Breeding Distribution of the Marbled Murrelet in Redwood National Park and Vicinity During 1988

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Abstract. We report on an intensive research effort to determine the present status of the marbled murrelet (*Brachyramphus marmoratus*) in the vicinity of Redwood National Park, in Del Norte and northern Humboldt Counties, California. This seabird is primarily an inhabitant of the nearshore waters and adjacent coastal redwood forests of the northern half of the state. Little is known of its ecology on land. Using remote sensing techniques, we mapped all old and mature forests, the potential habitat for the species. We then conducted systematic surveys of stands selected from the above inventory, recording the number of detections of birds, their behavior, and various vegetative aspects of the stands. Within the area including Redwood National Park, the nearby redwood state parks and private lands, 120 morning counts were conducted on 54 transects, with murrelets detected on 70% (38) of the transects. Bird distribution in the study area was patchy and essentially restricted to old-growth redwood forests.

INTRODUCTION

One of the last and most enduring mysteries of ornithology is the life history of the marbled murrelet (*Brachyramphus marmoratus*). Although

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fairly common in nearshore marine waters, the murrelet has kept its breeding grounds amazingly secret. The species occurs around the Pacific rim from Korea and Japan, through Alaska, and southward into central California. It is considered to be a marine species, although it is known to use inland lakes year-round in the Pacific Northwest (Carter and Sealy, 1986). On the west coast of North America, in the southern part of its range, it is thought to nest only in trees in old-growth forests (Sowls et al., 1980; Sealy and Carter, 1984), although through 1988 only four tree nests have been found anywhere in the species' range. In California, all evidence points to the bird nesting primarily in old-growth redwood (*Sequoia sempervirens*) forests, as summarized by Carter and Erickson (1988). These forests have been much reduced over the past 200 years, with old-growth stands now making up only about 10% of the former range of the redwood (L. Fox, pers. comm.). These remnants are still being harvested. Thus the status and continued persistence of the California murrelet population may be tied to these remnant forests. Despite this possibility, there have been no systematic inland surveys describing their breeding distribution or habitat use in the state. Research conducted on the species has focused primarily on observations at sea, including distribution (Sowls et al., 1980; Sealy and Carter, 1984), inferred breeding biology (Sealy 1975a; Hirsch et al., 1981), and feeding ecology (Sealy, 1975b). Nest and egg descriptions have included records from northern latitudes, where the species nests on the ground on treeless islands (Simons, 1980; Johnston and Carter, 1985), and from the southern parts of the range, where nests in trees have been found (Kyzyakin, 1963; Binford et al., 1975). Historical information on this species in California is summarized by Carter and Erickson (1988).

The purpose of this paper is to document the species' occurrence in Redwood National Park and surrounding areas, as a portion of a census that included stands from the Santa Cruz Mountains, Santa Cruz County, to the Oregon border (Paton and Ralph, 1988).

METHODS

Stand Selection

Although marbled murrelets have been reported at sites as far inland as 75 km in Washington (Carter and Sealy, 1986), the farthest inland murrelet site in California appears to be 39 km inland at Grizzly Creek Redwoods State Park. Therefore, we surveyed sites up to 40 km inland. Data collected by us at Redwood Experimental Forest near Klamath, California (Paton et al., in review) suggested that murrelets appear to be closely associated with closed canopy old-growth redwood stands. We therefore weighted our sampling scheme towards that habitat type, although we also surveyed younger stands.

In order to identify potential sites, we used data from a distributional study of the coastal redwood forests based on remote sensing techniques (L. Fox, pers. comm.). Maps were based on aerial photos taken at 19,800 m with high-definition Aerochrome infrared SO-131 film by a RC10 sensor with a six-inch focal length. Habitat types delineated by the photos include: (1) old-growth redwood, > 70% canopy closure; (2) old-growth redwood, < 70% canopy closure; (3) old-growth redwood/Douglas-fir (*Pseudotsuga menziesii*); (4) mature redwood; and (5) young or clearcut redwoods. Fox (pers. comm.) defined old-growth as stands in which some trees pre-date the arrival of Europeans in the 1700s.

