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The importance of plankton to Cassin's auklets during breeding

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Abstract. The breeding chronology, food habits, growth and reproductive success of Cassin's Auklets, *Ptychoramphus aleuticus*, were investigated on Triangle Island, British Columbia. The breeding of Cassin's Auklets coincides with the plankton bloom in the eastern North Pacific. Cassin's Auklets in British Columbia feed their young mostly large copepods, *Calanus cristatus*, and euphausiids, chiefly *Thysanoessa spinifera*, but fish was an important food item in one summer. Chicks which hatched early, grew and survived better than late-hatched chicks and this may relate to food availability. Adults and chicks on Triangle Island were heavier than those on South Farallon Island, California. The heavier weight and greater numbers of Cassin's Auklets in British Columbia as compared with regions to the south may relate to *Calanus cristatus* availability and abundance in northern areas.

Introduction

Plankton feeding alcids developed different strategies to feed their young. Six species are known to bring food to their young in a gular or neck pouch. Five of those in arctic and subarctic regions feed their chicks diurnally; they are the Dovekie, *Alle alle*, the only plankton feeding alcid in the North Atlantic, and the Least Auklet, *Aethia pusilla*, Whiskered Auklet, *Aethia pygmaea*, Crested Auklet, *Aethia cristatella* and Parakeet Auklet, *Cyclorhynchos psittacula* in the North Pacific (Bédard, 1969a, Udvardy, 1963). The Cassin's Auklet, *Ptychoramphus aleuticus* carries food to its young at night and has the most extensive latitudinal range of plankton-feeding alcids as it breeds from subtropical to subboreal regions along the North American west coast. The Dovekie, Crested, Least and Parakeet Auklets make several trips per day to feed their young (Norderhaug, 1970, Bédard, 1969b). The Cassin's Auklet uses its large pouch to store food and each parent makes only one feeding trip to the young per day and that during darkness.

The natural history and reproduction of Cassin's Auklets has been studied on Southeast Farallon Island, California by Thoresen (1964), Manuwal (1974, 1979) and Speich and Manuwal (1974) while its selection of nesting habitat has been quantitatively described on Triangle Island, British Columbia where 40% of the world's known breeding population of this species breeds (Vermeer *et al.* 1979). Quantitative information on the Cassin's Auklet diet is lacking. Available data suggests that their young are fed the euphausiid, *Thysanoessa spinifera*, in British Columbia (Carl *et al.* 1951) and euphausiids, squids and amphipods on Southeast Farallon Island (Manuwal, 1974). Most alcids are known to be fish eaters. In British Columbia plankton feeders apparently breed earlier than fish-eating alcids

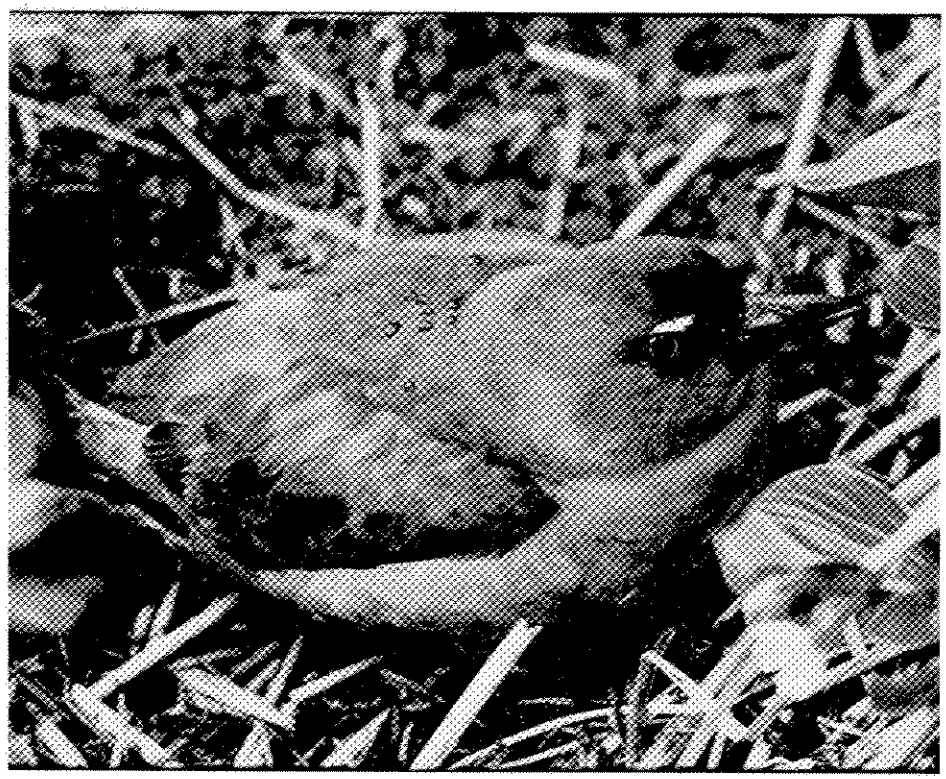

Plate 1. Cassin's Auklet in breeding plumage.

(Sealy, 1975, Vermeer, unpublished data). In view of the apparent relationship between early breeding and plankton feeding, the breeding chronology and food of Cassin's Auklets was investigated on Triangle Island, British Columbia (56° 52′N, 129° 05′W) in 1978 and 1979. Growth and reproductive success of the birds was also studied inasmuch as they may be influenced by plankton availability.

