

## MARbled MURRELET DISTRIBUTION IN THE SISKIYOU NATIONAL FOREST OF SOUTHWESTERN OREGON

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**ABSTRACT**—We summarized data from 2,479 intensive 2-hr morning surveys and 950 general surveys (< 2 hr duration) between 1988 and 1994 to determine the distribution of marbled murrelets (*Brachyramphus marmoratus*) in mature and old-growth forest stands on the Siskiyou National Forest of southwestern Oregon. Marbled murrelets were detected on 449 of these surveys. Murrelets were found in Douglas-fir (*Pseudotsuga menziesii*) or coast redwood (*Sequoia sempervirens*) stands within the western hemlock (*Tsuga heterophylla*) vegetation zone on the western part of the Forest. Murrelets were not detected in the mixed conifer/mixed evergreen zone on the eastern part of the Forest. This zone, which extends from 20–60 km inland, is drier and has smaller trees than the western hemlock vegetation zone. The distribution of murrelets on the Siskiyou National Forest may be limited by the availability of trees with suitable nesting limbs.

Marbled murrelets (*Brachyramphus marmoratus*) are closely associated with older-aged coniferous forests (Marshall 1988, Hamer 1995, Hamer and Nelson 1995a, Miller and Ralph 1995). Unlike most species of the family Alcidae, marbled murrelets most often nest in trees. Sixty-five tree nests have been found in North America (Hamer and Nelson 1995a). Stands used for nesting by murrelets usually have large-diameter trees, relatively low canopy closure, and high numbers of potential nesting platforms (Grenier and Nelson 1995, Hamer and Nelson 1995a). The marbled murrelet was listed as a threatened species in Washington, Oregon and California (U.S. Fish and Wildlife Service 1992) primarily because of habitat loss from logging and development.

Currently, surveys for marbled murrelets are mandatory for all proposed activities (primarily timber harvest) on federal lands within 80 km of the ocean that may affect their potential (old-growth and mature) habitat. Murrelets primarily travel up to 84 km inland in search of suitable nest sites (Carter and Sealy 1986, Paton and Ralph 1990, Nelson et al. 1992, Hamer 1995, Hamer and Nelson 1995a), although sightings are known from as far as 108 km inland in Oregon, and 101 km in British Columbia (Rodway et al. 1992; S. K. Nelson, pers. comm.). S. K. Nelson (unpubl. data) and P. W. C. Paton (unpubl. data) conducted limited surveys for murrelets on the Siskiyou National

Forest between 1988 and 1990. They found murrelets as far as 42 km inland. Additional information was needed on murrelet distribution in the coastal forests of the Siskiyou Mountains to aid in habitat management. Therefore, between 1991 and 1994 we conducted additional surveys for murrelets. The purpose of this study was to summarize marbled murrelet distribution from existing information and our surveys, and relate its presence to general habitat features. Because marbled murrelets nest primarily in large trees with large moss-covered limbs and they appear more abundant close to the coast (Hamer and Nelson 1995a), we hypothesized that factors such as habitat suitability, vegetation type, topography, climate (including temperature and relative humidity), and distance from the ocean would limit murrelet distribution.

### METHODS

#### *Study Area*

The study area was located on the Siskiyou National Forest in southwestern Oregon and north-west California. Surveys were conducted up to 75 km from the ocean in an area that extended north for 96 km from the California-Oregon border, and included portions of Josephine, Coos, Curry, and Del Norte (CA) counties. Data were also included from several surveys in Josephine and Curry counties, on lands managed by the Bureau of Land Management.

The study area is divided into 2 vegetation zones



described by Franklin and Dyrness (1973): the western hemlock (*Tsuga heterophylla*) vegetation zone to the west, and the mixed conifer/mixed evergreen vegetation zone farther inland. Atzet and Wheeler (1982) noted that tanoak (*Lithocarpus densiflorus*) is actually the climax species in much of the western hemlock zone in this area, therefore, we hereafter use the term tanoak/western hemlock vegetation zone to describe the western portion of the Siskiyou National Forest.

