particularly young Spotted Owls. If a Great Horned Owl or Northern Goshawk is heard or seen during the survey, the survey point and adjacent call points are aborted for that survey visit. Surveyors move to the next call point out of hearing distance (approximately 1 mile) of the predator and continued to survey. If a Great Horned

Owl or Northern Goshawk is seen or heard during a follow-up visit the visit is aborted immediately to reduce the chance of attracting potential predators to responding Spotted Owls.

RESULTS

FIREPRO funding was received in 2009 for Spotted Owl surveys in fire management areas. The GR11, Crescent block B, Hole, Lava roadside, and Raker burn units were surveyed in 2009. All these areas were surveyed to protocol with no spotted owls detected.

No new Spotted Owls were discovered in 2009. Visits to historical pairs are listed below.

Lost Creek Pair: This pair was discovered in 2005. The pair was determined to be non-nesting in 2005 and 2006. In 2007 a nest was found and the pair successfully fledged one young although 2 young were seen on the initial reproductive visit. The fate of the second juvenile is unknown. In 2008, this pair did not use the nest tree found in 2007 and nesting status was unknown. Several visits to the nest tree found no evidence of nesting activity in 2008. In 2009, the same pair found in 2008 were successful in fledging 2 young. The pair used the same nest tree that was used in 2007. The female was positively identified as the female from 2007 by her band and tab. The male is suspected to be the same male as 2008 as well. The tab on his band has not been confirmed since he was found despite repeated efforts to identify the tab. The band color is the same as the 2008 male so it is suspected to be the same male. A collaborative effort with PSW to band the juveniles was conducted. In the first attempt both adults and the two juveniles were located but neither of the juveniles could be captured because they could not be coaxed into coming low enough to capture despite repeated efforts. In a second attempt PSW crews were successful in banding one of the juveniles later in the season. The second juvenile was not caught and therefore was not banded.

Willow Lake pair: This pair was monitored by PSW in 2009 and successfully fledged one young. PSW was unable to band the juvenile despite repeated attempts. PSW was able to confirm the male and female were the same pair that inhabited the nest area in 2008. A new nest tree was used in 2009 that is located SE of the original nest tree.

Bathtub West Pair (North Prospect): This pair of owls used a nest that is inside the park near the park boundary on the north side of Prospect Peak in 2002. This pair moved outside of the park to Forest Service lands in 2003. The two known nest sites for this pair were surveyed twice in 2008 and three times 2009 with no response.

Fantastic Pair (South Prospect): This pair was not surveyed in 2009 due to staff priorities and workloads.

Other owl species detected: During the 2009 survey season three Great Horned Owls were detected. One Great Horned Owl was found in each of the GR11, Raker, and Hole burn units. When these owls were heard, the surveys were halted according to protocol and resumed out of hearing distance of the Great Horned Owl.

During the Fairfield Management fire, one juvenile Northern Saw-whet Owl was seen and pictures taken by fire personnel just north of Fairfield peak while on the Pacific Crest Trail.

This is the first confirmed Saw-whet Owl sighting since 1942 which was in the Manzanita Lake area. It is anticipated that surveys will be conducted in the Fairfield area for Saw-whet Owls in 2010.

None of the surveys had to be aborted for any reason in 2009.

FUTURE DIRECTION

Lassen Volcanic National Park will continue to monitor known nests and pairs annually. FIREPRO funding was received for surveys in 2010 of fuel treatment areas (prescribed fire, mechanical thinning, and pile burning). Surveys will be conducted in these areas in 2010 following the current Forest Service protocol prior to project initiation.

BLACK-TAILED DEER MONITORING

INTRODUCTION

The East Tehama Deer Herd (ETDH) of Columbian black-tailed deer (*Odocoileus hemionus columbianus*) is the largest migratory herd in California and occupies a range that is considered the most extensive in the state. It has a migration route of up to 150 km, and during the summer, occurs throughout the park and surrounding national forest lands. Based on 50-year datasets maintained by the California Department of Fish and Game (CDFG), the ETDH population reached a high of around 100,000 animals in the late 50s and early 60s. Later, due to the droughts of the 70s, numbers drastically fell off to about 35,000, then climbed back up to about 70,000 by the mid-1980s. Though large fluctuations in populations have been recorded in the 50 years of CDFG record-keeping, today's record low populations of around 25,000-30,000 animals appear not to be sufficiently rebounding. This has generated some concern among wildlife biologists and ecologists, as the ecological impact of this large deer herd on the Lassen region, both as a dominant herbivore and as prey for cougars and coyotes, is substantial. Changes in vegetation structure and composition through fire suppression may be the most important factor reducing the deer condition (Walker 1997).

PROJECT HISTORY

In 1996, Lassen Volcanic National Park (LVNP), in cooperation with the Lassen National Forest (LNF) and CDFG, assisted in the establishment of two spotlight trend survey routes in the Almanor Basin to complement a route which had been run yearly by CDFG biologists since 1992. Another route was established on LNF in 1997 to make a total of four routes that were surveyed annually from 1997 through 1999. The original route run by CDFG was eliminated after the 1999 count due to a change in policy, leaving a total of three routes that are currently surveyed annually. The purpose of these routes is to provide additional trend data to complement several other methods used by CDFG (including triplicate surveys of deer winter range in early winter and early spring) to census and develop accurate population trends and estimates for the ETDH.

METHODS

Fixed spotlight trend surveys are conducted according to protocols established by CDFG. In summary, 25-mile-long permanent road transects are surveyed for total deer numbers for three consecutive nights during the first two weeks of August. Routes are begun one hour before local sunset, and conclude around three hours after local sunset. Two observers, a driver and a passenger, conduct independent surveys on either side of the road while keeping vehicle travel speed at about eight miles per hour except for brief stops to record count information. Spotlights used in the surveys are 1 million candle power. Data is recorded on standardized data sheets and include weather information, deer observation times, and vehicle mileage at each observation. Total deer count is the most important data obtained, with sex and age classes being secondary information only recorded when there is absolutely no doubt about the accuracy of these judgments.

RESULTS

Fixed spotlight trend surveys were conducted on permanent transects in LVNP and LNF from August 3-August 5, 2009. All three transects (Juniper Lake, Swain Mountain, and Hay Meadows) were surveyed. This was the fourteenth year for Juniper Lake and Hay Meadows, and the thirteenth year for Swain Mountain. The Juniper Lake route in 2009 showed an approximate 23% increase in numbers observed over 2008 results. The Hay Meadow route showed an approximate 32% decline from 2008 results. The Swain Mountain route had the same number observed as in 2008. Refer to Figure 7 and Table 6 for 2009 results. All three routes were run with no problems or delays in 2009.

FUTURE DIRECTION

Fixed spotlight trend surveys will continue because they are an efficient method to obtain trend data while deer are on their summer range. These datasets have been important in corroborating the findings of other methods used by CDFG to monitor ETDH demographics.

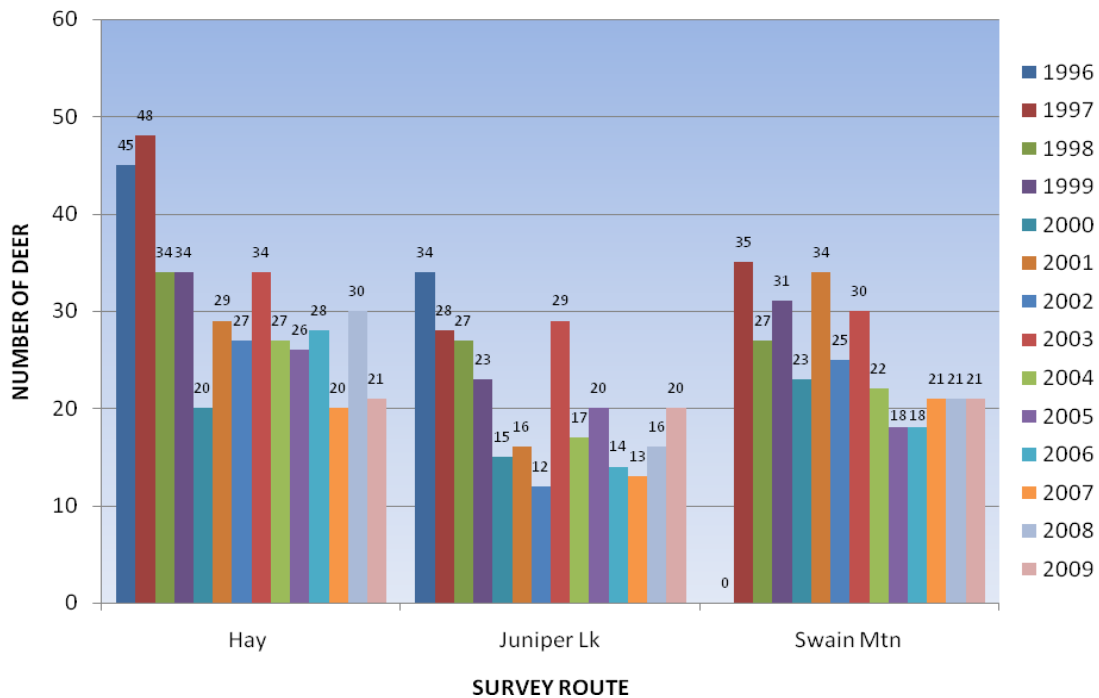


Figure 7. Average Annual Counts from Three Fixed Spotlight Deer Trend Surveys on Lassen Volcanic National Park and Lassen National Forest, 1996-2009

Table 6. 2009 Results from Three Fixed Spotlight Trend Surveys in Lassen Volcanic National Park and Lassen National Forest

HAY MEADOWS ROUTE

Survey Night	No. of Bucks	No. of Does	No. of Fawns	Unknown	Total
1	2 (0)	11 (17)	1 (2)	1 (11)	15 (30)
2	2 (5)	18 (14)	1 (5)	3 (6)	24 (30)
3	2 (2)	15 (17)	2 (4)	4 (8)	23 (31)
Route Totals	6 (7)	44 (48)	4 (11)	8 (25)	62 (91)
Nightly Avg.	2 (2.3)	14.7 (16)	1.33 (3.67)	2.67 (8.3)	20.7 (30.3)

JUNIPER LAKE ROUTE

Survey Night	No. of Bucks	No. of Does	No. of Fawns	Unknown	Total
1	3 (0)	11 (5)	2 (0)	0 (2)	16 (7)
2	1 (0)	11(9)	4 (4)	1 (3)	17(16)
3	5 (2)	11(16)	7 (2)	5 (4)	28(24)
Route Totals	9 (2)	33 (30)	13 (6)	6 (9)	61 (47)
Nightly Avg.	3(.67)	11 (10)	4.33(2)	2 (3)	20.3 (15.7)

SWAIN MOUNTAIN ROUTE

Survey Night	No. of Bucks	No. of Does	No. of Fawns	Unknown	Total
1	4 (1)	16 (15)	6 (2)	3 (6)	29 (24)
2	4 (1)	18 (7)	1 (3)	0 (4)	23 (15)
3	0 (0)	7 (17)	1 (0)	2 (7)	10 (24)
Route Totals	8 (2)	41 (39)	8 (5)	5 (17)	62 (63)
Nightly Avg.	2.67 (.67)	13.7 (13)	2.67 (1.7)	2 (5.7)	20.7 (21)

Note: The numbers of mule deer counted during 2008 surveys are listed in parentheses.

AMERICAN PIKA INVENTORIES

INTRODUCTION

The American pika (*Ochotona princeps*) is a small (6-8" long), egg-shaped mammal, closely related to rabbits and hares (Smith and Weston 1990). The American pika is discontinuously distributed throughout western North America, from central British Columbia and Alberta to the southern portions of the Sierra Nevada and Rocky Mountain ranges (Grayson 2005).

Pikas are characterized by moderately large rounded ears, a buried tail, and a densely furred body and are extremely well-adapted to living in cold environments (Smith and Weston 1990). Pikas have a high body temperature and a relatively low upper lethal temperature, and a few hours of exposure to temperatures in excess of 27°C (81°F) can be fatal (Grayson 2005, Smith and Weston 1990). Throughout their range, pika are obligate residents of talus or talus-like habitats (including lava flows) that provide protection from predators and thermal refugia from warm surface level temperatures (Grayson 2005, Beever et.al. 2008).

