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Pacific West Region
Oakland, California



Northern Spotted Owl Inventory on Federal Lands in Marin County

2006 Annual Report

Natural Resource Technical Report NPS/PWR/SFAN/NRTR—2007/006



ON THE COVER

Northern Spotted Owl (*Strix occidentalis caurina*).
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Natural Resource Technical Report NPS/PWR/SFAN/NRTR—2007/006

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Executive Summary

This report details the results of the tenth year of the Northern Spotted Owl (*Strix occidentalis caurina*) Monitoring Program in Marin County, California. The goal of the 2006 monitoring effort was to complete an inventory of suitable Spotted Owl habitat on federally legislated lands within Marin County. The intended audience of this report includes partners in our monitoring program as well as appropriate agencies at the county, state, and federal levels. The report provides an overview of the 2006 Northern Spotted Owl inventory on federal lands and summarizes the results of the data collected during the field season.

In 2006, the monitoring program completed an inventory of suitable Spotted Owl habitat within the legislative boundaries of Point Reyes National Seashore (PORE), Golden Gate National Recreation Area (GOGA), and Muir Woods National Monument (MUWO). The 2006 inventory study is intended to part of the ongoing, long-term monitoring program initiated in 1999, succeeding the initial Spotted Owl inventory effort completed during 1997-1998 breeding seasons. During the breeding season, we inventoried the study area for Spotted Owl presence using a combination of known activity site monitoring and standard inventory methods. The goal was to collect occupancy information for all Spotted Owls detected including current owl activity centers, owl occupancy status, age of owl, sex of owl, and if applicable, band identification. Due to the increased workload of surveying inventory areas in addition to known sites, reproductive information was collected opportunistically in 2006 and therefore will not be included in this report.

During the 2006 breeding season, Marin County's survey teams completed 298 surveys to a total of 43 known Spotted Owl territories or "sites" and 22 inventory areas. Additionally, 19 known Spotted Owl territories situated outside the perimeter of federal lands were monitored based on resource management needs. For this report, only information pertaining to the 65 inventory areas and monitoring sites was included. The 2006 official status of each Spotted Owl territory or inventory area was determined using the USFWS "Protocol For Surveying Proposed Management Activities That May Impact Northern Spotted Owls" (USFWS 1992).

At a minimum, a single Spotted Owl response was detected at 59 of the 65 areas monitored for occupancy and inventory purposes in 2006. Pairs of Spotted Owls occupied 43 of the 65 (66%) areas. Eight of the 65 areas (12%) were confirmed to resident single status. At an additional eight areas were categorized as single unknown status. Single unknown status indicates that a Spotted Owl response was detected, but despite repeated survey efforts the Spotted Owl status could not be confirmed to USFWS protocol. Areas where Spotted Owls were not detected composed 10% of the survey effort.

Introduction

The U.S. Fish and Wildlife Service (USFWS) listed the Northern Spotted Owl (*Strix occidentalis caurina*) as a threatened species on June 22, 1990. Northern Spotted Owls are distributed in forested regions from southern British Columbia through Washington, Oregon, and northwestern California. They reach the southern limit of their range in coastal California north of San Francisco Bay, where they occur in Golden Gate National Recreation Area (GOGA), Muir Woods National Monument (MUWO), Point Reyes National Seashore (PORE), and other parts of Marin County.

In a 1997-1998 Spotted Owl inventory study, all evergreen forest habitat located on federal lands within Marin County were thoroughly and systematically surveyed for Spotted Owl presence using followed the USFWS “Protocol For Surveying Proposed Management Activities That May Impact Northern Spotted Owls” (USFWS 1992). Approximately 75 Spotted Owl activity sites were documented during the 1997-1998 inventory, although large portions of private lands were not surveyed and the overall number of pairs is undoubtedly higher. Beginning in 1999, 46 sites were selected for annual long-term monitoring for occupancy and reproductive success. The sites were chosen to represent a variety of habitat types and according to the amount of existing data, ongoing management concerns, accessibility, and funding availability.

Between 1998 and 2003, we captured and color banded owls at 26 sites within a 24,700 acre study area centered around Bear Valley in PORE. In 2004, we ceased banding Spotted Owls due to logistical constraints and limited sample size. We have continued to determine band identification on all Spotted Owls encountered. Additional sites surveyed for management purposes also serve to expand the probability of resighting banded owls that have relocated out of the central study area as well as detecting Barred Owls in the area.

Habitat and Nests

In the northern portion of their range, Northern Spotted Owls are typically found in mature coniferous forests (e.g., Forsman et al. 1984). In Marin County, they inhabit Douglas fir (*Pseudotsuga menziesii*), coast redwood (*Sequoia sempervirens*), bishop pine (*Pinus muricata*), mixed conifer-hardwood, and evergreen hardwood forests. Logging occurred in Marin County from the mid 1800’s to the mid 1900’s, a large fire burned in the mid 1940’s, and another 12,000 acre fire occurred in 1995, all of which altered forested habitats (Evens 1988). Most of the areas altered prior to the 1940’s have re-grown and are now mature second growth. The area where the Vision Fire occurred in 1995 contains a mosaic of young, dense stands of mixed conifer-hardwood forest and coastal scrub. All forest types and ages contain a significant hardwood component.

During inventory and monitoring surveys from 1997 to 2005, Spotted Owl researchers located a total of 195 Spotted Owl nests. Of the 195 unique nests, 19 (9%) have been cavities and 176 (91%) have been platform nests. The ratio of nest types in Marin is similar to the ratio seen in other younger aged forests such as the Wenatchee National Forest on the east slope of the Cascade Mountains in Washington (Buchanan and Irwin 1993). In the Wenatchee study, 16.5% of nests were cavities; while in older forests in Northwestern California and the Olympic

Peninsula in Washington, 80% and 90% of nests were in cavities, respectively (LaHaye and Gutierrez 1999; Forsman and Giese 1997). LaHaye and Gutierrez (1999) theorized that nest type depends on the age of the forest and this is supported in Marin where both logging and fire have created a younger-aged forest habitat.

Platform nesting structures in Marin have included tree forks, large limbs, broken top trees with lateral branches, old raptor, corvid, squirrel, and woodrat nests, debris piles, poison oak tangles (*Toxicodendron diversilobum*) and dwarf mistletoe infestations (*Arceuthobium* spp.). Cavity nests included both side entry and top entry cavities. Spotted Owl nests have been documented in a variety of tree species including coast redwood, Douglas fir, bishop pine, California bay (*Umbellularia californica*), tanbark oak and coast live oak. Approximately 80% of the documented nests have been in coast redwood and Douglas fir.