Methods

Food and gular pouch

Adult Cassin's Auklets were caught at night in a net as they returned to their nest burrrows after spending the day at sea. The net (10 x 5 m and 1½ cm mesh size), was deployed in front of a gently rising slope on which the birds nested. The birds were netted from 2200 to 2400 PST. Food, which the parents brought in their gular pouches to their young, was obtained by forcing the birds to regurgitate into plastic bags. One hundred and twelve and 129 samples were collected in 1978 and 1979 over four discrete periods in each year: 27 May-3 June, 25-29 June, 13-20 July and 25 July. The food samples were weighed in the field with 50 g Pesola scales and preserved in 10% formalin. In the laboratory they were strained

through a 0.5 mesh sieve to remove the preservative. The contents were separated into categories like copepods, euphausiids, decapods, amphipods, gooseneck barnacles, fish and unidentified organic matter. The wet weight of each category was measured to the nearest 0.1 g on a Mettler H_{35} balance. The lengths of some organisms from each sampling period were measured to the nearest 0.1 mm. The weights of the various components of the contents of the gular pouch were tested for differences between periods using analyses of variance. Caloric values of fresh and undamaged prey organisms from the same sampling period were determined by microbomb calorimeter in cal/g dry weight.

Gular pouch lengths of 88 breeding adults captured in their burrows in 1978 were measured with a thin, smooth plastic rod to determine if the pouch size increased over the hatching and nestling period. The pouches of non-breeders were measured for comparison.

Growth and reproductive success

In 1978, 66 burrows with incubating Cassin's Auklets were marked from 15 to 17 May. Subsequent visits to the burrows were on 21, 22 and 24 May. As 48% of the eggs had been deserted by 24 May visits were made only every fifth day thereafter until the remaining eggs hatched. The desertion rate at that frequency of checking was low. Newly hatched chicks brooded by an adult could be removed from the burrow without causing desertion providing the adult remained calm. If the adult became excited the chick was not removed. New burrows were investigated until 20 June after which date no further eggs were found. Chicks were weighed with 100 and 200 g Pesola scales at 0800 and 2000 PST each day. Growth of chicks was analyzed by plotting mean weights of chicks of known age.

The effect of disturbance on the birds by the investigators was evaluated by using a control plot with 24 burrows which were checked twice during the study period in 1978; once during late incubation and just prior to the fledging of the first chicks. Fledgling weights were not determined in the control plots to prevent disturbance to the chicks. Healthy chicks present at the time of the second check are presumed to have fledged. Reproductive success between the two plots was compared. In 1979, a further 24 burrows were investigated to compare reproductive success between years.

Chronology

The breeding chronology of Cassin's Auklets was determined by observing actual hatching and fledging dates in nest burrows checked for reproductive success and growth. Where hatching dates were unknown, the ages of recently hatched chicks were estimated to the nearest day from tarsus length and body weights. A further comparison between 1977, 1978 and 1979 was made noting the percentages of burrows with eggs, chicks and nestlings fledged on 25 and 26 June each year.

Results and Discussion

Food

Food brought by Cassin's Auklets to their young weighed on average 17.6 g in

Table I. Comparison of weights of meals carried by Cassin's Auklets to their young on Triangle Island, 1978 and 1979.

Collection period 1978 and 1979	No. complete meals collected 1978	1979	Total wet weight(g) 1978	1979	Mean wet weight and sd (g) per meal 1978	1979
27 May - 3 June	28	39	526	869	18.8 ± 10.2	22.3 ± 7.9
25 -29 June	42	46	757	1015	18.0 ± 6.9	22.1 ± 7.8
13 -20 June	37	36	603	569	16.3 ± 7.3	15.8 ± 7.3
25 July	5	8	89	88	17.8 ± 6.6	11.0 ± 5.5
Total no. meals and average samples weight	112	129	1976	2541	17.6 ± 8.0	19.7 ±8.5

1978 and 19.7 g in 1979, but the difference between years was not statistically significant (Table I). In 1978 the weights of the meals were similar over the nestling period, but in 1979 declined significantly after June ($p < 0.005$). The most important food in 1978 and 1979 was the copepod, *Calanus cristatus,* which made up 38% of the prey weight in both years (Table II). Euphausiids formed the second most important prey in 1978 (25%) and in 1979 (15%). From 1978 to 1979 the fish component of the diet increased significantly in both weight (3 to 17%) and occurrence (23 to 64%). Conversely, euphausiids and amphipods decreased significantly between the two years (table II, $p < 0.05$). Of the euphausiids, *Thysanoessa spinifera,* was dominant in weight and occurrence. *T. spinifera* accounted for 5.7 and 4.6% by weight of the food collected in 1978 and 1979. Those percentages are undoubtedly too low as many euphausiids could not be identified because of poor specimen condition. *Euphausia pacifica* was the second most important euphausiid in 1978. Of the amphipods, *Parathemisto pacifica* and *Vibilia propingua* were the species highest in both weight and occurrence in 1978. In 1979, however, the latter was present only in trace amounts.

