Marbled Murrelet
(Brachyramphus marmoratus)

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The marbled murrelet, *Brachyramphus marmoratus*, is a small seabird (length 24-25 cm; mass 190-270 g; Nelson 1997) belonging to the auk family (Alcidae). It is found coastally from northern California to the western Aleutian Islands, although the vast majority of birds occupy the central portions of this range in Southeast Alaska (Nelson 1997, Agler et al. 1998). The bird's marbled gray-brown breeding plumage contrasts sharply with its distinct black and white winter (basic) plumage (Fig 1). Like other auks, marbled murrelets are expert divers and underwater swimmers. They mostly feed on small schooling fish, such as Pacific herring *(Clupea barengus),* capelin *(Mallotus villosus),* and Pacific sand lance *(Ammodytes hexapterus)* (Nelson 1997). Like other seabirds, the marbled murrelet visits land only during the breeding season. Unlike nearly all other seabirds, however, this species nests as solitary pairs, most often in mature conifers within 30 km from the coast (Burger 2004). Little is known about the general ecology, life history, and habitat requirements of this species in Southeastern Alaska (Southeast) (DeGange 1996). The majority of breeding season information comes from the Pacific Northwest and British Columbia—areas that have witnessed significant murrelet population declines in recent decades (Nelson 1997, Burger 2002).

FIG 1. Marbled murrelet on the water winter plumage. (Milo Burcham)

STATUS IN SOUTHEASTERN ALASKA

Distribution

Marbled murrelets are abundant and widely distributed throughout the waters of Southeast (Agler et al. 1998). Their at-sea distribution in summer finds them using inside sheltered waters, and often within several miles (km) of the shoreline. Agler et al. (1998) and Lindell (2005) reported a number of areas within Southeast where murrelets appeared to be abundant during surveys. It is not clear whether those represent areas with consistently high marbled murrelet numbers, or only transitory aggregations. Preferred inland nesting areas have not been documented in Southeast.

Abundance and Trend

Obtaining a reliable estimate of the Southeast marbled murrelet population is difficult. Secretive nesting behavior, low detect ability on nests, high risk of repeated counts of individuals on the water, and inter-observer variability all contribute to the difficulty in establishing population estimates for marbled murrelets (Agler et al. 1998, Whitworth et al. 2000). Large aggregations, commonly observed throughout the year, may shift during very short time frames, adding to the difficulty in accurately identifying populations of murrelets at sea (DeGange 1996).

Summer estimates of the Southeast population of marbled murrelets range from approximately 100,000 (Piatt and Ford 1993) to nearly 900,000 (upper CI, Agler et al. 1998). The population in 1996 was conservatively estimated to be in the low hundreds of thousands (DeGange 1996).

Population trend information for marbled murrelets is hampered by lack of long-term consistent monitoring across the region. However, there is good agreement with rates of decline estimated from Icy Strait and Glacier Bay (-12.7 vs. -11.8%), and these estimates are supported by observed trends from a region wide survey (-11.5%) (Piatt et al. 2007). Taken together, these efforts suggest a region-wide population decline in Marbled Murrelets of 79% over the past 20 years (Piatt et al. 2007). Multiple factors are likely contributing to the observed decline, including loss of old-growth habitat, changing ocean conditions, mortality from oil pollution and fishing nets, and increased natural predation (Piatt et al. 2007).

Special Taxonomic Considerations

No subspecies of marbled murrelet is recognized in North America. A closely related species, the long-billed murrelet *(B. perdix)*, is found along the coast of Asia (American Ornithologists' Union 1997).

Special Management and Conservation Designations

Because of the apparent reliance of the marbled murrelet on old-growth forests for nesting habitat (Fig 2) and the observed population declines over much of its range (Beissinger 1995, Nelson 1997, Burger 2002), the marbled murrelet has attracted the attention of wildlife agencies and conservation groups in western North America. In California, Oregon, Washington, and in Canada, marbled murrelets are considered threatened under the U.S. and Canadian endangered species acts (this status, however, is under review and may soon change). A recent decision by the Assistant Secretary of the Interior to unify these at-risk populations with the relatively abundant Canadian and Alaskan populations reverses an earlier conclusion by the U.S. Fish and Wildlife Service (USFWS) that the lower 48 population of marbled murrelets deserved separate protection. The USFWS recently completed a 5-year status review of the entire North American population of marbled murrelets (McShane et al. 2004).

