APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Lands

APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Lands

Introduction

The Draft Biodiversity, Fire, and Fuels Integrated Plan (BFFIP) describes actions that the Marin Municipal Water District (District) will take over the next 5 years to minimize fire hazards and maximize ecological health on its watershed lands. The purpose of the BFFIP is to define and guide the methods to minimize the risk from wildfires while simultaneously preserving and enhancing existing significant biological resources.

Portions of District lands, including much of the Mount Tamalpais Watershed are within northern spotted owl (NSO) designated Critical Habitat [Unit 3:Redwood Coast, RDC 5] and numerous NSO activity centers occur within and near areas where BFFIP activities would occur (**Figure 1**). Avoidance measures would be implemented to protect active NSO nests and activity centers during BFFIP-related activities, and therefore, the direct loss or noise-related disturbance of an active NSO nest would be avoided; the avoidance measures to protect active NSO nests are included in **Appendix A**.

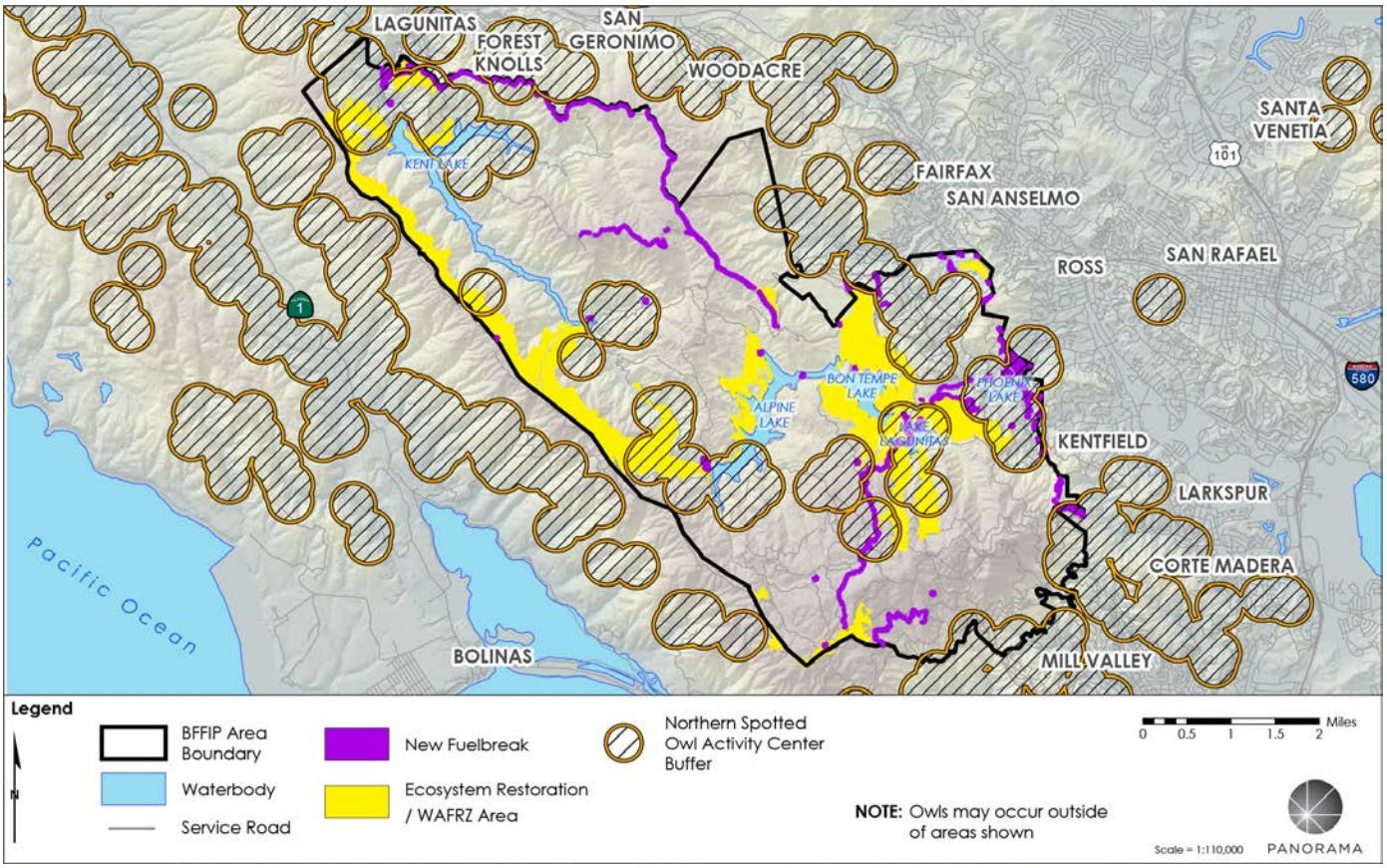
However, potential effects from BFFIP activities on designated NSO critical habitat and its use by NSO also merits evaluation. In general, the proposed BFFIP woodland treatments are aimed at removing the flammable understory vegetation to reduce the overall fuel load, as well as to decrease the chance of a crown fire and to preserve the woodland by removing ladder fuels. Some portion of the shaded forest understory will be opened as shrubs are removed and smaller herbaceous plants and ferns are retained. More specifically, the following proposed BFFIP management actions (MA) include new habitat disturbances within potentially suitable or occupied NSO habitat:

- *MA-21 (Fuelbreak construction):* This action includes constructing 117 acres of new fuelbreaks, with 59 acres of these fuelbreaks to be constructed over the first five-year period. It is anticipated that 5 acres of new fuelbreaks would be constructed in Year 1, 10 acres in Year 2, 10 acres in Year 3, 10 acres in Year 4, and 24 acres in Year 5. The new fuelbreaks would primarily occur along existing fire roads, but there are several areas where the work would occur away from roads. Construction of the fuelbreaks would be conducted using manual and mechanical techniques. Chain saws or other hand tools would generally be used to remove the lower branches of trees (limbed to about 10 feet), and low-lying vegetation, such as woody debris and flammable shrubs, would be cleared. Trees less than 12 inches diameter at breast height could be removed. Of the 117 acres of new fuelbreaks to be constructed, approximately 58 acres are within 0.25 mile of a known NSO activity Center (**Figure 1**).

- *MA-23 (Improve forest stand structure):* This action involves reducing accumulated fuels and brush density in conifer and mixed hardwood stands. This includes treatment of fuels in the Ecosystem Restoration/Wide Area Fuel Load Reduction Zones (WAFRZ), which are areas where fuel load reduction and ecosystem improvements would occur within habitats in order to achieve

a combination of wildfire risk reduction and habitat enhancement goals. Treatment activities within the Ecosystem Restoration/WAFRZ are designed to both reduce understory fuels and mimic the beneficial effects of wildfire. Accumulated fuels and brush density in conifer and mixed hardwood forest would be thinned. Mid-canopy Douglas-fir trees may require thinning by felling or girdling. Prescribed burning is the primary means of maintenance, but manual and mechanical techniques (e.g., hand pulling, chainsaws, chipping, etc.), pile burning, and mowing are also employed. It is anticipated that 20 acres of fuel and brush density reduction would occur in Year 1, 20 acres in Year 2, 30 acres in Year 3, 50 acres in Year 4, and 60 acres in Year 5; for these years treatment activities would only occur adjacent to fuelbreaks. The precise location where fuel treatment and ecosystem enhancement activities would occur within the Ecosystem Restoration/WAFRZ has not been identified, but 902 acres of the 2,651acre Ecosystem Restoration/WAFRZ are within 0.25 mile of a known NSO activity Center (**Figure 1**).

Figure 1: NSO Activity Centers with 0.25 Mile Buffer, New Fuelbreaks, and Ecosystem Restoration/WAFRZ



To provide context of how the proposed management activities could affect NSO habitat use, a summary of the habitat affinities and behavior of NSO is provided below. A discussion of NSO distribution in the project area, an evaluation of how the proposed management activities could affect NSO habitat, and additional recommended avoidance measures are then provided.

(I) SUMMARY OF HABITAT AFFINITIES AND BEHAVIOR

Habitat affinities

The ecological requirements of the NSO have been carefully studied and are well documented, although most of those studies have focused on more northerly forests with higher rainfall and less equable climate than in Marin County (Gutierrez, Franklin and Lahaye 1995) (U.S. Fish & Wildlife Service 2011) (U.S. Fish & Wildlife Service 2012a). According to those studies, the NSO is found most commonly in old-growth forest or mixed stands of old-growth and mature conifers, usually 150-200 years old (Shuford 1993). The owls select older forest because a multi-layered, closed canopy provides a variety of roosting opportunities and therefore aids in thermoregulatory behavior under differing weather conditions. The habitat associations of NSO differ somewhat in Marin County, however, which is located at the southern limit of the species' distributional range. In Marin County, NSO may be found in younger forest stands that contain structural characteristics of older forests. Locally, habitat may be provided by mature redwood-fir-pine forests as well as mixed hardwood associations. Live-oak woodlands with closed canopies may also be used as roost sites and occasionally selected for nest sites (Shuford 1993, Stralberg *et al*. 2009, NPS files). However, here as in other areas, NSO select forests with a nearly closed canopy and moderate undergrowth with a high component of woody debris, at least in some portion of their territory.

Most of the local owl territories are in canyon bottoms or mid-slope locations and often include small perennial watercourses. In the Stralberg modeling study (2009), topographic conditions were the strongest predictors of owl nest-site occurrence, with occupied sites lower in the watershed and more south-facing than unoccupied sites. The importance of slope orientation may be explained by a variety of factors, including susceptibility to heat stress, predator avoidance, prey abundance and availability, and nest structure availability. Exposure is an important component of suitable habitat, with ideal nesting habitat providing shelter from the predominant northwesterly winds of spring and summer. Ridgetops are generally avoided and lower elevations, protected from prevailing spring winds, usually preferred for nesting.

Behavior

NSOs are non-migratory and commonly occupy the same home range year-round (Gutierrez et al. 1995). Typically, NSOs form long-term pair bonds and share the same territory (Forsman et al. 1984). They are philopatric (site faithful) to nest sites and activity centers and because territories are usually occupied over successive years by nesting pairs, sites occupied in previous years are commonly occupied in subsequent years.

The nesting period in Marin (and Unit 3, the Redwood Coast region) spans February 1 through August 31 to encompass pair formation, nest selection, nest building, incubation, provisioning and fledging of young (Press et al. 2010). Young are independent by late summer and disperse from natal areas by September-October (Gutierrez et al. 1995). Based on a study of 195 nest sites in Marin (Jensen et al. 2006), nests are located in a variety of tree species (most commonly Redwood and Douglas fir). Dusky-footed Woodrats (*Neotoma fuscipes*) are a primary prey species in Marin, comprising approximately 50 percent of the prey base.

(ii) NSO DISTRIBUTION IN THE PROJECT AREA

The distribution of NSOs within the District watershed (and adjacent public lands) is well-documented based on protocol-level surveys conducted by various researchers (National Park Service, Point Blue Conservation Science, Avocet Research Associates, etc.) on a nearly annual basis, 1999 to present. A compilation of multi-year data, provided by the National Park Service, was used to generate **Figure 1**. The polygons in the figure represent NSO activity centers and were created by drawing a polygon around NSO occurrences documented between 1999 and 2017 that were clustered in a general area. The polygon also includes a 0.25 mile around the activity center polygon, which serves to identify areas in which BFFIP management activities could occur within 0.25 mile of an activity center. Although NSOs do not necessarily nest annually, they usually occupy the same habitat in non-nesting years as in nesting years and protection of these areas is critical to the future reproductive success of the owls; therefore all activity centers with multiple occurrences are considered 'occupied habitat' regardless of nesting status in a given year.

(ii) EVALUATION OF POTENTIAL IMPACTS TO NSO HABITAT

<u>Approach</u>

For the purposes of this evaluation, we focus on "activity centers" of NSOs to identify occupied habitat but also consider the impacts of the BBFIP on "foraging habitat." Definitions of each habitat type are provided in the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011, 2012b):

***Activity Center**: Spotted owls have been characterized as central-place foragers, where individuals forage over a wide area and subsequently return to a nest or roost location that is often centrally-located within the home range (Rosenberg and McKelvey 1999). Activity centers are a location or point representing "the best of detections" such as nest stands, stands used by roosting pairs or territorial singles, or concentrated nighttime detections. Activity centers are within the core use area and are represented by this central location*.

