



**Northern Spotted Owl Monitoring on Marin County Open Space District and
Marin Municipal Water District Lands, 2015 Report**



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INTRODUCTION

The Northern Spotted Owl (NSO; *Strix occidentalis caurina*), found primarily in older, coniferous forests, is a year-round resident from southern British Columbia to Marin County, California. The NSO was listed by the U.S. Fish and Wildlife Service (USFWS) as a Federally Threatened subspecies in 1990, with declines mostly attributed to habitat loss. After twenty-five years on the Endangered Species list, the NSO is still declining in many parts of its range (Forsman et al. 2011, USFWS 2011). While current and past habitat loss remains a major threat, the range expansion of the Barred Owl (*Strix varia*) also poses a large and complex threat to the NSO; the presence of Barred Owls has caused displacement of NSO and they compete with NSO for space and food (Gutiérrez et al. 2007, USFWS 2011, Wiens 2012). NSO in Marin County are not impacted by commercial tree harvesting operations as in other parts of their range, but they face other unique threats including urban development, human disturbance due to construction and/or recreational activities, noise disturbance, rodenticide poisoning, risk of wildfires along the urban-wildland interface, and genetic isolation (Stralberg et al. 2009). Additionally, while the invasion of Barred Owls in Marin County has not yet reached the high densities as in other parts of the NSO range (Jennings et al. 2011), a continued increase in Barred Owl numbers could pose a serious threat to the NSO population in Marin (e.g., Forsman et al. 2011, Wiens 2012).

Since 1997, biologists from Point Blue Conservation Science (formerly PRBO; hereafter Point Blue) have been monitoring NSO in Marin County. Marin County Open Space District (MCOSD) and Marin Municipal Water District (MMWD) have contracted Point Blue to survey NSO since 1999. Surveys are primarily on MMWD and MCOSD lands, but also include adjacent sites on private, municipal, state, and national park lands. The purpose of these surveys is (1) to monitor the population for trends in occupancy and reproductive success over time and (2) at sites where proposed management activities may occur, to determine occupancy and nesting status so that disturbance to nesting birds is avoided.

In 2015, Point Blue biologists continued to monitor occupancy, residency, nesting, and reproductive status for known NSO sites. We also conducted inventory surveys at other locations based on management plans, some of which have been surveyed in previous years with and without NSO detections. In this report, we present a summary of results for 30 known sites and 7 inventory sites.

METHODS

We surveyed a total of 30 known sites on or adjacent to MCOSD and MMWD land. These sites were chosen based on knowledge of NSO occurrence in previous years, and sites were prioritized where management activities were planned. In addition, we surveyed 7 inventory

sites based on management needs, some that have been surveyed for multiple years (Table 1). We assessed occupancy at all known sites and inventory sites, and nesting and reproductive status for all sites where owls were detected. We completed site search forms (including a detailed narrative of each survey) and maps (showing search area and location of any owls detected) for all fieldwork, status forms (occupancy, nesting, and reproductive outcome for the year, and supporting information) for each site, and vegetation measurements for nest trees. All data, including spatial information, will be submitted to MCOSED, MMWD, and to the California Department of Fish and Wildlife's California Natural Diversity Database. All 2015 surveys were conducted from March to July by Renée Cormier, Jenna Dodge, and Parker Forman of Point Blue.

Occupancy refers to whether an owl is detected or not detected. Occupancy surveys in 2015 followed the USFWS protocol to determine whether owl(s) were present and territorial (USFWS 2012). A site is considered unoccupied after 2 years of surveys with 6 nighttime visits each year with no owl response (USFWS 2012). For sites surveyed for disturbance projects only (as opposed to sites with planned habitat modification), 6 visits with no response in one year is sufficient to call a site unoccupied for that year until the start of the next breeding season (USFWS 2012). In this report, I classify any site with no response in 2015 as unoccupied, but specify if it is considered unoccupied for 2015 only.

