DIET AND ASPECTS OF FAIRY PRIONS BREEDING AT SOUTH GEORGIA

By P.A. PRINCE AND P.G. COPESTAKE

ABSTRACT

A subantarctic population of the Fairy Prion (*Pachyptila turtur*) was studied at South Georgia in 1982–83. Full measurements of breeding birds are given, together with details of breeding habitat, the timing of the main breeding cycle events, and chick growth (weight and wing, culmen and tarsus length). Regurgitated food samples showed the diet to be mainly Crustacea (96% by weight), fish and squid comprising the rest. Of crustaceans, Antarctic krill made up 38% of items and 80% by weight. Copepods (four species, mostly *Rhincalanus gigas*) made up 39% of items but only 4% by weight; amphipods (three species, principally *Themisto gaudichaudii* made up 22% of items and 16% by weight. Diet and frequency of chick feeding are compared with those of Antarctic Prions and Blue Petrels at the same site; Fairy Prions are essentially intermediate.

INTRODUCTION

The Fairy Prion (*Pachyptila turtur*) is one of six members of a genus confined to the temperate and subantarctic regions of the Southern Hemisphere. With the Fulmar Prion (*P. crassirostris*), it forms the subgenus *Pseudoprion*. Its main area of breeding distribution is between the Antarctic Polar Front and the Subtropical Convergence. It is widespread in the New Zealand region, from the north of the North Island south to the Antipodes Islands and Macquarie Island, where only about 40 pairs survive (Brothers 1984). Although widespread in the Indian Ocean at the Prince Edward, Crozet and Kerguelen Islands, in the South Atlantic Ocean it is known to breed only on Beauchene Island (Falkland Islands) (Strange 1968, Smith & Prince 1985) and South Georgia (Prince & Croxall 1983).

The species has been studied in some detail in New Zealand (Richdale 1964, Harper 1976) but data from elsewhere are largely anecdotal. The breeding biology and ecology of the Fairy Prion are thus unknown throughout the extensive subantarctic part of its range. This paper presents the results of a small but detailed study of Fairy Prion diet at Bird Island, South Georgia (54°00'S 38°02'W), in 1982–83, together with other information on the species' biology.

METHODS

The study site was at Prince Cove (see Hunter *et al.* 1982 for a map of Bird Island and a description of its habitats and topography). Eleven occupied nests had been found by mid-December. We visited these nests every three days until the first chick hatched, after which we visited nests daily, whenever possible in the early afternoon. Wing, culmen and tarsus length of chicks were measured daily, and chicks were weighed daily with a 300 g Pesola balance until they fledged (left the nest cavities). We took food samples by catching, in a plastic funnel with a polythene bag attached, regurgitations from birds trapped in mist nets. Samples were analysed by the procedure described in Prince (1980). Measurements were taken as described in Cox (1980).

RESULTS

This species was first recorded at South Georgia in 1977, when four birds were capture aboard the RV *Hero* while at Elsehul (5 km due east of Bird Island) (Jehl *et al.* 1978). At the same time, PAP saw unidentified prions beneath the north cliffs of Bird Island, flying and behaving differently from Antarctic Prions (*P. desolata*). In 1981, Prince & Croxall (1983) confirmed their breeding in Prince Cove. Since then several other sites have been discovered on Bird Island beneath the north-facing cliffs. Most are inaccessible from land and can be approached only by small boat. The nearby Willis Islands have many colonies, wherever the habitat (see below) is suitable. The distribution of the species on mainland South Georgia remains uncertain. Several areas of appropriate habitat are at the south-east corner of the island (Diaz Cove to Larsen Harbour), but in December 1987 only *P. desolata* was there. Snow and ice were very severe that summer, and so early-breeding species may have already abandoned breeding attempts because the nest sites were inaccessible.

The colonies are typically at the foot of steep cliffs where rock and boulder debris has accumulated. The birds nest in cavities between large boulders. Other sites viewed from boats close inshore include narrow caves 5–10 metres above sea level below steep cliffs. Birds started returning to their sites on Bird Island as early as 12 August. Unlike Antarctic Prions, Fairy Prions visit the breeding sites at all times of the day and can be seen alighting on rocks, where they sometimes remain for several minutes before disappearing into a rock crevice. Peak activity at Prince Cove was in late October when up to 20 birds were seen flying around and investigating crevices during the day.