Pika are diurnal, although they tend to be most active above the surface of the rock during the cooler morning and evening hours. They are generalist herbivores and coprophagous, sometimes storing caecal pellets in food caches for future use (Verts and Carraway 1998). Pikas also harvest and store vegetation in 'haypiles,' which they commonly locate beneath a large, overhanging rock (Verts and Carraway 1998). Pikas are active year-round -- the amount of food stored in haypiles is insufficient to provide an exclusive source of food during the winter, therefore, they are believed to forage along snow tunnels near the talus-meadow interface throughout the long winter months (Huntly et.al.1986, Millar and Zwickel 1972, Verts and Carraway 1998).

Recent reports indicate that pika may be vulnerable to the existing and predicted effects of climate change. From the Pleistocene to the present, warming temperatures have resulted in distribution shifts of valley dwelling vertebrates to the north and mountain dwelling species upward in elevation to increasingly isolated 'islands' of habitat (Beever et.al.2008, Guralnick 2007). Grayson (2005) concluded that the distribution of both prehistoric and extant populations of pika in the Great Basin have progressively increased in elevation since the Pleistocene. Recent surveys in the Great Basin sites discovered that greater than 25% of historic sites surveyed had apparently been extirpated within the last half century (Beever et al. 2003). Both Grayson (2005) and Beever, et. al. (2003) suggested that anthropogenic influences combined with longer scale climatic and vegetation changes may be responsible.

The Center for Biological Diversity (CBD) filed a petition with the California Fish and Game Commission (CDFG) to list the American Pika as threatened in August 2007. A CDFG evaluation of the petition found insufficient evidence to warrant listing the pika under the California Endangered Species Act. In October 2007, the CBD petitioned the Secretary of Interior to add the pika to the list of Threatened or Endangered species subject to federal protection under the Endangered Species Act. The USFWS has agreed to determine if the American pika warrants protection, however, their determination is still forthcoming.

PROJECT HISTORY

In May 2006, park biologists attended a pika monitoring workshop held at Lava Beds National Monument (LBE), lead by Chris Ray, of the University of Colorado, Boulder. LBE was beginning the second year of research on pika inhabiting the extensive low-elevation lava flows within the Monument, and convened the workshop for its seasonal staff along with staff from other National Park Service units and a number of researchers. The objectives of the workshop were to review pika ecology, train researchers in pika detection and monitoring techniques, and establish a network for sharing data and research relating to pika population dynamics and climate change.

After attending the LBE workshop, LVNP staffs began a review of records and databases to gather information about 'historic' pika detections within the park. Information came from a variety of sources, including Lassen Volcanic National Park Wildlife Observation Records, information from miscellaneous wildlife surveys conducted within the park, records from Grinnell, Dixon and Linsdale's *Vertebrate Natural History of Northern California through the Lassen Peak Region*, and the online collections database maintained by the Museum of Vertebrate Zoology at Berkeley. From this review, a list of sixty-one detections between 1923 and 2005 was developed; these detections represented thirty-four distinct locations. Of the thirty-four sites, seven could not be reliably relocated. The descriptions of the remaining 27 sites vary from specific (i.e. behind lower bathrooms on Lassen Peak trail) to general (i.e. east side of Bonte Peak), however, even the most general locations revealed historic pika occupancy in distinct areas of the park and were resurveyed.

OBJECTIVES

The objectives of the project include:

1. Review historic wildlife sighting cards and other sources of information to generate a list of historic pika sightings within LVNP.
2. Revisit each historic location and search for evidence of current pika activity
3. Collect site information at currently or historically occupied sites according to methods developed at Lava Beds National Monument (Ray and Beever 2007).

METHODS

Using available information (site description, hand-drawn maps, and occasionally GPSed locations), a site is relocated from historic data. The survey crew begins a visual and aural survey for pika occupancy. Active sites are identified by the following: a pika seen or heard, the presence of a 'fresh' haypile (containing current year's cut vegetation), and fresh pika scat in conjunction with observation of freshly cut and dragged vegetation. Inactive sites are identified by the detection of old haypiles, pika scat or pika urine stains.

The survey crew identifies a site center based on whether the site is active or inactive. If the site is inactive and one or more old haypiles have been located, the haypile closest to the estimated 'historic' location is selected as the site center. If the site is active, the fresh haypile located closest to the estimated 'historic' location is selected as the site center. At an active site with no haypile located, the site center is established where a pika was observed or heard.

Within 10 meters of the site center the following information is recorded : current weather conditions (which may affect a surveyor's ability to detect pika activity) site feature type (basalt or dacite talus, lava flow, cave site, etc), site aspect, slope, elevation, maximum observable depth of rock insulation, distance of haypile from the edge of the rocky habitat patch, plants species observed within the haypile and general vegetation information (primarily identified to life form classification). In addition, the following information is collected about the entire site: patch size, proximity to roads and observations of the presence or sign of other mammals, particularly bushy-tailed woodrat (*Neotoma cinerea*) and yellow-bellied marmot (*Marmota flaviventris*).

RESULTS

In 2009, a total of 22 sites were surveyed, 9 of these sites were revisits of historic sites surveyed in 2007 and 2008 and 13 surveys were first time visits to one of the 27 'historic' locations. Of the 22 sites surveyed, 16 were identified as active and 6 as inactive. The inactive sites were Diamond Peak, Emerald Lake, Hemlock Lake, Lost Creek Campground, Table Mountain and Widow Spring. Pika activity has been observed at three of these sites (Hemlock, Lost Creek and Widow Spring) at one or more years between 2006 and 2008. In addition to the historic location resurveys, 5 additional sites identified through recent observations were surveyed.

FUTURE DIRECTION

In 2010, the park will be working with a research associate hired by the Upper Columbia River Basin Inventory and Monitoring Network (UCBN) to conduct pilot surveys for an American Pika Monitoring Protocol. The protocol was developed by UCBN staff in conjunction with staff from Crater Lake National Park, Craters of the Moon National Monument, Lassen Volcanic National Park, Lava Beds National Monument and the Klamath Network Inventory and Monitoring Network and is currently undergoing peer-review.

WILDLIFE SIGHTINGS

INTRODUCTION

A new system for recording wildlife observations from park staff and visitors at Lassen Volcanic National Park was initiated in 1999. This new system was needed to help park resource manager's accurately record wildlife observation data. There have been at least five different sighting report forms used at Lassen Volcanic National Park (Perrine and Arnold 2001). These forms ranged from the National Park Service's official Natural History Field Observation Form 10-257, to separate forms for reporting black bears and red foxes. The Interpretation Division also had its own form. Each form collected different information with an inconsistent level of detail. These forms did not have adequate space to describe the animal's physical attributes, location or behavior. Observer information was also incomplete which made it impossible to contact the observer if follow-up was needed. The data was stored in a dBase III+ electronic database that was familiar to only one person in the Resource Management Division. Because of the lack of familiarity with this database, the forms were filed without being entered into the electronic database. Without being entered into a user friendly database the query of the data was a long tedious process that yielded incomplete data. A new system was needed that would be user friendly to visitors and staff.

METHODS

A new system was developed that consisted of a new form with a map of Lassen Volcanic National Park on the back. The front of the form has short spaces for observer name, phone number and address, as well as date, time and location of the sighting. Longer spaces are provided to describe the animal and document behavior, the presence of offspring, and other information such as whether the animal is collared or tagged or injured. The back of the form has a map of the park showing roads, trails, campgrounds and other landmarks such as lakes and mountain peaks. The person completing the form fills out the front of the form and then marks the location on the map. The visitor gives the form to a park service employee who then forwards it to the Natural Resource Management Division.

The Resources Management staff has an overlay that divides the park into a grid of 1 square mile (mi²) sections. Each section has a code associated with it. One mi² was chosen because it was an acceptable compromise between accuracy and confidence. The overlay is used to determine in which grid square the sighting was located, and consequently what location code should be recorded in the database for the sighting.

After the location code is determined, all the sighting information is entered into a Microsoft Access database using a computerized data entry form. Basic queries can be run in this program to determine a wide variety of information. Some examples include the total number of sightings for a particular time period and the number of a given species between any given dates. The results can then be imported into ArcGIS to generate maps of sighting occurrences for particular species. These maps can illustrate either the number of reports received or the number of animals sighted, since several individuals of the same species may be reported as one sighting.

RESULTS

There were a total of 185 sighting reports turned in to the Resource Management Division in 2009. A total of 336 animals were reported representing 40 species (Table 7). In 2006, an article was published in the park newspaper asking visitors to report sightings of wildlife they thought were worthy of reporting. Although the numbers of reports turned in were not substantially different than 2005 (134 in 05 and 153 in 06), the number of species reported jumped from 37 in 2005 to 59 species in 2006. In 2007 the number of species reported declined from 59 in 2006 to 41. In 2008, the number of species reported declined from 41 in 2007 to 26. In 2009, the number of species reported increased from 26 in 2008 to 39. The same article asking visitors to report wildlife sightings was also published in 2009. In 2009, black bears were the most reported species in the park with 92 sighting reports recording 171 animals. There were a number of sightings of the same bears from the Kings Creek, Lost Creek, and Warner Valley areas which is why this number is so high for 2009. This year there was one female with three cubs observed three times near the Southwest entrance area. American marten had the second most sighting reports with 11 sighting reports recording 11 individuals for both species. Pika had the third highest sighting report numbers with 10 sighting reports recording 12 animals.

Two new species were recorded in 2009 that have not been previously recorded in the sightings database but are unconfirmed. One Wandering tattler and a group of six White-faced Ibis were observed by park visitors. A fairly detailed description was given on the Wandering Tattler but this sighting may have been a juvenile Spotted Sandpiper. The White-faced Ibis report did not give any details other than “feeding in the south end shallows of Snag Lake”. While this report seems credible due to the unusual characteristics of this species (fairly large greenish colored bird with large decurved bill) it cannot be verified.

The new sighting reports emphasize filling out a report for significant or unusual wildlife (such as cougars, bears, foxes, coyotes, marten, eagles, falcons, etc) or any animal that is injured or acting strangely. The result is most of the animals actually seen by visitors and staff, go undocumented.

FUTURE DIRECTION

Lassen Volcanic National Park will continue to use this system to record wildlife sightings.

Table 7. Number of animals reported in 2009 in Lassen Volcanic National Park
(The total number of reports submitted is in parentheses)

Species	Total # of animals	
Carnivores		
Badger	1	(1)
Bear, black	171	(92)
Bobcat	1	(1)
Coyote	8	(6)
Fox, red	3	(3)
Mountain lion	3	(3)
Marten, American	11	(11)
Weasel, long-tailed	1	(1)
Other Mammals		
Deer, Mule	2	(1)
Pika	12	(10)
Marmot, yellow-bellied	4	(4)
Snowshoe hare	1	(1)
Raptors		
Eagle, Bald	11	(8)
Eagle, Golden	7	(4)
Falcon Peregrine	2	(2)
Falcon Prairie	1	(1)
Goshawk, Northern	1	(1)
Hawk, Cooper's	4	(3)
Hawk, Red-tailed	3	(3)
Owl, Great Horned	4	(4)
Owl, Spotted	7	(2)
Owl, Saw-Whet	1	(1)
Other Birds		
Bufflehead	20	(4)
Crane, Sandhill	2	(1)
Cormorant, double-crested	1	(1)
Dipper, American	2	(1)
Egret, Great	2	(2)

Table 7 (continued).

Other Birds (continued)

Flicker, Northern	1	(1)
Grouse, Blue	3	(1)
Heron, Great Blue	1	(1)
Heron, Green	1	(1)
Ibis, White-faced	6	(1)
Merganser, common	30	(1)
Pigeon, Band-tailed	2	(1)
Tattler, Wandering	1	(1)
Towhee, Green-tailed	1	(1)
Unknown sandpiper	1	(1)
Warbler, Townsend's	1	(1)

Reptiles

Boa, Rubber	1	(1)
Sceloporus Spp	1	(1)

Total Observations	336	(185)
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NONNATIVE PLANT TREATMENT AND MONITORING

INTRODUCTION

The nonnative invasive plant program in Lassen Volcanic National Park (LVNP) consists of five primary management strategies. These strategies are:

1. **Prevent** the introduction and spread of invasive nonnative plants through public education and proactive management.
2. **Survey** and map nonnative vegetation and prioritize its potential for invasiveness and ecological displacement as an early-detection tool.
3. **Treat** infested areas using minimum tool requirements according to LVNP Weed Management Plan guidelines.
4. **Monitor** populations and treatment areas to gauge program effectiveness.
5. **Adapt** management strategies based on monitoring results and LVNP Weed Management Plan guidelines.

