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GEOGRAPHIC DISTRIBUTION OF THE MARBLED MURRELET IN CALIFORNIA AT INLAND SITES DURING THE 1988 BREEDING SEASON

by

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ABSTRACT

We report on an intensive research effort to determine the present status of the Marbled Murrelet (Brachyramphus marmoratus) at inland sites in California. This seabird is, in large part, an inhabitant of the coastal redwood forests of the northern half of the state, and little is known of its ecology away from the ocean. We identified old and mature forests as potential habitat for the species using remote sensing techniques. Then, we conducted systematic surveys of stands selected from the above inventory, quantifying the relative abundance of detections of birds, their behavior, and various vegetative aspects of the stands. A total of 283 morning counts were conducted on 127 transects, with murrelets detected on 53% (66) of the transects. In addition, stationary counts were conducted on 37 mornings and 31 evenings. Eighty percent of the murrelet detections occurred from 30 minutes before to 30 minutes after sunrise. Morning censuses had five to six times more detections than evening censuses at the same point during the same 24 hour period. About 25% of the detections were visual observations, the rest were auditory. Flock size was small, single birds and pairs accounted for 80% of all detections in which birds were seen. Bird distribution was patchy and restricted to the old-growth redwood forests in Del Norte, Humboldt, San Mateo, and Santa Cruz Counties. No birds were detected in Mendocino, Sonoma, and Marin Counties, with the exception of one possible detection in Mendocino County. Areas with relatively high detection rates of murrelets included: Jedediah Smith State Park; Redwood Experimental Forest; Prairie Creek State Park; the Redwood Creek drainage and Lost Man Creek drainage of Redwood National Park; Pacific Lumber Company lands northeast of Carlotta; Humboldt Redwoods State Park; Butano State Park; Portola State Park; and Big Basin State Park. The farthest inland that murrelets were detected was Grizzly Creek State Park, 39 km from the ocean.

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INTRODUCTION

The Marbled Murrelet (Brachyramphus marmoratus) is considered to be an oceanic species, although they are 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 in trees in old-growth forests (Sowls et al. 1980, Sealy and Carter 1984) which are still being harvested. In California, all evidence points to this species being found primarily in old-growth redwood (Sequoia sempervirens) forests. Thus the status and continued health of the California murrelet population may be tied to these remnant forests. Despite this potential, no systematic surveys have been conducted at inland sites to describe their distribution or habitat use patterns. Research conducted on the Marbled Murrelet has focused primarily on their biology at sea, including distribution (Sowls et al. 1980, Sealy and Carter 1984), inferred breeding biology (Sealy 1975a, Hirsch et al. 1983), and feeding ecology (Sealy 1975b). Nest and egg descriptions have included records from northern latitudes where the species nests on the ground (Simons 1980, Johnston and Carter 1985), and in the southern parts of their range where nests have been found in trees (Kyzyakin 1963, Binford et al. 1975). Historical information on this species in California is summarized by Carter and Erickson (1988) in a companion report to the California Department of Fish and Game.

There were four objectives to the 1988 field work, based on the tasks outlined by the California Fish and Game's request for proposal:

(1) Identify groves of both older and younger growth redwood and Douglas-fir to be searched for breeding Marbled Murrelets.
(2) Conduct systematic surveys of the potential breeding range to locate and enumerate Marbled Murrelets.
(3) Generally describe the physiographic features and vegetation characteristics of all habitats surveyed.
(4) Assess over-all condition of habitats surveyed, including potential threats and general age characteristics of the stand surveyed.

METHODS

Stand Selection

Current knowledge of the Marbled Murrelet's use of inland sites suggests that they can use sites as far as 75 km (46 mi) from salt water (Carter and Sealy 1986). Grizzly Creek Redwoods State Park, 39 km (24 mi) inland, was the farthest inland murrelet site in California to our knowledge. Therefore, we surveyed sites up to 40 km (25 mi) inland. Data collected by us at Redwood Experimental Forest in California (Paton et al. in review) suggested murrelets appear to be closely associated with closed canopy old-growth redwood stands, therefore we weighted our sampling scheme towards that habitat type, although we also surveyed younger stands. In addition, surveys at sea by Sowls et al. (1980) showed murrelets to be most common from Eureka to the Oregon border and Santa Cruz to Half Moon Bay. Therefore, we placed only 20% of our transects in other coastal counties where we thought the species might be rare or absent: in Mendocino, Sonoma, and Marin Counties. We felt that this would maximize the probability of locating birds, since the primary objective of this year's work was to identify the most important inland sites that might be potential nesting stands. It is certainly possible that this resulted in us missing murrelets nesting in isolated clumps of appropriate habitat.

In order to identify potential sites, we collaborated with Dr. Lawrence Fox of Humboldt State University, who had mapped the distribution of the coastal redwood forests in the state using remote sensing techniques. Maps were based on aerial photos taken from U2 flights. The U2 images, generated by NASA Ames Research Center, were from high definition Aerochrome infrared SO-131 film taken by an RC10 sensor with a 6 inch focal length. The flight altitude was 19,800 m (65,000 f). The photographic overlap was 60% to allow stereo viewing.

The U2 false color photographs, like color film, have three emulsion layers, yellow, cyan, and magenta. A filter (2.2 Av) was used to block out blue light that may produce haze at high altitudes. The combination of false colors provides a unique color for different vegetation types and stages of maturity.

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/clearcut redwoods. Fox (pers. comm.) defined old-growth as stands in which some trees predate the arrival of European man in the area. We define old-growth in this report following the definitions of Franklin et al. (1986) as stands in excess of 200 years of age containing a variety of tree sizes, with little history of human-induced disturbance. Based on the maps, we selected the sites to be visited. We tried to place transects in essentially every old-growth redwood stand greater than about 20 ha (50 acres) in the state. Only the few areas of old-growth on lands belonging to Miller-Rellim Lumber Company in Del Norte County were not surveyed, as permission to survey these areas proved impossible to obtain.

Bird Surveys

On the basis of the distribution of vegetation, we laid out 127 transects (Fig. 1a, 3a, 5a, Table 1) from Del Norte through Santa Cruz counties. Coverage of state park lands was extensive because of the cooperation of 13 park rangers, who surveyed many of the redwood parks in northern California. Ownership of the lands under survey included state, federal, and private lands (Fig. 7; Table 1).

Surveys were conducted from 15 May to 15 August, following the protocol of Paton et al. (1988), with slight modifications. To survey as much habitat as possible each morning, we established between eight and 13 fixed stations for each day's surveys along a transect (Table 1). Depending upon road or trail conditions, stations were placed 250-1000 m (820-3280 ft) apart. Spacing between stations was 250 m along trails, 500 m along rough roads, and usually 1 km along paved roads. Counts began 45 minutes before sunrise and continued for 1 hour and 30 minutes after sunrise for a total of 2 hours 15 minutes of survey time available. Sunrise and sunset were determined using the Nautical Almanac Office listing in the Supplement to the American Ephemeris (1946). Each station was surveyed for 10 minutes. Each transect was usually surveyed at least twice, and the order of stations was reversed each time the transect was done in order to reach a given station at different times of the morning. We tried to not visit each transect at less than two week intervals to minimize the effects of weather, moon and tide cycles, and seasonal differences in murrelet detectability. Variables measured during each survey included: the time a station count started; time detection was heard; estimated number of birds seen or heard during each detection; compass direction birds were first detected; closest distance birds came to observer; behavior of birds (i.e. flying in a straight line over the canopy, circling over the canopy, etc.); if the bird was heard or seen (if heard, the number of call notes); and the direction the birds flew off.

In addition to transect surveys, we also conducted stationary counts at a single point for the entire morning period at selected sites during the morning and evening hours. The morning stationary count period was the same as during transect counts, and the variables quantified were identical also. The evening period covered a 1 hour 30 minute period from 1 hour before to 30 minutes after sunset.

The basis of survey was the "detection", defined as the sighting or hearing of a single bird or a group of birds, acting in a similar manner, e.g. flying together in the same direction. Due to variations in visibility at different sites, we felt that the relative abundance of detections, rather than the average number of birds seen or heard, was a more reliable estimator of the difference in relative abundance between transect locations. It should be pointed out that we do not yet know the correlation between the number of detections and the actual number of birds using a particular stand. However, we do feel that detections can be used as an index for bird abundances for a given area at the same time of the year. An area with one detection in the middle of July compared to another stand that has 100 detections the same month probably has fewer birds using the stand. It has not been resolved, however, how great the absolute difference between the two stands might be.

We caution readers that the relative abundance trends suggested here are preliminary results based on a relatively small number of visits to each site. We probably missed birds at some stands where murrelets existed, and some transects with moderate numbers of detections could have had more birds than our data suggest. Much needs to be learned about daily variation in murrelet use of inland sites, and the factors that might influence murrelet detectability at a particular site.

Vegetation quantification

The overall objective was to characterize each survey station as to the number and species composition of larger trees. The vegetation measures used in this report were those taken within 50 m (164 ft) of each station, although birds were detected as far as 400 m (1,300 ft) from stations. Each observer noted if there was evidence of logging from stumps or other signs, and if very large trees, more than 1.5 m (5 ft) diameter at breast height, were present. At each station we estimated the amount of the 50 m radius circle covered by logging or very large trees, with 100% being the amount if the stand was solidly stocked, or completely logged. The categories of cover were: none present; trace, less than 5%; sparse, 5-40%; medium density, 41-70%; and dense, more than 70% cover.

Training of observers

During training, time was spent on various aspects of field survey techniques, including listening to tapes of murrelet vocalizations and spending time in the field in areas with high murrelet activity and with personnel familiar with murrelet vocalizations. Most observers spent at least two mornings in the field being trained, one morning in an area of high murrelet activity prior to their first survey and another morning after the observer had completed a few surveys to verify the person was detecting all murrelets in the area. The great majority of stations were covered by three people with at least one week of training and who spent the entire summer just surveying for murrelets.

RESULTS

Temporal Patterns of Abundance

Seasonal Distributions. Stationary counts, conducted at a single station for the entire morning, provided invaluable information about the daily patterns of bird abundance, especially at Lost Man Creek and at Redwood Experimental Forest (Table 2). Murrelets were highly seasonal in their detection rate. At Lost Man Creek in Redwood National Park, the number of detections were low in early spring, increased and reached a peak in mid-July, and then declined abruptly after mid-August (Fig. 8). As we would not expect non-breeding birds to move in during this period, this peak suggests a rise in activity of the birds, rather than an increase in numbers of birds using the site. This increased activity could also be related to the fledging period of the young. During the incubation phase, one adult probably comes into the nest each morning, and the other leaves. As the young gets older and independent, both adults may come in to feed the young and both leave the area, thereby increasing activity levels and detections. From these data, we suggest that future surveys in California be confined to the period 1 May to 15 August. If areas are thought to contain especially low numbers, or if there is some other reason for maximizing detections, then surveys should be taken between 15 June and 1 August.

Morning versus evening counts. To compare the efficacy of surveying during the morning hours, as opposed to evening hours, we surveyed on a series of paired days at Lost Man Creek (Tables 2, 3). An observer would count at the stationary station one evening, and then count from the same location the next morning. We did this throughout the summer (Fig. 9). These comparisons showed murrelet activity to be about five to six times greater during morning surveys. Murrelets were more detectable around sunrise than sunset. However, it is possible that birds might fly into the stand after our evening count periods. Gary Strachan (pers. comm.) has observed birds flying inland off the ocean in the evening just as it was about too dark to see the birds and Alan Franklin (pers. comm.) reported hearing murrelets flying over his house east of Eureka at 21:30 PDT on 3 September 1988, 1 hour and 45 minutes after sunset. Little is known about the daily movement patterns of murrelets to inland sites, and the evening movements of the birds are poorly understood. Suffice it to say that evening surveys tend to be poorer indicators of murrelet activity in the area, and the emphasis should be on morning surveys if the objective is determining murrelet presence in a stand.

Duration of calling: mornings. Using the 2041 detections from all 127 transects, we divided the morning into 10 minutes increments (Fig. 10), and found a rapid increase in detections beginning 40 minutes before sunrise, followed by a more gradual decline until about 60 minutes after sunrise. Eighty percent of the detections were in the one hour period from 30 minutes before to 30 minutes after sunrise. The earliest we heard a bird was 53 minutes before sunrise, prior to initiation of the count period. The latest birds were heard were at 10:00 AM and 2:00 PM at Big Basin State Park, during an intensive survey looking for evidence of murrelet nests in the park. It should also be noted that murrelet activity tended to start later on foggy, misty mornings, but continued for a longer period of time and appeared to be more intense than on clear days.

Duration of calling: evenings. In our evening surveys (Table 3), we found a similar pattern for evening detections (Fig. 11), with a peak about 20 minutes before to 20 minutes after sunset. It appears that murrelet activity patterns are tied to light conditions and are fairly regular in their peaks, in contrast to data from Oregon, where Kim Nelson (pers. comm.) found that the evening peak of activity was from about sunset to 25 minutes after sunset.

Observations of Behavior

Types of Detections. While most detections were of birds that were only heard, about 25% of the birds were seen (Fig. 12). Of the 25% seen, this consisted of 28% that did not vocalize, and the remaining 72% which were seen and heard. We were surprised that 25% of the total were seen, as our previous work in the closed canopy forests (Paton et al. in review) had led us to expect few visual detections. These data will enable us, in future analyses, to work on directions of bird flight and to pinpoint possible nesting sites.

Vocalizations. The most common vocalization the murrelet gives is a "keer" call. When recording detections, observers noted the number of "keer" calls heard (Fig. 13). Approximately 35% of the detections of birds involved one to three call notes, and over 30% involved over nine call notes. Therefore, observers have to be attentive to detect murrelet presence when less than three vocalizations may be all that are given. On rare occasions, non-calling birds could be heard due to the sound of their wing beats. Murrelets also go into a steep dive and make a mechanical sound similar to a jet, which we only heard on five occasions. This "jet" sound was heard in both June and July in Prairie Creek State Park and the Lady Bird Johnson Grove, Redwood National Park.

Flight behavior. On half of the detections during the transect surveys, we were not able to determine the flight path of the birds (Fig. 14). During detections where only one to three vocalizations were heard and the bird was not seen, it was extremely difficult to determine the flight path. The most common flight behavior was birds flying over the tops of the trees in a straight direction, observed in about 40% of the 2041 transect detections. The next most common behavior was circling over the canopy, followed by flying below or through the canopy. Only on rare occasions did we observe birds circle below the canopy, call from a tree, or land in a tree.

We did observe singles and pairs of birds landing in a 35 m (115 ft) high, 4 m (13 ft) DBH broken top redwood snag in mid-July at Redwood Experimental Forest on three successive mornings. A tree climber ascended the snag, but he found no evidence of a nest in the area where the birds had landed. It is interesting to note that the birds were silent as they flew into the stand of trees near the snag prior to landing. Birds perched out of view for 5 seconds to 3 minutes and then left the stand, starting to vocalize when about 100 m (328 ft) away from the snag. Despite several days of intensive stationary counts by several people, leading to observations of other birds landing in other trees in the vicinity of the snag at the Experimental Forest, we were not successful in finding any nests this field season (Paton et al. in review).

Flock size. The number of birds seen together in a detection varied, but the vast majority of birds were observed either as singles or as pairs (Fig. 15). As many as seven birds were seen flying together, although flocks of more than four birds were extremely rare.

Distribution of Murrelets from Transect Data

Morning surveys were conducted 283 times over the 127 transects (Table 4). Birds were detected on 66 (53%) of the transects. We have ranked the transects in terms of the average number of detections per transect (Table 5), and also by the average number of birds estimated at the station (Table 6). The rankings for individual transects are similar when comparing Tables 5 and 6, but there is not an exact correspondence between the detection rate and the number of birds estimated at a station. It was common for a pair of birds to fly overheard, with only one vocalizing, which would have been recorded as a single bird if the birds were only heard and not seen. However, the actual differences in relative abundance between transects is unknown when comparing the mean number of detections. We feel comparisons of detection rates of a magnitude or more probably indicate real differences.

The distribution of the species between the Oregon border and the southern populations was patchy (Figs. 1b, 2b, 3b). The species had three areas where birds were detected in Del Norte, Humboldt, San Mateo, and Santa Cruz counties and were similar to those reported by Sowls et al. (1980) and Carter and Erickson (1988). These areas are coincident with the remaining areas of old-growth redwood forests (Figs. 1c, 2c, 3c). Despite surveys in areas of second-growth forests (Figs. 1d, 2d, 3d), we detected no birds over extensive areas in Mendocino, Sonoma, and Marin counties, with the exception of one possible detection in central Mendocino County.

We identified three primary areas of murrelet activity at inland sites in California: (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.

Potential hot spots of activity and specific areas where murrelets were detected are given in Figures 16-25.

Region 1-Del Norte County and northern Humboldt County

Jedediah Smith State Park and surrounding area. The area of State Parks in Del Norte County had a moderate to high detection rate, concentrated in the immediate area of the Smith River, with birds observed on several transects (Fig. 16). The Walker Road (WARD) transect had the greatest number of detections for the area, averaging 1.5 detections/station. The Boy Scout Trail transect (BOYS) heading into the center of the old-growth in Jedediah Smith State Park had birds detected at all but one station, suggesting relatively high use of the center of the stand by murrelets. Murrelets were detected in the Myrtle Creek drainage (MYCR), the first time birds were found in this part of Six Rivers National Forest. This is the only area in the entire state where we found birds where the dominant habitat type was not redwood. This drainage is primarily Douglas-fir and Port Orford Cedar (Chamaecyparis lawsoniana). Birds appeared to be flying south out of this drainage, probably to the Smith River and out to the ocean. 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 to see if birds might be using that drainage. The only marked directionality observed was at Myrtle Creek, where birds were generally observed heading south, towards the confluence with the Smith.

There are some places in this area that we did not detect birds, but where murrelets have been heard recently, such as Hutsinpillar Creek, at the north end of the 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 strip of old-growth redwood following the coastline. There were small numbers of murrelet detections at most stations on the Damnation Trail transect (DAMN), at the southern end of the park, west of Highway 101 (Fig. 17). A few murrelets were detected on Simpson Timber Company lands just to the east of Del Norte Redwoods, on the WTEN transect.

Interestingly, the Simpson lands are heavily fragmented with small patches of old-growth redwood. The lack of more detections on the WTEN transect suggests that many of the birds using this part of the coastline are probably stopping in Del Norte Coast Redwoods and not proceeding farther east. The Wilson Creek (WICR) transect had two stations near Wilson Creek that had 14 detections, including 13 on 28 July. Therefore, it appears there are still some birds using these old-growth islands on private lands.

Redwood Experimental Forest to the mouth of the Klamath River. The Requa transect (REQU; Fig. 18), west of the Yurok Loop Trail in Redwood National Park, was not very productive and birds detected there could have come from the Redwood Experimental Forest (HPCB and OVER Transects; Fig. 18). Relatively high detection rates of murrelets were found on this parcel of U.S. Forest Service land, where an average of 2.4 detections/station were recorded on the High Prairie/Yurok transect (HPCB). Birds here, and at the Overlook transect (OVER) nearby, were heading down High Prairie Creek in a southwest direction towards the ocean It appears from the distribution of the detections that most birds appear to be confined to the Research Natural Area (RNA) on the Experimental Forest. A series of stationary counts were conducted in late July, when the number of detections reached 146 in one morning at a station along the flight corridor to the RNA.

Of the six other transects on Simpson lands in Del Norte and Humboldt Counties, only one other had murrelets detected 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 devoid of substantial numbers of murrelets in the areas we were able to survey. We did get two detections west of Klamath and there have been murrelets detected flying down Terwer Valley as recently as 10 July 1987 (Carter and Erickson 1988). However, we were unable to determine the origin of those birds. These lands generally were very fragmented, with signs of recent timber harvesting, with only small patches of old-growth/mature stands remaining.

The Alder Camp transect (ALDR; Fig. 18) in Redwood National Park was a somewhat active transect, with birds either originating from the adjacent old-growth redwood stands or flying over from areas farther inland. The lack of detections along the Camp Klamath (CAKL) Transect suggests the point of origin for the detections on the ALDR Transect was probably the redwoods just east of Flint Rock Head.

Prairie Creek State Park. Very high detection rates were found here, with the James Irvine Trail transect (JITR; Fig. 19) having an average of 8.7 detections/station. 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 in the rate of murrelet detections. Clearly, this area is one of the centers of murrelet abundance in the state. As can be seen from the distribution of stations and relative abundances (Fig. 19), birds were present in all areas of the park. There was no evidence from our observations here of any aggregations of birds, or coloniality. The directions recorded for murrelets observed flying were usually to the northwest, out drainages and towards the sea, with birds apparently funneling out of the Fern Canyon area down Godwood Creek.

However, just to the east of the park, the North By-Pass (BYPN) and South By-Pass (BYPS) transects, had no detections. This was an astonishing observation to us, as we expected to have quite a few detections along these two transects, adjacent to old-growth forests. To the east of the park there are virtually no areas of old-growth forest remaining. The lack of detections to the east of the park, with high numbers of detections in the park is highly suggestive that murrelet nesting activity is confined within the park boundaries, which is primarily a closed canopy, old-growth redwood forest.

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 activity centers at the confluence of the two main forks of the creek (Fig. 20). Flight paths in this area tended to be along drainages, either northeast or due east. Interestingly, no birds were detected along the Geneva Road transect (GNVA) east of the old-growth redwoods, in second growth hardwood habitats. The detections on the LLMC and GNVA transects were confined to the old-growth redwood areas along the drainages, suggesting this is another murrelet nesting area.

The Lady Bird Johnson Grove (LBJG) was an area with constant murrelet use (Fig. 20), but the adjacent Lower Redwood Creek transect (LRCK) had the most detections of any transect in the park, averaging 6.6 detections/station. 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 birds at survey points in old-growth redwood, but no detections were made on the ridge where the Bald Hills road is in second-growth areas and grasslands. The Horse Trail (HORS) had birds at most stations. Either birds are nesting nearby or flying over the ridge from Lower Redwood Creek, something we could not determine since birds were 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 areas near Redwood Creek (Fig. 20).