In Alaska, the USFWS lists the marbled murrelet as a species of management concern. The U.S. Forest Service (USFS) considers it a species of concern in the Tongass National Forest (2002), and Audubon Alaska (2005) has placed the marbled murrelet on its WatchList because of the potential loss of breeding habitat in Southeast.

FIG 2. Adult marbled murrelet on a nest in the top of an old-growth hemlock on Baranof Island in southeastern Alaska. (Jeff Hughes)

In the 1997 Tongass National Forest Land and Resource Management Plan, the USFS noted a dearth of data on the marbled murrelet in Southeast. In the plan, the USFS recommended coordination between multiple state and federal agencies to increase understanding of murrelet biology. In addition, the USFS suggested the following: a 600-ft (200-m) no cut buffer zone be maintained around identified murrelet nests, minimization of activity within the buffer zone, and monitoring of nests during the nesting period. Although made in the spirit of conservation, the recommendations are inadequate. Marbled murrelet nests are extremely difficult to find, and conservation measures that rely on known nest locations are futile. A more effective conservation strategy would be that used in the Pacific Northwest, where a buffer of 0.5 mi (0.8 km) radius is placed around any stand that is "occupied" by marbled murrelets (Raphael 2006). A stand is defined as occupied if murrelets are observed flying beneath or within the canopy, or are observed circling tightly above a stand.

In April, 2006, a panel of species experts on forest-nesting birds (USFS 2006) recommended consideration of 7 conservation measures for marbled murrelets in Southeast:

1.Maintain a system of Old Growth Reserves to conserve viable, well-distributed populations of marbled murrelets across the Forest.
2. Move or enlarge the Old-Growth Reserves to include important habitat identified by the marbled

murrelet habitat suitability model, and mapped using MARXAN.
3. Conduct bi-annual at-sea surveys of marbled murrelets. Coordinate these efforts with other agencies.
4. Remove the current standard and guideline that creates buffers around "found nests." Replace it with one that protects "occupied stands." Conduct appropriate field surveys during timber sale layout to identify these stands.
5. Consider deferring timber harvesting in rare, large-tree stands between 0.3 and 19 mi (0.5 and 30 km) from the shore. Allow exceptions where rigorous field surveys show a stand is unoccupied.
6. Promote and help fund research into marbled murrelet population trends, habitat requirements and limiting factors in Southeast.
7. Convene an independent task force of marbled murrelet researchers from Alaska and British Columbia. Regularly revise the marbled murrelet habitat model and amend standards and guidelines to ensure they reflect best available science

Significance to the Region and Tongass National Forest

Southeast represents just 10-15% of the species linear range, but it supports 60-70% of the global marbled murrelet population (USFS, 2006). Marbled murrelets contribute to the rich natural heritage of the Tongass National Forest. Nowhere in the world are these distinctive birds found in densities as high as those occurring in Southeast. The marbled murrelet is an important part of the complex ecology of both forest and nearshore marine environments, the 2 most striking attributes of the Tongass National Forest.

HABITAT RELATIONSHIPS

In summarizing the known terrestrial habitat characteristics of marbled murrelets in Southeast, DeGange (1996) stated, "Limited research has been undertaken in Southeast Alaska to assess terrestrial habitat characteristics, use, and suitability. This topic remains the single largest data gap for this species in this portion of its range in North America." In its supplemental environmental impact statement (SEIS) (2003) to the Tongass National Forest Land and Resource Management Plan (1997), the USFS lists important habitat for marbled murrelets as: "productive old growth within 31 mi (50 km) of the ocean, and at lower elevation in heads of bays." Conservation options stated in the SEIS are to "maintain productive old growth in heads of bays, emphasizing those near aquatic or terrestrial concentration areas." The beach fringe area (within 0.3 mi [0.5 km]) is not used by marbled murrelets for nesting, presumably because of the higher densities of avian predators found there (Burger 2004).

Specific requirements for nesting habitat of marbled murrelets in Southeast are presumably similar to requirements of the bird in British Columbia. Key microhabitat characteristics for marbled murrelet nest sites in British Columbia were listed by Burger (2004, citing Hamer and Nelson 1995, Nelson 1997, and Burger 2002) as:

1. Sufficient height to allow stall landings and jump-off departures;
2. Openings in the canopy for unobstructed flight access;
3. Sufficient platform diameter to provide a nest site and landing pad;
4. Soft substrate to provide a nest cup; and
5. Overhead cover to provide shelter and reduce predation by predators.

