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DISCOVERY OF A GROUND-NESTING MARBLED MURRELET

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ABSTRACT.—An exposed ground nest of a Marbled Murrelet discovered on 8 July 1978, on East Amatuli Island, Barren Islands, Alaska, was studied for 51 days. The behavior and activity patterns of the adults throughout incubation and the nestling stage exhibit adaptations to reduce detection of the nest and avoid predators. The highly cryptic chick remains alone on the nest for approximately 27 days and is fed at least once a night by the adults. A tenacious layer of down is apparently preened off by the chick just prior to fledging, allowing the nestling to remain inconspicuous until juvenal plumage has fully developed. Analysis of the chick's growth parameters indicates a relatively high rate of growth as compared with other alcids. This is apparently made possible because the food supply is readily accessible, and in turn reduces the period of the chick's exposure to predators. Fledging behavior in the Marbled Murrelet remains a mystery although evidence indicates that chicks fly to sea and are independent after leaving the nest.

The nesting habits of the Marbled Murrelet (*Brachyramphus marmoratus*) have puzzled and intrigued North American ornithologists for over a century. Although common from northern California to central Alaska (A.O.U. 1957), early researchers were frustrated in their attempts to locate even a single nest. Cantwell (1898) made reference to Indian legends that murrelets nested "high up on mountains in hollow trees," and it soon became apparent to other investigators that some nesting areas were to be found inland (Brooks 1928). Further evidence, which included several accounts of flightless young found inland (Jewett 1934, Barber 1941, Munro and Cowan 1947) and possible nest discoveries (Booth 1927, Guiguet 1956, Gabrielson and Lincoln 1959), continued to accumulate for the next fifty years. A comprehensive review of the evidence prior to 1960 is provided in Drent and Guiguet (1961) and additional summaries are found in Sealy (1974) and Binford et al. (1975). Strong evidence of tree nesting was obtained fortuitously in 1967 when "two young, flightless birds with webbed feet dropped out of a tree being felled by loggers on Vancouver Island, British Columbia" (Harris 1971). One bird was killed in the fall and destroyed, the other was sent to the Canadian Wildlife Service and identified by Harris as a young Marbled Murrelet. The nest was reported to be approximately 60 ft from the ground in a cedar about four miles from the ocean. This account is consistent with the observations reported by Kuzyakin (1963) of a tree-nesting Marbled Murrelet in Eastern Siberia. Tree nesting in North America was confirmed in 1974 by the discovery of a nest and a downy Marbled Murrelet chick 45 m above the ground in a Douglas-fir (*Pseudotsuga taxifolia*) located in Big Basin Redwoods State Park, Santa Cruz County, California (Binford et al. 1975).

On 8 July 1978, in the course of conducting studies on the breeding biology of several species of seabirds in the Barren Islands, Alaska, I chanced upon a Marbled Murrelet adult which was incubating a single egg on the ground. The discovery of this nest, and subsequent observations for 51 days, provide basic information on the breeding habits of the species and a framework from which prior theories and observations can be evaluated.

STUDY AREA AND METHODS

The Barren Islands (58°55'N, 152°10'W) are one of the richest and most diverse seabird breeding grounds in central Alaska. Located at the entrance to Cook Inlet between the Kenai Peninsula and Kodiak Island, the

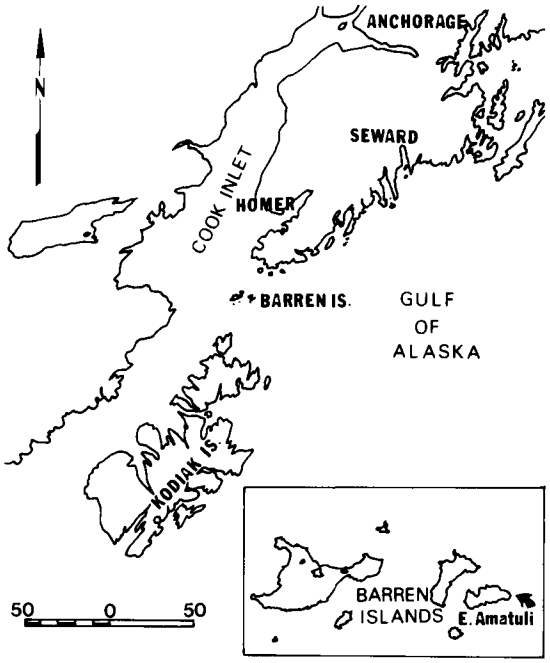

FIGURE 1. Location of the Barren Islands, Alaska.