Four species were the primary focus of the 2009 nonnative plant program. Bull thistle (*Cirsium vulgare*) and woolly mullein (*Verbascum thapsus*) are the most persistent and widespread weeds in the park. Cheatgrass (*Bromus tectorum*) occurs in three areas and is a significant threat for spread to others. Reed canary grass (*Phalaris arundinacea*) threatens the integrity of the Drakesbad and Dersch Meadows wetlands.

A different suite of exotic species occurs at the Park Headquarters; inventory, treatment and monitoring activities were concentrated here to help prevent spread of these species to the park proper. Ox-eye daisy (*Leucanthemum vulgare*), Klamathweed (*Hypericum perforatum*), Himalayan blackberry (*Rubus armenaicus*), and cheatgrass are the species of greatest concern. Other exotic species within the area include smooth brome (*Bromus inermis*), orchard grass (*Dactylis glomerata*), Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*), foxglove (*Digitalis purpurea*), sheep sorrel (*Rumex acetosella*) and chicory (*Chicorium intybus*).

Inventories included exotic species known to occur in the park as well as those that are likely to appear because of their existence in lands surrounding the park or along roads leading to the park. Yellow starthistle (*Centaurea solstitialis*), Dalmatian toadflax, Canada thistle (*Cirsium arvense*), and medusahead (*Taeniatherum caput-medusae*) are the species most likely to become established within the park in the next five years.

Treatment strategies vary among the invasive species targeted for management in the park. Mechanical treatments, primarily digging and hand-pulling, are the main tool used for exotic plant control. Chemical treatments are limited and used only in accordance with the LVNP Weed Management Plan. Other treatments, such as planting native species, mulching, and solarization (weed cloth), were used in special situations.

PROJECT HISTORY

The nonnative invasive plant program is implemented by the Natural Resource Management Division with assistance from the Fire Management and Maintenance Divisions. The weed program does not have permanent staff. It has been supported by grants from the EPMT program, Wildland Fire Use Fire, Federal Lands Highways Project, Disturbed Lands, and by the efforts of volunteer groups.

In 2002, the California Exotic Plant Management Team (CaEPMT) crew began assisting park staff with weed surveys and treatment. Since 2007, the CaEPMT has funded park-specific proposals in lieu of sending a crew from San Francisco. Two biological technicians funded by the Bluff Wildland Fire Use Fire Burned Area Emergency Restoration project surveyed and treated nonnative species within the Snag Lake watershed in 2005 and 2006. Since 2006, Biological Technicians assigned to the Federal Lands Highway Project survey and treat areas along the main Park road to prevent the spread of exotics related to construction projects. Volunteers from the local area and the national chapter of the Sierra Club have contributed more than 2500 hours to the LVNP nonnative plant program since 2002.

In 2008 LVNP completed a Weed Management Plan and Environmental Assessment (LVNP 2008). This document expanded the scope of treatment options for the park's weeds to include techniques such as wilting and herbicides.

METHODS

Surveys

Because the Plant Ecologist was new to LVNP, the 2009 weed inventory program was more extensive than in recent years. In addition to surveys of areas already documented in the Weed Information System Management database, every trail was surveyed as well as the margins of most wetlands and lakes in the park. Surveys of areas scheduled for prescribed burns in 2009 and 2010 were a priority for weed inventories. The surveys were completed mostly by the Plant Ecologist and three seasonal Biological Science Technicians. Other park staff, volunteers, and park visitors contributed additional weed sighting reports.

A survey consisted of crew members walking in a regular grid pattern over an area such that any weed species will be noticed. The distance at which two members of a survey crew are separated from each other varies from about 5m to 50m depending on the visibility through the vegetation. Extra care was taken when surveying probable weed habitat such as moist or disturbed sites. When an infestation was found, the species, number of plants and percentage of reproductive plants were noted. The location and extent of each infestation was recorded in a global positioning system (GPS) unit. All data were entered in the Weed Information Management System (WIMS).

Treatment

Manual removal was the sole treatment method the park used for controlling weeds in 2009. The Weed Management Plan (LVNP 2008) allows more integrated approach to weed management and techniques applied in 2008 included wilting and herbicide applications. The wilting technique had limited success, as indicated by the dense growth of cheatgrass in all known locations in 2009. Herbicide (Milestone) applied in 2008 to woolly mullein and bull thistle in the vicinity of Butte Lake and Snag Lake was more successful in reducing weed densities, but a significant manual control effort was still necessary in 2009. No herbicides were applied in 2009, primarily because the new Plant Ecologist lacked time to prepare Pesticide Use Proposals for regional approval.

Even with herbicides as a treatment option, the majority of LVNP weed populations are treated manually. The roots of the plants are loosened with a pick or hoe before the plants are pulled out of the ground. Care is taken to remove roots of plants because most species have the potential to resprout. If the plants are reproducing, the flowering heads are bagged and carried out of the field. Seedlings are scraped out of the ground with the flat part of a pick unless they are too abundant to warrant complete treatment. If possible, a revisit to an infestation is performed about four weeks after the first visit to treat any plants that were missed.

Mapping and Data Management

In the limited time available between her EOD and the start of field season, the Plant Ecologist was not able to get the latest versions of WIMS (3.0b and 3.0c) to transfer properly to or from the standard field computers (Trimble GPS units or iPAQ PDAs equipped with Bluetooth GPS). Automated mapping and tracking was therefore abandoned for the 2009 field season and manual techniques used instead. Nonnative plant locations were documented in the field using either Trimble XT GPS units (sub-3m accuracy) or recreational-grade Garmin GPS units (approx 10m accuracy) to record the centroid of each occurrence. Each nonnative occurrence was described using a paper WIMS form and the data manually input to the WIMS database following the end of field season.

RESULTS

Inventory

The expanded survey effort resulted in the identification of new nonnative species and significant new infestations of known species, including a report by a visitor of Scotch broom in Warner Valley (found and removed by Park staff on August 25) and a large population of reed canary grass in Dersch Meadows (inventoried, mapped, and treated by mowing / weed cloth in August). Numerous new populations of bull thistle and woolly mullein were also found and treated. All weed occurrences previously documented in WIMS and assessed in 2009 still supported nonnative plant infestations, although the density was reduced in many sites.

Treatment

The Plant Ecologist and three seasonal Biological Science Technicians used manual techniques to treat cheatgrass at Manzanita Lake, Butte Lake, and Terminal Geyser, reed canary grass at Drakesbad and Dersch Meadows, smooth brome and intermediate wheatgrass along the park highway, several species at park headquarters, and bull thistle and woolly mullein at numerous sites throughout LVNP. Table 8 is a summary of sites and species treated.

Park staff efforts were supplemented by those of several work groups. In late July, an 11-person group of international volunteers sponsored by American Conservation Experience (ACE) spent six days manually treating bull thistle and woolly mullein in Warner Valley and around Snag Lake. At the end of the month, the Lassen County Special Weeds Action Team (SWAT) spent three days manually treating bull thistle and woolly mullein around Butte Lake. In early August, 15 Sierra Club members spent four days manually treating bull thistle and woolly mullein in the Manzanita Lake and Lost Creek Campground areas. The Lost Creek treatment was significant in that it was the first concerted attempt in more than a decade to control (rather than merely contain) a major infestation within a 25-acre burn.

The 2008 treatment of Himalayan blackberry (*Rubus armenaicus*) at Terminal Geyser was apparently effective, as the population was not relocated in 2009. Other negative searches included Canada thistle (*Cirsium arvense*) at Snag Lake.

The most significant new weed occurrence was a large population of reed canary grass (*Phalaris arundinacea*) found approximately 150 meters northwest of the Summit Lake Ranger Station on the margin of Dersch Meadows. The population totals approximately 8000 square feet. It consists of two large patches and more than a dozen scattered satellite patches within an area of approximately 12 acres. The larger patches were weed whacked to eliminate seed production and covered with weed cloth in September 2009. The smaller satellite patches were hand pulled. The location of each patch was recorded in a Trimble GPS unit. This treatment will continue indefinitely until the patches stop sending up new shoots.

Mapping and Data Management

Inventory, assessment, and treatment data collected on paper forms in 2009 were manually entered into the Weed Information System (WIMS) database. The WIMS software, first used by LVNP in 2006, has many advantages. It is a sophisticated, comprehensive relational database with an attractive interface and useful built-in tools, forms, and reports that make it relatively easy to input and retrieve data. This data management system does, however, have several serious problems that make it undesirable for use over the long term. We used WIMS to store nonnative plant data collected in 2009, but will be transitioning to an ArcGIS-based geodatabase system for use in 2010 and beyond. Reasons for this transition include:

- The complexity of WIMS is also a significant drawback. When used at a single site with a single manager (as at LVNP), much of the software's complexity is

dead weight. It is almost impossible to for all but the most sophisticated users to modify or add new forms, reports or data elements. The complexity also creates opportunities for bugs and problems with data transfer, especially as related software evolves. The Nature Conservancy, which developed WIMS, is no longer supporting the program; this function has devolved to a user-group sharepoint site where problems and solutions are discussed. The time needed for a new user (like the current Plant Ecologist) to master WIMS and work through its problems is greater than the time to manually collect and enter the data into a simpler data structure. Over time, WIMS is likely to be discarded by other users in this region in favor of a system with better integrity and support.

- The MSAccess format used by WIMS is rapidly becoming obsolete for tracking spatial data such as weed occurrences. In order to view or analyze Access data in a GIS such as ArcMap, the database must be exported from Access, then imported to the GIS, a time-consuming process that must be reiterated every time WIMS receives new data. Current GIS technology allows geodatabases to track spatial data in real time. An ArcGIS geodatabase can store all the information in WIMS in a relational database so that every time new data is entered, it is immediately available in the GIS for viewing, map making, and analysis. Another obsolete feature of WIMS is its use of latitude and longitude for spatial reference. The current NPS standard is to use UTM, NAD83 for mapping purposes.
- WIMS does not have a clearly defined method for delineating or naming new sites or occurrences. When entering data into WIMS it is impossible to know whether an occurrence is a new one. As a result, there are dozens of records in WIMS for the same occurrence reported by different observers using different names for the same location. This situation makes tracking occurrences nearly impossible. A geodatabase can be set up with site boundaries and standardized names for sites and occurrences as well as a grid system for identifying new occurrences. The software identifies and names the site, not the user. This will greatly reduce confusion and increase the accuracy of data analysis.

PLANNING

Because the nonnative plant management program has limited resources, clear and focused priorities must be established before each field season. These priorities are based on results of the previous field season, available resources, advances in technology and methodology, and effectiveness monitoring of past treatments. The 2008 LVNP Weed Management Plan will continue to guide nonnative plant management strategies.

The highest priorities for the 2010 field season will include:

- Surveys of proposed 2011 prescribed burn units (currently Crescent, Flumetank, Raker, Table Mountain, and Crescent Block C). These surveys include searches for rare or sensitive plants and communities as well as nonnative plants.

Surveying burn units before ignition is a priority because it is required by the Fire Management Plan Environmental Assessment.

- Revisits of known weed populations in areas burned in 2009 and previous years.
- Intensive survey and treatment of the headquarters area will continue in order to limit the introduction of new species to the park interior by staff traveling between the two areas.
- Intensive treatment of populations of the most invasive and disruptive species (reed canary grass, cheatgrass, Scotch broom, Himalayan blackberry, and Klamathweed) wherever they are known or found within the park.
- Intensive treatment of cheatgrass populations at Butte Lake (2 sites), Manzanita Lake (2 sites), headquarters (1 site), Terminal Geyser (1 site), and Boiling Springs Lake. This effort is supported by CA EPMT funds and will include chemical treatment and mechanical treatment. A simple monitoring study will be installed at Terminal Geyser to determine effectiveness of the Matrix herbicide treatment.
- Intensive treatment (hand pulling) of woolly mullein and bull thistle populations at Lost Creek Campground, Manzanita Lake, Nobles Emigrant Trail, Snag Lake, Butte Lake, and Warner Valley by ACE and Sierra Club service crews.