For sites where owls were detected at least once (occupied), we determined residency status – whether owls were territorial – based on USFWS protocols. Residency categories are summarized as follows (for more details see USFWS 2012 and Press et al. 2010): Territorial Pair (hereafter, Pair) = male and female heard within 0.25 miles on the same survey, and/or nesting is confirmed; Resident Single = response by a single owl on three or more occasions in the same year or over subsequent years, with no response by an owl of the opposite sex; Unknown = male and/or female detected, but did not meet the above criteria; Single Unknown = a single owl is detected but does not meet the above criteria for Resident Single (this category is specific to the Marin protocol and not part of USFWS protocol). I present occupancy and residency from 1999 to 2015 as a percent of sites with each USFWS status: Pair, Resident Single, Unknown, or Unoccupied. Because not all sites have been surveyed each year, and because in some years we surveyed more areas where pairs are less likely to occur (e.g., inventory surveys in marginal habitat), for the summary of Resident Status I only included sites that met Pair status at least once (this year or historically).

We also used the USFWS protocol (2012) for nesting and reproductive surveys, but whenever possible we attempted to gather nesting and reproductive information without the use of mice, per the modified protocol for surveying NSO in Marin County (Press et al. 2010). The modified

protocol attempts to minimize “mousing” owls to avoid habituating them to being fed since the owls are often in close proximity to humans and heavily-used trails and roads in Marin County. For sites with planned management activities (e.g., noise disturbance), we conducted mousing surveys if nesting status could not be determined without the use of mice by early April. To compare nesting status for sites with pairs for each year from 1999 to 2015, I show the percent of pairs that nested successfully, had a failed nest, had confirmed nesting with unknown outcome, were non-nesting, and where nesting status was unknown. I then calculated fecundity since it is a measure commonly used with NSO data and can be compared across studies (e.g., Anthony et al. 2006, Forsman et al. 2011). Fecundity is defined here as the total number of female young per territorial female. Fecundity was calculated by dividing the total number of young produced by 2 (assuming a 1:1 sex ratio of young), and then dividing by the total number of territorial females (paired females and Resident Single females). I did this for each year from 2000 to 2015, excluding 1999 since very few sites were surveyed that year and a large proportion had unknown nesting status or nesting outcomes.

RESULTS

Occupancy. Among all 37 sites surveyed in 2015, 32 have been occupied by a pair at least once in previous years; this year, 30 (94%) of those 32 sites were occupied by pairs, with no sites of unknown occupancy status (Figure 1).

Occupancy at inventory sites. Lower Summit met pair status for the first time since surveys began in 2010; the pair was classified as non-nesting and both male and female were sub-adults (Table 1). Jewell Trail met Resident Single status for the second year in a row, occupied by a single male (Table 1). At Arturo Trail and Madera Park Tank, NSO were detected, but not on more than one visit, thus not meeting “resident” status. There were no NSO detections at the other 3 of 7 inventory sites.

Occupancy at known NSO sites. Of 30 sites, 29 (97%) were occupied by pairs (Table 2). King Mountain was occupied by a Resident Single male, which has otherwise been occupied by a pair since surveys began in 2007. Soulajule was occupied by a pair this year, after being occupied by a single owl in 2014.

Nesting and Reproduction. In 2015, the proportion of pairs that attempted nesting (57%) was slightly lower than the study average (61%; Figure 2); additionally, due to many nesting failures (9 out of 17 attempts) combined with non-nesting pairs, overall fecundity (0.22) was below the study average (0.40; Figures 2 and 3).

Barred Owls. No Barred Owls were detected during 2015 Point Blue NSO surveys.

Banding/Rehabilitation. An adult NSO was taken to WildCare rehabilitation center on 20 February 2015, prior to onset of breeding; it was found near the side of a road near the Whites Hill pair. The owl was treated for blood parasites (*Haemoproteus* sp.). I banded the owl prior to its release on 20 March, and it was released at same location where owl was found. The banded owl has not been detected post-release.

Table 1. Inventory sites surveyed by Point Blue Conservation Science for Northern Spotted Owls in 2015 in Marin County on or adjacent to MCOSD and MMWD lands.