The eastern edge of the tanoak/western hemlock vegetation zone is bordered by 2 major geologic and climatic features. On the southern two-thirds of the study area, part of the Klamath Province (Franklin and Dyrness 1973), a major north-south 1000-m high ridge lies 20–28 km inland. This ridge marks the interface between the tanoak/western hemlock zone and mixed conifer/mixed evergreen vegetation zone to the east. This ridge causes a rain-shadow effect (Atzet and Wheeler 1982); coupled with the fact that areas east of this ridge have less productive soils (Atzet et al. 1992), this likely influences the change in vegetation zone from tanoak/western hemlock to mixed conifer/mixed evergreen. On the northern one-third of the study area, part of the Coast Range Province (Franklin and Dyrness 1973), Atzet and Wheeler (1982) describe a major north-south change in vegetation and climatic zone along the Rogue and Elk/Coquille River divide (Fig. 1). North of this divide the coastal fog belt extends up to 60 km inland, but south it extends only 20–28 km inland.

Throughout the tanoak/western hemlock vegetation zone, the maritime influence west of the north/south ridge and north of the Rogue River divide exerts a profound and ameliorating influence on mean daily temperature, high temperatures, and overall relative humidity (unpublished Siskiyou National Forest Fire Weather Data; Franklin and Dyrness 1973). Additionally, the interval between natural fires is longer in the tanoak/western hemlock vegetation zone (Atzet and Wheeler 1982).

#### Surveys

Surveys were conducted between 1991 and 1994 for the primary purpose of inventorying potential timber sale areas. Intensive and general surveys (protocols developed by murrelet researchers and the Pacific Seabird Group, PSG [Paton et al. 1990; 1992–1994, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA, unpubl. reps.]) were used to determine murrelet presence and absence. Survey locations were established in potential marbled murrelet habitat, i.e., mature (with or without an old-growth component) and old-growth coniferous forests and younger coniferous forest stands that have deformations or structures suitable for nesting. A stand was defined as a group of trees forming contiguous potential habitat.

All surveys were conducted from 1 May to 15 August during a 2-hr period from 45 min before, to 75 min after, official sunrise, and spaced throughout the survey season. One survey station was generally established per 10 ha. For intensive surveys, a minimum of 4 (number depended on stand size) 2-hr survey visits were conducted per year. For general surveys, 9–10 survey stations were established at a minimum of 0.3-km intervals along logging roads and each station was surveyed for 10 min per survey visit. Most intensive and general surveys were conducted for 2 consecutive yr. However, because of changes in land allocations prescribed by the President's Forest Plan (U.S. Forest Service and Bureau of Land Management 1994a and 1994b), some stands were surveyed only for 1 yr (surveyed in 1993, but not in 1994). Murrelet absence may not be accurately determined from surveys conducted for less than 2 yr.

We included additional presence data from random detections and past research efforts between 1988 and 1992 in the analysis of murrelet distribution on the Forest (S. K. Nelson, unpubl. data; P. W. C. Paton, unpubl. data). Similar survey methods were used to collect these data.

#### RESULTS

We summarized presence and absence data from 2,479 intensive 2-hr surveys and 950 10-min general surveys. Murrelets were detected on 449 (13%,  $N = 3,429$ ) of these surveys (Table 1, Fig. 1). Murrelets were present in stands dominated by Douglas-fir (*Pseudotsuga menziesii*) or coast redwood (*Sequoia sempervirens*). Although surveys were conducted up to 75 km inland, no murrelets were found farther than 51 km from the ocean (Fig. 2). South of the Rogue River divide (Klamath Province) no murrelets were found farther than 28 km inland (Fig. 1).

All 449 survey visits with murrelet detections were within the tanoak/western hemlock zone, except one. Three surveys were conducted in a Douglas-fir stand just east of the north-south ridge. This stand contained numerous large Douglas-fir trees with platforms, and was located in the transition area between the tanoak/western hemlock and mixed conifer/mixed evergreen vegetation zones. However, most (84%) surveys in the tanoak/western hemlock zone were 2-yr intensive surveys, while only 36% of surveys in the mixed conifer/mixed evergreen zone followed the 2-yr intensive protocol (Figs. 1, 3A, and 3B). Murrelets may not be absent in some stands surveyed for only 1 yr. However, similar patterns of absence