***Foraging Habitat**: Foraging habitat is defined as lands that provide foraging opportunities for spotted owls, but without the structure to support nesting and roosting (USFWS 1992). Spotted owls often forage in forest conditions that meet the definition of nesting/roosting habitat, but also use a broader range of forest types for foraging. This definition identifies habitat that functions as foraging habitat, but does not meet requirements for nesting or roosting.*

The NSO data set from the combined years of protocol-level surveys was used to identify the activity centers represented in **Figure 1**. As shown, much of the proposed fuelbreak expansion would occur at distances of greater than 0.25 mile of a NSO activity center; therefore, such activities would have little to no effect on NSO habitat use. However, there are new fuelbreaks proposed within 0.25 mile of a NSO activity center (**Figure 1)**, and maintenance of existing fuelbreaks could also occur within 0.25 mile of an activity center. Additionally, portions of the Ecosystem Restoration/WAFRZ contain NSO activity centers or are within 0.25 mile of an NSO activity center (**Figure 1**). Therefore, fuelbreak expansion and maintenance, and management activities within the Ecosystem Restoration/Wide Area Fuel Load Reduction Zones could occur in habitat used by NSO.

To develop an understanding of the types of management activities that could take place in potential NSO habitat, a field reconnaissance of representative sites in which BFFIP management activities would occur was conducted on May 24, 2017 by Seth Bunnell (Avocet Research) and Josh Phillips (Pacific Biology). Mr. Brunnell and Mr. Phillips were accompanied by District and Panorama Environmental staff who provided an overview of the proposed management activities that would occur at different locations. It should be noted that only four (4) representative sites were visited, and that all proposed management areas within potential NSO habitat were not evaluated. Therefore, the focus of the assessment was to generally assess how the proposed management activities could alter NSO habitat.

<u>Overview of Types of Impacts to Occur in or Near NSO Habitat</u>

In general, the proposed BFFIP woodland treatments are aimed at removing the flammable understory vegetation to reduce the overall fuel load, as well as to decrease the chance of a crown fire and to preserve the woodland by removing ladder fuels. The shaded forest understory will be opened as shrubs are removed and smaller herbaceous plants and ferns are retained. More specifically, the following proposed BFFIP management actions could occur in an NSO

activity center or within 0.25 mile of a NSO activity center:

- *MA-21 (Fuelbreak construction):* Chainsaws will be used to remove the lower branches of trees (limbed to about 10 feet);
- *MA-21 (Fuelbreak construction):* Woody debris and flammable shrubs on the ground will be cleared by hand crews;
- *MA-21 (Fuelbreak construction):* Trees less than 12 inches diameter at breast height could be removed;
- *MA-23 (Improve forest stand structure):* Accumulated fuels and brush density in conifer and mixed hardwood forest would be thinned;
- *MA-23 (Improve forest stand structure):* Mid-canopy Douglas-fir trees may require thinning by felling or girdling;
- *MA-23 (Improve forest stand structure):* Prescribed burning is the primary means of maintenance, but manual and mechanical techniques (e.g., hand pulling, chainsaws, chipping, etc.), pile burning, and mowing may also be employed.

As previously discussed, the proposed new fuelbreaks and forest management activities within the Ecosystem Restoration/WAFRZ would not occur all at once. The BFFIP includes constructing 117 acres of new fuelbreaks, with 59 acres of the fuelbreaks to be constructed over the first five-year period; it is anticipated that 5 acres of new fuelbreaks would be constructed in Year 1, 10 acres in Year 2, 10 acres in Year 3, 10 acres in Year 4, and 24 acres in Year 5. It is anticipated that 20 acres of fuel and brush density reduction would occur in Year 1, 20 acres in Year 2, 30 acres in Year 3, 50 acres in Year 4, and 60 acres in Year 5; for these years treatment activities would only occur adjacent to fuelbreaks. The phasing of these forest management activities would serve to limit the extent of disturbance within potential NSO habitat during any given year.

Of the 117 acres of new fuelbreaks to be constructed, approximately 58 acres are within 0.25 mile of a known NSO activity Center (**Figure 1**). Of the 2,651 acre the Ecosystem Restoration/WAFRZ, 902 acres are within 0.25 mile of a known NSO activity Center (**Figure 1**).

<u>Guidance Provided by Revised Recovery Plan for the Northern Spotted Owl</u>

The Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011) [hereafter "the Plan"] provides useful guidance for land managers, recommending that landscape-level adaptive management strategies that include active management of forest habitat should be encouraged (Wright and Agee 2004, Lee and Irwin 2005, Carey 2007, Keeton et al. 2007, Littell et al. 2008). Millar et al. (2007) suggest a conceptual framework for managing forested ecosystems in a way that helps ecosystems accommodate changes adaptively. As discussed in the Plan, "recommendations for spotted owl recovery in this area [referring to dry forests, as occur on MMWD land] also need to be considered alongside other land management goals – sometimes competing, sometimes complimentary – such as fuels management and invasive species control. In some cases, failure to intervene or restore forest conditions may lead to dense stands heavy with fuels and in danger of stand-replacing fires and insect and disease outbreaks." As further discussed in the Plan, "our intent in this Revised Recovery Plan is to embed spotted owl conservation and recovery within broader dry forest ecosystem restoration efforts to increase the likelihood spotted owl habitat will remain on the landscape longer and develop as part of this fire adapted community instead of being consumed by uncharacteristic wildfires." The guidance provided by the Plan is relevant to evaluating the effects of BFFIP forest management activities on NSO habitat, and reinforces the need for forest management to maintain habitat quality and NSO populations in the long term.

A goal of MA-23 is to both reduce understory fuels and mimic the beneficial effects of wildfire. This goal is compatible with actions recommended in the Plan, as supported by the following excerpts (references deleted):

> *Managing for resilient forests should also be considered a fundamental recovery goal for spotted owls.*
>
> *Vegetation management should be designed to include a mix of disturbed and undisturbed areas, retention of woody debris and development of understory structural diversity to maintain small mammal populations across the landscape.*
>
> *Vegetation management of fire-prone forests can retain spotted owl habitat on the landscape by altering fire behavior and severity and, if carefully and strategically applied, it could be part of a larger disturbance management regime for landscapes that attempts to reintegrate the relationship between forest vegetation and disturbance regimes, while also anticipating likely shifts in future ecosystem processes due to climate . . . Such an approach is more likely to achieve ecologically and socially acceptable outcomes, and*

could enable transitions to more acceptable disturbance regimes, even if it includes more frequent but less severe wildfires.

In many areas, fire could be encouraged to perform its ecological role of introducing and maintaining landscape diversity, although it may be desirable to manage fire severity or return intervals through vegetation management at various temporal and landscape scales.

The following excerpts from the Plan also offer some guidance that may be applicable to the BFFIP:

Within provincial home ranges but outside core-use areas, opportunities exist to conduct vegetation management to enhance development of late- successional characteristics or meet other restoration goals in a manner compatible with retaining resident spotted owls. Restoration activities conducted near spotted owl sites should first focus on areas of younger forest less likely to be used by spotted owls and less likely to develop late-successional forest characteristics without vegetation management. Vegetation management should be designed to include a mix of disturbed and undisturbed areas, retention of woody debris and development of understory structural diversity to maintain small mammal populations across the landscape.

(iv) CONCLUSIONS

A primary goal of the BFFIP is to minimize fire hazard, which includes managing District lands to prevent a fire that would burn at an intensity that severely damages the forest and associated NSO habitat. This goal is consistent with the goals of the Revised Recovery Plan for Northern Spotted Owl, which specifically addresses the need for fuel management and invasive species control to prevent stand-replacing fires and habitat degradation. To the extent that the BFFIP achieves this goal by utilizing small scale prescribed burns and other management activities that mimic the beneficial effects of fire, and by creating conditions that limit the potential of a catastrophic fire, NSO habitat will benefit.

The BFFIP will also improve foraging habitat for NSO to the extent that it will reduce understory density and therefore permit foraging by owls in flight, with the added benefit of reduction in fuel load. If existing woodrat nests are avoided, impacts to prey (wood-rat) density should not be affected; a study of dusky-footed woodrats in the redwood region of California did not find an association between abundances of woodrats and different intensities of forest thinning (Hamm and Diller 2009).

It is important to note that some of the proposed management actions in the BFFIP may degrade spotted owl foraging habitat in local areas in the short-term, but may be beneficial to spotted owls in the long- term if they reduce future losses of ecosystem structure or better incorporate future disturbance events to improve overall forest ecosystem resilience to climate change (Ager *et al.* 2007a, Spies *et al.* 2010). For example, removing too much woody debris or substantially lessening the structural diversity of habitat within an NSO activity center could adversely affect the prey base, and by extension the NSO. Therefore, strategic planning of management activities that occur in suitable habitat within 0.25 mile of an activity center should be implemented, such that the actions meet the management goals in a manner compatible with retaining resident spotted owls and in the long-term enhancing population stability and habitat quality.

The following actions are recommended for BFFIP management activities that occur within 0.25 mile of an activity center:

1. It should be determined if the activity will occur within a forest habitat type that provides potential NSO foraging, roosting, and/or nesting habitat. This may be accomplished as follows:
    - First conducting a review of GIS data to determine if the activity would occur in a forest type potentially used by NSO (i.e., Douglas fir, redwood, mixed conifer/hardwood forest, mature broadleaf/evergreen forest types). If the activity would not occur within a forest type potentially used by NSO, then no further actions would be required to protect NSO habitat.
    - If the activity would occur in a forest type potentially used by NSO (i.e., Douglas fir, redwood, mixed conifer/hardwood forest, mature broadleaf/evergreen forest types), then a site-specific habitat evaluation should be conducted by a qualified NSO biologist to determine if the area provides the required habitat characteristics to provide NSO foraging, roosting, and/or nesting habitat.
2. For projects within 0.25 mile of an activity center, and which would occur in potential NSO foraging, roosting, or nesting habitat, the following actions should be implemented prior to management activities:
    A. Habitat alteration within core use areas (nesting and roosting habitat) should be planned and conducted under the guidance of a qualified NSO biologist.

Opportunities to conduct vegetation management to enhance development of late-successional characteristics or meet other restoration goals in a manner compatible with retaining resident spotted owls should be evaluated and implemented. Restoration activities conducted near spotted owl sites should first focus on areas of younger forest less likely to be used by spotted owls and less likely to develop late-successional forest characteristics without vegetation management. Vegetation management should be designed to include a mix of disturbed and undisturbed areas, retention of woody debris and development of understory structural diversity to maintain small mammal populations across the landscape.

B. Woodrat stick house should be avoided during vegetation clearing activities.

References

Ager, A.A., M.A. Finney, B.K. Kerns and H. Maffei. 2007. Modeling wildfire risk to northern spotted owl (*Strix occidentalis caurina*) habitat in Central Oregon, USA. Forest Ecology and Management 246:45–56.

American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. American Ornithologists' Union, Washington, D.C.

California Natural Diversity Data Base (CNDDB). Accessed 9 September 2013. http://www.dfg.ca.gov/whdab/html/cnddb.html

Carey, A.B. 2007. AIMing for Healthy Forests: active, intentional management for multiple values. General Technical Report PNW-GTR-721, Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service, Portland, Oregon. ,

Chow, N. 2001. Distribution and habitat associations of Northern Spotted Owls in Marin County, California. M.S. Thesis. Humboldt State University, Arcata, CA

Comier, R. 2013. Northern Spotted Owl Monitoring on Marin County Open Space District and Marin Municipal Water District Lands in Marin County, CA: 2013 Report. Point Blue Conservation Science (formerly PRBO), December 16, 2013.

Evens, J. 2008. The Natural History of the Point Reyes Peninsula. University of California Press. 366 pp.

Delaney, D.K., T.G. Grubb, P. Beier, L.L. Pater, and M.H. Reiser. 1999. Effects of helicopter noise on Mexican spotted owls. Journal of Wildlife Management 63:60-76.

Forsman, E. D., E. C. Meslow, and H. M. Wight. 1984. Distribution and biology of the Spotted Owl in Oregon. Wildl. Monogr. 87.

Gutiérrez, R. J., A. B. Franklin and W. S. Lahaye. 1995. Spotted Owl (*Strix occidentalis*), The Birds

of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/179

Hamm, K.A., and L.V. Diller. 2009. Forest management effects on abundance of woodrats in northern California. Northwestern Naturalist 90:97-106.

Howell, J.T., F. Almeda, W. Follette, and C. Best. 2007. Marin Flora. California Academy of Sciences and California Native Plant Society (Marin Chapter). 510pp.

Jennings, S., R.L. Cormier, T. Gardali, D. Press, and W.W. Merkle. 2011. Status and distribution of the Barred Owl in Marin County, California. Western Birds 42:103-110.

Jensen, H.J., D.B. Adams, and W.W. Merkle. 2006. Northern Spotted Owls in Marin County, California: 2005 Annual Report. Point Reyes National Seashore. http://www.sfnps.org/download_product/1215/0

Keeton, W.S., P.W. Mote and J.F. Franklin. 2007. Climate variability, climate change, and western wildfire with implications for the urban-wildland interface. Advances in the Economics of Environmental Resources 6:225–253.

Kelly, J. P., K. L. Etienne, and J. E. Roth. 2002. Abundance and distribution of the Common Raven and American Crow in the San Francisco Bay area, California. Western Birds 33: 202-217.

Lee, D.C., and L.L. Irwin. 2005. Assessing risks to spotted owls from forest thinning in fire-adapted forests of the western United States. Forest Ecology and Management 211:191–209.