Inventory Route	Description	Known NSO sites within Inventory Route	NSO Status
Bolinas Ridge	Forest Resiliency, Sudden Oak Death study	None	Unoccupied in 2015: no NSO detected on 6 night surveys.
Jewell Trail	Jewel Creek Fish Passage, Sites 100 and 115, Cross Marin Trail, Winter Habitat Site 1	Jewell Trail	Resident Single: NSO detected on 2 nights, and when combined with 2014 detections, meets Resident Single status.
Lagoon Fire Road	MMWD planned trail decommission and Forest Resiliency, Sudden Oak Death study	Arturo Trail, Hidden Lake	Arturo Trail (single, unknown residency status): female detected on 6th and 7th night visits; Hidden Lake (unoccupied in 2015): no NSO detected on 6 night surveys.
Laurel Dell	Forest Resiliency, Sudden Oak Death study	None	Unoccupied in 2015: no NSO detected on 6 night surveys.
Lower Summit	MCOSD preserve - annual roadside mowing by Mill Valley Fire Dept.	Lower Summit	Non-nesting pair. This is the first time a pair has been detected at this site; both male and female were sub-adults, hatched in 2013.
Madera Park Tank	MMWD Tank work	Madera Park Tank	Single, unknown residency status: a female NSO detected on 1st of 6 night surveys and located her the following day; did not detect any NSO on 5 other night surveys.

Table 2. Status of known Northern Spotted Owl sites surveyed by Point Blue Conservation Science in Marin County on or adjacent to MCOSD and MMWD lands in 2015.

Location	Status 2015	Landowner
Arroyo Corte Madera	Nesting Failure	MCOSD
Baltimore Canyon	Nesting Failure	MCOSD
Bates Canyon	Non-nesting pair	MCOSD
Blake Canyon	Fledged 2	MMWD
Camino Alto	Nesting Failure	MCOSD
Cascade Park	Fledged 1	Municipal
Concrete Pipe	Fledged 2	MMWD
East Peters Dam	Nesting Failure	MMWD
Five Corners	Nesting Failure	MMWD
Forest Knolls	Fledged 2	MCOSD
French Ranch	Non-nesting pair	Private
Indian Tree	Non-nesting pair	MCOSD
Indian Valley	Fledged 1	MCOSD
Iron Spring	Fledged 1	Private
King Mountain	Resident Single Male	MCOSD
Lagunitas	Non-nesting pair	MCOSD
Larkspur	Fledged 2	MCOSD/Private
Madrone Canyon	Nesting Failure	Private
Phoenix Lake	Nesting Failure	MMWD
Ross	Fledged 2	Municipal
Roys Redwoods	Non-nesting pair	MCOSD
San Anselmo Creek	Nesting Failure	Municipal/Private
Shaver Grade	Pair, Nesting Status Unknown	MMWD
Soulajule	Non-nesting pair	MMWD
Swimming Hole	Non-nesting pair	SPTSP ¹
Upper Kent Lake	Non-nesting pair	MMWD
Warner Canyon	Non-nesting pair	MCOSD
West Blithedale	Non-nesting pair	Private
West Peters Dam	Nesting Failure	MMWD
Whites Hill	Non-nesting pair	MCOSD