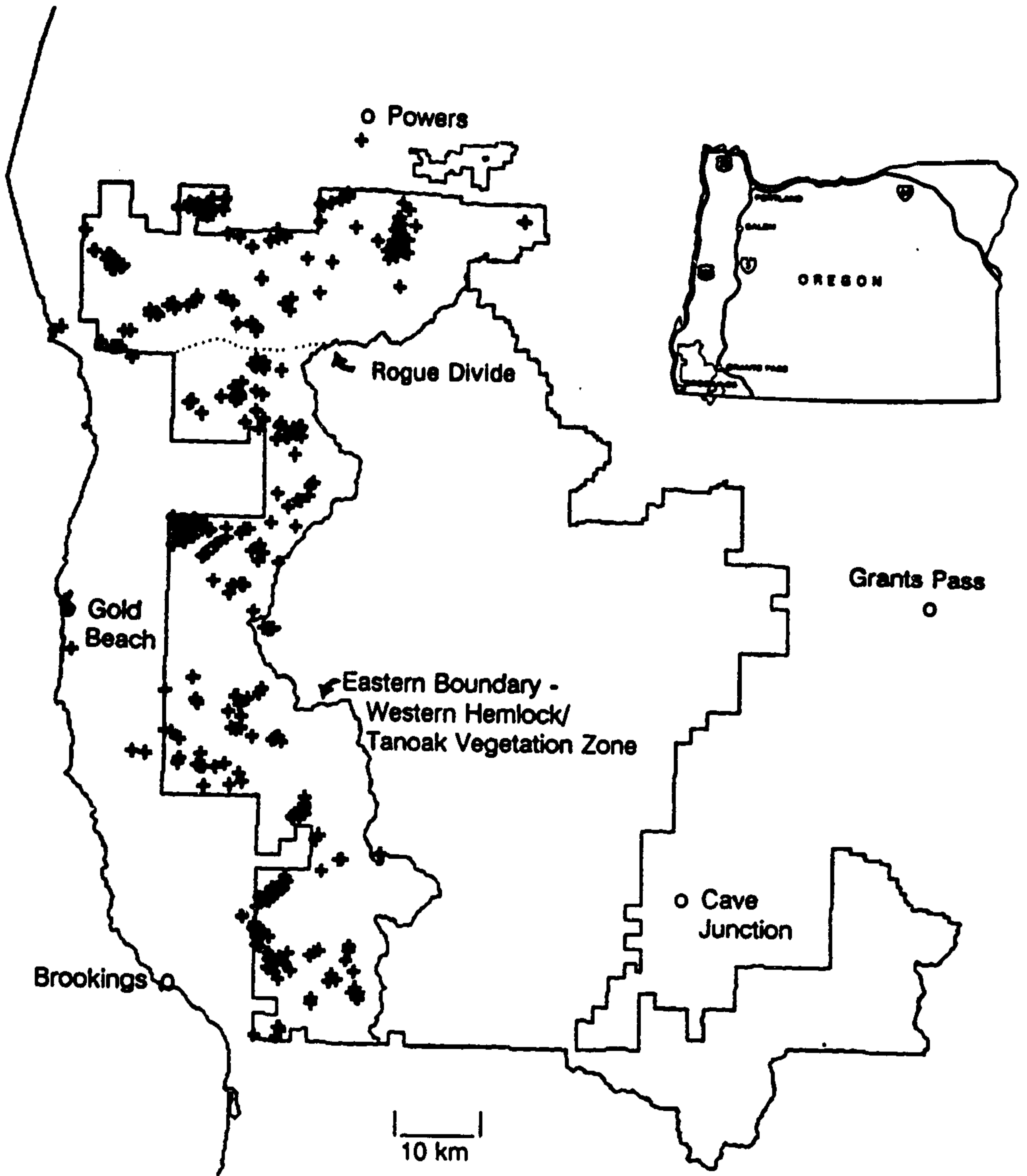


FIGURE 1. Sites where marbled murrelets have been detected on the Siskiyou National Forest, 1988-1994.

and presence from 1- and 2-yr surveys may indicate that 1-yr data were accurate.

Subcanopy and circling flight behaviors were detected on 130 (29%) visits with murrelet presence. These behaviors indicated that murrelets were likely nesting, or using the stand for some purpose associated with breeding (1994 PSG survey protocol).