Development of an ArcGIS-based geodatabase for storing, analyzing and retrieving weed tracking data will continue through the fall and winter of 2009-2010. Once the geodatabase has been tested, all WIMS data will be transferred to it. Beginning in 2010, new data will be recorded in the field in Trimble GeoXT GPS units using TerraSync software and a standardized data dictionary and then uploaded directly into the geodatabase. Data fields will match those in the WIMS database, but tables and relationships will be simplified in the geodatabase. Analysis and summaries needed for annual reporting will be streamlined by having the geographic and descriptive information in a single place.

Table 8. Weed Treatment by Species and Location in Lassen Volcanic National Park, 2009

Location	Species											
	BRTE	CIVU	ELIN	CYSC	HYPE	LEVU	PHAR	POBU	RUAR	TRDU	VETH	VIMA
Butte Lake	W, M	M						Mon			M	
Crescent Burn Unit B		M										
Dersch Meadows							S, M, W					
GRII Prescribed Burn Unit		M										
Headquarters	W	M			M	M		Mon	M	M	M	Mon
Hole Prescribed Burn Unit		M										
Lost Creek Campground Burn		M								M	M	
Manzanita Lake / Summertown	W, M	M			M				DNR		M	
Park Highway Corridor		M	M								M	
Snag / Rainbow Lakes		M									M	
Terminal Geyser	M	M							DNR			
Warner Valley		M		M			S, M	Mon		M	M	

Treatment Codes

M	Manual removal
Mon	Monitored only
W	Weed whacked
S	Solarization (Weed cloth)
DNR	Did not relocate

Species Codes:

BRTE	<i>Bromus tectorum</i>	cheatgrass
CIVU	<i>Cirsium vulgare</i>	bull thistle
CYSC	<i>Cytisus scoparius</i>	Scotch broom
ELIN	<i>Elytrigia intermedia</i>	intermediate wheatgrass
HYPE	<i>Hypericum perforatum</i>	Klamathweed
LEVU	<i>Leucanthemum vulgare</i>	oxeye daisy
PHAR	<i>Phalaris arundinacea</i>	reed canary grass
POBU	<i>Poa bulbosa</i>	bulbous bluegrass
RUAR	<i>Rubus armeniacus</i>	Himalayan blackberry
TRDU	<i>Tragopogon dubius</i>	yellow salsify
VETH	<i>Verbascum thapsus</i>	woolly mullein
VIMA	<i>Vinca major</i>	greater periwinkle

DISTURBED LANDS RESTORATION

In 2009, Lassen Volcanic National Park used funds from several sources, including the Centennial Challenge Flexible Park Base Program and the Federal Lands and Highway Program to support disturbed lands restoration. Revegetation work included the installation of more than 5000 containerized plants and spreading more than 5 lbs of native seed in eight disturbed sites (Table 9). Remaining funds were directed to a plant propagation contract for future revegetation work at restored quarry and dump sites, as well as extensive revegetation work at the new visitor center.

Table 9. Revegetation by Species and Location in Lassen Volcanic National Park, 2009

Location	Containers			Seed		
	PIJE	ARNE	CECO	ELGL	WYMO	FORB
Summertown	500					
Emigrant Trailhead	200					
Crags Dump	700					
Kings Creek Roadside Berms		600				
Hat Creek-Devastated Area Roadside Berms	250					
SW Visitor Center		1200	450	3 lbs	2 lbs	0.1 lb
Sulphur Works		200	100	0.75 lb	0.25 lbs	
Manzanita Lake Campground	1100					

Species Codes:

PIJE	<i>Pinus jeffreyi</i>	Jeffrey pine
ARNE	<i>Arctostaphylos nevadensis</i>	pinemat manzanita
CECO	<i>Ceanothus cordulatus</i>	whitethorn
ELGL	<i>Elymus glaucus</i>	blue wildrye
WYMO	<i>Wyethia mollis</i>	mule's ear
FORB	N/A	mix of native forbs

Containerized plant materials installed in 2009 were propagated from seeds or cuttings collected between 2006 and 2008 and grown by the Natural Resource Conservation Service (NRCS) Plant Material Center in Corvallis, Oregon. The native grass seed spread at the SW Visitor Center was also grown out by the NRCS (Meeker, Colorado) and supplemented by forb seeds added as accents were planted by resource management staff and a Student Conservation Association work crew in the fall. Over 5,600 plants were produced and delivered to the new visitor center project site and another 4000 cuttings (mainly greenleaf manzanita) were collected for propagation in 2010.

VEGETATION MAPPING

INTRODUCTION

The National Park Service has partnered with the US Geological Survey to undertake the complex and long-term process of developing detailed, interactive digital vegetation maps and databases for all units in the NPS system with significant natural resource values. In 2006, Lassen Volcanic National Park (LVNP) was chosen as a project site to compare the accuracy, efficiency, and effectiveness of manual mapping techniques with that of a technology-based approach.

The primary goal of the LVNP vegetation mapping project is to develop a digital vegetation map and database for the park. A more focused goal is to determine if a methodology other than traditional aerial photo mapping (APM) might be more efficient in developing an accurate and detailed vegetation database. APM has been used to map the vegetation of more than 100 national parks under the USGS-NPS Vegetation Mapping Program, but with recent advances in cartographic, GIS, and remote sensing technologies, the national Vegetation Mapping Program managers determined that it was desirable to examine technology-based alternatives to vegetation mapping. One of these approaches is Discrete Classification Mapping (DCM).

Lassen was chosen as a test site for comparing the two methods because of its moderate size, relative ease of access, and mix of vegetation cover types. The intent is to use the current standards and levels of expertise in the design, execution, and application of each methodology without bias. Because this project will compare aspects of both the APM and DCM, there are goals specific to each methodology and to the comparison and implementation of the methodologies.

AERIAL PHOTO INTERPRETATION MAPPING METHODOLOGY (APM)

APM is a process whereby a trained photointerpreter examines stereo aerial photos of the park and attempts to recognize and delineate consistent patterns in the imagery that represent specific vegetation types. Ancillary data sets such as vegetation plot data, fire history data, and soils, geology, and topographic maps assist the photointerpreter in creating a mental model for how vegetation is distributed across the landscape. The results are transferred to a digital format by any of a number of methods. The specific goals of APM at LVNP are to:

1. Produce a vegetation map consisting of map class polygons representing vegetation types at the alliance level of the National Vegetation Classification (NVC), and where possible, the association level. Each map class will have an estimated accuracy of at least 80% within a 90% confidence interval.
2. Provide density, pattern, and height attributes for each polygon as defined by the USGS-NPS Vegetation Mapping Program.

DISCRETE CLASSIFICATION MAPPING METHODOLOGY (DCM)

DCM essentially uses computer software to take the same information available to a photointerpreter, apply it to the pixels of a digital image and organize the pixels into discrete units (polygons) with homogenous vegetation and environmental characteristics.

In its implementation at LVNP, DCM has several additional goals and objectives:

1. Develop a comprehensive quantitative vegetation/land cover component and cover descriptions that would include discrete estimates of species composition and stand components. These estimates form the basis of canopy cover estimates for individual species, species groups (e.g. true-fir and pine), and major species classes (e.g. conifer, hardwood, shrub, graminoid, and forb).
2. Generate estimates of size to enable characterization of relative tree size, as well as canopy structure.
3. Characterize ground surface conditions, including characterization of bare ground, litter, or woody debris information, that are associated with the specific vegetation and land-cover characteristics being mapped. The rigorous comparison and implementation of the results of the two methodologies will be followed by recommendations regarding future similar mapping efforts.

METHODS

The methodology for this project will be described the final project report.

CURRENT STATUS

Review of the plot data and classification completed by GRS revealed deficiencies that were deemed unacceptable. Accordingly, the USGS-NPS Vegetation Mapping Program allocated resources for the collection of supplementary vegetation plot data and a reworking of the data for a classification that is consistent with national standards. Field work was carried out by a team led by Dr. Ayzik Solomesheh and supervised by Dr. Dennis Odion of Southern Oregon University.

In 2009, a field crew led by Ayzik Solomesheh of U.C. Davis collected 170 plots of data to support the revised vegetation classification. Dr. Solomesheh's work focused on areas of the park and vegetation types that were not as thoroughly sampled by the DCM field crews:

- Mountain hemlock woodlands
- Sparse vegetation
- Sphagnum bogs

- Thermal areas
- Vernal pools

The APM draft map is complete (not accuracy assessed) and the park is in possession of this database. The DCM map is also in draft form, although the park has not yet received a working version of this map.

The contractor responsible for the DCM version of the vegetation map has completed collection of accuracy assessment data for both the APM and DCM maps. Analysis of the accuracy assessment field data will continue through early 2010, but the initial results show an estimate of 69% accuracy for the APM map and 82% accuracy for the DCM map.

FUTURE DIRECTION

As of December, 2009, the accuracy assessment analysis phase of both the APM and DCM approaches continues. A second season of classification data collection has been funded through the Klamath Inventory and Monitoring Network and will concentrate on areas that were unavailable for sampling in 2009 (northeastern parts of the park and Lassen Peak). The vegetation classification is under revision by Dr. Ayzik Solomesheh of UC Davis and is expected to be completed in the spring of 2011. Final products from all versions of the vegetation map should be delivered in 2011.

PRESCRIBED BURN TREATMENT AREA SURVEYS

LVNP planning documents require surveys for sensitive and nonnative species in all areas planned for fuels reduction by means of mechanical thinning, piling, or prescribed burn treatments species. Six fuels planning areas were inventoried by the Vegetation Crew in 2009:

- Lava Springs
- GRII
- Flatiron
- Crescent Unit B
- Raker
- Hole

The Vegetation Crew inventoried parts of these areas considered most likely to support sensitive plant communities (wetlands and riparian areas) or habitat for rare or nonnative plant species. GRII, Hole, Raker, and Crescent B units contain wetland and/or riparian habitats. Nonnative plant populations (primarily bull thistle) were located and removed from Hole, GRII, Flatiron, and Crescent B units. Known sensitive plant populations were relocated in the GRII unit. Other than the planned buffers around riparian areas, no mitigation is necessary to protect vegetation resources in the fuels units. All units should be re-visited in the year following the burn in order to reduce the potential for nonnative plants to become established.

Detailed maps and narratives describing findings were created for each area.

QUAKING ASPEN INVENTORY AND EVALUATION

INTRODUCTION

Trembling or quaking aspen (*Populus tremuloides*) communities are an important component of biodiversity within Lassen Volcanic National Park (LVNP). In the U.S., the species is most abundant across Colorado and Utah, while in western states aspen stands tend to comprise a relatively small component of more extensive coniferous forests (Jones 1985, Shepperd et. al. 2006). Aspen is a clonal species that regenerates vegetatively when hormonal stimulation of the roots is triggered by a disturbance event such as fire, avalanche or disease (Bartos 2001). When a disturbance event removes or damages overstory trees, the widely spreading roots system produces numerous genetically identical suckers (ramets) that re-establish the next stand (Lieffers, 2001). Aspen stands provide forage and habitat for a variety of wildlife and understory plant species (Shepperd et. al. 2006). Aspen are identified as a keystone species in the Park's 1999 Natural and Cultural Resource Management Plan (NPS 1999). In addition, aspen are valued by park visitors for their aesthetic appeal.

Aspen communities throughout the west are being replaced by conifers due to changes in historic fire regime and long-term, extensive herbivory by ungulates (Bartos and Campbell 1998). Di Orio et al. (2004) estimated that aspen acreage in the Warner Mountains of northeastern California declined by approximately 28% between 1946 and 1994. A review by Bartos (2001) found evidence of a 50%-96% decline in aspen in the western U.S. Fire suppression has given an advantage to fire-intolerant species such as white fir (*Abies concolor*). White fir encroaches upon aspen communities, gradually overtopping and shading out mature trees and inhibiting the suckering of young trees. LVNP is taking an important step in the management of this species by implementing a standard protocol to map and evaluate the condition of aspen stands within the park. Based on the information collected through this mapping and evaluation project, the park will be able to develop monitoring and management strategies for aspen.