¹SPTSP = Samuel P. Taylor Sate Park

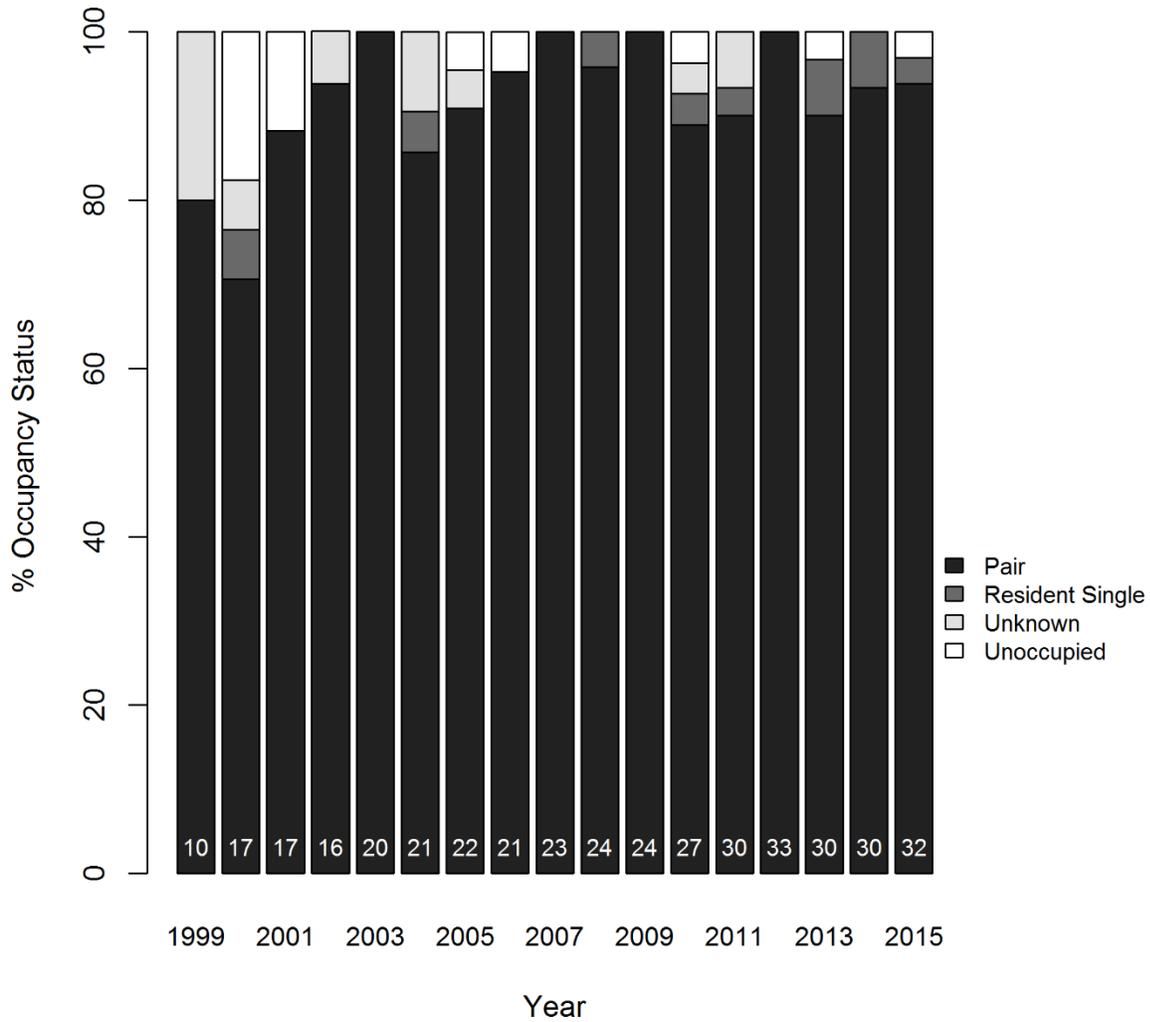


Figure 1. Northern Spotted Owl occupancy status for sites surveyed by Point Blue Conservation Science in Marin County on or adjacent to MMWD and MCOSD lands (1999 to 2015). Because not all sites have been surveyed each year, and because in some years we survey more areas where pairs are less likely to occur, only sites that have been occupied by a pair at least once have been included. Sample size is shown for each year in white at the base of each bar.