We do not know the precise timing of laying but can estimate this from the few known hatching dates. In New Zealand, *P. turtur* has an incubation period of 55 days (Richdale 1965). If this is also true of Bird Island, then, from the timing of hatching (mean 29 Dec, SD 2.8; range 24 Dec–1 Jan; n = 7), eggs would have been laid in early November. This is consistent with the peak of adult activity we observed in the colony towards the end of October. Two eggs measured 46.7 × 33.2 mm and 46.5 × 33.5 mm.

The mean fledging period was 49.5 days (SD 1.3, range 48–51 d, n = 4), and the mean fledging date was 15 February (SD 3.9, range 11–19 February, n = 4). Chick growth data are summarised in Fig. 1–4. Mean chick weight at hatching was 21.0 g (SD 2.0; range 18.5–24.0). Mean maximum chick weight was 200.0 g (SD 14.7; range 189.0–214.0), which is 137% of average adult body weight, at an average age of 37 days, decreasing to 94% of adult weight at fledging.

As Fullagar (1972) stated, the identification of prions depends critically on the shape, form and size of the bill. Therefore we have followed Cox (1980) in providing a wide range of bill measurements (Table 1). In his study, Cox

TABLE 1 — Measurements of adult Fairy Prions (*Pachyptila turtur*) at Bird Island, South Georgia

	A	B	C	D	E	F	G	H	I	J
	11.5	4.9	8.9	7.1	7.8	21.2	3.0	186	32.6	147
	11.5	4.0	10.2	7.1	7.6	20.5	3.5	186	31.4	139
	10.2	4.5	10.6	7.2	8.0	21.9	4.7	184	33.3	175*
	10.2	4.2	10.1	7.4	8.0	23.4	5.1	188	34.4	137
	10.7	4.4	10.4	7.8	8.1	22.9	5.1	187	31.6	156*
	10.4	4.5	10.9	7.3	7.6	20.5	4.0	193	34.0	136
	10.1	4.0	9.6	6.2	7.2	21.7	5.0	184	31.7	126
	10.6	4.2	9.6	7.0	7.4	20.2	4.0	185	33.0	134
	10.4	4.3	10.7	7.2	7.0	23.9	4.2	186	33.4	147*
	11.4	4.2	10.6	8.0	8.5	24.0	4.3	185	32.5	165*
	11.0	4.6	10.0	6.7	7.0	22.3	4.6	183	32.5	140*
	10.5	4.5	9.2	6.6	7.4	20.4	4.9	189	33.4	154*
	10.9	4.2	10.5	7.2	8.1	21.7	4.3	195	33.4	162*
	10.2	4.5	10.1	6.9	7.5	22.4	4.5	187	34.2	158*
	10.4	3.9	9.6	7.4	7.5	23.0	-	187	33.0	155
	9.9	3.9	9.4	6.6	6.8	21.8	3.4	181	32.5	159
	10.3	4.2	10.1	7.2	7.8	21.6	4.1	183	34.2	130
	10.4	4.0	10.4	7.1	7.6	21.4	4.2	184	33.4	129
	10.7	4.6	10.7	8.7	8.5	23.5	5.6	189	34.2	130
	10.8	4.2	10.2	7.3	7.8	23.2	5.0	186	33.5	131
Mean	10.6	4.3	10.1	7.2	7.7	22.1	4.4	186	33.1	145.5
SD	0.5	0.3	0.6	0.5	0.5	1.8	0.7	3	1.7	14.2

Key to Columns

A = Bill width at base (mm)

B = Bill width at max, unguis (mm)

C = Bill depth, base nasal tubes (mm)

D = Bill depth, front of nostrils (mm)

E = Bill depth, at unguis (mm)

F = Bill length (exposed culmen) (mm)

G = Distance nail to nostril (mm)

H = Wing length (mm)

I = Tarsus (mm)

J = Weight (g) (* = full proventriculus)

(1980) calculated index values reflecting the stoutness of the bill. We believe that this method provides a constructive approach to examining variation between and within species. At present most morphometric data on prions refer to museum specimens where bills have certainly shrunk (Kinsky & Harper 1968). In addition, many specimens have been collected at sea or found dead during beach surveys and therefore are of unknown origin. We believe that further resolution of prion taxonomy requires measurements