Leskiw, T., and R. J. Gutiérrez. 1998. Possible predation of a spotted owl by a barred owl. Western Birds 29:225–226.

Littell, J.S., D.L. Peterson and M. Tjoelker. 2008. Douglas-fir growth in mountain ecosystems: water limits tree growth from stand to region. Ecological Monographs 78:349-368.

Millar, C.I., N.L. Stephenson and S.L Stephens. 2007. Climate change and forests of the future: managing in the face of uncertainty. Ecological Applications 17:2145–2151.

National Park Service. 2013. Northern Spotted Owl database. Contact: Dave_Press@nps.gov

Olson, G. S., R. G. Anthony, E. D. Forsman, S. H. Ackers, P. J. Loschl, J. A. Reid, K. M. Dugger, E. M. Glenn, and W. J. Ripple. 2005. Modeling of site occupancy dynamics for northern spotted owls, with emphasis on the effects of barred owls. Journal of Wildlife Management 69:918–932.

Press, D., D. Adams, H. Jensen, K. Fehring, W. Merkle, M. Koenen, L. A. Starcevich. 2010. San Francisco Bay Area Network Northern Spotted Owl monitoring protocol: version 6.4. Natural Resource Report NPS/SFAN/NRR—2010/245. National Park Service, Fort Collins, Colorado.

Press, D., W.W. Merkle and H.J. Jensen. 2011. Monitoring Northern Spotted Owls on federal lands in Marin County, California: 2009 annual report. Natural Resources Technical Report NPS/SFAN/NRTR-2011/423. National Park service, Fort Collins, CO.

Rockweit, J.T., A.B. Franklin, G.S. Bakken, and R.J. Gutierrez. 2012. Potential Influences of Climate and Nest Structure on Spotted Owl Reproductive Success: A Biophysical Approach. PLOS One.

Rosenberg, D.K., and K.S. McKelvey. 1999. Estimation of habitat selection for centralplace foraging animals. Journal of Wildlife Management 63:1028–1038.

Shuford, W.D. 1993. Marin County Breeding Bird Atlas. Bushtit Books, Bolinas CA.

Shuford W.D. and I.C. Timossi. 1989. Plant Communities of Marin County. Marin chapter of the California Native Plant Society. Sausalito. Special Publication #10.

Spies, T.A., J.D. Miller, J.B. Buchanan, J.F. Lehmkuhl, J.F. Franklin, S.P. Healey, P.F. Hessburg, H.D. Safford, W.B. Cohen, R.S.H. Kennedy, E.E. Knapp, J.K. Agee and M. Moeur. 2010. Underestimating risks to the northern spotted owl in fire-prone forests: response to Hanson *et al.* Conservation Biology 24:330–333.

Stralberg, D., K. E. Fehring, L. A. Pomara, N. Nur, D. B. Adams, D. Hatch, G. R. Geupel, S. Allen. 2009. Modeling nest-site occurrence for the Northern Spotted Owl at its southern range limit in central California. Landscape and Urban Planning 90: 76-85.

U.S. Fish and Wildlife Service. 1990. Endangered and Threatened Wildlife and Plants: determination of threatened status for the northern spotted owl. Federal Register 55:26114-26194.

U.S. Fish and Wildlife Service. 1992. Protocol for surveying proposed management activities that may impact northern spotted owls. U.S. Fish and Wildlife Service, Portland, OR

U.S. Fish and Wildlife Service. 2006. "Estimating the Effects of Auditory and Visual Disturbance to Northern Spotted Owls and Marbled Murrelets in Northwestern California."

http://www.fws.gov/arcata/es/reports/MAMUNSO%20Harassment%20Guidance%20NW%20CA%202006Jul31.pdf

U. S. Fish and Wildlife Service. 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). U. S. Fish and Wildlife Service, Portland, Oregon. xvi + 258 pp. http://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/RevisedNSORecPlan2011.pdf

U. S. Fish and Wildlife Service. 2012a. Endangered and Threatened Wildlife and Plants; Designation of Revised Critical Habitat for the Northern Spotted Owl; Final rule. Federal Register Vo. 77, No. 233:71876-72068.

U. S. Fish and Wildlife Service. 2012b. Protocol for surveying proposed management activities that may impact Northern Spotted Owls. 2 February 2011, revised 9 January 2012. Endorsed by the U.S. Fish and Wildlife Service. 42pp.

U.S. Fish and Wildlife Service. 2017. Northern Spotted Owl. Species account accessed Jun 13, 2017. https://www.fws.gov/arcata/es/birds/NSO/ns_owl.html

Wright, C.S., and J.K. Agee. 2004. Fire and vegetation history in the eastern Cascade Mountains, Washington. Ecological Applications 14:443–459.

APPENDIX A

Northern Spotted Owl Avoidance of Nesting Season

When possible, mowing with heavy equipment, mechanical removal of vegetation, and prescribed burns within 0.25-mile of a known NSO activity center shall occur during the period of September 1 to January 31 (which is outside of the NSO nesting season). The District commissions annual NSO activity center/nesting surveys and maintains the collected GIS data; this data shall be consulted prior to implementation of a project to determine if a project location is within 0.25-mile of an activity center.

NSO Avoidance During Nesting Season

If mowing with heavy equipment or the mechanical removal of vegetation is to occur within the NSO nesting season (February 1 to August 31, which encompasses pair formation, nest site selection, nest building, incubation, provisioning and fledging of young). The District shall commission two surveys for nesting NSO during the months of April and May preceding the commencement of these activities. At a minimum, the survey area shall include all suitable nesting habitats within 0.25-mile of any planned activity sites, and then one of the two options listed below shall be implemented:

1. Following a round of protocol-level NSO surveys, if it is conclusively determined that there are nesting NSO, planned activities that generate noise (e.g., mowing, heavy equipment usage) that are within 0.25-mile of an identified active nest shall not begin prior to September 1 unless the young have fledged, at which time work may begin no earlier than July 10. Prescribed burns may only occur within suitable NSO habitat (as determined by a qualified biologist) during the nesting season if protocol surveys have determined that NSO nesting is not occurring.

2. Or, the District shall perform a calculation to determine the minimum buffer needed to avoid impacts to this species from noise generation by equipment. The calculation shall be based on the guidance and methodology in the USFWS (2006) “Transmittal of Guidance: Estimating the Effects of Auditory and Visual Disturbance to Northern Spotted Owls and Marbled Murrelets in Northwestern California,” which takes into consideration the baseline noise levels, the noise and duration of noise generated by the loudest equipment, and the topography of the landscape. The resulting buffer calculated using these methods shall be a minimum buffer, but in no case shall the buffer be less than 500 feet. If the calculation is not performed, a conservative 0.25-mile buffer shall be implemented per (1), above. If nesting NSOs are found, activities shall not occur prior to September 1 unless the young have fledged, at which time work may begin no earlier than July 10.

3. Manual methods shall not occur within 131 feet of the line-of-site of a nesting NSO.

APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Lands

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Aerial Information Systems, Inc.
112 First Street
Redlands, California

Table of Contents

Introduction

In 2015, Marin Municipal Water District (MMWD) contracted Aerial Information Systems, Inc. (AIS) to conduct the photo interpretation of sudden oak death (SOD) affected vegetation stands for the Mt. Tamalpais Watershed Forest and Woodlands Project. The resulting database is an update of impacts on vegetation from Sudden Oak Death from 2009 to 2014. There are 2 ArcGIS feature classes within the 2014 database: Vegetation and LargestGaps. The Vegetation feature class is an update of the 2009 vegetation database, containing 4 new fields created to help quantify the effects of SOD within polygons. The LargestGaps feature class is new for this update and reflects the largest single continuous gap within a polygon that is a result of SOD (see Additions to the 2014 Vegetation Map section). (See Figure 1 below)

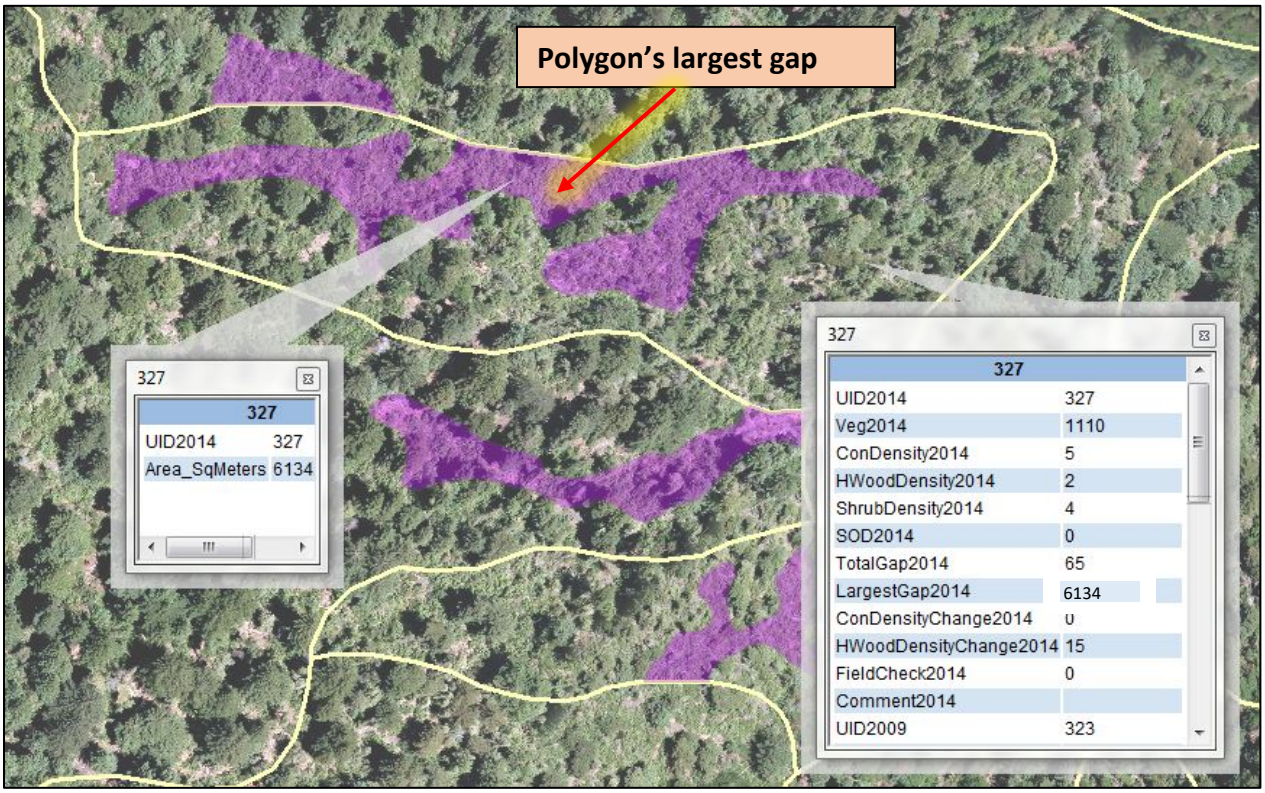


Figure 1: New feature class (LargestGaps) showing total area of the largest canopy gap in each polygon affected by sudden oak death. The largest gap polygon for polygon 327 (UID2014 327) is shaded in purple. The table on the right references the "parent" vegetation polygon depicting in this example all of the 2014 attributes for that particular polygon. 2009 & 2004 attributes are not displayed in this figure for simplicity. The original mapped UID2009 is displayed at the bottom of the table to the right. The UID2009 field enables the user to reference the same polygon on the 2009 vegetation map.

Overview

The purpose of the database is to inventory the severity of SOD in the Mt. Tamalpais Watershed reflecting 2014 conditions and measure the SOD related changes over a 5-year period from 2009 to 2014. This project originated in 2004, when a vegetation map was created for the Mt. Tamalpais Watershed including the Nicasio and Soulajule Reservoirs, using the MMWD Preliminary Mapping Classification. A dead vegetation modifier (named SOD2004) was used to identify areas impacted by SOD. For the 2009 and 2014 updates, the original study area was reduced by excluding the Nicasio and Soulajule Reservoirs. In addition, only a subset of polygons were evaluated for the 2009 and 2014 databases. The subset only consisted of vegetation polygons that had potential to be affected by SOD (approximately 50 different vegetation types that are noted in Appendix B with an asterisk).

In addition to the attributes previously mapped in 2009, there were 4 new attributes created for the 2014 data update. These new attributes (TotalGap2014, LargestGap2014, ConDensityChange2014, and HWoodDensityChange2014) were related to the effects that sudden oak death had on impacted stands of vegetation. See the Additions to the 2014 Vegetation Map section of the report for a description of these attributes.

Once SOD has infected a tree, the eventual demise of the tree can take a number of years, depending on the species. After the tree has completely died and fallen to the ground, an opening in the canopy is created. These openings are referred to as “gaps” and can be either barren or vegetated on the 2014 imagery, depending on the original cover type, environmental setting and/or level of SOD severity.