PROJECT HISTORY

In the mid- to late-1990's biologists on the Eagle Lake Ranger District (ELRD) of Lassen National Forest began a project to map and evaluate the health of aspen on forest lands adjacent to the park. ELRD also implemented a research study to determine the response of aspen sucker recruitment to mechanical thinning treatments (Jones et. al. 2005). The District began participating in the Aspen Delineation Project in the 1990's. The Aspen Delineation Project (ADP) is a cooperative interagency effort between the Bureau of Land Management, the U.S. Forest Service and the California Department of Fish and Game to assess the extent, condition, history of treatment, and management options for quaking aspen in the Sierra Nevada and Cascade mountain ranges. Lassen Volcanic National Park began working with the ADP in 2004.

In 2004, David Burton of the ADP spent 3 days in LVNP training park staff and volunteers on how to assess the condition of aspen stands using a standard protocol developed by the ADP. That year, staff and volunteers began to map and evaluate stands primarily along Hot Springs Creek in Warner Valley. In 2005, the work in Hot Springs Creek drainage continued, and expanded to include areas along the West Fork of Hat Creek and in the proposed Raker prescribed burn unit.

The objectives of the project are to:

1. Identify and map the current location of aspen stands throughout the park and assess the condition of these stands. Priority is given to stands within areas designated as prescribed burn units in the park's 2005 Wildland Fire Management Plan (NPS 2005).
2. Establish and implement a monitoring strategy that will assist resource managers monitoring the condition of these stands over time and also to evaluate the impacts of the timing and intensity of prescribed fire on aspen sucker recruitment and survival.

METHODS

Field crews evaluate each stand using a standard protocol. The initial protocol implemented in 2004 was the Aspen Location and Condition Assessment Protocol developed by the ADP (ADP 2002). In 2005 and 2006, the protocol used in LVNP has been modified based on protocols being implemented on Eagle Lake and Almanor Ranger Districts and also to suit conditions more appropriate to the park (i.e. impact from cattle is not a management issue on park lands as it is on LNF). The revised protocol collects data on:

- a) Stand condition including size class distribution, presence of overtopping conifers, sucker recruitment, browsing or hedging of young suckers, site characteristics and stand size;
- b) Management problems from potential human and infrastructure impacts;
- c) Incidental information including wildlife observations, the presence of historic tree carvings known as dendroglyphs, and the presence of other hardwood species such as Scouler's willow (*Salix scouleriana*), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) and mountain alder (*Alnus incana* ssp. *tenuifolia*).

The ADP protocol calls for surveyors to rank the health of each aspen stand. Although the final ranking is subjective, a variety of measurements are used to evaluate stand condition in the development of the ranking. In general, stands were identified as "highest risk" if they were impacted both from above (encroachment and shading by conifers) and below (intense browsing or hedging); and "high risk" if they were impacted from either above or below risk factors.

RESULTS

In 2009, the park received assistance funding from the Lassen Park Foundation to conduct an aerial overflight of the park to map the general location of all aspen stands. Invaluable assistance was provided by Bobette E. Jones, Ecologist, Lassen National Forest, and Zachary Heath, Aerial Survey Program Manager, USDA Forest Service Forest Health Protection, towards the planning and implementation of this aerial global positioning system (GPS) mapping effort. The flight was conducted on October 8, 2009 through which 52 sites (which may contain one or more stands) were mapped.

FUTURE DIRECTION

Park staff and volunteers will continue to map and evaluate aspen stands in 2010. Data obtained from the aspen overflight will provide important baseline information for field crews during the 2010 season. Crews will conduct field assessments of areas mapped during the flight to: a) confirm the presence of aspen, b) GPS the actual extent of each stand and, c) collect the stand assessment data described above.

HAZARDOUS TREE INVENTORIES AND MITIGATION

INTRODUCTION

Hazardous tree management is the process of reducing exposure to risks from known (i.e. observed and rated) tree hazards. Generally, known hazards are isolated from public use by either 1) closing or relocating facilities or restricting use, or 2) directly mitigating the hazard by removing the tree or pruning a defective limb or top. While equal analysis of both options must be undertaken, usually facilities of a moveable nature or those temporarily used -- such as picnic tables or individual campsites -- can be relocated or temporarily closed. Permanent facilities except those targeted for replacement will probably entail a direct mitigation option.

Natural Resources Management staff has identified and delineated portions of the park's designated developed zone subject to hazardous tree management. These include campgrounds, visitor contact stations, utilities, residential areas, ranger stations, concession facilities, administrative offices and facilities, roadside exhibits, road systems, and backcountry structures.

DETECTION OF HAZARDOUS TREES

Detection of hazardous trees is a process of locating and marking individual problem trees within developed areas. This is a two part process combining surveillance and examination. Surveillance is the rapid overall inspection of developed areas for hazardous trees. It is somewhat analogous to a hasty search in a search and rescue. General surveillance is done at all development zone locations — except roadside units — every year before the visitor season. These may also occur on an unplanned basis during or following any conditions that are known to generate tree hazards e.g. severe windstorms, floods, wet snow, insect or disease outbreaks. Examination entails thorough, individual evaluation of hazardous conditions indicated by surveillance work and includes tree identification and measurement, defect assessment, hazard rating, mapping, and tagging. Complete examinations are scheduled for every two years at all front country and back country locations. Road corridors are subject to surveillance as a secondary priority. Roadside surveys are conducted within 100'-200' of the road.

RATING SYSTEM

Evaluating and rating tree hazards is based on assessing 1) the possibility of a "target" being hit due to its location and its significance, and 2) severity of the defect, the apparent likelihood of failure, the damage potential due to size, length or weight of hazard. The basic hazard rating system analyzes these factors, which are added as points in a two-part equation to give a final hazard rating.

The combined value for each rated tree is the basis for assigning priorities for taking management action, selecting either abatement (restricting use or isolating the risk) or

mitigation (removal or pruning). The highest priority for management action is seven, indicating a high value target with great exposure potential for extensive damage, injury, or death. The lowest priority that can be assessed is a 2. Hazardous conditions rated 4 and above entail monitoring or observation to determine when defective conditions increase. Hazard ratings of 5 (with a 3 defect), 6, and 7 entail additional management response. This will be in priority order with actions taken to address 7 ratings first. Where known 7-rated hazardous conditions exist, affected area closure —with signing, barriers, or other suitable means – should be promptly undertaken. This may be on a temporary basis until direct mitigation can be accomplished, if that is the selected management action. A permanent closure should be established if the affected facilities are not essential, or where affected cultural or natural resources take precedence.

MARKING AND MAPPING TREES

During examinations, hazardous tree conditions with ratings of 4, 5, 6 or 7 are individually tagged and mapped. Tagging consists of nailing a pre-numbered surveyor's tag on the north side of the tree bole approximately 6 feet above the ground. All vital information about the tree is recorded onto a standard field form and its location is recorded on hand drawn basemaps. Data from the field forms are entered into the park's hazard tree database, an MS Access relational database developed by Sequoia and Kings Canyon National Parks. A new GIS-based mapping system was begun in 2008 and continued in 2009.

MITIGATION

Mitigation is usually completed early in the summer by Roads and Trails staff. In rare cases when trees must be climbed for hazard mitigation, work is either contracted or performed by tree crews from Yosemite or Sequoia and Kings Canyon National Parks. Mitigation is sometimes accomplished by contractors.

RESULTS

Hazardous trees identified and rated during systematic surveys in 2008 were mitigated in 2009 by in-house staff from Roads and Trails and a private contractor. Of the 142 trees recommended for removal in 2008, 136 trees were removed, and 6 were rescheduled for removal in 2010 (Table 10).

Table 10. Hazard Tree Surveys and Mitigation, 2009

	Trees Recommended for Removal by Diameter Class					Actually Removed	Resched Removal	"Abated" Hazards
	<12"	12-24"	25-36"	>36"	TOTAL			
Butte Lake Campground		2	5	3	10	10		
Butte Lake Picnic Area		1	4	1	6	6		
Butte Lake Corrals/Water Trtmnt		2	2	4	8	8		
Drakesbad		3	2	1	6	6		
Lost Creek Campground	1	8	3	6	18	18		
Crags Campground	1	6	1	1	9	9		
Juniper Lake Campground	1	7	3		11	11		
Juniper Lk Cabins/Trlhd		5	3	2	10	10		
Manzanita Lake Campground	1	6	5		12	12		
Manz Lake Loomis/Recycling			1	1	2	2		
Manz Lake Crossroads		2	1		3	3		
Manz Lake Boatlaunch		1			1	1		
Southwest	1	4	5	2	12	8	4	
Summit Campground North		13			13	13		
Summit Campground South		10	5	1	16	14	2	
Summit Ranger Station	1	2			3	3		
Summit Lake Corral		2			2	2		
Totals Grand Total					142	136	6	

FOREST MONITORING IN LOST CREEK AND CRAGS CAMPGROUNDS

INTRODUCTION

A Vegetation Management Plan (VMP) was implemented in Lost Creek and Craggs campgrounds in 2006 (Phases I and II) and 2008 (Phase III). Phase I called for removing white fir (*Abies concolor*) trees up to 18" diameter at breast height (dbh) from beneath healthy overstory Jeffrey pine (*Pinus jeffreyi*) and ponderosa pine (*Pinus ponderosa*) to provide them with more growing space. Phase II was aimed at reducing overall stocking levels to within carrying capacity and reducing ladder fuels. Phase III targeted natural and artificial regeneration of Jeffrey pine and ponderosa pine. Overall goal of the project was to help to restore forest health to a condition that could be more sustainably managed. Project objectives were to 1) improve the vigor and survival of overstory pine and fir, 2) establish young Jeffrey and ponderosa pine in the understory, 3) reduce the occurrence and spread of root disease, and 4) reduce the occurrence of hazardous trees. Post-project monitoring was conducted at long-term plots in 2009.

PROJECT HISTORY

Following a green tree failure in the campground in 2002, an investigation by USFS and NPS scientists concluded that armillaria root disease (*Armillaria* spp.) and annosus root disease (*Heterobasidion annosum*) were abundant in both campgrounds and were killing fir trees but not affecting pines. Mature pines were suffering heavy mortality from bark beetles and pine regeneration was insufficient to replace the declining pine overstory (Woodruff, 2002). Based on this report a decision was made to 1) aggressively pursue reducing root disease by removing infected fir trees and thinning overstocked fir stands, and 2) use silvicultural prescriptions that would nudge campground forests back toward a more open, root-disease resistant pine-dominated forest containing larger trees.

Systematic sampling methods were used to inventory campgrounds. This served to define baseline forest conditions and served as the basis for formulating and evaluating VMP prescriptions. Stand tables generated from inventories were used to calculate tree density, basal area, quadratic mean diameter, and site density index. All measurements were important for determining stand stocking levels and whether the forest was growing within sustainable carrying capacity. All three measures of stand stocking indicated forests were at or above maximum sustainable carrying capacity in Stands 1 and 3 and were within carrying capacity in Stands 2 and 4 (Table 11). Cumulative basal area curves were developed from inventory data that identified appropriate cutting thresholds to achieve target stocking levels.

Full implementation of Phase I and partial implementation of Phase II was carried out under contract by handcrews in 2006. Planting portion of Phase III was completed in 2008 when 4000 ponderosa and Jeffrey pines nursery-grown seedlings were

transplanted into existing openings in Stands 2 and 4 and within created openings in Stands 1 and 3. This phase will continue to be accomplished over the next several years by both natural and artificial means.

METHODS

Monitoring in 2009 was a repeat of the measurements collected during the baseline inventory. During the baseline inventory 40 nested plots (fixed radius plots within variable radius plots) were systematically established in a grid over the project area (Figure 8). Because of the large variation in stand structure the project area was separated into 4 separate stands. For the 2009 monitoring work, each plot was relocated and a 30 BAF cruising prism was used to tally “in” trees. Trees too small to be counted during prism surveys were tallied within fixed radius plots. Diameter at breast height (dbh) and species were recorded for each tallied tree. Trees less than 4.5 feet tall were counted as seedlings. Repeat photography was conducted at each plot according to VMP monitoring protocols.

