

**Bird monitoring in the Muir Woods National  
Monument: summary of results from 1997 – 1999 and  
suggested long-term monitoring plan**

by

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**Abstract:** The Point Reyes Bird Observatory together with the Golden Gate National Recreation Area conducted a bird inventory and monitoring study from 1997 – 1999 in the Muir Woods National Monument, Marin County, California. Muir Woods and environs are the last contiguous stand of old-growth coast redwood (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii*) in Marin County. Baseline data on bird occurrence and abundance were documented during the course of the study. Fully 55 species were encountered. The Pacific-slope Flycatcher (*Empidonax difficilis*), a species of conservation priority, was the most common species encountered. Of special interest was documenting the breeding occupancy status of the Federally Endangered Marbled Murrelet (*Brachyramphus marmoratus*). No Marbled Murrelets were detected over the course of the study and probably did not breed in Muir Woods during the study. A repeatable long-term monitoring plan was established in order to facilitate future monitoring efforts. We recommend the continued use of point counts to monitor landbirds and two methods, shore-based surveys and radar, to monitor Marbled Murrelets.

## INTRODUCTION

Old growth coast redwood (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii*) forests are threatened and important habitat types in California and the Pacific Northwest. In Marin County, the last contiguous stand of old growth coast redwood is found in Muir Woods National Monument and environs (MUWO). Because of its close proximity to San Francisco, Muir Woods is one of the most accessible old growth redwood forests in California and as such can average 8,000 - 10,000 visitors per day during peak months.

In 1997, the Point Reyes Bird Observatory (PRBO) together with the Golden Gate National Recreation Area (GOGA) began an inventory and monitoring project of birds in Muir Woods and environs. We were primarily interested in determining the breeding status of the Federally Endangered Marbled Murrelet in MUWO, a species that relies on old growth forests for breeding.

Of equal importance was collecting baseline data on bird use and occurrence in MUWO while simultaneously establishing a standardized/repeatable monitoring program. As a result, changes in population size and/or composition can be measured over time—a *critical component to any monitoring program*.

This final report summarizes data collected from 1997 – 1999 on bird use and occurrence in MUWO and environs. In addition, we provide specific long-term monitoring guidelines.

## METHODS

### STUDY SITE

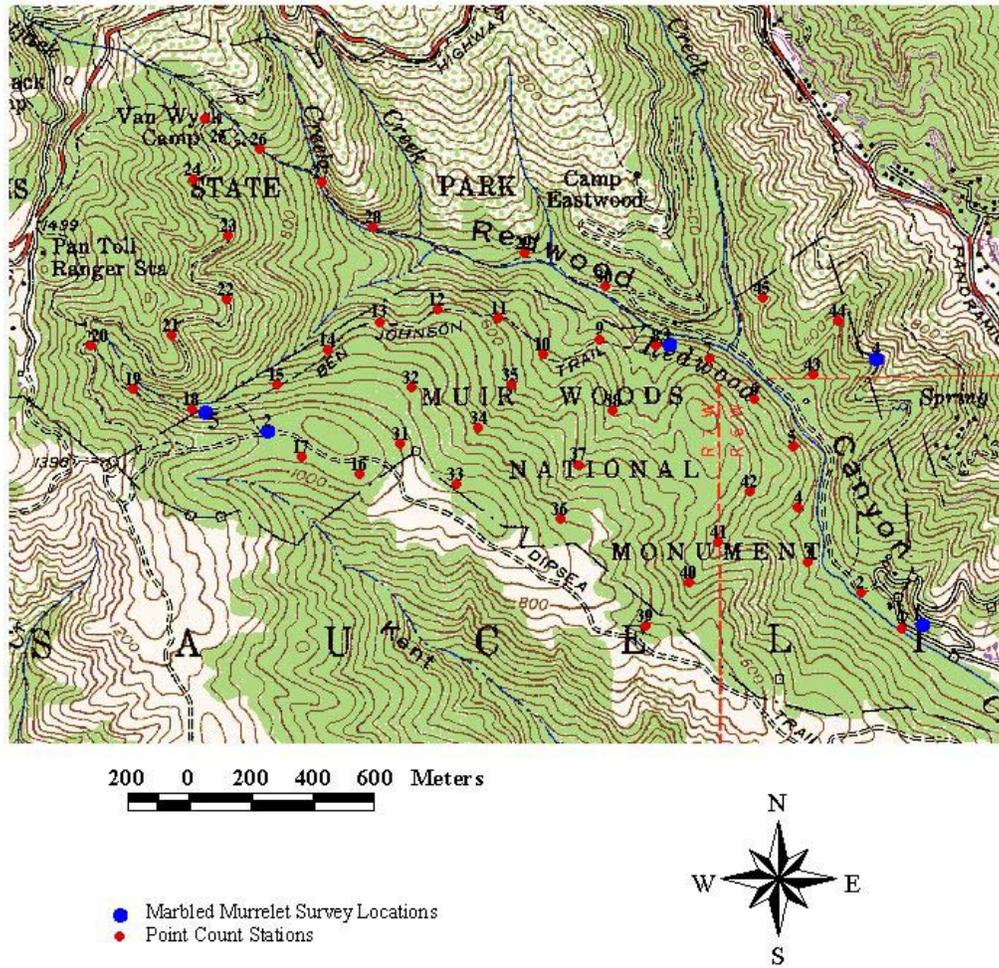
The area studied was primarily within the boundaries of Muir Woods National Monument, Marin County, California. The only exception was the census route along the TCC and the Bootjack Trails located adjacent to MUWO but owned and managed by Mt. Tamalpais State Park (Figure 1).

Old and young growth coast redwood and Douglas fir forests dominated the study site. A subcanopy of California bay (*Umbellularia californica*) and tan oak (*Lithocarpus densiflora*) was common. The bays were most often found with coast live oak (*Quercus agrifolia*) at forest edges or along moist canyons while the tan oaks were more ubiquitous.

Redwood Creek runs through MUWO and leaves the redwood forest near the visitors center; at this juncture the habitat changes into riparian forest dominated by red alder (*Alnus rubra*) and willows (*Salix* spp.), bordered by mixed oak woodlands and coastal scrub. Grasslands with pockets of coastal scrub border the western edge of MUWO.

### Muir Woods Bird Census Locations

Figure 1. Point count and Marbled Murrelet survey locations, 1997-1999.



**MARBLED MURRELETS (*Brachyramphus marmoratus*)**

Four intensive census stations were surveyed in 1997 and 1998. One new census station was established in 1998 along the Stapelveldt Trail (Figure 1; UTM coordinates in Appendix 1). The sites selected for the survey stations were in areas with large trees and an opening in the canopy to maximize the potential for visual detections of Marbled Murrelets (Nelson 1989, O'Donnell 1993, 1995).

Marbled Murrelet census methodology followed guidelines set by the Pacific Seabird Group (Ralph et al. 1994). Each station was surveyed four times throughout the breeding season. Two of the surveys for each station were conducted within the last three weeks of July, when Marbled Murrelet activity is thought to be the highest. One survey station was visited per morning. All surveys were initiated at 45 minutes before local sunrise and conducted until 75 minutes after sunrise. The survey information was recorded on data sheets provided by the Pacific Seabird Group. See Appendix 2, Tables 1-2 for a list of the dates each survey station was censused.

