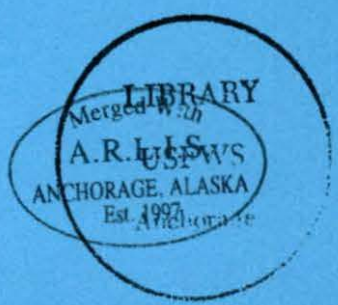
LOGY OF NESTING CRESTED, LEAST, AND WHISKERED AUKLETS AT BULDIR ISLAND, ALASKA .



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The genus Aethia contains three species which nest mostly on islands in or near the Bering Sea and the Sea of Okhotsk (Fig. 1). Crested Auklets (Aethia cristatella) breed in the most wide-spread locations of the Aethia. They breed on Bering Sea islands from the Diomedes to the Pribilofs, east to the Shumagin Islands, westerly along the Aleutian Islands and Commander Islands, then south to the central Kurile Islands and Sakhalin Island (A.O.U. 1957).

Least Auklets (Aethia pusilla) nest in mixed colonies with Crested Auklets nearly everywhere they occur; however, Least Auklets do not nest west (Johansen 1961) or east of the Aleutian Islands.

Whiskered Auklets (Aethia pygmaea) nest west of Unimak Island in the Aleutians as far west as Buldir (Byrd and D.D.Gibson unpub. data), in the Commander Islands (Stejneger 1885), and in the central Kurile Islands (Snow 1896).

Due to the isolated breeding areas, the biology of Aethia is poorly known, except at St. Lawrence Island, Alaska where Crested and Least Auklets have been intensively studied (Faye and Cade 1959, Bedard 1967, Sealy 1968, Bedard 1969, Sealy and Bedard in press, and Searing 1977). Stejneger (1885), Kozlova (1961), and others present limited data on all three species of Aethia from the Commander Islands.

Murie (1959), Gabrielson and Lincoln (1959), and Sekora et al. (in press) have summarized the distribution of auklets in the Aleutian Islands, but little data on breeding biology are available from this region.

During avifaunal investigations at Buldir Island 1974-1976, some aspects of the biology of Crested, Least, and Whiskered Auklets were investigated in a colony where all three species nested. This paper summarizes data on breeding chronology, nest site characteristics, diurnal rhythms, mensural characteristics, and productivity of the three Aethia. Comparisons are made among the three species and with data from St. Lawrence Island and the Commander Islands.

Study Area

Buldir Island (52° 21' N, 175° 56' E) is the westernmost island in the Rat Island group of the Aleutian Islands, Alaska. It is the most isolated island in the Aleutians being 113 km from Shemya Island on the west and Kiska Island on the east (fig. 1). Volcanic in origin, Buldir has three dominent peaks, the tallest 655 m high.

Buldir's flora includes a tall-plant lowland association extending from near sea level to 300-350 m elevation and a short-plant upland association above 300-350 m elevation. The former

association's most common tall species are Elymus arenarius, Heracleum lanatum, Angelica lucida, and Athyrium felix-femina. Carex macrochaeta, Festuca rubra, and Claytonia siberica are common lower plants in the tall-plant association. In the upland, dwarf forms of lowland plants are common along with Salix spp., several species of mosses, Empetrum nigrum, and several species of Geum.

Soil-covered talus slopes had thick mats of plants, including Festuca rubra, Achillia borealis, and Puccinellia sp.

During the period auklets were present at Buldir (May thru August), daily maximum and minimum temperatures at Main Camp averaged:

May

June

July

August

Buldir is extremely humid, and most summer days are overcast.

Buldir is about 6.4 km long and 3.2 km wide with an area slightly over 2,000 ha. It has three small islets extending 2 km off Northwest Point. The main island has about 8 ha of talus area, and 1 ha of talus is found on Middle and Outer Rocks combined. Buldir has a 20 km-long coastline, 7.8 km (39%) of which is densely strewn with medium to large diameter boulders which is also used by auklets.