#### DISCUSSION

Marbled murrelets on the Siskiyou National Forest occur in the tanoak/western hemlock vegetation zone within 51 km of the coast. All stands with murrelets, except one, were located west of the interface that separates the tanoak/western hemlock vegetation zone from the mixed conifer/mixed ever-



TABLE 1. Number of intensive and general survey visits and presence of marbled murrelets on the Siskiyou National Forest, 1988-1994.

Year	No. detections		Presence		Total no. surveys	
	General	Intensive	General	Intensive	General	Intensive
1988	—	—	10	—	10	—
1989	11	—	143	—	154	—
1990	122	—	19	—	141	—
1991	7	29	21	73	28	102
1992	264	487	29	63	293	550
1993	278	938	5	47	283	985
1994	40	804	1	38	41	842
Total	722	2258	228	221	950	2479

green vegetation zone to the east. The ridges that create this interface and divide the vegetation zones have caused major localized climatic differences wherein the east and southeast sides of the ridges are drier and therefore may contain habitat conditions that create fewer potential nesting sites for marbled murrelets.

Based on a series of "eco-plots" that have been permanently established across the forest (T. R. Atzet, unpubl. data), old-growth stands are known to differ in tree diameter, tree height, and crown ratio (percent of tree height which supports a live crown) on either

side of the vegetation zone line. A small non-formal random sample of these plots (12 plots, 230 trees; T. R. Atzet, unpubl. data) showed that stands west of the zone boundary contained larger trees ( $\bar{x}$  = 112 cm, median = 114 cm) than stands east of the zone boundary ( $\bar{x}$  = 84 cm, median = 74 cm). In general, the tallest trees occurred west of the zone compared to east of the zone boundary (median = 48 m vs. 46 m, respectively). Mean crown ratio was 51% (median = 50%) and 54% (median = 60%) west and east of the zone boundary, respectively. However, west of the zone boundary, there was a greater variety of percent