Bird Surveys

On the basis of the distribution of vegetation, we laid out 54 transects (Fig. 1). Surveys, following a modified protocol of Paton et al. (1988), were conducted from 15 May to 15 August 1988 in order to include the seasonal peak of murrelet activity in the stand. Each transect was made up of 8-13 fixed stations surveyed in one morning (Table 1). Depending upon road or trail conditions, stations were placed 250-1000 m apart, with 250 m spacing between stations along trails, 500 m along rough roads, and usually 1 km along paved roads. In order to encompass the peak of daily bird activity, counts began 45 minutes before sunrise and continued for one hour and 30 minutes after sunrise. Each station was surveyed for 10 minutes, and each transect surveyed at least twice during the study (see Table 1). The order of stations was reversed each time the transect was done, so as to have each station surveyed at different times during the morning.

The basic datum recorded was the "detection," defined as the sighting or hearing of one or more birds flying together. Most birds were detected as they rapidly flew overhead, usually within about 200 m of the ground. Morning surveys were conducted 120 times over the 54 transects (Table 1). Birds were detected on 38 (70%) of the transects.

We do not yet know the relation between the number of detections and the actual number of birds using a particular stand. However, we believe the detections are an index of bird abundance. Due to variations in visibility at different sites, we believe the detections, rather than the number of birds seen or heard, are a more reliable estimator of the difference in relative abundance among transect locations. A stand with one detection compared to another stand with 100 detections during the same time period is assumed to have fewer birds. The differences in relative abundance among stands are preliminary results based on only a few visits to each site. An observer will miss birds at stands where murrelets are present, and some transects with only a few detections could have had many more birds.