The habitat and nest data collected through the monitoring program has been used to quantify the known and predicted distribution and density of owls through Geographic Information Systems (GIS) analysis, and a habitat model was developed in cooperation with PRBO Conservation Science (Stralberg et al. in press). The models indicated that forest connectivity and topographic conditions were the strongest predictors of owl presence. We are characterizing habitats around owl nest sites through GIS analysis and in the future hope to relate reproductive success to specific habitat characteristics.

The Marin County study area supports the highest density of Northern Spotted Owls within this subspecies range. Based on a recent analysis, the density of Spotted Owl activity sites was estimated at 0.52 owls/km² which is slightly higher than a previous Marin County estimate due to the discovery of several additional owl sites and the use of a more limited, geographically relevant boundary for the study area (Chow 2001, Stralberg et al. in press).

Owl Fecundity

Fecundity measured at long-term monitoring sites in this region has remained relatively stable and the average fecundity for the years 1998-2005 was 0.46 (s.e. ± 0.078). Fecundity ($\pm$ SE) is defined as the number of female young fledged per territorial female. Marin County has one of the highest reported adult female fecundity rates within the Northern Spotted Owl's range (Courtney, et al. 2004).

Prey Species

Previous pellet analyses indicate that Spotted Owls in Marin County forage primarily on dusky-footed woodrats (*Neotoma fuscipes*) which make up over 75% of their diet by weight. Other prey includes small mammals such as deer mice (*Peromyscus maniculatus*), California meadow vole (*Microtus californicus*), and brush rabbit (*Sylvilagus bachmani*) as well as a variety of forest-dwelling birds (Chow and Allen 1997, Fehring 2003).

Threats to the Population

Marin County's Northern Spotted Owl population is subject to unique threats present in this portion of the range including: 1) urban development along open space boundaries, 2) disturbance due to intense recreational pressures, 3) potential effects of hazardous fuel management practices to Spotted Owl distribution and productivity, 4) potential for catastrophic wildfires along the urban/wildland interface, 5) possible genetic isolation and 6) emergent biological threats (Sudden Oak Death, West Nile Virus, and the continued range expansion of the Barred Owl).

Genetic studies of Northern Spotted Owls indicate that the Marin study area is relatively isolated population of Spotted Owls with minimal gene flow with the rest of the Northern Spotted Owl populations (Barrowclough et al. 2005, Henke et al. 2003). Barrowclough et al. (2005) indicates that due to the apparent genetic isolation of Marin County's Northern Spotted Owl population, the population warrants special management attention.

Emergent biological threats in Marin County such as Sudden Oak Death (SOD), West Nile Virus (WNV), and the continuing range expansion of the Barred Owl are new threats in which the long-term ramifications are not yet fully understood at this time. Sudden Oak Death involves the continuing die-off of tanbark oaks (*Lithocarpus densiflorus*), coast live oaks (*Quercus agrifolia*) and several other tree and shrub species throughout Spotted Owl habitat in Marin County. SOD may have long-term impacts on Spotted Owl nesting habitat and prey populations. West Nile Virus (WNV) has been confirmed to be lethal in the Strigidae family and the first positive confirmations of WNV occurred in 2004 in Marin County. Of special concern is the increase in Barred Owl detections throughout Marin County. Barred Owls have expanded their range into the Pacific Northwest, and are suspected of displacing Spotted Owls. In reviewing Barred Owl and Spotted Owl locations in Oregon between 1974 and 1998, Kelly et al. (2003) found that when Barred Owls invade Spotted Owl territories, mean annual occupancy of Spotted Owls decline when compared to territories without Barred Owls.

The parklands in this portion of the Spotted Owl's range are situated within the immediate San Francisco Bay Area and receive several million human visitors each year. Spotted Owl nest sites in Marin County are generally close to roads and trails. This is likely the result of the high density of trails and fire roads located within potential Spotted Owl habitat and the tendency to locate trails in riparian drainages where owls often nest. As a result of these circumstances, Spotted Owls of this region have a high potential for interaction with humans.

Standard Spotted Owl survey protocols may lead to changes in owl behavior due to repeated calling and the feeding of live mice (*Mus domesticus*) to owls (known as "mousing"). Owls habituated to people may be more vulnerable to disturbance and manipulation by park operations and visitors. Wildlife photographers and well-meaning wildlife enthusiasts have used mice to bring owls closer. Several pairs of Spotted Owls have been documented frequenting campgrounds, flying down to hikers and roosting near homes. In Marin County, we have developed a modified protocol that reduces the number of mice used to obtain the relevant nest site and reproductive information. The ease of access to nest sites and high visibility of nesting structures facilitates intensive nest checks as opposed to "mousing" to monitor reproductive

status. We rely on increased search time, more frequent visits and owl behavioral observations to gather the data. Some “mousing” is still necessary, but overall we have reduced the use of mice, while still maintaining our ability to obtain accurate reproductive data.

All long-term monitoring surveys for occupancy and reproductive information follow the Marin Modified Protocol developed for use in areas with high potential owl/human interaction. The “Modified Protocol For Spotted Owl Monitoring and Demographic Studies in Marin County California” (Fehring et al. 2001) is modeled directly from the widely used “Spotted Owl Monitoring Protocols for Demographic Studies” (Forsman 1995).

2006 Inventory Study Objectives

The 2006 inventory study is intended to be part of an ongoing, long-term monitoring program initiated in 1999, following the initial Spotted Owl inventory work done in 1997-1998. Between 1999 and 2005, 46 long-term monitoring sites were monitored for occupancy and reproductive success to determine overall population occupancy rates and fecundity and to collect nest site characteristics (Adams et al. 2005).

The purpose for doing the 2006 inventory was multi-fold. Completing an inventory in 2006 addressed the program’s long-term objective to monitor suitable habitats every 5-10 years in order to identify population expansion of target species and incorporate them into annual abundance estimates. It had been 7 years since the last inventory and our 46 monitoring sites had not all been selected at random from the known set of 1997-1998 activity sites, so we were unable to make inferences of results to the greater study area. We are seeking a sample design to increase efficiency and potentially decrease the annual effort and cost of monitoring Spotted Owls on federal lands in Marin County. Additionally, an inventory offers a greater opportunity to detect Barred Owls to assess the current population size and distribution of Barred Owls within the study area.