The change in quantity taken of each prey category during the Cassin's Auklet nestling period is shown in Figure 1. *Calanus cristatus* formed a substantial portion of the prey except in the last sampling of 1978 when only five meals were examined. *Pasiphaea pacifica* was a major food item in late May and early June collections. Amphipods made up only a small proportion of the food. Gooseneck barnacles, *Pollicipes polymerus,* occurred only on July 25, 1979. In 1978, fishes were a major food during the last sampling period. In 1979, fishes ranked second in importance to copepods during the first half of the nestling period but declined significantly after June ($p < 0.05$). Therefore, fishes can show up early as well as late in the diet of Cassin's Auklet chicks. The fishes which could be identified were the sandlance, *Ammodytes hexapterus* and the red and/or brown Irish lord, *Hemilepidotus hemilepidotus* and/or *H. sinosus.*

Both Triangle and South Farallon Island (Manuwal, 1974) studies show that plankton is the main food of Cassin's Auklets. *Calanus cristatus* was the major food on Triangle Island, while the euphausiid, *Thysanoessa spinifera* and the

Table II. Percentage wet weight and occurrence of Cassin's Auklet prey, Triangle Island, 27 May -25 July, 1978 and 1979.

Prey categories and species	% Wet weight 1978	% Wet weight 1979	% Occurrence 1978	% Occurrence 1979
Decapods				
Pasiphaea pacifica	3.3	5.0	22.3	25.6
Total decapods	3.3	5.0	22.3	25.6
Copepods				
Calanus cristatus	38.2	38.6	86.6	76.7
Metridia sp.	0.1	0	0.8	0
Total copepods	38.3	38.6	86.6	76.7
Euphausiids				
Thysanoessa spinifera	5.7	4.6	28.5	16.2
Thysanoessa longipes	0.5	0	1.8	0
Thysanoessa raschii	0.1	0.2	0.9	3.9
Unidentified Thysanoessa	1.6	2.0	10.7	8.5
Euphausia pacifica	2.4	0.1	13.4	1.6
Nematocelis difficilis	0	0.1	0	0.8
Unidentified euphausiids	14.5	8.1	68.8	38.0
Total euphausiids	24.8	15.0	73.2	57.4
Amphipods				
Parathemisto pacifica	2.2	0.3	26.8	8.5
Vibilia propingua	2.1	0.1	29.5	0.8
Hyperia medusarum	0.1	0.1	2.7	2.3
Hyperoche sp.	0.1	0.1	1.8	0
Calliopius sp.	0	0.1	0	1.6
Mephidippa sp.	0	0.1	0	1.6
Phromema sp.	0.1	0	0.9	0
Unidentified amphipods	0.4	0.1	7.1	7.8
Total amphipods	4.9	0.5	42.0	15.5
Cirripeds				
Pollicipes polymerus	0	0.1	0	1.6
Fishes	3.1	17.2	23.2	64.3
Unidentified organic matter	25.6	23.6	89.3	70.5

amphipod, *Phromema* were important prey species for Cassin's Auklet chicks on South Farallon Island. Manuwal (1974) did not report any *Calanus cristatus* in the Cassin's Auklet diet on South Farallon Island, which is not surprising as *C. cristatus* is either absent or exceedingly rare at South Farallon Island and in southern California waters (A.Fleminger, Scripps Institute of Oceanography, pers. comm.). The Cassin's Auklet therefore can serve as an indicator species of the abundance and changes in composition of plankton prey over its extensive latitudinal breeding range.

Except for *V. propingua,* all plankton species observed in Cassin's Auklet food on Triangle Island are abundant in the northeastern Pacific Ocean. *C. cristatus* and *Pasiphaea pacifica* are most abundant offshore, *T. spinifera* and *E. pacifica* are found mostly inshore along the margins of the continental shelf, and *Parathemisto pacifica* occurs near the surface in both habitats (R.Le Brasseur, pers comm.). All the plankton species migrate towards the ocean surface at dusk,