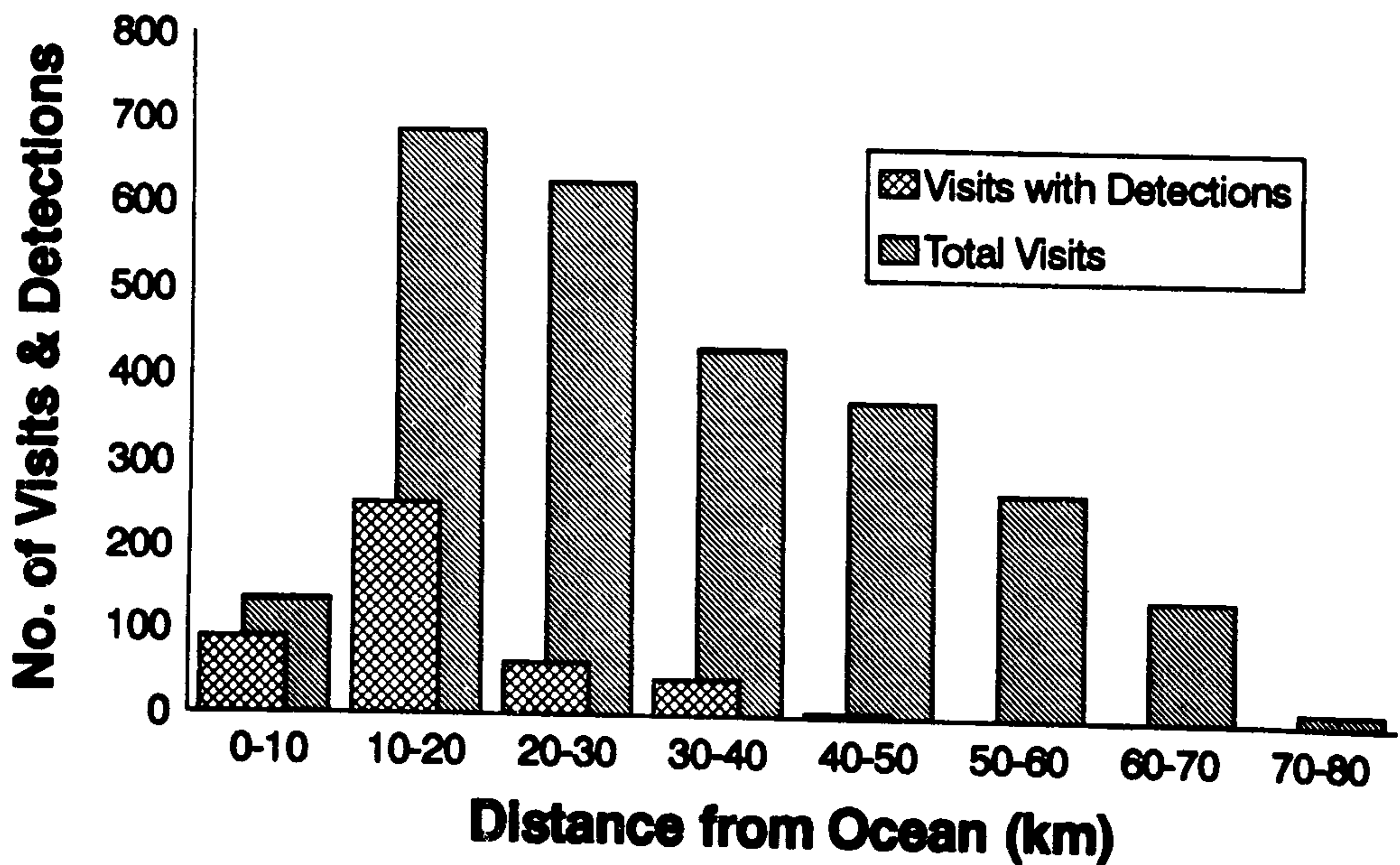


FIGURE 2. Presence of marbled murrelets in relation to distance inland, Siskiyou National Forest, 1988-1994. Data included all intensive surveys and general surveys where murrelets were present.