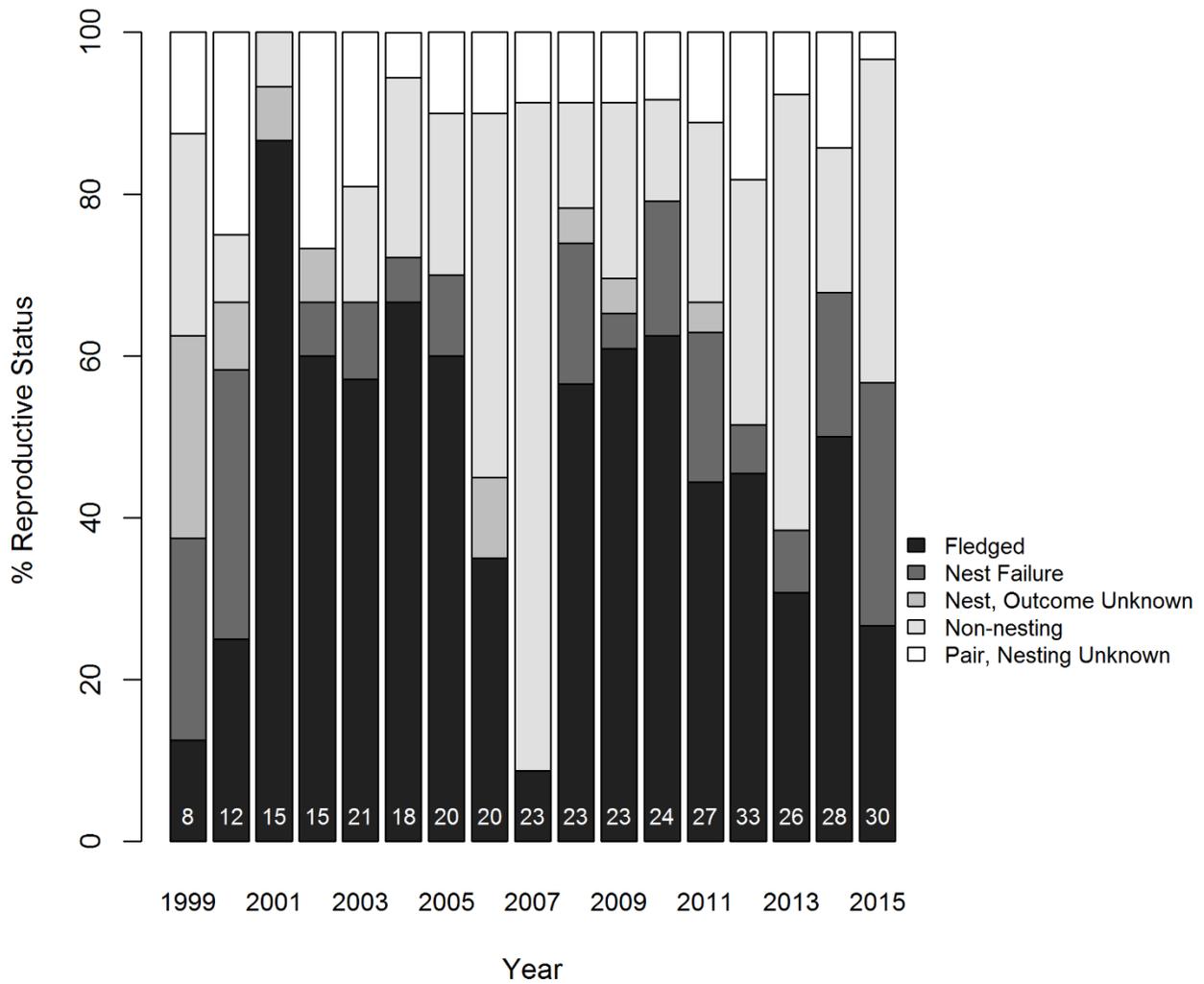


Figure 2. Reproductive status for Northern Spotted Owl pairs surveyed by Point Blue Conservation Science in Marin County on or adjacent to MMWD and MCOSD lands (1999 to 2015). Sample size is shown for each year in white at the base of each bar.

