PRELIMINARY OBSERVATIONS ON JUVENILE : ADULT RATIOS OF MARBLED MURRELETS IN AUKE BAY, SOUTHEAST ALASKA

HEIDE L. ANDERSEN[1] AND STEVEN R. BEISSINGER

School of Forestry and Environmental Studies, Yale University, 205 Prospect Street, New Haven, CT 06511, USA

ABSTRACT—Surveys of adult and juvenile marbled murrelets (*Brachyramphus marmoratus*) were conducted in Auke Bay, Alaska, from 15 July to 18 August 1993. Transects were surveyed at 800 m and 1400 m from shore to determine the proportion of juvenile murrelets at sea in Auke Bay. The proportion of juveniles was small, ranging from 0.4 to 3.1 %. Juveniles were seen only on the transect closer to shore. The ratio of juveniles to adults did not differ among weeks during the breeding season. Results are discussed in relation to the length and placement of transects designed to collect data for at-sea survey protocols to estimate murrelet productivity.

Marbled murrelets (*Brachyramphus marmoratus*) occur along the Pacific coast of North America from central California to the coast of Alaska, and westward to Kamchatka and the Kuril Islands (Marshall 1988, Carter and Morrison 1992). They feed mostly within 2 km of shore (Sealy 1975b, Sealy and Carter 1984), and nest almost exclusively in the high canopies of mature forests of Douglas-fir (*Pseudotsuga menzeisii*), coast redwoods (*Sequoia sempervirens*), Sitka spruce (*Picea sitchensis*), or mountain hemlock (*Tsuga mertensiana*) (Binford et al. 1975, Singer et al. 1991, Hamer and Nelson 1995a). During the last decade, marbled murrelet numbers have declined, and the species was recently listed as threatened in California, Oregon, and Washington under the Federal Endangered Species Act (ESA) (Carter and Erickson 1992, U.S. Fish and Wildlife Service 1992, Ralph et al. 1995b). Immediate threats to this species include dwindling nesting habitat due to extensive logging of coastal old-growth forests, and mortality from gill-net fishing and oil spills.

The Alaskan population may be the healthiest in North America (Mendenhall 1992). Consequently, drastic population declines as a result of timber harvesting in nesting areas would be important, because the greatest concentrations of murrelets are found in areas where logging is expected to expand (Mendenhall 1992). In southeast Alaska, where the largest of these forested regions is found, over 40% of the high-volume old-growth in Tongass National Forest has already been logged (Piatt and Naslund 1995). The marbled murrelet is currently listed in Alaska as a Category 2 species under the ESA, but better information is needed to determine if it should be listed as threatened. For this reason, knowledge of this marbled murrelet population is particularly important.

Very little is known about the demographics of the marbled murrelet. However, demographic models based on measures of murrelet productivity and estimates of annual survival have been used to determine population trends (Beissinger 1995). The proportion that juveniles comprise of the total population (juveniles, subadults and adults) at sea has been used to estimate productivity in the models (Beissinger 1995). Estimates of the proportion of juvenile marbled murrelets in the population depend on effective and consistent methods for conducting surveys at sea. To establish such a protocol, we need to understand the factors affecting spatial and temporal characteristics of habitat use by juveniles.

We surveyed adult and juvenile marbled murrelets in Auke Bay, Alaska. Transects were established at 2 distances from shore and surveyed regularly to determine if the proportion of juveniles was affected by the distance from shore and timing of surveys within the breeding season.

[1] Present address: *SWCA Inc., 56 West 400 South, Suite 201, Salt Lake City, Utah 84101 USA.*

