

COUNTING THE COUNTLESS: ESTIMATING THE NUMBER OF LEAST AUKLETS ATTENDING THE COLONY ON ST. GEORGE ISLAND, ALASKA

HEATHER M. RENNER, Alaska Maritime National Wildlife Refuge, U.S. Fish and Wildlife Service, 95 Sterling Highway, Suite 1, Homer, Alaska 99603; heather_renner@fws.gov

MARTIN RENNER, Department of Aquatic and Fishery Sciences, Box 355020, Seattle, Washington 98195-5020

ABSTRACT: Estimating the abundance of auklets at breeding colonies has proven extremely difficult, and no satisfactory method has emerged. Auklets nest in concealed rock crevices and socialize on the sea's surface during portions of the day. Several methods of estimating population trends have been attempted, but a true census has so far been unattainable at any colony. On St. George Island, Alaska, an unusually late snow cover in 2008 made possible a photo count of Least Auklets (*Aethia pusilla*) attending the inland colony at Ulakaia Ridge. We estimated the number of birds in the colony on 15 May 2008 to be $88,263 \pm 3056$. Because of the timing of the count and the known life history of the species, the count likely represented almost the entire population breeding at the colony that year.

The Least Auklet (*Aethia pusilla*) is among the most abundant seabirds in the North Pacific (Stephensen and Irons 2003), breeding typically in huge colonies on a few islands in the Bering Sea, Aleutian Archipelago, and Sea of Okhotsk. Numbers of these birds attending colonies were described by Gabrielson and Lincoln (1959) as "impossible to estimate and difficult to exaggerate." Indeed, even today, only subjective or highly variable guesses are available for breeding populations of auklets (Shuntov 1999). The reason populations are so hard to enumerate is that auklet nests are concealed in rock crevices. Adults are typically above ground during two daily activity periods (morning and evening) when they socialize on the surface between trips to and from subsurface nest sites or feeding areas at sea (Jones 1993). Their nesting strategy makes it difficult to determine the proportion of the population visible on the surface of the colony at any particular time, and counting is complicated by the presence of tremendous numbers of birds moving erratically both in the air and on the ground.

In recent decades numerous attempts have been made to assess the absolute abundance or to derive population indices of auklets at colonies, including use of "surface" counts, "net movement" counts, time-lapse photography, mark-resighting analysis, and colony mapping (Bédard 1969, Byrd et al. 1983, Piatt et al. 1990, Jones 1992, Sheffield et al. 2006, Renner et al. 2006). Many of these efforts tried to account for aspects of the species' behavioral ecology that might bias counts, but no monitoring method has proven satisfactory primarily because of the high variability of the resulting counts (e.g., Harding et al. 2005; summarized by Renner et al. 2006).

In 2008, we had a rare opportunity to obtain a census of Least Auklets at the Ulakaia colony on St. George Island, Alaska. An unusually late snow cover that spring made it possible to photograph birds at the colony site before they could enter crevices. Because of the timing of the count and the

COUNTING LEAST AUKLETS ON ST. GEORGE ISLAND, ALASKA

known life history of the species, the effort produced the first total count of auklets at the Ulakaia colony and thus offers a bench mark from which other methods of population assessment can be measured (Anderson 2001).

METHODS

On 15 May 2008, Nikolay Konyukhov photographed the Ulakaia Least Auklet colony at about 10:30 ADT over 2–3 minutes during the morning activity period. He used a digital single-lens reflex camera (with an 80-mm lens at aperture $f/11$) set on a tripod approximately 500 m downslope of the center of the colony. Following boundaries mapped in 2004 and 2006, Konyukhov provided us with a set of 30 overlapping images of the colony (Renner et al. 2006). We digitally stitched the images together into a composite image by means of the panorama-photo-stitching software Hugin (<http://hugin.sourceforge.net/>). We omitted one small portion of the colony (see upper left portion of Figure 1—about 3% in a low-density area; Renner et al. 2006) from the composite image because we could not resolve the photo's placement.

Three observers counted the auklets on the composite image (both those in the air and those on the ground) independently. Using Adobe Photoshop, we added a transparent layer to the image, and the observer systematically scrolled across the photo, placing a small dot on the image of each bird with the pencil tool. When all birds had been marked, we converted the layer to a grayscale GIF and counted the dots digitally with the “measure particles” tool in the image-processing software ImageJ (available from the National Institutes of Health at <http://rsb.info.nih.gov/ij/>). Also with ImageJ, we estimated the proportion of the colony covered with snow as well as the extent of snow-free polygons on 15 May by counting pixels in the portion of the photograph corresponding to the occupied colony.

RESULTS

Figure 1 shows the composite of stitched images of the colony taken on 15 May, the approximate 93% snow cover on that date, and the auklets clearly visibly against the white background. The mean of three independent counts of auklets visible on the stitched image was 88,263, standard deviation (SD) 3056.