In the study area, sudden oak death was primarily observed directly affecting 2 species: tanoak and coast live oak. To a lesser extent, it affected other species as well (e.g. black oak and giant chinquapin) but the majority of the die-off and resultant gaps were noted in stands historically containing either tanoak or coast live oak.

When SOD was detected in stands that affected tanoak, the tanoak usually took more than 5 years to totally die off and create a gap in the canopy. Since 2004, the number of tanoak stands has greatly decreased in the watershed (see Appendix E for SOD Tables). In 2014, there were still tanoak individuals present, however, stands mapped to the tanoak alliance or a vegetation type co-dominating with tanoak were rare. In general, the gaps created by dead tanoaks were replaced with another type of vegetation relatively quickly. Occasionally, California bay tree saplings or shrubs such as blue blossom were noted in these gaps, but the majority of the gaps in tanoak – mixed conifer forest settings were repopulated with California huckleberry (*Vaccinium ovatum)*. Once a gap was created after SOD devastation, a notable change in density (conifer, hardwood or shrubs) may take place. When a change in density for either hardwood or conifer occurred, and it was at least 2.5%, then a change in density was attributed in +/- 5% increments. When a change in density in shrub cover was observed in the stand, the shrub cover class category was updated, only if that change corresponded to a different cover class category.

When SOD was noted in stands that affected coast live oak, the diseased trees felled relatively quickly, usually creating a gap within a 5-year span. In many examples, living coast live oaks were seen on the 2009 imagery that were completely downed by 2014, resulting in a gap in the stand that contained only the larger branches of the downed tree. Standing dead coast live oak trees were rarely seen on the 2014 imagery, but when they were encountered, they were inventoried as part of the dead vegetation modifier (SOD2014) instead of the gap. The gaps that were created from dead coast live oak were frequently sparsely vegetated, with little to no new shrubs or trees regenerating in the location. This resulted in a loss of hardwood within the polygon. (See Figure 2 below)

Figure 2: Complete cycle from 2009 (image on left) to 2014 depicting unaffected coast live oak to a fully downed tree in 2014. In this example the SOD 2014, 2014 Hardwood Change and Total Gap fields are all assessed since all events occurred after the 2009 imagery was created.

Mapping Conventions and Methodologies

Update Mapping

Update mapping is the process of revising the spatial and attribute data of an existing dataset using current sources of information for change detection. When the attributes are analyzed in a geographic information system (GIS), areas of change are noted. Ideally, the project classification, mapping criteria, and data capture method of the update should be the same as the previous data compilation effort in order to make accurate comparisons. For the 2014 update, the project classification remained the same as the 2009 mapping effort. The mapping criteria remained the same (e.g. review vegetation code, densities and SOD modifier) except for the analysis of the 4 new variables, noted in the Additions to the 2014 Vegetation Map section. The data capture method was the same with the exception of adding a new ArcGIS feature class (named LargestGaps) to delineate the largest gaps in appropriate polygons. Note that all attributes had the potential to be modified, not just the 4 newly created ones for this project.

The 2014 attributes were the focus of this vegetation map, but on some occasions a need to reclassify codes in 2009 or 2004 were necessary. This need to retroactively change codes prior to 2014 was rare and was usually a result of the 2014 imagery yielding better clarity of an area.

Data Inventory, Organization of Project Materials and Uploading of Digital Files

Primary data Sources

Several data sources were used during the mapping process. The primary data sources are listed below.

- ***2014 digital imagery:*** This 6-inch resolution, natural color imagery, dated 2014 and provided by MMWD, served as the base for the 2014 mapping update. The imagery was uploaded to AIS servers.

- ***2009 SOD Vegetation database:*** The 2009 Vegetation database was used as the base for the 2014 SOD Vegetation database update.

Ancillary Data Sources

There were several sources of ancillary data used to help facilitate the 2014 vegetation mapping. They are listed below:

- Topology maps
- Contour lines
- Field recon points from the 2004 Vegetation Mapping project
- 2004 digital imagery
- 2009 digital imagery
- Google Earth imagery

Preliminary Digital Imagery Signature Identification

Prior to the mapping process, the photo interpreters reviewed the project area with the 2014 digital imagery in order to identify any problematic signatures and develop any questions for the MMWD Ecologist.

Photo Interpretation

After the base imagery for the project was uploaded onto the AIS servers, the photo interpretation could begin. Following many of the same mapping rules and criteria established for the 2009 database, the photo interpreter used heads-up digitizing techniques and custom ArcGIS tools that AIS developed to update the existing database.

The 2009 database was used as the starting point for the 2014 SOD vegetation update. A selection on the Veg2009 codes was created that included all mapping types that had potential to be affected by sudden oak death, which was approximately 50 types (see Appendix B for designation of which types were included in the selection). This resulted in roughly 2200 polygons (approximately 13, 000 acres) to be reviewed for the 2014 SOD vegetation update.

When possible, the photo interpreter worked in regions that contained similar vegetation types. Within these regions, the photo interpreter would visit the polygons from the SOD selection set and evaluate them in the context of SOD modifications to the floristic, structural and health of the vegetation. By focusing on smaller, similar areas within the study area, the photo interpreter became more familiar with the region and local trends in the vegetation.

Registration between the 2009 imagery and the 2014 imagery was evaluated to ensure the accuracy of the database. The 2014 base imagery was then compared to the 2009 vegetation database for any changes. If any changes were detected, then the attributes were updated to reflect the change. Occasionally, this resulted in a polygon being split based on differing levels of SOD devastation within the stand. The 2014 imagery was then compared to the 2004 imagery in order to analyze the gaps within each polygon. The 2004 imagery was used as the starting point for measuring the gaps.

As mapping progressed, the spatial registration between the 2009 and 2014 sets of imagery was found to be inconsistent in some areas. There were also splicing errors found in a few locations on the 2014 imagery. In addition, because only a selected set of polygons were reviewed for SOD in this update project, and the ID number assigned each polygon in 2009 (UID2009) was retained, the original linework from 2009 was unaltered. For this reason, within the Vegetation feature class, the spatial base imagery for the vegetation polygons remained to be the 2009 image dataset. The 2014 attributes for each vegetation polygon were coded based on the 2014 imagery since it was the most current imagery. Since 2014 imagery was solely used to delineate the largest gap polygons within the LargestGaps feature class, the spatial base imagery for the LargestGaps feature class was therefore the 2014 image dataset.

In other words, unless the polygon boundaries within the Vegetation feature class had changed due to a change in attributes (e.g. vegetation change, change in density, etc.), the boundaries were kept as they were mapped to the 2009 imagery but the polygon attributes were updated using the 2014 imagery. However, for the LargestGaps feature class, the largest gap delineations were based on the 2014 imagery since it was the most current imagery available. ***Note** that if a vegetation polygon was split due to 2014 conditions, it created multiple vegetation polygons in the Vegetation feature class that contained the same UID2009 values, but different UID2014 values. This was not common within the study area.

Base Imagery Used for 2014 Mapping Update

ArcGIS Feature Class	**Imagery Used for Spatial Base (location of polygons)**	**Imagery Used for Attribute Base (attribute coding)**
Vegetation	2009	2014
LargestGaps	2014	2014

Additions to the 2014 Vegetation Map

New ArcGIS Feature Class

As a result of mapping the new attribute called LargestGap2014 (see New Attributes section below), a new ArcGIS feature class was created in order to show the location of the largest gaps within polygons that contained one. The largest gap was mapped when a polygon had been affected by SOD at some time between 2004 and 2014, which resulted in a measurable continuous gap within the polygon. The best way to inventory the size of the largest gap was to map it within the polygon in the Vegetation feature class. The largest gap polygons were then extracted into a separate ArcGIS feature class, named LargestGaps, within the 2014 database. There were only 2 attributes that were coded for the LargestGaps feature class: UID2014 and AreaSqMeters. The UID2014 attribute correlated with the UID2014 in the Vegetation feature class since they were both located within the same vegetation polygon. The area of the largest gap was in the AreaSqMeters attribute within the LargestGaps feature class and correlated with the LargestGap2014 attribute in the Vegetation feature class.

Correlating Attributes Within Vegetation and LargestGaps Feature Classes in the 2014 Database

ArcGIS Feature Class	**Correlating Attribute Names**	**Correlating Attribute Names**
Vegetation	UID2014	LargestGaps
LargestGaps	UID2014	AreaSqMeters

New Attributes

Four new attributes for the Vegetation feature class were created for the 2014 update (TotalGap2014, LargestGap2014, ConDensityChange2014, and HWoodDensityChange2014). Two were related to measuring the gaps within a polygon from 2004 to 2014, and the other 2 were the density changes of hardwood and/or conifer from 2009 to 2014, usually due to SOD.

Gap Analysis

Since the vegetation map was initially created in 2004, the 2004 data was used as the benchmark for starting conditions related to the gap measurements. Within the Vegetation feature class, the total gap percentage (TotalGap2014 attribute) and the largest gap (LargestGap2014 attribute) were measured from 2004 to 2014. TheTotalGap2014 attribute was a collective measurement of all the gaps within a polygon and was assigned a percentage in 5% increments. The LargestGap2014 attribute was the area in square meters of the largest continuous gap within a polygon. Several vegetation polygons that were evaluated had multiple gaps within them, but did not have a LargestGap2014 attribute defined because the existing gaps were extremely small and discontinuous across the stand. The largest gap polygons were located within a separate feature class, named LargestGaps, within the 2014 database.

Density Changes

Density changes in conifer and hardwood were only evaluated in the polygons that were selected for SOD impact between 2009 and 2014. The density changes were measured in positive or negative 5% increments, using 2.5% as the floor for measurable change (rounding up to 5%). In most examples, the conifer density changes were due to increasing crown size, but in some cases, it was due to saplings regenerating in a gap. The hardwood density changes that resulted in an increase were generally due to the young California bay saplings that regenerated in the gaps left from dead tanoak trees. Decreases in hardwood density were usually found in areas of coast live oak death since there was little to no regeneration of hardwoods in this setting. Note that increases or decreases in shrub cover were indicated in a cover class change from 2009 to 2014 only where the change was significant enough to change cover classes.

See Figure 3 below visually depicting the 4 new attributes:

- Total Gap Percentage (TotalGap2014) – Example below: 70% of the polygon is a gap
- Largest Gap in the polygon (LargestGap2014) – Example below: 2068 square meters
- Conifer Density Change – Example below: 5% increase from 2009
- Hardwood Density Change – Example below: 10% increase from 2009

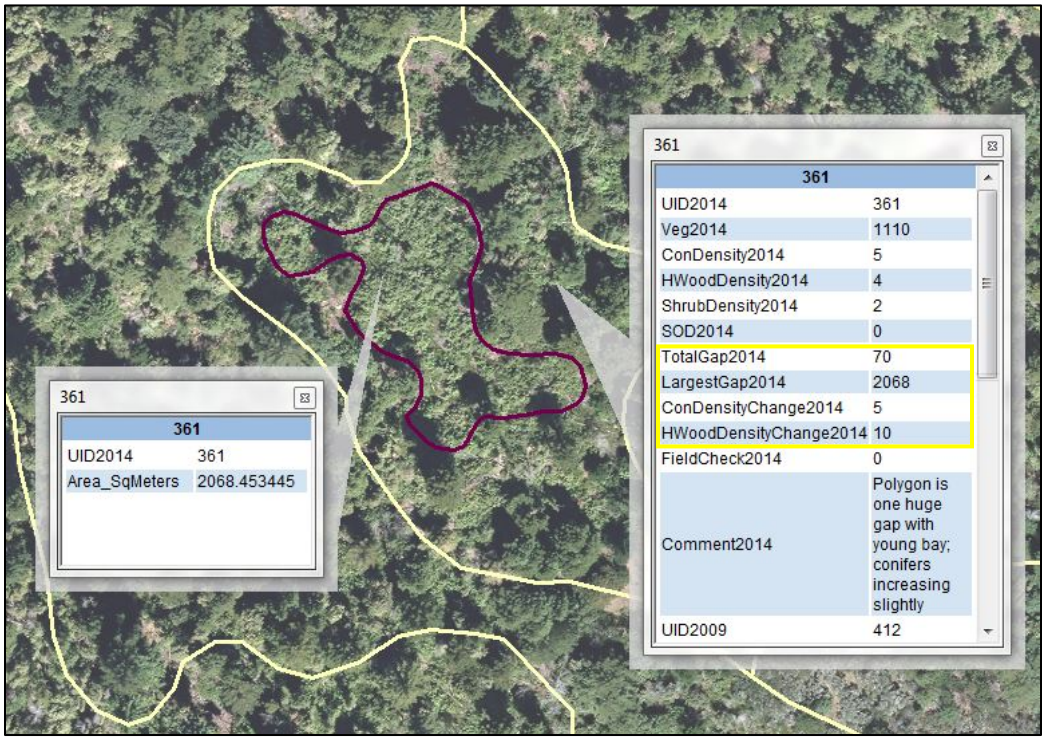


Figure 3: Four new attributes in the Vegetation feature class (highlighted in yellow), as depicted in the table to the right. Largest gap of the parent vegetation polygon is outlined in purple (also a new feature class named LargestGaps) to the left with its corresponding area. Other attributes in the vegetation polygon were also reviewed for change. Polygons in both feature class have the same UID2014 and area of largest gap. Not depicted in this example is a change in shrub cover from less than 2% (Category 0) in 2009 to 40-60% (Category 2) in 2014.