Stand tables generated from analyzed data reported on tree density by species and size class, basal area by species and size class, quadratic mean diameter (QMD), and stand density index (SDI).

RESULTS

Treatment (thinning plus planting) reduced tree density (trees ≥ 0.1 ” dbh) from 547 tree per acre (tpa) to 159 in stands 1 and 3, and from 282 tpa to 72 in stands 2 and 4. Seedling-sized trees (trees ≤ 0.1 ” dbh) in stands 1 and 3 changed from 104 tpa (0:1 pine to fir) to 138 (6.25:1 pine to fir), and in Stands 2 and 4 from 47 tpa (0:1 pine:fir) to 320 (16:1 pine to fir). Basal area was reduced in Stand 1 and 3 from 263 (100% max stocking) to 220 (83% of max stocking), and from 154 (58% of max stocking) to 147 (56% of max stocking) in Stands 2 and 4. SDI was reduced from 456 to 358 in Stands 1 and 3, and from 282 to 219 in Stands 2 and 4. Quadratic Mean Diameter increased from 9” dbh to 16” dbh in Stands 1 and 3, and from 10” dbh to 19” dbh in Stands 2 and 4 (figures 9 and 10).

Because handcrew was limited to removing trees ≤ 10 ” dbh during Phase II, post-treatment target of 70-75% maximum stocking in Stands 1 and 3 was not achieved. However, had full implementation of Phase II occurred — which called for the removal of approximately 95% of white fir trees ≤ 12 ” dbh in stands 1 and 3 — stand basal area would have been reduced to 189 ft²/Ac (72% of maximum stocking) and SDI to 273 (75% of maximum SDI).

FUTURE DIRECTION

- In several years after Phase III seedlings have established, stem spacing will be thinned to approximately 8-15 feet.

- Because there is a large height and age gap between overstory pines and planted seedlings, future planting will be staggered at a 7-10 year interval for the next 20-30 years. Seeds collected on-site in 2006 are being stored at the USFS nursery for this purpose.
- Next monitoring will be conducted in 2016.

Figure 8. Map of Treated Stands in Lost Creek and Craggs Campgrounds

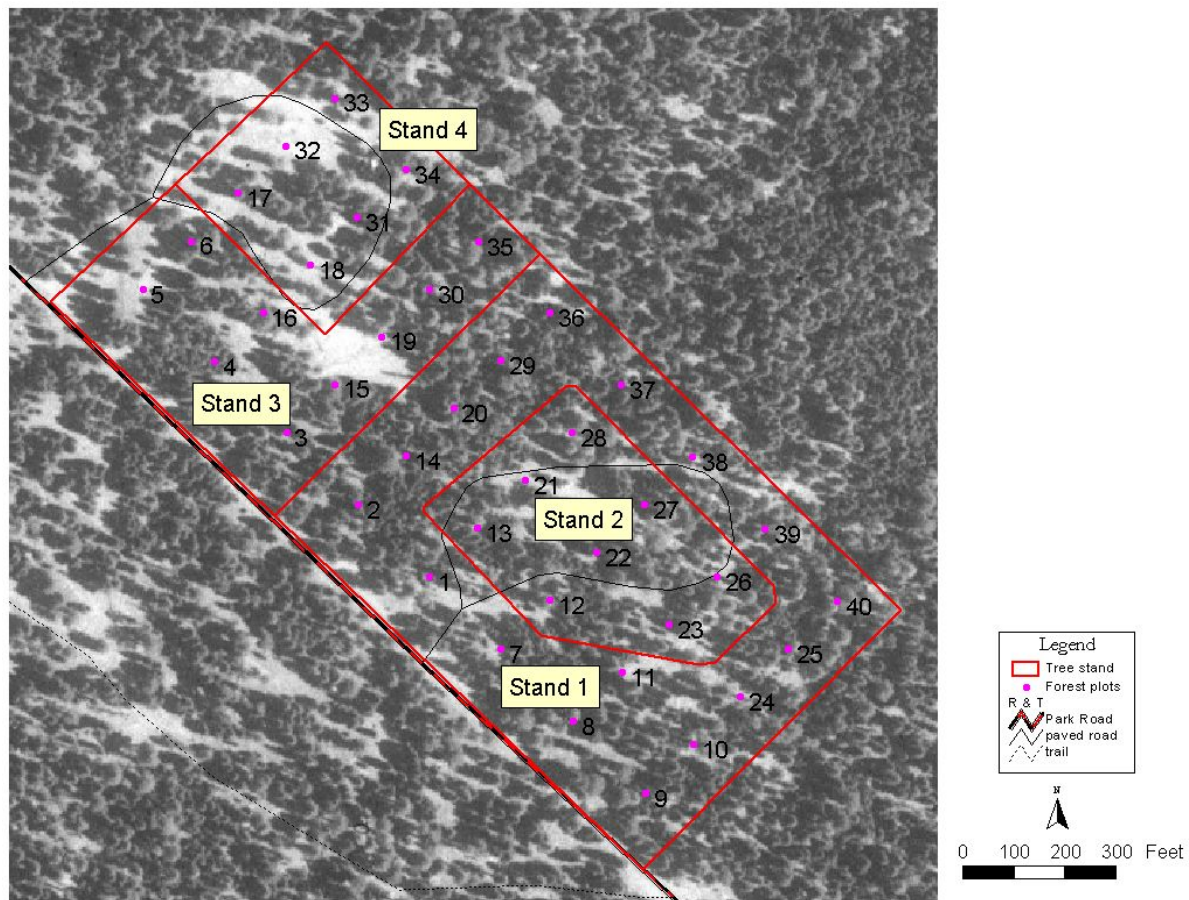
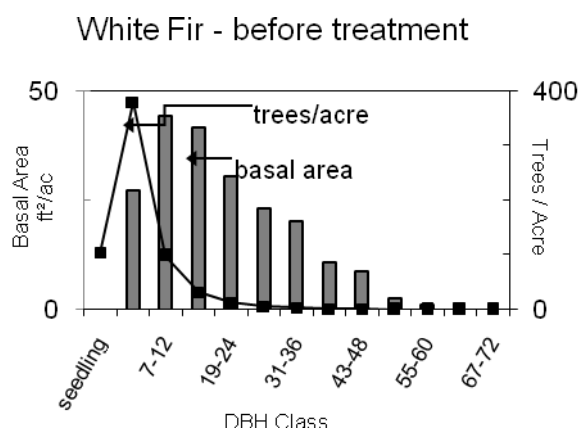


Table 11. Results of Tree Thinning Treatment in Lost Creek and Craggs Campgrounds

STAND	TREES/ACRE	BASAL AREA (ft ² /AC)	S.D.I	Q.M.D.
1 and 3 (Before)	547	263 (100% of max)	456 (125% of max)	9"
1 and 3 (After)	159	220 (83% of max)	358 (98% of max)	16"
2 and 4 (Before)	282	154 (58% of max)	282 (77% of Max)	10"
2 and 4 (After)	72	147 (56% of max)	219 (60% of max)	19"

Figure 9. White Fir Density and Basal Area Pre- and Post-Treatment

Stands 1 and 3



Stands 2 and 4

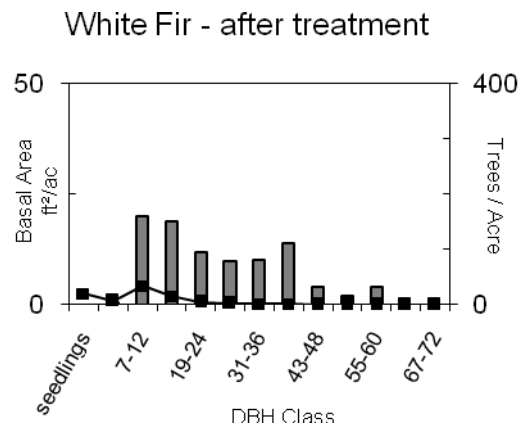
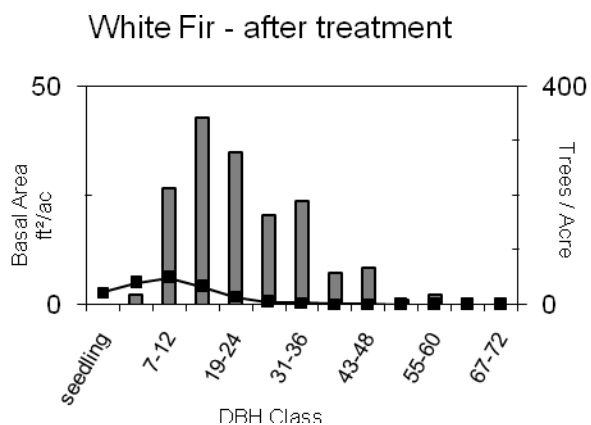
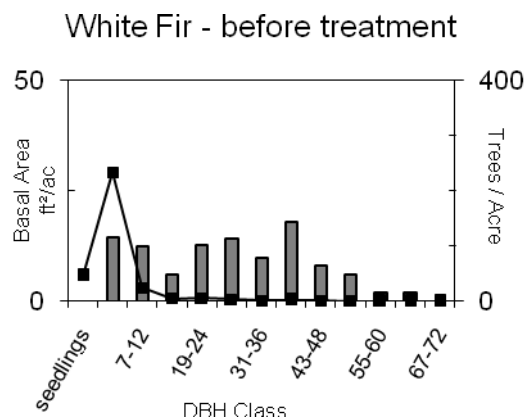
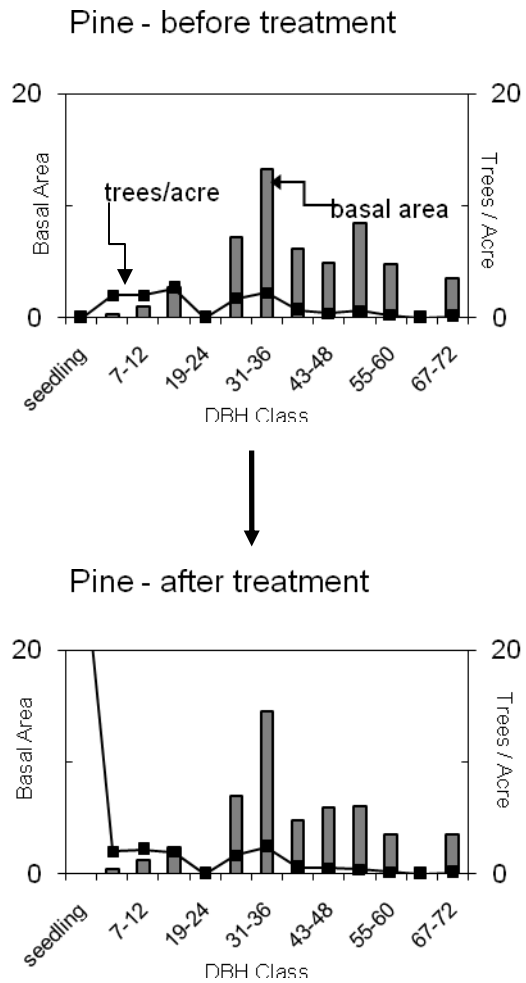
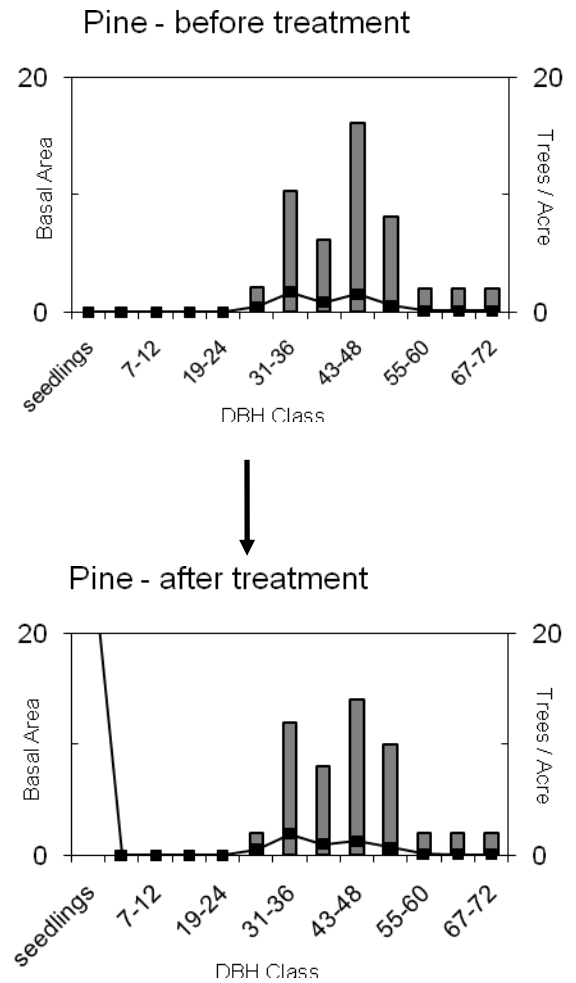


Figure 10. Pine Density and Basal Area Pre- and Post-Treatment

Stands 1 and 3



Stands 2 and 4



AIR QUALITY MONITORING

INTRODUCTION

In a national park, air pollution affects natural resources as well as the health of residents and visitors. The National Park Service (NPS) has established an air pollutant monitoring program to determine the status of each park unit's air quality and to determine if a park is exceeding the National Ambient Air Quality Standards (NAAQS) established by the Environmental Protection Agency (EPA). The program is designed to detect trends in pollution levels over time. Monitoring may also be linked with studies of the biological impacts of air pollution.