These surveys were not conducted in 1999 because: (1) the Pacific Seabird Group recommends two consecutive years of survey to determine occupancy, and (2) we felt that time spent investigating Marbled Murrelet occupancy by other methods (see below) had the potential to be more productive.

***Eggshell Surveys***

In 1999 Marbled Murrelet eggshell surveys were conducted around potential nest trees. We established a criterion for choosing a “nest tree” in order to reduce the subjectivity inherent in deciding which trees to survey. This criterion was based on the characteristics of known nest trees (Hamer and Nelson 1995a). For example, we only surveyed for eggshell fragments around trees with branches suitable to support a nest—there needed to be more than 1 branch that was at least 15 cm in diameter coupled with the presence of at least one of the following: moss/lichen, mistletoe, and/or deformities. See Appendix 3 (data form) for all tree variables recorded.

Surveys involved 2 observers walking and sometimes crawling around in circles radiating out from the trunk to the drip line of the tree. By having one observer follow the other we doubled our survey effort. Observers would carefully search the area under the tree and it was often necessary to pick up bits of lichen or snail shells to be sure they were not eggshell fragments. Surveys were done mid day when the lighting was optimal.

Unfortunately, not all suitable nest trees were surveyed due to time and personnel constraints. Trails surveyed include Ben Johnson, Hillside, Oceanview, Lost, Fern Creek, and Stapelveldt. We surveyed for eggshell fragments up to 50 meters away from either side of trail.

A total of 17 trees were surveyed: 14 Douglas fir and 3 coast redwood; mean diameter at breast height was 214 cm  $\pm$  9.64 SE; estimated mean tree height was 44.4 m  $\pm$  1.81 SE; mean number of limbs  $\geq$  15 cm/tree was 7.9  $\pm$  0.60 SE; 82.4% of the limbs  $\geq$  15 cm had some moss, none had mistletoe, 94% had lichen or debris, 65% showed some

deformities, 88% showed signs of decadence; canopy cover averaged  $56.25 \pm 3.63$  SE; and in all cases redwood trees dominated the surrounding area.

### ***Shore-based Surveys***

Additionally, we opportunistically conducted shore-based surveys of the sea from Muir Beach Overlook. One observer scanned the sea beyond the surf line with a 50 power spotting scope for at least 20 minutes to a distance that varied with weather conditions. We recorded all species seen (Appendix 4). A total of 9 days accumulating 4.7 hours were spent looking for Marbled Murrelets on the water. Other studies have used shore-based surveys to index at sea abundance patterns in the breeding season (Strong et al. 1995). See Recommended Monitoring Plan below.

### **POINT COUNT CENSUS**

The point count method is used to study the yearly changes of bird populations at fixed points, differences in species composition between habitats, and to assess breeding status and abundance patterns of species.

Point count methodology followed guidelines described in Ralph et al. (1993 and 1995a). In summary, we used five minute, fifty meter, fixed radius point count stations 200 meters apart. A total of 45 permanent point count stations (Figure 1; UTM coordinates in Appendix 5) were censused 3 times in each year from 1997 to 1999 (see Appendix 6, Tables 1 - 3 for a list of the dates each point count transect was visited for all years). The Ben Johnson transect (BJTR) points were numbered 1 – 15, Bootjack (BOTR) 16 – 30, and Muir Woods Off-trail (MWOT) 31 – 45. All points were permanently marked with "racetrack-shaped" aluminum tags.

### **NORTHERN SAW-WHET OWL (*Aegolius acadicus*)**

We broadcast calls of the Northern Saw-whet owl on three occasions over the course of the study. On the first occasion, 1997, we walked from the visitor center parking area up the Hillside and Ben Johnson Trails broadcasting approximately every 500 meters. Twice in 1999, we broadcast along Muir Woods road at approximately 800 m intervals beginning at Muir Beach and finishing approximately 1 km into MUWO along the Main Trail and up the Bootjack Trail.

### **VAUX'S SWIFT (*Chaetura vauxi*)**

Supplemental to the point count censuses and the Marbled Murrelet surveys we spent 9 evenings for a total of 16.4 hours looking for swifts. Marbled Murrelet census stations were used as the Vaux's Swift census stations as they offer the best view of the sky (Figure 1). Census station # 2 was especially attractive as it is in an area with a relatively high number of snags, habitat preferred by swifts for nesting (Grinnell and Miller 1944, Bull and Hohmann 1992).

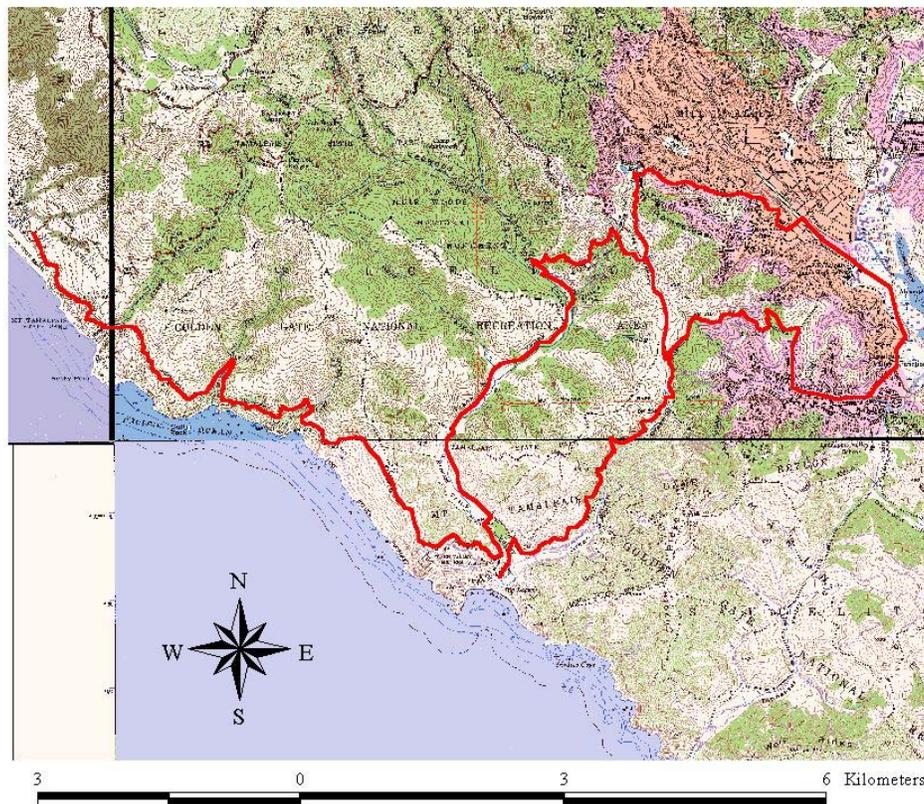
### **COMMON RAVEN (*Corvus corax*)**

Common Ravens were censused by car based on studies presented in Bibby et al. (1992). A car works especially well for large and conspicuous birds which occur at low densities, such as Common Ravens. In 1997 and 1998 survey routes and effort were mostly

opportunistic. In 1999, we collaborated with Audubon Canyon Ranch to consistently survey for ravens and American Crows (*Corvus brachyrhynchos*) over a much larger area: the San Francisco Bay area.