The 2006 inventory study had several objectives:

1. Determine the study area boundaries using the habitat model (Stralberg et al. in press).
2. Inventory the study area for Spotted Owl presence using a combination of known activity site monitoring and standard inventory methods.
3. Determine the number of known Spotted Owl sites within the legislative boundaries of MUWO, PORE, GOGA to continue the long-term monitoring program in 2007 using a randomly selected sample population from a larger known population of current and historic owl activity sites.
4. Determine the number of Barred Owl detections and distributions of Barred Owls within the legislative boundaries of MUWO, PORE, and GOGA to prepare for a more intensive barred owl habitat use and movement study in FY07 or FY08.

Study Area

In 2006, all inventory surveys occurred within a 33,842-acre area of Marin County, which includes forested lands identified through the habitat model (Stralberg et al. in press) that fall within the federally legislated boundaries or within a 400 meter buffer of federal boundaries. All habitat inventoried in 2006 was within the legislative boundaries or within a 400 meter buffer of the boundaries of PORE, GOGA and MUWO, which includes California State Park (CSP) lands in Mount Tamalpais State Park and Samuel P. Taylor State Park. Tomales Bay State Park is not contained within the federal boundaries of PORE and was not included in the inventory effort or acreage calculation. Also not included in the acreage calculation, are additional management surveys that occurred outside the perimeter of federal lands on CSP, the City of Mill Valley, and the Marin Municipal Water District (MMWD) lands.

Wet winters and dry summers characterize the Mediterranean climate in Marin County. Rainfall varies according to topography and the ocean influence keeps temperatures moderate year-round. Elevations range from sea level to 784 meters on Mount Tamalpais in southern Marin County.

The results of the inventory of Spotted Owl habitat on NPS lands do not necessarily represent conditions across Marin County and in general, the inventory results and long-term monitoring program results may not apply to areas outside the study area.

Methods

Study Design

In 2006, the monitoring program proceeded with an inventory of suitable Spotted Owl habitat. We determined the study area boundaries using the habitat model (Stralberg et al. in press). Starting with the high probability of occurrence model layer (containing 80% of known Spotted Owls nests between 1998 and 2002); we applied a 400 meter (1/4 mile) buffer around the model boundaries. The final inventory study area included all the buffered model areas within the legislative boundaries of MUWO, PORE and GOGA lands. We also included any buffered model areas that were within 400m of the legislative boundaries. The purpose of the 400m buffer along the federal boundary was to include Spotted Owl territories or “sites” that have the potential to be affected by management activities occurring on federal lands. Areas of Mount Tamalpais State Park and Samuel P. Taylor State Park are within the federal legislative boundary of Golden Gate National Recreation Area and Muir Woods National Monument, but Tomales Bay State Park is outside of the federal boundary thus its Spotted Owl habitat and known territories are excluded from the study.

Additional habitat determinations were made by the project biologists. Although the majority of the suitable Spotted Owl habitat was identified by the Spotted Owl habitat suitability model, several instances occurred in which suitable habitat identified by the habitat model was discarded based on researchers direct habitat observations (Appendix A). The GIS layers of habitat model did not take into account the 12,000 acres of the Point Reyes National Seashore’s that were affected by the Mt. Vision fire of 1995 (Chow and Allen 1997) thus a large area was discarded after researchers investigated the habitat. In other instances, areas were discarded because very

marginal habitat was included in the habitat model (i.e. eucalyptus stands). In contrast, instances occurred where suitable habitat was not identified by the habitat model, but was included in the survey efforts based on biologist's observations. Pockets of suitable habitat along Bolinas Ridge were surveyed by biologists due to direct habitat observations although not identified by habitat model.

We inventoried the study area for Spotted Owl presence using a combination of known activity site monitoring and standard inventory methods. Included in the 2006 inventory effort were 43 known Spotted Owl territories and 22 areas surveyed for inventory purposes. At historic Spotted Owl territories, the initial visit was a day visit to survey for Spotted Owl occupancy. We applied a 660 meter buffer around the historic and occupied Spotted Owl activity sites. The 660 meter buffer was determined by halving the median distance between nearest neighboring sites (across all years, 1998-2001) that was determined through the habitat model. The median distance was 1,322 m and the average distance was 1,376 m ($\pm$ 519 SD), with a range of 592 to 3,335 m (Stralberg et al. in press).

Inventory routes were designed to cover all the additional areas not covered by the buffers around known owl sites. Initial visit to all inventory areas was a night or predawn visit. All inventory areas received three night visits staggered throughout the breeding season using established call routes on roads and trails with strategically-placed, ten minute call stations (Appendix A). The goal was to collect occupancy information for all Spotted Owls detected including occupancy status, age of owl, sex of owl, and if applicable, band identification. Due to the increased workload of surveying inventory areas in addition to known sites, reproductive information was collected opportunistically in 2006.

All inventory efforts in 2006 were completed as a part of a single year inventory. One reason for repeating survey efforts in a standard two year inventory is to counterbalance the effects of poor nesting years when Spotted Owls can become less responsive (Forsman 1983). Since fecundity and the percentage of Spotted Owls nesting yearly has remained relatively stable on a local level from 1998-2005, it seemed feasible to complete a single year inventory effort to capture Spotted Owl presence on inventory areas. Inventory areas where Spotted Owls were detected in 2006 will be incorporated into future monitoring efforts to further verify occupancy status and activity centers.

We determined the number of known Spotted Owl sites within the legislative boundaries of MUWO, PORE, and GOGA, with the goal of continuing the long-term monitoring program in 2007, using a randomly selected sample population from a larger known population of current and historic owl activity sites. Additionally, we determined the number of Barred Owl detections within the Spotted Owl study area to prepare for a more intensive Barred Owl habitat use and movement study in fiscal year 2007 or 2008.

We used a hybrid of the Marin County Spotted Owl Monitoring Protocol and the U.S. Fish and Wildlife Service's "Protocol For Surveying Proposed Management Activities That May Impact Northern Spotted Owls" (USFWS 1992) to define survey methods and standardized search procedures. Occupancy status classifications were based on USFWS protocol criteria.