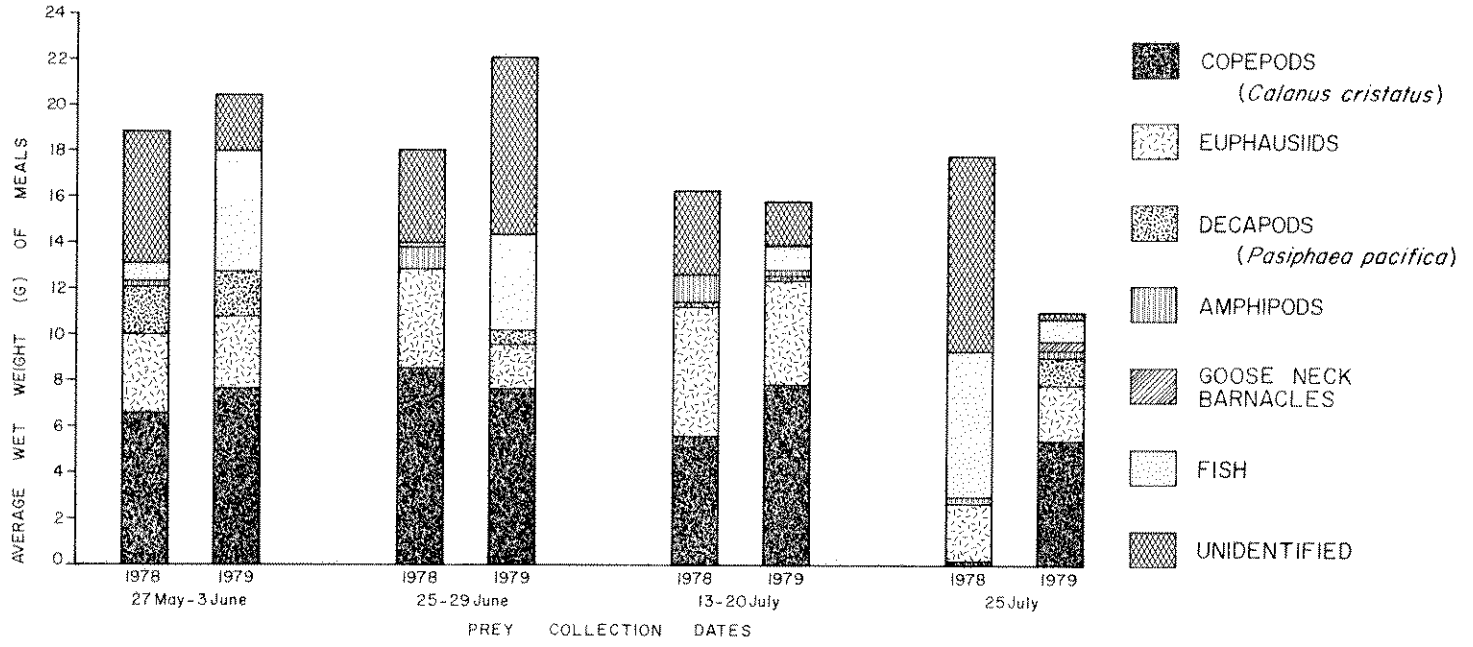

Fig. 1. Weight of meals and component prey categories over the Cassin's Auklet nestling period, Triangle Island, 1978-1979.

Table III. Average total length and standard deviation (in mm) of principal plankton species in Cassin's Auklet food, Triangle Island, 1978 and 1979 (sample size in parentheses).

Species, year	27 May - 3 June	25-29 June	13-20 July	25 July	Range in length
Pasiphaea pacifica, 1978	22.6 ± 3.9 (40)				11.0 - 46.0
Pasiphaea pacifica, 1979	15.7 ± 4.1 (40)	17.5 ± 4.3 (20)			
Calanus cristatus, 1978	7.6 ± 0.3 (40)	7.3 ± 0.4 (40)	7.6 ± 0.4 (40)	7.3 ± 0.3 (40)	6.4 - 9.3
Calanus cristatus, 1979	7.9 ± 0.4 (40)	8.0 ± 0.5 (40)	8.0 ± 0.4 (40)	8.3 ± 0.6 (24)	
Thysanoessa spinifera	18.5 ± 1.5 (38)	25.1 ± 2.8 (40)	23.1 ± 2.4 (40)		15 - 38
Thysanoessa spinifera, 1979			23.5 ± 3.1 (40)		
Thysanoessa sp., 1978 (juveniles)		16.0 ± 4.1 (40)			
Thysanoessa sp., 1979 (juveniles)		16.1 ± 3.5 (40)	15.5 ± 3.1 (40)		
Euphausia pacifica, 1978		22.3 ± 4.4 (40)	22.1 ± 2.9 (40)		18.0 - 26.5
Vibilia propingua, 1978		8.8 ± 0.5 (40)	8.8 ± 0.7 (40)	9.4 ± 0.6 (11)	7.6 - 10.5
Parathemisto pacifica, 1978	6.5 ± 0.6 (14)	7.8 ± 0.6 (40)	8.1 ± 0.8 (40)		5.6 - 9.3
Parathemisto pacifica, 1979			8.2 ± 0.7 (22)		

*Average lengths of *Thysanoessa raschii* and *T. longipes* from different periods in 1978 were 15.3 (6) and 15.5 (10) mm respectively.

Table IV. Change in gular pouch length of breeding Cassin's Auklets over 1978 season, Triangle Island

Date	No. pouches measured	Mean pouch length and standard deviation (mm)
Breeders		
17 May	26	53.0 ± 12.7
4 - 10 June	13	75.6 ± 16.7
25 June - 4 July	24	98.5 ± 22.4
13 - 25 July	25	98.2 ± 12.9
Non-breeders		
4 - 10 June	10	33.9 ± 6.3

some from greater depth than others and this may facilitate capture by birds. *C. cristatus* does not make extensive diel migrations and is the largest abundant *Calanus* species (7-8 mm.) found in the northeastern Pacific. The most frequent of the larger calanoid species encountered in plankton nets, however, is *C. plumchrus* (ca 4.5 mm). Both species tend to be near the surface in spring and early summer, their diel migrations in the spring being usually restricted within the surface layer (R.Le Brasseur, pers. comm.).