PROJECT HISTORY

In 1977, Lassen Volcanic National Park (LVNP) was one of many parks designated as a Class I area under the Clean Air Act Amendments. The act gives park managers responsibility to protect air quality and related values, such as visibility, from the adverse effects of air pollution.

In 1988, LVNP became part of the NPS gaseous pollutant (ozone) monitoring program and the Improving Protected Visual Environments (IMPROVE) visibility monitoring network. Initially, the park intended to collect about five years of baseline air quality data. A monitoring station was established in an existing building near the helicopter landing at Manzanita Lake. A visibility camera was set up on the ski lifts just inside the southwest entrance.

In 1995, LVNP was designated as a trend site for the Northern California Mountain area, and, as a result, year-round air quality monitoring began. Although the visibility camera was removed in 1995 after collection of baseline information, additional equipment was installed at the Manzanita air quality station to measure dry deposition (primarily sulfates and nitrates in gaseous or particulate form) for the Clean Air Status and Trends Network (CASTNet).

In the summer of 2000, LVNP became a participant in the National Atmospheric Deposition Program/National Trends Network (NADP/NTN). NADP/NTN monitors long-term spatial and temporal trends in atmospheric deposition (i.e. wet deposition in the form of acid rain).

METHODS

Four primary types of air quality data are collected at the air quality station within LVNP.

First, ambient ozone is measured 24 hours a day, 365 days a year. Exposure to ground-level ozone affects human health and may trigger a variety of respiratory problems, as well as impair the body's immune system. Ozone also affects vegetation. Research shows that some plants are more sensitive than humans to ozone and that effects on plants may occur well below the EPA NAAQS (NPS 2004). Along with the ozone, several meteorological parameters are measured including wind speed, wind direction, temperature, relative humidity, rainfall, and solar radiation. The equipment is checked once a week by the air

quality station operator and twice a year by a contractor who completes a detailed site calibration. In fall 2000, the DataView system of recording these parameters was introduced to LVNP, which replaced the old strip chart and paper recording forms. Recording and submitting results via computer saves time during station checks and makes the results more accessible for review.

Second, the amount and type of particulate matter in the air is monitored for the IMPROVE visibility network. The IMPROVE monitoring system is comprised of five particulate sampler modules and one control module. Three of the modules collect fine particles (called PM₂₅ which are 0-2.5 microns in diameter) and one collects larger particles that are 0-10 microns in diameter (PM₁₀). The fifth module was installed for 'quality assurance' in 2003; it is a duplicate of one of the PM₂₅ modules. Different materials used in each PM₂₅ filter capture particles of different chemical compositions. A controller runs the modules for a 24-hour period every three days. The filters are changed weekly by the station operator and returned to the Crocker Nuclear Lab at UC Davis for chemical analysis. The five samples obtained are analyzed for composition, concentration of fine particles that produce light extinction, and for tracers that can identify emission sources (Crocker Nuclear Lab 1995).

Third, dry deposition monitoring is done by continuously pumping air through a CASTNET filter for one week. The station operator changes the filter and sends it to an EPA contractor for analysis. These filters are analyzed to obtain: 1) weekly concentrations of particulate sulfate, particulate nitrate, particulate ammonium, sulfur dioxide, and nitric acid; 2) hourly concentrations of ambient ozone levels; 3) meteorological conditions required for calculating dry deposition rates.

Fourth, wet deposition monitoring for NADP/NTN provides data on the chemistry of the rain and snow that falls at the air quality station. The station operator changes a precipitation collection bucket once a week. The operator decants any rainwater collected into a sample bottle and sends the sample to the Central Analytical Laboratory (CAL) which measures pH, conductivity and also analyzes the sample for sulfate, nitrate, ammonium, chloride and base cations. Recently, updates were made to the infrastructure and equipment at the site, including the construction of a new rain collector platform (August 2007), and the installation of an electronic NOAA IV raingage (August 2008), which replaced the original Belfort raingage model.

RESULTS

The following results primarily summarize 2008 and earlier data, which are generally the most current annual summaries available for air quality data.

Ozone Levels

In March 2008, the Environmental Protection Agency (EPA) made the NAAQS primary ozone standard more stringent by lowering the allowable average ozone concentration over an 8-hour period from 85 parts per billion (ppb) to 75 ppb. The standard is exceeded when calculated value of the 3 -year average of the annual fourth-highest daily maximum 8-hour average ozone concentration is greater than 75 ppb (this is called the 4th highest maximum 8-hour ozone standard).

Over the past decades, ambient ozone measured at LVNP is near background (natural) levels for most of the year. However in 2008, the park exceeded EPA standards for the first time since ozone monitoring began in 1988. In 2008, the park experienced unusually high levels of ozone (and haze) between June 13 and July 26th due to wildfires burning in surrounding counties. As a result, the 8 hour ozone standard was exceeded 8 times; the highest maximum 8 hour ozone average recorded in 2008 was 104 ppb. The 4th highest maximum 8 hour standard was also exceeded at 83 ppb. (NPS 2008). The park did not exceed the primary ozone standard in 2009.

Although ozone levels are generally considered low in the park, it should be noted that park ozone levels appear to be slowly increasing. Jaffe and Ray (2007) evaluated ozone data from 1987-2004 and found a statistically significant increase in ozone at seven out of nine sites in the western U. S. LVNP data analyzed in their study showed an increase of 0.32-0.33 parts per billion by volume per year (ppbv/year) ($P < 0.01$), or a total increase of 5-6 ppbv over the 18 year period.

Visibility

Aerosol bext measures light extinction resulting from the presence of liquid or solid particles suspended in the atmosphere (atmospheric aerosols). These particles can be generated naturally (i.e. forest fires, plant transpiration) or from human activities (industrial manufacturing, vehicle emissions). A higher aerosol bext measurement indicates a greater amount of haze resulting in poorer visibility.

On average, LVNP's visibility is very good relative to much of the United States. However, in 2008, wildfires in surrounding counties created unusually hazy conditions in the park from mid-June through July. The 2008 average aerosol bext measured at the Manzanita Lake station was 113.79 Mm⁻¹. Refer to Figure 11 for a summary of the average annual aggregation of the worst 20% aerosol bext measurements from the station between 1988 – 2008.

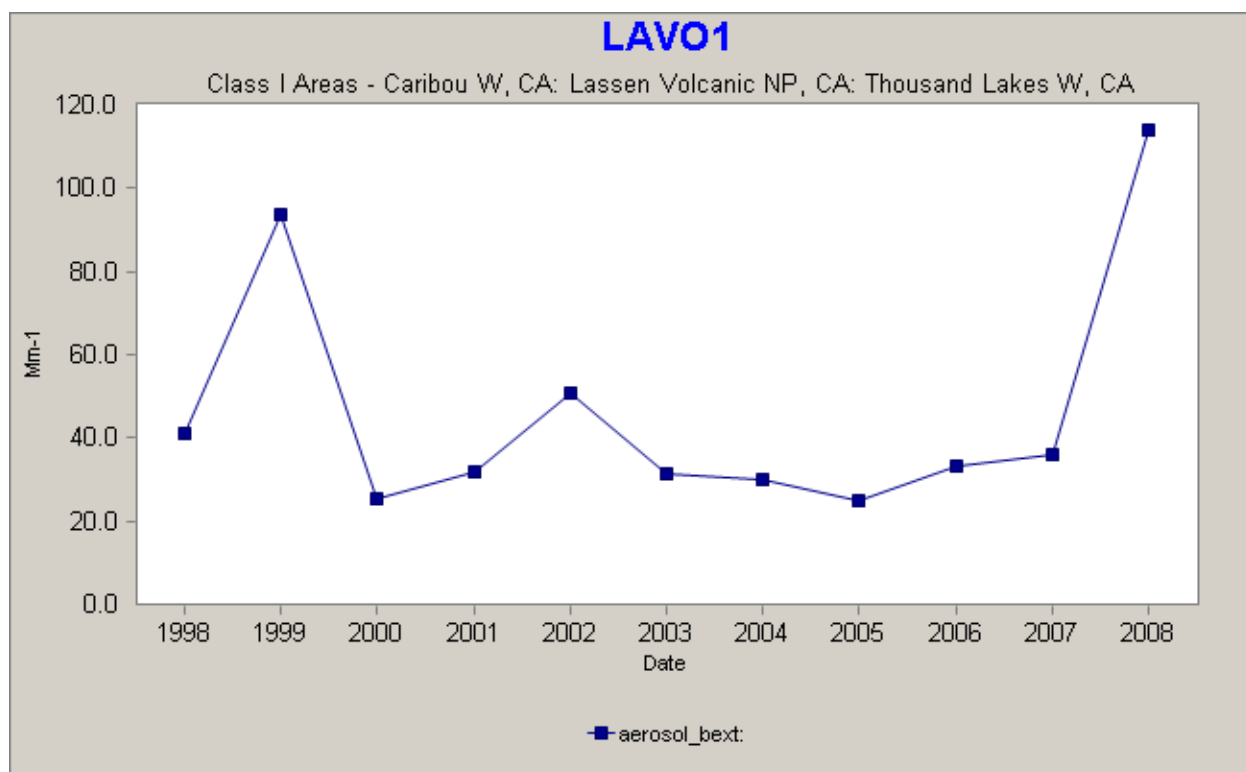


Figure 11. 1998 – 2008 Average Annual Aggregation of the Worst 20% Aerosol Bext Measurements (LAVO 1 is the site code for the Manzanita Lake Air Quality Station, Lassen Volcanic National Park). Source: Views, 2010

Dry Deposition

Dry acid deposition is a significant problem in the eastern United States. Concentrations of sulfur dioxide (SO₂) and particulate nitrate (NO₃) emissions observed at western CASTNET sites are significantly lower than in the East with only a few sites measuring levels above 1.0 ug/m³ (Harding ESE 2002). The total nitrogen deposition measured at the air quality station in 2007 (the most recent annual summary available) was 1.1 kg-N/ha (EPA 2009a). The total sulfur deposition recorded at the site in 2007 was 0.5 kg/ha (EPA 2009b). Both concentrations are well below the national annual averages.

Wet Deposition

The 2007 Annual Data Summary provides the most current annual data for the park. In 2007, annual average pH of the samples collected at the site was 5.33. Average annual deposition for a variety of compounds is shown in Table 12 (NADP 2009).

Table 12. Statistical Summary of Annual Precipitation Chemistry Deposition for Valid LVNP Samples, 2008

Annual Deposition (kg/ha)							
Ca	Mg	K	Na	NH4	NO3	Cl	SO4
0.22	0.033	0.065	0.268	0.58	1.65	0.46	1.05

FUTURE DIRECTION

Air quality monitoring at LVNP will continue. The Park is also implementing operating practices to reduce its own pollution emissions, which include the use of electric and hybrid vehicles, installation of motion sensors to control the use of outdoor lighting, and implementation of dust abatement measures during project work.