Wehle (1976) summarizes information on the physical and biological oceanography of the seas surrounding the island. He also describes the sea floor, pointing out the close proximity of sea mounts, banks, ridges, and reefs to Buldir. These areas provide favored feeding areas for Aethia.

Buldir is one of the few Aleutian Islands that has had no introduction of land mammals. As a result 19 species of seabirds nest there, including 11 species of Alcids. The most common species nesting in the talus slopes near Aethia are Parakeet Auklet (Cyclorrhynchus psittacula) and Horned Puffin (Fratercula corniculata).

Methods

Investigators lived in a field camp at Buldir mid-May thru August 1974 and 1975 and mid-May thru September 1976. In 1974 and 1975 observations of auklets were incidental to more intensive investigations of the other birds at Buldir, but in 1976 two to six biologists visited the Main Talus study area at least weekly. Knudtson searched for auklet eggs intensively in early June and studied the marked eggs and chicks until mid-August.

Measurements of birds and eggs were made to within 0.1 mm using vernier calipers. Birds were weighed with Pesola spring scales

accurate to within 1.0 g. Auklets were captured in 10 m-long mist nets stretched between hand-held bamboo poles. Investigators concealed the net behind boulders and raised it in the path of auklets flying from crevices.

To determine diurnal rhythms six 10 m^2 plots were randomly selected at Main Talus in 1976. Observation posts were established 10-20 m from the plots. Plot corners and mid-boundaries were marked with spots of red spray paint,and corners were permanently marked with metel stakes after auklets departed. Watches were made at each of the six plots every 10 to 14 days, late-May to mid-July. The number of birds of each species present on the plots was recorded every 15 minutes, and the number of birds arriving and departing from the plot was recorded during 15 of every 30 minutes. Counts were then averaged for all plots and expressed in terms of birds per 100 m^2 of talus during a particular hour.

To describe the Main Talus study area all rocks on the surface of each of the six plots were measured (length, width, and depth), and the shape which the rock most closely fit was recorded (sphere, triangle, or cube). The depth of the scree mantle was measured in as many places as crevices would allow. The data were evaluated in three ways:

1. Areas of imaginary cross-sections of boulders were calculated

2. Volumes of cube or sphere-shaped boulders were calculated using V=LWH, and volumes of triangular-shaped boulders was determined using:

$$V=\frac{b^2a}{12} \quad \text{where } a=\frac{h+w}{2} \quad \text{and b=length}$$

3. A frequency distribution was formulated

Arrival and Pre-laying Period

Thousands of auklets were seen near Buldir on 30 April 1974, but none were seen on the Main Talus that day. All three species of Aethia were present on the Main Talus study area by 15-18 May 1974-1976. At St. Lawrence Island (63° 46' N latitude) auklets first arrived on the nesting slopes 20-29 May at which time snow still covered rock crevices (Searing 1977). The Main Talus at Buldir is mostly snow-free by mid-May.

Prior to laying, all three species of Aethia engaged in displaying, calling, and competing for attention much as described for Cassin's Auklet (Ptchoramphus aleutica) by Thoresen (1966). Prominent boulders were favored landing spots and display sites. Social dominance between species seems to depend on the differences in body size. Crested Auklets, the largest of the three Aethia, almost always displaced Least and Whiskered Auklets in encounters. The outcome of encounters between the two smaller auklets was less predictable, but Whiskered Auklets displaced Least Auklets in about 70 percent of the encounters we observed.

Nest Sites

At Buldir auklets nested in rock crevices of talus slopes and boulder-strewn beaches. The main concentrations of Aethia were at the Main Talus, Round Mountain talus, on the slopes below Dry Lake, and on Middle and Outer Rocks (fig. 2).