We surveyed for ravens and crows using a team of two, one driver and one observer, twice per month from March through June. Our survey began from a standardized starting point and was approximately 33 kilometers in length (Figure 2). We attempted to travel at speeds that ranged from 35-45 miles per hour. For each observation of Common Raven or American Crow, we recorded the following information: distance along survey route, species name, group size, flight direction, perpendicular distance and direction from road, and behavior (Kelly and Etienne 1999).

Figure 2. Common Raven survey route.



### SHARP-SHINNED HAWK (*Accipiter striatus*) AND COOPER'S HAWK (*A. cooperii*)

During the breeding season, broadcasts of tape recorded calls are useful in eliciting vocal and behavioral responses, increasing detection rates, and locating nests for these two closely related species (Rosenfield et al. 1985, 1988, Mosher et al. 1990). Playback of conspecific calls of both Sharp-shinned and Cooper's Hawks were given at the end of a normal point count census, on one visit only at each site in 1997 and 1998. Any response to the playback within five minutes was recorded separate from the normal point count census.

### **VEGETATION ASSESSMENT**

Vegetation at each point count station was assessed using a relevé, a plot of 50 meter radius centered on the census point, following the procedures outlined in Ralph et al. (1993, pp. 37-39: “Methods of Habitat Assessment: Estimation of stand characteristics”). General habitat characteristics of the site were recorded (maximum tree dbh, canopy cover, aspect). The cover, abundance, and height of each vegetation stratum (tree, shrub, herb, and bare ground) were estimated. Within each vegetation stratum the species composition was determined and each species’ relative cover estimated, as a percent of the total cover for that stratum.

### **STATISTICAL ANALYSIS**

Point count census data yielded information on relative abundance, species richness (defined as the number of species detected within 50 m) and species diversity. Species diversity measures ecological diversity based on the number of species detected within 50 meters weighted by the number of individuals of each species. A high score indicates high ecological (species) diversity. Species diversity was measured using a modification of the Shannon-Wiener index (also called Shannon-Weaver index or just Shannon index; Krebs 1989). We used a transformation of the usual Shannon-Weiner index (symbolized  $H'$ ). This transformed index, which was introduced by MacArthur (1965) is  $N_1$  where  $N_1 = 2^{H'}$ . The advantage of  $N_1$  over  $H'$  (the original Shannon-Wiener metric) is that  $N_1$  is measured in terms of species whereas  $H'$  is measured in terms of bits of information, and thus the former is more easily interpretable. Also, species diversity (measured as  $N_1$ ) and richness can be compared.

We used linear regression to examine the relationship between bird species diversity and both general and specific vegetation variables. All statistical analyses were carried out using the program STATA (STATA Corp. 1997).

### **FORMS AND DATABASES**

Copies of many of PRBO's most commonly used forms, instructions, databases, and data entry and proofing programs are available at <http://www.prbo.org/tools/tools.html>.

## RESULTS AND DISCUSSION

### SPECIES LIST

Fully 55 species were recorded within the study area (see annotated list Appendix 7). In addition, Appendix 8 summarizes the information in the annotated list as well as presents information on conservation status: Species of Management Concern as defined by the Office of Migratory Bird Management of the U.S. Fish and Wildlife Service (1995) are in **bold**; High priority species as defined by Partners in Flight species prioritization process (Carter et al. 2000) and adopted by the Audubon WatchList program (Muehler 1998) are underlined; Federally threatened species are marked with an asterisk\*.

Both lists are based upon information summarized from all three years of study and uses data gathered by standardized surveys as well as incidental observations. Breeding status and frequency of occurrence (percent of points the species was detected at within a 50-meter radius; average of all three years) are presented.

### MARBLED MURRELET

No Marbled Murrelets were detected by any method for all three years of the study. In addition, we found no Marbled Murrelet eggshells although we did find eggshell fragments for two passerine species.

Many lines of evidence suggest that Marbled Murrelets do not breed in MUWO:

- 1) At least 2 published studies of offshore distribution and abundance reported no Marbled Murrelets in waters adjacent to MUWO during the breeding season (Briggs et al. 1987, Ralph and Miller 1995).
- 2) Our 1997 and 1998 surveys for breeding season occupancy in MUWO detected no murrelets.
- 3) Our 1999 shore-based surveys detected no murrelets in the nearshore waters off of Muir Beach.
- 4) Our 1999 eggshell surveys failed to locate any murrelet eggshells.
- 5) Anecdotal observations suggest that relatively few trees in MUWO appear to possess suitable nest site characteristics (Gardali pers. obs.).
- 6) An unpublished report summarizing bird occurrence at Muir Beach in 1994 and 1995 (including waters out to 200 m) did not detect any murrelets (Stallcup 1995).

However, if Marbled Murrelets occur in low densities or are not present in some years (such as El Niño; Ralph et al. 1994) it is possible our survey efforts may not have been sufficient. See Recommended Management Plan below.

### VAUX'S SWIFT

No Vaux's Swifts were detected during any of the various censuses during the three years of study indicating that they were probably not present in Muir Woods during the breeding season. Typically communal during the breeding season, it is unlikely that nesting Vaux's Swifts would go undetected.

Vaux's Swifts have never been confirmed nesting in Marin County, but breeding has been assumed by its presence in the nesting season (Shuford 1993).

Grinnell and Miller (1944) suggest that hollow burnt out tree trunks seem to be a "prerequisite" for the occurrence of Vaux's Swifts as breeders. Bull and Cooper's (1991) data also showed the importance of hollow trees especially those with holes created by Pileated Woodpeckers. Field observations revealed very few trees that appeared to possess suitable nest substrate qualities (Gardali pers. obs.).

#### **SHARP-SHINNED AND COOPER'S HAWKS**

No Sharp-shinned or Cooper's Hawks were detected during any of the playback censuses indicating no territorial pairs were present near our survey points. It is not surprising that neither Sharp-shinned nor Cooper's Hawks responded to broadcast calls, as both prefer non-old growth habitat types for breeding (see Shuford 1993 for review).

#### **COMMON RAVEN**

Common Ravens have been significantly increasing in California from 1966 to 1998 (Sauer et al. 1999) probably due to their ability to exploit a variety of food sources (e.g., picnic areas) and nest sites (e.g., telephone poles) associated with human-dominated landscapes (Boarman 1993, Marzluff et al. 1994). Common Ravens are opportunistic nest predators and may adversely affect some populations, especially those already vulnerable (Littlefield 1995). Common Ravens are known predators of Marbled Murrelets (Nelson and Hamer 1995) and may influence their presence or absence in MUWO. In addition, there has recently been local concern over the impact of raven predation on Snowy Plovers (*Charadrius alexandrinus*) and Common Murres (*Uria aalge*) (Roth et al. 1999).

The route we surveyed is near MUWO and may represent general abundance patterns in the landscape that includes MUWO. Preliminary results (Kelly and Etienne 1999) show that our survey route (out of a total of 18) had the third highest index of Common Ravens (0.24/km) and the fourth highest index of American Crows (0.32/km).