Although there were quite a few detections at TTGR and the A-9 Road (ANIR), there were virtually no detections on the transects to the west of these two transects: Stone Lagoon (STLA), Lagoons (LAGS), and West Side Access Road (WSAR; Fig. 20). The lack of detections on these three transects and the abundance of detections on Lower Redwood Creek suggests the birds might be flying north following the Redwood Creek drainage from TTGR rather than heading due west.

Area east of Trinidad. Murrelet detections were relatively low in this area, with the apparent concentration of birds in the Devil's Creek (DECR) drainage in Redwood National Park (Fig. 21). Birds from DECR could have been detected on the LP M-Line (LPML) Transect. All transects on Louisiana-Pacific lands in this area (LPMC, LPRL, LPML, LPTL, ALIN, LRII) did not have substantial numbers of murrelet detections, although murrelets were observed on LP lands. Transects on LP lands all passed through second growth habitat, while the only large stand of old-growth found in the area was on the DECR transect in the park.

Region 2-Southern Humboldt Bay to Humboldt Redwoods State Park

Pacific Lumber Company. This population was previously unknown, although birds had been recorded in the Carlotta area in the 1920s and '30s (Carter and Erickson 1988). Relatively high numbers of detections were found in the Salmon Creek (SACR) drainage, averaging of 3.4 detections/station, and in the Elk's Head Spring (EHSP) area, with 1.0 detections/station (Fig. 22). At least from the Elk's Head Springs transect, birds were flying northwest, towards Elk River, rather than towards the Eel River. Small detection rates were found in the Yager Creek drainage (YACR), Owl Creek (OWCR), and Lawrence Creek (LACR). Birds were not detected on transects in the Shaw Creek area (SHAW; Fig. 22), Lower Freshwater Creek (LFWC) or the Freshwater area (FRES; Fig. 1b). However, Pacific Lumber employees conducting their own murrelet surveys heard murrelets along Freshwater Creek (T4N, R2E, Sec 7) in an area of residual old-growth redwood (R. Stephens pers. comm.).

Grizzly Creek State Park. This area (GRCR) was the farthest inland that we found murrelets, 39 km (24 mi), and we know of no other areas where they have been detected farther inland in California (Carter and Erickson 1988). Birds seemed to be using both the Grizzly Creek stand, and possibly Cheatham Grove, at the west end of the transect (Fig. 23). No birds were heard upstream from the eastern boundary of the park, suggesting that there might be no other murrelet populations farther east on the Van Duzen River. This transect was visited eight times, and during the peak in late June, 1.9 detections/station were made, a relatively high rate (Table 4).

Humboldt Redwoods State Park and vicinity. This area apparently supports a moderate population of murrelets. This is the southernmost population in Humboldt County that we detected, and is concentrated along the Eel River, largely in a narrow corridor of old-growth trees known as the Avenue of the Giants (Fig. 24). The Redcrest/Federation (RDFD) transect had the highest counts, with an average of 1.3 birds/station. Murrelets also seemed to using the area along Bull Creek towards Luke Prairie and Big Tree (BTSF and LOPR transects). The Humboldt Redwoods/Bull Creek (BUCR; Fig. 1a) transect just to the southwest of Humboldt Redwoods/Big Tree (BITR) transect did not have any detections. No birds were detected in the southern groves of the park, the Hidden Springs (HISP) and Miranda/Myers Flat (MIMF) transects.

The flight corridor for birds using this area is still uncertain. The relative abundance of detections to the north of the park along the RDFD transect and some detections along the Pepperwood (PEPP) transect to the north of the park suggest birds might be flying along the Eel River to get to the ocean. The other possible flight corridor would be through Panther Gap towards Honeydew and the mouth of the Mattole River.

Region 3-San Gregorio to Ano Nuevo

Portola State Park and vicinity. The concentration of birds in the various State and County Parks in Santa Cruz and San Mateo counties is impressive, and probably represents the southern-most nesting population in North America. The Iverson Trail (IVTR; Fig. 25) and Portola (PORT; Fig. 3b) transects, ranked as two of the transects where murrelets were most abundant with an average of 3.0 and 1.4 detections/station, respectively (Table 6). Flight path directions of the birds suggested a northwest direction, probably towards the ocean via Pescadero Creek. Birds were also detected in Memorial County Park (MEMO) and Sam McDonald Park (HAPR).

Butano State Park and vicinity. Murrelet detectability in this area was moderate to high (Fig. 25), with the primary use areas along Butano Creek (BCBC) averaging 0.8 detections/station and GOAT, at the southwest edge of the park, with 0.6 detections/station (Table 6). Gazos Creek (GAZO) had the high activity for this area, with 1.5 detections/station. GAZO was apparently a flight corridor for birds from Butano State Park, and possibly from Portola and Big Basin.

Big Basin State Park. The Waddell Creek (WADD) transect (Fig. 25) had high detection rates with birds flying over this drainage, averaging 2.8 detections/station (Table 4). Somewhat surprisingly, the birds appeared to not follow the drainage completely to the ocean, but rather headed southwest over a ridge towards the ocean towards Point Ano Nuevo. Bird use around Big Basin State Park headquarters appeared to be somewhat concentrated, with one faint detection at a station away from the old-growth redwood areas on the park headquarters (HEAD) and Lodge Road (LODG) transects (Fig. 25). Murrelets were using the northwest corner of Big Basin (SUNS), with relatively high detection rates, 1.2 detections/station. Interestingly, no birds were detected alongWhitehouse Creek (WHCR) suggesting the drainage is not a major flight corridor for the park, although birds have been detected there in the past (Carter and Erickson 1988).

Additional observations

Mendocino County. The Russian Gulch-Van Damme State Park transect in Mendocino County did have a detection that the observer was only fairly sure were murrelets (Fig. 3b). We only included detections in this report when the observer was certain the birds were murrelets (Tables 5, 6). However, there were murrelets observed in Russian Gulch State Park in May 1976 (Carter and Erickson 1988), and at 5:40 PM (PST) on 16 November 1988, a pair of murrelets was heard flying inland 1 km east of the town of Mendocino (F. Sharpe pers. comm.). So, it is probable that small numbers of murrelets are using this area.

Oregon. In addition, just north of the California border, Paton heard and saw murrelets in six inland and two coastal areas on the Chetco Ranger District, Siskiyou National Forest (Fig. 28). Five of these inland areas were drainages dominated by Douglas-fir.

Discontinuities in Distribution

A large gap in the species' distribution occured from just south of Humboldt Redwoods State Park to San Mateo County. As can be best seen from Figures 1a-6d, this discontinuity is coincident with the lack of old-growth forest over this area of almost 300 miles. Early Russian settlers at Fort Ross cleared drainages in this area, followed by subsequent Spanish, Mexican, and European settlers' use of the areas. Now, except for tiny remants, almost entirely in State Parks, virtually no old-growth remains. None of the remnants surveyed supported detectable populations of murrelets, using our method of two visits/transect.

There is still a possibility that some murrelets nest in other areas of Mendocino, Sonoma, or Marin Counties, but their numbers probably represent a small proportion of the murrelets nesting in California. Isolated birds also could exist in second growth areas with residual old-growth trees, such as the Louisiana-Pacific lands east of Trinidad. The Trinidad area, in the 1920s, was one of the better areas in the state to find Marbled Murrelets (Carter and Erickson 1988), yet few birds are heard there now.

Habitat Relationships

We considered stations with the presence of logging and with a dense canopy closure of very large trees present (more than 1.5 m dbh) to be the best measures of disturbance and lack thereof (Tables 7, 8). A comparison of the forest profile of transects with none, less than one, and more than one bird per station (Fig. 26) shows that transects with high detection rates tended to have higher concentrations of very large trees, than stations with low detection rates, or no birds detected.

An important way of viewing the results is a comparison of the number of detections in comparison with the size of stands of old-growth trees. Comparing average detections per transect to the size of the largest stand of old-growth within 1.6 km (1 mile) of the transect (Fig. 27), there is a striking correlation. Stands for this analysis generally had clearly defined borders and were placed into broad size class categories to get some idea if there might be a minimum stand size that murrelets use. Smaller stands, less than 40 ha (100 acres) had very few birds, while transects with the vast majority of murrelets traversed stands greater than 200 ha (500 acres).

The primary habitat type we surveyed this year was redwood dominated, which is where we detected the vast majority of murrelets. As mentioned earlier, murrelet detections were not confined exclusively to redwood dominated stands as birds were heard along Myrtle Creek in the Six Rivers National Forest. The vegetation in this drainage is predominately Douglas-fir and Port Orford Cedar.

DISCUSSION

The overall pattern of murrelet distribution was quite similar to that seen in the offshore survey of Sowls et al. (1980), and the historical inland records compiled by Carter and Erickson (1988). The striking correlations with the presence of old-growth timber in these areas, and the marked discontinuties when old-growth is not present, suggest that the majority of the individuals of this species probably require old-growth forests in California in order to breed. There are some lands which we did not survey that probably have murrelets, of which Miller-Rellim Company land and some other properties in northern Del Norte County are an example.

In all probability, we did not detect murrelets in some areas where the birds occur, especially if they only support an isolated pair. Little is known about the detectability of this species when comparing an isolated pair to a large concentration of murrelets. There is a chance that isolated pairs tend to be quiet and secretive, while large groups tend to be vocal and social.

The largest concentrations are in protected lands of State and National Parks, however, about 10-20% of coastal old-growth lands are not under this protection (Save-the-Redwoods League, pers. comm.). Since present survey methods preclude population estimates, we do not know what the loss of all old-growth habitat on the remaining lands in private hands would mean to the murrelet's population, assuming that it indeed requires old-growth forests. It is our judgement that this would result in an immediate loss of 10-20% of the breeding population. Over the course of the next few hundred years, the population would probably further decline as windfalls, extinction of isolated small populations, and fires further reduce the habitat. After this period, assuming that the species is fairly mobile, we would expect the population to increase, as areas of second-growth in reserve status recover.

It is apparent from preliminary surveys done in Oregon (Kim Nelson, pers. comm.) and Washington (Eric Cummings, pers. comm.), that the California populations are probably the largest south of the Puget Sound area. If so, and if these populations to the north continue to decline, as very little old-growth remains 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 this isolation.

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First and foremost we wish to acknowledge the people who carried out the surveys. The active help of the following employees and volunteers made it all possible. David Craig, Brian O'Donnell, and Bud Widdowson were the mainstays of our effort in the north, ably assisted by Michelle McKenzie, Linda Doerflinger, Nancy Naslund, John Sterling, Dave Vezie, Randy Wilson, and Durrell Kapan. The National Park Service provided personnel at Redwood National Park, Aivars Zakis and Bob Coey, and at Muir Woods National Monument, Mia Monroe and Don Goetz. Help was also obtained from Allen Fish of the Golden Gate Raptor Observatory. California State Park personnel were very important in the north with a great deal of help from Dan Scott, Alan and Barbara Wilkinson, Rick Johnson, Paul Anderson, and Jim Baird. The southern surveys were coordinated by the indefatigable Gary Strachan, Superintendant of Ano Nuevo State Reserve, with able assistance from state Parks employees: Brooks Collum, Heidi Horvitz, Richard French, Terry Roeder, Carol Kemnitz, and Roland Franz, as well as Steve Singer and John Hunter. Tom Sander provided the tape of murrelet calls for training observers.

We are especially grateful to the private land owners who joined with us in this effort to determine the status of this species. These include: Pacific Lumber Company (Robert Stephens), Simpson Lumber Co (Dave Kaney), Louisana Pacific Company (Chuck Ciancio). Six Rivers National Forest (Jack Kahl, David Solis, and Jeff Matteson) gave us moral, financial, and physical help at all stages.

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Fig. 1. A) Distribution of Marbled Murrelet transects in Del Norte and Humboldt Counties, California, in 1988. Numbers correspond to the ID No. column in Table 1. B) Geographic distribution of Marbled Murrelets in Del Norte and Humboldt Counties, California, in 1988 based on data from Table 5. Open circles are transects with no birds detected, small solid circles averaged less than one detection per station and large solid circles are more than one detection per station.

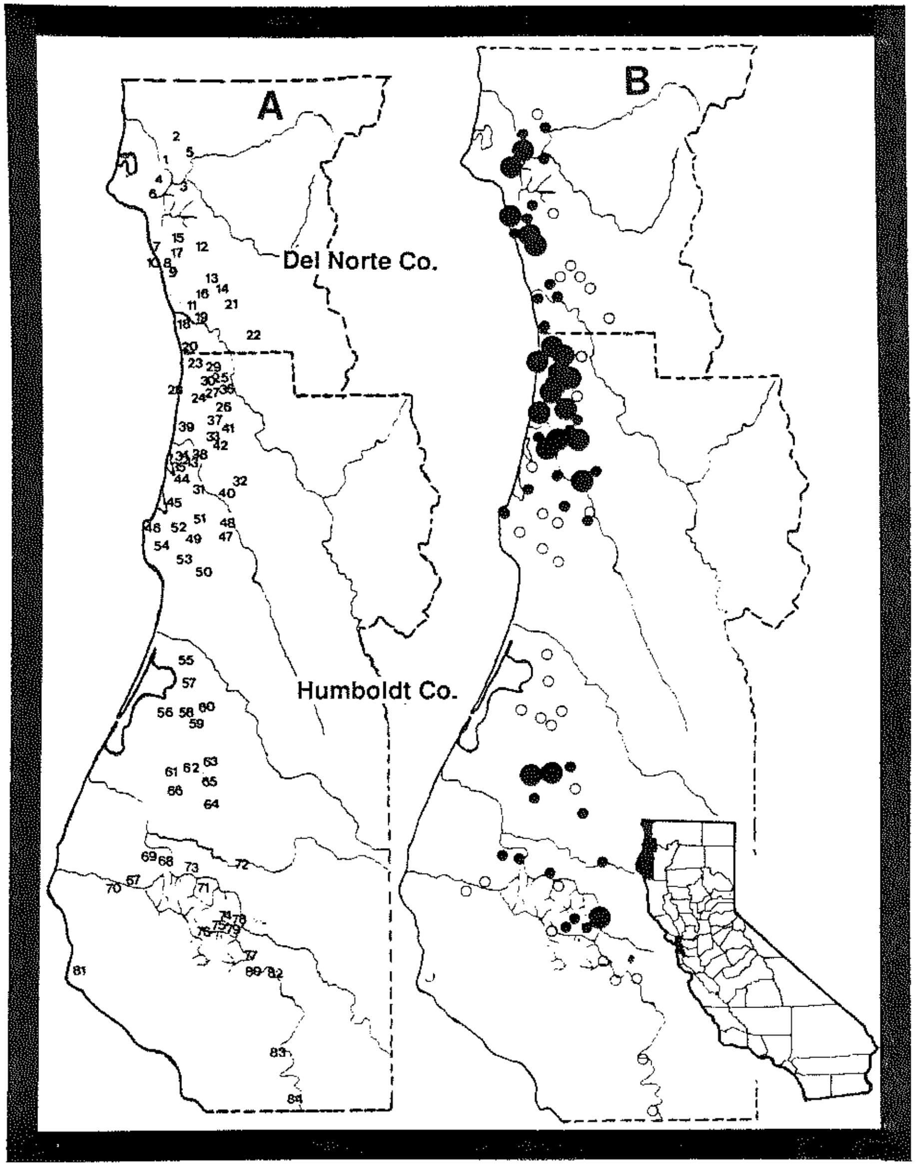

Fig. 2. A) Distribution of old-growth redwood dominated forests in Del Norte and Humboldt Counties, California. Data was generated by Dr. Larry Fox, Humboldt State University, using remote sensing techniques from U2 photos taken in 1986.
B) Distribution of second-growth redwood dominated forests and recent plantations in Del Norte and Humboldt Counties, California.

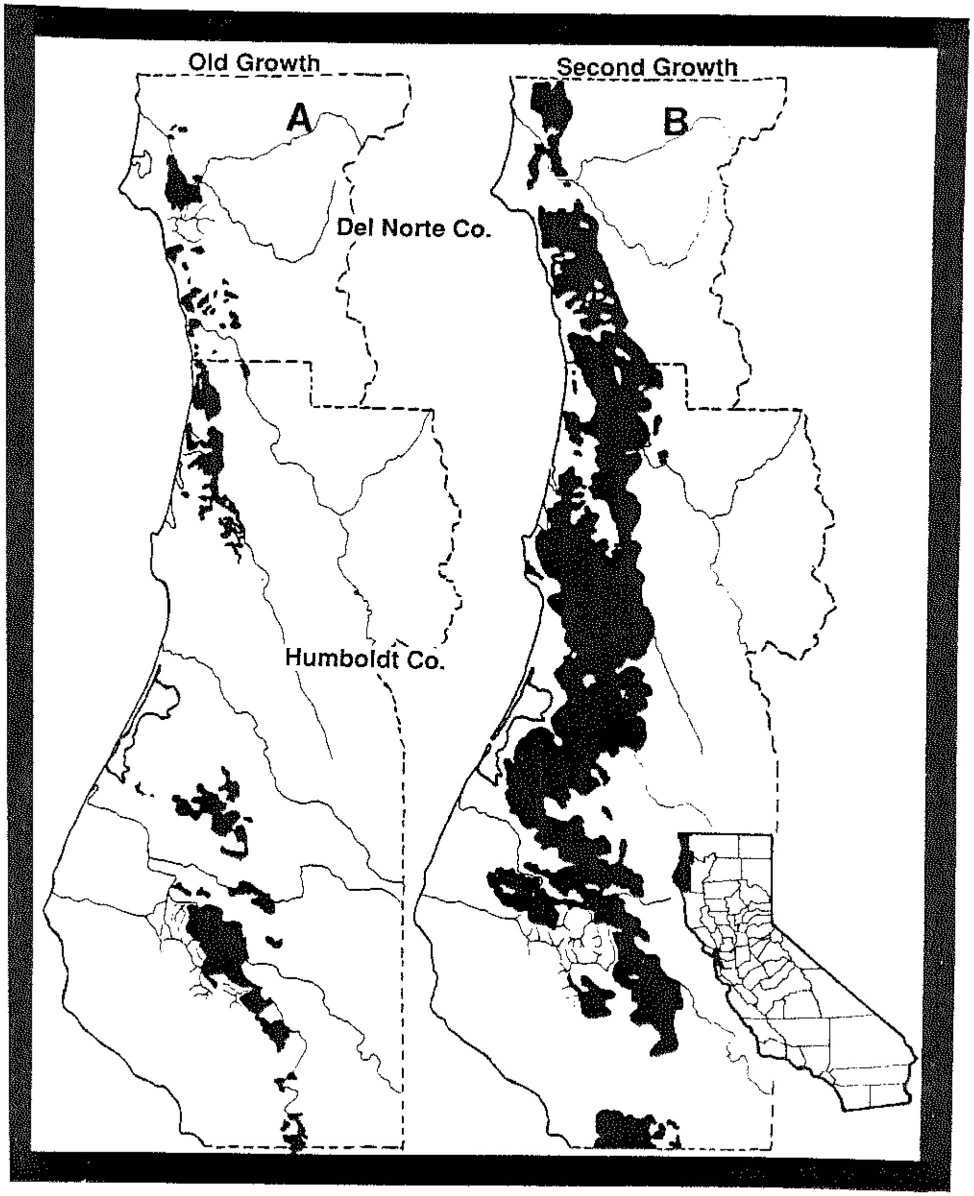

Fig. 3. A) Distribution of Marbled Murrelet transects in Mendocino, Sonoma, and Marin Counties, California, in 1988. Numbers correspond to the ID No. column in Table 1. B) Geographic distribution of Marbled Murrelets in Mendocino, Sonoma, and Marin Counties, California, in 1988 based on data from Table 5. Open circles are transects with no birds detected, small solid circles averaged less than one detection per station and large solid circles are more than one detection per station.