These requirements explain the overwhelming preference for marbled murrelets nesting in trees. There are records of ground nesting birds as well, especially in the treeless northern edge of the species range (Ford and Brown 1994, Marks and Kuletz 2001), although the proportion of the population that ground nests is relatively small (Piatt and Naslund, 1995).

Burger (2004) summarized suitable nesting habitat for breeding marbled murrelets as "old seral stage coniferous forest providing large trees with suitable platforms (limbs or deformities > 6 in [15 cm] in diameter), and a variable canopy structure allowing access to platforms." Several studies that used radar to track movements of marbled murrelets found that watershed populations were directly proportional to available old-growth forest (Burger 2002).

DeGange (1996) compared nest site characteristics of all 6 confirmed marbled murrelet nests (4 tree nests, 2 ground nests) found in Southeast. In all cases, stands were classified as "old growth, uneven age," canopy cover was dense, and nest material was moss. All tree nests in Southeast were in broken-topped hemlock in declining health (including 1 nest in mountain hemlock *[Tsuga mertensiana]* (Quinlan and Hughes 1990) and three nests were in western hemlock [*Tsuga heterophylla*]). Whether these recorded nesting sites are representative of nesting habitat for the entire

Southeast population of marbled murrelets is unknown. Based on examination of over 200 nests in British Columbia, Burger (2004) concluded it was unlikely that murrelets select particular tree species, but that certain species are more likely to provide the microhabitat requirements listed above.

In British Columbia, murrelet nesting habitat occurred over a broad range of elevations but the tendency was for nesting at elevations below 2,600 ft (800 m), with less suitable conditions at 2,952 to 4,920 ft (900-1500m), and areas above 4,920 ft (1500 m) unlikely to be used (Burger 2004, Zharikov et. al. 2006). Those thresholds are probably unduly high for Southeast, where temperatures are cooler and the tree line is lower than in British Columbia.

Marbled murrelets do nest on steep slopes, and in some studies, nest success was correlated with slope (Bradley 2002). At two study areas on the coast of British Columbia, murrelets preferred steep slopes with the mean slope of nest locations greater than 30 degrees (Zharikov et. al. 2006, Huettmann, unpublished data). Other studies have shown negative or neutral effects of slope on rates of occupied detections and measures of nest habitat quality (Burger 2002). Aspect does not appear to have a strong effect on the placement or success of nests (Burger 2004).

Marbled murrelets in Southeast and British Columbia travel substantial distances between foraging areas and nesting habitats (Newman et al. 2005, Huettmann, unpublished data). Whitworth et al. (2000) followed six individuals radio-tagged in Auke Bay (north of Juneau) during the breeding season (24 June–17 July). On 20 occasions, the same individual was located at both coastal and at-sea sites on the same day. Distance between these locations varied considerably up to a maximum of 77 mi (124 km). Generally, these six birds were moving between inland sites at Auke Bay and western Icy Strait/Glacier Bay, a known seabird foraging area. Therefore, they can be dependent on near-shore waters and still travel long distances in a day. However, they are traveling these long distances to access rich foraging sites, not to access inland forests. Hull et al. (2001) concluded that, in British Columbia, the distance of nest from water and nest success was not related.

Generally, marbled murrelets are more numerous in nearshore environments (about 1.3 mi [2 km]) than offshore. Whether at-sea murrelet distribution is dictated by bathymetric features is unknown (DeGange 1996), although it may be related to up-wellings and tide-rips which create food-rich feeding zones. At-sea habitat use in Southeast can be influenced by a variety of temporal variables, including tide, time of day, and season (Speckman et al. 2000).

Habitat Capability Model

To evaluate marbled murrelet habitat values within watersheds and compare watershed values within biogeographic provinces, a model for nesting habitat capability was developed by a group of interagency experts. Habitat values were rated by using data on murrelet habitat selection from studies in adjacent regions, including Prince William Sound, British Columbia, and the Pacific Northwest. The model estimates relative value of nesting habitats for marbled murrelets during summer based on forest stand age, tree size, distance from shoreline, and slope. Further details of the model (including habitat coefficients) are presented in Chapter 2. The nesting habitat values of watersheds to murrelets are ranked within each biogeographic province, an approach that avoids watershed comparisons between provinces (Appendix B).