Attributes for the 2014 Update

The attributes coded for the 2014 Vegetation feature class are listed below with a brief description (see Appendix C for attribute values).

UID2014: Unique ID number for each polygon mapped in 2014. This number also corresponds to the polygon ID number (UID2014) in the LargestGaps feature class.

Veg2014: The updated 4-digit numeric code that corresponds to the floristic type from the MMWD Vegetation Mapping Classification (see Appendix B for the Mapping Classification).

ConDensity2014: The updated conifer cover class, assigned by using a range of values.

HWoodDensity2014: The updated hardwood cover class, assigned by using a range of values.

ShrubDensity2014: The updated shrub cover class, assigned by using a range of values.

SOD2014: The updated SOD Severity (also referred to as Dead Vegetation) Modifier, assigned by a range of values.

TotalGap2014: The collective area of any gaps within the polygon since 2004, mapped in 5% increments. The value represents a percent of the total polygon covered in gaps.

LargestGap2014: The area of the largest continuous gap created since 2004. The LargestGap2014 in the Vegetation feature class corresponds to the AreaSqMeters attribute in the LargestGaps feature class.

ConDensityChange2014: Mapped in +/-5% increments, the change of conifer density in a polygon since 2009, usually as a result of SOD. In some instances the change was not a result of SOD, but was noted as such in the Comments2014 attribute.

HWoodDensityChange2014: Mapped in +/-5% increments, the change of hardwood density in a polygon since 2009, usually as a result of SOD. In some instances the change was not a result of SOD, but was noted as such in the Comments2014 attribute.

FieldCheck2014: Attribute used to flag polygons that were sent as questions or answered by MMWD staff.

Comment2014: Answers to field questions along with and any other pertinent information associated with the mapped polygon was put in this attribute.

The attributes coded for the 2014 LargestGaps feature class are listed below with a brief description (see Appendix C for attribute values).

UID2014: Unique ID number for each polygon mapped in 2014. This number also corresponds to the polygon ID number (UID2014) in the Vegetation feature class.

AreaSqMeters: The LargestGap2014 in the Vegetation feature class corresponds to the AreaSqMeters attribute in the LargestGaps feature class.

Field Checking Effort

During the photo interpretation process, questions that arose were noted by flagging the polygon, which were then answered by the MMWD Ecologist. These answers were implemented into the 2014 database and extrapolated as necessary throughout the study area.

Quality Control

Once the photo interpretation was completed and answers to the field questions were incorporated in the database, a comprehensive quality control (QC) was performed by the senior photo interpreter. The QC steps included a visual check on signature and attribute correlation as well as automated programs to check the validity of coding and linework.

Final Processing and Documentation

Automated processes were performed on the database to create a seamless coverage with no GIS errors. Upon completion of the steps above, AIS provided MMWD with a Photo Interpretation Summary Report and the final data, in digital format, with supporting metadata.

APPENDIX A

AREA REPORT

VEG2014 Type	Frequency	Area (acres)
1100	6	6.75
1101	103	583.27
1102	19	168.48
1103	26	90.89
1104	60	584.61
1110	149	785.47
1111	96	450.52
1112	6	7.45
1113	260	517.67
1114	127	670.79
1115	68	226.76
1116	12	63.03
1117	60	733.00
1160	19	27.44
1170	35	64.33
1171	28	70.88
1180	44	48.60
1201	7	14.60
1210	8	4.62
1211	2	13.68
1212	91	1482.53
1213	2	1.71
1214	76	712.72
1215	63	121.28
1216	97	1168.78
1217	33	368.20
1220	18	33.29
1221	52	236.29
1222	208	3072.45
1223	36	109.11
1224	1	47.10
1225	2	2.95
1226	26	26.30
1227	53	124.20

VEG2014 Type	Frequency	Area (acres)
1230	8	9.36
1231	11	13.35
1232	6	7.53
1240	6	14.64
1241	77	289.84
1242	24	33.76
1310	10	4.76
1410	4	5.65
2110	46	100.37
2111	124	205.03
2112	2	1.99
2113	8	17.08
2210	5	6.15
2220	16	11.90
2231	2	9.98
2321	2	4.85
3000	1	0.30
3100	2	0.56
3110	8	4.39
3112	65	49.91
3114	148	116.69
3115	150	174.68
3120	83	69.87
3121	324	516.68
3122	45	91.25
3130	37	87.03
3140	2	0.19
3150	58	91.18
3160	32	24.53
3161	352	752.70
3170	3	2.56
3180	76	83.60
3190	412	1056.62
3210	41	25.71
3220	6	4.59
3221	18	11.03
3222	87	52.84

VEG2014 Type	Frequency	Area (acres)
3223	45	30.93
3310	3	2.04
3311	11	7.16
3410	5	1.98
4101	3	1.33
4110	5	2.57
4120	1	0.24
4210	12	3.15
4211	16	12.71
4310	4	1.16
4311	290	1042.33
4312	30	86.94
4313	44	39.99
4400	1	0.39
4500	6	22.74
4510	3	0.63
4520	1	0.77
4610	151	126.96
4620	8	1.82
9000	1	14.64
9100	48	65.32
9302	2	4.73
9400	31	14.92
9401	95	30.09
9420	78	14.68
9810	8	847.70
9820	2	0.13
9999	20	12.39

APPENDIX B

Marin Watershed Mapping Classification

Revised for SOD Update – October 2011

**= Types reviewed for the 2014 SOD Update*

CLASS

Group or Formation Level Categories

Alliances

Mapping units or Potential Associations yet to be defined

1000 – 2000 – FORESTS & WOODLANDS

*1100 – Temperate Broadleaf Sclerophyll Evergreen Forests & Woodlands (Mixed Hardwoods)

1101 – Lower Elevation Mixed Broadleaf Mapping Unit (Trending Xeric) – Coast Live Oak, Madrone or Black Oak dominant* *(At least two species co-dominate, may include Madrone – Coast Live Oak, Black Oak – Coast Live Oak, or Black Oak – Madrone.)***

1102 – Tanoak – California Bay – Canyon Oak Mixed Forest* *(Either Tanoak or California Bay dominate but the other either co-dominates or is present. Canyon Oak may or may not be present but generally does not co-dominate.)***

1103 – California Bay – Alder – Big Leaf Maple – Willow spp. Riparian Forest (**California Bay is always present in association with any or all three riparian species.)***

1104 – Madrone – California Bay – Tanoak* *(Madrone co-dominates with either Tanoak or California Bay including Madrone – Tanoak, Madrone – California Bay, and California Bay – Black Oak – Madrone.)***

**1110 – California Bay Alliance*

**1111 – California Bay (pure)*

**1112 – California Bay – Buckeye*

**1113 – California Bay – Interior Live Oak*

**1114 – California Bay – Canyon Oak*

**1115 – California Bay – Coast Live Oak*

**1116 – California Bay – Tanoak*

**1117 – California Bay – Madrone*

**1140 – Tanoak Alliance*

**1160 – Madrone Alliance*

1170 – Canyon Oak Alliance* *(Includes Canyon Live Oak with lower cover of Tanoak.)***

**1171 – Canyon Oak – Interior Live Oak*

1180 – Giant Chinquapin Alliance* *(Includes a possibility of 3 associations that include Eastwood Manzanita, and stands are sometimes shrub-like in nature.)***

*1200 – Temperate Needleleaf Evergreen Forests & Woodlands

**1201 – Planted Stands of Pine (Monterey Pine – Bishop Pine – Monterey Cypress and other spp.*

**1210 – Redwood Alliance*

1211 – Redwood / Tanoak* *(Includes a possibility of at least 2 associations.)***

**1212 – Redwood – Douglas-fir – (Mixed Hardwoods)*
**1213 – Redwood / Chinquapin*
**1214 – Redwood / California Bay*
1215 – Redwood (pure)* *(often young dense stands)***
1216 – Redwood - Upland Mixed Hardwoods (**Generally California bay, Tanoak, occur as co-dominant or subordinate species in upland settings.)***
1217 – Redwood – Riparian* *(Redwoods in riparian settings with maple, California bay, Tanoak, and/or White alder in the secondary canopy.)***
1218 – Redwood – Madrone* *(Surveys suggest this type with Vaccinium ovatum in the understory)***
**1220 – Douglas-fir Alliance*
1221 – Douglas-fir - Mixed Hardwoods in upland drier settings (Coast Live Oak, Madrone)* *(Generally in smaller stands often adjacent to grassland or shrublands.)***
1222 – Douglas-fir Mixed Hardwoods in upland forest settings (California Bay, Canyon Oak, Tanoak – Madrone)* *(Canyon Oak often occurring in larger stands adjacent to other conifer forests.)***
1223 – Douglas-fir – California Bay Mapping Unit* *(May include Coast Live Oak as an associate.)***
**1224 – Douglas-fir – Tanoak*
1225 – Douglas-fir – Riparian* *(Douglas-fir in riparian settings with White Alder, Blackberry, etc., in understory.)***
1226 – Douglas-fir (pure)* *(Little understory development other than Douglas-fir regenerating)***
**1227 – Douglas-fir – California Bay / Interior Live Oak*
1230 – Bishop Pine Alliance
1231 – Bishop Pine / Eastwood Manzanita
1232 – Bishop Pine (pure)
1240 – Sargent Cypress Alliance
1241 – Sargent Cypress / Mt. Tamalpais Manzanita
1242 – Sargent Cypress (pure)
1243 – Sargent Cypress – Riparian ***(May be very rare.)***

1300 – Temporarily Flooded Cold Season Deciduous Forests & Woodlands

1310 – Mixed Willow Mapping Unit (Arroyo Willow, Red Willow, and Yellow Willow Alliances)
1320 – White Alder Alliance
1321 – White Alder – California Bay
1330 – Red Alder Alliance

*1400 – Cold Season Deciduous Forests

**1410 – Black Oak Alliance*

*2000 – WOODLANDS

*2100 – Xeric Sclerophyll Evergreen Forests & Woodlands

**2110 – Coast Live Oak Alliance*
**2111 – Coast Live Oak / (Grass-Poison Oak)*
**2112 – Coast Live Oak – Riparian*

*2113 – Coast Live Oak – Douglas-fir ***(A small component of conifer cover (< or = 5%), as compared to 1221)***

*2200 – Cold Season Deciduous Woodlands

*2210 – Oregon Oak Alliance (small stands) ***(Includes Oregon Oak mixed with lower to equal Coast Live Oak or California bay cover)***

*2220 – California Buckeye Alliance ***(Includes California Buckeye mixed with lower Coast Live Oak) [mapped based on plot data and some local extrapolation]***

*2230 – Valley Oak Alliance

*2231 – Valley Oak Riparian Mapping Unit ***(California Bay and/or Big Leaf Maple- Alder are a co-dominant in a riparian setting)***

*2300 – Temporarily Flooded Cold Season Deciduous Woodlands

*2320 – Big-leaf Maple Alliance

*2321 – Big-Leaf Maple – California Bay Mapping Unit ***(May be co-dominant or one slightly higher in cover than the other.)***

3000 – SHRUBLANDS

3100 – Temperate Broadleaf Sclerophyll Evergreen Shrublands

3110 – Chamise Alliance

3112 - Chamise - Serpentine Chaparral ***(Relatively pure chamise on ultramafic soils)***

3114 – Chamise ***(Stands with a co-dominance of chamise with other shrub species such as Sticky Monkey-flower or Wedgeleaf Ceanothus)***

3115 – Chamise (pure)

3120 – Mt. Tamalpais Manzanita Alliance ***(Includes possibly 3 associations with Eastwood Manzanita, Chamise, or Jepson's Ceanothus as associates.)***

3121 - Mt. Tamalpais Manzanita - Chamise - (Garraya - Leather Oak – Jepson ceanothus) – Serpentine Chaparral)

3122 – Mt. Tamalpais Manzanita - \ with Sparse Douglas-fir emergent (5 - 25%)

3130 – Sensitive Manzanita Alliance ***(Small stands that may include Eastwood Manzanita or Huckleberry.)***

3132 – Jepson's Ceanothus (stand noted at Nicasio Reservoir)

3140 – Silver Leaf Manzanita Alliance ***(Small stands that may include Eastwood Manzanita and Chamise.)***

3150 – Eastwood Manzanita Alliance ***(May have up to 10-15% Douglas-fir emergent)***