The lengths of principal prey were measured to determine the prey size of Cassin's Auklets. The average lengths of the main prey in adult and pre-adult stages are shown in Table III. Of the *Thysanoessa* species, juveniles made up about twice the weight of adults both in 1978 and 1979. The identification of juveniles was difficult as they were mostly broken up. Measurements of reconstructed juvenile *Thysanoessa* have been included in Table III for comparison with those of adults and pre-adults. The 25 mm *T. spinifera,* 7.5 mm *C. cristatus* as well as the largest lengths of most others shown in Table III represent the largest stages of those species. The abundance of large stages of plankton species in Cassin's Auklet food suggest selection of prey. Six to seven mm *C. cristatus* and *Parathemisto pacifica* may be the smallest prey actively selected. However the most abundant copepod in the area, *C. plumchrus,* with a maximum length of five mm, was not taken. Very small larval plankton forms may be incidentally ingested. Of the fishes measured in Cassin's Auklet food, five *Ammodytes hexapterus* averaged 40 mm (range 35-45 m) and six *Hemilepidotus* averaged 20 mm (range 17-25 mm) in length.

Gular pouch

Speich and Manuwal (1974) showed that the gular pouch of Cassin's Auklet on South Farallon Island increases in length from 25-28 mm just before egg laying to double that length several days later. During the nestling period it becomes still larger before regressing after fledging. Data from this study (Table IV) confirm these events. Pouch length just before hatching was, at 53.0 mm, not statistically different from South Farallon Island values, and reached a maximum of 98.5 mm during the chick rearing period.

Table V. Comparison of growth parameters of Cassin's Auklets between Triangle and South arallon Islands

Growth parameters	Triangle Island n $\bar{x}$ and SD	South Farallon Island Mean (source)
Peak weight at 0800 PST (g)	41 188.1 ± 14.5	153 (1)
Peak weight at 2000 PST (g)	41 172.6 ± 16.3	
Fledging weight at 0800 PST (g)	41 168.8 ± 12.5	149 (1), 147 (2)
Fledging weight at 2000 PST (g)	41 159.2 ± 11.7	
Adult weight (g)	25 187.8 ± 16.0	168 (3)
Age at peak weight (d)	41 36.9 ± 3.2	37-38 (2)
Age at fledging (d)	42 43.5 ± 4.4	44.7 (1); 41.1 (2)

(1) Thoresen, 1964 (2) Manuwal, 1974 (3) Manuwal, pers. comm.

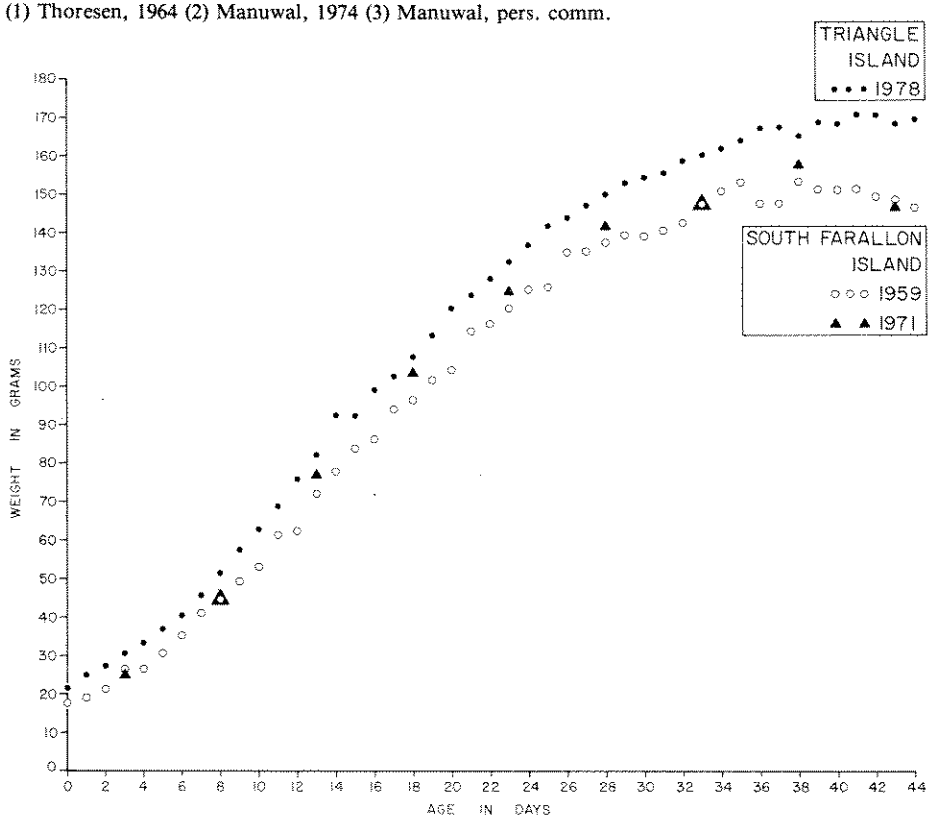

Fig. 2. Comparison of Cassin's Auklet growth at Triangle Island (this study) and South Farallon Island (Thoresen, 1964, Manuwal, 1974). Growth curve of Cassin's Auklets on Triangle Island is based on averages of morning and evening weights (see Appendix).