FIGURE 2. Marbled Murrelet nest site and egg, 8 July 1978, Barren Islands, Alaska.

seven islands range in size from 60 ha to 17,000 ha and totalling 25,000 ha cover an area 21 km long and 8 km wide (Bailey 1976) (Fig. 1).

The climate, although often more extreme, resembles that of Kodiak some 125 km to the south. Temperatures are characteristic of a marine environment and exhibit a limited daily and annual variation with a mean of approximately 4.5°C (N.O.A.A. 1977). Precipitation occurs on more than 200 days each year, averaging almost 148 cm in Kodiak with a range of 100–200 cm. Wind velocities average 16.5 km per hour in Kodiak and are certainly higher in the Barrens where steep cliffs of metamorphic rock, rising to over 450 m on the larger islands, intensify the winds; gusts of 90–110 km per hour are not uncommon. Harsh weather and violent tide rips surrounding the islands have made the Barrens notorious to mariners and have limited human disturbance of the seabird populations.

The vegetation of the Barren Islands has been described by Bailey (1976), and Manuwal and Boersma (1976). Beach and marsh communities at lower elevations are dominated by beach rye (*Elymus arenarius*), two species of sedge (*Carex* sp.) and *Honckenya peploides*. The lush and very moist mid-elevation boulder community is characterized by cow parsnip (*Heraculum lanatum*), *Angelica lucida*, *Anemone narcissiflora*, and lady fern (*Athyrium filix-femina*). The vegetation at the upper elevations is composed primarily of alpine tundra plants such as *Empetrum*, *Vaccinium*, *Lupinus*, *Silene*, and *Potentilla*. Aside from Ushagat which contains several hundred acres of dense sitka spruce (*Picea sitchensis*), the islands are treeless.

While none of the three species of murrelets found in the Barren Islands is abundant, the cavity-nesting Ancient Murrelet (*Synthliboramphus antiquus*) is the most common with an estimated population of approximately 500 pairs. Kittlitz's (*Brachyramphus brevirostris*) and Marbled murrelets are present in smaller numbers around the islands. Bailey (1976) reported flushing an adult Kittlitz's Murrelet off the ground on East Amatuli in July of 1975 suggesting that it, like the Marbled Murrelet, breeds there in low numbers. Both species are considerably more numerous in the areas surrounding the Barrens and frequently are seen from the western end of the Alaska Peninsula to Glacier Bay (Bent 1919, Gabrielson and Lincoln 1959).

Following its discovery, the nest was visited daily except for 10 July. Weights and measurements were made with 100 or 300 g Pesola spring scales and a steel caliper or ruler. Wing measurements were made by measuring the distance from the proximal end of the wrist to the extreme tip of the wing. All measurements were made at approximately 13:00 daily.

Logistic growth equations were obtained by computer, employing the graphical method described by Ricklefs (1967, 1968). In Ricklefs' terminology, the equation for the logistic growth equation is $dW/dt = KW(1 - W)$, where W is the weight of the growing bird, K is a constant related to the overall growth rate, and t is time. Three other factors were also calculated enabling interspecific growth comparisons. Ka/4 and $KR/4 \times 100$ represent the maximum instantaneous growth rate of the chick at the inflection point of the fitted logistic curve and may yield a better estimate of the overall growth rate than K (Hussell 1972). Ricklefs' t_{10-90} is also used and represents the time of growth from 10–90% of the asymptote. It is calculated by the formula

$$t_{10-90} = \frac{(C_{90} - C_{10})}{dW/dt}$$

where C_{90} and C_{10} are conversion factors calculated from daily weights.