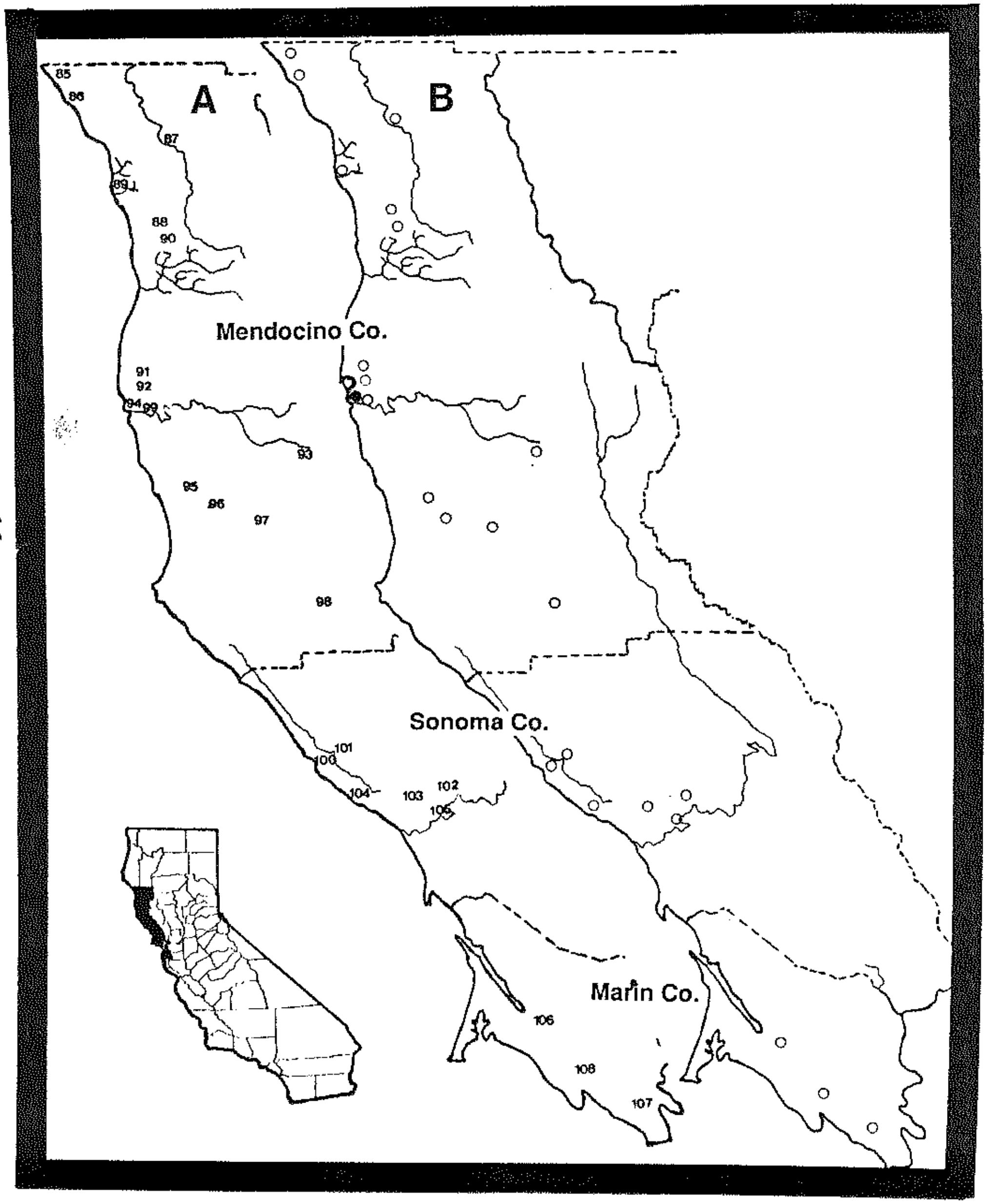

Fig. 4. A) Distribution of old-growth redwood dominated forests in Mendocino, Sonoma, and Marin Counties, California. Data was generated by Dr. Larry Fox, Humboldt State University, using remote sensing techniques from U2 photos taken in 1986.
B) Distribution of second-growth redwood dominated forests and recent plantations in Mendocino, Sonoma, and Marin Counties, California.

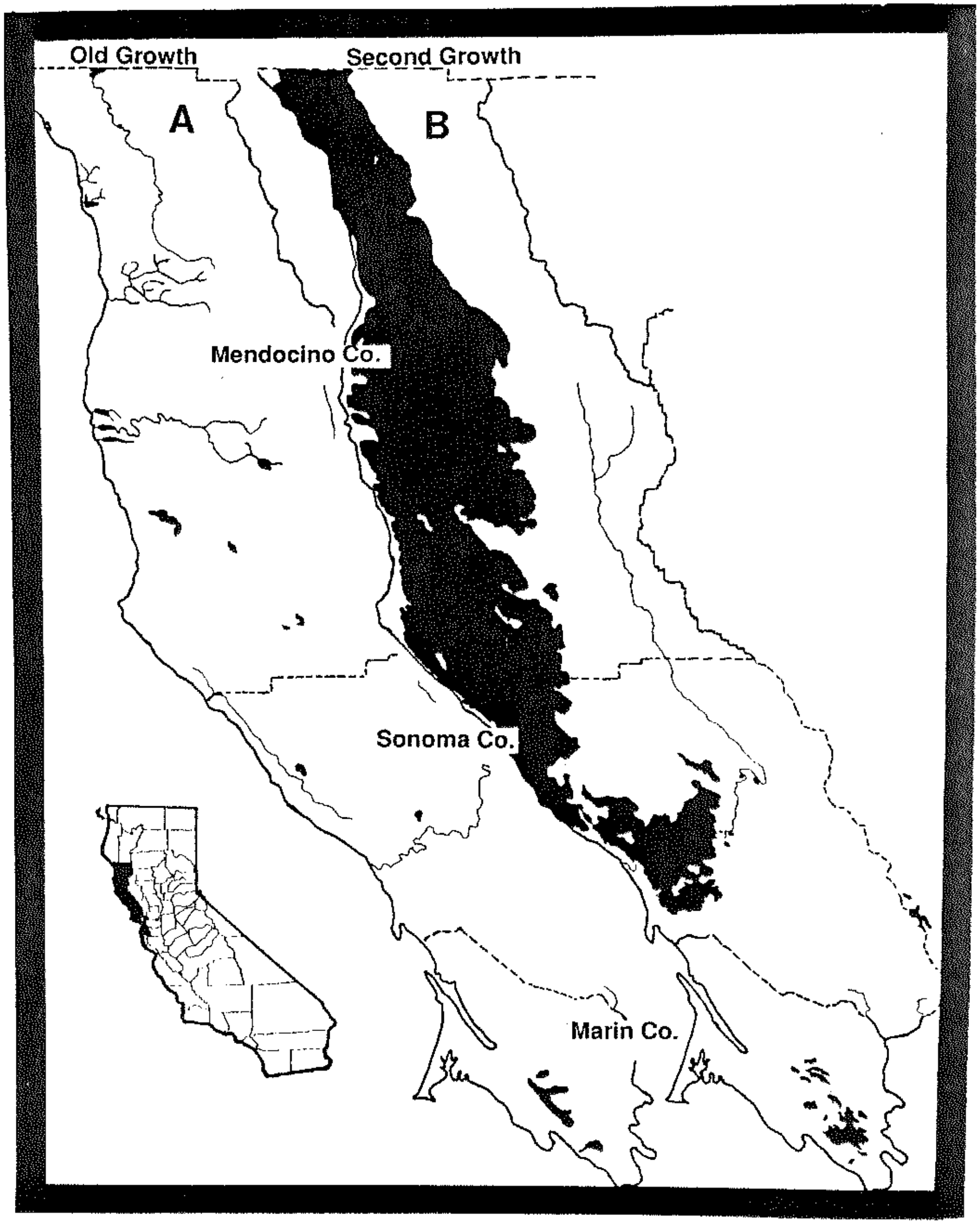

Fig. 5. A) Distribution of Marbled Murrelet transects in San Mateo and Santa Cruz Counties, California, in 1988. Numbers correspond to the ID No. column in Table 1. B) Geographic distribution of Marbled Murrelets in San Mateo and Santa Cruz Counties, California, in 1988 based on data from Table 5. Open circles are transects with no birds detected, small solid circles averaged less than one detection per station and large solid circles are more than one detection per station.

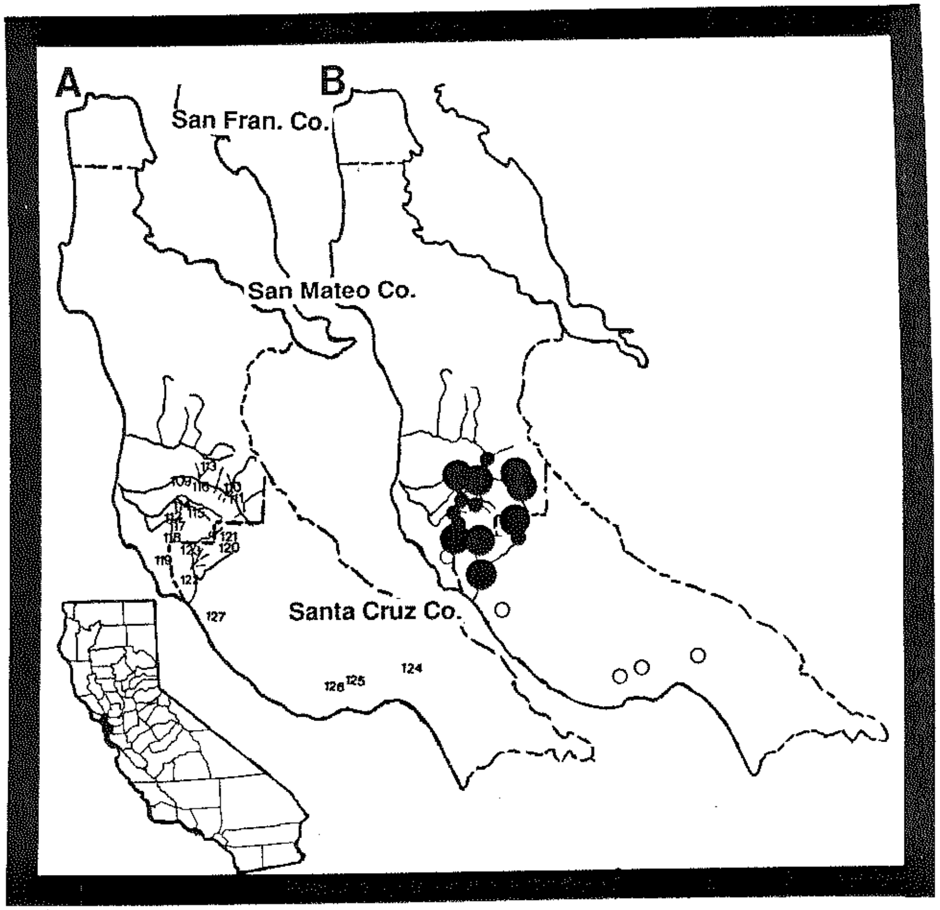

Fig. 6. A) Distribution of old-growth redwood dominated forests in San Mateo and Santa Cruz Counties, California. Data was generated by Dr. Larry Fox, Humboldt State University, using remote sensing techniques from U2 photos taken in 1986.
B) Distribution of second-growth redwood dominated forests and recent plantations in San Mateo and Santa Cruz Counties, California.

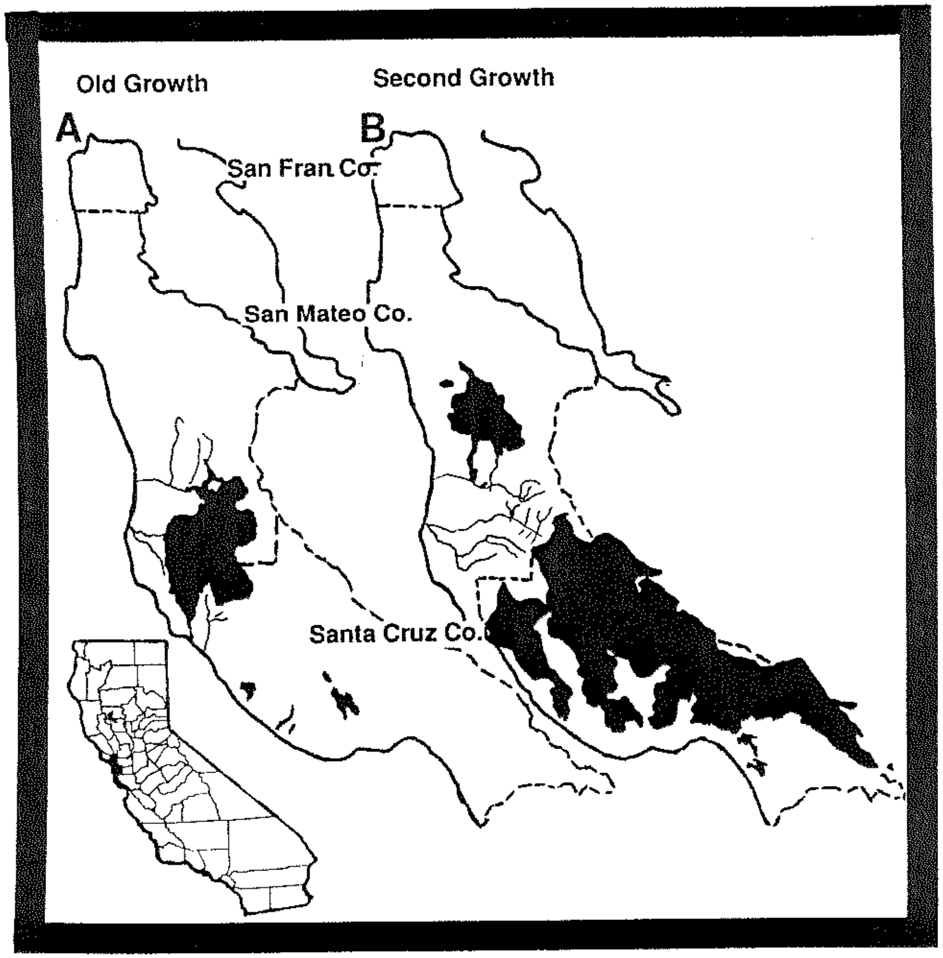

Fig. 7. Transect landowners during the 1988 California murrelet survey.

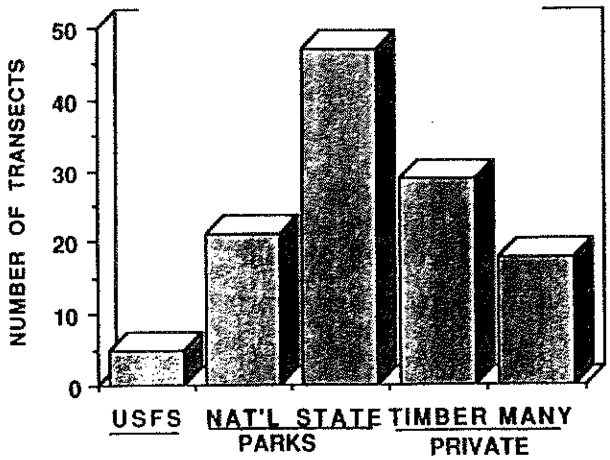

Fig. 8. Seasonal differences in Marbled Murrelets detections during a stationary count at Lost Man Creek, Redwood National Park.

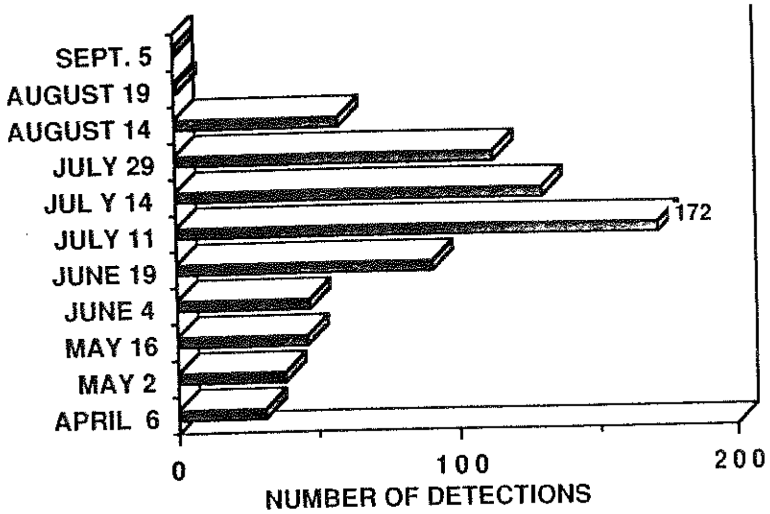

Fig. 9. Differences in murrelet detectability on mornings versus evenings during a stationary count at Lost Man Creek, Redwood National Park.

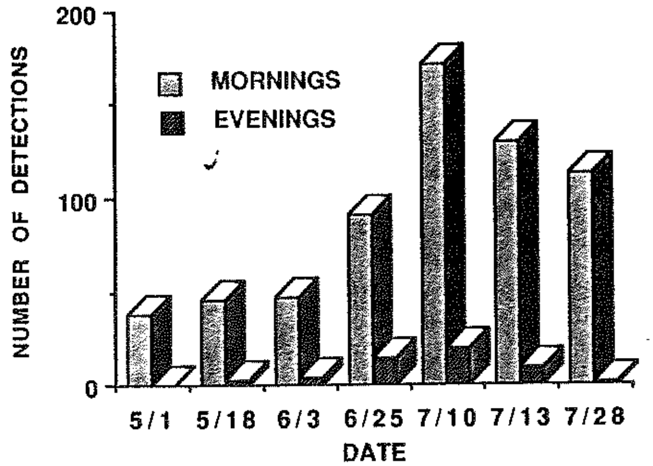

Fig. 10. Probability of detecting a Marbled Murrelet during a 2.25 hour morning census period. Data is derived from transect survey data.

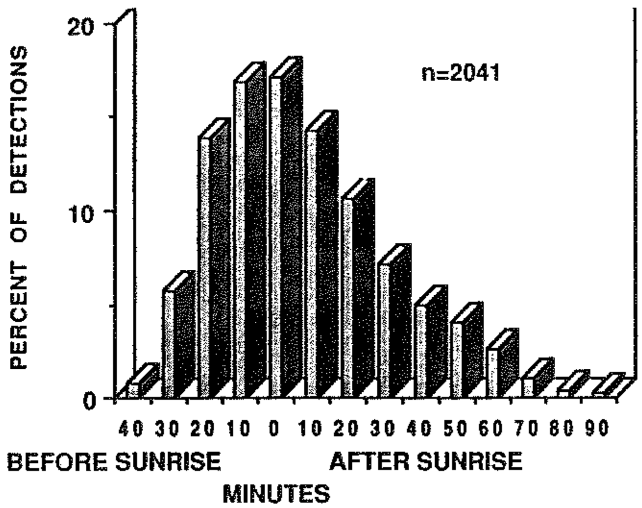

Fig. 11. Probability of detecting a Marbled Murrelet during a 1.25 hour evening census period. Data is derived from stationary counts at Lost Man Creek, Redwood National Park.

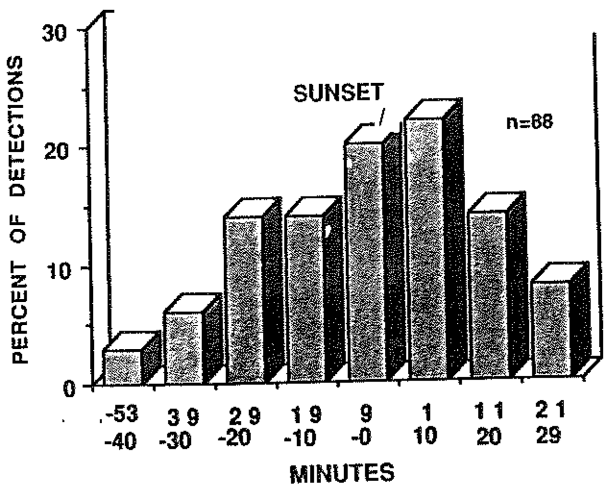

Fig. 12. Probability of only hearing, only seeing, or seeing and hearing a murrelet from transect data. The unknown category is when observer did not record the type of observation.

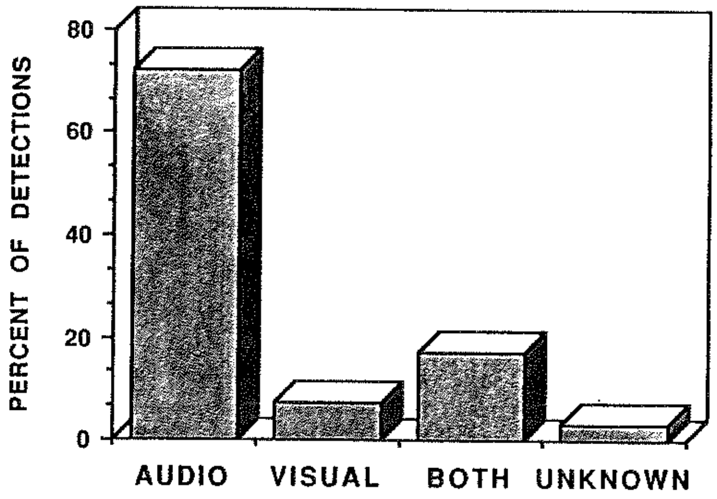

Fig. 13. Number of 'keer' call notes heard during individual murrelet detections from transect data.

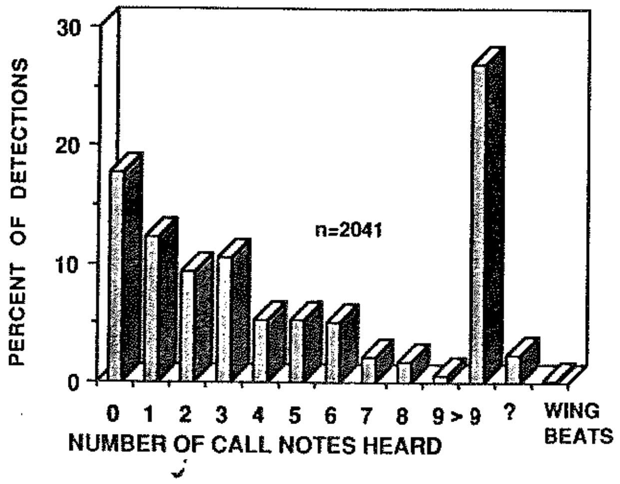

Fig. 14. Flight behavior of murrelets from transect data.

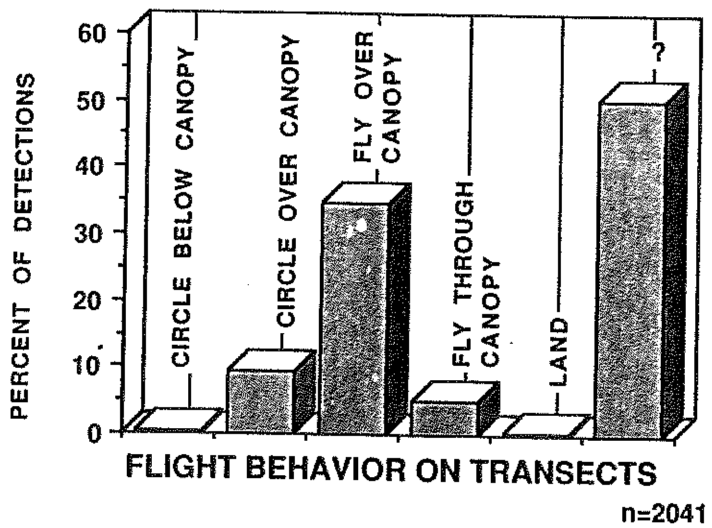

Fig. 15. Flock size during detections when the birds were observed.