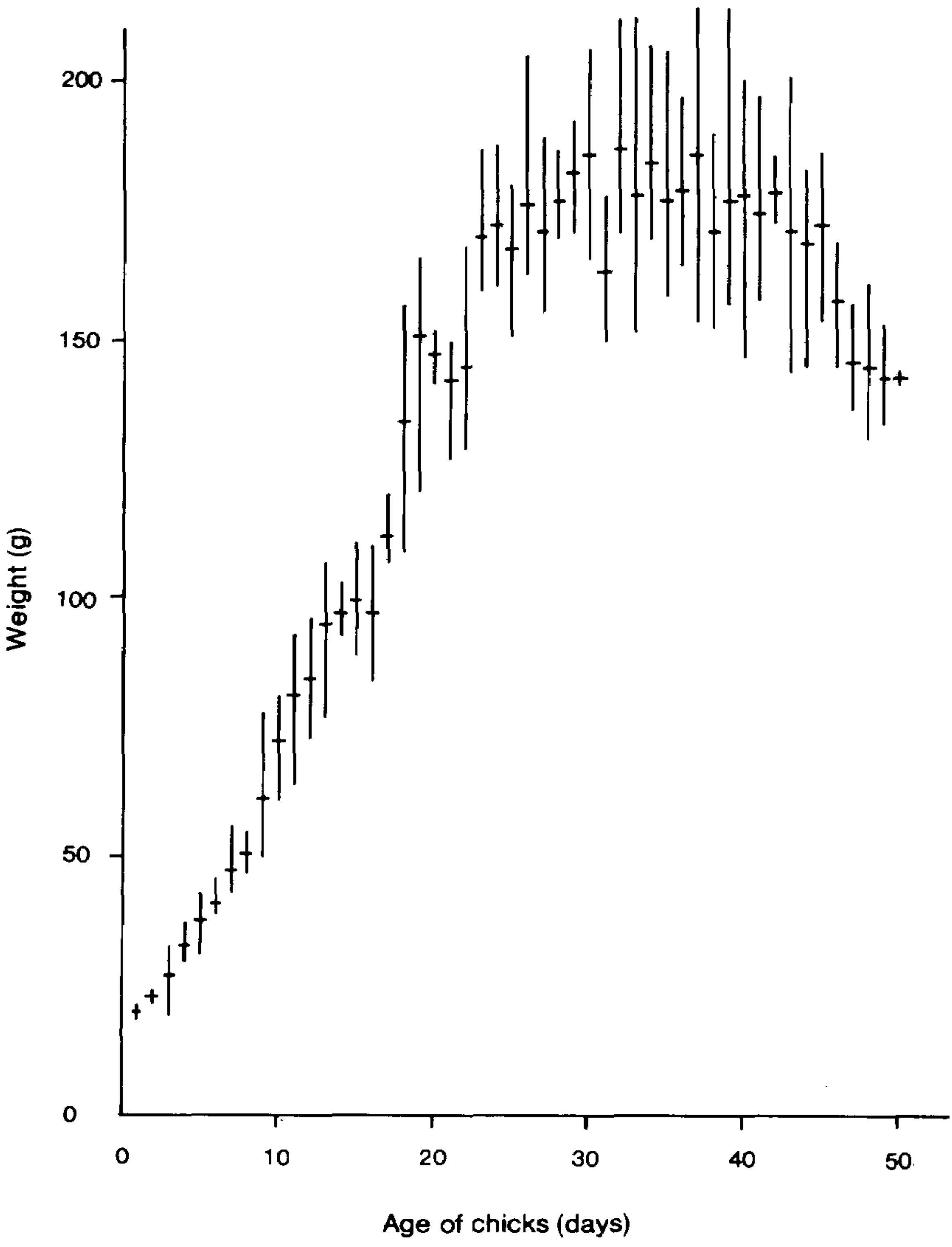

FIGURE 1 — Change in weight with age in *P. turtur* chicks at Bird Island, South Georgia. Values shown are mean ± 1 SD (n = 4)

of living birds at their breeding localities. At South Georgia, *P. desolata* is the only other breeding prion, although the Thin-billed Prion (*P. belcheri*) is occasional (Prince & Croxall 1983). In the hand both are easily distinguished from Fairy Prion by their longer culmen. For measurements and information on the field identification of prions, see Harper (1980).