3160 – Interior Live Oak Alliance

3161 – Interior Live Oak- Eastwood Manzanita ***(QUWI and ARGL co-dominate)***

3170 – Blue Blossom Alliance ***(Small stands, and may include at least 2 associations with Coyote Brush – Poison Oak and with Shrub Interior Live Oak.)***

3180 – Leather Oak – Chamise – Mt. Tamalpais Manzanita Serpentine Chaparral

3190 –Chamise – Eastwood Manzanita

3200– Temperate Microphyllous Evergreen Shrubland

3210 – (French) Broom Alliance ***(May include low cover of Coyote Brush.)***
3220 – Coyote Brush Alliance
3221 – Coyote Brush – California Sagebrush – Sticky Monkey Flower
3222 – Coyote Brush / Annual or Perennial Grasslands (open stands)
3223 – Coyote Brush – Mixed Shrub / Grass ***(May include Poison Oak or California Blackberry with mixture of grass species.)***

3300 – Temperate Xeric Mixed Drought-Deciduous Evergreen Shrubland

3310 - California Sagebrush Alliance
3311 – California Sagebrush – Sticky Monkey Flower

3400 – Temperate Broadleaf Cold Season Deciduous Shrubland

*3410 – Poison Oak Alliance (****Small stands found in Coyote Brush patches)***
3420 – Riparian Deciduous Shrubland ***(Includes Western Azalea.)***

4000 – HERBACEOUS

4100 – Saturated Temperate Perennial Graminoids

4101 – Undifferentiated Marsh (cattail, bulrush, other scirpus spp.)
4110 – Cattail Alliance
4120 – Bulrush Alliance

4200 – Seasonally or Temporarily Flooded Graminoids

4210 –Sedge – Rush – Wet Graminoids Meadow (Including Juncus, Carex, and Hordeum brachyantherum – Meadow barley)
4211- Temporarily flooded or saturated Meadow Edge

4300 – Tall Temperate Annual Graminoids

4310 – California Annual Grasslands Alliance (Native Component Variable)
4311 – Grasslands on well-developed soils ***(generally dense bio-mass)***
4312 – Grasslands on poorly developed soils ***(generally sparse bio-mass)***
4313 – Grasslands with a fern or sub-shrub component (either Thermopsis or fern)

4400 – Tall Temperate Perennial Herbaceous
4410 – Harding Grass Alliance
4420 – Teasal Alliance (Dipsacus sativa)
4430 – Reed Canary Grass Alliance (Festuca arundinacea)

4500 – Native Temperate Perennial Grasslands

4510 – California or Idaho Fescue Grasses ***(Small patches in grassland settings.)***
4520 – Purple Needlegrass ***(Small patches with annual grasses and sometimes other native grasses such as California Melic)***

4600 – Serpentine Grassland

4610 – Upland Serpentine Grassland ***(May include perennial and annual species at varying cover seasonally and annually, such as Purple Needlegrass, Torrey's Melic, Dwarf Plantain, Small Fescue, Sticky Western Rosinweed)***

4620 – Wetland Serpentine Grassland ***(May include perennial and annual species at varying cover seasonally and annually, such as Meadow barley, Rosinweed, Goldfields, etc.)***

9000 – LAND USE / UNVEGETATED

9800 – WATER

9100 – Urban Developed – Built Up

9302 – Quarry

9400 – Sparsely Vegetated or Unvegetated Areas

9401 - Serpentine Balds ***(Including rare species such as Tamalpais Jewelflower)***

9410 – Landslides

9420 – Cliffs – Rock Outcrops

9810 – Reservoirs

9820 – Small Asian Elephant Ponds (it just won't change, will it) – never in a thousand years

9999 – Field questions

APPENDIX C

MMWD SOD Vegetation Mapping Attribute Values for 2014 Update

Vegetation Feature Class Attribute Values

UID2014: Unique ID number for polygons in 2014 database

Veg2014: 4-digit code that corresponds with floristic type from the MMWD Mapping Classification in the 2014 database (see Appendix B)

ConDensity2014, HWoodDensity2014, ShrubDensity2014: Densities for conifer, hardwood and shrubs in the 2014 database

Density 2014 Range	
Code Value	Range
0	<2%
1	>60%
2	40-60%
3	25-40%
4	10-25%
5	2-10%

SOD2014: Updated Sudden Oak Death (dead vegetation) Severity Code in the 2014 database
Note: Evaluation of SOD is done on the total tree cover of the affected polygon.

SOD Modifier 2014 Values	
Code Value	SOD Severity
0	No mortality
1	Low: 1-5% of polygon has canopy mortality
2	Moderate: 5-10% of polygon has canopy mortality
3	Severe: >10 of polygon has canopy mortality
4	Trace: <1% of polygon has canopy mortality

TotalGap2014: Percentage of collective gap within a polygon in the 2014 database, using 5% increments

Total Gap 2014 Values	
Code Value	Increments (in 5%)
0	0 - 2.5%
5	>2.5% - 7.5%
10	>7.5% - 12.5%
15	>12.5% - 17.5%
20	>17.5%- 22.5%
25	>22.5% - 27.5%
30	>27.5% - 32.5%
35	>32.5% - 37.5%
40	>37.5% - 42.5%
45	>42.5% - 47.5%
50	>47.5% - 52.5%
55	>52.5% - 57.5%
60	>57.5% - 62.5%
65	>62.5% - 67.5%
70	>67.5% - 72.5%
75	>72.5% - 77.5%
80	>77.5% - 82.5%
85	>82.5% - 87.5%
90	>87.5% - 92.5%
95	>92.5% - 97.5%
100	>97.5%- 100%

LargestGap2014: Area of largest gap within a polygon in the 2014 database, in square meters

FieldCheck2014: Indicates a polygon that was flagged for a field question or visited/ answered by MMWD staff in the 2014 database

Field Check 2014 Values	
Code Values	Type of Field Check
0	No field question
1	Flagged for field questions
2	Field question answered

Comment2014: Within the 2014 database, answers to field questions along with and any other pertinent information associated with the mapped polygon was contained in this attribute.

ConDensityChange2014, HWoodDensityChange2014: Changes in density in the 2014 database, in 5% increments. Note that a minus sign (–) indicates a decrease in density. 2.5% was used as lowest number to round up to 5%.

Density Change 2014 Values	
Code Value	Increments (in 5%)
0	0 - 2.5%
+/- 5	+/- >2.5% - 7.5%
+/- 10	+/- >7.5% - 12.5%
+/- 15	+/- >12.5% - 17.5%
+/- 20	+/- >17.5%- 22.5%
+/- 25	+/- >22.5% - 27.5%
+/- 30	+/- >27.5% - 32.5%
+/- 35	+/- >32.5% - 37.5%
+/- 40	+/- >37.5% - 42.5%
+/- 45	+/- >42.5% - 47.5%
+/- 50	+/- >47.5% - 52.5%
+/- 55	+/- >52.5% - 57.5%
+/- 60	+/- >57.5% - 62.5%
+/- 65	+/- >62.5% - 67.5%
+/- 70	+/- >67.5% - 72.5%
+/- 75	+/- >72.5% - 77.5%
+/- 80	+/- >77.5% - 82.5%
+/- 85	+/- >82.5% - 87.5%
+/- 90	+/- >87.5% - 92.5%
+/- 95	+/- >92.5% - 97.5%
+/- 100	+/- >97.5%- 100%

2009 attributes (with updates to the names in the 2014 database):

2014 Database Name	2009 Database Name
UID2009	AIS_ID
Veg2009	Veg_09
ConDensity2009	ConDensity_09
HWoodDensity2009	HWoodDensity_09
ShrubDensity2009	ShrubDensity_09
*Broom2009	Broom_09
SOD2009	SOD_09
FieldCheck2009	FieldCheck_09
Comment2009	Comment_09
Veg2004	Veg_04
ConDensity2004	ConDensity_04
HWoodDensity2004	HWoodDensity_04
ShrubDensity2004	ShrubDensity_04
*Broom 2004	Broom
SOD2004	SOD_04
Comment2004	Note_04
FieldCheck2004	Field_04

**Not evaluated in 2014 effort*

LargestGaps Feature Class Attribute Values

UID2014: Unique ID number

AreaSqMeters: Area of largest gap polygon in square meters

APPENDIX D

SUDDEN OAK DEATH VS. GAP GUIDELINES

Sudden Oak Death (dead vegetation) Measurements

Death in vegetation (SOD2014 attribute) is only measuring die-off severity between 2009 and 2014.

If dead vegetation is visible in 2009, then it is not counted in the SOD2014 field since it occurred before 2009, even if it is still visible in 2014. This enables the user to evaluate the actual die-off that has occurred since the 2009 update.

If a complete death cycle has occurred between 2009 and 2014 (e.g. it is alive on 2009 imagery, but dead or gone on 2014 imagery), the polygon **DOES** get counted in the 2014 SOD variable (common in coast live oak settings).

Standing dead trees count as a component to the dead vegetation modifier, not to the gaps.

For the most part, SOD in coast live oak stands observed in 2014 is death that has occurred since 2009 since die-off normally occurs during a relatively short period of time. This includes the gaps that have been created from coast live oak trees that have died and felled since 2009 as well as any early stages of sudden oak death occurring in the canopy since 2009. When a coast live oak is dead and down, it is coded as part of the gap AND the dead vegetation modifier even if the downed remains are visible on the imagery.

When a death severity is noted in the SOD2014 field, with little or no hardwoods regenerating in the canopy openings, there will be generally be a hardwood density loss noted in the hardwood density 2014 field. These situations more often occur in coast live oak types. When a death severity is noted in the SOD2014 field with hardwood regeneration since 2009, then an increase in cover will be noted in the hardwood density 2014 field. If the canopy gap is regenerating primarily by shrub species, then the shrub density 2014 cover class value will be increased if the change is significant enough to change cover classes. Both of these situations more often occur in tanoak types.

Conifer death is not counted when assessing the Updated SOD Severity code.

Gap Measurements

Gaps are measured from 2004 until 2014. An opening in canopy resulting from SOD (as long as it occurred prior to the 2014 imagery) is considered part of the gap.

Gaps are openings created from dead trees that have fallen due to SOD. The gaps include any new growth of vegetation regardless of stature.

Conifer death does not count towards the gap modifiers.

Standing dead trees do not count as a gap. Standing dead is more frequently noted in tanoak and mixed tanoak forests. Diseased coast live oaks tend to take less time to fall and will more often create gaps soon after the trees die.

If the collective gap in a polygon is small (<2.5%), a value of 0% is defined for Total Gap Percentage. Minor canopy openings such as these that are due to SOD is noted in the comments field.

The LargestGap2014 attribute measures the presence of a continuous, uninterrupted gap in an existing polygon. Small gaps that normally occur in a forest canopy are not measured as part of this attribute.

For the most part, gaps are not mapped under tree canopies or in shadows unless a clearly visible gap extends beyond the shadowed area.

APPENDIX E

SUDDEN OAK DEATH TABLES

Table 1

Decrease in Tanoak and Mixed Tanoak Forests by Type (area in acres)

VEG2014 Type	Area 2014	Area 2009	Area 2004
1102	168.48	226.67	617.07
1104	584.61	580.12	1191.92
1116	63.03	284.57	917.96
1140	0.00	0.00	53.46
1211	13.68	14.05	152.44
1212	1482.53	1520.12	1519.76
1216	1168.78	1272.77	1536.62
1217	368.20	368.20	368.20
1222	3072.45	3074.97	3081.79
1224	47.10	47.10	47.10
Total Area:	**6968.87**	**7388.57**	**9486.31**

Table 2

Decrease in Hardwood Cover in Coast Live Oak Woodland Types Since 2009

VEG2014 Type	HW Change -25%	HW Change -20%	HW Change -15%	HW Change -10%	HW Change -5%	HW Change 0%	HW Change 5%	HW Change 10%
1101			16.50	26.93	196.30	343.54		
1115		11.36	1.18	1.38	36.79	176.05		
1221						229.73		6.56
2110			6.35	16.53	13.43	54.89	6.51	2.65
2111	0.99			5.36	82.72	115.74	0.13	0.10
2112						1.99		
2113				0.71		16.38		

Table 3
Total Area of Hardwood Recovery in Post SOD Tanoak and Mixed Tanoak Forests

VEG2014 Type	HW Change -5%	HW Change 0	HW Change 5%	HW Change 10%	HW Change 15%	HW Change 20%	HW Change 25%	HW Change 30%
1102	8.45	147.82	12.22					
1104	74.15	494.13	15.71					0.62
1116		47.45	15.58					
1211		5.49		8.18				
1212	2.75	864.68	495.78	92.98	26.34			
1216	12.10	629.17	417.86	109.64				
1217	3.72	338.26	21.69	4.53				
1222	18.57	3005.98	42.92	1.05	0.22			3.72
1224		47.10						

Table 4
Total Tanoak Loss Since 2004 (measured in acres)

VEG2014 Type	Tanoak Loss
1102	168.48
1104	584.61
1116	63.03
1211	13.68
1212	1482.53
1216	1168.78
1217	368.20
1222	3072.45
1224	47.10
Total:	**6968.86**