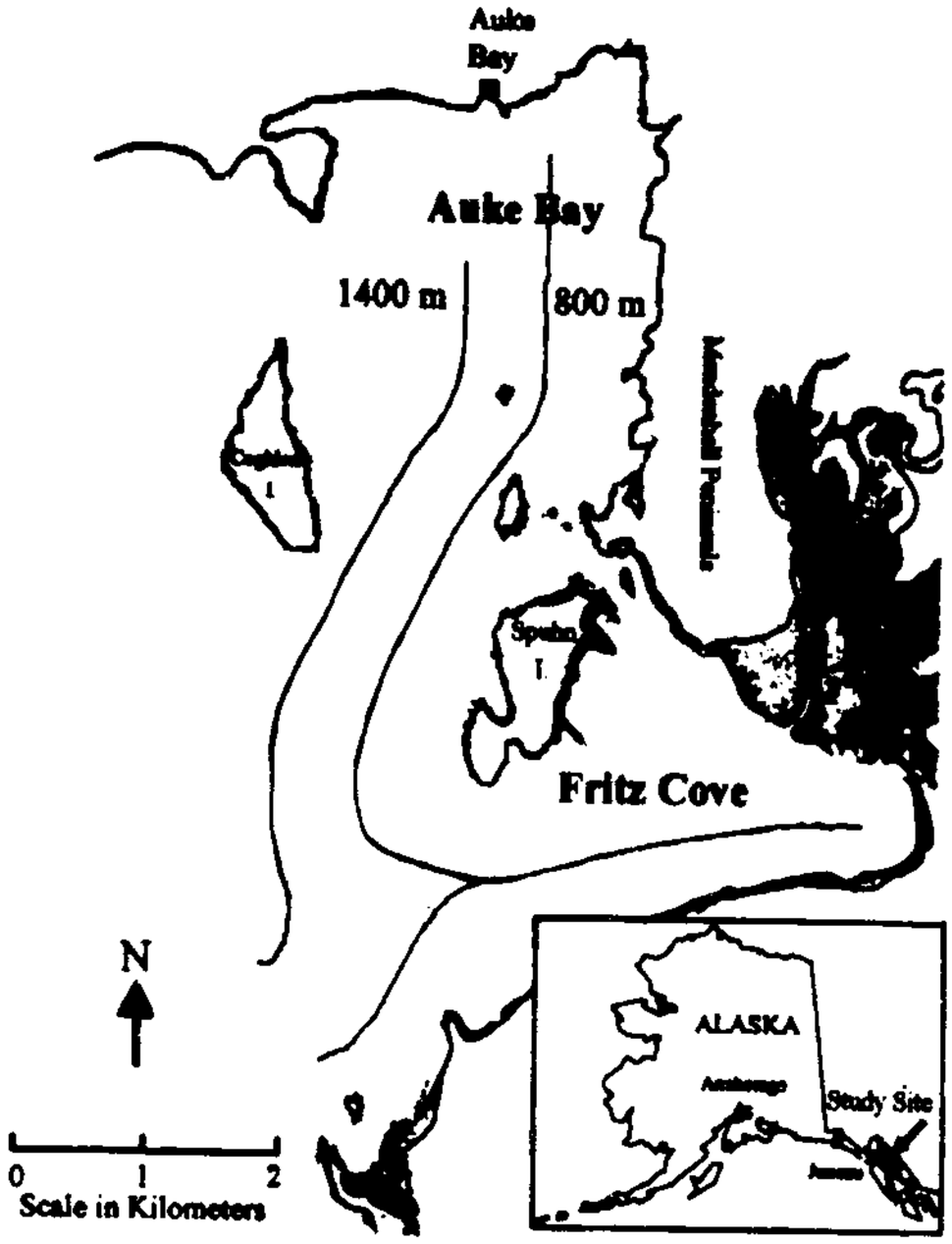

FIGURE 1. Navigational map of the 2 at-sea transects (800 m and 1400 m) in Auke Bay and Fritz Cove in southeast Alaska (source: National Oceanic and Atmospheric Administration Chart No. 17315: Gastineau Channel and Taku Inlet Chart [58° N, 134° W]). Stippled areas indicate tidal or glacial mudflats.

METHODS

At-sea surveys were conducted in the Auke Bay–Fritz Cove area of Tongass National Forest (58° N, 134° W) in southeast Alaska (Fig. 1) from 15 July to 18 August 1993. The beginning of the survey coincided with the first sighting of a juvenile marbled murrelet (S. Speckman, pers. obs.). It ended before a large number of subadults and adults had begun molting into winter plumage, at which time it became difficult to distinguish age classes (Carter and Stein 1995). Surveys were conducted 2–3 days a week with at least a 1-day interval between surveys to reduce the chance of double-counting birds.

The extensive survey protocol of Ralph and Miller (1995), and Ralph and Long (1995) was used. Using nautical maps and visual markers, 2 transects were established parallel to the coastline at 800 m and 1400 m from the shore (Fig. 1). The transects were divided into 9 plots, each 2 km in length. Total transect lengths were 12 km at 800 m and 6 km at 1400 m. Observations were taken standing from a 5-m skiff with an open deck.

Each survey began on the 800-m transect, and returned on the 1400-m transect. Surveys were started before 1000 hr and lasted about 2 hr. The boat was driven at approximately 5 knots, but was slowed to make observations. A painted buoy was periodically towed 100 m behind the boat as a distance reference. An 180°-arc was scanned from beam to beam, ahead of the boat.

The first 25 murrelets encountered within 100 m from the boat in each plot were identified as juveniles or adults based on careful examination of the plumage of each bird (Carter and Stein 1995). Additional birds were surveyed in each plot as time permitted. To ensure the accuracy of our classification, we recorded: (1) whether the bird was front, side, or back lit and whether it was seen from the front, side, or back; (2) the plumage of each murrelet by evaluating feather coloration on the breast, scapulars, belly, sides, wings, and back, and whether the bird was an adult in alternate (breeding) plumage, an adult in basic (winter) plumage, or a juvenile; and (3) presence of an egg tooth.

Spatial and temporal factors affecting the percentage of juveniles in the population were examined by pooling survey data into 1-wk periods: 15–22 July (3 surveys), 23–30 July (2 surveys), 31 July–6 August (2 surveys), 7–14 August (2 surveys), and 15–22 August (2 surveys). Because few juveniles were observed and all occurred on a single transect, it proved difficult to evaluate our data set statistically. Thus trends were evaluated by inspection.