All owl activity centers (either nest location or major roost site) are recorded in GPS (Global Positioning System) coordinates using a Garmin 3+ or similar GPS unit. Roost sites or nest trees for which GPS satellite access is not available are mapped on topographic maps from compass bearings taken in the field and GPS coordinates are obtained by using ArcGIS 9.1 (ESRI 2005). Each year at every known nest location, nest tree parameters are measured and surrounding habitat is described using a standardized protocol found in the Monitoring Protocol (Adams et al. 2005).

All site search, owl detections, and nest record field data are compiled in a Microsoft Access database maintained at Point Reyes National Seashore. All areas surveyed are mapped using ArcGIS 9.1 GIS software program and the data layers are made available to agencies involved in land management and planning projects within Marin County. The 2002 through 2005 Spotted Owl location data has been submitted to the CA Natural Diversity Database Project (Rarefind) and the Biogeographic Information and Observation System (BIOS) database. In addition, we provide the U.S. Department of Fish and Game and the Marin County Development Agency with Spotted Owl locations.

Results and Discussion

General Monitoring

On March 9th, 2006, staff members assembled at Point Reyes National Seashore to discuss proposed changes to the 2006 fieldwork and future protocol changes in survey design. We addressed current protocol questions and finalized an inventory design. A second meeting was held on May 4th, to discuss the progression of the field season and address any field-based issues or protocol questions that may have evolved. The 2006 NPS field crews were composed of returning staff members with the addition of a PRBO field technician and a handful of long-term volunteers.

Occupancy Status

From March 3rd to August 25th, the survey teams made 298 visits (mean visits/site = 4.6, range 1-12) to a total of 65 Spotted Owl territories and inventory areas. Surveys were made to 43 known Spotted Owl territories and 22 inventory areas identified as having suitable Spotted Owl habitat.

At a minimum, a single Spotted Owl response (Spotted Owl was detected on at least one of the surveys) was detected at 59 of the 65 areas (91%) monitored for occupancy and inventory purposes in 2006 (Figure 1 and Appendix B). Collectively at 65 areas monitored for occupancy and inventory purposes, Spotted Owl pairs occupied 43 of the 65 locations (66%). Resident single status was confirmed at 8 of the 65 sites and areas (12%). At an additional 8 locations (12%), a single unknown category was used to indicate cases where a Spotted Owl response was detected, but despite repeated survey efforts could not be confirmed to any protocol status. At 6 of the 65 sites occupancy sites and inventory areas (10%), no Spotted Owl response was detected by staff.

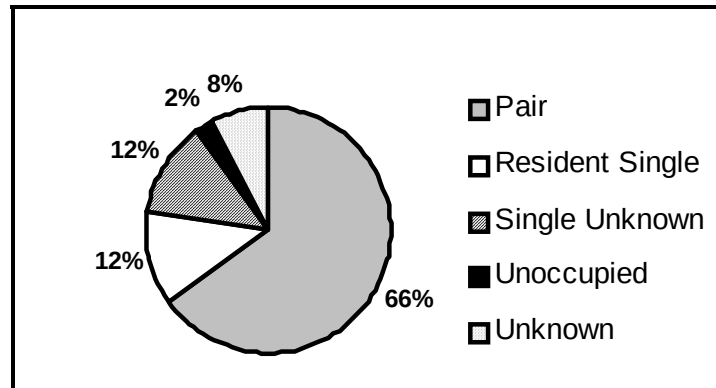


Figure 1. Occupancy status for occupancy sites and inventory areas for 2006 (N=65).

At the 43 known Spotted Owl territories, 36 of the sites (84%) were confirmed to be occupied by pairs of Spotted Owls and 4 of the locations (9%) were occupied by resident single Spotted Owls (Figure 2). From 1998-2005, the percent of sites occupied by pairs or single owls at the 46 sites monitored for occupancy and reproductive purposes has remained fairly constant at about 90%. This 90% occupancy rate is reflected in the 2006 occupancy rate at the 43 known Spotted Owl territories. This is not unexpected due to the lack of major habitat changes observed over the study period.

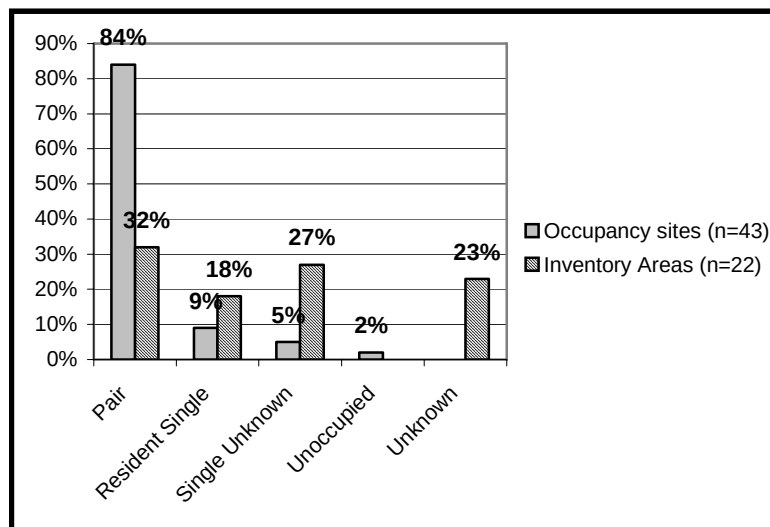


Figure 2. Occupancy status for occupancy sites (n=43) and inventory areas (n=22) for 2006.

In the 22 inventory areas, 17 of the 22 areas (77%) surveyed had some sort of positive Spotted Owl response (Figure 2). Pairs of Spotted Owls occupied 7 of 22 areas (32%) of the inventory areas. Resident singles were located at 4 of the 22 (18%) of the areas. Six of the 22 inventory areas were categorized as single unknown status. Inventory areas with single unknown status had at least one survey where a Spotted Owl was detected, but the owl could not be relocated on subsequent surveys. At five inventory areas, Spotted Owls were not detected and the Spotted Owl status at these areas remains unknown.

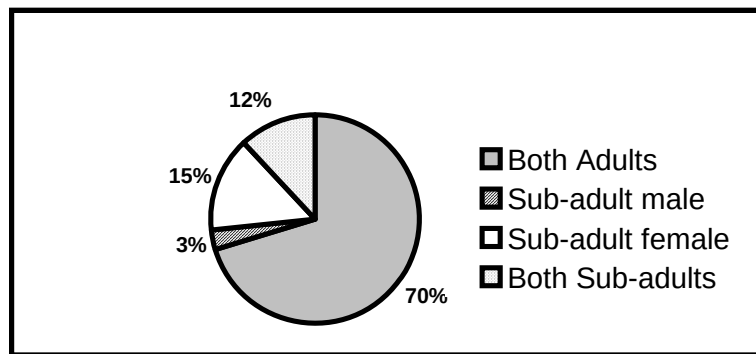


Figure 3. Age of Spotted Owls in 2006 pairings (n=34).