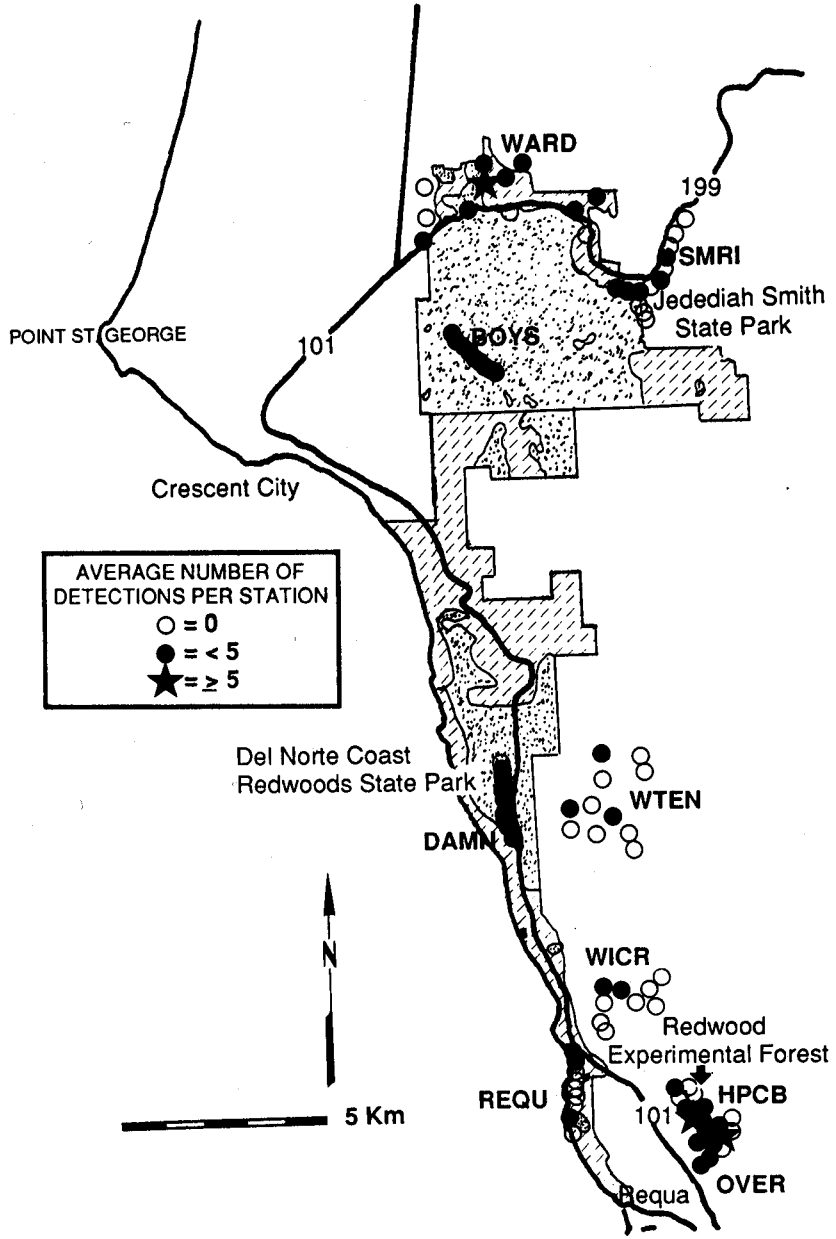

FIGURE 1. Map of study sites at Jedediah Smith, Del Norte Coast, Wilson Creek and Redwood Experimental Forest areas, showing each station with an indication of the number of birds detected. The mnemonic for the transect name is indicated (see Table 1); park extent is shown by cross hatching, and old-growth forests by stipling.

Table 1. Location and number of marbled murrelets detected during the 1988 survey. The Code indicates the name on Figure 1, the Type refers to: CARL = car long, 1 km between stations; CARS = car short, 0.5 km between stations; WALK = walking transect, 250 m between stations; and BIKE = 0.5 km between points on a bike. Also shown is the number of stations done at each transect (Sta), the number of detections (Det), the detections per station, and the number of days that the transect was censused. The transects are arranged from the most northern to the most southern in the study area.

Transect	Code	County	Owner	Type	Sta	Det	Det /Sta	No. of days
Rowdy Creek	ROCR	Del Norte	Private-Many	CARL	33	2	0.0600	3
Kermit Miller Exch.	KEMI	Del Norte	US Forest Ser.	CARS	41	0	0.0000	4
Smith River/Hiouchi	SMRI	Del Norte	Public/Private	CARL	22	7	0.3150	2
Walker Road	WARD	Del Norte	State Park	CARL	20	29	1.4500	2
Myrtle Creek	MYCR	Del Norte	US Forest Ser.	WALK	30	11	0.3667	3
Boy Scout Trail	BOYS	Del Norte	State Park	WALK	22	55	2.5000	2
Damnation Tr. (Bluff)	DAMN	Del Norte	Nat'l Park Ser.	BIKE	21	24	1.1428	2
High Prairie-Yurok	HPCB	Del Norte	US Forest Ser.	CARS	55	134	2.4340	5
Overlook (Yurok E.)	OVER	Del Norte	US Forest Ser.	CARS	44	71	1.6150	4
Requa (N. Klam. Riv.)	REQU	Del Norte	Nat'l Park Ser.	WALK	22	3	0.1350	2
S-A Forestry Headqrt.	FOHE	Del Norte	Simpson	CARL	18	1	0.0550	2
S-A H500/P500	HFPF	Del Norte	Simpson	CARL	19	0	0.0000	2
S-A K-One	KONE	Del Norte	Simpson	CARL	20	0	0.0000	2
S-A U-Ten	UTEN	Del Norte	Simpson	CARL	18	0	0.0000	2
S-A W-Ten	WTEN	Del Norte	Simpson	CARL	20	11	0.5500	2
S-A Upper Corners	UPCO	Del Norte	Simpson	CARL	20	0	0.0000	2
S-A Wilson Creek	WICR	Del Norte	Simpson	CARL	16	14	0.8750	2
Alder Camp (N. Klam.)	ALDR	Del Norte	Nat'l Park Ser.	CARL	22	10	0.4550	2
Camp Klamath	CAKL	Del Norte	Private-Many	CARL	22	2	0.0900	2
Klamath	KLAM	Del Norte	Nat'l Park Ser.	CARL	22	5	0.2250	2
Red Mountain	REMO	Del Norte	US Forest Ser.	CARL	22	0	0.0000	2