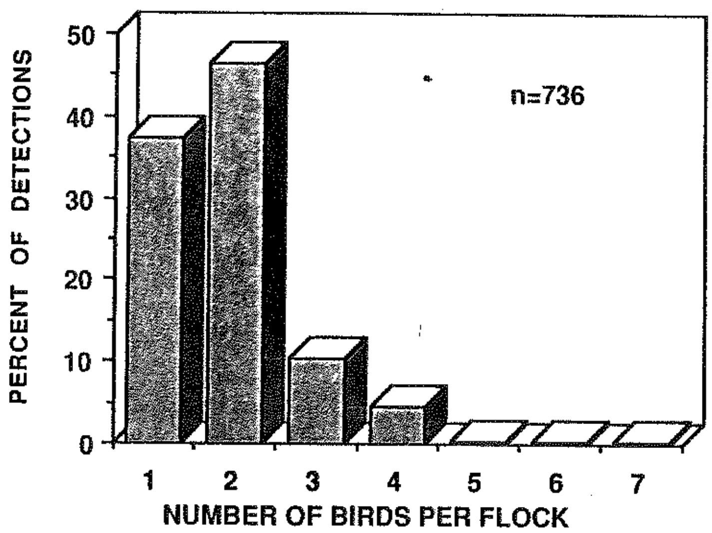

Fig. 16. Marbled Murrelet transect stations in 1988 in the Jedediah State Park region, Del Norte County. The arrows refer to the primary flight path direction of birds leaving the area.

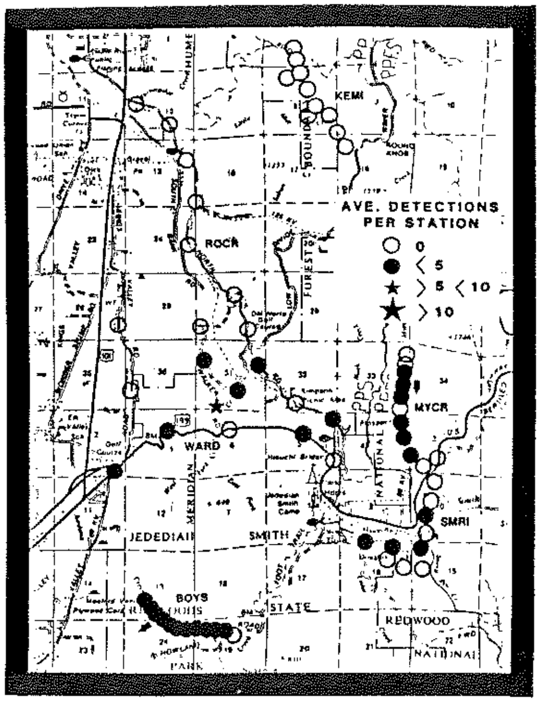

Fig. 17. Marbled Murrelet transect stations in 1988 in Del Norte Coast Redwoods State Park, and Simpson Timber Company lands near Wilson Creek, Del Norte County.

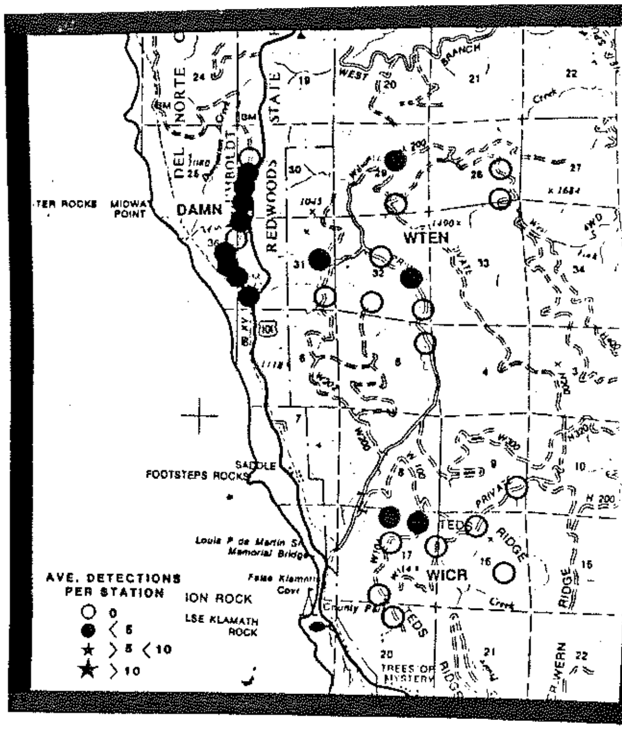

Fig. 18. Marbled Murrelet transect stations in 1988 near the mouth of the Klamath River, Del Norte County. The arrow refers to the primary flight path direction of birds leaving the area.

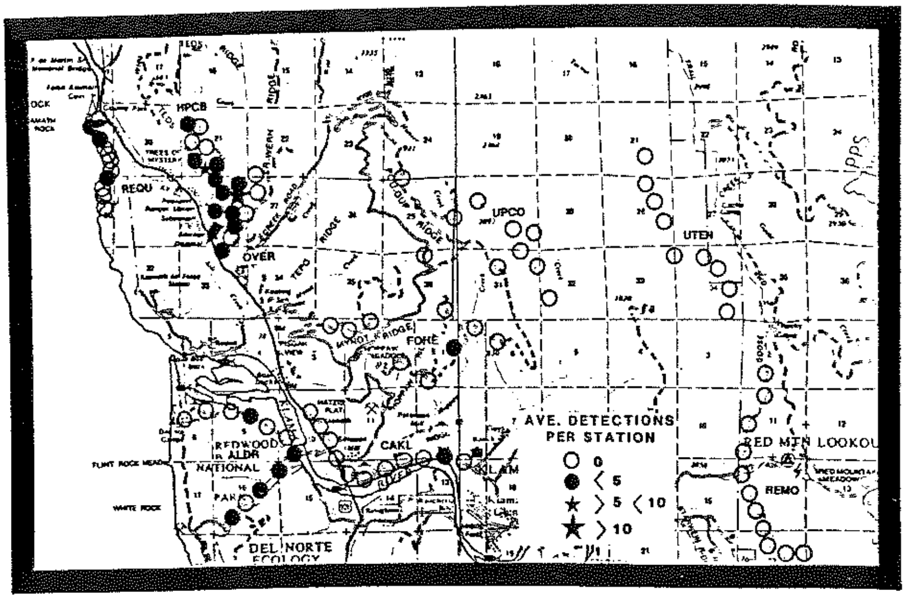

Fig. 19. Marbled Murrelet transect stations in 1988 in Prairie Creek State Park, Humboldt County. Arrows refer to primary flight path directions of birds leaving the area.

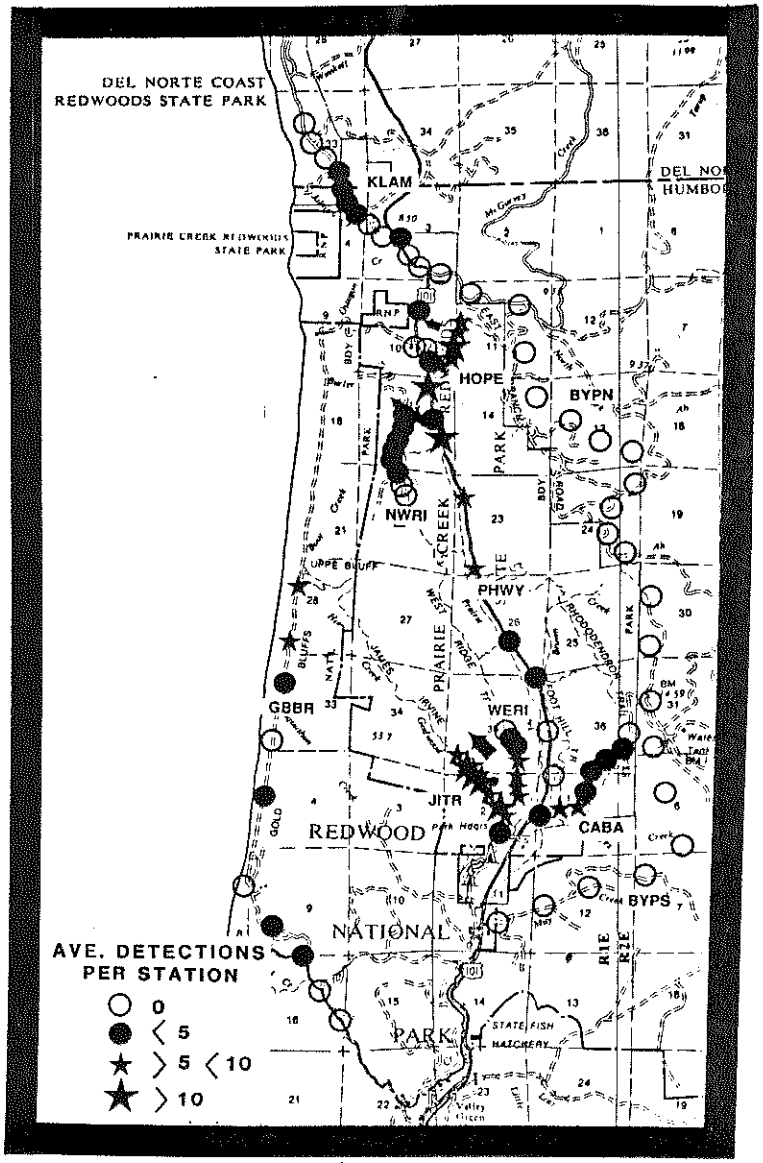

Fig. 20. Marbled Murrelet transect stations in 1988 near Redwood Creek in Redwood National Park, Humboldt County.

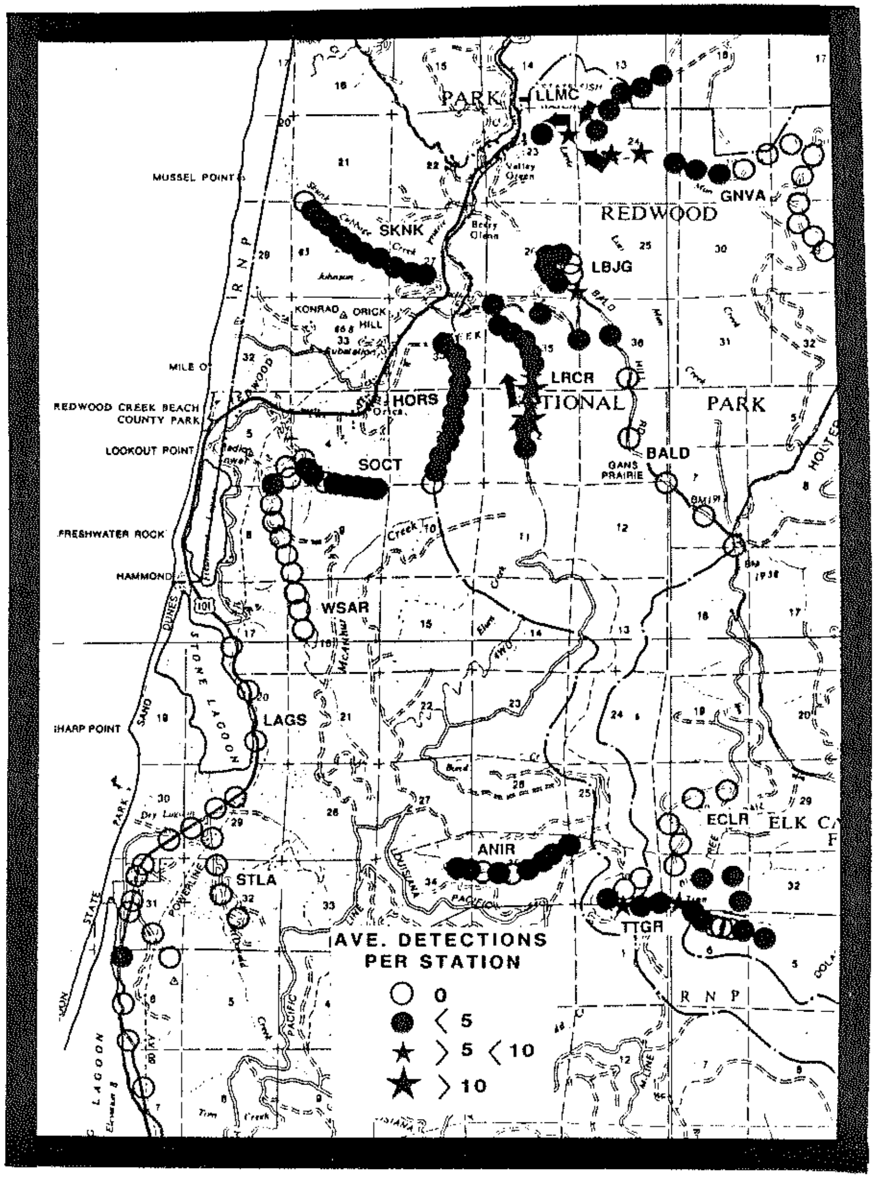

Fig. 21. Marbled Murrelet transect stations in 1988 on or near Louisiana-Pacific lands east of Trinidad, Humboldt County.

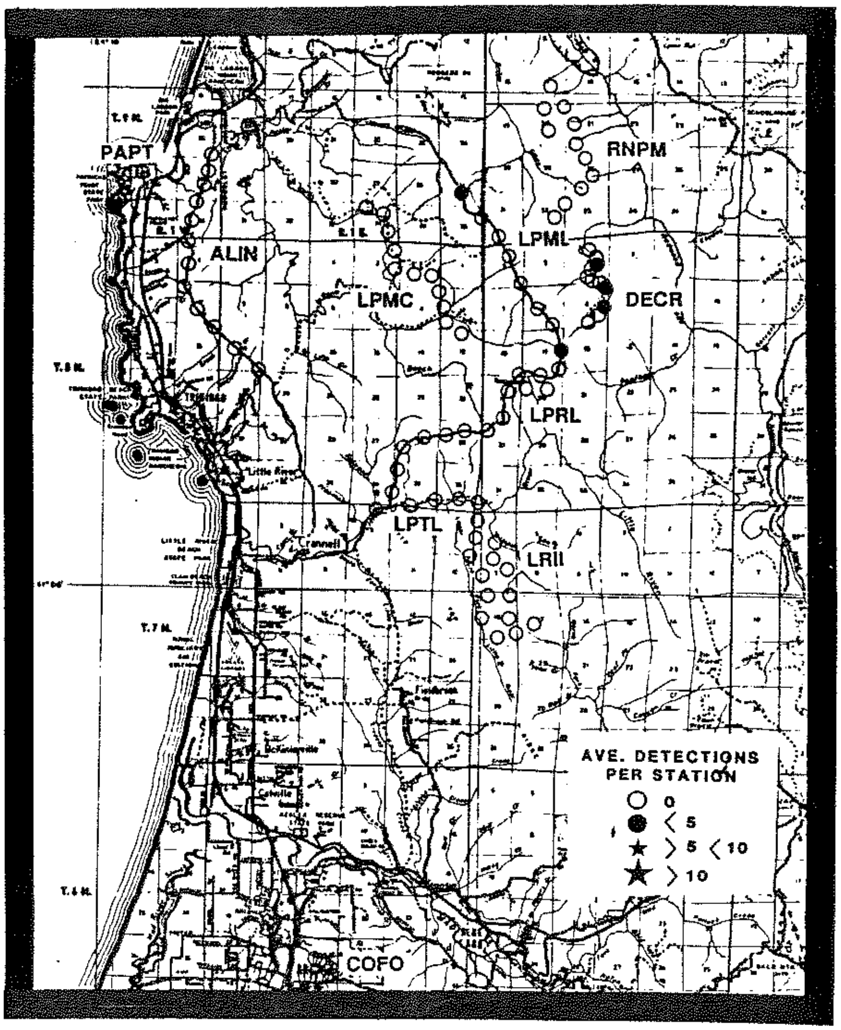

Fig. 22. Marbled Murrelet transect stations in 1988 on Pacific Lumber Company lands, Humboldt County.

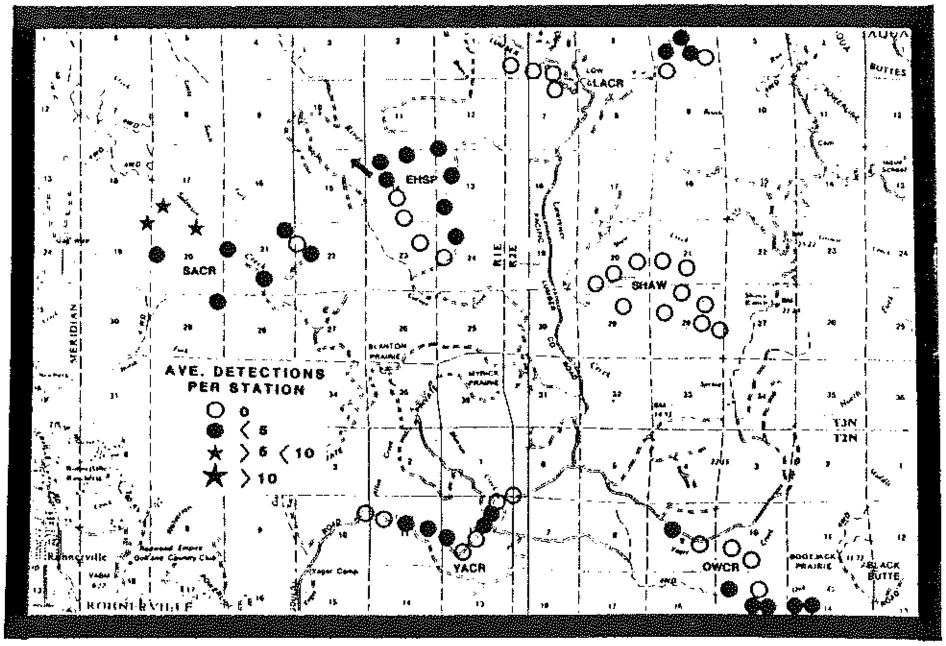

Fig. 23. Marbled Murrelet transect stations in 1988 by Grizzly Creek Redwoods State Park, Humboldt County.

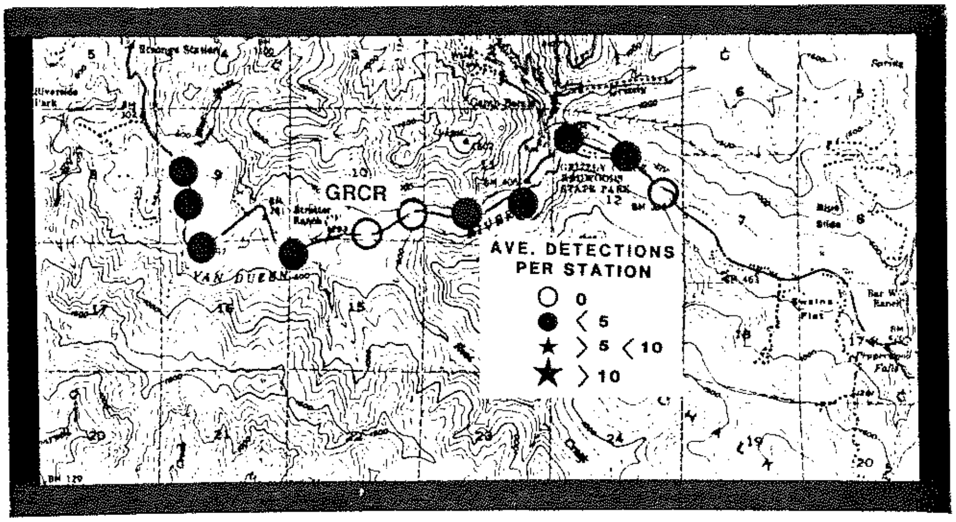

Fig. 24. Marbled Murrelet transect stations in 1988 near Humboldt Redwoods State Park, Humboldt County.

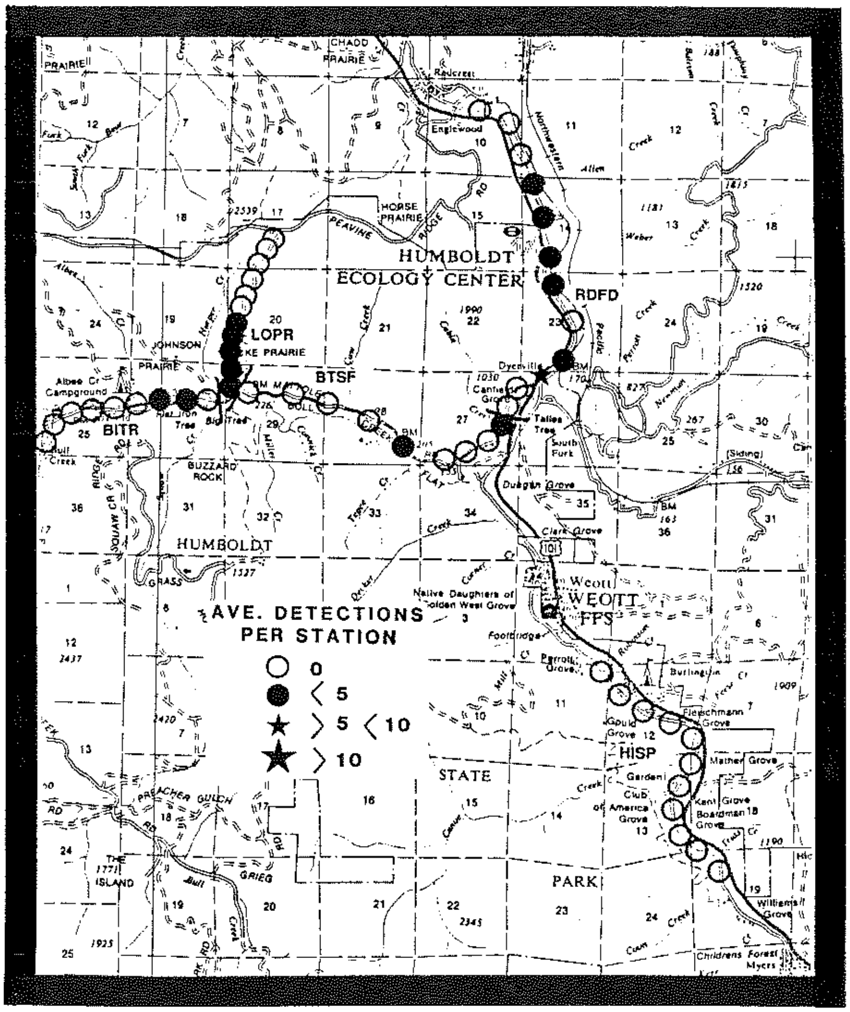

Fig. 25. Marbled Murrelet transect stations in 1988 on or near state park lands in San Mateo and Santa Cruz Counties. The PORT transect paralleled the IVTR and the two were too close to each other to both be shown in this figure.