Biologists determined the ages of 79 Spotted Owls in 2006. Adults constitute 81% or 64 of the 79 Spotted Owls whose age was identified. Twelve second year sub-adults (15%) and three first year sub-adults (4%) were located. At 34 Spotted Owl territories, biologists were able to age both pair members (Figure 3). As expected, adult pairings composed the majority of the Spotted Owl population.

Identifications of Banded Owls

Of the 110 Northern Spotted Owls banded before 2004, 50 were banded as juveniles, 23 as subadults, and 37 as adults. In 2006, 20 banded owls were resighted (8 females and 12 males), with two owls resighted in different locations. A total of 12 Spotted Owls (9 juveniles and 3 adults) whose identity has been positively determined have been resighted at new territories since 1999. The two juvenile band resights from 2006, were male siblings that were banded as juveniles in 2002. The banded owls that dispersed to a new territory include 9 of the 50 owls banded as juveniles as well as 3 males banded after their juvenile year. The nine resighted juveniles moved an average distance of 9.4 km (n=9) from where their banding location (nest site). The shortest distance moved by a juvenile was 2.0 km and the longest was 22.5 km. Four of these owls were detected outside the study area at other sites within Marin County. Two sub-adult males moved distances of 5.7 and 6.4 km while one adult male relocated to the adjacent territory 1.0 km away. The average distance the three non-juveniles moved was 4.4 km.

Barred Owls and Hybrids

Barred Owls are a species of owl from the Eastern U.S. that has moved across the Canadian Rocky Mountains and down the West Coast of the United States. Barred Owls are slightly larger than Spotted Owls and appear to exhibit aggressive behavior toward Spotted Owls. The first Barred Owl record for Marin County occurred in May 2002 in MUWO. Physical confrontations and aggressive interactions between Barred and Spotted Owls have been documented at multiple Spotted Owl sites within Marin County. Temporary and permanent displacement of Spotted Owl pairs from their historic sites as a result of the immigration of the Barred Owls into the Spotted Owl's range has been documented by biologists in the Pacific Northwest (Gremel 2000). Marin County is likely to see a similar effect, but the ramifications of Barred Owl occupancy in relation to reproductive success of the Northern Spotted Owls is not yet known.

One of the objectives of the 2006 inventory was to detect Barred Owls to assess the current population size and distribution of Barred Owls within the study area and to prepare for a potential Barred Owl telemetry study. In 2006, a total of 12 separate Barred Owl (9 unknown sex and 3 male) detections were recorded in Marin County at six historic Spotted Owl territories. Surprisingly, no Barred Owls were detected during surveys in the inventory areas.

Of the 12 surveys that incidentally detected a Barred Owl, only three of the 12 visits also detected a Spotted Owl. Eight of the 12 Barred Owl detections occurred at three Spotted Owl sites concentrated in a 2.5 mile (4 km) area on the west side of Bolinas Ridge and Olema Valley. The remaining four detections were concentrated in a 1.6 mile (2.5 km) area in Muir Woods. Since Barred Owls in Marin County are not marked, the exact number of individuals cannot be confirmed. Based upon the sex determination, frequency and repetition of the incidental Barred Owl detections, and distance between Barred Owl detections it is likely that at least two males are current residents of Marin County. This is the fifth year a male Barred Owl has been detected at MUWO and the third year a male Barred Owl was located on the west side of the Bolinas Ridge. In August of 2005, biologists recorded the first Barred Owl pair detection in Marin County, less than a mile (1.4 km) west of the 2005 male Barred Owl's location on the Bolinas Ridge. In 2006, there was no female or Barred Owl pair vocalizations observed.

As of 2006, nesting by Barred Owls has not been documented. To date, no Spotted/Barred Owl hybrids have been detected at any of the long term monitoring sites. Future staff members and volunteers should be made aware of the potential of hybridization and the importance of confirming the identity of both pair members.

Research Activities and Recommendations

Barred Owl Study

In response to the steady influx of Barred Owls into the most southern part of the Northern Spotted Owl's range, a study is being developed to investigate habitat use and movement patterns of Barred Owls. The project would be a joint project from GOGA, MUWO, and PORE with the hope of collaborating with other Barred Owl biology studies across the range of the Northern Spotted Owl. Preliminary objectives of the study are to track Barred Owl movements, predict areas likely to see Barred and Spotted Owl interactions, provide insight to the overlap of diet, habitat use, and interspecific behavior. Barred Owls would be banded with color and USFWS bands and attached with radio transmitters. Ultimately, the study would provide a better understanding of the magnitude of the threat Barred Owls present to the long-term persistence of Marin County's Northern Spotted Owl population. Furthermore, we may learn more about management needs to benefit Spotted Owls in the presence of Barred Owls. We hope to implement the study in 2008, funding dependent.

Vocalization Study

During the 2006 breeding season, Spotted Owl staff members worked with independent researcher, Rick Johnson, to investigate the potential of identifying individual Northern Spotted

Owls through vocalization analysis. Vocal identification has been proven to be an effective tool to distinguish between individuals in the genus *Strix*, specifically the African Wood Owl (*Strix woodfordii*: Delport et al. 2002). The purpose of the research project was to determine if recordings of owl vocalizations, specifically four note location calls, can be used as a management tool to identify individual birds and used as an alternative to banding, which has been proposed for the Mexican Spotted Owl (*Strix occidentalis lucida*: Kuntz and Stacy 1997).

Initially, six Spotted Owl territories were selected based on the criteria that at least one of the pair members had color bands present during the 2005 field season. Four additional Spotted Owl sites were incorporated into the study over the course of the field season. All sites were located on NPS lands. A mix of unsolicited and solicited male and female vocalizations were recorded during day and night surveys. Forty-two male four note location calls were collected from a total of eight individuals and eight female four note location calls were collected from a total of four owls. The sounds were studied using spectrograms (Figure 4) and five parameters were selected to evaluate the spectrograms. The quantitative measures used to distinguish between individuals were based on the timing of the calls, pitch of the four note, and shape of the four note and were based on previous work on Northern Spotted Owls and California Spotted Owls (Van Gelder 2003). Preliminary results indicate that currently identification of individual Spotted Owls by vocalization alone is not likely to be an efficient monitoring tool for project staff to utilize in a demographic study. The vocalization study will continue in 2007, collecting vocal recordings Spotted Owls and Barred Owls. This technique may prove to be appropriate for the identification of a smaller population of Barred Owl individuals.