Table 1. (continued)

Transect	Code	County	Owner	Type	Sta	Det	Det /Sta	No. of days
S-A B-900	BNHU	Humboldt	Simpson	CARL	22	0	0.0000	2
North West Ridge	NWRI	Humboldt	State Park	WALK	20	43	2.1500	2
James Irvine	JITR	Humboldt	State Park	WALK	17	148	8.7059	2
North By-Pass	BYPN	Humboldt	Nat'l Park Ser.	CARL	22	0	0.0000	2
South By-Pass	BYPS	Humboldt	Nat'l Park Ser.	CARL	20	0	0.0000	2
West Ridge Trail	WERI	Humboldt	State Park	WALK	19	67	3.5263	2
Gold Bluff Road	GBBR	Humboldt	State Park	WALK	20	34	1.7000	2
Hope Creek-Ten Tappo	HOPE	Humboldt	State Park	WALK	20	80	4.0000	2
Prairie Creek Hwy 101	PHWY	Humboldt	State Park	CARL	20	109	5.4500	2
A-9 Road	ANIR	Humboldt	Nat'l Park Ser.	CARS	27	14	0.5167	3
East C-line Road	ECLR	Humboldt	Nat'l Park Ser.	CARS	33	8	0.2400	3
Lady Bird Johnson	LBJG	Humboldt	Nat'l Park Ser.	WALK	27	16	0.5933	3
South Operations	SOCT	Humboldt	Nat'l Park Ser.	WALK	33	11	0.3300	3
West Side Access Rd.	WSAR	Humboldt	Nat'l Park Ser.	CARS	33	1	0.0300	3
Cal-Barrel Rd.	CABA	Humboldt	State Park	CARL	17	39	2.2941	2
Lost Man Picnic Area	LLMC	Humboldt	Nat'l Park Ser.	CARS	20	69	3.4500	2
Lower Redwood Creek	LRCK	Humboldt	Nat'l Park Ser.	WALK	33	218	6.6060	3
Skunk Cabbage Creek	SKNK	Humboldt	Nat'l Park Ser.	WALK	22	44	1.9950	2
Tall Trees Grove	TTGR	Humboldt	Nat'l Park Ser.	WALK	21	41	1.9524	2
Geneva Road	GNVA	Humboldt	Nat'l Park Ser.	CARS	22	5	0.2250	2
Bald Hills Road	BALD	Humboldt	Nat'l Park Ser.	CARL	22	28	1.2700	2
Orick Horse Trail	HORS	Humboldt	Nat'l Park Ser.	WALK	22	23	1.0450	2
Stone Lagoon	STLA	Humboldt	Private-Many	CARL	22	0	0.0000	2
Lagoons (Stone-Big)	LAGS	Humboldt	State Park	CARS	23	1	0.0435	2
Patrick's Point	PAPT	Humboldt	State Park	BIKE	18	1	0.0550	2

Table 1. (continued)

Transect	Code	County	Owner	Type	Sta	Det	Det /Sta	No. of days
Devil's Creek	DECR	Humboldt	Nat'l Park Ser.	WALK	22	12	0.5450	2
M-Line (S. RNP)	RNPM	Humboldt	Nat'l Park Ser.	CARL	22	0	0.0000	2
LP #5 R-Line	LPRL	Humboldt	Louisiana-Pac.	CARL	22	0	0.0000	2
LP #2 Little River 2	LRII	Humboldt	Louisiana-Pac.	CARL	20	0	0.0000	2
LP #3 M-Line	LPML	Humboldt	Louisiana-Pac.	CARL	22	5	0.2250	2
LP #6 Maple Creek	LPMC	Humboldt	Louisiana-Pac.	CARL	21	0	0.0000	2
LP #4 T-Line	LPTL	Humboldt	Louisiana-Pac.	CARL	22	0	0.0000	2
LP #1 A-Line	ALIN	Humboldt	Louisiana-Pac.	CARL	22	0	0.0000	2

RESULTS

In our survey of the state, we identified three primary areas of murrelet breeding activity: (1) the Crescent City area south to Redwood Creek in Redwood National Park; (2) Pacific Lumber Company lands east of southern Humboldt Bay to Humboldt Redwoods State Park on the Eel River; and (3) state parks in southern San Mateo and northern Santa Cruz Counties. In this paper, we will discuss the survey results in Del Norte and northern Humboldt Counties.