Table 5

Total Coast Live Oak Loss since 2004 (measured in acres)

VEG2014 Type	Coast Live Oak Loss
1101	583.27
1115	226.76
1221	236.29
2110	100.37
2111	205.03
2112	1.99
2113	17.08
Total:	**1370.79**

APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Lands

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
Ducks, Geese, and Swans			
Canada Goose	*Branta canadensis*	Known	Uncommon
Wood Duck	*Aix sponsa*	Known	Uncommon
Gadwall	*Anas strepera*	Known	Irregular
American Wigeon	*Anas americana*	Known	Irregular
Mallard	*Anas platyrhynchos*	Known	Common
Cinnamon Teal	*Anas cyanoptera*	Known	Irregular
Northern Shoveler	*Anas clypeata*	Known	Irregular
Northern Pintail	*Anas acuta*	Known	Irregular
Green-winged Teal	*Anas crecca*	Known	Irregular
Canvasback	*Aythya valisineria*	Known	Irregular
Ring-necked Duck	*Aythya collaris*	Known	Uncommon
Greater Scaup	*Aythya marila*	Known	Rare
Lesser Scaup	*Aythya affinis*	Known	Irregular
Bufflehead	*Bucephala albeola*	Known	Uncommon
Common Goldeneye	*Bucephala clangula*	Known	Uncommon
Barrow's Goldeneye	*Bucephala islandica*	Known	Irregular
Hooded Merganser	*Lophodytes cucullatus*	Known	Rare
Common Merganser	*Mergus merganser*	Known	Common
Red-breasted Merganser	*Mergus serrator*	Likely	Unknown
Ruddy Duck	*Oxyura jamaicensis*	Known	Rare
Grouse, Quail, and Allies			
California Quail	*Callipepla californica*	Known	Common
Wild Turkey (non-native)	*Meleagris gallopavo*	Known	Common
Loons			
Common Loon	*Gavia immer*	Known	Irregular
Pacific Loon	*Gavia pacifica*	Known	Irregular
Grebes			
Pied-billed Grebe	*Podilymbus podiceps*	Known	Common
Eared Grebe	*Podiceps nigricollis*	Known	Irregular
Western Grebe	*Aechmophorus occidentalis*	Known	Uncommon
Clark's Grebe	*Aechmophorus clarkii*	Known	Irregular
Pelicans and Allies			
Double-crested Cormorant	*Phalacrocorax auritus*	Known	Uncommon
American White Pelican	*Pelecanus erythrorhynchos*	Known	Irregular

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
Herons and Allies			
Great Blue Heron	*Ardea herodias*	Known	Common
Great Egret	*Ardea alba*	Known	Common
Snowy Egret	*Egretta thula*	Known	Irregular
Green Heron	*Butorides virescens*	Known	Uncommon
Black-crowned Night-Heron	*Nycticorax nycticorax*	Likely	Unknown
Vultures, Hawks and Falcons			
Turkey Vulture	*Cathartes aura*	Known	Common
Osprey	*Pandion haliaetus*	Known	Common
White-tailed Kite	*Elanus leucurus*	Known	Common
Bald Eagle	*Haliaeetus leucocephalus*	Known	Uncommon
Northern Harrier	*Circus cyaneus*	Known	Uncommon
Sharp-shinned Hawk	*Accipiter striatus*	Known	Common
Cooper's Hawk	*Accipiter cooperii*	Known	Uncommon
Red-shouldered Hawk	*Buteo lineatus*	Known	Common
Swainson's Hawk	*Buteo swainsoni*	Likely	Unknown
Red-tailed Hawk	*Buteo jamaicensis*	Known	Common
Ferruginous Hawk	*Buteo regalis*	Likely	Irregular
Rough-legged Hawk	*Buteo lagopus*	Known	Irregular
Golden Eagle	*Aquila chrysaetos*	Known	Uncommon
American Kestrel	*Falco sparverius*	Known	Common
Merlin	*Falco columbarius*	Known	Rare
Peregrine Falcon	*Falco peregrinus*	Known	Irregular
Prairie Falcon	*Falco mexicanus*	Known	Rare
Cranes and Rails			
Virginia Rail	*Rallus limicola*	Known	Irregular
Sora	*Porzana carolina*	Known	Irregular
Common Gallinule	*Gallinula galeata*	Known	Irregular
American Coot	*Fulica americana*	Known	Common
Shorebirds			
Killdeer	*Charadrius vociferus*	Known	Common
Black-necked Stilt	*Himantopus mexicanus*	Known	Irregular
Spotted Sandpiper	*Actitis macularius*	Known	Uncommon
Greater Yellowlegs	*Tringa melanoleuca*	Known	Irregular
Least Sandpiper	*Calidris minutilla*	Likely	Irregular
Baird's Sandpiper	*Calidris bairdii*	Likely	Irregular
Pectoral Sandpiper	*Calidris melanotos*	Likely	Irregular
Wilson's Snipe	*Gallinago delicata*	Known	Irregular

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
Gulls and Terns			
Ring-billed Gull	*Larus delawarensis*	Known	Common
Western Gull	*Larus occidentalis*	Known	Rare
California Gull	*Larus californicus*	Known	Rare
Herring Gull	*Larus argentatus*	Known	Irregular
Glaucous-winged Gull	*Larus glaucescens*	Known	Rare
Caspian Tern	*Hydroprogne caspia*	Known	Common
Common Tern	*Sterna hirundo*	Known	Irregular
Pigeons and Doves			
Band-tailed Pigeon	*Patagioenas fasciata*	Known	Common
Mourning Dove	*Zenaida macroura*	Known	Common
Owls			
Barn Owl	*Tyto alba*	Known	Common
Western Screech-Owl	*Megascops kennicottii*	Known	Uncommon
Great Horned Owl	*Bubo virginianus*	Known	Common
Northern Pygmy-Owl	*Glaucidium gnoma*	Known	Irregular
Northern Spotted Owl	*Strix occidentalis caurina*	Known	Uncommon
Northern Saw-whet Owl	*Aegolius acadicus*	Known	Uncommon
Goatsuckers			
Common Poorwill	*Phalaenoptilus nuttallii*	Known	Uncommon
Swifts and Hummingbirds			
Vaux's Swift	*Chaetura vauxi*	Known	Uncommon
White-throated Swift	*Aeronautes saxatalis*	Known	Irregular
Anna's Hummingbird	*Calypte anna*	Known	Common
Allen's Hummingbird	*Selasphorus sasin*	Known	Common
Rufous/Allen's Hummingbird	*Selasphorus rufus/sasin*	Likely	Rare
Kingfishers			
Belted Kingfisher	*Megaceryle alcyon*	Known	Uncommon
Woodpeckers			
Acorn Woodpecker	*Melanerpes formicivorus*	Known	Common
Red-breasted Sapsucker	*Sphyrapicus ruber*	Known	Irregular
Yellow-bellied Sapsucker		Likely	Rare
Nuttall's Woodpecker	*Picoides nuttallii*	Known	Uncommon
Downy Woodpecker	*Picoides pubescens*	Known	Common
Hairy Woodpecker	*Picoides villosus*	Known	Uncommon
Northern Flicker	*Colaptes auratus*	Known	Common
Pileated Woodpecker	*Dryocopus pileatus*	Known	Uncommon

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
Tryant Flycatchers			
Olive-sided Flycatcher	*Contopus cooperi*	Known	Uncommon
Western Wood-Pewee	*Contopus sordidulus*	Known	Common
Pacific-slope (Western) Flycatcher	*Empidonax difficilis*	Known	Common
Black Phoebe	*Sayornis nigricans*	Known	Common
Ash-throated Flycatcher	*Myiarchus cinerascens*	Known	Uncommon
Western Kingbird	*Tyrannus verticalis*	Known	Uncommon
Shrikes			
Loggerhead Shrike	*Lanius ludovicianus*	Known	Rare
Vireos			
Cassin's Vireo	*Vireo cassinii*	Known	Irregular
Hutton's Vireo	*Vireo huttoni*	Known	Uncommon
Warbling Vireo	*Vireo gilvus*	Known	Irregular
Jays, Magpies, and Crows			
Steller's Jay	*Cyanocitta stelleri*	Known	Uncommon
Western Scrub-Jay	*Aphelocoma californica*	Known	Common
American Crow	*Corvus brachyrhynchos*	Known	Common
Common Raven	*Corvus corax*	Known	Common
Larks			
Horned Lark	*Eremophila alpestris*	Known	Uncommon
Swallows			
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	Known	Irregular
Purple Martin	*Progne subis*	Known	Uncommon
Tree Swallow	*Tachycineta bicolor*	Known	Common
Violet-green Swallow	*Tachycineta thalassina*	Known	Common
Bank Swallow	*Riparia riparia*	Known	Irregular
Barn Swallow	*Hirundo rustica*	Known	Common
Cliff Swallow	*Petrochelidon pyrrhonota*	Known	Uncommon
Chickadees, Titmice, and Bushtits			
Chesnut-backed Chickadee	*Poecile rufescens*	Known	Common
Oak (Plain) Titmouse	*Baeolophus inornatus*	Known	Common
Bushtit	*Psaltriparus minimus*	Known	Common
Nuthatches and Creepers			
White-breasted Nuthatch	*Sitta canadensis*	Known	Common
Red-breasted Nuthatch	*Sitta carolinensis*	Known	Uncommon
Pygmy Nuthatch	*Sitta pygmaea*	Known	Uncommon
Brown Creeper	*Certhia americana*	Known	Uncommon

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
Dippers			
American Dipper	*Cinclus mexicanus*	Known	Irregular
Wrens			
Bewick's Wren	*Thryomanes bewickii*	Known	Common
House Wren	*Troglodytes aedon*	Likely	Irregular
Pacific (Winter) Wren	*Troglodytes pacificus*	Known	Uncommon
Marsh Wren	*Cistothorus palustris*	Known	Rare
Gnatcatchers			
Blue-gray Gnatcatcher	*Polioptila caerulea*	Known	Irregular
Kinglets			
Golden-crowned Kinglet	*Regulus satrapa*	Known	Uncommon
Ruby-crowned Kinglet	*Regulus calendula*	Known	Common
Wrentits (Old World Warblers)			
Wrentit	*Chamaea fasciata*	Known	Common
Thrushes			
Western Bluebird	*Sialia mexicana*	Known	Common
Townsend's Solitaire	*Myadestes townsendi*	Known	Irregular
Swainson's Thrush	*Catharus ustulatus*	Known	Uncommon
Hermit Thrush	*Catharus guttatus*	Known	Common
American Robin	*Turdus migratorius*	Known	Common
Varied Thrush	*Ixoreus naevius*	Known	Common
Mockingbirds and Thrashers			
Northern Mockingbird	*Mimus polyglottos*	Known	Irregular
California Thrasher	*Toxostoma redivivum*	Known	Rare
Starlings and Allies			
European Starling (introduced/non-native)	*Sturnus vulgaris*	Known	Common
Waxwings			
Cedar Waxwing	*Bombycilla cedrorum*	Known	Common
Wood-Warblers			
Orange-crowned Warbler	*Oreothlypis celata*	Known	Rare
Common Yellowthroat	*Geothlypis trichas*	Likely	Irregular
Yellow Warbler	*Setophaga petechia*	Known	Irregular
Yellow-rumped Warbler	*Setophaga coronata*	Known	Rare
Black-throated Gray Warbler	*Setophaga nigrescens*	Known	Rare
Townsend's Warbler	*Setophaga townsendi*	Known	Rare
Hermit Warbler	*Setophaga occidentalis*	Known	Rare
Wilson's Warbler	*Cardellina pusilla*	Known	Uncommon

Birds Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status	Abundance
New World Sparrows and Allies			
Spotted (Rufous-sided) Towhee	*Pipilo maculatus*	Known	Uncommon
Rufous-crowned Sparrow	*Aimophila ruficeps*	Known	Rare
California (Brown) Towhee	*Melozone crissalis*	Known	Common
Chipping Sparrow	*Spizella passerina*	Likely	Irregular
Lark Sparrow	*Chondestes grammacus*	Known	Uncommon
Savannah Sparrow	*Passerculus sandwichensis*	Potential	Unknown
Grasshopper Sparrow	*Ammodramus savannarum*	Known	Rare
Fox Sparrow	*Passerella iliaca*	Known	Uncommon
Lincoln's Sparrow	*Melospiza lincolnii*	Known	Irregular
Song Sparrow	*Melospiza melodia*	Known	Uncommon
White-crowned Sparrow	*Zonotrichia leucophrys*	Known	Common
Golden-crowned Sparrow	*Zonotrichia atricapilla*	Known	Common
Sage Sparrow	*Amphispiza bellii*	Known	Irregular
Dark-eyed Junco (Oregon)	*Junco hyemalis*	Known	Common
Cardinals, Grosbeaks, and Allies			
Western Tanager	*Piranga ludoviciana*	Known	Uncommon
Black-headed Grosbeak	*Pheucticus melanocephalus*	Known	Uncommon
Lazuli Bunting	*Passerina amoena*	Known	Uncommon
Blackbirds and Allies			
Red-winged Blackbird	*Agelaius phoeniceus*	Known	Common
Western Meadowlark	*Sturnella neglecta*	Known	Uncommon
Brewer's Blackbird	*Euphagus cyanocephalus*	Known	Uncommon
Brown-headed Cowbird	*Molothrus ater*	Known	Uncommon
Hooded Oriole	*Icterus cucullatus*	Known	Uncommon
Bullock's Oriole	*Icterus bullockii*	Known	Uncommon
Finches and Allies			
Purple Finch	*Carpodacus purpureus*	Known	Uncommon
House Finch	*Carpodacus mexicanus*	Known	Uncommon
Red Crossbill	*Loxia curvirostra*	Known	Irregular
Pine Siskin	*Spinus pinus*	Known	Uncommon
Lesser Goldfinch	*Spinus psaltria*	Known	Uncommon
American Goldfinch	*Spinus tristis*	Known	Uncommon
Old World Sparrows			
House Sparrow (non-native)	*Passer domesticus*	Known	Irregular