#### **NORTHERN SAW-WHET OWL**

No Northern Saw-whet Owls were detected during any type of censuses in the three years of study in MUWO. However, they were detected downstream on Redwood Creek where riparian vegetation dominates. This is not surprising as they rely on existing woodpecker nest cavities usually from Northern Flickers (*Colaptes auratus*) and Pileated Woodpeckers and have a general habitat preference for riparian areas (Cannings 1993). Both Northern Flickers and Pileated Woodpeckers have been documented breeding in the riparian portion of Redwood Creek below MUWO. Northern Flickers are more abundant in this area as well (Gardali and Geupel 1997). Saw-whet Owls were detected within MUWO during National Park Service Spotted Owl surveys in 1999 (Hatch pers. comm.).

#### **POINT COUNT DATA**

The number of individuals of each species detected within 50 meters during censuses is listed by site and year in Appendix 9. Pacific-slope Flycatchers were the most abundant species in MUWO detected at 93.33% of the census points. Other common species

include Winter Wrens (65.18%), Chestnut-backed Chickadees (56.29%), Golden-crowned Kinglets (54.07%), Brown Creepers (46.66%), and Dark-eyed Juncos (30.37%).

Data from point count surveys are summarized in Table 1 for all years of the study. Cumulative bird species diversity is simply a measure of diversity (see Methods, above) using all points in the transect. In two of the three years, species diversity was highest on the Bootjack transect, although the differences were not significant (all  $P > 0.05$ ).

**Table 1. Cumulative species diversity and richness for all species detected within 50 meters, 1997 - 1999.**

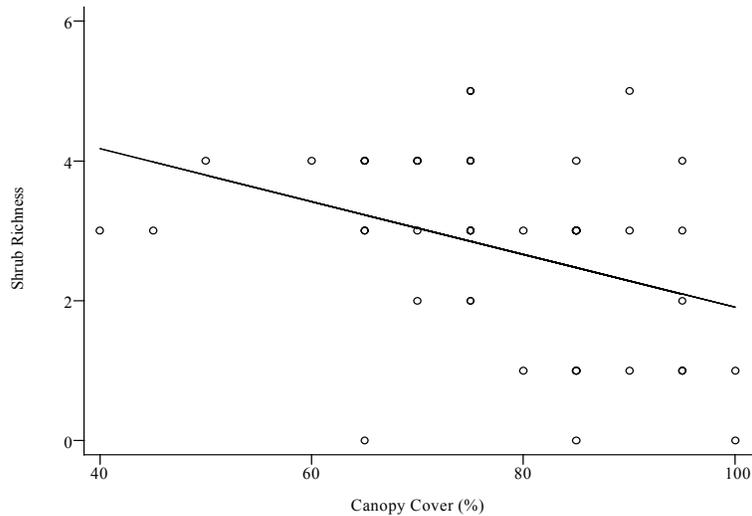
Station	1997		1998		1999	
	Cumulative Diversity	Species Richness	Cumulative Diversity	Species Richness	Cumulative Diversity	Species Richness
Ben Johnson	10.46	21	8.76	19	11.25	23
Bootjack	12.18	24	16.68	25	15.08	24
Off-trail	13.17	24	12.96	22	13.94	27

General vegetation variables correlated with bird diversity are presented in Table 2. Bird species diversity tended to decline with various measures of the shrub community, especially shrub species richness. Shrub richness increased as canopy cover decreased (Figure 3) and thus bird diversity may be lower because species primarily found within the canopy or associated with trees (e.g., Black-throated Gray Warblers and Brown Creepers) may not be present within 50 meters.

**Table 2. General vegetation variables correlated with bird species diversity (ns = not significant), 1997 – 1999.**

Variable	Correlation Coefficient	Significance Level
Herb richness	0.19	Ns
Shrub richness	-0.007	$P < 0.001$
Tree richness	-0.14	Ns
Herb cover	-0.002	Ns
Shrub cover	-0.02	$P = 0.05$
Tree cover	0.0004	Ns
Trail cover	-0.033	Ns
Stream cover	-0.17	$P = 0.05$
Litter cover	0.014	Ns
Low tree height	0.052	Ns
Min tree dbh	-0.061	Ns
Max tree dbh	-0.0029	Ns
Low shrub height	0.26	Ns
High shrub height	-0.198	$P = 0.03$
Low herb height	-0.018	Ns
High herb height	0.63	Ns

**Figure 3. Relationship between shrub species richness and canopy cover ( $P = 0.01$ ,  $r^2 = 0.12$ ,  $\beta = 0.04$ ).**



Specific vegetation variables correlated with bird diversity are presented in Table 3. The Bootjack transect had the highest species diversity in two of the three years and differs from the others in that Douglas firs, rather than redwoods, were the dominate trees. In fact there were significantly more Douglas fir on the Bootjack transect than on Ben Johnson ( $P < 0.001$ ) and the off-trail points ( $P < 0.001$ ). In addition, Douglas fir cover was nearly significantly positively correlated with bird species diversity (Table 3).

**Table 3. Specific vegetation variables (4 of 36 tested) that were significantly correlated with bird species diversity, 1997 - 1999.**

Variable	Correlation Coefficient	Significance Level
California blackberry	0.065	$P = 0.008$
Douglas fir	0.0117	$P = 0.06$
Tan oak	-0.020	$P = 0.003$
Toyon	0.094	$P = 0.03$

## RECOMMENDED MONITORING PLAN

### LANDBIRDS

We recommend the continued use of the point count method to monitor landbird populations. Specifically, the Bootjack and Ben Johnson transects should be censused a minimum of once every three years or, ideally, annually as funds allow. We do not recommend continued census of the “off-trail” points due to the difficulty of relocating the census stations.

#### *Instructions on the Point Count Method*

General instructions of the point count method are provided in the “Handbook of Field Methods for Monitoring Landbirds” (pages 29-35 in Ralph et al. 1993; enclosure). PRBO-specific guidelines as well as protocols that deviate from the handbook are listed below. Only observers trained in vocal and visual identification of bird in MUWO should conduct point count censuses.

1. Point count censuses should be conducted three times in the breeding season. Once in May and twice in June.
2. Allow approximately 2 weeks between censuses within a season.
3. Use a PRBO data form (<http://www.prbo.org/tools/tools.html>).
4. Duration of each census (i.e., at each point) should be 5 minutes.
5. Detections should be classified as S = song, V = visual, and C = call, in that order of priority. Therefore, if an individual is initially detected visually but then is heard singing, the record should be changed from “V” to “S”.

#### *Vegetation Assessment*

We recommend collecting vegetation data (the relevé method) at each point count station once every three years. General instructions of the relevé method are provided in the “Handbook of Field Methods for Monitoring Landbirds” (pages 37-39 in Ralph et al. 1993; enclosure). PRBO-specific guidelines as well as protocols that deviate from the handbook are listed below.

1. Identify plants in the herbaceous layer to species.
2. Estimate vegetation cover as a percent, do not use the “scale” suggested in Ralph et al. 1993.

#### *About the Point Count Method*

A priority of any monitoring project should be to assess population size and composition over time. The point count method is well suited to meet these objectives. This method readily provides an index of abundance, documents species composition among habitats and over time, and determines breeding status. In addition, this method is “data rich” allowing for the collection of many data points with *relatively* little effort. It should be noted that while the point count method can determine population trends it cannot explain their causation.

The objective of point count vegetation assessment is to relate the changes in bird composition and abundance to differences in vegetation. These vegetation changes can either be over time or due to differences between habitats or study sites.

