TWO MARBLED MURRELET NEST SITES ON PRIVATE COMMERCIAL FOREST LANDS IN NORTHERN CALIFORNIA

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ABSTRACT—Two marbled murrelet (*Brachyramphus marmoratus*) nest trees were found on commercial forest land in Humboldt County, California in 1992. Nest tree and stand structural information was collected from each site and compared. Nests were located in large (> 229 cm dbh), old-growth, coast redwood (*Sequoia sempervirens*) trees with 100% cover above the nest cup. Canopy cover within 50 m of the nest trees was 38% and 42%. Nest trees were the dominant trees within a 0.1-ha area surrounding the nest tree, in terms of crown diameter, height and dbh.

Over the past 20 years, 65 marbled murrelet (*Brachyramphus marmoratus*) nests have been located in inland forests from Alaska to California (Hamer and Nelson 1995a). Characteristically, forests containing nest sites have been described as old growth, referring to either stand age, structure, or silvicultural history (Paton and Ralph 1990, Hamer and Nelson 1995a, Ralph et al. 1995a). However, specific nest stand attributes that constitute nesting habitat in northern California are not completely known. Therefore, in the summer of 1992, the Pacific Lumber Company (PALCO) began an intensive effort to locate marbled murrelet nests on their lands within the coast redwood (*Sequoia sempervirens*)–Douglas-fir (*Pseudotsuga menziesii*) forests of northern California. The intent of this effort was to find and identify the characteristics of marbled murrelet nests, nest trees, and nest stands. Understanding the nest-site characteristics is the critical first step in the development of silvicultural systems for management. Such information is important to forest managers whose lands are affected by the listing of the marbled murrelet as a federally threatened and California State endangered species (California Fish and Game Commission 1992; U.S. Fish and Wildlife Service 1992). In this paper, we present information from 2 nest trees and sites, and discuss the relationship between the nest tree and the surrounding forest.

METHODS

Nest Search Procedure

Stand selection and survey methods.–PALCO owns land in southern Humboldt County that consists of nearly 79,380 ha of commercial forest (Fig. 1). We used survey techniques developed by the Pacific Seabird Group Marbled Murrelet Technical Committee (1992 Survey Protocol, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, CA, unpubl. rep.) to locate marbled murrelets on PALCO land. Murrelet surveys were conducted from 30 min before, to 90 min after, sunrise in forest stands with structural characteristics considered suitable for nesting (forests with trees >80 cm dbh).

We conducted 697 surveys in 25 areas from mid-April until the end of August. Permanent survey stations were established and surveyors recorded murrelet observations with hand-held tape recorders and transferred the data to survey forms upon completion of the survey. Follow-up surveys were conducted after a review of survey data indicated below-canopy, straight-line flight behavior. Surveyors were stationed along previously observed murrelet flight paths to determine the destination of the birds (*i.e.*, activity area) within 1–2 ha. Once activity areas were identified, trees with specific structural attributes, such as large limbs (> 14 cm diameter) were monitored for murrelet activity. If birds were seen landing in trees we noted the location and returned after the nesting season (after 15 September) to climb prospective nest trees. Nest trees were identified by either direct observation of a bird on the nest or a well-developed fecal ring located on a platform.

Three stands were selected to be searched for evidence of nesting based on murrelet flight behavior.

These stands included Shaw Creek, Elkhead Springs, and Bell-Lawrence. Tree species in these stands primarily included coast redwood mixed with Douglas-fir. Understory species consisted of tanoak (*Lithocarpus densiflora*), huckleberry (*Vaccinium spp.*) and salal (*Gaultheria shallon*).

Eggshell searches.—Searches for eggshells were conducted concurrently with site monitoring. Within 1–2 ha activity areas, a transect grid was marked so surveyors could traverse the area on parallel lines. The distance between parallel lines varied from 1.5 to 5.0 m, depending on density of the understory shrub layer. When the understory was denser the search pattern was tightened. Particular attention was paid to the area under the trees with large limbs and large crowns (> 50% live crown, > 50% opacity). We used 5–7 people in these searches. Eggshell locations were mapped (6.3 cm/km on contour maps) and flagged for future reference. Trees under which eggshell fragments were found were climbed after the breeding season in an effort to locate the actual nest site.

Habitat Characteristics

Stand characteristics.—Stand canopy closure was determined stereoscopically by photo interpreters in 1985 and was ground truthed and updated annually by the Forestry Department of PALCO. Elevation, distance inland (from the western edge of the stand to the ocean), site aspect, and stand area were determined from PALCO's geographic information system (GIS) database.