RESULTS

NEST SITE AND EGG

At 17:00 on 8 July 1978, while walking below the west ridge of East Amatuli Island, I stepped out from behind a rock outcrop at the base of the slope and was startled as a

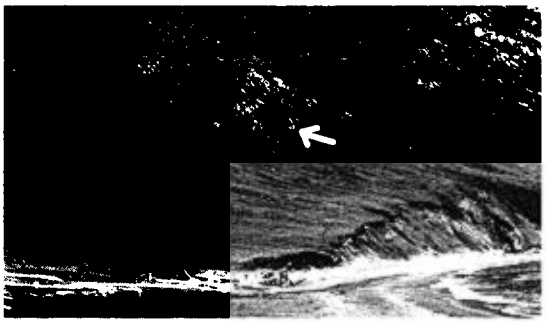

FIGURE 3. Location of Marbled Murrelet nest (arrow) on East Amatuli Island, Barren Islands, Alaska.

small bird flushed from the ground 2 m below me and flew off in a blur of wing beats to the sea. Only its size and flight behavior suggested that it might be a murrelet. Searching the area, I found a single egg resting in a small depression on the ground (Fig. 2). The sub-elliptical egg (Preston 1953) was pale olive green and covered with irregular brownish black, tar-colored spots. These spots were more prevalent around the larger end of the egg but covered it entirely. The egg weighed 41.0 g and measured 61.2 mm × 36.3 mm. No nest material was associated with the site; the egg rested on bare soil and matted vegetation. The shallow depression where the egg lay had apparently formed as a result of incubation activity. The nest site was located at the base of a rock outcrop at an elevation of 68 m, approximately 75 m from the water's edge (Fig. 3). Facing northward, the nest was protected on the south and east by the nearly vertical faces of the outcrop, and consequently never received direct sunlight. The circular nest depression, 15 cm in diameter, rested on a slight ledge within this cleft in the outcrop.

The vegetation surrounding the nest belonged to an ecotone between the grassland/beach community and the higher fellfield community composed of typical tundra vegetation (Manuwal and Boersma 1976). Two species of sedge (*Carex* sp.) predominated at the site along with short grasses and mosses. Also present around the nest were *Anemone narcissiflora, Campanula rotundifolia, Cornus suecica, Androsace chamaejasme,* and *Polygonum viviparum.*

INCUBATION

I returned to the nest at 13:00 the following day. By circling well to one side of it and dropping down to the spot from above, I was able to peer over the edge of the outcrop and view the nest undetected by its occupant. From 5 m above, I observed an adult Marbled Murrelet in breeding plumage. The incubating adult was resting in a somewhat flattened posture, absolutely motionless facing the water. The nest was not checked on 10 July, and when I returned during a severe storm on 11 July, I found the egg unattended and cold. I returned on 12 July fearing that the egg had been deserted but found an adult incubating as before. From then on the nest was attended every day until hatching.

The murrelets made little activity at the nest. They were observed on the nest 26 times totalling over 10 h of observation, and their behavior was quite uniform. The adults sat almost motionless facing the ocean and appeared extremely alert while incubating. They exhibited keen hearing and sight and responded to the slightest disturbance. Even a very faint unfamiliar noise would cause them to become agitated. On several occasions, my shuffling or the click of a camera shutter caused them to sit up erectly as if about to fly, looking cautiously from side to side for the source of the noise. They were also aware of Glaucous-winged Gulls (*Larus glaucescens*) and Ravens (*Corvus corax*) flying overhead, and several times I saw them flatten themselves against the ground in response to the calls or distant silhouettes of these predators. After observing the murrelets for several days, I was able to distinguish them by a slight difference in plumage. Both birds had whitish patches on the nape of the neck but on one adult the patches were considerably more distinct. The adults maintained a consistent 24-h shift throughout incubation, exchanging duties at night. As it became apparent that the adults were switching off each evening, I tried to observe the exchange. There are many accounts of murrelets flying inland at dusk (Bent 1919, Bailey 1927, Jewett et al. 1953, Guiguet 1956, Drent and Guiguet 1961, Savile 1972, Sealy 1974), and I hoped to be able to see or hear the birds at the nest. However, all my attempts to observe the adults exchange incubation duties failed.

On 1 August, the incubating bird appeared considerably more active as it jostled slightly from side to side, occasionally reaching underneath with its bill. The activity suggested either that the adult was brooding a chick or that the egg was hatching. I returned to the nest early that evening and at 04:30 discovered a downy chick alone on the nest.

FIGURE 4. Newly hatched Marbled Murrelet chick, 2 August 1978.