### ***On-line Data Forms, Databases, and Instructions***

Copies of many of PRBO's most commonly used forms, instructions, databases, and data entry and proofing programs are available at <http://www.prbo.org/tools/tools.html>.

### ***Analyses***

A statistical guide to data analysis of avian monitoring programs (Nur et al. 1999) is available from PRBO or the U.S. Fish and Wildlife Service Biological Technical Publication R6001-1999 (<http://www.fws.gov>).

### **MARBLED MURRELET**

Muir Woods has proven a difficult site to assess occurrence of Marbled Murrelets in the breeding season because of the lack of suitable survey locations. For this reason we recommend two methods better suited to the task (one direct and one indirect).

The first method, *Shore-based Survey*, will efficiently provide indirect evidence of breeding occurrence. The assumption being that the occurrence of murrelets in nearshore waters during the breeding season may indicate the use of MUWO for breeding (Ralph et al. 1995b). If at any time in the future Marbled Murrelets are detected using this method, immediate use of *Radar* (see below) within MUWO is recommended to determine breeding occupancy status. *Radar* may be the best method to determine breeding occupancy in MUWO.

### ***Shore-Based Survey Method***

Conduct shore-based surveys from Muir Beach Overlook twice a month annually during the peak of the Marbled Murrelet breeding season in California, May – July (Hamer and Nelson 1995). Because the goal is to document occurrence at sea during the breeding season and not to estimate population size, the number of observers and the frequency and duration of the survey need not be standardized.

Observer(s) should be equipped with a spotting scope of at least 20 power to carefully scan the sea beyond the surf line. Information to be recorded includes location, time start/end (at least 20 minutes), weather, and observation conditions (visibility), and numbers of all species seen. Only those observers confident in the field identification of murrelets should conduct the shore-based surveys.

### ***Radar***

Radar has advantages over ground-based surveys in that it does not rely on murrelets to vocalize for detection and can detect murrelets over a large area regardless of environmental conditions or observer ability (Hamer et al. 1995).

For information on the use of radar for Marbled Murrelet studies see Hamer et al. (1995). For radar survey services contact: Hamer Environmental, 19997 Highway 9, Mt Vernon, WA 98274, phone/fax = 360.422.6510, e-mail = hamert@aol.com.

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**Appendix 1. UTM coordinates of Marbled Murrelet survey locations in Muir Woods National Monument. Locations were estimated using field notes and topographic map. See also Figure 1.**

Trail Name/Area	Station #	Easting	Northing
Parking lot	1	537670	4193993
Dipsea	2	535565	4194616
Hillside	3	536852	4194895
Oceanview	4	537524	4194851
Stapelveldt	5	535359	4194682

**Appendix 2. Marbled Murrelet census dates, 1997-1998.**

**Table 1. Marbled Murrelet census dates in 1997 by station.**  
Census dates 1997

Station #	Visit #1	Visit # 2	Visit # 3	Visit # 4
1	May 25	June 26	July 10	July 20
2	May 26	June 27	July 11	July 21
3	May 27	June 28	July 13	July 22
4	May 29	June 29	July 14	July 23
5	May 30	June 30	July 15	July 24

**Table 2. Marbled Murrelet census dates in 1998 by station.**  
Census dates 1998

Station #	Visit #1	Visit # 2	Visit # 3	Visit # 4	Visit # 5
1	April 22	May 28	June 28	July 11	July 30
2	April 27	May 27	June 26	July 29	July 31
3	April 28	May 29	June 24	July 25	July 28
4	April 29	May 30	June 27	July 12	July 27

**Appendix 3. Data form showing variables measured around trees surveyed for Marbled Murrelet eggshell fragments.**

PRBO, Marbled Murrelet Eggshell Survey 1999

Tree Species								
Dbh (cm)								
Tree height (m)								
Tree condition	-	-	-	-	-	-	-	-
Alive/healthy								
Declining								
# limbs > 15 cm								
Limb condition	-	-	-	-	-	-	-	-
Alive/healthy								
Declining								
Moss index <sup>1</sup>								
Mistletoe index <sup>2</sup>								
Lichen/debris <sup>3</sup>								
Deformities <sup>3</sup>								
Decadence <sup>3</sup>								
Canopy cover (50 m)								
Dom. Sur. Tree sp.								
MAMU eggshells								
Trail name								
Date								

<sup>1</sup>Moss index: 0 = None, 1 = trace, 2 = 1-24%, 3 = 25-49%, 4 = 50-100%.

<sup>2</sup>Mistletoe index: 0 = None, 1 = < 1/3 of branches, 2 = > 1/3 of branches.

<sup>3</sup>0 = None, + = present, ++ = abundant

**Appendix 4. Bird species and number by date detected during the Marbled Murrelet shore-based surveys, 1999.**

Common name	Scientific name	Date								
		4/30	5/6	5/11	5/19	5/23	5/31	6/19	7/8	7/28
Common Loon	<i>Gavia immer</i>	1	1	1	0	0	0	0	0	0
Pacific Loon	<i>Gavia pacifica</i>	0	0	0	6	38	1	0	0	0
Red-throated Loon	<i>Gavia stellata</i>	3	0	2	4	6	0	0	0	0
Western Grebe	<i>Aechmophorus occidentalis</i>	215	16	10	31	2	4	0	7	0
Clark's Grebe	<i>Aechmophorus clarkii</i>	0	1	0	0	0	0	0	0	0
Brown Pelican	<i>Pelecanus occidentalis</i>	0	0	0	1	1	82	66	282	64
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	0	1	0	0	0	0	0	0	2
Pelagic Cormorant	<i>Phalacrocorax pelagicus</i>	0	0	0	2	3	1	6	3	0
Great Egret	<i>Casmerodius albus</i>	0	0	2	0	0	0	0	0	0
Surf Scoter	<i>Melanitta perspicillata</i>	5	23	0	4	19	0	0	0	0
Black Oystercatcher	<i>Haematopus bachmani</i>	0	0	0	0	0	1	0	0	1
Long-billed Curlew	<i>Numenius americanus</i>	0	1	0	0	0	0	0	0	0
Sandpipers, unknown	<i>Calidris</i> sp.	0	3	0	0	0	0	0	0	0
Heerman's Gull	<i>Larus heermanni</i>	0	0	0	0	0	0	0	26	137
Western Gull	<i>Larus occidentalis</i>	2	9	8	8	3	16	4	5	104
Glaucous-winged Gull	<i>Larus glaucescens</i>	0	1	0	0	0	0	1	0	0
Black-legged Kittiwake	<i>Rissa tridactyla</i>	0	2	0	0	0	0	0	0	0
Caspian Tern	<i>Sterna caspia</i>	0	2	1	3	0	2	2	6	3
Common Murre	<i>Uria aalge</i>	0	0	0	12	2	0	11	17	498
Pigeon Guillemot	<i>Cepphus columba</i>	8	1	3	7	7	12	4	8	6

**Appendix 5. UTM coordinates of bird survey point count locations in Muir Woods National Monument. Locations were estimated using field notes and topographic map (see Figure 1).**