Nest-site characteristics.—Nest-site characteristics were measured in a 0.1-ha plot that was established and centered on each nest tree. Plot-tree measurements were taken in September after nesting activity had ended. For each dominant tree within the plot, diameter at breast height (dbh), height, percent live crown, and crown diameter were measured. The crown diameter of each tree was determined from the ground by measuring the distance from the center of the tree to the outside edge of the tree canopy. Percent canopy closure within each plot was determined by totaling the canopy area for each tree and dividing by the total area of the plot.

Nest and nest-tree characteristics.–Diameter (dbh), tree height, nest branch height, branch diameter at the base, percent canopy closure above the nest cup, and nest distance to the trunk were measured for each nest tree. Distance from the nest plot to the nearest road or stand edge was also measured.

RESULTS

Five sets of eggshell fragments were discovered at the base of 3 trees in the 3 study sites. All eggshell fragments were identified by L. F. Kiff, and archived at the Western Foundation of Vertebrate Zoology. Nests were confirmed in 2 of these stands—Elk Head Springs and Shaw Creek.

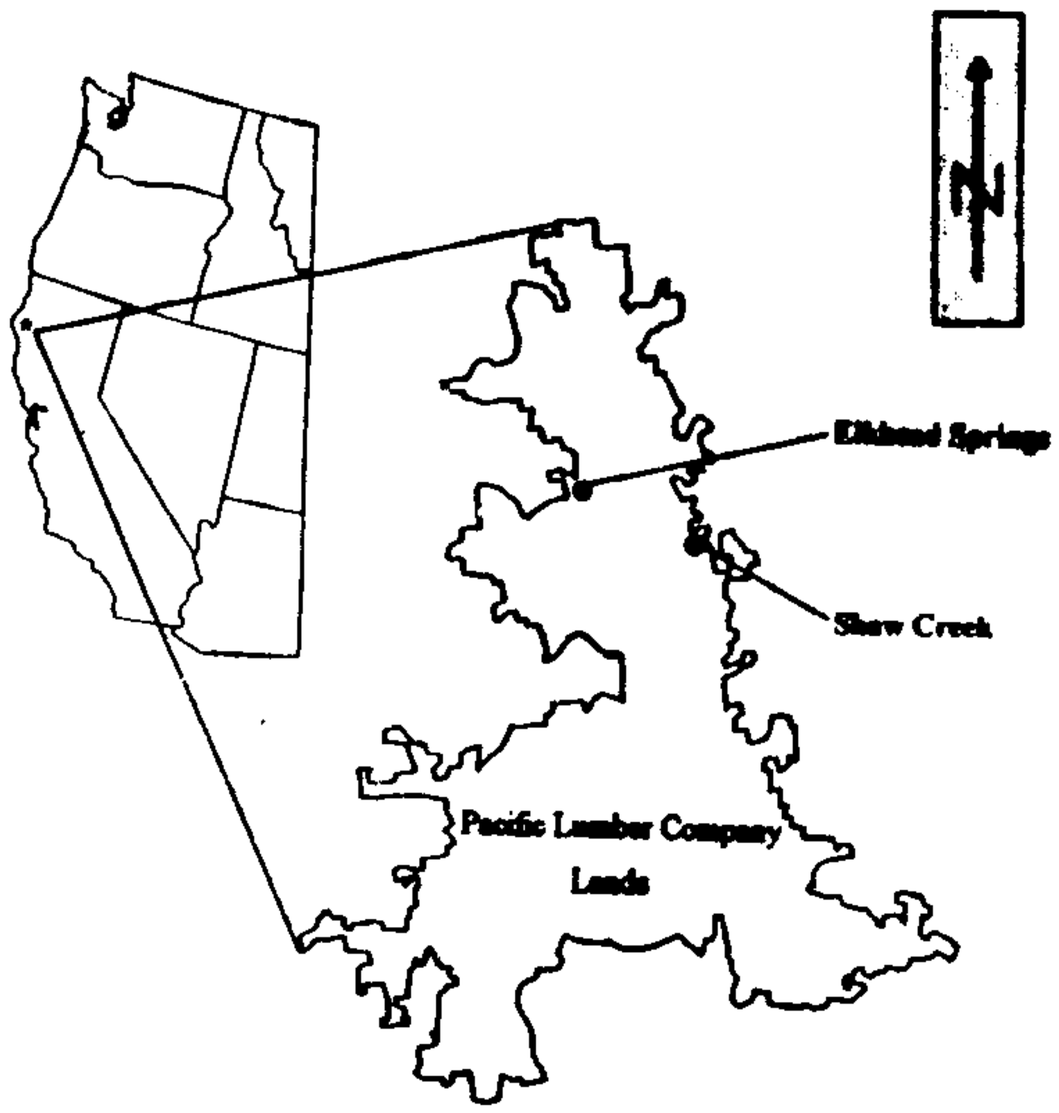

FIGURE 1. Pacific Lumber Company Lands within coastal northern California, and the locations of the Elkhead Springs and Shaw Creek nest sites.