APPENDIX F

Biological Resources Supporting Information

Butterflies Possibly Occurring on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status
Parnassians and Swallowtails		
Clodius Parnassian	*Parnassius clodius*	Unknown
Pipevine Swallowtail	*Battus philenor*	Known
Anise Swallowtail	*Papilio zelicaon*	Known
Western Tiger Swallowtail	*Papilio rutulus*	Known
Two-Tailed Swallowtail	*Papilio multicaudata*	Likely
Pale Swallowtail	*Papilio eurymedon*	Known
Whites and Sulphurs		
Checkered White	*Pontia protodice*	Unknown
Margined White	*Pieris marginalis (P. napi?)*	Unknown
Cabbage White	*Pieris rapae*	Likely
Large Marble	*Euchloe ausonides*	Unknown
Sara Orange-Tip	*Anthocaris sara*	Known
Orange Sulphur/Alfalfa	*Colias eurytheme*	Likely
California Dogface	*Colias [Zerene] eurydice*	Likely
Gossamer-wing Butterflies		
Great Copper	*Lycaena xanthoides*	Unknown
Gorgon Copper	*Lycaena gorgon*	Unknown
Purplish Copper	*Lycaena helloides*	Likely
Golden Hairstreak	*Habrodais grunus*	Known
Great Purple Hairstreak	*Atlides halesus*	Unknown
California Hairstreak	*Satyrium californica*	Unknown
Sylvan Hairstreak	*Satyrium sylvinus*	Unknown
Mountain-Mahogany Hairstreak	*Satyrium tetra*	Unknown
Hedgerow Hairstreak	*Satyrium saepium*	Known
Bramble Green Hairstreak	*Callophrys affinis*	Unknown
Brown Elfin	*Callophrys [Incisalia] augustinus*	Unknown
Moss' Elfin	*Callophrys [Incisalia] mossi*	Unknown
Gray Hairstreak	*Strymon melinus*	Unknown
Western Pygmy-Blue	*Brephidium exile*	Likely
Western Tailed-Blue	*Everes amyntula*	Likely
Spring Azure/Echo Blue	*Celastrina ladon*	Known
Dotted Blue	*Euphilotes enoptes*	Known
Silvery Blue	*Glaucopsyche lygdamus*	Likely
Boisduval's Blue	*Plebejus [Icaricia] icaroides*	Likely
Acmon Blue	*Plebejus [Icaricia] acmon*	Known

Butterflies Possibly Occurring on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Brush-footed Butterflies

Gulf Fritillary	*Agraulis vanillae*	Unknown
Field Crescent	*Phyciodes campestris (=pratensis)*	Known
Mylitta Crescent	*Phyciodes mylitta*	Known
Variable Checkerspot	*Euphydryas chalcedona*	Known
Edith's Checkerspot	*Euphydryas editha*	Likely
Satyr Comma	*Polygonia satyrus*	Known
Oreas Comma	*Polygonia oreas*	Likely
California Tortoiseshell	*Nymphalis californica*	Likely
Mourning Cloak	*Nymphalis antiopa*	Known
American Lady	*Vanessa virginiensis*	Likely
Painted Lady	*Vanessa cardui*	Likely
West Coast Lady	*Vanessa annabella*	Likely
Red Admiral	*Vanessa atalanta*	Likely
Common Buckeye	*Junonia coenia*	Known
Lorquin's Admiral	*Limenitis [Basilarchia] lorquini*	Known
California Sister	*Adelpha bredowii*	Known
Common Ringlet	*Coenonympha tullia*	Known
Common Wood Nymph	*Cercyonis pegala*	Known
Monarch	*Danaus plexippus*	Known

Skippers

Silver-Spotted Skipper	*Epargyreus clarus*	Unknown
Northern Cloudywing	*Thorybes pylades*	Unknown
Sleepy Duskywing	*Erynnis brizo*	Unknown
Propertius Duskywing	*Erynnis propertius*	Known
Mournful Duskywing	*Erynnis tristis*	Known
Pacuvius Duskywing	*Erynnis pacuvius*	Unknown
Persius Duskywing	*Erynnis persius*	Unknown
Two-Banded Checkered-Skipper	*Pyrgus ruralis*	Unknown
Small Checkered-Skipper	*Pyrgus scriptura*	Unknown
Common Checkered-Skipper	*Pyrgus communis*	Known
Northern White-Skipper	*Heliopetes ericetorum*	Unknown
Common Sootywing	*Pholisora catullus*	Unknown
Fiery Skipper	*Hylephila phyleus*	Unknown
Juba Skipper	*Hesperia juba*	Likely
Columbian Skipper	*Hesperia columbia*	Unknown
Lindsey's Skipper	*Hesperia lindseyi*	Known
Sandhill Skipper	*Polites sabuleti*	Unknown
Sachem	*Atalopedes campestris*	Unknown
Rural Skipper	*Ochlodes agricola*	Known
Woodland Skipper	*Ochlodes sylvanoides*	Known
Umber Skipper	*Poanes melane*	Known

APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status
Snakes		
Pacific Gopher Snake	*Pituophis catenifer catenifer*	Known
Western Yellow-bellied Racer	*Coluber constrictor mormon*	Known
California Kingsnake	*Lampropeltis getula californiae*	Known
Northern Rubber Boa	*Charina bottae*	Known
California Nightsnake	*Hypsiglena ochrorhyncha (torquata) nuchalata*	Likely
Sharp-tailed Snake	*Contia tenuis*	Likely
Pacific Ring-necked Snake	*Diadophis punctatus amabilis*	Known
California Striped Racer	*Coluber (=Masticophis) lateralis lateralis*	Likely
Coast Gartersnake	*Thamnophis elegans terrestris*	Known
California Red-sided Gartersnake	*Thamnophis sirtalis infernalis*	Known
Northern Pacific Rattlesnake	*Crotalus oreganus oreganus*	Known
Lizards		
Coast Range Fence Lizard	*Sceloporus occidentalis bocourtii*	Known
San Francisco Alligator Lizard	*Elgaria coerulea coerulea*	Known
California Alligator Lizard	*Elgaria multicarinata multicarinata*	Known
Skilton's Skink	*Plestiodon skiltonianus skiltonianus*	Known
Turtles		
Pacific Pond Turtle	*Actinemys marmorata*	Known
Red-eared Slider	*Trachemys scripta elegans*	Known
Frogs and Toads		
Sierran Treefrog (Pacific Treefrog)	*Pseudacris sierra (regilla)*	Known
California Toad	*Anaxyrus (Bufo) boreas halophilus*	Known
California Red-legged Frog	*Rana draytonii*	Adjacent
American Bullfrog	*Lithobates (Rana) catesbeianus*	Known
Foothill Yellow-legged Frog	*Rana boylii*	Known
Salamanders and Newts		
California Slender Salamander	*Batrachoseps attenuatus*	Known
Arboreal Salamander	*Aneides lugubris*	Known
Yellow-eyed Ensatina	*Ensatina eschscholtzii xanthoptica*	Known
Coast Range Newt	*Taricha torosa torosa*	Known
Rough-skinned Newt	*Taricha granulosa*	Known
California Giant Salamander	*Dicamptodon ensatus*	Known

APPENDIX F

Biological Resources Supporting Information

Northern Spotted Owl Memo

Summary Report for the 2014 Photo Interpretation and Floristic Reclassification of Mt. Tamalpais Watershed Forest and Woodlands Project

Birds Known or Likely to Occur on MMWD Lands

Butterflies Possibly Occurring on MMWD Lands

Reptiles and Amphibians Known or Likely to Occur on MMWD Lands

Mammals Possibly Occurring on MMWD Land

Mammals Possibly Occurring on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status
Marsupials		
Virginia Opossum	*Didelphis virginiana*	Known
Insectivores		
Ornate Shrew	*Sorex ornatus*	Likely
Vagrant Shrew	*Sorex vagrans*	Likely
Fog Shrew	*Sorex sonomae*	Likely
Trowbridge's Shrew	*Sorex trowbridgii*	Likely
American Shrew-mole	*Neurotrichus gibbsii*	Likely
Broad-footed Mole	*Scapanus latimanus*	Known
Rabbits and Rodents		
Desert Cottontail	*Sylvilagus audubonii*	Unknown
Brush Rabbit	*Sylvilagus bachmani*	Known
Black-tailed Jackrabbit	*Lepus californicus*	Known
Mountain Beaver	*Aplodontia rufa*	Unknown
Sonoma Chipmunk	*Neotamias sonomae*	Likely
Merriam's Chipmunk	*Neotamias merriami*	Unknown
Western Gray Squirrel	*Sciurus griseus*	Known
Eastern Fox Squirrel (non-native)	*Sciurus niger*	Likely
Botta's Pocket Gopher	*Thomomys bottae*	Known
California Pocket Mouse	*Chaetodipus californicus*	Unknown
Deer Mouse	*Peromyscus maniculatus*	Likely
California Mouse	*Peromyscus californicus*	Likely
Pinyon Mouse	*Peromyscus true*	Unknown
Western Harvest Mouse	*Reithrodontomys megalotis*	Unknown
Dusky-footed Woodrat	*Neotoma fuscipes*	Known
California Vole	*Microtus californicus*	Known
Common Muskrat	*Ondatra zibethicus*	Known
Norway Rat	*Rattus norvegicus*	Likely
Black Rat	*Rattus rattus*	Known
House Mouse	*Mus musculus*	Known
Pacific Jumping Mouse	*Zapus trinotatus*	Unknown
Heermann's Kangaroo Rat	*Dipodomys heermanni*	Unknown
Porcupine	*Erithizon dorsatum*	Known

Mammals Possibly Occurring on MMWD Lands (Mt. Tam, Nicasio, Soulajule)

Common Name	Scientific Name	Status
Bats		
Little Brown Myotis	*Myotis lucifugus*	Unknown
Yuma Myotis	*Myotis yumanensis*	Likely
Long-eared Myotis	*Myotis evotis*	Unknown
Fringed Myotis	*Myotis thysanodes*	Likely
Long-legged Myotis	*Myotis volans*	Likely
California Myotis	*Myotis californicus*	Known
Silver-haired Bat	*Lasionycteris noctivagans*	Likely
Big Brown Bat	*Eptesicus fuscus*	Known
Western Mastiff Bat	*Eumops perotis*	Unknown
Western Red Bat	*Lasiurus blossevillii*	Likely
Hoary Bat	*Lasiurus cinereus*	Likely
Townsend's Big-eared Bat	*Pelcotus townsendii*	Known
Pallid Bat	*Antrozous pallidus*	Known
Brazilian (Mexican) Free-tailed Bat	*Tadarida brasiliensis*	Known
Western Pipistrelle	*Pipistrellus hesperus*	Unknown
Carnivores		
Coyote	*Canis latrans*	Known
Gray Fox	*Urocyon cinereoargenteus*	Known
Red Fox (non-native)	*Vulpes vulpes*	Unknown
Ringtail	*Bassariscus astutus*	Unknown
Northern Raccoon	*Procyon lotor*	Known
Short-tailed Weasel	*Mustela erminea*	Unknown
Long-tailed Weasel	*Mustela frenata*	Known
American Mink	*Neovison vison*	Unknown
American Badger	*Taxidea taxus*	Known
Western Spotted Skunk	*Spilogale gracilis*	Unknown
Striped Skunk	*Mephitis mephitis*	Known
North American River Otter	*Lontra canadensis*	Known
Puma (Cougar, Mountain Lion)	*Puma concolor*	Known
Bobcat	*Lynx rufus*	Known
Hoofed Mammals		
Wild Pig (non-native)	*Sus scrofa*	Extirpated
Black-tailed (Mule) Deer	*Odocoileus hemionus*	Known
Cow (non-native)	*Bos taurus*	Known