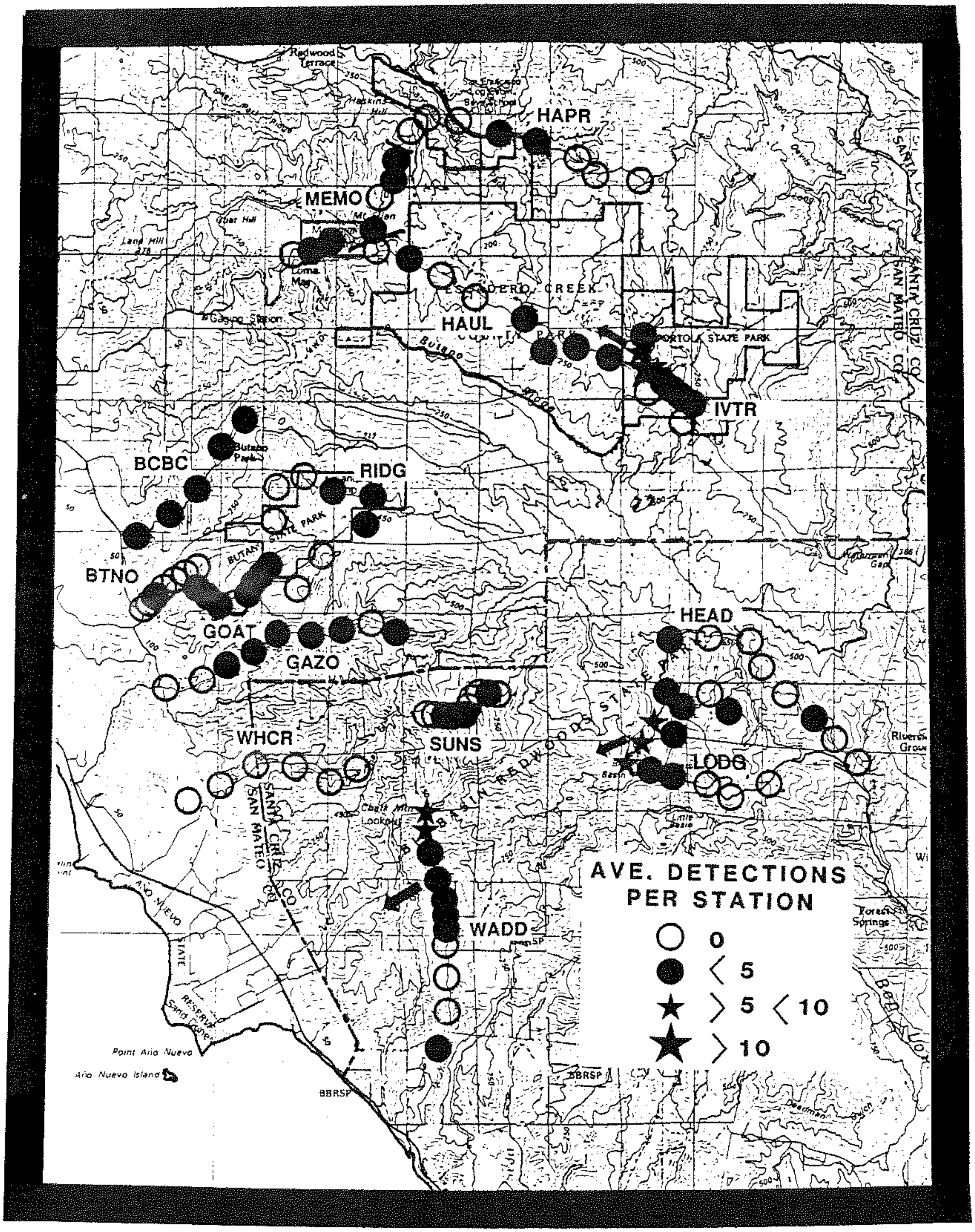

Fig. 26. Relationship between the relative density of trees greater than 1.5m DBH and the average number of murrelet detections, by individual station. The x-axis is a sliding scale ranging from no trees on the left side to many large trees on the right side.

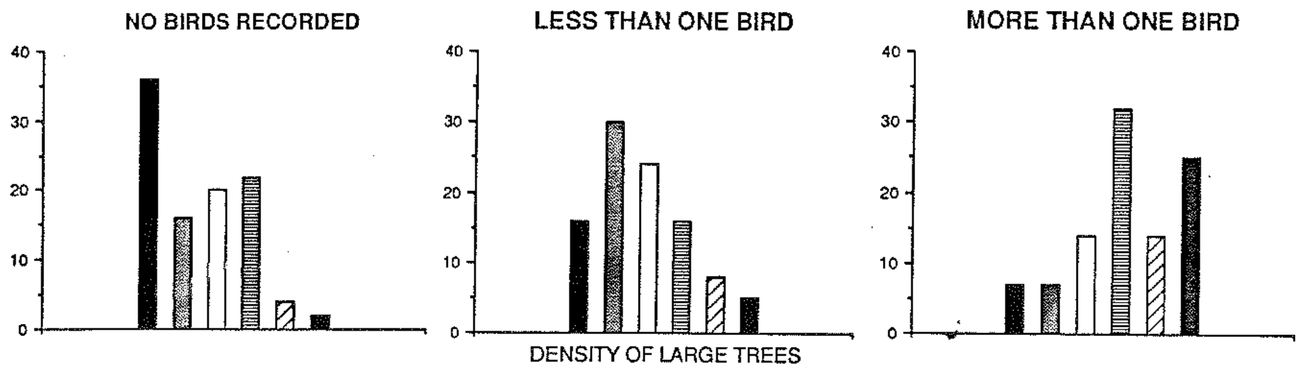

Fig. 27. A comparison of the average number of detections per station to the size of the largest stand of old-growth timber within 1 mile of the murrelet transect in 1988.

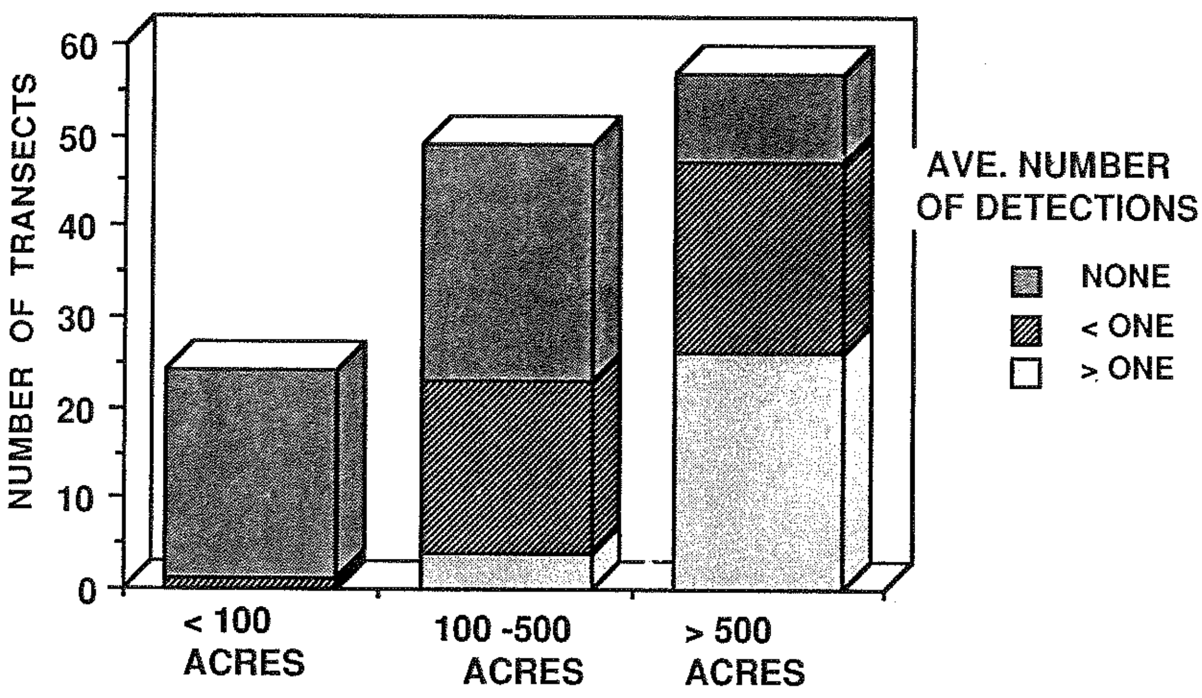

Fig. 28. Miscellaneous observations of Marbled Murrelets on the Chetco Ranger District of Siskiyou National Forest during the summer of 1988 by Paton. Observations were made during morning hours, except sightings on the ocean. (1) Loeb State Park: 6/28-12 detections, 7/13-6 detections, 7/20-1 detection, (2) Mill Creek: 7/12-2 detections, (3) saddle into Wheeler Creek: 7/14-2 detections, of 6 birds flying west, 7/15-8 detections, (4) East Fork of the Winchuck: 7/8-4 detections, (5) East Fork of the Winchuck: 6/29-1 detection, (6) Fourth of July Creek: 7/25-8 detections, (7) mouth of Chetco River: up to 8 birds seen on ocean from 6/9 to 7/25, (8) mouth of Winchuck River: 4 birds observed on 7/22 100m offshore.

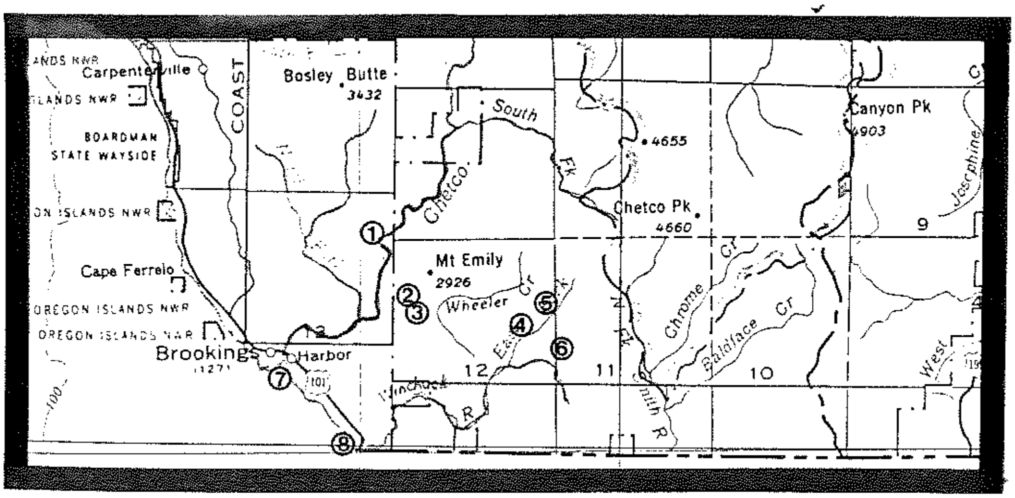

Table 1. Location of Marbled Murrelet census transects during the 1988 California survey. ID No. column gives references numbers for transects in Figures 1a, 3a, 5a. Column "Ocean"=distance from the ocean in kilometers. "Type": CARL=car long, 1 km between points, CARS= car short, 0.5 km between points, WALK= walking 250m between points, BIKE=0.5 km between points on a bike.

ID	TRANSECT	CODE	COUNTY	TOWNSHIP	RANGE	SECTION	OWNER	OCEAN	TYPE
1	ROWDY CREEK	ROCR	DEL NORTE	18N	1E	36	PRIVATE-MANY	9	CARL
2	KERMIT MILLER EXCH.	KEMI	DEL NORTE	17N	1E	8	US FOREST SER.	10	CARS
3	SMITH RIVER/HIOUCHI	SMRI	DEL NORTE	17N	1E	3	PUBLIC/PRIVATE	16	CARL
4	WALKER ROAD	WARD	DEL NORTE	17N	1W	31	STATE PARK	9	CARL
5	MYRTLE CREEK	MYCR	DEL NORTE	16N	1E	4	US FOREST SER.	14	WALK
6	BOY SCOUT TRAIL	BOYS	DEL NORTE	16N	1W	13	STATE PARK	6	WALK
7	DAMNATION TR.(BLUFF)	DAMN	DEL NORTE	15N	1E	30	NAT'L PARK SER	1	BIKE
8	HIGH PRAIRIE - YUROK	HPCB	DEL NORTE	14N	1E	21	US FOREST SER	2	CARS
9	OVERLOOK (YUROK B.)	OVER	DEL NORTE	14N	1E	27	US FOREST SER	3	CARS
10	REQUA (N. KLAM. RIV)	REQU	DEL NORTE	14N	1E	29	NAT'L PARK SER	0	WALK
11	S-A FORESTRY HEADQRT	FOHE	DEL NORTE	13N	1E	2	SIMPSON	5	CARL
12	S-A H500/P500	HFPP	DEL NORTE	14N	2E	5	SIMPSON	13	CARL
13	S-A K-ONE	KONE	DEL NORTE	14N	2E	18	SIMPSON	13	CARL
14	S-A U-TEN	UTEN	DEL NORTE	14N	2E	28	SIMPSON	14	CARL
15	S-A W-TEN	WTEN	DEL NORTE	15N	1E	32	SIMPSON	5	CARL
16	S-A UPPER CORNERS	UPCO	DEL NORTE	14N	2E	30	SIMPSON	11	CARL
17	S-A WILSON CREEK	WICR	DEL NORTE	14N	1E	17	SIMPSON	3	CARL
18	ALDER CAMP (N.KLAM)	ALDR	DEL NORTE	13N	1E	8	NAT'L PARK SER	1	CARL
19	CAMP KLAMATH	CAKL	DEL NORTE	13N	1E	10	PRIVATE-MANY	2	CARL
20	KLAMATH	KLAM	DEL NORTE	13N	1E	33	NAT'L PARK SER	1	CARL
21	RED MOUNTAIN	REMO	DEL NORTE	13N	2E	14	US FOREST SER	16	CARL
22	S-A B-900	BNHU	HUMBOLDT	12N	3E	17	SIMPSON	18	CARL
23	NORTH WEST RIDGE	NWRI	HUMBOLDT	12N	1E	10	STATE PARK	2	WALK
24	JAMES IRVINE	JITR	HUMBOLDT	11N	1E	2	STATE PARK	4	WALK
25	NORTH BY-PASS	BYPN	HUMBOLDT	12N	1E	13	NAT'L PARK SER	5	CARL
26	SOUTH BY-PASS	BYPS	HUMBOLDT	12N	2E	31	NAT'L PARK SER	6	CARL
27	WEST RIDGE TRAIL	WERI	HUMBOLDT	11N	1E	2	STATE PARK	5	WALK
28	GOLD BLUFF ROAD	GBBR	HUMBOLDT	12N	1E	33	STATE PARK	0	WALK
29	HOPE CREEK-TEN TAPPO	HOPE	HUMBOLDT	12N	1E	11	STATE PARK	3	WALK
30	PRAIRIE CREEK HWY101	PHWY	HUMBOLDT	12N	1E	26	STATE PARK	3	CARL
31	A-9 ROAD	ANIR	HUMBOLDT	10N	1E	35	NAT'L PARK SER	5	CARS
32	EAST C-LINE ROAD	ECLR	HUMBOLDT	10N	2E	31	NAT'L PARK SER	10	CARS
33	LADY BIRD JOHNSON	LBJG	HUMBOLDT	11N	1E	26	NAT'L PARK SER	4	WALK
34	SOUTH OPERATIONS	SOCT	HUMBOLDT	10N	1E	4	NAT'L PARK SER	2	WALK
35	WEST SIDE ACCESS RD	WSAR	HUMBOLDT	10N	1E	8	NAT'L PARK SER	2	CARS
36	CAL-BARREL RD.	CABA	HUMBOLDT	11N	1E	1	STATE PARK	4	CARL
37	LOST MAN PICNIC AREA	LLMC	HUMBOLDT	11N	1E	24	NAT'L PARK SER	5	CARS
38	LOWER REDWOOD CREEK	LRCK	HUMBOLDT	11N	1E	2	NAT'L PARK SER	4	WALK
39	SKUNK CABBAGE CREEK	SKNK	HUMBOLDT	11N	1E	28	NAT'L PARK SER	2	WALK
40	TALL TREES GROVE	TTGR	HUMBOLDT	9N	1E	1	NAT'L PARK SER	8	WALK
41	GENEVA ROAD	GNVA	HUMBOLDT	11N	2E	19	NAT'L PARK SER	9	CARS
42	BALD HILLS ROAD	BALD	HUMBOLDT	10N	1E	1	NAT'L PARK SER	6	CARL
43	ORICK HORSE TRAIL	HORS	HUMBOLDT	10N	1E	3	NAT'L PARK SER	3	WALK
44	STONE LAGOON	STLA	HUMBOLDT	10N	1E	29	PRIVATE-MANY	1	CARL
45	LAGOONS (STONE-BIG)	LAGS	HUMBOLDT	10N	1E	16	STATE PARK	1	CARS
46	PATRICK'S POINT	PAPT	HUMBOLDT	9N	1W	26	STATE PARK	0	BIKE
47	DEVIL'S CREEK	DECR	HUMBOLDT	9N	2E	16	NAT'L PARK SER	17	WALK
48	M-LINE (S. RNP)	RNPM	HUMBOLDT	9N	2E	8	NAT'L PARK SER	14	CARL
49	LP #5 R-LINE	LPRL	HUMBOLDT	8N	1E	25	LOUISIANA-PAC.	8	CARL
50	LP #2 LITTLE RIVER 2	LRII	HUMBOLDT	7N	1E	7	LOUISIANA-PAC.	4	CARL
51	LP #3 M-LINE	LPML	HUMBOLDT	8N	2E	6	LOUISIANA-PAC.	10	CARL
52	LP #6 MAPLE CREEK	LPMC	HUMBOLDT	8N	1E	12	LOUISIANA-PAC.	9	CARL
53	LP #4 T-LINE	LPTL	HUMBOLDT	8N	1E	16	LOUISIANA-PAC.	6	CARL
54	LP #1 A-LINE	ALIN	HUMBOLDT	8N	1E	8	LOUISIANA-PAC.	2	CARL
55	ARCATA COMM. FOREST	COFO	HUMBOLDT	6N	1E	27	ARCATA CITY	8	WALK
56	LOWER MITCHELL ROAD	LMRD	HUMBOLDT	5N	1E	31	PRIVATE-MANY	8	CARL
57	JACOBY CREEK	JACR	HUMBOLDT	5N	1E	11	PRIVATE-MANY	13	CARL
58	FRESHWATER/KNEELAND	FRES	HUMBOLDT	4N	1E	1	PACIFIC LUMBER	19	CARL
59	PL LOW FRESHWATER CR	LFWC	HUMBOLDT	4N	1E	26	PACIFIC LUMBER	18	BIKE
60	PL MCCREADY GULCH	MCGU	HUMBOLDT	5N	1E	34	PACIFIC LUMBER	16	CARS
61	PL SALMON CREEK	SACR	HUMBOLDT	3N	1E	20	PACIFIC LUMBER	10	CARL
62	PL ELK'S HEAD SPRING	EHSP	HUMBOLDT	3N	1E	14	PACIFIC LUMBER	20	CARL
63	PL LAWRENCE CREEK	LACR	HUMBOLDT	3N	2E	8	PACIFIC LUMBER	23	CARL
64	PL OWL CREEK	OWCR	HUMBOLDT	2N	2E	15	PACIFIC LUMBER	32	CARL
65	PL SHAW CREEK	SHAW	HUMBOLDT	3N	2E	20	PACIFIC LUMBER	28	CARL
66	PL YEAGER CREEK	YACR	HUMBOLDT	2N	1E	11	PACIFIC LUMBER	26	CARL
67	PL BEAR RIVER VALLEY	BERI	HUMBOLDT	1S	1W	11	PACIFIC LUMBER	19	CARL
68	PL GREENLAW CREEK	GLAW	HUMBOLDT	1N	1E	36	PACIFIC LUMBER	29	CARL
69	PL MONUMENT CREEK	MOCR	HUMBOLDT	1N	1E	19	PACIFIC LUMBER	21	WALK
70	PL LONG RIDGE	LORI	HUMBOLDT	1S	1W	16	PACIFIC LUMBER	14	CARL
71	PL REDCREST	REDC	HUMBOLDT	1S	2E	8	PACIFIC LUMBER	32	CARL
72	GRIZZLY CREEK	GRCR	HUMBOLDT	1N	2E	10	GC STATE PARK	36	CARL
73	PEPPERWOOD	PEPP	HUMBOLDT	1N	1E	32	PRIVATE/STATE	31	CARL
74	HUM RED/LOOK PRAIRIE	LOPR	HUMBOLDT	1S	2E	20	HR STATE PARK	30	CARL
75	HUM RED/BIG TREE	BITR	HUMBOLDT	1S	1E	25	HR STATE PARK	26	CARL
76	HUM RED/BULL CREEK	BUCR	HUMBOLDT	2S	1E	11	HR STATE PARK	23	CARL
77	HUM RD/HIDDEN SPRING	HISP	HUMBOLDT	2S	3E	7	HR STATE PARK	28	CARL
78	REDCREST/FEDERATION	RDFD	HUMBOLDT	1S	2E	23	HR STATE PARK	35	CARL
79	BIG TREES/SOUTH FORK	BTSF	HUMBOLDT	1S	2E	29	HR STATE PARK	32	CARL
80	MIRANDA/MYERS FLAT	MIMF	HUMBOLDT	2S	3E	28	PRIVATE/STATE	27	CARL
81	MILL CREEK	MILL	HUMBOLDT	2S	2W	17	EEL RIVER SAW.	5	CARS
82	MIRANDA	MIRA	HUMBOLDT	2S	3E	34	STATE PARK	27	CARL
83	REDWAY	REDW	HUMBOLDT	4S	3E	11	STATE PARK	21	CARL
84	PIERCY	PIER	HUMBOLDT	5S	3E	35	STATE PARK	19	CARS
85	SANCTUARY FOREST	SAFO	MENDOCINO	5S	2E	34	EEL RIVER SAW.	5	CARS
86	BEAR HARBOR	BEHA	MENDOCINO	24N	19W	25	B. LAND. MGT.	0	WALK
87	STANDISH HICKEY	STHI	MENDOCINO	23N	17W	3	STATE PARK	11	CARS
88	NO. COAST PRESERVE	NCPR	MENDOCINO	22N	16W	28	NATURE CONSER.	15	CARS
89	ROCKPORT	ROCK	MENDOCINO	22N	18W	23	PRIVATE-MANY	1	CARS
90	ADM. STANDLEY	ADST	MENDOCINO	21N	16W	26	STATE PARK	17	CARS
91	CASPAR CREEK	CACR	MENDOCINO	18N	17W	9	STATE FOREST.	6	CARL
92	JACKSON STATE FOR.	JASF	MENDOCINO	18N	17W	2	STATE FOREST.	5	CARS
93	MONTGOMERY WOODS SP	MOWO	MENDOCINO	16N	14W	23	MW STATE PARK	34	WALK
94	RUSSIAN G/VAN DAMME	RGVD	MENDOCINO	16N	17W	4	VD STATE PARK	4	CARL
95	NAVARRO RIVER	NARI	MENDOCINO	15N	16W	16	PRIVATE-MANY	6	CARL
96	PHILO-GREENWOOD	PHGR	MENDOCINO	14N	14W	19	STATE PARK	11	CARL
97	HENDY GROVE	HEGR	MENDOCINO	14N	15W		STATE PARK	19	CARS
98	MAILLARD REDWOODS	MAIL	MENDOCINO	12N	13W	8	STATE PARK	21	CARS
99	MENDOCINO WOODLANDS	MWDL	MENDOCINO	17N	17W	24	STATE PARK	8	CARS
100	KRUSE RHODO SP	KRRH	SONOMA	9N	13W	28	STATE PARK	1	CARS
101	TIN BARN ROAD	TBRO	SONOMA	9N	13W	15	PRIVATE-MANY	6	CARS
102	ARMSTRONG REDWOODS	ARRE	SONOMA	8N	10W	7	STATE PARK	14	WALK
103	CAZADERO HIGHWAY	CAHI	SONOMA	8N	11W	18	PRIVATE-MANY	5	CARL
104	FT. ROSS	FORO	SONOMA	8N	12W		LOUISIANA PAC.	1	WALK
105	RUSSIAN RIVER	RURI	SONOMA	7N	10W	6	PRIVATE-MANY	11	CARL
106	SAMUEL P. TAYLOR	SPTP	MARIN	2N	8W		STATE PARK	8	CARL
107	MUIR WOODS	MUIR	MARIN	1N	7W		NAT'L PARK SER	3	CARS
108	KENT LAKE	KENT	MARIN	1N	8W		STATE PARK	6	CARL
109	SAN MATEO MEM. PARK	MEMO	SAN MATEO	7S	4W	34	COUNTY PARK	10	CARL
110	PORTOLA SP	PORT	SAN MATEO	8S	3W	8	STATE PARK	18	CARL
111	IVERSON TRAIL	IVTR	SAN MATEO	8S	3W	8	STATE PARK	18	WALK
112	BUTANO SP	BTNO	SAN MATEO	8S	4W	29	STATE PARK	5	WALK
113	HERITAGE/ALPINE	HAPR	SAN MATEO	8S	4W	1	PRIVATE-MANY	13	CARL
114	BUTANO CREEK	BCBC	SAN MATEO	8S	4W	17	PRIVATE-MANY	8	CARL
115	RIDGE TRAIL	RIDG	SAN MATEO	8S	4W	22	STATE PARK	10	CARL
116	PESCADERO/HAUL ROAD	HAUL	SAN MATEO	8S	4W	1	PRIVATE-MANY	14	CARL
117	GOAT HILL/BUTANO SP	GOAT	SAN MATEO	8S	4W	27	STATE PARK	5	WALK
118	GAZOS CREEK	GAZO	SAN MATEO	8S	4W	28	STATE PARK	6	CARL
119	WHITEHOUSE CREEK	WHCR	SAN MATEO	8S	5W		STATE PARK	4	CARL
120	LODGE ROAD	LODG	SANTA CRUZ	9S	3W	4	STATE PARK	11	CARL
121	BIG BASIN SP HEADQRT	HEAD	SANTA CRUZ	8S	3W	33	STATE PARK	12	CARL
122	WADDELL CREEK	WADD	SANTA CRUZ	9S	4W	23	STATE PARK	4	CARL
123	SUNSET TRAIL BB	SUNS	SANTA CRUZ	9S	4W	2	STATE PARK	8	WALK
124	APTOS/NISENE MARKS	APTO	SANTA CRUZ	10S	1E		STATE PARK	7	CARL
125	HENRY COWELL SP	HECW	SANTA CRUZ	10S	2W	26	STATE PARK	8	CARS
126	HIGHWAY 9/SANTA CRUZ	HWYN	SANTA CRUZ	10S	2W	29	PRIVATE-MANY	8	CARS
127	SWANTON ROAD	SWAN	SANTA CRUZ	10S	3W	2	PRIVATE-MANY	1	CARL