RESEARCH PERMIT TRACKING

INTRODUCTION

The National Park Service (NPS) welcomes public and private institutions to conduct scientific research within park boundaries. In order to protect park resources from potential impacts that may result from research being conducted, a scientific research and collecting permit is required. This permit is required for scientific activities pertaining to natural resources or social science studies in National Park System areas that involve fieldwork, specimen collection, and/or have the potential to disturb resources or visitors (NPS 2006). The knowledge gained from outside researchers is used to better protect and understand natural processes that occur within National Park units.

METHODS

Researchers wishing to conduct biological or social science studies within Lassen Volcanic National Park (LVNP) must submit a research permit application. This is done electronically through the National Park Service Research Permit and Reporting System (RPRS) website. Once the application has been submitted, the park's research permit coordinator receives an electronic message notifying them of a new research permit application that needs to be processed. The research permit coordinator reviews the permit to determine if the project falls within the parameters of the programmatic categorical exclusion established for research permits. If the permit falls within those parameters, the research permit coordinator can issue the permit. If the scope of research does not fall within the parameters of the programmatic, the permit must be sent to the LVNP Compliance Council for review. The research permit coordinator enters the information into the Planning, Environment and Public Comment (PEPC) database for the park's Compliance Council review. The Compliance Council reviews the application and provides comments and concerns on the research. The researcher is then contacted by the research permit coordinator to respond to concerns the park has. Once the concerns have been addressed adequately to satisfy the Compliance Council, the research permit is issued. If the concerns cannot be adequately addressed, the permit will be denied. Each permit is issued for the calendar year. At the end of the calendar year the researcher is required to submit an Investigators Annual Report (IAR). The IAR is a short summary of accomplishments made by the researcher during the year. This is required so the NPS can track the progress of research being conducted. A permit will not be granted for a second year of research if an IAR was not completed for the previous year. Two copies of a final report are required to be given to the park at the completion of the research.

RESULTS

A total of 40 permits were issued for scientific research and collecting in LVNP in 2009. Geothermal and wildlife and fisheries studies had the most permits with twelve each, and vegetation studies had the second most permits with eight. All permits issued in 2009 are divided into the following nine categories.

Vegetation: 8 permits issued

- Lassen Volcanic National Park comparative vegetation mapping project.
- *Utricularia* studies in Lassen Volcanic National Park.
- Geographic diversity in chloroplast haplotypes in the California red fir noble fir species complex
- A model system revisited: Phylogenetic relationships and species limits among diploid taxa of *Beochera* (Brassicaceae)
- Invasive species early detection monitoring for Klamath Network parks
- *Scheuchzeria palustris* spp. *americana* specimen collection
- Verification of species identification of *Pinus ponderosa* and *P. jeffreyi* as related to a previous study on the determination of the dynamics of primary succession in the Chaos Jumbles area of Lassen Volcanic National Park.
- Post-fire quaking aspen regeneration response.

Geothermal: 12 permits issued

- Microeukaryotic (protist) genetic diversity in Mt. Lassen's hydrothermal features.
- Investigation of microbial diversity in high temperature/low pH geothermal features.
- Discovery, characterization and diversity of viruses of extreme thermophiles.
- Surveying and sampling Boiling Springs Lake with a remotely operated vessel.
- Discovery of new microbial life living at low pH and high temperatures.
- Monitoring the hydrothermal lakes, springs and gas at Lassen Volcanic National Park.
- Hydrothermal monitoring at Lassen Volcanic National Park.
- Bioprospecting for acidothermophiles that utilize cellulose and/or are tolerant of ethanol
- Discovering natural microbial communities in Lassen Volcanic National Park for biomass conversion in the carboxylate platform for biofuel production
- Hot springs microbial consortia in Lassen Volcanic National Park: functional analysis of microbial communities along environmental gradients.
- Survey and seasonal monitoring of hydrothermal features in Lassen Volcanic National Park by Lassen astrobiology interns.
- Gas sampling at fumeroles.

Wildlife and Fisheries: 12 permits issued

- Demographic parameters of the California Spotted Owl.
- Klamath Network bird monitoring
- Butterfly population study and census.
- Natural UVB environment of the sagebrush lizard (*Sceloporus graciosus*)
- Sierra Nevada red fox, wolverine, and American marten surveys and monitoring in the southern Cascades and Sierra Nevada.
- Investigations of amphibian deformities in the western United States.
- Status and distribution of declining amphibian populations in the Sierra Nevada mountains.
- Climate driven shifts in parasite host dynamics: consequences for amphibian malformations and mortality.
- Survey of small vertebrates in the meadows adjacent to Horseshoe Lake cabin, Lassen Volcanic National Park.

- Quantifying attributes of historic pika sites within Lassen Volcanic National Park.
- Ecoregion Biodiversity Monitoring (formerly landscape habitat and wildlife monitoring project).
- Extent of endocrine disruption and airborne contaminants in fish of western and Alaskan National Parks.

Insects: 1 permit issued

- Monitoring changes in the geographic distribution of *Bombus accidentalis* Greene in Western North America: Effects on diversity, abundance and genetic structure of populations.

Geology: 2 permits issued

- Textural analysis of mafic enclaves as an insight into magma mixing processes at Chaos Crags, Lassen Volcanic National Park
- Investigating pyroclastic flow deposits of the 1915-1917 eruption of Mt. Lassen

Fire history: 1 Permit issued

- Spatial characteristics and patterns of forest fire severity in the early 20th century.

Soil: 1 permit issued

- DNA repair of mycobacteria from volcanic soil.

Air Quality: 2 permits issued

- Forest Inventory and Analysis Biomonitoring Program.
- Air pollution profiling study –ground study: black carbon on rain and snow

Microbiota: 1 permit issued

- Fluorescence spectroscopy as a tool for finding biomolecules in extraterrestrial, subsurface missions

FUTURE DIRECTION

Lassen Volcanic National Park will continue to issue scientific research and collecting permits for research that is appropriate and beneficial to the park.

NEPA COMPLIANCE

INTRODUCTION

The National Environmental Policy Act (NEPA) was passed by Congress in 1969. This landmark legislation established this country's environmental policies, including the goal of achieving productive harmony between human beings and the physical environment for present and future generations. It provided the tools to carry out these goals by mandating that every federal agency prepare an in-depth study of the impacts of "major federal actions having a significant effect on the environment" and alternatives to those actions, and requiring that each agency make that information an integral part of its decisions. NPS Director's Order 12 and its correlating handbook guide very specifically how NEPA is to be implemented in National Park units.

OBJECTIVES

Natural and cultural resource protection within the National Parks is accomplished through compliance with National Environmental Protection Act (NEPA) and the National Historic Preservation Act (NHPA). They are briefly introduced in their respective sections below. The objective of NEPA is to make sure that agencies fully consider the environmental costs and benefits of their proposed actions before they make any decision to undertake those actions. The objective of NHPA is to make sure that agencies fully consider the effects of their proposed actions on this America's historical properties.

METHODS (NEPA & NHPA)

All park projects are presented at the Lassen Operations Team meeting for internal scoping of issues related to the project. After any necessary changes are made to the project, projects which LOT determines should proceed, are forwarded to the Compliance Council.

LVNP has a Compliance Council that is an interdisciplinary team made up of one staff member from each park division as well as the following staff members in the Natural Resources Division: Wildlife Biologist, Plant Ecologist, Forester, Chief, and the Compliance Specialist., the Compliance Council reviews the projects to determine if they can be Categorical Excluded from NEPA or if they need an Environmental Assessment or an Environmental Impact Statement completed. Most projects are determined to be categorically excluded, but there is still a specific NPS process that must be followed to document that decision making process. The cultural resources specialist also sits on the compliance council and recommends a course of action to comply with NHPA.

All documented compliance (NEPA and NHPA) is tracked in Planning, Compliance and Public Comment (PEPC) software. Hard copies of the signed compliance documents are kept in the Resources Management building.

Records of "non-documented" decisions are also kept in the resources management building. "Non-documented" means the compliance specialist did not believe the action was significant enough to involve formal NEPA and did not constitute "an undertaking" as

defined in the NHPA. These actions therefore did not warrant compliance documents signed by the superintendent.

The National Environmental Policy Act (NEPA)

The National Environmental Policy Act (NEPA) was passed by Congress in 1969. This landmark legislation established this country's environmental policies, including the goal of achieving productive harmony between human beings and the physical environment for present and future generations. It provided the tools to carry out these goals by mandating that every federal agency prepare an in-depth study of the impacts of "major federal actions having a significant effect on the environment" and alternatives to those actions, and requiring that each agency make that information an integral part of its decisions. NPS Director's Order 12 and its correlating handbook guide very specifically how NEPA is to be implemented in National Park units.

RESULTS

The Natural Resources staff continued to work on the Warner Valley Comprehensive Plan Environmental Impact Statement.

The Natural Resource staff completed 16 Categorical Exclusions in 2009. The following is a list of all the completed Categorical Exclusions and their Planning, Environment and Public Comment (PEPC) numbers:

22368	Construct new Drakesbad leachfield
23326	Manzanita Lake disturbed lands restoration project
24633	Lighting for ADA bathrooms at Manzanita Lake
25085	Bioprospecting for acidothermophiles that use cellulose
25086	Discovering natural microbial communities for biomass conversion
25118	Programmatic for Interior painting of historic buildings
25188	Refinishing treatment for interior floors at Drakesbad
25190	Repair exterior decks and stairs at Drakesbad
25192	Replace doors on cabins at Drakebad
25657	Programmatic for rodent exclusion
25693	Programmatic for exterior painting
25704	Programmatic for research permits
26769	Mill Creek Falls bridge
27976	Repair Drakesbad water plant access road
27977	Inspect wastewater mains
27978	Relocate conference room and fitness room to new building

Compliance for these fuels treatments was completed under the 2005 Fire Management Plan EA

21794	Mineral Headquarters Prescribed Burn
21796	Loomis Prescribed Burn
21797	Butte Lake Prescribed Burn

National Historic Preservation Act (NHPA)

National Historic Preservation Act compliance as well as all cultural resources issues were transferred from the Interpretation Division to the Resources Division in the spring of 2008. This transfer happened slowly as both the cultural resources position and the compliance position were vacant. Sean Eagan started as the compliance coordinator in July of 2008. On 14 November 2008 the NPS entered into a new Programmatic Agreement on how NHPA compliance will be accomplished and documented. It did not apply to any of these 2008 projects.

RESULTS

Eight projects were determined to be “No Historic Properties Effected”

25085	Bioprospecting for acidothermophiles that use cellulose
25086	Discovering natural microbial communities for biomass conversion
25704	Programmatic for research permits
26769	Mill Creek Falls Bridge
27978	Relocate conference room and fitness room to new building
21794	Mineral Headquarters Prescribed Burn
21796	Loomis Prescribed Burn
21797	Butte Lake Prescribed Burn

Eleven projects were determined to have “No Adverse Effect”

22368	Construct new Drakesbad leachfield
23326	Manzanita Lake disturbed lands restoration project
24633	Lighting for ADA bathrooms at Manzanita Lake
25118	Programmatic for Interior painting of historic buildings
25188	Refinishing treatment for interior floors at Drakesbad
25190	Repair exterior decks and stairs at Drakesbad
25192	Replace doors on cabins at Drakebad
25657	Programmatic for rodent exclusion
25693	Programmatic for exterior painting
27976	Repair Drakesbad water plant access road
27977	Inspect wastewater mains

Native American Graves Protection and Repatriation Act (NAGPRA)

There were no projects accomplished or planned in 2009 that triggered action under NAGPRA. LAVO collections are managed by Redwood National Park staff. They have been inventoried and do not contain items that need to be returned (through disposition or repatriation) to the tribes.

Additional Accomplishments:

- Coordinated alternative development on the Lassen Peak Trail EA
- Coordinated Warner Valley DEIS administration (incorporation of NPS comments, distribution, display development, and assistance with public meetings)
- Coordinated SHPO and US Fish and Wildlife Service consultation on Warner Valley DEIS
- Coordinated SHPO consultation the Mineral Water Treatment Plant

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