THE CHICK

The newly hatched chick was covered with a thick layer of yellowish down interspersed with irregular dark spots which were more prevalent on the head. Dense pale grey down covered the belly (Fig. 4). For a detailed description of the plumage of the downy chick see Binford et al. (1975). The plumage was extremely cryptic making the chick almost indistinguishable from above. Although the chick was presumably only one day old, it seemed very alert with well-developed vision and hearing. It responded immediately to unusual noises around the nest and could quickly detect my approach at distances of over 10 m. It regarded me intently, turning slowly on the nest to keep me in sight. If approached too closely the chick would rear back on its legs, open its bill in a threatening gape, and peck vigorously in self-defense. When handled, the chick frequently gave a very muted vocalization. The sound, a faint, raspy, single-syllable, ascending cry of approximately one second duration resembled that given by small puffin chicks (*Fratercula, Lunda, Cerorhinca*) when hatching or being fed. The nest site appeared much as it had when the egg was found 25 days earlier although the depression was considerably more distinct as a result of the matting of the vegetation by the incubating adults. When discovered, the chick weighed 39 g. At 11:30 the same day, I made the following measurements: weight, 34.5 g; wing, 25.0 mm; tarsus, 19.5 mm; culmen, 10.0 mm.

The heavy layer of down was retained through most of the nestling phase, concealing the juvenal plumage which grew

FIGURE 5. Twenty-five-day old Marbled Murrelet chick.

rapidly underneath. The ensheathed primary feathers began to emerge from the skin on day 5, and the feathers erupted on day 9. On day 6, the sheaths of all of the wing feathers were emerging as well as those of the scapulars and along the spinal tract. By day 10, all of the feathers along the spinal and ventral tracts were erupting from their sheaths as well as the secondaries and scapulars. The wing coverts emerged on day 17, and the feathers around the mandibles and forehead were complete and had lost most of their down. By day 21, the chick began to lose some of the down on its belly revealing the well-developed feathers beneath. At that point, the tail feathers were about half-way out of their sheaths and the feathers of the wing were complete. Although the growth of juvenal feathers was well advanced by day 21 the chick still had most of its down. By folding its wings, under the heavy layer of down on the body and resting with its head pulled in against its chest, the chick remained remarkably well concealed. On day 25, feather development was virtually complete beneath the remaining down (Fig. 5). By day 26, approximately 20% of the down had disap-

FIGURE 6. Twenty-seven-day old Marbled Murrelet chick.

TABLE 1. Weight gain and wing lengths of a Marbled Murrelet nestling.

Day	Weight (g)	Wing length (mm)
1	34.5	25.0
2	39.0	28.5
3	54.5	32.0
4	59.0	37.5
5	72.5	40.5
6	73.0	46.0
7	85.5	50.0
8	90.5	55.0
9	101.0	61.0
10	102.0	66.5
11	117.0	71.5
12	122.5	75.0
13	122.0	80.0
14	110.0	84.5
15	110.0	86.0
16	118.0	90.5
17	123.0	94.0
18	134.0	97.0
19	145.0	98.5
20	144.0	102.5
21	136.0	105.0
22	133.0	108.0
23	134.0	109.0
24	138.0	110.0
25	139.0	113.0
26	149.0	114.0

peared, but during the next 24 h a surprising transformation occurred. When I visited the nest that afternoon, the chick was in complete juvenal plumage except for a small patch of down still clinging to its rump. As I watched, the chick began to preen away the remainder of the down. It removed several clumps of down with its bill and promptly swallowed them. Traces of down remained around the nest, but it appeared that the chick may have consumed much of it. Binford et al. (1975) reported finding down feathers in the gut of the chick discovered in California. Now, in striking black and white winter plumage, the chick sharply contrasted with its surroundings, especially when viewed from above (Fig. 6).

It rained throughout the nestling period, with daily totals of over 15 mm on three days. The chick was capable of withstanding heavy rains and, although its down became matted several times, it never became soaked to the skin. Once, the chick was surprisingly dry following a heavy downpour the previous night, suggesting that it may have been brooded by a parent. It preened actively when wet, stripping the excess water from its down with its bill and carefully separating its matted feathers.

