Decline of Breeding Least Auklets on St. George Island, Alaska.—The 250,000 Least Auklets (*Aethia pusilla*) nesting on St. George Island (56°35'N, 169°35'W) in the southern Bering Sea (Hickey and Craighead 1977) represent a small fraction of the population thought to be nesting on the island at the turn of the century (Gabrielson and Lincoln 1959). During the 1981 and 1982 breeding seasons, we discussed the potential causes of this decline with St. George residents. Additionally, we studied the breeding biology of Least Auklets in the vicinity of St. George Village and at the colony located on the north-facing slopes of Ulakaia Hill, south of the village and about 1.5 km south of the nearest shoreline. We also reviewed earlier published accounts of Least Auklets on St. George Island to ascertain the extent of the decline and evaluate various hypotheses for the cause.

Historical accounts support the impression of St. George residents that Least Auklets have declined drastically in the last half century. Elliott (1881) estimated the population in the "millions." Palmer (1899) also estimated their numbers in the millions and wrote that they were "about as abundant as all the other seabird species together; certainly no one can be blamed for thinking so after seeing their abundance about the village of St. George." As late as 1940, Gabrielson estimated that "Least Auklets are the most numerous in the swarming millions of birds breeding on St. George" (Gabrielson and Lincoln 1959). Recent population estimates of Least Auklets and other seabirds on St. George Island (Hickey and Craighead 1977) suggest that Least Auklets have declined by an order of magnitude since the turn of the century.

In reference to breeding areas of Least Auklets, Elliott (1881) found Least Auklets breeding "over the entire surface of the north side of St. George." The talus slopes of Ulakaia Hill was the area where "they came in the greatest numbers . . . occupying over five square miles [c. 1300 ha] of basaltic shingle . . ." The present Ulakaia Hill colony (c. 129,000) occupies less than 15 ha (Hickey and Craighead 1977) and is restricted to a narrow strip of the steepest talus. Palmer (1899) wrote, "back from the cliff toward the village is an immense area of rolling, sloping ground thickly studded with huge masses of rock . . . under which . . . myriads of least auklet breed." This clearly refers to the "over five square mile" area that Elliott (1881) described. Osgood et al. (1915) wrote, ". . . on St. George the numbers of Least Auklets are so great as to be almost incredible . . . large areas nearly throughout the island are occupied by nesting colonies."

The extensive areas of basalt shingle that Elliott and Palmer described are still evident, extending from First Bluff east across Zapadni Bay Road and north of Ulakaia Hill to Gull Hill at the east end of the island, an area of over 700 ha. This area is largely overgrown with mosses, crowberry (*Empetrum nigrum*), and cloudberry (*Rubus chamaemorus*) and, with the exception of the Ulakaia Hill colony, is devoid of breeding auklets. Older residents of the village indicated that some now-vegetated talus areas to the east, north, and west of the present Ulakaia Hill colony had been sites of large auklet colonies within their lifetimes (Father M. Lestenkof, pers. comm.). The extensive distribution of such areas suggests that the population of Least Auklets could easily have exceeded a million, as various authors have claimed.

The Aleut residents are not in agreement over the cause of the decline. Some blame intense harvest by Aleuts prior to the 1950s; others blame disturbance associated with construction of the aircraft landing strip and road to Zapadni Bay in the early 1950s; while others blame predation by arctic foxes (*Alopex lagopus*). Palmer (1899) watched an Aleut catch about 200 Least Auklets with a long-handled net in a half-hour, but Osgood et al. (1915) observed that most of this harvest occurred prior to egg-laying and that "the birds are practically unmolested during the breeding season." Long-handled nets are an efficient means of capturing adult auklets and were used at least until 1953 (Peterson and Fisher 1955). These nets are not currently used by the Aleut residents and, at present, the only significant native harvest of Least Auklets is an annual take of several hundred eggs (pers. obs.). Most of these eggs are not collected at the Ulakaia Hill colony.

Prior to its discovery in 1786 by the Russians, St. George Island was naturally colonized by arctic foxes, apparently when sea ice formed a bridge to the mainland. While no recent estimates of arctic fox population size are available, government trappers in the 1950s regularly removed about 1000 each year (A. Merculief, pers. comm.). The present

population certainly exceeds 1000 and may be as high as 3000. Foxes prey extensively on breeding seabirds, particularly adult auklets which are more vulnerable to fox predation than cliff-nesting species, such as murres (*Uria* spp.) and kittiwakes (*Rissa* spp.). Murie (1959) felt that the introduction of arctic foxes to some islands in the western Aleutians was responsible for major reductions and, in one case, extirpation of Least Auklet breeding populations.