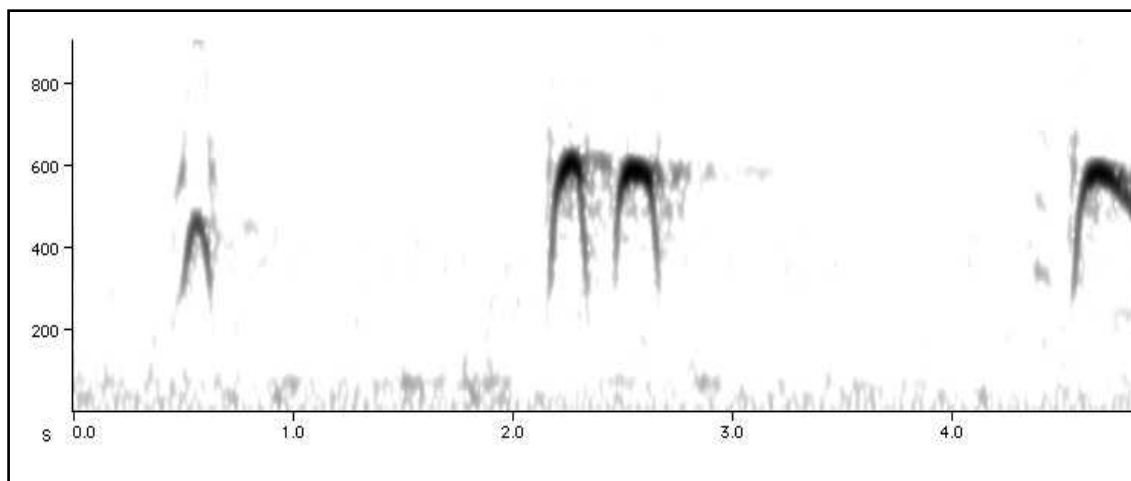


Figure 4. Example of a spectrogram (four note location call).

Sudden Oak Death

Marin County is one of 14 counties in California affected by the pathogen *Phytophthora ramorum* that causes Sudden Oak Death (SOD). *P. ramorum* is a water mold that acts like a fungus, attacking the trunk of a tree and causing a canker, or wound that eventually cuts off the tree's flow of nutrients. Other secondary decay organisms such as beetles and fungi often move in after the tree is infected. Trees infected with SOD may survive for one to several years as the

infection progresses. As the tree finally dies, the leaves may turn from green to brown within a few weeks, hence the appearance of sudden death (Davidson et al. 2003). Tanoaks (*Lithocarpus densiflorus*) and coast live oaks (*Quercus agrifolia*) are killed by the disease; other species affected are known as “foliar hosts” because their leaves and twigs may be infected. These foliar hosts can spread the disease, but are only occasionally killed.

The diversity of host species affected by *P. ramorum* indicates potential long-term landscape modifications through changes in the forest canopy, understory, and ground layer (Rizzo and Garbelotto 2003). A large scale habitat change due to *P. ramorum* has the potential to affect the whole forest ecosystem. Specifically, SOD has the potential to affect Spotted Owls through loss of canopy cover in roosting and nesting areas and changes in prey species due to loss or changes in prey habitat. Spotted Owl habitats affected by oak and tanoak dieoffs as a result of SOD are located in Samuel P. Taylor State Park, Mt. Tamalpais State Park, MUWO, Mill Valley, GOGA and most recently SOD was confirmed at multiple locations within PORE. For comprehensive information regarding SOD and links to current maps visit the California Oak Mortality Task Force website at www.suddenoakdeath.org.

Management of the pathogen at the Spotted Owl project level includes incorporating measures to prevent the spread of *P. ramorum*. As the range of SOD expands, simple precautionary measures and decontamination procedures have been added to our monitoring efforts so that we do not facilitate the transfer of infected plant material or soil to unaffected areas.

West Nile Virus

West Nile Virus (WNV) is an arbovirus that first appeared in the Western Hemisphere, specifically New York, in the early fall of 1999. Mosquitoes and migratory birds are the main species involved in the spread of WNV. Mosquitoes are the principle vector and avian species are considered the principle host species for WNV. WNV first appeared in California in 2002. By 2004, WNV had spread to all 58 counties of California and a total of 3,323 birds tested positive for WNV (Figure 5). On a local level, a total of 18 birds tested positive for WNV in Marin County in 2004, 14 birds tested positive in 2005, and as of September 2006 three birds and a mosquito have tested positive for WNV in Marin County. From 2004 to 2006, the top three species of birds infected by WNV in California are the American Crow (*Corvus brachyrhynchos*), Western Scrub-Jay (*Aphelocoma californica*), and Yellow-billed Magpies (*Pica nuttalli*). In 2005, 52 of California’s 58 counties recorded a total of 3,046 dead birds infected with WNV. As of September in 2006, 50 counties have detected WNV. For historical and current information that is updated weekly visit <http://westnile.ca.gov/>.

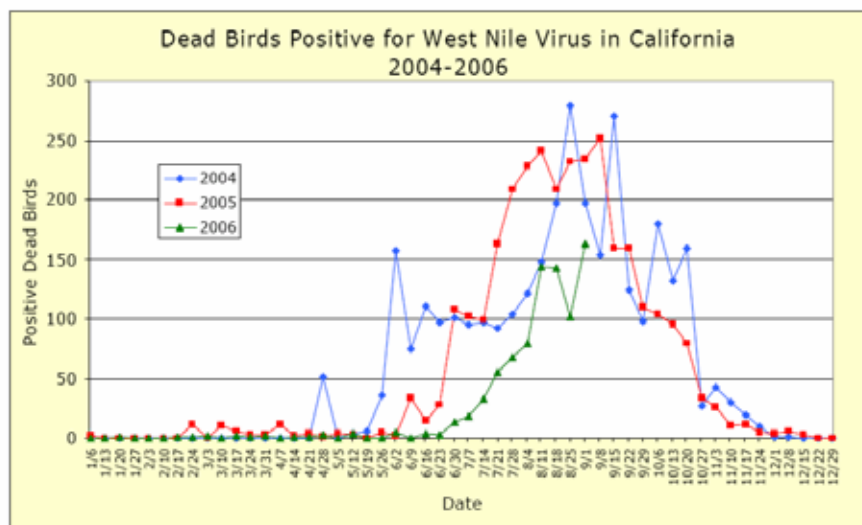


Figure 5. West Nile Virus Summary of 2004-2006.