Bedard (1967) classified talus nesting habitat for Aethia cristatella and A. pusilla at St. Lawrence Island according to differing rock sizes and shapes. He found that the density of Crested Auklets was positively correlated with boulder size, and that the density of Least Auklets decreased in areas with large-diameter boulders. Searing (1977) disagreed with Bedard's conclusions.

The Main Talus study area at Buldir was not clearly segragated into areas with similar boulder sizes. In order to determine the relationship between nesting crevice size and auklet body size, we measured the volume of open space surrounding the eggs of all three species of Aethia. The volume of Crested Auklet nest sites was significantly ($p=0.5$, $t=1.23$) larger than those of Least and Whiskered Auklets (table 1). There was not a significant difference between Least and Whiskered Auklet nest site volumes, although the small sample size of crevice measurements of Whiskered Auklets precludes strong conclusions.

Table 1 Dimensions of *Aethia* nest crevices at Buldir Island

The average weight of A. pygmaea is only 44 percent larger than that of A. pusilla (see section on mensural characterics) compared to the difference between the average weight of Crested Auklets and Whiskered Auklets (118 percent).

To explore the relationship between average boulder size and relative density of various species of Aethia, the six sample plots referred to in the methods section were censused, and the boulders in data were analysed in the three ways described previously; an area method, a volume method, and a frequency distribution. The average boulder sizes calculated by the volume method are more variable than those calculated by the area method (table 2). Plot 3 had the largest average boulder size using both methods, containing only 29 rocks on the surface. Over 60 percent of the boulders had average dimensions of over 1 m (table 3). Plot 2 had the next largest boulders, but unlike plot 3 it contained numerous small rocks on a portion of the plot. The average rock size in plot 1 was similar to plot 2, but the composition was different. Plot 1 was near the edge of the Main Talus and its surface was partially covered by a layer of soil and vegetation. The rocks on the surface were fairly equally distributed into all size classes (table 3).

Plots 4, 5, and 6 had the smallest average rock sizes.

Table 2 Average rock sizes in auklet plots at Main Talus, Buldir Island, Alaska

Plot	Total rocks	Average rock size with area method (s)	Average rock size with volume method (s)
1	31	.68 (2.5)	.40 (0.6)
2	167	.62 (1.5)	.80 (1.2)
3	29	1.94 (2.3)	1.80 (1.4)
4	103	.10 (0.2)	.28 (0.5)
5	73	.18 (1.4)	.16 (0.7)
6	101	.11 (0.4)	.28 (0.6)

Table 3. Frequency distribution of boulder size at Main Talus, Buldir I., Alsaka

Ave. Dimensions (L + W + H ÷ 3) of boulders (m)

Plot #	.2	.2 .4	.4 .6	.6 .8	.8 1.0	1.0	$\bar{X}$ depth (n)
1	(5)	(9)	(6)	(7)	(1)	(3)	1.1 (11)
n=31	16%	29%	19%	23%	3%	10%	
2	(59)	(23)	(15)	(24)	(13)	(33)	2.3 (15)
n=167	35%	14%	9%	14%	8%	20%	
3	(1)	(2)	(1)	(6)	(1)	(18)	1.9 (11)
n=29	3%	7%	3%	21%	3%	62%	
4	(30)	(32)	(22)	(10)	(3)	(6)	0.9 (26)
n=103	29%	31%	21%	10%	3%	6%	
5	(48)	(11)	(12)	(1)		(1)	0.2 (4)
n=73	66%	15%	16%	1%		1%	
6	(17)	(48)	(21)	(6)	(4)	(5)	0.7 (16)
n=101	17%	47%	21%	6%	4%	5%	

About 81 percent and 64 percent respectively of the particles on the surface of plots 5 and 6 were less than or equal to 0.4 m in size.

Data collected during talus watches 8-11 June and 25-29 June were used to determine the relative use by plot of the three species of Aethia. These watches were selected because they fall within the period when most auklets were incubating. It is recognized that non-breeding auklets were present during both periods. The average number of auklets present, arriving and departing from each plot was determined by averaging the figures for the two periods of observation (table 4).