Jedediah Smith State Park and Vicinity

The transects in northern Del Norte County had a moderate to high detection rate, concentrated in the immediate area of the Smith River (Fig. 1). Within the state park itself, the Walker Road (WARD) transect had the most detections, averaging 1.5 detections per station. The Boy Scout Trail transect (BOYS), which enters the center of the old-growth in the park, had birds detected at all but one station, suggesting relatively high use of the stand center.

One of the most interesting observations involved murrelets detected in the Myrtle Creek drainage (MYCR) of Six Rivers National Forest, where birds had not been previously suspected. This is the only transect in the entire state where we detected birds in an area not dominated by redwood trees. The larger trees were confined near the creek, in a drainage that consisted primarily of Douglas-fir and Port Orford cedar (*Chamaecyparis lawsoniana*). No birds were detected farther up the Main Fork of the Smith River than Myrtle Creek, and no transects were located on the South Fork of the Smith. The only marked directionality to flights observed was at Myrtle Creek, where birds generally headed south, probably towards the mouth of the Smith River.

We did not detect birds at some places where murrelets have recently been heard, such as Hutsinpillar Creek, at the north end of the Rowdy Creek transect (ROCR) (Carter and Erickson, 1988), and at Camp Lincoln on the Kings Valley Road (Dan Scott, pers. comm.).

Del Norte Coast Redwoods State Park and Wilson Creek Area

This state park is a relatively narrow coastal strip of old-growth redwood. We had modest numbers of murrelet detections at most stations on the Damnation Trail transect (DAMN), at the southern end of the park west of Highway 101. A few birds were also detected on the WTEN transect in Simpson Timber Company lands, just to the east of Del Norte Redwoods. The low number of detections on the WTEN transect suggests that many of the birds detected on the coastal transects are probably nesting in the state park, and not proceeding farther east. The Simpson Timber Company lands to the east of the park are heavily fragmented, and only small patches of old-growth redwood remain. The Wilson Creek

(WICR) transect on Simpson land included some old-growth islands, and two of the stations near Wilson Creek had a total of 14 detections.

Redwood Experimental Forest to the Mouth of the Klamath River

The Requa transect (REQU), west of the Yurok Loop Trail in Redwood National Park, had only a few detections, and those could have come from the Redwood Experimental Forest (HPCB and OVER transects). We detected many murrelets in tracts owned by the U.S. Forest Service, with an average of 2.4 detections per station on the High Prairie/Yurok transect (HPCB). Birds here and at the nearby Overlook transect (OVER) were generally detected as they flew down High Prairie Creek in a southwest direction towards the ocean. It appeared that most birds were confined to the Research Natural Area on the Experimental Forest. Several all-morning stationary counts at a single station were conducted here in late July, with a peak of 146 detections at a station along the flight corridor to the Natural Area.

Of the six other transects on the highly-fragmented Simpson lands in Del Norte and Humboldt Counties, only one had murrelets besides the WTEN and WICR transects. The S-A Forestry Headquarters (FOHE) transect had one detection on 29 July, but generally the Simpson lands appear to lack substantial numbers in the areas we were able to survey. We recorded two detections west of Klamath and murrelets had been detected flying down Terwer Valley on 10 July 1987 (Carter and Erickson 1988). However, we have no data to indicate the breeding areas of those birds.

The Alder Camp transect (ALDR) in Redwood National Park was somewhat active with birds either originating from the adjacent old-growth redwood stands or flying from farther inland. The lack of detections along the Camp Klamath (CAKL) transect suggests that the point of origin of the birds on the ALDR Transect was probably the redwoods just east of Flint Rock Head.