Raptors and owls have been noted to be particularly susceptible to WNV. A Spotted Owl was confirmed to have died from WNV at a captive wildlife facility, indicating that Spotted Owls are susceptible to WNV. Last year in California, WNV was detected multiple times within the family Strigidae. Six Great Horned Owls (*Bubo virginianus*) and three Western Screech Owls (*Megascops kennicottii*) were confirmed to have WNV in California in 2005. Special attention should be paid during the 2007 field season to document fatalities that may be due to West Nile Virus. Carcasses should be tested whenever possible and the population should continue to be monitored for declines due to this new threat.

Management Activities and Recommendations

Northern Spotted Owls in Marin County face a unique set of threats. In contrast to the Pacific Northwest, large-scale loss and modification of habitat due to commercial logging is not the primary threat. Humans and their activities, including development along the wildland/urban interface, land management practices, and recreation are the most significant sources of impact. We recommend that owl occupancy and reproductive monitoring surveys continue, and that land managers use these data to ensure that management activities do not impact the habitat or the productivity of Northern Spotted Owls. We encourage continued communication between land managers and their maintenance crews in planning and executing projects in Spotted Owl habitat. Information on owl site locations should continue to be made available to USFWS, all land managers and local city and county planning departments and can be accessed through the California Department of Fish and Game (CDFG) Natural Diversity Database (www.dfg.ca.gov/whdab/html/cnddb.html) and the Biogeographic Information and Observation System (BIOS) database that is managed by Gordon Gould of the CDFG.

Given the mixed ownership patterns in Marin County, several owl home ranges contain both public and private lands. Coordination between park managers and local planners is essential. Loss of owl habitat and owl pairs due to residential land management practices (i.e. rodenticide)

and urban development is an urgent local threat. Due to the fragmented and isolated nature of the Marin County owl habitat, declines along the urban edges may impact overall population health throughout the local range.

Range-wide Spotted Owl/Barred Owl Meeting

On February 9th, 2006 federal biologists convened in Portland for a workshop on the science of the Northern Spotted Owl hosted by USFWS, BLM, and USFS. The Portland conference served as a follow-up to a June 2005 Barred Owl Conference in Arcata, CA. As a result of the 2005 Barred Owl conference, a Barred Owl resolution was drafted which encouraged research to provide scientifically sound evidence of the impacts of Barred Owls on Spotted Owls to aid future management decisions. The February 2006 conference in Portland provided Spotted Owl researchers with an opportunity to highlight several of the ongoing research projects and published results. An overall summary of Barred Owl studies, which included current, pilot, and proposed Barred Owl research projects, was presented. As of February 2006, there were six projects in progress, three projects funded to begin in FY2006, one proposed project, and 2 pilot efforts. Topics of current and proposed Barred Owl projects include habitat, movement, diet, detectability, interaction, and removal. In attendance from the Marin County Spotted Owl monitoring program was Heather Jensen (PORE, Biological Technician). A copy of the resolution drafted at the 2005 Barred Owl Conference and a list of scientists who support the resolution can be viewed at <http://www.sei.org/owl/BarredOwlWorkshop.htm>.

Conservation Genetics

We are continuing to opportunistically collect Northern Spotted Owl feathers with the potential to provide these for additional genetic analysis. Feather samples collected in 1999 and 2000 from Marin County's population were part of a study conducted at the Conservation Genetics Laboratory at San Jose State University. The Conservation Genetics Lab compared Marin County's Northern Spotted Owl population with other populations of Northern and California Spotted Owls. Their results indicated that the Marin County Spotted Owl population has very little gene flow with Spotted Owl populations farther to the north (Barrowclough et al. 2005, Henke et al. 2003). Barrowclough et al. (2005) indicates that due to the apparent genetic isolation of Marin County's Northern Spotted Owl population, the population warrants special management attention.