If Bedard's premise holds for the Main Talus at Buldir, plots 1, 2. and 3 would be expected to have a higher percentage of Crested Auklets than the other plots,which should have a higher percentage of Least Auklets than the plots with larger diameter boulders. Similar in body size to Least Auklets, Whiskered Auklets should be found more commonly in plots 4, 5, and 6. Interestingly Least Auklets accounted for 65.8 percent of the auklets in plot 1 and 53.1 percent of the auklets in plot 3, but they accounted for only 20.8 percent in plot 5 and only 31.3 percent in plot 4! Whiskered Auklets were most common in plots 3 and 2. It appears there is no correlation between average boulder size and relative abundance of the three species of Aethia in the Main Talus area at Buldir.

Table 4. Average percentages of auklets in study plots at Main Talus in June 1976

	Plot Number						
	1	2	3	4	5	6	Overall
Crested Auklet	34.2	57.3	45.6	68.6	79.2	46.8	55.3
Least Auklet	65.8	42.1	53.1	31.3	20.8	53.2	44.4
Whiskered Auklet	0	0.6	1.3	0.1	0	0	00.3

Similarly, boulder size was not positively correlated with the total number of auklets found on plots. Plots 4 and 2 had the most birds (table 5), followed by plots 3 and 6. Plots 1 and 5 had the fewest birds.

Possibly the great variability in boulder size on most plots makes strong conclusions about the relationship between species and boulder size questionable. In fact, the premise of Bedard (1967) appears true when Middle and Outer Rocks are considered. The rocks on these islets was mostly flattened shale, most particles being less than 0.5 m average dimensions. On these islands Crested Auklets were strongly outnumbered by Least Auklets, and Whiskered Auklets apparently reached their greatest abundance on the islets. It seems probable that crevice size is the important factor in determining which species nests where. In the case of the flattened shale of Middle and Outer Rocks, crevices were predominently small.

Auklet eggs were found on the following surfaces: level rock, level soil, depressions in bare soil, depressions among small pebbles, and at contact points between boulders. Plant material was discovered in only two nests, one each Crested and Least Auklet. Crested Auklets laid eggs in depressions 65 percent of the time and 21 percent of their eggs were found on level soil (table 6). Only 20 percent of the Least Auklets we examined were found in depressions. The species favored level soil 46 percent of the

Table 5. The average number of auklets present, arriving, and departing study plots at the Main Talus in June 1976* (number in parenthesis is the percentage of total auklets)

	Plot Number					
	1	2	3	4	5	6
Crested Auklet						
Number present	1.6 (30.0)	28.4 (60.3)	6.0 (47.2)	37.2 (76.5)	1.6 (80.0)	1.5 (40.5)
Number arriving	3.0 (37.5)	38.0 (56.5)	14.3 (42.2)	76.4 (64.4)	7.9 (78.2)	10.6 (50.0)
Number departing	2.8 (35.0)	29.6 (55.0)	20.0 (47.5)	50.0 (64.9)	7.3 (79.3)	11.0 (50.0)
Least Auklet						
Number present	3.7 (70.0)	18.5 (39.2)	6.4 (50.4)	11.3 (23.3)	0.4 (20.0)	2.2 (59.5)
Number arriving	5.0 (62.5)	29.0 (43.1)	19.3 (56.9)	42.1 (35.5)	2.2 (21.8)	10.6 (50.0)
Number departing	5.2 (65.0)	23.7 (44.1)	21.9 (52.0)	27.0 (35.1)	1.9 (20.7)	11.0 (50.0)
Whiskered Auklet						
Number present	0	0.2 (00.1)	0.3 (02.4)	0.1 (00.2)	0	0
Number arriving	0	0.3 (00.4)	0.3 (00.9)	0.1 (00.1)	0	0
Number departing	0	0.5 (00.9)	0.2 (00.5)	0	0	0
Total Aethia						
Number present	5.3	47.1	12.7	48.6	2.0	3.7
Number arriving	8.0	67.3	33.9	118.6	10.1	21.2
Number departing	8.0	53.8	42.1	77.0	9.2	22.0

* Counts for the two count periods in June were averaged.

time and contact points between boulders 27 percent. Only six Whiskered Auklet nest cups were evaluated; two each (33 percent) were on level rock and level soil (table 6).