The growth patterns of the chick (Table 1) indicate that it was probably fed every night of the observation period except, perhaps, on day 15. The chick gained weight on 19 days, lost weight on five, and remained the same on one. On three occasions, visits to the nest by an adult were observed. The chick had been weighed before the parental visit and was re-weighed afterward to determine the size of the loads being delivered (Table 2). On 21 and 23 August, I watched from a clump of dwarf spruce 15 m away. In both cases a single adult arrived shortly after sunset, its approach and landing at the nest being so subtle that had I not been staring intently at the site I would certainly have missed the bird entirely. The adults appeared to fly directly to the nest from the water. Flying very low and fast, they were barely visible in the fading light. I saw them for just a fraction of a second as they landed, a muted fluttering of wings and a brief movement being the only clues to their arrival. Visits to the nest were short and averaged seven minutes. The departing adults, flying rapidly and low over the ground in a direct line to the water, were a bit easier to detect although their dark backs, which merged with the ground and water below, made it impossible to follow them for more than two or three seconds.

TABLE 2. Feeding visits of adult Marbled Murrelets.

Date	Arrival time	Time on nest (min)	Load delivered (g)
8/21	21:02	3	15.0
8/23	20:45	8	20.0
8/25	20:44	10	8.0
Mean	20:50	7	14.3

On 25 August, I was able to observe an adult at the nest directly. When the bird arrived I moved from the spruce to a point above the nest. As I approached, two ravens flew overhead calling loudly, and when they had passed I looked down to find the murrelet approximately 25 cm from the nest facing the water, motionless, and pressed flat against the ground. The chick, also still, was hunched up in a tight ball on the nest facing the adult. Both birds held their positions for six minutes, then the adult turned toward the chick, holding a single fish about 8 cm long crosswise in its bill. The fish appeared to be a capelin (*Mallotus* sp.), a common prey species for several of the alcids nesting in the Barren Islands (Manuwal and Boersma 1976). The adult walked toward the chick and stood facing it for one minute before dropping the fish on the ground in

TABLE 3. Features of Marbled Murrelet breeding biology.

Nesting dispersion	Solitary
Nest type, location	Open scrape on ground and in trees along coasts. Possibly at similar sites inland also
Egg weight	41 g
Adult weight (W)	222 g[a]
Egg weight as % adult weight	18.5
Circadian pattern	Crepuscular
Incubation schedule	Egg attended constantly throughout incubation, 24-h incubation shift
Incubation period	Over 25 days, c. 30 days[b]
Hatching weight	c. 35 g[c]
Brooding period	12–24 h
Nestling period	c. 27 days
Nestling food	
Location of food resource	Inshore[a]
Method of feeding nestling	1–3 whole fish carried in bill[d]
Feeding frequency	1, perhaps 2 or more trips per day
Load size	c. 14 g
Nestling growth	
Asymptote (a)	144 g
R = a/W	0.65
Fledging weight (FW)	c. 150 g
FW/W (%)	68
K	.230
Fledging behavior	Unknown, chicks probably fly to sea, walking may be possible in some locations

[a] Sealy (1975a).
[b] Sealy (1974).
[c] Estimated from Table 1.
[d] Savile (1972).

front of the chick. It then turned toward the water and flew quickly away. The chick picked up the fish and swallowed it without hesitation. I heard no vocalizations during any of the visits. Although no direct evidence was obtained, comparison of the chick growth data with known food loads suggests that the chick may have been fed more than once a night on several nights during the nestling phase. On 25 August the chick was fed a single 8-g fish at 20:44 after which it weighed 142 g. The following afternoon at 13:44, the chick weighed 139 g, a weight loss of 2.1% over that time period. Weight losses over approximately the same time interval on four occasions during the previous week averaged 9.8%. The see-saw pattern of weight gain from days 2 to 12 also suggests the possibility of multiple feedings.

Throughout the nestling period, a ring of droppings deposited by the chick accumulated around the perimeter of the nest. The ring, similar to that described by Binford et al. (1975) grew inevitably as a result of the sedentary behavior of the chick and the confining nature of the nest site. The droppings resembled the lichen-covered rock surrounding the nest and did not appear conspicuous at a distance.

DISCUSSION

The discovery of this nest clarifies several aspects of the breeding biology of the Marbled Murrelet (Table 3). The most interesting facet is the location of the nest itself. Previously shown to nest only in trees, Marbled Murrelets are now known to nest also on open ground short distances from the sea. No other species of alcid appears to use such a variety of nesting habitats. Earlier accounts of ground nesting (Booth 1927, Jewett et al. 1953, Gabrielson and Lincoln 1959) are now more credible.

