Nelson, OR Coop. Wildl. Res. Unit, pers. comm. 1995).

Nesting occurs over an extended period from late March to late September (Carter and Sealy 1987; Hamer and Nelson 1995b). During the breeding period, the female marbled murrelet lays a single egg in a tree containing a suitable nesting platform (e.g., large or forked limbs, dwarf mistletoe (Arceuthobium spp.) infections, witches brooms, deformities, etc. (Hamer and Nelson 1995b)). Both sexes incubate the egg in alternating 24hour shifts for approximately 30 days, and the young fledges after an additional 27 to 40 days (Simons 1980; Hirsch et al. 1981; Singer et al. 1991; Hamer and Nelson 1995a; Nelson and Hamer 1995a). Adults feeding young fly from ocean feeding areas to nest sites at all times of the day, but most often at dusk and dawn (Hamer and Cummins 1991; Nelson and Hamer 1995a). Chicks are fed at least once a day. The adults usually carry only one fish at a time to the young (Carter and Sealy 1987; Hamer and Cummins 1991; Singer et al. 1992; K. Nelson, pers. comm. 1992; Nelson and Hamer 1995a). The young are semi-precocial. Before leaving the nest, the young molt into a distinctive juvenile plumage. A fledgling's first flight is from the nest directly to the marine environment (Hamer and Cummins 1991).

Marbled murrelets have been observed at some inland sites during all months of the year (Paton *et al.* 1987; Naslund 1993). Attendance at breeding sites during the non-breeding season may enhance pair bond maintenance, facilitate earlier breeding, or reinforce familiarity with flight paths to breeding sites (Naslund and O'Donnell 1995; O'Donnell *et al.* 1995).

With respect to critical habitat, the Service considered two components of marbled murrelet habitat that are biologically essential—(1) terrestrial nesting habitat, and (2) marine foraging habitat used during the breeding season. Forested areas with conditions that support nesting marbled murrelets are referred to as "suitable nesting habitat." Marine areas with conditions that support foraging marbled murrelets are referred to as "suitable foraging habitat."

Throughout the forested portion of the species' range, marbled murrelets typically nest in forested areas containing characteristics of older forests (Binford *et al.* 1975; Sealy and Carter 1984; Carter and Sealy 1987; Carter and Erickson 1988; Marshall 1988; Paton and Ralph 1988; Nelson 1989, 1992; Hamer and Cummins 1990, 1991; Quinlan and Hughes 1990; Kuletz 1991; Singer *et al.* 1991, 1992; Nelson *et al.* 1992; Hamer *et al.* 1994; Ralph *et al.* 1995a).

The marbled murrelet population in Washington, Oregon, and California nests in most of the major types of coniferous forests in the western portions of these states, wherever older forests remain inland of the coast. Although marbled murrelet nesting habitat characteristics are somewhat variable throughout the range of the species, some general habitat attributes are characteristic throughout its range, including the presence of nesting platforms, adequate canopy cover over the nest, landscape condition, and distance to the marine environment.

Individual tree attributes that provide conditions suitable for nesting include large branches (average of 32 centimeters (13 inches), range of 10 to 81 centimeters (4 to 32 inches) in Washington, Oregon, and California) or forked branches, deformities (e.g., broken tops), dwarf mistletoe infections, witches brooms, or other structures large enough to provide a platform for a nesting adult murrelet (Carter and Sealy 1987; Hamer and Cummins 1990, 1991; Singer et al. 1991, 1992; Ralph et al. 1993; Hamer et al. 1994; Hamer and Nelson 1995b). These structures are typically found in old-growth and mature forests, but may be found in a variety of forest types including younger forests containing remnant large trees.

Northwestern forests and trees typically require 200 to 250 years to attain the attributes necessary to support marbled murrelet nesting, although characteristics of nesting habitat sometimes develop in younger coastal redwood (Sequoia sempervirens) forests. Forests with older residual trees remaining from earlier forests may also develop into nesting habitat more quickly than those without residual trees. These remnant attributes can be products of fire, wind storms, or previous logging operations that did not remove all of the trees. Other factors that may affect the time required to develop suitable nesting habitat characteristics include site productivity and microclimate.

As of January 1, 1994, 65 nests had been located in North America, including 6 in Washington, 22 in Oregon, and 10 in California (Binford *et al.* 1975; Varoujean *et al.* 1989; Quinlan and Hughes 1990; Hamer and Cummins 1990, 1991; Kuletz 1991; Singer *et al.* 1991, 1992; Hamer and Nelson 1995b). All of the nests in Washington, Oregon, and California were in large trees that were more than 81 centimeters (32 inches) diameter at breast height (dbh). Of the 37 nests for which data were collected, 70 percent were on a moss substrate and 30 percent were on litter, such as bark pieces, conifer needles, small twigs, or duff. Fifty-nine percent of the nests were on large or deformed branches, 16 percent were on forked limbs, 6 percent were on a limb where it attached to the tree bole, 11 percent were on dwarf mistletoe, and 8 percent were on other structures (T. Hamer, Hamer Environmental, pers. comm. 1995).

More than 94 percent of the nests were in the top half of the nest trees, which may allow easy nest access and provide shelter from potential predators and weather. Canopy cover directly over the nests was typically high (average 84 percent, range 5 to 100 percent) in Washington, Oregon, and California (T. Hamer, pers. comm. 1995). This cover may provide protection from predators and weather. Such canopy cover may be provided by trees adjacent to the nest tree, and/or by the nest tree itself. Canopy closure of the nest stand/site varied between 12 and 99 percent and averaged 48 percent (T. Hamer, pers. comm. 1995).

Nest stand size in Washington, Oregon, and California varied between 3 and 1,100 hectares (7 and 2,717 acres) and averaged 206 hectares (509 acres) (Hamer and Nelson 1995b). Miller and Ralph (1995) found in California that stand size had no effect on whether murrelets were present or occupied a stand. However, the effects of stand size on murrelet presence and use may be masked by other factors such as small sample sizes in the larger stand categories, stand history, and proximity of a stand to other old-growth stands.

General landscape condition also may influence the degree to which marbled murrelets nest in an area. In Washington, marbled murrelet detections increased when old-growth/ mature forests comprised more than 30 percent of the landscape (Hamer and Cummins 1990). Hamer and Cummins (1990) found that detections of marbled murrelets decreased in Washington when the percentage of clear-cut/ meadow in the landscape increased above 25 percent. Additionally, Raphael et al. (1995) found that the percentage of old-growth forest and large sawtimber was significantly greater within 0.8kilometer (0.5-mile) of sites (203-hectare (501-acre) circles) that were occupied by murrelets than at sites where they were not detected. Raphael et al. (1995) suggested tentative guidelines based on this analysis that sites with 35 percent old-growth and large sawtimber in the landscape are more likely to be occupied. In California, Miller and Ralph (1995) found that the density of