The depressions Crested Auklets favored seemed to have been dug by the birds. Perhaps the relatively large egg of Crested Auklets needs a depression to ~~prohibit~~ reduce chances of dislodgment from precarious sites.

A unique nesting habitat accessable to investigators was two 10-15 m^2 chambers up to 4 m deep in the Main Talus. Each chamber contained 10 to 20 Crested Auklet nests, but no Least or Whiskered Auklets were found in this habitat type. Birds nesting in these caves used a single common entrance to each area. Nests 15 cm apart were found in situations where rocks acted as visual barriers. When no visual barrier was present 1 m was the smallest nearest-neighbor distance.

Eggs

Sealy (1968) describes the eggs of Crested and Least Auklets as being dull white and without luster. We found that his description also fits Whiskered Auklet eggs.

The average size of eggs of the three Aethia are positively correlated with their body size (table 7). The measurements are only slightly different from those given by Sealy (1968) and Kozlova (1961).

As others have found, Aethia lay a single egg; however, we found two instances of Crested Auklets incubating two-egg clutches. In both cases only one egg hatched. The other died early in development. Second eggs could have been left from the previous year.

Laying

Egg laying for all three species of Aethia was synchronous, most occurring over a 10-12 day period. In 1976 eggs of all auklets were found 31 May, the first day we searched intensively. Judging from the range of hatching dates, the earliest eggs were laid about 24 May and most laying was completed by 4 June. Least and Whiskered Auklets laid approximately 80 percent of their eggs by 1 June (table 8) at which time Crested Auklets had laid only 64 percent of their eggs.

The laying dates for Crested and Least Auklets are approximately two weeks earlier than those recorded by Sealy (1968) and Searing (1977) at St. Lawrence Island. Stejneger (1885) found a downy Crested Auklet 30 June in the Commander Islands. He also reported that Whiskered Auklets hatch in "the latter part of June". Kozlova (1961) reports that the breeding season for Whiskered Auklets begins at the end of May or early June in the Commander Islands. Apparently the nesting chronology for Aethia cristatella and A. pygmaea is very similar to the chronology at Buldir.

Table 8. Distribution of laying dates for three species of Aethia at Buldir Island, Alaska, 1976

	n	Total (%) nests per period				
		24-26 May	27-29 May	30 May - 1 June	2-4 June	5-7 June
Crested Auklet	36	6 (17)	10 (28)	7 (19)	12 (33)	1 (03)
Least Auklet	15	3 (20)	6 (40)	3 (20)	2 (13)	1 (07)
Whiskered Auklet	6	2 (33)	2 (33)	1 (17)	1 (17)	0

Incubation

Auklets apparently incubate their eggs almost continually from the time of laying until hatching (Sealy 1968). We were able to determine minimum incubation periods for all three species to within one to three days. Crested Auklets incubated at least 41 days; Least and Whiskered Auklets were on eggs 35-36 days. All these periods are longer than the exact periods calculated by Sealy (1968) for Crested Auklets (35.6 days) and Least Auklets (31.2 days) at St. Lawrence Island. The limited ice-free period at St. Lawrence would force auklets nesting there to conclude nesting activities as quickly as possible, whereas at Buldir the climate is much milder, allowing a longer time for activities like incubation.