Prairie Creek State Park

Many birds were found here, with the James Irvine Trail transect (JITR) having an average of 8.7 detections per station, the highest of any transect in the state (Fig. 2). Within a few kilometers, the Hope Creek-Ten Tappo (HOPE), Cal-Barrel Road (CABA), West Ridge Trail (WERI), North West Ridge (NWRI), and Prairie Creek Highway 101 (PHWY) transects all ranked in the top 15 transects statewide, based on the relative number of murrelet detections. Murrelets in these transects usually flew northwest, out of drainages and towards the sea, with birds apparently funneling out of the Fern Canyon area down Godwood Creek.

In contrast, just to the east of the park, the North By-Pass (BYPN) and South By-Pass (BYPS) transects had no detections. This was quite unexpected, as the two transects were adjacent to the old-growth forests con-

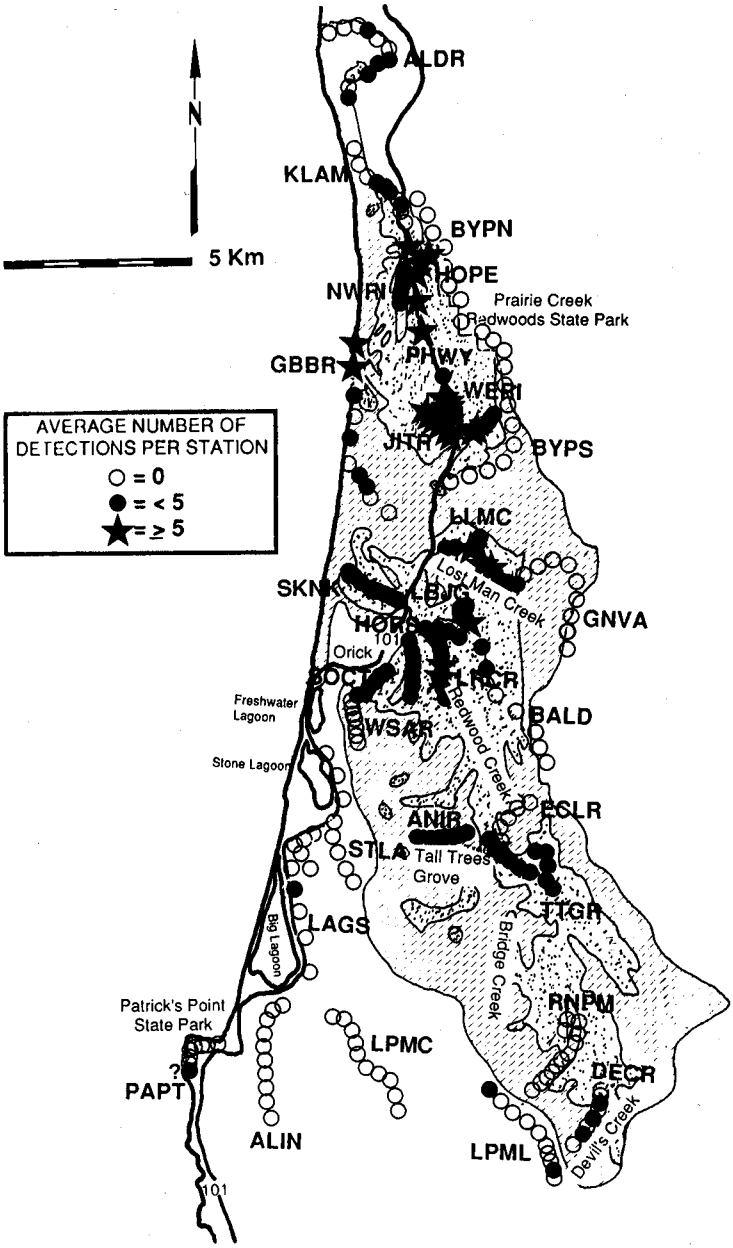

FIGURE 2. Map of study sites at Prairie Creek and Redwood National Park areas, showing each station with an indication of the number of birds detected. The mnemonic for the transect name is indicated (see Table 1); park extent is shown by cross hatching, and old-growth forests by stipling.

taining the transects mentioned above. To the east of the park, in the area of the two By-Pass transects, virtually no areas of old-growth forest remain because it has been thoroughly harvested, primarily in the past 20 years.