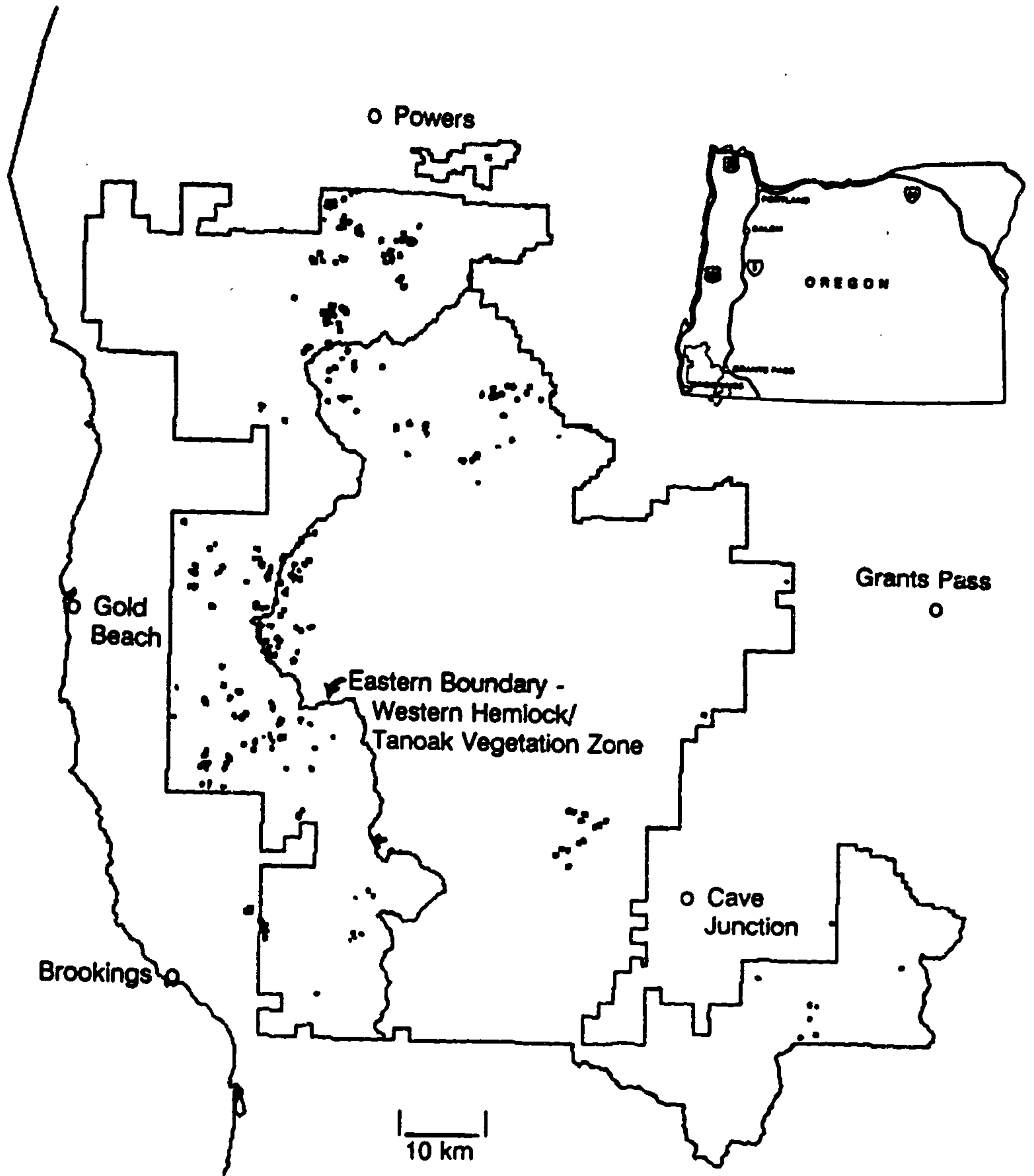


FIGURE 3A. Survey stands with no marbled murrelet detections, Siskiyou National Forest, 1988-1994. Data only includes intensive 2-yr surveys.

crown ratio, and some trees had crown ratios of nearly 100%. A tree with a large dbh and a crown ratio may be more likely to support large limbs (potential nest platforms).

The comparison of these habitat data with our presence data suggest that the distribution of marbled murrelets on the Siskiyou National Forest may be correlated to vegetation.

Although we collected no specific vegetation data for forest stands where murrelet surveys were conducted, we believe conditions for tree growth west of the zone boundary may be more conducive to the development of suitable habitat for marbled murrelets than are conditions east of the line. The availability of large trees with large limbs on the west