Hatching

Hatching dates for Crested Auklet eggs ranged from 1-16 July 1976, but 80 percent hatched 5-12 July 1976 (table 9). Least and Whiskered Auklet eggs hatched 27 June-8 July 1976, slightly earlier than Crested Auklet eggs. In 1974 and 1975 hatching of all species was apparently a few days earlier than in 1976. In 1977 extremely mild spring weather prevailed in the western Aleutian Islands, and the nesting chronology of auklets at Buldir was earlier than 1976 by about 3-5 days (R.H. Day pers. comm.).

Table 9 Distribution of hatching dates for three species of Aethia at Buldir Island, Alaska 1976

	total (%) nests per period				
	24-30 June	1-4 July	5-8 July	9-12 July	13-16 July
Crested Auklet n=36	0	6 (17)	13 (36)	16 (44)	1 (03)
Least Auklet n=15	3 (20)	8 (53)	3 (20)	1 (07)	0
Whiskered Auklet n=6	4 (67)	0	2 (33)	0	0

Chick Growth Rates

Periodic measurements were made of the body weight, culmen length, tarsus length, and length of errupted primaries of chicks of all three species of Aethia (table 10). As shown there was a decrease in sample size as the nestling period progressed due to the loss of chicks by death or movement deeper into the talus out of our reach. There was a weight loss just prior to fledging similar to that described by Sealy (1968) for Aethia at St. Lawrence Island. Aethia chicks at St. Lawrence fledged at about 88 to 89 percent adult weight. It was not possible to weigh Aethia chicks regularly after they reached 23 days of age at Buldir, but weight loss began about age 18 or 19 days in all three species (table 10).

Fledging and Departure

The first fledglings of each species were found at the end of July each year, but most chicks fledged during the first 10 days of August. By mid-August most auklets had departed Buldir although a few of each species were seen as late as 22 August.

Whiskered and Least Auklet chicks fledged slightly earlier than Crested Auklets at Buldir. Sealy and Bedard (in press) found that Crested Auklets had a 4-day longer nestling period than Least Auklets at St. Lawrence Island, where Crested Auklets fledged the first two weeks of September and Least Auklets fledged mid-August to early September. Stejneger (1898) found whiskered Auklets still present in the central Kuriles 22-25 August.

Table 10 Growth in Crested, Least, and Whiskered Auklets on Buldir Island, Alaska.

Age in days	Sample Size	Mean Crested Weight	Mean Least Weight	Mean Whiskered Weight
0	13, 18, 4	29.5	12.3	19.8
1	13, 18, 4	33.8	15.4	25.7
2	13, 18, 4	39.6	18.1	27.8
3	13, 17 ,4	48.6	21.9	29.7
4	12, 17, 4	55.6	26.1	34.2
5	12, 17, 4	63.4	29.4	39.1
6	12, 17, 4	74.3	33.2	42.4
7	12, 17, 4	77.8	35.8	45.3
8	12, 17, 4	82.4	41.1	49.4
9	11, 17, 3	85.4	43.3	53.4
10	11, 17, 3	91.0	45.8	56.7
11	11, 15, 3	99.9	49.5	59.9
12	11, 15, 3	1o3.8	51.1	63.2
13	11, 15, 3	106.6	57.8	69.9
14	10, 14, 3	109.8	65.6	76.5
15	9, 14, 3	130.3	74.4	83.7
16	9, 14, 3	150.6	86.6	99.6
17	9, 14, 3	161.4	93.4	103.4
18	9, 14, 3	184.5	94.3	112.3
19	9, 14, 3	197.6	90.6	109.6
20	9, 14, 3	188.0	88.4	107.6
21	8, 13, 3	183.5	83.6	101.5
22	3, 7, 1	180.9	79.4	100.5
23	2. 4, 0	176.4	74.5	-

Production

At least 76 percent of Crested Auklet eggs hatched , and 68 percent of Least Auklet eggs hatched in 1976 (table 11). Six of seven (86 percent) Whiskered Auklet eggs we observed hatched. As chicks became older thus more mobile they tended to move deeper into rock crevices. As a result of this movement it was often impossible to relocate individual chicks, therefore 37 to 50 percent of the chicks of all species were not accounted for throughout the nestling period. Searing (1977) encountered the same type of movement in his study area on St. Lawrence Island. Of known-fate chicks, 33 percent of Crested Auklets and 25 percent of Least Auklets died; most during the first 10 days of life. None of the six Whiskered Auklet chicks are known to have died.