Elkhead Springs Nest

The nest at Elk Head Springs was in a 106-ha stand 25 km from the ocean at 341 m elevation. Stand aspect was north and east. The nest was found on 6 August 1992 by observing adult birds entering and leaving the suspected nest tree and by sighting a nestling on a limb. Two observers monitored the nest site simultaneously from 6 August through 23 August 1992 from 1 hr before sunrise to 1 hr after sunset. On the 17th day of observation the nestling collapsed and died of a heart aneurysm caused by pulmonary edema. The cause of the edema was undetermined. The necropsy of the nestling, performed by T. M. Work, Wildlife Investigations Laboratory of the California Department of Fish and Game, determined the bird to be otherwise healthy.

The nest was in a large redwood tree (87 m tall, 229 cm dbh) 70 m from a logging road. The nest was on the north side of the tree and was located above the top of other trees in the plot. The nest was next to the trunk on a 21-cm diameter branch, 67 m above the ground. Cover above the nest was 100%. The nest tree was the largest tree in the 0.1-ha plot in height, dbh, %

live crown, and live crown diameter. Mean dbh of 16 other redwood and 1 Douglas-fir was 70 cm and mean height was 36 m. Canopy closure in the plot was 42%, slightly less than the stand canopy closure (from aerial photographs) of 50–75%.

Shaw Creek Nest

The nest at Shaw Creek was in a 100-ha stand 18 km from the ocean at 451 m elevation. Stand aspect was north and west. The nest was found by climbing a tree under which eggshell fragments were found. The nest was inactive when found but had a well-developed fecal ring on a lateral branch. No fledgling remains were found at the nest or within the nest plot.

The nest was in a 74-m tall coast redwood tree (254 cm dbh), 37 m from a logging road. The nest was located on the south side of the tree and was higher than all but 2 other trees in the plot. The nest was 18 cm from the trunk on a 20-cm diameter branch, 67.5 m above the ground. Cover above the nest was 100%. Again, the nest tree was the largest tree in the plot in height, dbh, % live crown, and live crown diameter. Mean dbh of 5 other redwoods and 5 Douglas-firs was 114 cm and mean height was 54 m. Canopy closure in the plot was 38%, while stand canopy closure (from aerial photographs) was 75–100%.

DISCUSSION

The 2 nest trees were the dominant trees within their respective 0.1-ha plots, similar to other murrelet nest trees found in North America (Hamer and Nelson 1995a, Jordan and Hughes 1995, Manley and Kelson 1995, Naslund et al. 1995, Singer et al. 1995). Limited nest cover was provided by adjacent trees because the nest limbs were higher than the surrounding trees. Other nest limbs have been higher than the surrounding canopy (Naslund et al. 1995), however this has not been the case at many nests (Hamer and Nelson 1995a).

Generally murrelet nests have been in stands with a wide range of canopy closure and nest sites have had less cover than adjacent sites (Hamer and Nelson 1995a, this study). Marbled murrelets may need some openings near the nest tree to gain access to the nest limb. However, because most nests were located along edges, where birds are easier to observe, results regarding canopy closure at the nest may be biased. This and other factors (*e.g.*, relationship between the nest plot and the surrounding forest, or distance between the trunk and the nest) that may be important for nesting require further investigation.

The Elkhead Springs nest did not fledge a chick in 1992. At the Shaw Creek site, a well-developed fecal ring and lack of evidence of predation or incidental death around the nest site (*i.e.*, bones or other remains) suggests fledging could have occurred. However, fecal rings had been observed when chicks were 3 wk old and some have failed at this stage (Nelson and Hamer 1995a). With this small sample size, it is difficult to relate nesting success to habitat characteristics. Only limited information is available on the characteristics of murrelet habitat in relation to reproductive success. Nelson and Hamer (1995a) found that successful nests were further from edges and had higher cover at the nest than unsuccessful nests.

To integrate forest management successfully with sustaining and enhancing murrelet habitat, an understanding of the specific nesting habitat requirements of this species is necessary. Additional research with larger sample sizes and data on the relationship between nest success and forest characteristics are needed to determine more specific attributes of preferred murrelet habitat in northern California.

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