Several adaptations that may reduce predation during the breeding season were noted. The cryptic appearance of the egg, chick, and adult presumably reduce detection, and the extremely keen senses, alertness, and rapid flushing and flight behavior of the adults help prevent predators from finding the nest. Crepuscular activity and brief visits to the nest also reduce detection. The widely divergent nesting habitat, which apparently includes both coastal and inland nesting areas (Booth 1927), as well as what must be very low nesting densities, may discourage specific predators. The nest location, being clearly visible only from directly above, and the fact that the nest never

TABLE 4. Growth parameters of some other alcids.

Species	K	Ka/4 (g/day)	KR/4 × 100 (%/day)	t_{10-90} (days)
Marbled Murrelet (*Brachyramphus marmoratus*)	0.230	8.28	3.74	19.1
Least Auklet[a] (*Aethia pusilla*)	0.244	5.28	5.7	18.0
Crested Auklet[a] (*Aethia cristatella*)	0.197	12.53	4.3	22.3
Parakeet Auklet[a] (*Cyclorrhynchus psittacula*)	0.183	10.93	3.8	24.0
Cassin's Auklet[b] (*Ptychoramphus aleutica*)	0.149	6.07	3.65	29.68
Horned Puffin[c] (*Fratercula corniculata*)	0.12	13.1	2.2	37.1
Tufted Puffin[c] (*Lunda cirrhata*)	0.11	16.5	2.1	39.7

[a] Sealy 1973.
[b] Manuwal 1972.
[c] Amaral 1977.

received direct sunlight, made it very inconspicuous. The chick, whose senses and thermoregulatory capacities appear to be well developed shortly after hatching, requires little parental care. This further reduces the exposure of the adults to predators and allows them to devote more time and energy to foraging. In addition, the vocalizations of the chick are extremely muted and its quiet behavior at the nest helps to keep it inconspicuous. The long retention of the down allows the contrasting juvenal plumage to develop fully without being exposed.

The distance to, and distribution of, the food resource are powerful influences on the breeding habits of all seabirds. Sealy (1975a, b, 1976) investigated the role of food in the ecology of two species of murrelets in British Columbia. The Ancient Murrelet uses patchy, offshore food; it nests colonially in burrows, with a two-egg clutch, a 72-h incubation shift and precocial chicks which leave the nest shortly after hatching accompanied by the adults who, apparently, lead them to the food resource. Marbled Murrelets use a mostly stable, evenly distributed, inshore food resource and nest in low densities in a variety of habitats. The single egg is incubated for at least 25 days with the adults exchanging duties nightly. The proximity of the food supply permits the semiprecocial chick to be fed at least once a night at the nest for approximately 27 days and it is presumably independent at fledging. Thus, the breeding habits of these two species appear to be directly related to the distribution of their food resource. One can only speculate on how the breeding biology of individuals nesting inland may differ from the coastal nest described here. If these murrelets do indeed nest far inland, one might expect such modifications as an increase in the duration of the incubation shift, altered attendance and feeding patterns, and a reduced growth rate of the chick, reflecting the increased foraging distance traveled by the adults.

The growth parameters indicate that the Marbled Murrelet grows relatively quickly as compared to other alcids (Table 4), which is understandable in view of the selective forces acting on these birds. Although many influences are presumably involved in shaping the evolution of growth patterns, predation and the distribution of the food resource must be important selective agents acting upon ground-nesting Marbled Murrelets. Cody (1971) stated that the relative safety of the nest should be a significant influence on the length of the nestling period. This case appears to confirm his prediction since many other alcids, which use more protected nest sites, develop more slowly. However, Sealy (1973) pointed out several exceptions to this generalization and maintained that the distribution of the food resource is the major selective force shaping reproductive habits in alcids. It is likely that both forces are important, although in most species the accessibility of the food resource must ultimately regulate the growth rate of the chick. It may be that the capacity for a high growth rate allows the usage of unprotected nest sites due to a reduction of the nestling period and exposure to predation.

Recent accounts have indicated that the

Kittlitz's Murrelet, the northern counterpart of the Marbled Murrelet, nests inland at upper elevations (Thayer 1914, Bailey 1943, Thompson et al. 1966, Bailey 1973). The breeding habits of both species are probably similar although the paucity of information on these birds makes conclusions difficult. The Barren Islands lie at the northern edge of the breeding range of the Marbled Murrelet and may represent a transition zone between ground- and tree-nesting in the genus. A possible exception is Booth's (1927) report of a ground nest 24 km inland in Whatcom Co., Washington.