Growth

Cassin's Auklet chicks spent on average 43.5 days in their burrows, reached peak weight at 37 days (when they weighed as much as their parents) and fledged at 90% of the adult weight (Table V). On South Farallon Island, Cassin's Auklet

chicks reached fledging weights at 41.1 days and as on Triangle Island fledged at 90% of adult weight (Manuwal, 1974). Daily weight loss of chicks between peak and fledging weights at South Farallon (2.5%) and at Triangle Island (1.6%) was similar. Chick weights of Cassin's Auklets on South Farallon in 1959 and 1971 were always less (Fig. 2) and fledging weights from 12 (800 PST) to 20 g lower (2000 PST) than those at Triangle Island (Table V). The weight differences may reflect a difference in feeding conditions. Chicks on Triangle Island, however were calculated to receive on average 35 and 39 g of food daily in 1978 and 1979 respectively on the basis of two feedings per night compared to 55 g on South Farallon island (Manuwal, 1974). Energy acquired from food on Southeast Farallon Island may have been less than on Triangle Island. *Calanus cristatus,* which occurred in the Cassin's Auklet diet on Triangle Island but not on Southeast Farallon contained 6200 cal/g compared to 5400 cal/g for *Thysanoessa spinifera.* Those caloric differences, however, are insufficient to explain the chick weight discrepancies observed between islands. Most likely the meal sizes examined on Southeast Farallon were not respresentative of the overall nestling period as they were collected only at one time period (D.A.Manuwal, pers. comm.) Boekelheide (pers. comm.) observed that Cassin's Auklet meals declined to 17g by the end of the nestling period on Southeast Farallon Island in 1979. That figure is the same as that observed for Cassin's Auklets on Triangle Island in 1978.

Cassin's Auklets breeding in British Columbia grow heavier than those farther south. Cassin's Auklet chicks were heavier on Triangle Island than on South Farallon Island (Fig. 2.) Nestlings measured in 1980 on Frederick Island, 345 km to the north of Triangle Island, had similar weights as those on Triangle Island in 1978 (Author, unpubl. inform.). Cassin's Auklet adults and chicks are not only heavier in British Columbia than in southern California, but 65% of their known population nests in a relatively small portion of their breeding range from Triangle Island to Forrester Island on the Alaska-British Columbia boundary (Vermeer *et al,* 1979). The simultaneous occurrence of heavier chicks and adults and larger populations of Cassin's Auklets in British Columbia suggest greater availability and abundance of the high energy *Calanus cristatus* in northern areas than farther south.

Cassin's Auklet chicks which hatched May 10 to 25 in 1978 grew somewhat heavier than those which hatched May 26 to June 6 in the same year (Figure 3). Chicks hatched on Triangle Island June 7 to July 5 were significantly lighter in the second half of their nestling period than those from the preceding periods (Figure 3, $p<0.05$). Lighter weights of late-hatched chicks may result from food shortages at the close of the breeding season. Food shortages may also cause adults to abandon their young as suggested by the many underweight chicks in fledgling plumage encountered on the nesting slope at the end of July through August. The average fledging weights of five chicks found on the slope in July 1976 to 1979 was 138 g as compared with an average of 90 g for eleven chicks weighed there in August 1976 to 1979.