Redwood National Park

Just to the south of the Prairie Creek area, the Lost Man Creek drainage (LLMC) had many murrelet detections, with the highest numbers at the confluence of the two main forks of the creek (Fig. 2). Flight paths in this area tended to be along drainages, either northeast or east. Interestingly, no birds were detected along the upper portion of the nearby Geneva Road (GNVA) transect once the transect left the old-growth redwoods, and went into a second growth, hardwood-dominated forest. With the detections on the LLMC and GNVA transects confined to the old-growth redwood areas along the drainages, it appeared that the birds were not nesting to the east.

The Lady Bird Johnson Grove (LBJG) was an area with many murrelet detections, but the adjacent Lower Redwood Creek transect (LRCR) had the most detections of any transect in the park, averaging 6.6 detections per station (the second highest number in the state). This is probably the result of relatively large numbers of murrelets nesting in this area and using the drainage as a flight corridor. The Bald Hills Road (BALD) transect had detections at stations in old-growth redwood, but none on the ridge where the Bald Hills Road moves into second-growth forests. The Horse Trail (HORS) transect had detections at most stations. We speculate that either birds were nesting nearby or flying over the ridge from Lower Redwood Creek. In all likelihood both were involved, since birds were observed to be flying in all directions on this transect. The Tall Trees Grove (TTGR) had relatively high numbers of detections, 2.0 per station, with most birds confined to stations near Redwood Creek. Although there were many detections at TTGR and the A-9 Road (ANIR), we had almost no detections on the transects closer to the coast: Stone Lagoon (STLA), Lagoons (LAGS), and West Side Access Road (WSAR).

Area east of Trinidad

Murrelet detections were relatively low in this area, with only one apparent concentration of birds in the Devil's Creek (DECR) drainage in Redwood National Park. Birds from DECR could be responsible for the few birds detected on the Louisiana-Pacific (LP) Company's M-Line (LPML) transect. All the transects on LP Company lands in this area (LPMC, LPRL, LPML, LPTL, ALIN, LRII) had few detections. Transects on these private lands all passed through second growth habitat, while the only large stand of old-growth in the area was on the DECR transect in the park.

DISCUSSION AND CONCLUSIONS

There are limits to the type of survey data that can be collected on such an elusive bird as the marbled murrelet. While we believe large numbers of detections indicate a fairly high murrelet population, we do not suggest that there is a 1:1 relationship between the number of detections and the number of birds in an area. In all probability, we failed to detect murrelets on some transects where the birds occurred, especially when the area may have supported only a few pairs. Little is known about the detectability of this species when comparing an isolated pair to a large concentration. There is a possibility that isolated pairs might be quiet and secretive, while large groups are vocal and social.

Based on preliminary surveys conducted in Oregon (Kim Nelson, pers. comm.) and Washington (Eric Cummings, pers. comm.), the California populations in the vicinity of Redwood National Park are probably the largest south of the Puget Sound area. If the murrelet populations to the north continue to decline, and the little remaining old-growth is removed in coastal Oregon and Washington, the California population will become increasingly isolated. We have no information about the mobility of the species, but there should be concern about possible genetic isolation.

The value of the population now preserved within the boundaries of Redwood National Park, and nearby portions of the California State Park System, is very high. Clearly, the park is one of the centers of murrelet abundance in the state. The lack of detections along the coast on STLA, LAGS, and WSAR transects, and the abundance of birds on Lower Redwood Creek just to the east, suggests that they might be flying north following the Redwood Creek drainage from TTGR rather than heading due west directly towards the ocean. The lack of detections to the east of Redwood National Park and Prairie Creek State Park, with many detections in the parks themselves, is highly suggestive that murrelet nesting activity is confined to the park, primarily in a closed canopy, old-growth redwood forest. Other than small populations in private timber company lands to the southeast, these are the only murrelets remaining in the state, except for an even smaller, isolated concentration in the Santa Cruz Mountains, 200 km to the south.

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