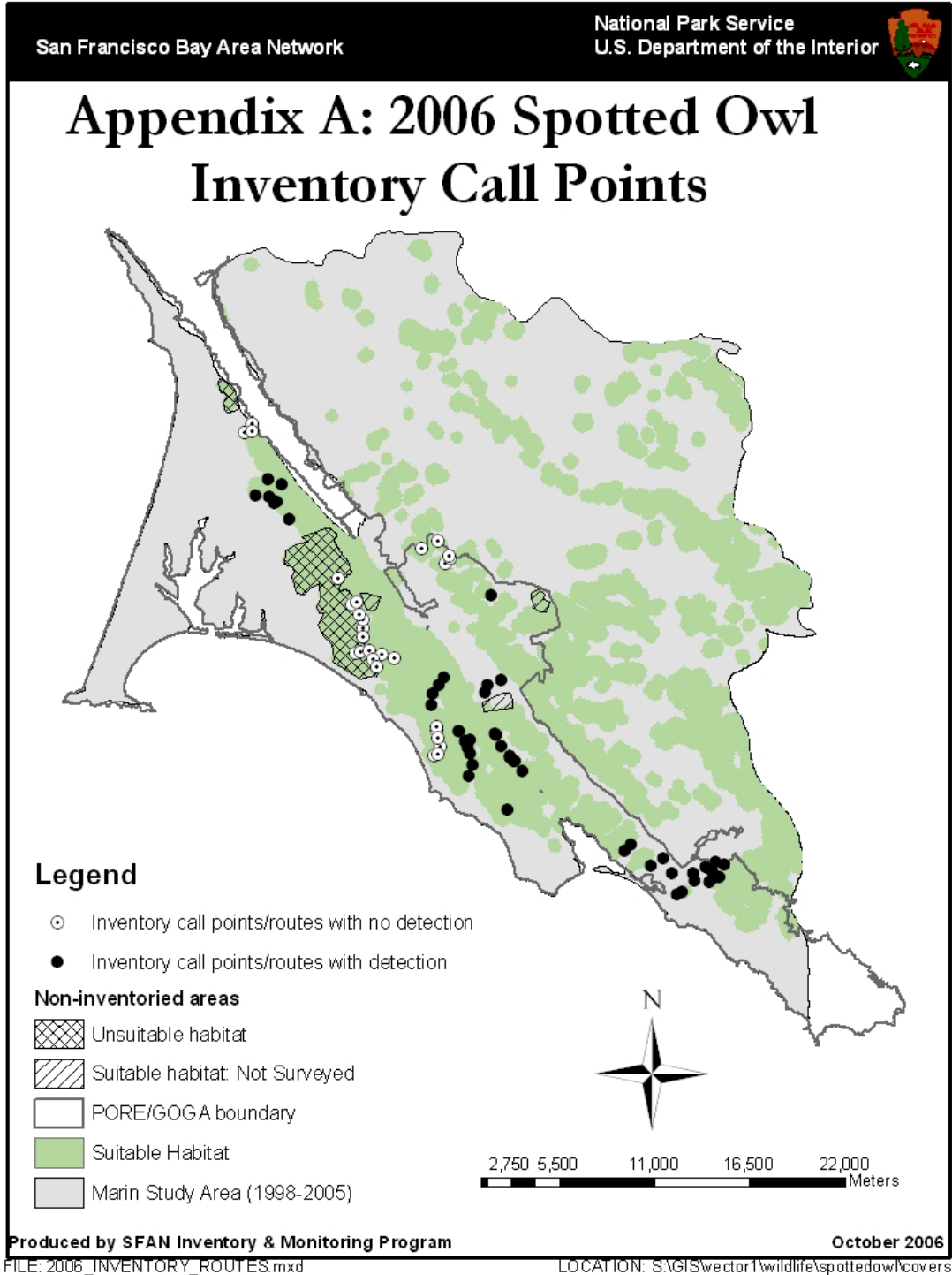
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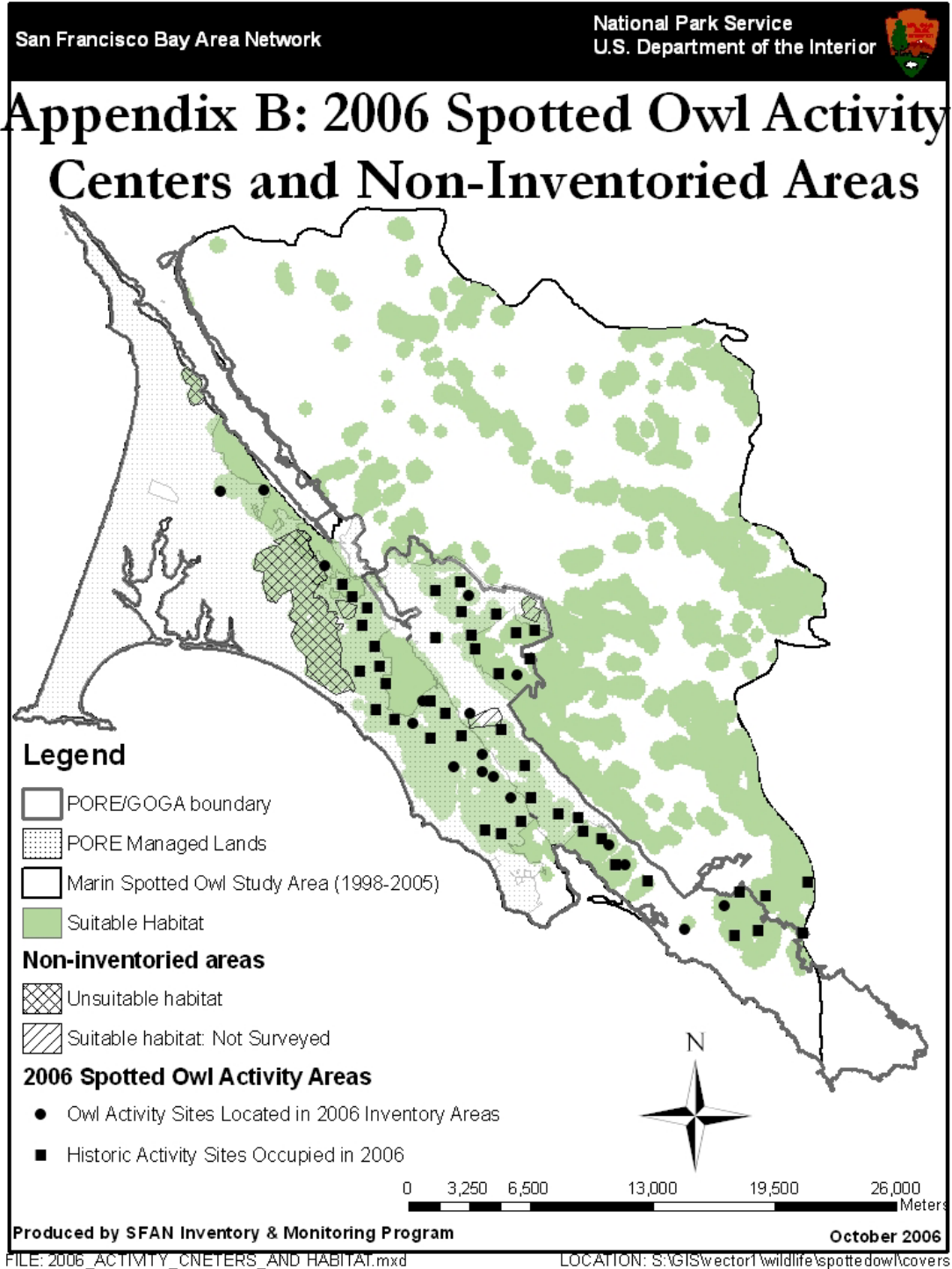
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Appendix A



Appendix B



The U.S. Department of the Interior (DOI) is the nation's principal conservation agency, charged with the mission "*to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.*" More specifically, Interior protects America's treasures for future generations, provides access to our nation's natural and cultural heritage, offers recreation opportunities, honors its trust responsibilities to American Indians and Alaska Natives and its responsibilities to island communities, conducts scientific research, provides wise stewardship of energy and mineral resources, fosters sound use of land and water resources, and conserves and protects fish and wildlife. The work that we do affects the lives of millions of people; from the family taking a vacation in one of our national parks to the children studying in one of our Indian schools.

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