Transect Name	Station #	Easting	Northing
Ben Johnson Trail	1	537609	4193981
	2	537476	4194094
	3	537306	4194191
	4	537273	4194369
	5	537257	4194567
	6	537132	4194721
	7	536986	4194851
	8	536816	4194891
	9	536634	4194912
	10	536452	4194863
	11	536310	4194980
	12	536112	4195009
	13	535925	4194968
	14	535759	4194879
	15	535597	4194766
Bootjack Trail	16	535861	4194478
	17	535674	4194531
	18	535322	4194685
	19	535132	4194750
	20	534994	4194891
	21	535257	4194924
	22	535432	4195041
	23	535440	4195247
	24	535326	4195426
	25	535363	4195620
	26	535541	4195523
	27	535739	4195417
	28	535905	4195272
	29	536391	4195187
30	536654	4195082	
Muir Woods Off Trail	31	535994	4194576
	32	536027	4194754
	33	536172	4194446
	34	536245	4194624
	35	536350	4194766
	36	536508	4194333
	37	536569	4194507
	38	536678	4194681
	39	536783	4193989
	40	536921	4194126
	41	537018	4194260
	42	537119	4194422
	43	537322	4194798
	44	537403	4194972
	45	537160	4195045

## Appendix 6. Point count census dates, 1997-1999.

### Table 1. Point count census dates in 1997 by site.

Census dates 1997

Site (point numbers)	Visit # 1	Visit # 2	Visit # 3
Ben Johnson Trail (1-15)	May 4	June 4	June 19
Bootjack Trail (16-30)	May 7	June 10	June 25
Muir Woods off-trail (31-45)	May 6	June 7	June 24

### Table 2. Point count census dates in 1998 by site.

Census dates 1998

Site (point numbers)	Visit # 1	Visit # 2	Visit # 3
Ben Johnson Trail (1-15)	May 6	June 4	June 15
Bootjack Trail (16-30)	May 8	June 2	June 16
Muir Woods off-trail (31-45)	May 14	June 8	June 23

### Table 3. Point count census dates in 1999 by site.

Census dates 1999

Site (point numbers)	Visit # 1	Visit # 2	Visit # 3
Ben Johnson Trail (1-15)	May 12	May 27	June 30
Bootjack Trail (16-30)	May 12	June 8	June 28
Muir Woods off-trail (31-45)	May 13	June 10	June 29

## Appendix 7. Annotated bird list.

List of species detected in Muir Woods National Monument and vicinity (see Methods; Study Site; Figure 1) from mid-March to mid-July, 1997-1999. The number in parentheses following the species scientific name is the percent of points the species was detected at within a 50-meter radius (average of all three years).

Abundance status was the most subjective variable for species not well sampled by point counts such as raptors, swallows, swifts, crows, and ravens.

Breeding status was determined by pooling a variety of sources and follows Shuford (1993). In general, “possible breeder” refers to species encountered in the breeding season in appropriate habitat, “probable breeder” was assigned to those species apparently holding territories, and “confirmed breeder” refers to those individuals that we observed engaging in breeding activities such as nest building. All other species are given “no evidence of breeding” because they did not fit any of the above criteria.

**Mallard** (*Anas platyrhynchos*) (0.74%) Rare; no evidence of breeding. Only detected on one occasion in Redwood Creek near the main entrance to the monument at deciduous riparian (where this species breeds) and old growth redwood ecotone.

**Turkey Vulture** (*Cathartes aura*) (2.2%) Uncommon but regular (overhead); possible breeder. Notoriously secretive nesting habits makes breeding conformation difficult. Two individuals, presumably a pair, observed perched low (< 15) in canyon bottom with Redwood overstory. Frequently drifted overhead.

**Sharp-shinned Hawk** (*Accipiter striatus*) (2.2%) Uncommon; no evidence of breeding. Playback surveys (see Methods) did not elicit any response. All individuals encountered were likely transients passing through or dispersing immatures.

**Cooper’s Hawk** (*Accipiter cooperii*) Rare; no evidence of breeding. One adult was seen flying from Kent Canyon to the forest edge of Muir Woods near the upper junction of the Deer Park Fire Road and the Dipsea Trail on June 7, 1997.

**Red-shouldered Hawk** (*Buteo lineatus*) Rare; no evidence of breeding. One individual in juvenal plumage was observed on the Bootjack Trail, 1999.

**Red-tailed Hawk** (*Buteo jamaicensis*) (2.2%) Uncommon but regular; confirmed breeder. One active nest was located in 1997 and again at the same location in 1999. Nest was in a redwood tree near forest ecotone with open meadow (Deer Park Fire Road).

**California Quail** (*Callipepla californica*) (0.74%) Rare; possible breeder. Never detected in forest interior. It is probable that this species breeds at edges of MUWO.

**Band-tailed Pigeon** (*Columba fasciata*) (14.81%) Common; confirmed breeder. Nesting activity was observed all three years and ranged from courtship displays to nest material carries to active nests. Nests located were in tan oak and huckleberry.

**Mourning Dove** (*Zenaidura macroura*) (2.96%) Uncommon; confirmed breeder. Nest located in willow on Bootjack trail.

**Spotted Owl** (*Strix occidentalis*) confirmed breeder.

**White-throated Swift** (*Aeronautes saxatalis*) Uncommon but regular; no evidence of breeding. Observed in small numbers foraging overhead.

**Anna’s Hummingbird** (*Calypte anna*) (7.40%) Uncommon but regular; possible breeder. Nesting activity never observed.

**Allen's Hummingbird** (*Selasphorus sasin*) (26.66%) Common; confirmed breeder. Detected in forest interior as well as near edges. Nest located in small Douglas fir (approx. 19 m) at a height of approximately 17 m with huckleberry dominating understory.

**Belted Kingfisher** (*Ceryle alcyon*) (0.74%) Uncommon but regular; no evidence of breeding. Only observed using Redwood Creek for foraging.

**Acorn Woodpecker** (*Melanerpes formicivorus*) (1.48%) Rare but regular; confirmed breeder. One pair observed consistently using same nest tree on Ben Johnson trail for all three years of study. Nest located by observing food carries to nest cavity in dead Douglas fir.

**Downy Woodpecker** (*Picoides pubescens*) (4.44%) Uncommon but regular; probable breeder.

**Hairy Woodpecker** (*Picoides villosus*) (4.44%) Common; confirmed breeder. Observed dependent young. More common than Downy Woodpecker despite being detected at the same percentage of points.

**Red-shafted Flicker** (*Colaptes auratus cafer*) (0.74%) Uncommon but regular; confirmed breeder by food carry.

**Pileated Woodpecker** (*Dryocopus pileatus*) (2.96%) Uncommon but regular; probable breeder. A pair was observed foraging together on Hillside trail.

**Pacific-slope Flycatcher** (*Empidonax difficilis*) (93.33%) Common; confirmed breeder. This flycatcher was ubiquitous throughout the study area in all years. The most commonly encountered species as evidenced by point counts. Breeding status was determined by nest-material carries as well as the location of an active nest. The nest was tucked into a piece of bark that had slightly pulled away on a large Douglas Fir (dbh = 240 cm).

**Black Phoebe** (*Sayornis nigricans*) Rare; possible breeder. This species often nests on bridges and other structures and so the potential to nest in and around MUWO is great. However, we found no evidence of breeding.

**Ash-throated Flycatcher** (*Myiarchus cinerascens*) Rare; probable breeder. This species was never encountered within the interior of the woods and is probably restricted to the open edges.