The fledging behavior of the Marbled Murrelet remains unknown. Having twice postponed our departure from the Barrens in order to follow this nest, we were forced to leave on 27 August. At that time the chick appeared as it does in Figure 6. Weight and wing length were well within the range for fledglings given by Sealy (1972), and the dramatic change in plumage that occurred on the day prior to our departure indicated that fledging was imminent. Many authors have speculated that fledglings reach the sea by flying and this seems highly likely in light of the small number of flightless young that have been found (Jewett 1930, Barber 1941, Munro and Cowen 1947, Drent and Guiguet 1961). On 27 August, the chick's wings were fully developed. It was capable of raising itself from my open hand with strong and sustained wing beats and appeared close to independent flight at that time. The nest location had unobstructed access to the sea some 75 m away and, as the chick was capable of walking, it could have reached the ocean on foot as well. Presumably, fledging behavior and additional aspects of the biology of Marbled Murrelets will be revealed as future nests are found. Although it was difficult to leave the island with the chick still on the nest, it seems appropriate that this enigmatic species retains some of the secrets that have fascinated and confounded ornithologists for so many years.

ADDENDUM

I returned to the Barren Islands for six days on 4 June 1979 but found no evidence of nesting at the location of the 1978 nest. Two researchers from the University of Washington, Katie Hirsch and Doug Woodby, remained on the islands until late August and checked the location periodically. Another nest was found 10 m south of the 1978 nest on 7 July 1979. The egg measured 58.9 mm × 36.3 mm, weighed 38.5 g when discovered and hatched on 20 July. The chick weighed approximately 32 g at hatching and its growth and development was very similar to that of the 1978 chick. The nestling period was confirmed at 28 days and the chick fledged at an estimated 140 g.

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LITERATURE CITED

AMARAL, M. J. 1977. A comparative breeding biology of the Tufted and Horned puffin in the Barren Islands, Alaska. M.S. thesis, Univ. Washington, Seattle.

AMERICAN ORNITHOLOGISTS' UNION. 1957. Checklist of North American birds. Fifth ed. Am. Ornithol. Union, Baltimore.

BAILEY, A. M. 1927. Notes on the birds of southeastern Alaska. Auk 44:1–23.

BAILEY, A. M. 1943. The birds of Cape Prince of Wales. Proceedings of the Colorado Museum of Natural History. 18(1):105.

BAILEY, E. P. 1973. Discovery of a Kittlitz's Murrelet nest. Condor 75:457.

BAILEY, E. P. 1976. Breeding bird distribution and abundance in the Barren Islands, Alaska. Murrelet 57:2–12.

BARBER, O. 1941. Juvenal Marbled Murrelet found on Coos River. Murrelet 22:38–39.

BENT, A. C. 1919. Life histories of North American diving birds. U.S. Natl. Mus. Bull. 107.

BINFORD, L. C., B. G. ELLIOT, AND S. W. SINGER. 1975. Discovery of a nest and the downy young of the Marbled Murrelet. Wilson Bull. 83:303–319.

BOOTH, E. J. 1927. Egg of the Marbled Murrelet. Murrelet 8:16.

BROOKS, A. 1928. Does the Marbled Murrelet nest inland? Murrelet 9:68.

CANTWELL, G. G. 1898. Notes on the egg of the Marbled Murrelet. Auk 15:49.

CODY, M. L. 1971. Ecological aspects of reproduction, p. 461–512. *In* Farner, D. S. and J. R. King [eds.], Avian biology. Vol. 1. Academic Press, New York and London.

DRENT, R. H., AND C. J. GUIGUET. 1961. A catalog of British Columbia seabirds. Occas. Pap. B. C. Prov. Mus. 12:1–173.

GABRIELSON, I. N., AND F. C. LINCOLN. 1959. Birds of Alaska. Stackpole Co., Harrisburg, Pennsylvania.