Table 2. Summary of all Marbled Murrelet morning stationary counts in 1988, which lists the total number of detections and estimated total number of birds for each day's survey.

	TRANSECT NAME	OWNER	CODE	MONTH	DAY	NO. OF DETECTIONS	NO. OF BIRDS
1	BIG BASIN SP	STATE PARK	BBSP	6	19	75	124
2	CASCADE RANCH	PRIVATE	CASP	7	12	5	9
3	CHETHAM GROVE	STATE PARK	CHET	5	6	0	0
4	GRIZZLY CR. SP	STATE PARK	GRIZ	5	5	3	4
5	JED. SMITH SP	STATE PARK	JEDS	7	23	10	21
6	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	4	6	31	58
7	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	5	2	38	65
8	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	5	16	46	83
9	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	6	4	47	88
10	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	6	19	91	128
11	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	11	172	334
12	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	14	130	272
13	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	29	113	225
14	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	8	14	58	90
15	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	8	19	1	1
16	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	9	5	0	0
17	MILL CREEK	EEL RIVER SAWM	MILL	6	5	0	0
18	PORTOLA SP	STATE PARK	PORT	5	28	45	83
19	PRAIRIE CR. SP	REDWOOD NAT'L P	PRAI	5	24	58	99
20	REDWOOD CREEK	REDWOOD NAT'L P	RECR	9	5	5	5
21	REDWOOD EX. FOR	US FOREST SER	REFO	5	1	31	60
22	REDWOOD EX. FOR	US FOREST SER	REFO	5	14	24	43
23	REDWOOD EX. FOR	US FOREST SER	REFO	5	21	24	36
24	REDWOOD EX. FOR	US FOREST SER	REFO	7	1	18	25
25	REDWOOD EX. FOR	US FOREST SER	REFO	7	1	11	12
26	REDWOOD EX. FOR	US FOREST SER	REFO	7	1	7	8
27	REDWOOD EX. FOR	US FOREST SER	REFO	7	18	95	134
28	REDWOOD EX. FOR	US FOREST SER	REFO	7	18	?	53
29	REDWOOD EX. FOR	US FOREST SER	REFO	7	19	?	77
30	REDWOOD EX. FOR	US FOREST SER	REFO	7	19	?	51
31	REDWOOD EX. FOR	US FOREST SER	REFO	7	19	?	55
32	REDWOOD EX. FOR	US FOPEST SER	REFO	7	20	?	64
33	REDWOOD EX. FOR	US FOREST SER	REFO	7	21	146	214
34	REDWOOD EX. FOR	US FOREST SER	REFO	7	23	41	67
35	REDWOOD EX. FOR	US FOREST SER	REFO	7	26	52	52
36	TWIN REDWOODS	STATE PARK	TWRE	5	30	3	5
37	WADDELL CREEK	STATE PARK	WADD	5	22	6	20

Table 3. Summary of all Marbled Murrelet evening stationary counts in 1988.

	TRANSECT NAME	OWNER	CODE	MONTH	DAY	NO. OF DETECTIONS	NO. OF BIRDS
1	ARCATA COM FOR	ARCATA CITY	ACFI	4	30	0	0
2	ANO NUEVO SP	STATE PARK	ANON	5	22	2	5
3	BUTANO SP	STATE PARK	BCBC	6	12	1	1
4	BUTANO SP	STATE PARK	BCBC	6	15	0	0
5	BUTANO SP	STATE PARK	BCBC	6	18	0	0
6	BUTANO SP	STATE PARK	BCBC	6	24	0	0
7	BUTANO SP	STATE PARK	BCBC	6	30	0	0
8	BUTANO SP	STATE PARK	BCBC	7	8	1	2
9	BUTANO SP	STATE PARK	BCBC	7	8	1	1
10	BUTANO SP	STATE PARK	BCBC	7	10	1	2
11	BUTANO SP	STATE PARK	BTNO	6	22	0	0
12	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	5	1	0	0
13	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	5	18	3	5
14	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	5	19	0	0
15	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	6	3	4	4
16	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	6	25	14	15
17	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	10	20	28
18	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	13	9	9
19	LOSTMAN CREEK	REDWOOD NAT'L P	LOST	7	28	1	1
20	PRAIRIE CR. SP	STATE PARK	PCRH	7	5	11	23
21	REDWOOD CREEK	REDWOOD NAT'L P	RECR	7	19	10	15
22	REDWOOD EX. FOR	US FOREST SER	REFO	5	20	0	0
23	REDWOOD EX. FOR	US FOREST SER	REFO	6	30	0	0
24	REDWOOD EX. FOR	US FOREST SER	REFO	6	30	0	0
25	REDWOOD EX. FOR	US FOREST SER	REFO	6	30	0	0
26	REDWOOD EX. FOR	US FOREST SER	REFO	7	15	0	0
27	REDWOOD EX. FOR	US FOREST SER	REFO	7	18	6	9
28	TWIN REDWOODS	STATE PARK	TWRE	5	29	0	0
29	WADDELL CREEK	STATE PARK	WADD	5	21	12	31
30	WADDELL CREEK	STATE PARK	WADD	6	5	2	2
31	WOODLAWN VILLA	PRIVATE	WOGR	6	1	1	1

Table 4. Summary of every murrelet transect each morning it was censused in 1988. Transects are listed in alphabetical order, with the number of survey stations, total number of detections, average number of detections per station, total number of birds, and average number of birds per station listed.

TRANSECT	CODE	MONTH	DAY	NO. STA	NO. DETECT	DETECT/STA	NO. BIRDS	NO./STA
ADM. STANDLEY	ADST	6	23	11	0	0.00	0	0.00
ADM. STANDLEY	ADST	7	26	11	0	0.00	0	0.00
ALDER CAMP (N.KLAM)	ALDR	5	25	11	10	0.91	13	1.18
ALDER CAMP (N.KLAM)	ALDR	6	28	11	0	0.00	0	0.00
LP #1 A-LINE	ALIN	6	17	11	0	0.00	0	0.00
LP #1 A-LINE	ALIN	7	23	11	0	0.00	0	0.00
A-9 ROAD	ANIR	6	15	9	2	0.22	2	0.22
A-9 ROAD	ANIR	6	29	9	2	0.22	2	0.22
A-9 ROAD	ANIR	7	20	9	10	1.11	19	2.11
APTOS/NISENE MARKS	APTO	5	18	12	0	0.00	0	0.00
APTOS/NISENE MARKS	APTO	6	15	12	0	0.00	0	0.00
APTOS/NISENE MARKS	APTO	7	26	12	0	0.00	0	0.00
ARMSTRONG REDWOODS	ARRE	7	18	10	0	0.00	0	0.00
ARMSTRONG REDWOODS	ARRE	8	7	10	0	0.00	0	0.00
BALD HILLS ROAD	BALD	5	20	11	0	0.00	0	0.00
BALD HILLS ROAD	BALD	6	20	11	28	2.54	42	3.82
BUTANO CREEK	BCBC	6	18	5	4	0.80	7	1.40
BUTANO CREEK	BCBC	8	7	5	4	0.80	5	1.00
BEAR HARBOR	BEHA	5	9	5	0	0.00	0	0.00
BEAR HARBOR	BEHA	5	30	6	0	0.00	0	0.00
PL BEAR RIVER VALLEY	BERI	6	11	11	0	0.00	0	0.00
PL BEAR RIVER VALLEY	BERI	7	8	11	0	0.00	0	0.00
HUM RED/BIG TREE	BITR	7	24	9	5	0.56	10	1.11
HUM RED/BIG TREE	BITR	8	7	9	0	0.00	0	0.00
S-A B-900	BNHU	6	18	11	0	0.00	0	0.00
S-A B-900	BNHU	8	1	11	0	0.00	0	0.00
BOY SCOUT TRAIL	BOYS	6	7	11	23	2.09	30	2.72
BOY SCOUT TRAIL	BOYS	6	30	11	32	2.91	48	4.36
BUTANO SP	BTNO	5	16	8	1	0.12	1	0.12
BIG TREES/SOUTH FORK	BTSF	7	18	10	1	0.10	1	0.10
BIG TREES/SOUTH FORK	BTSF	8	2	10	6	0.60	11	1.10
HUM RED/BULL CREEK	BUCR	7	24	11	0	0.00	0	0.00
HUM RED/BULL CREEK	BUCR	8	6	11	0	0.00	0	0.00
NORTH BY-PASS	BYPN	5	26	11	0	0.00	0	0.00
NORTH BY-PASS	BYPN	7	16	11	0	0.00	0	0.00
SOUTH BY-PASS	BYPS	5	26	11	0	0.00	0	0.00
SOUTH BY-PASS	BYPS	7	16	9	0	0.00	0	0.00
CAL-BARREL RD.	CABA	7	1	8	30	3.75	52	6.50
CAL-BARREL RD.	CABA	7	6	9	9	1.00	10	1.10
CASPAR CREEK	CACR	6	24	11	0	0.00	0	0.00
CASPAR CREEK	CACR	7	20	11	0	0.00	0	0.00
CAZADERO HIGHWAY	CAHI	7	19	11	0	0.00	0	0.00
CAZADERO HIGHWAY	CAHI	8	11	11	0	0.00	0	0.00
CAMP KLAMATH	CAKL	6	7	11	0	0.00	0	0.00
CAMP KLAMATH	CAKL	7	7	11	2	0.18	3	0.27
ARCATA COMM. FOREST	COFO	7	11	11	0	0.00	0	0.00
ARCATA COMM. FOREST	COFO	7	29	11	0	0.00	0	0.00
DAMNATION TR.(BLUFF)	DAMN	5	23	11	7	0.64	9	0.82
DAMNATION TR.(BLUFF)	DAMN	6	27	10	17	1.70	22	2.20
DEVIL'S CREEK	DECR	5	27	11	8	0.73	8	0.73
DEVIL'S CREEK	DECR	8	4	11	4	0.36	6	0.55
EAST C-LINE ROAD	ECLR	6	8	11	0	0.00	0	0.00
EAST C-LINE ROAD	ECLR	6	22	11	2	0.18	2	0.18
EAST C-LINE ROAD	ECLR	7	13	11	6	0.54	14	1.27
PL ELK'S HEAD SPRING	EHSP	6	12	10	4	0.40	5	0.50
PL ELK'S HEAD SPRING	EHSP	7	10	10	16	1.60	26	2.60
S-A FORESTRY HEADQRT	FOHE	6	2	9	0	0.00	0	0.00
S-A FORESTRY HEADQRT	FOHE	7	29	9	1	0.11	1	0.11
FT. ROSS	FORO	7	19	8	0	0.00	0	0.00
FT. ROSS	FORO	8	16	8	0	0.00	0	0.00
FRESHWATER/KNEELAND	FRES	6	23	8	0	0.00	0	0.00
FRESHWATER/KNEELAND	FRES	8	8	11	0	0.00	0	0.00
GAZOS CREEK	GAZO	6	14	9	10	1.11	19	2.11
GAZOS CREEK	GAZO	6	24	9	17	1.88	38	4.22

TRANSECT	CODE	MONTH	DAY	NO. STA	NO. DETECT	DETECT/STA	NO. BIRDS	NO./STA
GOLD BLUFF ROAD	GBBR	6	19	10	2	0.20	3	0.30
GOLD BLUFF ROAD	GBBR	7	30	10	32	3.20	55	5.50
PL GREENLAW CREEK	GLAW	6	11	11	0	0.00	0	0.00
PL GREENLAW CREEK	GLAW	7	9	11	1	0.09	3	0.27
GENEVA ROAD	GNVA	5	19	11	5	0.45	6	0.54
GENEVA ROAD	GNVA	6	29	11	0	0.00	0	0.00
GOAT HILL/BUTANO SP	GOAT	6	15	8	2	0.25	5	0.62
GOAT HILL/BUTANO SP	GOAT	6	23	9	13	1.44	19	2.11
GOAT HILL/BUTANO SP	GOAT	7	7	9	1	0.11	1	0.11
GRIZZLY CREEK	GRCR	6	7	11	2	0.18	2	0.18
GRIZZLY CREEK	GRCR	6	14	8	1	0.25	1	0.13
GRIZZLY CREEK	GRCR	6	21	11	0	0.00	0	0.00
GRIZZLY CREEK	GRCR	6	28	11	21	1.91	43	3.91
GRIZZLY CREEK	GRCR	7	5	6	9	1.50	13	2.17
GRIZZLY CREEK	GRCR	7	12	9	12	1.33	21	2.33
GRIZZLY CREEK	GRCR	7	19	10	12	1.20	21	2.10
GRIZZLY CREEK	GRCR	7	26	9	4	0.44	6	0.67
HERITAGE/ALPINE	HAPR	6	25	8	6	0.75	8	1.00
HERITAGE/ALPINE	HAPR	8	13	8	0	0.00	0	0.00
PESCADERO/HAUL ROAD	HAUL	7	2	10	4	0.40	5	0.50
PESCADERO/HAUL ROAD	HAUL	7	31	9	24	2.67	54	6.00
BIG BASIN SP HEADQRT	HEAD	5	15	12	12	1.00	12	1.00
BIG BASIN SP HEADQRT	HEAD	6	22	12	28	2.33	48	4.00
BIG BASIN SP HEADQRT	HEAD	7	18	12	24	2.00	65	3.61
HENRY COWELL SP	HECW	6	1	10	0	0.00	0	0.00
HENRY COWELL SP	HECW	6	28	10	0	0.00	0	0.00
HENRY COWELL SP	HECW	7	27	10	0	0.00	0	0.00
HENDY GROVE	HEGR	6	21	11	0	0.00	0	0.00
HENDY GROVE	HEGR	7	21	11	0	0.00	0	0.00
S-A H500/P500	HFPF	6	6	10	0	0.00	0	0.00
S-A H500/P500	HFPF	7	30	9	0	0.00	0	0.00
HUM RD/HIDDEN SPRING	HISP	7	25	11	0	0.00	0	0.00
HOPE CREEK-TEN TAPPO	HOPE	6	24	10	34	3.40	39	3.90
HOPE CREEK-TEN TAPPO	HOPE	7	10	10	46	4.60	88	8.80
ORICK HORSE TRAIL	HORS	5	24	11	14	1.27	22	2.00
ORICK HORSE TRAIL	HORS	6	30	11	9	0.82	13	1.18
HIGH PRAIRIE - YUROK	HPCB	5	18	11	34	3.09	49	4.45
HIGH PRAIRIE - YUROK	HPCB	5	31	11	11	1.00	17	1.55
HIGH PRAIRIE - YUROK	HPCB	6	5	11	11	1.00	16	1.45
HIGH PRAIRIE - YUROK	HPCB	7	6	11	15	1.36	24	2.18
HIGH PRAIRIE - YUROK	HPCB	7	15	11	63	5.72	99	9.00
HIGHWAY 9/SANTA CRUZ	HWYN	6	26	10	0	0.00	0	0.00
HIGHWAY 9/SANTA CRUZ	HWYN	7	10	10	0	0.00	0	0.00
IVERSON TRAIL	IVTR	6	28	12	37	3.08	63	5.25
IVERSON TRAIL	IVTR	7	11	12	50	4.16	92	7.67
IVERSON TRAIL	IVTR	7	26	12	20	1.67	29	2.42
JACOBY CREEK	JACR	6	16	9	0	0.00	0	0.00
JACKSON STATE FOR.	JASF	6	24	11	0	0.00	0	0.00
JACKSON STATE FOR	JASF	7	20	11	0	0.00	0	0.00
JAMES IRVINE TRAIL	JITR	5	22	7	66	9.42	99	14.10
JAMES IRVINE TRAIL	JITR	6	26	10	82	8.20	129	12.90
KERMIT MILLER EXCH.	KEMI	6	13	10	0	0.00	0	0.00
KERMIT MILLER EXCH.	KEMI	7	7	10	0	0.00	0	0.00
KERMIT MILLER EXCH.	KEMI	7	12	10	0	0.00	0	0.00
KERMIT MILLER EXCH.	KEMI	7	26	11	0	0.00	0	0.00
KENT LAKE	KENT	7	25	10	0	0.00	0	0.00
KENT LAKE	KENT	8	10	10	0	0.00	0	0.00
KLAMATH	KLAM	5	23	11	2	0.18	2	0.18
KLAMATH	KLAM	6	27	11	3	0.27	5	0.45
S-A K-ONE	KONE	6	15	10	0	0.00	0	0.00
S-A K-ONE	KONE	7	28	10	0	0.00	0	0.00
KRUSE RHODO SP	KRRH	7	18	11	0	0.00	0	0.00
KRUSE RHODO SP	KRRH	8	12	11	0	0.00	0	0.00
PL LAWRENCE CREEK	LACR	6	12	9	5	0.56	6	0.67