DISCUSSION

The unusually late snow cover at St. George Island in the spring of 2008 provided a rare opportunity for a snapshot estimate of the number of Least Auklets attending the Ulakaia colony. On 15 May, when the images were taken, huge numbers of birds were present at the colony but they were prevented from reaching their nesting sites under the snow. Thus they were visible and countable against the white background.

The photo count is likely a very close estimate of the number of auklets nesting in the colony that year, but several factors could have biased the number we counted with respect to the number that actually nested in 2008.

COUNTING LEAST AUKLETS ON ST. GEORGE ISLAND, ALASKA

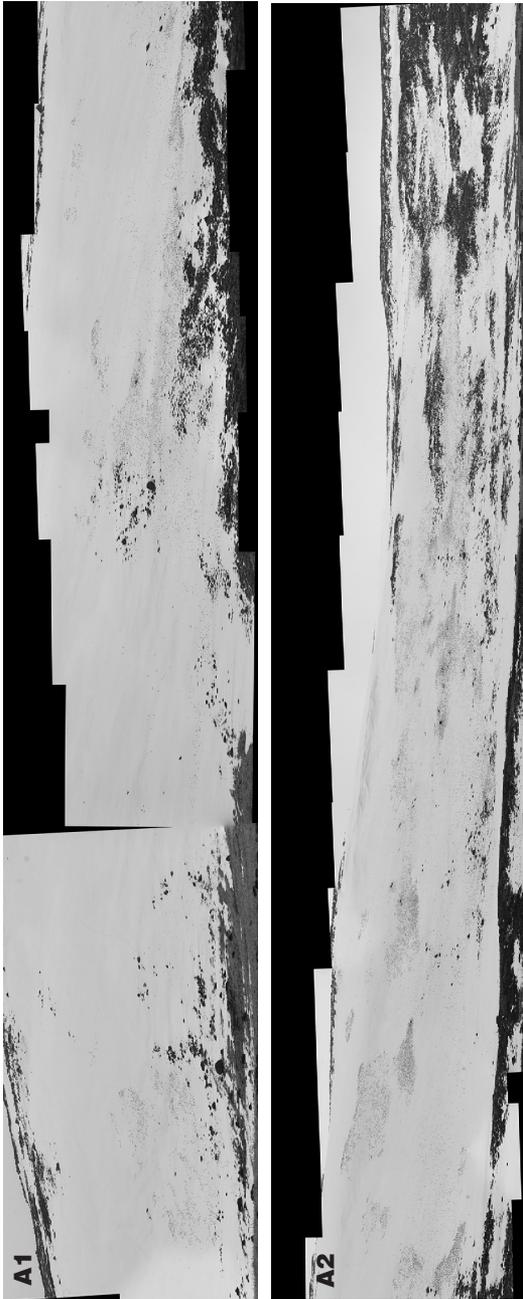


Figure 1. (A) Composite photograph of the Least Auklet colony on Ulakaia Ridge, St. George Island, Alaska, on 15 May 2008. The colony extends approximately 1330 m from left to right. (B) Magnification of a portion of the colony to show how auklets appeared for counting.

Image from photos by Nikolay Konyukhchou

COUNTING LEAST AUKLETS ON ST. GEORGE ISLAND, ALASKA



Figure 1B.

For example, about 7% of the colony was snow-free, and, while we could distinguish some auklets against dark backgrounds on the images, there were likely others present that we did not detect. Conversely, we are confident that no birds were in crevices under the snow and thus not counted. And, although a minor factor, about 3% of the colony (in a low-density area) was omitted from the composite photo.

We also had to consider that some breeding birds stayed at sea that particular morning and/or that an unknown, but likely small, proportion of the auklets that eventually nested at the colony were not yet attending the colony when the images were taken. We have no information on birds that may have been at sea that morning, but in previous years, resightings of marked birds imply that most individuals that nested were at the colony daily before laying (U.S. Fish and Wildlife Service unpubl. data). Despite the late snow cover on the colony in 2008, the chronology of Least Auklet breeding appeared normal that year. The first birds were observed flying to the colony on 18 April (K. Holser pers. comm.), and the distribution of dates of hatching in 2008 ($16 \text{ July} \pm 3.7 \text{ SD}$, $n = 39$) was similar to that during the preceding and following years when there was no snow cover on 15 May (2007: $18 \text{ July} \pm 4.2 \text{ SD}$, $n = 17$; 2009: $9 \text{ July} \pm 3.2 \text{ SD}$, $n = 67$; U.S. Fish and Wildlife Service unpubl. data). Given an incubation period of about 30 days (Jones 1993), the mean date of laying in 2008 would have been 16 June, almost two months after the birds arrived at the colony.