GUIGUET, C. J. 1956. Enigma of the Pacific. Audubon 58:164–167, 174.
HARRIS, R. D. 1971. Further evidence of tree nesting in the Marbled Murrelet. Can. Field-Nat. 85:67–68.
HUSSELL, D. J. T. 1972. Factors affecting clutch size in arctic passerines. Ecol. Monogr. 42:317–364.
JEWETT, S. G. 1930. Notes on the Dowell bird collection. Condor 32:123–124.
JEWETT, S. G. 1934. The mystery of the Marbled Murrelet deepens. Murrelet 15:24.
JEWETT, S. G., W. P. TAYLOR, W. T. SHAW, AND J. W. ALDRICH. 1953. Birds of Washington State. University of Washington Press, Seattle.
KUZYAKIN, A. P. 1963. On the biology of the Long-billed Murrelet. Ornitholgyia 6:315–320. (Engl. transl. in the Van Tyne Memorial Library of the Wilson Ornithological Society, University of Michigan).
MANUWAL, D. A. 1972. The population ecology of Cassin's Auklet on Southeast Farallon Island, California. Ph.D. diss., Univ. California, Los Angeles.
MANUWAL, D. A., AND D. BOERSMA. 1976. Dynamics of marine bird populations on the Barren Islands, Alaska. Annual report of U.S. Fish and Wildlife Service, Office of Biological Services, Anchorage, Alaska.
MUNRO, J. A., AND I. MCT. COWAN. 1947. A review of the bird fauna of British Columbia. B.C. Prov. Mus. Spec. Publ. 2.
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. 1977. Local climatological data. Kodiak, Alaska. N.O.A.A. Climatic Center, Asheville, North Carolina.
PRESTON, F. W. 1953. The shapes of birds eggs. Auk 70:166.
RICKLEFS, R. E. 1967. A graphical method of fitting equations to growth curves. Ecology 48:978–983.
RICKLEFS, R. E. 1968. Patterns of growth in birds. Ibis 110:419–451.
SAVILE, D. B. O. 1972. Evidence of tree nesting by the Marbled Murrelet in the Queen Charlotte Islands. Can. Field-Nat. 86:389–390.
SEALY, S. G. 1972. Adaptive differences in breeding biology in the marine bird family Alcidae. Ph.D. diss., Univ. Michigan, Ann Arbor.
SEALY, S. G. 1973. Adaptive significance of post-hatching developmental patterns and growth rates in the Alcidae. Ornis. Scand. 4:113–121.
SEALY, S. G. 1974. Breeding phenology and clutch size in the Marbled Murrelet. Auk 91:10–23.
SEALY, S. G. 1975a. Feeding ecology of the Ancient Murrelet and Marbled Murrelets near Langara Island, British Columbia. Can. J. Zool. 53:418–433.
SEALY, S. G. 1975b. Aspects of the breeding biology of the Marbled Murrelet in British Columbia. Bird-Banding 46:141–154.
SEALY, S. G. 1976. Biology of Ancient Murrelets. Condor 78:294–306.
THAYER, J. C. 1914. Nesting of the Kittlitz's Murrelet. Condor 16:117–118.
THOMPSON, M. C., J. Q. HINES, AND F. S. L. WILLIAMSON. 1966. Discovery of the downy young of Kittlitz's Murrelet. Auk 83:349–351.

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RECENT PUBLICATIONS

Kompendium der Geflügelanatomie. Dritte Auflag.—Erich Schwarze and Lothar Schröder, with the collaboration of Günther Michel. 1979. VEB Gustav Fischer Verlag, Jena. 306 p. This is a German textbook on the gross and microscopic anatomy of domestic birds. Using a descriptive treatment, it straightforwardly marches through the organ systems. As compared with the previous edition (1966), it has been thoroughly revised and greatly enlarged, especially by the addition of material on histology and embryology. Many anatomical drawings and photomicrographs; references; index. This work is more comprehensive and detailed than that by King and McLelland (noticed in *Condor* 78:148–149), particularly in regard to the skeletomuscular, digestive, and cardiovascular systems; on the other hand, the English book is more functional and has some useful diagrams. The need continues for avian anatomists to be able to read German.

A Bundle of Feathers.—Edited by Sidney Dillon Ripley II. 1978. Oxford University Press, Delhi. 241 p. $16.95. This is a festschrift proffered to Sálim Ali, for his 75th birthday in 1971. Two of the papers are personal views of the man who is the doyen of Indian ornithology. Reflecting his range of interests, the remaining 19 papers deal with topics in such areas as life history, zoogeography, systematics, migration, vocalization, and avian lice. The collection is a mixed bag, as is typical of such works, perhaps chiefly of interest to those who study Asian birds. Illustrations and index.