**Hutton's Vireo** (*Vireo huttoni*) (2.96%) Uncommon but regular; probable breeder. This species was only found at forest edges dominated by oaks and bays.

**Warbling Vireo** (*Vireo gilvus*) (11.85%) Uncommon but regular; confirmed breeder. Similar to Hutton's Vireo, the species was only found at edges dominated by oaks and bays. Breeding was confirmed by observation of a food carry.

**Steller's Jay** (*Cyanocitta stelleri*) (20%) Common; confirmed breeder. This species is found throughout the area from the depths of the forest to the edges, where it seems equally at home in the parking lot. We discovered dependent young being fed by adults and we located an old nest. On occasion we observed this species utilizing the main parking lot to feed on trash left by visitors. We suspect that visitors intentionally feed Steller's Jays in Muir Woods.

**American Crow** (*Corvus brachyrhynchos*) (0.74%) Uncommon but regular; possible breeder at forest edges. Never encountered in forest interior.

**Common Raven** (*Corvus corax*) (6.66%) Uncommon but regular; probable breeder at forest edges.

**Tree Swallow** (*Tachycineta bicolor*) (0.74%) Uncommon but regular (overhead); confirmed breeder. Nest located in snag (species unknown).

**Violet-green Swallow** (*Tachycineta thalassina*) Uncommon but regular (overhead); possible breeder.

**Northern Rough-winged Swallow** (*Stelgidopteryx serripennis*) Rare (overhead); no evidence of breeding.

**Cliff Swallow** (*Hirundo pyrrhonota*) Uncommon but regular (overhead); no evidence of breeding.

**Barn Swallow** (*Hirundo rustica*) Uncommon but regular (overhead); no evidence of breeding.

**Chestnut-backed Chickadee** (*Parus rufescens*) (56.29%) Common; confirmed breeder. Always present in the interior as well as at forest edges. Evidence of breeding from food carries, dependant young, and nests.

**Red-breasted Nuthatch** (*Sitta canadensis*) (2.22%) Uncommon; probable breeder.

**Pygmy Nuthatch** (*Sitta pygmaea*) (9.62%) Uncommon but regular; confirmed breeder. Observed fledgling being fed by both parents atop a Douglas fir.

**Brown Creeper** (*Certhia americana*) (46.66%) Common; confirmed breeder. Observed food carry.

**Bewick's Wren** (*Thryomanes bewickii*) (0.74%) Rare; possible breeder. This species is primarily found at forest edges and/or open areas with developed understories.

**Winter Wren** (*Troglodytes troglodytes*) (65.18%) Common; confirmed breeder. This species occupies dark moist forests and can be easily found throughout MUWO most often near water. Breeding was confirmed by observations of individuals with nesting material and food carries to dependent young.

**Golden-crowned Kinglet** (*Regulus satrapa*) (54.07%) Common; confirmed breeder. A true denizen of Redwood and Douglas fir forests, this species was observed building a nest near the visitor's center.

**Swainson's Thrush** (*Catharus ustulatus*) (1.48%) Uncommon; probable breeder. This species was only detected near the parking area where alder trees dominated. This species is a common breeder on the lower portions of Redwood Creek.

**Hermit Thrush** (*Catharus guttatus*) (11.85%) Common; confirmed breeder. This species replaces Swainson's Thrush in the forest interior. Observed nesting material carry but did not locate nest.

**American Robin** (*Turdus migratorius*) (16.29%) Common; confirmed breeder. Conspicuous nests, food carries, and young begging for food observed.

**Wrentit** (*Chamaea fasciata*) (2.22%) Uncommon but regular; probable breeder. In MUWO this species occupies open areas with a well-developed shrub layer.

**Orange-crowned Warbler** (*Vermivora celata*) (4.44%) Uncommon; possible breeder. Not a forest interior species, this warbler was only detected at edges and open areas with sufficient ground cover for nesting.

**Yellow-rumped Warbler** (*Dendroica coronata*) (0.74%) Rare; confirmed breeder. Detected almost entirely in areas dominated by Douglas fir at uppermost edge of study area (nearing Pantoll Ranger Station). A single food carry event was observed in 1999 on the TCC Trail.

**Black-throated Gray Warbler** (*Dendroica nigrescens*) (6.66%) Uncommon but regular; probable breeder. Song often heard but bird rarely seen. In MUWO, this warbler is found primarily in the mixed evergreen forests dominated by Douglas fir.

**Hermit Warbler** (*Dendroica occidentalis*) (0.74%) Rare; confirmed breeder. This warbler was found in areas dominated by large Douglas firs. Although we first detected this species in 1999 it is probable that it

occurred in very low densities all years of study. Observed one case of male and female Hermit Warblers repeatedly carrying food to nest. Nest was roughly 40 m up a large Douglas fir (dbh approx. 90 cm).

**Wilson's Warbler** (*Wilsonia pusilla*) (33.33%) Common; confirmed breeder. The most abundant warbler in MUWO, occurring in the understory where sword fern and huckleberry are common. Wilson's Warblers were observed feeding dependent fledglings and one nest under construction was located at the base of a sword fern (*Polystichum munitum*) on steep slope.

**Spotted Towhee** (*Pipilo maculatus*) (6.66%) Uncommon but regular; confirmed breeder. Mostly found in open areas with well developed understory.

**California Towhee** (*Pipilo crissalis*) (0.74%) Rare; probable breeder. This edge-associated species was only detected near parking area.

**Song Sparrow** (*Melospiza melodia*) (1.48%) Rare; probable breeder. This species was detected almost entirely at forest edges with coastal scrub or riparian habitats.

**Dark-eyed Junco** (*Junco hyemalis*) (30.37%) Common; confirmed breeder. This species was found at edges as well as forest interior. Breeding was confirmed by the observation of food carries to dependent young.

**Purple Finch** (*Carpodacus purpureus*) (17.77%) Common; probable breeder. This species was rarely seen but often heard singing from the canopy.

**Red Crossbill** (*Loxia curvirostra*) (0.74%) Rare; no evidence of breeding. Unpredictable breeding habits (vary annually as well as seasonally) make assessing their breeding status difficult.

**Pine Siskin** (*Carduelis pinus*) (8.14%) Uncommon but regular; probable breeder.

**American Goldfinch** (*Carduelis tristis*) Rare; no evidence of breeding. Only detected flying overhead.

## Appendix 8. Species list.

Species of Management Concern as defined by the Office of Migratory Bird Management of the U.S. Fish and Wildlife Service (1995) are in **bold**. High priority species as defined by Partners in Flight species prioritization process (Carter et al. 2000) and adopted by the Audubon WatchList program (Muehter 1998) are underlined. Federally threatened species are marked with an asterisk\*. Percent (%) of points the species was detected at within a 50-meter radius (average of all three years).