IMPLICATIONS FOR CONSERVATION

It is widely believed that logging old-growth coniferous forests has contributed to substantial declines in marbled murrelet populations in the Pacific Northwest (Nelson 1997, Burger 2002). Because murrelet nests are difficult to locate, recommended practices prescribed by the USFS to minimize impacts on known nest sites are neither practical nor adequate. Widespread harvest of old-growth forest throughout the Tongass and adjacent private lands poses a significant risk to marbled murrelets nesting in old growth. Direct impacts of logging on murrelet nesting habitat can be assumed. Buffer zones are recommended by the USFS, but the effectiveness of buffers is unknown and more significantly few nests have ever been found and not a single buffer prescribed.

Because of short (100-yr) timber rotation cycles, clear-cut logging will permanently reduce murrelet nesting habitat in Southeast. Hundred-year timber rotations result in the permanent conversion of old-growth forest to even-aged second growth stands. Timber harvest rotations of less than approximately 250–300 years eliminate complex, old-growth forest structures, including large limbs with abundant moss, which are necessary for murrelet nesting platforms.

Trees in younger forests are much smaller and lack the large branches and robust epiphyte growth required for successful nesting sites. The more open canopy and vertical complexity of old growth also allows murrelets better flying conditions for landing on nest sites than the more densely stocked, closed-canopy second growth. In Southeast, stands of old, very large trees, characterized by large mean diameters and low stems per acre (Caouette and DeGayner 2005) are of importance to nesting marbled murrelets (USFS 2006) (Fig 3).

Fragmentation of nesting habitat, and the resulting decrease in forest patch size, can negatively affect murrelet populations. As forest patch size decreases, forest-edge habitat and predator access increases. Some avian predators of murrelets, especially corvids (i.e., ravens, crows, jays), are known to increase both with forest fragmentation and proximity to human activity (Burger 2002). Studies in British Columbia and Oregon revealed that nest success was higher at nesting sites farther from forest edges. Nest predation rates were also higher near forest edges (Burger 2002). Fragmented forests differ from contiguous forests in temperature, solar radiation, and wind penetration. The influence of these factors on murrelets through direct (such as thermal stress) and indirect (such as epiphyte growth patterns) mechanisms has been suggested but requires further study (Burger 2002). Alternatively, Zharikov et. al. (2006) suggest that murrelets may continue nesting in fragmented old-growth patches greater than 25 acres (10 hectares).

Marbled murrelets spend most of the year in nearshore environments and are susceptible to any threats posed there. Pollutant discharge (e.g., oil or fuel spills) may affect murrelets directly or through food web interactions (Carter and Kuletz 1995).

Commercial fishing nets pose a threat to murrelets foraging in shallow waters (Piatt and Naslund 1995). Mortality of murrelets in fisheries relying on other gear types is considered to be less problematic. Gillnet mortality of Marbled murrelets is a special concern in areas where murrelet aggregations and increased fishing effort overlap. The biggest overlaps in Southeast likely occur along Sumner Strait and the mainland shores of Stephens Passage (Carter et al. 1995). Murrelet bycatch, combined with nesting habitat loss, can be very detrimental to local populations. Long-lived species with low fecundity, common life history traits of seabirds, are especially sensitive to adult mortality.

Conservation of Southeast marbled murrelets depends on accurate population estimates, reliable population trend data, and a feasible monitoring protocol (DeGange 1996, Speckman et al. 2000). Several methods have been used or suggested to monitor marbled murrelets (Piatt and Ford 1993; Agler et al. 1998; Speckman et al. 2000, Burger 2001, USFS 2001). The Alaska Department of Fish and Game is currently conducting a study to compare different survey methods, including boat-based line and strip transects, aerial strip transects, shore-based flyway counts, and ornithological radar.

Ensuring productive, sustainable populations requires maintaining adequate habitat. Recent research in the lower 48 states and British Columbia has established the need to maintain undisturbed tracts of

FIG 3. Contrasting photos of old-growth forest canopy (left) and second-forest canopy (right). Old growth trees have large limb structures with abundant moss which provide nest platforms for murrelets. The canopy gaps in old growth may also allow better flight access to nest sites. In contrast, second growth has smaller limbs with less moss and a more closed canopy making flight to and from nest more difficult. (John Schoen)

old-growth forest to prevent further declines in marbled murrelet populations. Forest management that reduces and fragments large-tree old growth will likely have negative impacts on murrelet populations (Burger 2002).

Clearly, increasing the understanding of the life history of Southeast marbled murrelets and establishing basic requirements for nesting habitat will be important for developing conservation goals and management recommendations. Although several models for habitat suitability and habitat capability have been generated for the ranges of murrelets elsewhere, it is essential that regional models also be developed to account for differences in vegetation characteristics, climate, biogeography, and landscape conditions across the murrelet range in Southeast.

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