Because of the large percentage of chicks that we could not locate regularly enough to determine their fate, fledging success was based on small samples. Disregarding the chicks of unknown fate, it was estimated that 66 percent of the Crested Auklet chicks that hatched, fledged. Least Auklets fledged 75 percent of the chicks that hatched. All three known-fate Whiskered Auklet chicks fledged.

The overall production was estimated by calculating the percentage of known-fate eggs that produced a fledgling: Crested Auklet, 14 of 35 (40 percent); Least Auklet 9 of 21 (43 percent); and Whiskered

Table 1 Hatching and fledgeing success of auklets at Buldir Island, Alaska 1976

	Total eggs	Number (%) dead eggs	Number (%) hatched eggs	Number (%) dead chicks	Number (%) unknown chicks	Number (%) known-fate chicks fledged	Number (%) known-fate eggs that produce fledgling
Crested Auklet	59	14 (24)	45 (76)	7 (~~16~~ 33)	24 (53)	14 (~~66~~ 67)	14 of 35 (40)
Least Auklet	28	9 (32)	19 (68)	3 (~~16~~ 25)	7 (37)	9 (75)	9 of 21 (43)
Whiskered Auklet	7	1 (14)	6 (86)	0	3 (50)	3 (100)	3 of 4 (75)

Auklet, 3 of 4 (75 percent).

Mortality Factors

Eggs- In 1976 at the Main Talus study area 14 (24 percent) of the 36 Crested Auklet eggs, 9 (32 percent) of 28 Least Auklet eggs, and one (14 percent) of seven Whiskered Auklet eggs failed to hatch. Most died during the early stages of incubation, but a few were well developed when they died. None of the eggs we studied were taken by predators, but Glaucous-winged Gulls (Larus glaucescens) probably took a small percentage of Aethia eggs.

Chicks- Crested Auklets had higher chick mortality (33 percent) than Least Auklets (25 percent). All three Whiskered Auklet chicks we observed fledged. Chick mortality occurred within the first week of life usually. Sealy and Bedard (in press) point out that thermoregulation begins in chicks of Crested Auklets at 3-4 days of age and in Least Auklets at 5-6 days old. It seems likely that chick mortality reduces drastically after the ability to thermoregulate is obtained. Also any severe congenital problems would be expected to cause death within the first week. Glaucous-winged Gulls might have taken a few nestlings that were visible from the surface of the talus, but we did not record this event.

Adults- Bald Eagles (Haliaeetus leucocephalus), Peregrine Falcons (Falco peregrinus), and Glaucous-winged Gulls were the major predators of the three species of Aethia at Buldir. Of the food items we identified in Peregrine eyries, 81 percent were Aethia (table 12). Of these, Least Auklets comprised 85 percent. White (1975) has related the distribution and abundance of Peregrine Falcons in the Aleutians to the distribution of auklets. Buldir supported 4 or 5 breeding pairs of Peregrines 1974-1976, a particularly dense population.

Aethia comprised 40 percent of the prey items found at the single active Bald Eagle eyrie on Buldir each year (table 12). Crested Auklets seemed to be favored, comprising 73 percent of the auklets taken.

Glaucous-winged Gulls actively hunted alcids daily at the Main Talus. We saw gulls catch auklets on over 50 occasions. Gulls captured auklets that stood on the surface of the talus, birds that were in flight, or auklets that were in the sea near shore. Aethia made up a fairly small percentage of the food items of gulls over the whole island (Trapp in press), because storm-petrels (Oceanodroma spp.) which nested abundantly near most gull colonies provided a major food source. Judging from gull pellets examined near the Main Talus, Crested and Least Auklets were taken with a relatively similar frequency there.