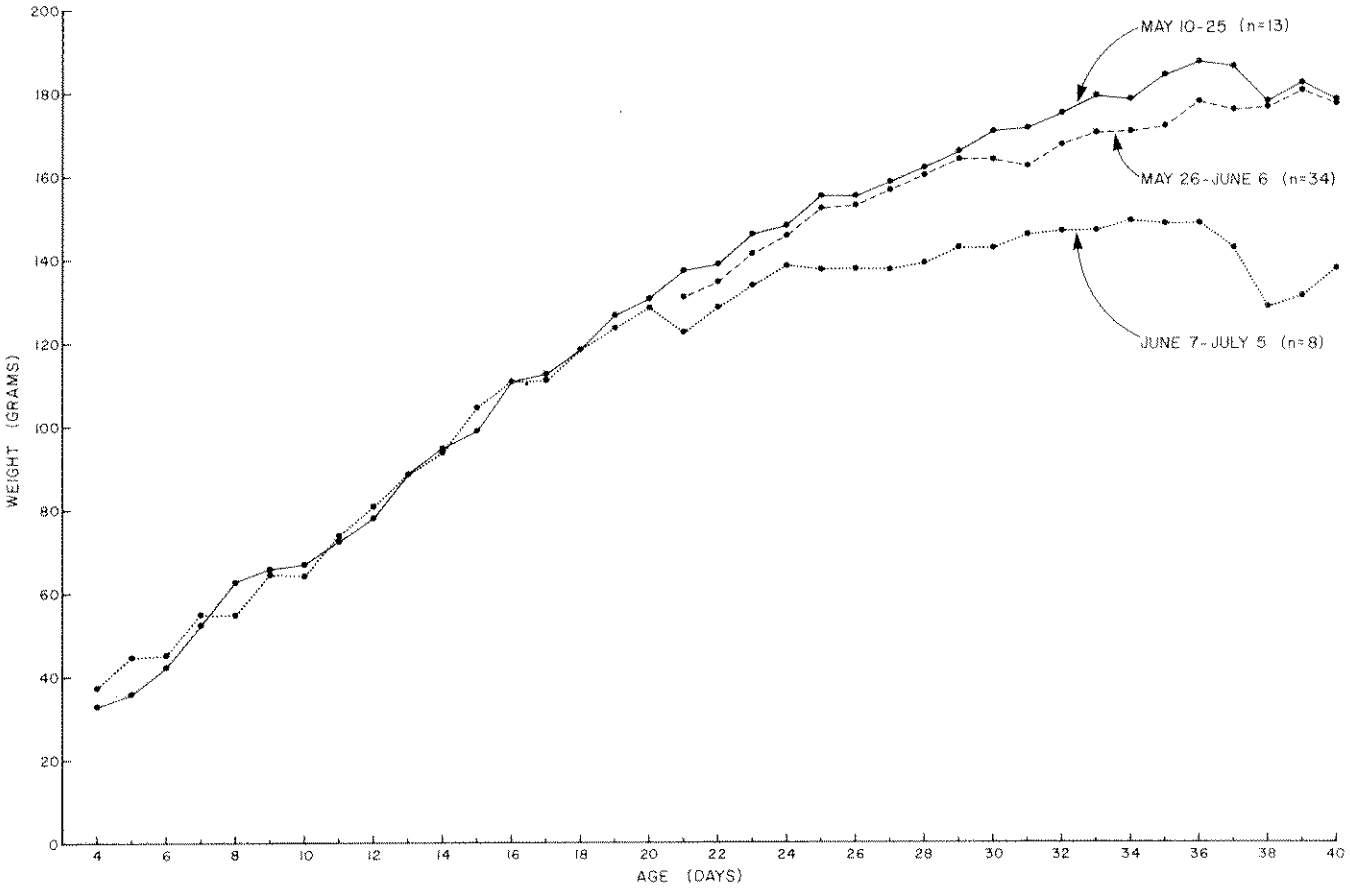

Fig. 3. Comparison of Cassin's Auklet growth, hatched at different periods, Triangle Island, 1978.

Table VI. Reproductive success of Cassin's Auklets, Triangle Island, 1978 and 1979.

% per egg	Hatching success			Fledging success		
	No. eggs in sample	No.	%	No. chicks fledged	% per chick hatched	% per egg laid
Experimental 1978	66	34	52	24	71	36
Control 1978	24	-	-	16	-	67
Control 1979	24	-	-	16	-	67

Table VII. Stage of breeding of Cassin's Auklets on Triangle Island, June 25-26 1977, 1978 and 1979.

Year	Adults incubating eggs		Chicks		Fledged	
	Number	%	Number	%	Number	%
1977	5	3	153	86	20	11
1978	0	0	54	96	2	4
1979	1	2	49	98	0	0

Reproductive success

Chicks which hatched earlier also had a correspondingly higher fledging success. The fledging success of chicks hatched May 10-25 (n = 13), May 26-June 6 (n = 34) and June 7-July 5 (n = 8) in 1978 were 76.9, 67.6 and 37.5% respectively. Overall breeding success in control burrows was 67% in both years (Table VI) which is similar to estimates of 56% and 71% for 1970 and 1971 at South Farallon Island. In the experimental plot during incubation 48% of the burrows were deserted, probably as a result of our investigations. Thoresen (1964) observed a 58.6% egg loss in Cassin's Auklets on South Farallon Island, of which 33.3% was caused by desertion of eggs, which he attributed to his investigations. However, of all chicks that hatched 71% fledged; in Thoresen's study the figure was 64.5%. The overall reproductive success of Cassin's Auklets on Triangle and South Farallon Islands appear similar.

Breeding chronology and appearance of zooplankton

In Cassin's Auklets on Triangle Island, hatching occurred over an eight week period from the beginning of May to the beginning of July and peaked in the latter half of May 1978 (Figure 4). In 1977 the breeding season seemed more prolonged than in 1978, nevertheless the data in Table VII suggests that the peak of hatching activity occurred at approximately the same time. Based on an average incubation period of 38 days (Manuwal, 1974), Cassin's Auklets on Triangle Island, commenced laying by the end of March or the beginning of April, similar to those on South Farallon Island (Manuwal, 1979). However, laying is more prolonged on South Farallon Island as it continued until August in 1971 (Manuwal, 1979) but most late layers do not appear to produce fledglings (Thoresen, 1964; Manuwal, 1979). Nevertheless the productive season is approximately one month

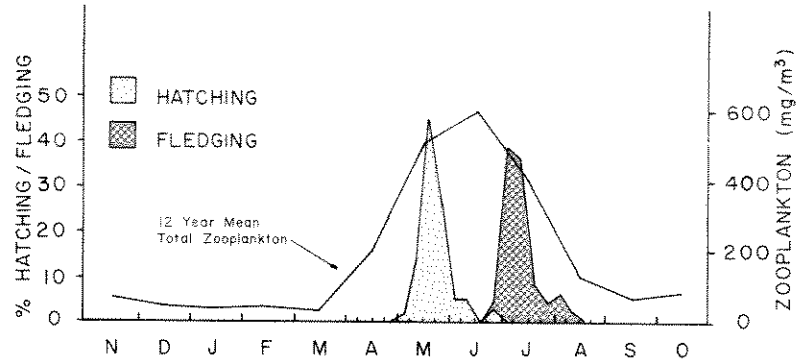

Fig. 4. Comparison of hatching and fledging of Cassin's Auklets, Triangle Island, 1978 with 12 year mean of zooplankton bloom at Station Papa (mean plankton curve drawn by K.Iseki on basis of data by Fulton, 1978).

longer than on Triangle Island where most auklets had fledged by the fourth week of July.