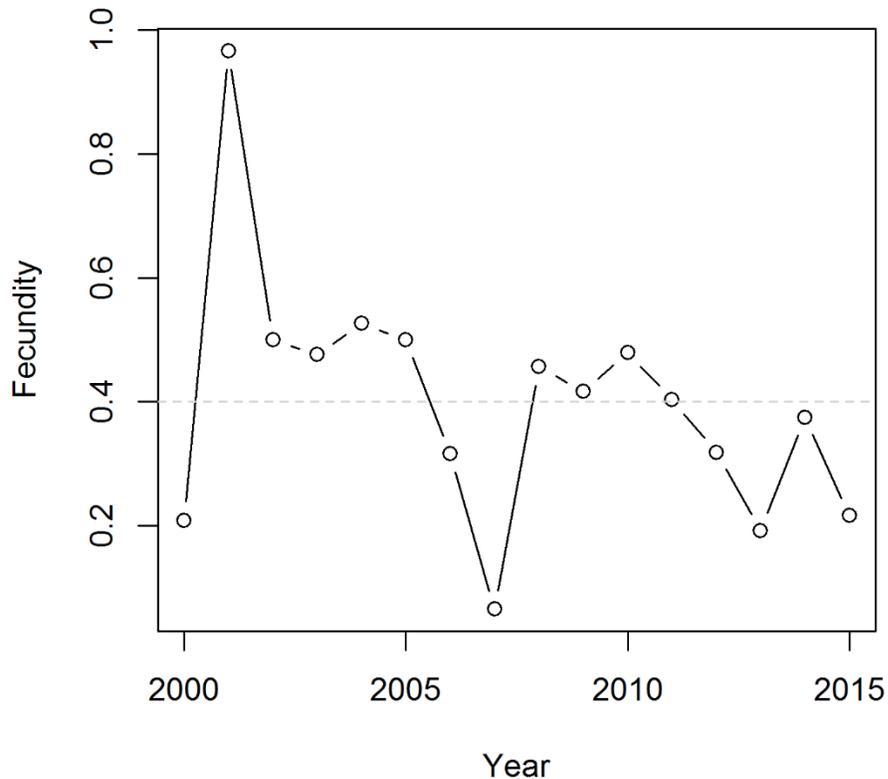


Figure 3. Fecundity (the number of female young produced per territorial female) for Northern Spotted Owls surveyed by Point Blue Conservation Science in Marin County on or adjacent to MCOSD and MMWD lands (2000-2015). Sample size varies (from n=9 to n=33) and not all sites were surveyed each year. Study average is shown as a dashed gray line.

DISCUSSION

Occupancy. The proportion of known sites with pairs in 2015 was high. NSO were also detected at several inventory sites. Detections of NSO in new locations and at sites that are not surveyed each year highlight the importance of NSO surveys in areas with appropriate habitat where proposed management activities are planned. While some of the owls that were only detected on a small proportion of the nights may be transients, they may also prove to be established breeding sites or activity centers if we continue to detect owls at these sites.

Nesting and Reproduction. Nesting failures were above average in 2015 resulting in a lower than average fecundity. In a previous NSO study, fecundity ranged from 0.306 to 0.560 depending on geographic region and the California coast averaged 0.442 (Anthony et al. 2006),

similar to our study average (0.40) in Marin and above our 2015 rate (0.22). Forsman et al. (2011) found that fecundity has declined over time in most parts of the NSO range at long-term study sites, but because fecundity is so variable, models of demographic change were most sensitive to changes (declines) in adult survivorship. While we don't have a marked population of owls in Marin County to estimate survival, we can estimate trends in occupancy (MacKenzie et al. 2012); Point Blue and National Park Service staff are currently collaborating on this analysis and a manuscript will be submitted for publication in 2016.

Barred Owls. No Barred Owls were detected during NSO surveys on MMWD or MCOSD lands in 2015, and the last to be detected on these surveys was a single owl in 2010 (Cormier 2010). Additionally, there were no known pairs of Barred Owls in Marin this year, unlike in the period from 2007 to 2014 when a pair was present in Muir Woods (NPS, unpublished data). An increase in Barred Owls may threaten the NSO population in Marin County through competition for space and food (Anthony et al. 2006, Gutiérrez et al. 2007, Wiens 2012). A growing number of studies have found negative associations from Barred Owls on NSO, including on occupancy of nesting territories (Kelly et al. 2003, Olsen et al. 2005 Wiens 2012), fecundity (Olsen et al. 2004, Forsman et al. 2011), and apparent survival (Anthony et al. 2006, Forsman et al. 2011, Dugger et al. 2016). Additionally, Barred Owls tend to have more a more diverse diet likely reducing their sensitivity to declines in one prey species, produce more young than NSO, and have higher survival (Wiens 2012). In Marin County, we are still experiencing relatively low numbers of Barred Owl detections (Jennings et al. 2011, NPS and Point Blue unpublished data), but we predict they will increase based on the pattern of the invasion documented in the northern part of the NSO range. Point Blue is following the recently-updated USFWS-recommended protocol (USFWS 2012) which should increase our ability to detect Barred Owls, if present, and to monitor any changes in the population. Additional surveys specific to Barred Owl may be warranted to increase our detection likelihood of this species (Wiens et al. 2011); NPS biologists began Barred Owl-specific surveys on their lands in Marin County in 2012.

Conclusions. NSO surveys on MMWD and MCOSD lands documented pairs at most known sites in 2015. However, a high number of nest failures and non-nesting pairs resulted in low overall fecundity. Monitoring NSO in Marin County during the breeding season is an essential component to evaluating population health and ensuring that management activities do not negatively impact owls, including at inventory sites where management activities are slated to occur. Frequent communication and cooperation among MMWD, MCOSD and Point Blue staff have been valuable in ensuring that activities that could negatively impact nesting owls are prevented.

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