Table 4. continued

TRANSECT	CODE	MONTH	DAY	NO. STA	NO. DETECT	DETECT/STA	NO. BIRDS	NO./STA
LAGOONS (STONE-BIG)	LAGS	6	15	12	0	0.00	0	0.00
LAGOONS (STONE-BIG)	LAGS	7	16	11	1	0.09	2	0.18
LADY BIRD JOHNSON	LBJG	6	6	9	2	0.22	4	0.44
LADY BIRD JOHNSON	LBJG	6	20	9	0	0.00	0	0.00
LADY BIRD JOHNSON	LBJG	7	11	9	14	1.56	31	3.44
PL LOW FRESHWATER CR	LFWC	7	17	11	0	0.00	0	0.00
LOST MAN PICNIC AREA	LLMC	5	19	10	41	4.10	68	6.80
LOST MAN PICNIC AREA	LLMC	6	29	10	28	2.80	41	4.10
LOWER MITCHELL ROAD	LMRD	7	17	11	0	0.00	0	0.00
LOWER MITCHELL ROAD	LMRD	8	3	9	0	0.00	0	0.00
LODGE ROAD	LODG	6	1	12	0	0.00	0	0.00
LODGE ROAD	LODG	6	12	12	13	1.08	15	0.08
LODGE ROAD	LODG	7	4	12	15	1.25	25	2.08
LODGE ROAD	LODG	7	26	12	0	0.00	0	0.00
HUM RED/LOOK PRAIRIE	LOPR	7	25	11	15	1.36	22	2.00
HUM RED/LOOK PRAIRIE	LOPR	8	2	11	0	0.00	0	0.00
PL LONG RIDGE	LORI	6	11	9	0	0.00	0	0.00
PL LONG RIDGE	LORI	7	8	9	0	0.00	0	0.00
LP #6 MAPLE CREEK	LPMC	7	23	10	0	0.00	0	0.00
LP #6 MAPLE CREEK	LPMC	7	30	11	0	0.00	0	0.00
LP #3 M-LINE	LPML	6	17	11	0	0.00	0	0.00
LP #3 M-LINE	LPML	7	23	11	5	0.45	5	0.45
LP #5 R-LINE	LPRL	6	17	11	0	0.00	0	0.00
LP #5 R-LINE	LPRL	7	24	11	0	0.00	0	0.00
LP #4 T-LINE	LPTL	6	16	11	0	0.00	0	0.00
LP #4 T-LINE	LPTL	8	3	11	0	0.00	0	0.00
LOWER REDWOOD CREEK	LRCK	6	13	11	10	0.91	15	1.36
LOWER REDWOOD CREEK	LRCK	7	13	11	100	0.09	203	18.45
LOWER REDWOOD CREEK	LRCK	7	25	11	108	9.82	197	17.91
LP #2 LITTLE RIVER 2	LRII	6	16	9	0	0.00	0	0.00
LP #2 LITTLE RIVER 2	LRII	7	30	11	0	0.00	0	0.00
MAILLARD REDWOODS	MAIL	6	20	11	0	0.00	0	0.00
MAILLARD REDWOODS	MAIL	7	20	11	0	0.00	0	0.00
PL MCCREADY GULCH	MCGU	7	17	11	0	0.00	0	0.00
PL MCCREADY GULCH	MCGU	7	31	11	0	0.00	0	0.00
SAN MATEO MEM. PARK	MEMO	6	21	6	4	0.67	6	1.00
SAN MATEO MEM. PARK	MEMO	7	23	6	3	0.50	5	0.83
MILL CREEK	MILL	6	18	8	1	0.13	1	0.13
MILL CREEK	MILL	7	31	8	0	0.00	0	0.00
MIRANDA/MYERS FLAT	MIMF	7	11	11	0	0.00	0	0.00
MIRANDA/MYERS FLAT	MIMF	8	10	11	0	0.00	0	0.00
MIRANDA	MIRA	6	22	11	0	0.00	0	0.00
MIRANDA	MIRA	7	9	11	0	0.00	0	0.00
PL MONUMENT CREEK	MOCR	6	11	8	2	0.25	2	0.25
PL MONUMENT CREEK	MOCR	7	8	8	0	0.00	0	0.00
MONTGOMERY WOODS SP	MOWO	6	23	10	0	0.00	0	0.00
MONTGOMERY WOODS SP	MOWO	7	22	10	0	0.00	0	0.00
MUIR WOODS	MUIR	7	20	9	0	0.00	0	0.00
MUIR WOODS	MUIR	8	9	9	0	0.00	0	0.00
MENDOCINO WOODLANDS	MWDL	6	24	10	0	0.00	0	0.00
MENDOCINO WOODLANDS	MWDL	7	30	10	0	0.00	0	0.00
MYRTLE CREEK	MYCR	6	10	10	4	0.40	5	0.50
MYRTLE CREEK	MYCR	7	13	10	4	0.40	6	0.60
MYRTLE CREEK	MYCR	7	27	10	3	0.30	4	0.40
NAVARRO RIVER	NARI	6	22	11	0	0.00	0	0.00
NAVARRO RIVER	NARI	7	21	11	0	0.00	0	0.00
NO. COAST PRESERVE	NCPR	7	21	11	0	0.00	0	0.00
NO. COAST PRESERVE	NCPR	8	3	11	0	0.00	0	0.00
NORTH WEST RIDGE	NWRI	5	25	10	23	2.30	34	3.40
NORTH WEST RIDGE	NWRI	8	15	10	20	2.00	28	2.80
OVERLOOK (YUROK E.)	OVER	5	20	11	1	0.09	1	0.09
OVERLOOK (YUROK E.)	OVER	5	31	11	9	0.82	18	1.64
OVERLOOK (YUROK E.)	OVER	7	6	11	20	1.82	35	3.18
OVERLOOK (YUROK E.)	OVER	7	24	11	41	3.73	72	6.54
PL OWL CREEK	OWCR	6	12	11	1	0.09	1	0.09
PL OWL CREEK	OWCR	7	17	11	6	0.55	8	0.73
PATRICK'S POINT	PAPT	7	17	9	1	0.11	1	0.11
PATRICK'S POINT	PAPT	8	1	9	0	0.00	0	0.00
PEPPERWOOD	PEPP	6	11	11	3	0.27	3	0.23
PEPPERWOOD	PEPP	7	30	11	1	0.09	1	0.09
PHILO-GREENWOOD	PHGR	7	22	11	0	0.00	0	0.00
PRAIRIE CREEK HWY101	PHWY	6	18	10	22	2.20	33	3.30
PRAIRIE CREEK HWY101	PHWY	7	17	10	87	8.70	143	14.30
PIERCY	PIER	6	20	9	0	0.00	0	0.00
PIERCY	PIER	7	29	9	0	0.00	0	0.00

TRANSECT	CODE	MONTH	DAY	NO. STA	NO. DETECT	DETECT/STA	NO. BIRDS	NO./STA
PORTOLA SP	PORT	5	31	10	8	0.80	15	1.50
PORTOLA SP	PORT	6	21	10	19	1.90	25	2.50
REDCREST/FEDERATION	RDFD	7	10	12	28	2.33	69	5.75
REDCREST/FEDERATION	RDFD	7	25	12	3	0.25	5	0.42
PL REDCREST	REDC	7	9	11	0	0.00	0	0.00
PL REDCREST	REDC	7	11	11	0	0.00	0	0.00
REDWAY	REDW	6	20	11	0	0.00	0	0.00
REDWAY	REDW	7	11	11	0	0.00	0	0.00
RED MOUNTAIN	REMO	6	14	11	0	0.00	0	0.00
RED MOUNTAIN	REMO	7	25	11	0	0.00	0	0.00
REQUA (N. KLAM. RIV)	REQU	5	25	11	1	0.09	1	0.09
REQUA (N. KLAM. RIV)	REQU	6	27	11	2	0.18	2	0.18
RUSSIAN G/VAN DAMME	RGVD	6	14	10	0	0.00	0	0.00
RUSSIAN G/VAN DAMME	RGVD	7	29	10	0	0.00	0	0.00
RUSSIAN G/VAN DAMME	RGVD	8	1	10	0	0.00	0	0.00
RIDGE TRAIL	RIDG	7	15	8	5	0.63	8	1.00
RIDGE TRAIL	RIDG	7	29	8	0	0.00	0	0.00
M-LINE (S. RNP)	RNPM	5	27	11	0	0.00	0	0.00
M-LINE (S. RNP)	RNPM	6	10	11	0	0.00	0	0.00
ROCKPORT	ROCK	6	22	11	0	0.00	0	0.00
ROCKPORT	ROCK	7	27	11	0	0.00	0	0.00
ROWDY CREEK	ROCR	6	14	11	2	0.18	3	0.27
ROWDY CREEK	ROCR	7	7	11	0	0.00	0	0.00
ROWDY CREEK	ROCR	7	12	11	0	0.00	0	0.00
RUSSIAN RIVER	RURI	7	19	11	0	0.00	0	0.00
RUSSIAN RIVER	RURI	8	7	11	0	0.00	0	0.00
PL SALMON CREEK	SACR	7	1	10	46	4.60	93	9.30
PL SALMON CREEK	SACR	7	17	10	22	2.20	36	3.60
SANCTUARY FOREST	SAFO	6	21	11	0	0.00	0	0.00
SANCTUARY FOREST	SAFO	7	22	11	0	0.00	0	0.00
PL SHAW CREEK	SHAW	6	12	11	0	0.00	0	0.00
PL SHAW CREEK	SHAW	7	10	11	0	0.00	0	0.00
SKUNK CABBAGE CREEK	SKNK	5	24	11	17	1.54	24	2.18
SKUNK CABBAGE CREEK	SKNK	6	30	11	27	2.45	44	4.00
SMITH RIVER/HIOUCHI	SMRI	6	14	11	6	0.54	11	1.00
SMITH RIVER/HIOUCHI	SMRI	7	12	11	1	0.09	1	0.09
SOUTH OPERATIONS	SOCT	6	11	11	4	0.36	5	0.45
SOUTH OPERATIONS	SOCT	6	24	11	1	0.09	1	0.09
SOUTH OPERATIONS	SOCT	7	13	11	6	0.54	7	0.64
SAMUEL P. TAYLOR	SPTP	7	22	10	0	0.00	0	0.00
SAMUEL P. TAYLOR	SPTP	8	12	10	0	0.00	0	0.00
STANDISH HICKEY	STHI	6	21	11	0	0.00	0	0.00
STANDISH HICKEY	STHI	7	28	11	0	0.00	0	0.00
STONE LAGOON	STLA	6	10	11	0	0.00	0	0.00
STONE LAGOON	STLA	6	28	11	0	0.00	0	0.00
SUNSET TRAIL BB	SUNS	5	29	10	12	1.20	16	1.60
SWANTON ROAD	SWAN	5	28	6	0	0.00	0	0.00
SWANTON ROAD	SWAN	7	31	6	0	0.00	0	0.00
TIN BARN ROAD	TBRO	7	18	11	0	0.00	0	0.00
TIN BARN ROAD	TBRO	8	13	11	0	0.00	0	0.00
TALL TREES GROVE	TTGR	6	15	11	20	1.82	26	2.36
TALL TREES GROVE	TTGR	7	29	10	21	2.10	36	3.60
S-A UPPER CORNERS	UPCO	6	7	10	0	0.00	0	0.00
S-A UPPER CORNERS	UPCO	7	28	10	0	0.00	0	0.00
S-A U-TEN	UTEN	6	15	9	0	0.00	0	0.00
S-A U-TEN	UTEN	7	29	9	0	0.00	0	0.00
WADDELL CREEK	WADD	6	8	11	31	2.82	58	5.27
WADDELL CREEK	WADD	6	21	11	30	2.73	59	5.36
WALKER ROAD	WARD	6	10	10	6	0.60	11	1.11
WALKER ROAD	WARD	6	29	10	23	2.30	39	3.90
WEST RIDGE TRAIL	WERI	5	22	8	31	3.88	46	5.75
WEST RIDGE TRAIL	WERI	6	29	11	36	3.27	46	4.18
WHITEHOUSE CREEK	WHCR	6	13	6	0	0.00	0	0.00
WHITEHOUSE CREEK	WHCR	7	30	6	0	0.00	0	0.00
S-A WILSON CREEK	WICR	6	13	9	1	0.11	2	0.22
S-A WILSON CREEK	WICR	7	28	7	13	1.86	25	3.57
WEST SIDE ACCESS RD	WSAR	6	13	11	0	0.00	0	0.00
WEST SIDE ACCESS RD	WSAR	6	27	11	0	0.00	0	0.00
WEST SIDE ACCESS RD	WSAR	7	18	11	1	0.09	1	0.09
S-A W-TEN	WTEN	6	2	9	1	0.11	1	0.11
S-A W-TEN	WTEN	7	13	11	10	0.91	16	1.45
PL YEAGER CREEK	YACR	6	12	11	6	0.54	7	0.64
PL YEAGER CREEK	YACR	7	10	11	3	0.27	4	0.36

Table 5. Relative abundance of Marbled Murrelets from the 127 transects surveyed in 1988, using the average number of detections per station to rank transects. Transects are listed in descending order, with those transects having the highest detection rates listed first.

TRANSECT	CODE	NO. STA	NO. DETECT	DETECT/STA	NO. DAYS
JAMES IRVINE TRAIL	JITR	17	148	8.7059	2
LOWER REDWOOD CREEK	LRCK	33	218	6.6060	3
PRAIRIE CREEK HWY101	PHWY	20	109	5.4500	2
HOPE CREEK-TEN TAPPO	HOPE	20	80	4.0000	2
WEST RIDGE TRAIL	WERI	19	67	3.5263	2
LOST MAN PICNIC AREA	LLMC	20	69	3.4500	2
PL SALMON CREEK	SACR	20	68	3.4000	2
IVERSON TRAIL	IVTR	36	107	2.9700	3
WADDELL CREEK	WADD	22	61	2.7750	2
BOY SCOUT TRAIL	BOYS	22	55	2.5000	2
HIGH PRAIRIE - YUROK	HPCB	55	134	2.4340	5
CAL-BARREL RD.	CABA	17	39	2.2941	2
NORTH WEST RIDGE	NWRI	20	43	2.1500	2
SKUNK CABBAGE CREEK	SKNK	22	44	1.9950	2
TALL TREES GROVE	TTGR	21	41	1.9524	2
BIG BASIN SP HEADQRT	HEAD	36	64	1.7767	3
GOLD BLUFF ROAD	GBBR	20	34	1.7000	2
OVERLOOK (YUROK E.)	OVER	44	71	1.6150	4
PESCADERO/HAUL ROAD	HAUL	19	28	1.5350	2
GAZOS CREEK	GAZO	18	27	1.5000	2
WALKER ROAD	WARD	20	29	1.4500	2
PORTOLA SP	PORT	20	27	1.3500	2
REDCREST/FEDERATION	RDFD	24	31	1.2900	2
BALD HILLS ROAD	BALD	22	28	1.2700	2
SUNSET TRAIL BB	SUNS	10	12	1.2000	1
DAMNATION TR.(BLUFF)	DAMN	21	24	1.1428	2
ORICK HORSE TRAIL	HORS	22	23	1.0450	2
PL ELK'S HEAD SPRING	EHSP	20	20	1.0000	2
S-A WILSON CREEK	WICR	16	14	0.8750	2
GRIZZLY CREEK	GRCR	75	61	0.8133	8
BUTANO CREEK	BCBC	10	8	0.8000	1
HUM RED/LOOK PRAIRIE	LOPR	22	15	0.6800	2
GOAT HILL/BUTANO SP	GOAT	26	16	0.6154	3
LADY BIRD JOHNSON	LBJG	27	16	0.5933	3
SAN MATEO MEM. PARK	MEMO	12	7	0.5850	2
LODGE ROAD	LODG	48	28	0.5825	4
PL LAWRENCE CREEK	LACR	9	5	0.5600	1
S-A W-TEN	WTEN	20	11	0.5500	2
DEVIL'S CREEK	DECR	22	12	0.5450	2
A-9 ROAD	ANIR	27	14	0.5167	3
ALDER CAMP (N.KLAM)	ALDR	22	10	0.4550	2
PL YEAGER CREEK	YACR	22	9	0.4050	2
HERITAGE/ALPINE	HAPR	16	6	0.3750	2
MYRTLE CREEK	MYCR	30	11	0.3667	3
BIG TREES/SOUTH FORK	BTSF	20	7	0.3500	2
SOUTH OPERATIONS	SOCT	33	11	0.3300	3
PL OWL CREEK	OWCR	22	7	0.3200	2
RIDGE TRAIL	RIDG	16	5	0.3150	2
SMITH RIVER/HIOUCHI	SMRI	22	7	0.3150	2
HUM RED/BIG TREE	BITR	18	5	0.2800	2
EAST C-LINE ROAD	ECLR	33	8	0.2400	3
GENEVA ROAD	GNVA	22	5	0.2250	2
KLAMATH	KLAM	22	5	0.2250	2
LP #3 M-LINE	LPML	22	5	0.2250	2
PEPPERWOOD	PEPP	22	4	0.1800	2
REQUA (N. KLAM. RIV)	REQU	22	3	0.1350	2
BUTANO SP	BTNO	8	1	0.1250	1
PL MONUMENT CREEK	MOCR	16	2	0.1250	2
CAMP KLAMATH	CAKL	22	2	0.0900	2
MILL CREEK	MILL	16	1	0.0650	2
ROWDY CREEK	ROCR	33	2	0.0600	3
S-A FORESTRY HEADQRT	FOHE	18	1	0.0550	2
PATRICK'S POINT	PAPT	18	1	0.0550	2
PL GREENLAW CREEK	GLAW	22	1	0.0450	2
LAGOONS (STONE-BIG)	LAGS	23	1	0.0435	2
WEST SIDE ACCESS RD	WSAR	33	1	0.0300	3
ADM. STANDLEY	ADST	22	0	0.0000	2
LP #1 A-LINE	ALIN	22	0	0.0000	2
APTOS/NISENE MARKS	APTO	36	0	0.0000	3
ARMSTRONG REDWOODS	ARRE	20	0	0.0000	2
BEAR HARBOR	BEHA	11	0	0.0000	2
PL BEAR RIVER VALLEY	BERI	22	0	0.0000	2
S-A B-900	BNHU	22	0	0.0000	2
HUM RED/BULL CREEK	BUCR	22	0	0.0000	2
NORTH BY-PASS	BYPN	22	0	0.0000	2
SOUTH BY-PASS	BYPS	20	0	0.0000	2
CASPAR CREEK	CACR	22	0	0.0000	2
CAZADERO HIGHWAY	CAHI	22	0	0.0000	2
ARCATA COMM. FOREST	COFO	22	0	0.0000	2
FT. ROSS	FORO	16	0	0.0000	2
FRESHWATER/KNEELAND	FRES	19	0	0.0000	2
HENRY COWELL SP	HECW	30	0	0.0000	3
HENDY GROVE	HEGR	22	0	0.0000	2
S-A H500/P500	HFPF	19	0	0.0000	2
HUM RD/HIDDEN SPRING	HISP	11	0	0.0000	1
HIGHWAY 9/SANTA CRUZ	HWYN	20	0	0.0000	2
JACOBY CREEK	JACR	9	0	0.0000	1
JACKSON STATE FOR.	JASF	22	0	0.0000	2
KERMIT MILLER EXCH.	KEMI	41	0	0.0000	4
KENT LAKE	KENT	20	0	0.0000	2
S-A K-ONE	KONE	20	0	0.0000	2
KRUSE RHODO SP	KRRH	22	0	0.0000	2
PL LOW FRESHWATER CR	LFWC	11	0	0.0000	1
LOWER MITCHELL ROAD	LMRD	20	0	0.0000	2
PL LONG RIDGE	LORI	18	0	0.0000	2
LP #6 MAPLE CREEK	LPMC	21	0	0.0000	2
LP #5 R-LINE	LPRL	22	0	0.0000	2
LP #4 T-LINE	LPTL	22	0	0.0000	2
LP #2 LITTLE RIVER 2	LRII	20	0	0.0000	2
MAILLARD REDWOODS	MAIL	22	0	0.0000	2
PL MCCREADY GULCH	MCGU	22	0	0.0000	2
MIRANDA/MYERS FLAT	MIMF	22	0	0.0000	2
MIRANDA	MIRA	22	0	0.0000	2
MONTGOMERY WOODS SP	MOWO	20	0	0.0000	2
MUIR WOODS	MUIR	18	0	0.0000	2
MENDOCINO WOODLANDS	MWDL	20	0	0.0000	2
NAVARRO RIVER	NARI	22	0	0.0000	2
NO. COAST PRESERVE	NCPR	22	0	0.0000	2
PHILO-GREENWOOD	PHGR	11	0	0.0000	1
PIERCY	PIER	18	0	0.0000	2
PL REDCREST	REDC	22	0	0.0000	2
REDWAY	REDW	22	0	0.0000	2
RED MOUNTAIN	REMO	22	0	0.0000	2
RUSSIAN G/VAN DAMME	RGVD	30	0	0.0000	3
M-LINE (S. RNP)	RNPM	22	0	0.0000	2
ROCKPORT	ROCK	22	0	0.0000	2
RUSSIAN RIVER	RURI	22	0	0.0000	2
SANCTUARY FOREST	SAFO	22	0	0.0000	2
PL SHAW CREEK	SHAW	22	0	0.0000	2
SAMUEL P. TAYLOR	SPTP	20	0	0.0000	2
STANDISH HICKEY	STHI	22	0	0.0000	2
STONE LAGOON	STLA	22	0	0.0000	2
SWANTON ROAD	SWAN	12	0	0.0000	2
TIN BARN ROAD	TBRO	22	0	0.0000	2
S-A UPPER CORNERS	UPCO	20	0	0.0000	2
S-A U-TEN	UTEN	18	0	0.0000	2
WHITEHOUSE CREEK	WHCR	12	0	0.0000	2

Table 6. Relative abundance of Marbled Murrelets from the 127 transects surveyed in 1988, using the average number of birds per station to rank transects. Transects are listed in descending order, with those transects having the highest number of birds listed first.