RESULTS

Juvenile murrelets ranged from 0.4% (1 of 238) to 3.1% (5 of 156) of the birds observed at sea and composed 1.3% of all birds surveyed during the study period (Table 1). The few juveniles encountered appeared to frequent different areas than did adults. All juveniles were

TABLE 1. Numbers of juvenile (Juvs) and after-hatch-year (Adults) marbled murrelets observed at two distances from shore in Auke Bay, Alaska.

	15–22 July		23–30 July		31–6 August		7–14 August		15–22 August	
Distance	Juvs	Adults	Juvs	Adults	Juvs	Adults	Juvs	Adults	Juvs	Adults
800 m	4	224	1	94	1	184	5	142	1	93
1400 m	0	86	0	44	0	54	0	14	0	5
Total	4	310	1	138	1	238	5	156	1	98

observed on the transect closer to shore, and most were found at the head of Fritz Cove (Fig. 1). There were no obvious trends in the proportion of juveniles during the 5 wk of study. The proportion of juveniles was greatest during the week of 7–14 August.

Discussion

The Auke Bay–Fritz Cove area is near Lynn Canal, which is considered to be an area of high marbled murrelet concentration during the breeding season (Piatt and Naslund 1995). Yet, the overall proportion of juvenile murrelets in the population at sea in Auke Bay (1.3%) was low compared to surveys conducted in other areas (Beissinger 1995). The highest proportion of juveniles observed was 3.4% . This value was lower than estimates for similar surveys conducted in British Columbia (Kelson et al., unpubl. data) and central Oregon, where the proportions were 4–5% (Nelson and Hardin 1993, Strong 1995), but was similar to surveys conducted in California (Ralph and Long 1995).

This low measure of productivity for an Alaskan population may indicate a very low reproductive rate. Perhaps only a small proportion of the birds nested in 1993 or most nests failed. Transects surveyed by S. G. Speckman (pers. comm.) even closer to shore than ours (200 m) found few additional juvenile marbled murrelets. However, there are several reasons why our results may have underestimated juvenile:adult ratios. First, our study site extended only 10 km in length and may not have had much suitable habitat for juveniles. The Auke Bay area in general may not be suitable for juveniles because it contains shoreline roads, homes, and a marina. Second, although old-growth stands of the Tongass National Forest are immediately adjacent to Auke Bay, juveniles may have dispersed to other areas (*e.g.*, the outer coast) after fledging. Surveys with transects running both for greater distances and closer to the shore might have detected more juveniles.

We did not find obvious temporal changes in the proportion of juveniles. Temporal increases in the proportion of juveniles should occur during the breeding season as young fledge asynchronously (Beissinger 1995, Hamer and Nelson 1995b). An increase in the proportion of juvenile murrelets occurred almost universally in other studies that have surveyed larger areas, which indicates that the proportion of juveniles could be a useful tool for assessing the productivity of a population (Beissinger 1995). However, our study site was small, so that shifts in the proportion of juveniles may have reflected local rather than population-level changes.

In Alaska, most juveniles have been sighted alone, whereas adults often occurred in small groups (Piatt and Naslund 1995). This and other data suggest that habitat use by adults and juveniles might differ (Beissinger 1995). Our results were consistent with this hypothesis. All juveniles were observed on the transect closer to shore, and the majority were sighted in Fritz Cove. This cove is a protected bay in a glacial outwash, and is offshore from the Mendenhall Glacier mudflats. Juveniles may be more likely to forage near such mudflats than near the rocky or developed shoreline that composed the rest of the study area.

Because distance from shore appears to be related to the proportion of juveniles in this and other studies (Beissinger 1995), standard protocols for productivity analyses must account for this trend elsewhere. Unlike the straight shorelines of coastal California and Oregon, in Alaska a transect fixed at a particular distance from shore does not necessarily follow depth contours because of the presence of many islands, coves, inlets, glacial outwashes, and rock outcroppings. Due to tidal changes and physiographic features in our study area, it was difficult to establish transects that consistently remained 800 m and 1400 m from shore. Survey protocols probably should include multiple transects, beginning at distances close to shore (*e.g.*, 200 m), and running parallel to the shorelines of the mainland and large islands. Future studies should be conducted to explore spatial and temporal behavior patterns of juvenile murrelets to refine estimates of productivity from at-sea surveys.

Acknowledgments

We gratefully acknowledge J. Lindell, J. Piatt, and the Ecological Services office of the U. S. Fish and Wildlife Service in Juneau, Alaska, for providing funding and support for this study. S. Speckman and L. Brace provided valuable field assistance as boat drivers. L. Gall and J. Gibbs assisted with the data analysis, and K. Briggs, J. Gibbs, P. James, K. Nelson, T. Rubenstein, G. Sanger, S. Sealy, and O. Schmitz reviewed various drafts of this manuscript.