All these factors could lead to underestimates of the number of breeding birds, but the possibility that some birds at the colony on 15 May were

COUNTING LEAST AUKLETS ON ST. GEORGE ISLAND, ALASKA

prospecting nesting sites but did not nest that year would have produced an overestimate. Mark-resighting data from previous years suggest this rarely occurs when the colony is initially occupied, and it is not until the incubation and chick-rearing stages that nonbreeding adults are common (H. and M. Renner pers. obs.; Jones 1992). Taken together, the factors contributing to this one-day snapshot of the colony's size preclude much of the variability within a day typically observed on small plots within auklet colonies (e.g., Jones 1992) and thus offer a fairly precise measure of the number of Least Auklets breeding at Ulakaia in 2008. This has not been achieved at any other auklet colony

Our estimate of 88,000 auklets (or 44,000 pairs) is markedly lower than the previous estimate of 129,000 birds at the Ulakaia colony in the 1970s (Hickey and Craighead 1977), but it is difficult to assess whether this difference is rooted in the census method or is a true decline due to vegetation encroachment, as suggested by Roby and Brink (1986) and Renner et al. (2006).

In conclusion, we realize what we report here resulted from a rare seasonal event and that it can be replicated only opportunistically rather than on a formal schedule. Counts from photos might be most practical at colonies farther north and during late springs when retention of snow should be more common. Indeed, during late springs at colonies on St. Lawrence and Little Diomedé islands, Least Auklets have often been observed sitting on snow (Sealy 1975). However, because of the inherent difficulties in assessing populations of crevice-nesting alcids the method should be capitalized on whenever possible as an added means of calibrating population estimates.

ACKNOWLEDGMENTS

We thank Brie Drummond and Sarah Thomsen for countless hours placing digital dots on photos, and Nikolay Konyukhov for photographing the Ulakaia colony. Vernon Byrd, Brie Drummond, Adrian Gall, Robert Gill, Arthur Kettle and an anonymous reviewer provided useful comments which improved the manuscript.

LITERATURE CITED

- Anderson, D. R. 2001. The need to get the basics right in wildlife field studies. *Wildlife Soc. Bull.* 29:1294–1297.
- Bédard, J. 1969. The nesting of the Crested, Least, and Parakeet Auklets on St. Lawrence Island, Alaska. *Condor* 71:386–398.
- Byrd, G. V., Day, R. H., and Knudtson, E. P. 1983. Patterns of colony attendance and censusing of auklets at Buldir Island, Alaska. *Condor* 85:274–280.
- Gabrielson, I. N., and Lincoln, F. C. 1959. *The Birds of Alaska*. Stackpole, Harrisburg, PA.
- Harding, A.M.A., Piatt, J. F., Byrd, G. V., Hatch, S. A., Konyukhov, N. B., Golubova, E. G., and Williams, J. C. 2005. Variability in colony attendance of crevice-nesting Horned Puffins: Implications for population monitoring. *J. Wildlife Mgmt.* 69:1279–1296.
- Hickey, J. J., and Craighead, F. L. 1977. A census of the seabirds of the Pribilof Islands, in *Environmental assessments of the Alaskan continental shelf, Annual Reports, vol. 2*, p. 96–195. Outer Continental Shelf Environmental Assessment Program, Boulder, CO.
- Jones, I. L. 1992. Colony attendance of Least Auklets at St. Paul Island, Alaska: Implications for population monitoring. *Condor* 94:93–100.

COUNTING LEAST AUKLETS ON ST. GEORGE ISLAND, ALASKA

- Jones, I. L. 1993. Least Auklet (*Aethia pusilla*), in The Birds of North America (A. Poole and F. Gill, eds.), no. 69. Acad. Nat. Sci., Philadelphia.
- Piatt, J. F., Roberts, B. D., and Hatch, S. A. 1990. Colony attendance and population monitoring of Least and Crested Auklets on St. Lawrence Island, Alaska. *Condor* 92:97–106.
- Renner, H. M., Renner, M., Reynolds, J. H., Harding, A. M. A., Jones, I. L., Irons, D. B., and Byrd, G. V. 2006. Colony mapping: A new technique for monitoring crevice-nesting seabirds. *Condor* 108:423–434.
- Roby, D. D., and Brink, K. L. 1986. Decline of breeding Least Auklets on St. George Island, Alaska. *J. Field Ornithol.* 57:57–59.
- Sealy, S. G. 1975. Influence of snow on egg-laying in auklets. *Auk* 92:528–538.
- Sheffield L. M., Gall, A.E., Roby, D. D., Irons, D. B., and Dugger, K. M. 2006. Monitoring planktivorous seabird populations: Validating surface counts of crevice-nesting auklets using mark-resight techniques. *Can. J. Zool.* 84:846–854.
- Shuntov, V. P. 1999. Seabirds of the western Bering Sea, in Dynamics of the Bering Sea (T. R. Loughlin and K. Ohtani, eds.), pp. 651–682. University of Alaska Sea Grant, Fairbanks.
- Stephensen, S. W., and Irons, D. B. 2003. Comparison of colonial breeding seabirds in the eastern Bering Sea and Gulf of Alaska. *Marine Ornithol.* 31:167–173.

Accepted 23 June 2010



Least Auklet

Computer painting by George C. West