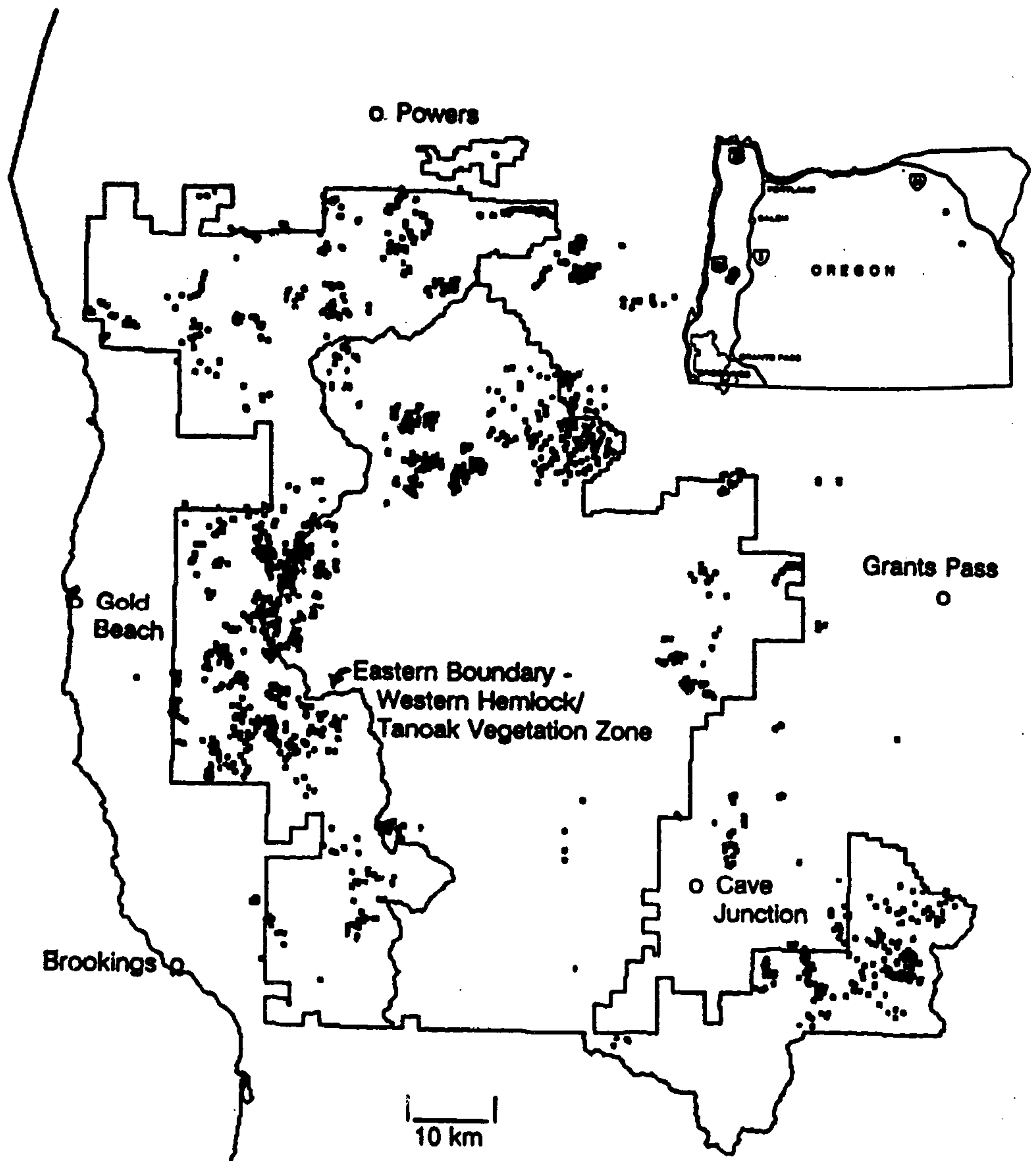


FIGURE 3B. Survey stands with no marbled murrelet detections, Siskiyou National Forest, 1988–1994. Data include 1-yr intensive and all general surveys (surveys not conducted to protocol).

side of the forest may provide more potential nest sites than stands in the mixed conifer/mixed evergreen vegetation zone to the east.

The physical barrier caused by elevation of the north/south ridge in the Klamath Province and the ridge north of the Rogue River in the Coast Range Province does not likely limit murrelets, because many researchers (Prestash

et al. 1992; Hamer 1995; S. K. Nelson, pers. comm.) have found murrelets flying at similar elevations and crossing ridges. The energetics associated with flying long distances inland could also be a factor limiting the distribution inland. However, murrelets have been found farther inland in Oregon than we have found in the study area (Nelson et al. 1992). Murrelets



occur as far as 61 km inland in the Coast Ranges Province (J. Witt, BLM, Roseburg, OR, pers. comm.), and 108 km inland in the north central portion of the Western Cascades Province (S. K. Nelson, pers. comm.). Both of these areas occur within the western hemlock zone and contain large trees for nesting.

Several cautions should be applied to our results. Murrelets may not be absent in some stands surveyed for only 1 yr. Murrelets may be more difficult to detect at sites farther from the coast because numbers are generally lower (1994 PSG survey protocol). Recent data analyses show that 10 or more survey visits are required to detect murrelets behavior that indicate nesting activity (T. E. Hamer, pers. comm.). Finally, much of the data were collected between 1991 and 1993 when an El Niño current occurred off the Pacific Coast. The nutrient-poor waters usually present during El Niño events may have affected murrelet nesting attempts (Ainley and Boekelheide 1990) and associated inland detection rates. Inland detections of murrelets were lower in central Oregon

in 1991 and 1992 compared with 1989 and 1990 (S. K. Nelson, unpubl. data). Despite these potential influencing factors, the distributional information presented in this paper helps refine the range of the marbled murrelet on the Siskiyou National Forest, and the additional information on potential habitat associations will aid in marbled murrelet management. These data, combined with future research and surveys, should provide a basis for delineating and revising the range of the marbled murrelet on the Siskiyou National Forest.

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