Four fox dens within the Ulakaia Hill auklet colony each produced 8–12 kits in 1982. The foxes' reliance on Least Auklets as their major food source was evident from the large number of auklet remains near active dens: the remains of 471 Least Auklets (mostly wings) were gathered near one fox den at the Ulakaia Hill colony prior to the fledging of nestlings in 1981. Assuming this represents approximately half the harvest by a pair of adult foxes providing food for kits (many carcass remains were widely scattered over the colony or concealed by vegetation or in rock crevices), a reasonable estimate of the total fox take at the Ulakaia Hill colony is 4000 adults per year. In addition, many fledgling auklets were taken as they attempted to leave the breeding site. This level of predation is significant, but it does not appear to be sufficient to precipitate a drastic population decline.

Disturbance associated with construction activities and aircraft traffic also does not appear to be solely responsible for the population decline. During our stay on the island, flights were infrequent, involved small, twin-engine aircraft, and did not appear to significantly disrupt the activities of breeding adults. Suitable breeding sites in beach rubble and basaltic cliffs near the village and airstrip were still used by Least Auklets. A small colony (c. 20 pairs) nested in a stone wall next to the village dock and was subjected to considerable human disturbance throughout the day. Least Auklets continue to nest in driftwood piles at Zapadni Beach and in beach rubble at "Airplane Wing" despite intensive egg collecting by residents each year. While construction of the Zapadni Bay Road may have been responsible for localized abandonment, it cannot be blamed for the complete disappearance of other inland colonies far from the road.

Aleut harvest, fox predation, and disturbance associated with human activity may have played a part in the major decline of Least Auklets on St. George Island, but, in our opinion, these factors, even in concert, could not have resulted in a decline of the magnitude indicated. Drastic changes have apparently occurred in availability of breeding sites over the last century. Soil and peat have accumulated in the now abandoned auklet colonies to the extent that few suitable crevices remain. Vegetation has become established on these abandoned colonies and appears to be encroaching on the remaining inland auklet colony at Ulakaia Hill. "Wild celery" (*Angelica lucida*), ferns (*Dryopterus dilatata*), wormwood (*Artemesia arctica* and *A. Tilesii*), grasses (*Calamagrostis canadensis* and *Arctagrostis latifolia*), and mosses are the dominant pioneer plants on the stabilized talus at the periphery of the Ulakaia Hill colony. At present, only a small portion (c. 2000 m^2) of the talus breeding area is devoid of these plants. Primary plant succession on the stabilized talus has proceeded to where extensive areas of once-suitable auklet breeding habitat no longer provide a high density of crevices that are inaccessible to foxes.

There is some historical evidence that primary plant succession has resulted in major changes in the vegetation of St. George Island since permanent settlement, perhaps partly as a consequence of introduced plants. At the time of discovery in 1786, the Russians described St. George Island as "at first without vegetation . . . except on the places where the carcasses of dead animals rotted," but gradually it was "covered with grass" (Veniaminov 1840 *in* Elliott 1881). By the time Elliott visited the island it supported a "fresh and luxuriant" vegetation that probably spread rapidly onto stabilized talus where excrement from breeding auklets provided essential nutrients.

The adverse effects of plant succession on the availability of auklet breeding sites are exacerbated by fox predation. At the periphery of the Ulakaia Hill colony a lush growth of pioneer vegetation was present by the end of the breeding season. Adult auklets experienced difficulty landing and departing in densely vegetated areas and foxes were observed using this to their advantage in stalking and capturing auklets. The accumulation of peat and weathered smaller rocks in crevices also forced auklets to nest close to the surface where eggs and nestlings are more vulnerable to fox predation. We predict that encroachment by vegetation at the Ulakaia Hill colony and continued pressure from fox predation will result

in the decline and eventual extirpation of the only remaining inland auklet colony on St. George Island. Fox control measures may slow the rate of decline, but will not reverse it.

If this hypothesis for the cause of the decline is correct, then numbers of Least Auklets breeding on St. George Island are severely limited by availability of suitable breeding sites. This conclusion is supported by the use of breeding sites, such as driftwood piles, beach rubble, and talus slopes more than 1.5 km from the shore, that are rarely used elsewhere. At other major colonies on the Aleutian Islands, St. Matthew Island, and St. Lawrence Island, most Least Auklets breed in talus slopes over-looking the sea (Bédard 1969; Knudtson and Byrd 1982; A. L. Sowls, pers. comm.).

On St. Lawrence Island in the northern Bering Sea, Least Auklets are apparently stable or increasing at inland colonies (Searing 1977), and there is no suggestion of a loss of breeding habitat due to vegetation encroachment on talus slopes (Bédard 1969). However, populations of Least Auklets breeding on Buldir, Big Koniuji, and Kiska islands in the western Aleutians appear to be limited by breeding sites (R. H. Day, pers. comm.; Knudtson and Byrd 1982), as they are on St. George Island. Primary plant succession and resultant soil formation appear to be important factors limiting Least Auklet breeding populations in the Aleutian Islands and islands in the southern Bering Sea.

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