TRANSECT	CODE	NO. STA	NO. BIRDS	NO. BIRDS/STA	NO. DAYS
JAMES IRVINE TRAIL	JITR	17	228	13.4000	2
LOWER REDWOOD CREEK	LRCK	33	415	12.5758	3
PRAIRIE CREEK HWY101	PHWY	20	176	8.8000	2
PL SALMON CREEK	SACR	20	129	6.4500	2
HOPE CREEK-TEN TAPPO	HOPE	20	127	6.3500	2
LOST MAN PICNIC AREA	LLMC	20	109	5.4500	2
WADDELL CREEK	WADD	22	117	5.3150	2
IVERSON TRAIL	IVTR	36	184	5.1133	3
WEST RIDGE TRAIL	WERI	19	92	4.8421	2
HIGH PRAIRIE - YUROK	HPCB	55	205	3.7260	5
CAL-BARREL RD.	CABA	17	62	3.6471	2
BOY SCOUT TRAIL	BOYS	22	78	3.5400	2
PESCADERO/HAUL ROAD	HAUL	19	59	3.2500	2
GAZOS CREEK	GAZO	18	57	3.1667	2
NORTH WEST RIDGE	NWRI	20	62	3.1000	2
SKUNK CABBAGE CREEK	SKNK	22	68	3.0900	2
REDCREST/FEDERATION	RDFD	24	74	3.0800	2
TALL TREES GROVE	TTGR	21	62	2.9524	2
GOLD BLUFF ROAD	GBBR	20	58	2.9000	2
BIG BASIN SP HEADQRT	HEAD	36	125	2.8700	3
OVERLOOK (YUROK E.)	OVER	44	126	2.8625	4
WALKER ROAD	WARD	20	50	2.5050	2
PORTOLA SP	PORT	20	40	2.0000	2
BALD HILLS ROAD	BALD	22	42	1.9100	2
S-A WILSON CREEK	WICR	16	27	1.6875	2
SUNSET TRAIL BB	SUNS	10	16	1.6000	2
ORICK HORSE TRAIL	HORS	22	35	1.5900	2
PL ELK'S HEAD SPRING	EHSP	20	31	1.5500	2
DAMNATION TR.(BLUFF)	DAMN	21	31	1.4762	2
GRIZZLY CREEK	GRCR	75	107	1.4267	8
LADY BIRD JOHNSON	LBJG	27	35	1.2933	3
BUTANO CREEK	BCBC	10	12	1.2000	1
HUM RED/LOOK PRAIRIE	LOPR	22	22	1.0000	2
GOAT HILL/BUTANO SP	GOAT	26	25	0.9615	3
SAN MATEO MEM. PARK	MEMO	12	11	0.9150	1
A-9 ROAD	ANIR	27	23	0.8500	3
S-A W-TEN	WTEN	20	17	0.8500	2
DEVIL'S CREEK	DECR	22	14	0.6400	2
BIG TREES/SOUTH FORK	BTSF	20	12	0.6000	2
ALDER CAMP (N.KLAM)	ALDR	22	13	0.5900	2
HUM RED/BIG TREE	BITR	18	10	0.5550	2
SMITH RIVER/HIOUCHI	SMRI	22	12	0.5450	2
LODGE ROAD	LODG	48	40	0.5400	4
HERITAGE/ALPINE	HAPR	16	8	0.5000	2
MYRTLE CREEK	MYCR	30	15	0.5000	3
RIDGE TRAIL	RIDG	16	8	0.5000	2
PL YEAGER CREEK	YACR	22	11	0.5000	2
EAST C-LINE ROAD	ECLR	33	16	0.4833	3
PL OWL CREEK	OWCR	22	9	0.4100	2
SOUTH OPERATIONS	SOCT	33	13	0.3933	3
PL LAWRENCE CREEK	LACR	9	6	0.3350	1
KLAMATH	KLAM	22	7	0.3150	2
GENEVA ROAD	GNVA	22	6	0.2700	2
LP #3 M-LINE	LPML	22	5	0.2250	2
PEPPERWOOD	PEPP	22	4	0.1600	2
CAMP KLAMATH	CAKL	22	3	0.1350	2
PL GREENLAW CREEK	GLAW	22	3	0.1350	2
REQUA (N. KLAM. RIV)	REQU	22	3	0.1350	2
BUTANO SP	BTNO	8	1	0.1250	1
PL MONUMENT CREEK	MOCR	16	2	0.1250	2
ROWDY CREEK	ROCR	33	3	0.0900	3
MILL CREEK	MILL	16	1	0.0650	2
S-A FORESTRY HEADQRT	FOHE	18	1	0.0550	2
PATRICK'S POINT	PAPT	18	1	0.0550	2
LAGOONS (STONE-BIG)	LAGS	23	2	0.0434	2
WEST SIDE ACCESS RD	WSAR	33	1	0.0300	3

TRANSECT	CODE	NO. STA	NO. BIRDS	NO. BIRDS/STA	NO. DAYS
ADM. STANDLEY	ADST	22	0	0.0000	2
LP #1 A-LINE	ALIN	22	0	0.0000	2
APTOS/NISENE MARKS	APTO	36	0	0.0000	3
ARMSTRONG REDWOODS	ARRE	20	0	0.0000	2
BEAR HARBOR	BEHA	11	0	0.0000	2
PL BEAR RIVER VALLEY	BERI	22	0	0.0000	2
S-A B-900	BNHU	22	0	0.0000	2
HUM RED/BULL CREEK	BUCR	22	0	0.0000	2
NORTH BY-PASS	BYPN	22	0	0.0000	2
SOUTH BY-PASS	BYPS	20	0	0.0000	2
CASPAR CREEK	CACR	22	0	0.0000	2
CAZADERO HIGHWAY	CAHI	22	0	0.0000	2
ARCATA COMM. FOREST	COFO	22	0	0.0000	2
FT. ROSS	FORO	16	0	0.0000	2
FRESHWATER/KNEELAND	FRES	19	0	0.0000	2
HENRY COWELL SP	HECW	30	0	0.0000	3
HENDY GROVE	HEGR	22	0	0.0000	2
S-A H500/P500	HFPF	19	0	0.0000	2
HUM RD/HIDDEN SPRING	HISP	11	0	0.0000	1
HIGHWAY 9/SANTA CRUZ	HWYN	20	0	0.0000	2
JACOBY CREEK	JACR	9	0	0.0000	1
JACKSON STATE FOR.	JASF	22	0	0.0000	2
KERMIT MILLER EXCH.	KEMI	41	0	0.0000	4
KENT LAKE	KENT	20	0	0.0000	2
S-A K-ONE	KONE	20	0	0.0000	2
KRUSE RHODO SP	KRRH	22	0	0.0000	2
PL LOW FRESHWATER CR	LFWC	11	0	0.0000	1
LOWER MITCHELL ROAD	LMRD	20	0	0.0000	2
PL LONG RIDGE	LORI	18	0	0.0000	2
LP #6 MAPLE CREEK	LPMC	21	0	0.0000	2
LP #5 R-LINE	LPRL	22	0	0.0000	2
LP #4 T-LINE	LPTL	22	0	0.0000	2
LP #2 LITTLE RIVER 2	LRII	20	0	0.0000	2
MAILLARD REDWOODS	MAIL	22	0	0.0000	2
PL MCCREADY GULCH	MCGU	22	0	0.0000	2
MIRANDA/MYERS FLAT	MIMF	22	0	0.0000	2
MIRANDA	MIRA	22	0	0.0000	2
MONTGOMERY WOODS SP	MOWO	20	0	0.0000	2
MUIR WOODS	MUIR	18	0	0.0000	2
MENDOCINO WOODLANDS	MWDL	20	0	0.0000	2
NAVARRO RIVER	NARI	22	0	0.0000	2
NO. COAST PRESERVE	NCPR	22	0	0.0000	2
PHILO-GREENWOOD	PHGR	11	0	0.0000	1
PIERCY	PIER	18	0	0.0000	2
PL REDCREST	REDC	22	0	0.0000	2
REDWAY	REDW	22	0	0.0000	2
RED MOUNTAIN	REMO	22	0	0.0000	2
RUSSIAN G/VAN DAMME	RGVD	30	0	0.0000	3
M-LINE (S. RNP)	RNPM	22	0	0.0000	2
ROCKPORT	ROCK	22	0	0.0000	2
RUSSIAN RIVER	RURI	22	0	0.0000	2
SANCTUARY FOREST	SAFO	22	0	0.0000	2
PL SHAW CREEK	SHAW	22	0	0.0000	2
SAMUEL P. TAYLOR	SPTP	20	0	0.0000	2
STANDISH HICKEY	STHI	22	0	0.0000	2
STONE LAGOON	STLA	22	0	0.0000	2
SWANTON ROAD	SWAN	12	0	0.0000	2
TIN BARN ROAD	TBRO	22	0	0.0000	2
S-A UPPER CORNERS	UPCO	20	0	0.0000	2
S-A U-TEN	UTEN	18	0	0.0000	2
WHITEHOUSE CREEK	WHCR	12	0	0.0000	2

Table 7. Summary of the relative abundance of trees greater than 1.5m DBH within 50m of each census station on a transect. Transects having a relatively dense canopy of old-growth would have a high percentage of stations in the "Dense" category, whereas transects with no old-growth would have a all stations in the "None" category. Total equals the number of stations censused on each transect.

Transect	None	Trace	Sparse	Medium	Dense	Unknown	Total
ADST	10	1	0	0	0	0	11
ALDR	8	3	0	0	0	0	11
ALIN	8	3	0	0	0	0	11
ANIR	7	1	1	0	0	0	9
APTO	12	0	0	0	0	0	12
BALD	2	4	1	2	2	0	11
BCBC	3	1	0	0	1	0	5
BEHA	3	0	2	1	0	0	6
BERI	11	0	0	0	0	0	11
BITR	5	1	0	3	0	0	9
BNHU	10	1	0	0	0	0	11
BOYS	0	0	1	4	6	0	11
BTNO	4	4	0	0	0	0	8
BTSF	3	1	1	5	0	0	10
BUCR	11	0	0	0	0	0	11
BYPN	8	1	1	0	0	0	10
BYPS	9	0	0	0	0	0	9
CACR	11	0	0	0	0	0	11
CAHI	7	3	1	0	0	0	11
CAKL	10	1	0	0	0	0	11
COFO	9	2	0	0	0	0	11
DAMN	1	0	0	3	7	0	11
DECR	5	2	4	0	0	0	11
ECLR	10	0	1	0	0	0	11
EHSP	8	2	0	0	0	0	10
FOHE	7	2	0	0	0	0	9
FORO	8	0	0	0	0	0	8
GAZO	6	1	0	0	0	0	7
GBBR	10	0	0	0	0	0	10
GLAW	11	0	0	0	0	0	11
GNVA	7	2	2	0	0	0	11
GOAT	8	1	0	0	0	0	9
GRCR	7	2	1	1	0	0	11
HAPR	7	1	0	0	0	0	8
HAUL	10	0	0	0	0	0	10
HEAD	5	0	6	1	0	0	12
HECW	8	0	0	1	1	0	10
HEGR	9	2	0	0	0	0	11
HFPF	3	4	3	0	0	0	10
HISP	0	3	1	7	0	0	11
HOPE	0	0	0	0	10	0	10
HORS	4	0	7	0	0	0	11
HPCB	3	3	1	1	0	0	8
HWYN	10	0	0	0	0	0	10
IVTR	4	8	0	0	0	0	12
JASF	10	0	0	0	1	0	11
JITR	0	0	3	2	5	0	10
KEMI	8	1	1	0	0	0	10
KENT	0	0	0	0	0	10	10
KONE	8	0	1	1	0	0	10
KRRH	10	1	0	0	0	0	11
LAGS	11	0	0	0	0	0	11
LBJG	0	0	0	1	8	0	9
LFWC	11	0	0	0	0	0	11
LLMC	2	0	2	2	4	0	10
LMRD	9	0	0	0	0	0	9
LODG	4	0	8	0	0	0	12
LOPR	4	2	1	3	1	0	11
LORI	7	0	0	0	0	0	7

Transect	None	Trace	Sparse	Medium	Dense	Unknown	Total
LPMC	11	0	0	0	0	0	11
LPML	11	0	0	0	0	0	11
LPRL	8	3	0	0	0	0	11
LPTL	11	0	0	0	0	0	11
LRCK	3	7	1	0	0	0	11
LRII	8	0	1	2	0	0	11
MAIL	5	6	0	0	0	0	11
MCGU	11	0	0	0	0	0	11
MEMO	4	3	0	0	0	0	7
MILL	2	2	3	1	0	0	8
MIMF	0	5	1	5	0	0	11
MIRA	0	1	10	0	0	0	11
MOCR	5	2	1	0	0	0	8
MOWO	0	4	3	3	0	0	10
MWDL	10	0	0	0	0	0	10
MYCR	10	0	0	0	0	0	10
NARI	8	3	0	0	0	0	11
NCPR	7	2	1	1	0	0	11
NWRI	4	1	5	0	0	0	10
OVER	6	1	1	0	0	0	8
OWCR	9	2	0	0	0	0	11
PAPT	3	6	0	0	0	0	9
PEPP	2	0	4	0	5	0	11
PHGR	10	1	0	0	0	0	11
PHWY	0	1	1	0	8	0	10
PIER	4	3	2	0	0	0	9
PORT	7	2	1	0	0	0	10
RDFD	1	5	3	3	0	0	12
REDC	11	0	0	0	0	0	11
REDW	7	2	2	0	0	0	11
REMO	7	0	2	1	1	0	11
REQU	10	1	0	0	0	0	11
RGVD	10	0	0	0	0	0	10
RIDG	7	1	0	0	0	0	8
ROCK	11	0	0	0	0	0	11
ROCR	7	4	0	0	0	0	11
RURI	11	0	0	0	0	0	11
SACR	6	2	2	0	0	0	10
SAFO	8	3	0	0	0	0	11
SHAW	7	4	0	0	0	0	11
SKNK	7	3	1	0	0	0	11
SMRI	8	3	0	0	0	0	11
SOCT	10	1	0	0	0	0	11
SPTP	2	5	3	0	0	0	10
STHI	10	1	0	0	0	0	11
STLA	11	0	0	0	0	0	11
SUNS	2	1	7	0	0	0	10
SWAN	3	2	1	0	0	0	6
TBRO	10	1	0	0	0	0	11
TTGR	0	0	5	4	1	0	10
UPCO	8	2	0	0	0	0	10
UTEN	5	3	0	0	1	0	9
WADD	7	1	1	0	0	0	9
WARD	7	0	0	3	0	0	10
WERI	0	0	11	0	0	0	11
WHCR	3	3	0	0	0	0	6
WSAR	11	0	0	0	0	0	11
WTEN	3	6	2	0	0	0	11
YACR	10	1	0	0	0	0	11

Table 8. Summary of logging history for each station on each transect. Transects that are on areas that have been heavily logged would have most stations in the "Dense" category, whereas areas with no evidence of stumps would have all stations in the "None" category. Total equals the number of stations censused on each transect.

Transect	None	Trace	Sparse	Medium	Dense	Unknown	Total
ADST	0	0	0	0	11	0	11
ALDR	0	0	1	2	8	0	11
ALIN	0	0	0	0	11	0	11
ANIR	0	9	0	0	0	0	9
APTO	8	0	0	4	0	0	12
BALD	0	0	3	2	6	0	11
BCBC	3	2	0	0	0	0	5
BEHA	2	1	1	1	1	0	6
BERI	3	4	2	2	0	0	11
BITR	0	3	0	6	0	0	9
BNHU	0	0	0	1	10	0	11
BOYS	11	0	0	0	0	0	11
BTNO	4	2	2	0	0	0	8
BTSF	9	0	1	0	0	0	10
BUCR	0	0	0	0	11	0	11
BYPN	0	1	0	0	9	0	10
BYPS	0	0	0	1	8	0	9
CACR	0	0	0	0	11	0	11
CAHI	0	0	1	1	9	0	11
CAKL	0	0	0	4	7	0	11
COFO	0	0	0	0	11	0	11
DAMN	0	10	0	0	1	0	11
DECR	0	0	0	4	7	0	11
ECLR	0	4	7	0	0	0	11
EHSP	0	0	0	1	9	0	10
FOHE	0	0	0	5	4	0	9
FORO	2	0	0	0	6	0	8
GAZO	1	0	3	0	3	0	7
GBBR	6	1	0	0	3	0	10
GLAW	0	0	1	0	10	0	11
GNVA	0	0	1	1	9	0	11
GOAT	9	0	0	0	0	0	9
GRCR	5	0	1	1	4	0	11
HARP	5	2	1	0	0	0	8
HAUL	0	3	4	3	0	0	10
HEAD	3	0	8	1	0	0	12
HECW	8	0	0	2	0	0	10
HEGR	0	0	1	8	2	0	11
HFPF	0	0	1	3	6	0	10
HISP	0	1	6	3	1	0	11
HOPE	10	0	0	0	0	0	10
HORS	1	1	4	1	4	0	11
HPCB	0	1	2	0	5	0	8
HWYN	1	9	0	0	0	0	10
IVTR	10	2	0	0	0	0	12
JASF	0	0	0	0	11	0	11
JITR	10	0	0	0	0	0	10
KEMI	0	1	1	2	6	0	10
KENT	0	0	0	0	0	10	10
KONE	0	0	1	2	7	0	10
KRRH	0	0	0	5	6	0	11
LAGS	11	0	0	0	0	0	11
LBJG	9	0	0	0	0	0	9
LFWC	0	0	0	0	11	0	11
LLMC	0	4	3	2	1	0	10
LMRD	0	0	0	0	9	0	9
LODG	4	0	5	2	1	0	12
LOPR	8	0	1	1	1	0	11
LORI	6	0	1	0	0	0	7
LPMC	0	0	0	0	11	0	11
LPML	0	0	0	0	11	0	11
LPRL	0	0	0	0	11	0	11
LPTL	0	0	0	0	11	0	11
LRCK	5	1	1	1	3	0	11
LRII	0	0	0	0	11	0	11
MAIL	0	0	0	9	2	0	11
MCGU	0	0	0	0	11	0	11
MEMO	3	4	0	0	0	0	7
MILL	1	0	4	0	3	0	8
MIMF	6	5	0	0	0	0	11
MIRA	0	8	3	0	0	0	11
MOCR	0	0	1	0	7	0	8
MOWO	0	4	4	2	0	0	10
MWDL	2	0	0	8	0	0	10
MYCR	0	3	0	1	6	0	10
NARI	0	0	0	0	11	0	11
NCPR	0	8	0	3	0	0	11
NWRI	4	0	1	0	5	0	10
OVER	0	0	0	1	7	0	8
OWCR	0	0	0	9	2	0	11
PAPT	7	2	0	0	0	0	9
PEPP	1	0	5	1	4	0	11
PHGR	0	0	0	0	11	0	11
PHWY	10	0	0	0	0	0	10
PIER	0	0	0	4	5	0	9
PORT	4	2	3	1	0	0	10
RDFD	0	2	5	4	1	0	12
REDC	0	0	0	0	11	0	11
REDW	0	5	2	3	1	0	11
REMO	0	0	1	1	9	0	11
REQU	0	8	2	0	1	0	11
RGVD	0	0	3	7	0	0	10
RIDG	7	1	0	0	0	0	8
ROCK	0	0	1	0	10	0	11
ROCR	0	0	0	1	10	0	11
RURI	0	0	0	0	11	0	11
SACR	0	0	3	4	3	0	10
SAFO	0	0	1	1	9	0	11
SHAW	0	0	1	5	5	0	11
SKNK	3	3	3	1	1	0	11
SMRI	0	0	2	7	2	0	11
SOCT	8	3	0	0	0	0	11
SPTP	6	3	1	0	0	0	10
STHI	0	0	0	0	11	0	11
STLA	0	0	0	1	10	0	11
SUNS	9	0	0	1	0	0	10
SWAN	5	1	0	0	0	0	6
TBRO	1	0	2	0	7	1	11
TTGR	10	0	0	0	0	0	10
UPCO	0	0	0	9	1	0	10
UTEN	0	0	0	2	7	0	9
WADD	3	1	4	1	0	0	9
WARD	9	0	0	1	0	0	10
WERI	11	0	0	0	0	0	11
WHCR	1	1	2	0	2	0	6
WSAR	0	11	0	0	0	0	11
WTEN	0	0	1	2	8	0	11
YACR	0	0	0	5	6	0	11