Common Name	Scientific Name	No Evidence	Breeding Status			%
			Possible	Probable	Confirmed	
Mallard	<i>Anas platyrhynchos</i>	X				0.74
Turkey Vulture	<i>Cathartes aura</i>		X			2.2
Sharp-shinned Hawk	<i>Accipiter striatus</i>	X				2.2
Cooper's Hawk	<i>Accipiter cooperii</i>	X				-
<b>Red-shouldered Hawk</b>	<i>Buteo lineatus</i>	X				-
Red-tailed Hawk	<i>Buteo jamaicensis</i>				X	2.2
<u>California Quail</u>	<i>Callipepla californica</i>		X			0.74
<u>Band-tailed Pigeon</u>	<i>Columba fasciata</i>				X	14.81
Morning Dove	<i>Zenaidura macroura</i>				X	2.96
<b>Northern Spotted Owl*</b>	<i>Strix occidentalis caurina</i>				X	-
White-throated Swift	<i>Aeronautes saxatalis</i>	X				-
Anna's Hummingbird	<i>Calypte anna</i>		X			7.40
<u>Allen's Hummingbird</u>	<i>Selasphorus sasin</i>				X	26.66
Belted Kingfisher	<i>Ceryle alcyon</i>	X				0.74
Acorn Woodpecker	<i>Melanerpes formicivorus</i>				X	1.48
Downy Woodpecker	<i>Picoides pubescens</i>			X		4.44
Hairy Woodpecker	<i>Picoides villosus</i>				X	4.44
Red-shafted Flicker	<i>Colaptes auratus cafer</i>				X	0.74
Pileated Woodpecker	<i>Dryocopus pileatus</i>			X		2.96
<u>Pacific Slope Flycatcher</u>	<i>Empidonax difficilis</i>				X	93.33
Black Phoebe	<i>Sayornis nigricans</i>		X			-
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>			X		-
Hutton's Vireo	<i>Vireo huttoni</i>			X		2.96
Warbling Vireo	<i>Vireo gilvus</i>				X	11.85
Steller's Jay	<i>Cyanocitta stelleri</i>				X	20
American Crow	<i>Corvus brachyrhynchos</i>		X			0.74
Common Raven	<i>Corvus corax</i>			X		6.66
Tree Swallow	<i>Tachycineta bicolor</i>				X	0.74
Violet-green Swallow	<i>Tachycineta thalassina</i>		X			-
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	X				-
Cliff Swallow	<i>Hirundo pyrrhonota</i>	X				-
Barn Swallow	<i>Hirundo rustica</i>	X				-
<u>Chestnut-backed Chickadee</u>	<i>Parus rufescens</i>				X	56.29
Red-breasted Nuthatch	<i>Sitta canadensis</i>			X		2.22
Pygmy Nuthatch	<i>Sitta pygmaea</i>				X	9.62
Brown Creeper	<i>Certhia americana</i>				X	46.66
<b>Bewick's Wren</b>	<i>Thryomanes bewickii</i>		X			0.74
Winter Wren	<i>Troglodytes troglodytes</i>				X	65.18
Golden-crowned Kinglet	<i>Regulus satrapa</i>				X	54.07
Swainson's Thrush	<i>Catharus ustulatus</i>			X		1.48
Hermit Thrush	<i>Catharus guttatus</i>				X	11.85
American Robin	<i>Turdus migratorius</i>				X	16.29
Wrentit	<i>Chamaea fasciata</i>			X		2.22
Orange-crowned Warbler	<i>Vermivora celata</i>		X			4.44
Audubon's Warbler	<i>Dendroica coronata</i>				X	0.74
<u>Black-throated Gray Warbler</u>	<i>Dendroica nigrescens</i>			X		6.66
<u>Hermit Warbler</u>	<i>Dendroica occidentalis</i>				X	0.74
Wilson's Warbler	<i>Wilsonia pusilla</i>				X	33.33
Spotted Towhee	<i>Pipilo maculatus</i>				X	6.66
California Towhee	<i>Pipilo crissalis</i>			X		0.74
Song Sparrow	<i>Melospiza melodia</i>			X		1.48
Oregon Junco	<i>Junco hyemalis</i>				X	30.37
Purple Finch	<i>Carpodacus purpureus</i>			X		17.77
Red Crossbill	<i>Loxia curvirostra</i>	X				0.74
Pine Siskin	<i>Carduelis pinus</i>			X		8.14
American Goldfinch	<i>Carduelis tristis</i>	X				-

**Appendix 9. Total number of individuals of each species detected (within 50 meters) during point counts censuses by site, 1997 – 1999.**

Species	1997			1998			1999		
	Ben Johnson	Boot-jack	Off trail	Ben Johnson	Boot-jack	Off trail	Ben Johnson	Boot-jack	Off Trail
Mallard	0	0	0	1	0	0	0	0	0
Turkey Vulture	0	0	0	0	1	0	0	1	2
Sharp-shinned Hawk	1	1	0	0	0	1	0	0	0
Red-tailed Hawk	0	1	3	0	0	0	0	0	2
California Quail	0	0	0	0	0	3	0	0	0
Band-tailed Pigeon	8	1	3	1	1	1	2	4	4
Morning Dove	0	0	1	0	0	1	1	0	1
Anna's Hummingbird	1	1	0	1	0	4	1	1	1
Allen's Hummingbird	1	1	4	5	6	7	1	7	11
Belted Kingfisher	2	0	0	0	0	0	0	0	0
Acorn Woodpecker	2	0	1	0	0	0	0	0	0
Downy Woodpecker	0	2	0	0	4	0	1	0	0
Hairy Woodpecker	0	0	1	0	0	1	0	2	3
Red-shafted Flicker	0	0	0	0	1	0	0	0	0
Pileated Woodpecker	0	0	0	0	2	0	0	1	1
Pacific Slope Flycatcher	49	23	37	42	21	34	0	0	2
Black Phoebe	0	0	0	0	0	0	1	0	0
Hutton's Vireo	0	1	0	0	0	0	0	2	3
Warbling Vireo	0	1	2	4	2	0	3	5	1
Steller's Jay	5	3	11	5	2	6	1	2	6
American Crow	0	5	0	0	0	0	0	0	0
Common Raven	0	2	0	1	2	0	1	3	3
Tree Swallow	0	0	0	0	0	1	0	0	0
Chestnut-backed Chickadee	17	29	17	13	13	10	17	13	28
Brown Creeper	14	5	9	9	7	9	9	15	5
Red-breasted Nuthatch	0	1	1	0	0	0	0	1	0
Pygmy Nuthatch	2	0	1	0	0	1	0	3	9
Winter Wren	16	8	22	36	18	27	21	22	19
Bewick's Wren	0	0	0	0	1	0	0	0	0
Golden-crowned Kinglet	14	11	19	17	13	15	2	9	6
Swainson's Thrush	1	0	0	1	0	0	0	0	0
Hermit Thrush	4	1	6	2	6	2	2	7	2
American Robin	3	1	3	2	2	3	7	3	2
Wrentit	0	3	0	0	3	0	0	0	0
Orange-crowned Warbler	0	1	0	0	2	0	1	2	0
Audubon's Warbler	0	1	0	0	0	0	0	0	0
Black-throated Gray Warbler	0	0	1	0	3	0	2	3	1
Hermit Warbler	0	0	0	0	0	0	0	0	1
Wilson's Warbler	8	12	7	1	13	4	3	20	10
California Towhee	0	0	0	0	0	0	2	0	0
Spotted Towhee	0	0	1	0	4	2	0	4	1
Song Sparrow	1	0	0	0	0	0	1	0	0
Oregon Junco	2	10	7	1	6	9	13	13	4
Purple Finch	2	0	6	3	2	7	6	0	3
Red Crossbill	0	0	1	0	0	0	0	0	0
Pine Siskin	1	0	1	3	4	6	0	0	2