Table 12. Aethia remains found in the eyries of Peregrine Falcons and Bald Eagles at Buldir Island, Alaska

Predator	Total food items examined	Total individuals and percent of total food items composed of: Crested Auklet	Least Auklet	Whiskered Auklet	Combined Aethia
Peregrine Falcon	75	7 (09)	52 (69)	2 (01)	61 (81)
Bald Eagle	83	24 (29)	8 (10)	1 (01)	33 (40)

Molt

Aethia were in adult breeding plumage when they arrived on the Main Talus area in May. By the third week of July the remiges and coverts of all three species of Aethia were brownish and worn. By the last week in July the white eye line and plumes at the base of the upper mandible of Crested Auklets were noticable diminished. Crested Auklets were sheding rosettes and there bills were noticably lighter by 3 August.

Diurnal Rhythm

Sealy and Bedard (in press) found that Aethia cristatella and Aethia pusilla populations at St. Lawrence Island reached peaks twice daily at the nesting colonies. Sealy and Bedard (in press) recorded a morning peak between 0900 and 1200, a lull in activity in mid-afternoon, and another peak in activity just before darkness. At St. Lawrence there was a complete lack of activity by Aethia at the colony prior to hatching in mid-afternoon, but when adults were feeding young activity continued throughout the day, although the lull was still evident in mid-afternoon. Sealy and Bedard (in press) did not separate activities of the two Aethia and they were unable to quantify the activity.

At Buldir in 1976 we observed auklets in up to six plots at the Main Talus during all hours of activity four times during the

summer: 24-30 May (pre-laying), 8-11 June (incubation), 25-29 June (late incubation-early hatching), and 9-10 July (feeding chicks). Aethia at Buldir exhibit similar rhythms to the genus at St. Lawrence.

Table . Measurements of Aethia at Buldir Island, Alaska, June - early August, 1974-1976

$\bar{X}$ / S / R / N

	A. cristatella	A. pusilla	A. pygmaea
CULMEN	11.9/ 0.8/10.3-15.5/184	8.9/ 0.5/ 7.3-10.1/339	9.8/ 0.6/ 8.8-10.8/62
BILL DEPTH	11.7/ 0.9/10.0-13.5/ 89	7.7/ 0.7/ 6.1- 8.2/180	7.6/ 0.3/ 6.6- 8.0/55
GONY	10.4/ 0.9/ 9.6-11.5/ 4		8.2/ 1.1/ 7.0- 9.6/30
NOSTRIL TO BILL TIP	8.3/ 0.9/ 7.0-10.5/ 30		6.4/ 0.2/ 5.5- 7.3/44
WING (cord)	134.3/ 3.6/ 125-143 /154	90 / 3.9/ 81-100 /338	104.6/ 5.0/ 97-129 /61
DIAGONAL TARSUS	28.1/ 1.3/24.2-31.3/155	19.2/ 0.8/16.9-21.0/338	21.1/ 0.9/18.2-26.7/63
MID. TOE (w/o claw)	31.1/ 1.5/28.9-33.2/ 13	21.2/ 0.6/20.1-21.8/ 8	23.9/ 1.5/21.2-27.4/45
MIDDLE CLAW	7.2/ 1.0/ 5.6- 8.6/ 15		7.2/ 0.8/ 5.3- 8.5/44
TAIL	35.4/ 1.1/ 33-37 / 23	27.1/ 2.2/ 22-30 / 37	29.2/ 1.4/ 26-33 /45
WEIGHT	263.5/19.2/ 195-330 /192	83.8/ 7.3/ 72-98 /457	120.7/ 7.3/ 102-137.5/60
TOTAL BODY LENGTH	238.6/10.2/ 225-258 / 16	167.9/ 9.9/ 150-182 / 10	181.3/ 9.1/ 158-202 /44