The Cassin's Auklets breeding chronology is compared in Figure 4 with the zooplankton bloom at Station Papa, a weathership station 1200 km off the British Columbia coast in the northeastern Pacific. The zooplankton data at Station Papa are the best annual quantitative data available in the northeastern Pacific. The zooplankton is composed mostly of copepods, amphipods, euphausiids, and chaetognaths. Calanoid copepods generally constitute the main portion of the zooplankton biomass. There are fewer data on the plankton bloom closer to the British Columbia coast but apparently it occurs earlier than at Station Papa (Parsons *et al.* 1966). Egg-laying and incubation of Cassin's Auklets coincide with plankton bloom initiation and chick-rearing coincides with the peak of bloom. In 1978, fish appeared in the Cassin's Auklet diet towards the end of the nestling period, but in 1979 fish were more important during the first half of chick-rearing. Differences in fish appearance as a Cassin's Auklet food may relate to annual variation in the timing of the plankton bloom. The presence of a storage pouch allows Cassin's Auklets to take advantage of plankton farther from the coast as well as permitting a 6 week growing period for the young in burrows. Inasmuch as the plankton bloom declines correspondingly earlier along the coast than farther out at sea (Parsons *et al.* 1966) Cassin's Auklers could compensate for the decline by flying farther out to sea towards the end of the nestling period.

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Appendix.

Morning and evening weights of Cassin's Auklets, Triangle Island, 1978

Age in days	0800 PST No. chicks	0800 PST Mean and S.D.(g)	0800 PST Range (g)	2000 PST No. chicks	2000 PST Mean and S.D.(g)	2000 PST Range (g)
0	8	21.4± 3.2	16- 25	2	21.4± 0.7	21- 22
1	7	25.1± 2.5	21- 27	2	24.5± 6.4	20- 29
2	7	27.6± 4.7	18- 31	2	26.0± 2.8	24 -28
3	11	33.7± 2.3	31- 39	3	27.3± 3.1	24- 30
4	15	34.6± 3.1	30- 41	5	31.6± 4.0	28- 36
5	18	40.2± 5.9	31- 52	11	32.5± 4.4	22- 40
6	13	42.6± 8.4	20- 54	16	37.6± 7.4	16- 49
7	20	50.9± 6.7	39- 67	17	42.2± 5.5	31- 53
8	28	56.9± 8.5	36- 71	17	46.2± 7.8	30- 61
9	31	62.5±10.2	41- 85	29	52.4± 7.5	36- 62
10	32	67.1±10.6	42- 85	34	57.6± 9.4	35- 73
11	34	74.7±10.7	57-103	42	63.0± 8.7	42- 84
12	40	82.4±14.0	52-119	42	69.0±10.2	45- 98
13	41	88.7±13.7	56-116	43	75.8±10.5	49- 96
14	41	96.0±13.8	58-133	46	88.8±11.1	48-108
15	41	97.9±15.7	61-136	44	85.5±12.2	52-115
16	42	106.6±15.3	67-151	46	91.4±12.7	56-127
17	42	109.4±15.4	70-150	47	95.9±13.9	54-128
18	41	115.7±16.6	72-159	48	99.4±15.3	59-136
19	44	121.4±19.3	70-163	49	105.8±15.1	60-140
20	42	129.4±18.0	90-176	48	111.4±14.8	65-146
21	44	130.9±18.8	79-169	48	115.6±15.9	68-148
22	45	136.4±21.3	76-184	48	119.9±17.0	66-154
23	47	141.6±20.6	81-199	48	123.6±17.1	70-163
24	45	145.6±21.6	93-198	48	127.3±17.5	75-164
25	42	151.3±19.9	75-195	48	132.5±17.5	73-169
26	44	151.6±22.7	85-196	48	135.3±18.5	77-173
27	48	155.3±22.3	88-198	48	138.5±19.0	80-176
28	44	159.2±21.3	90-197	46	140.4±18.9	83-173
29	45	162.8±23.8	94-200	46	143.3±20.0	82-174
30	45	162.1±25.7	82-210	47	146.5±21.4	83-184
31	43	162.0±24.5	84-196	46	147.6±22.1	79-181
32	44	166.4±24.9	88-205	47	150.7±22.4	80-184
33	39	168.6±26.5	78-201	45	152.2±23.6	74-191
34	41	161.0±26.4	77-203	41	154.9±24.0	72-191
35	41	170.6±26.4	68-210	42	158.4±20.8	84-188
36	40	175.9±22.1	96-209	40	159.0±20.5	87-192
37	39	174.2±20.1	101-206	39	159.7±18.8	90-195
38	36	172.3±21.1	106-205	37	158.9±18.7	95-187
39	34	176.2±19.1	108-208	36	161.8±16.3	102-185
40	36	175.0±16.5	115-202	37	162.2±15.3	104-186
41	34	178.3±17.6	118-216	35	164.0±15.5	108-187
42	31	178.1±18.8	112-222	31	163.9±15.6	104-184
43	28	175.4±19.6	104-215	26	162.7±17.3	100-185
44	23	176.3±23.6	92-219	18	163.3±25.4	90-189
45	18	173.3±25.4	90-208	18	161.9±22.9	89-196
46	12	166.4±30.5	89-200	12	158.4±28.4	78-182