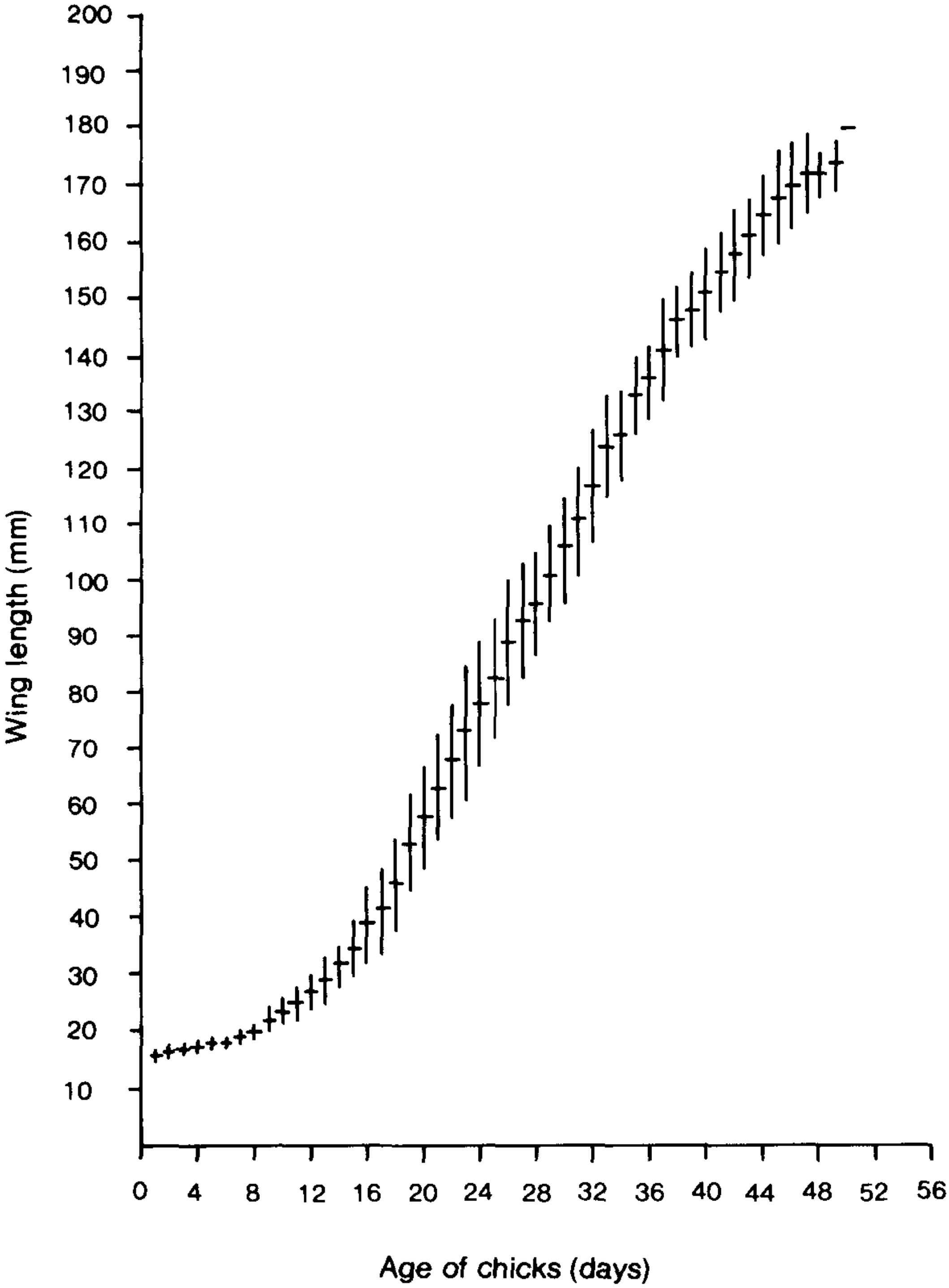

FIGURE 2 — Change in wing length with age in *P. turtur* chicks at Bird Island, South Georgia. Values shown are mean ± 1 SD (n = 4)

Table 2 gives the proportions by weight of the three main elements of the food samples: liquid, unidentifiable material and identifiable material. Solid material comprised 67% of the total, of which 75% could be identified. Table 3 summarises the identifiable components of the diet. Fish were too digested to be identified. One sample contained fragments of squid eye lenses but beaks were not found. Crustaceans were the major food of chicks, whether measured by frequency of occurrence, numbers, or weight. Crustaceans in the samples were well preserved and Table 4 shows their composition in detail. By frequency of occurrence (95%) and especially by weight (80%),

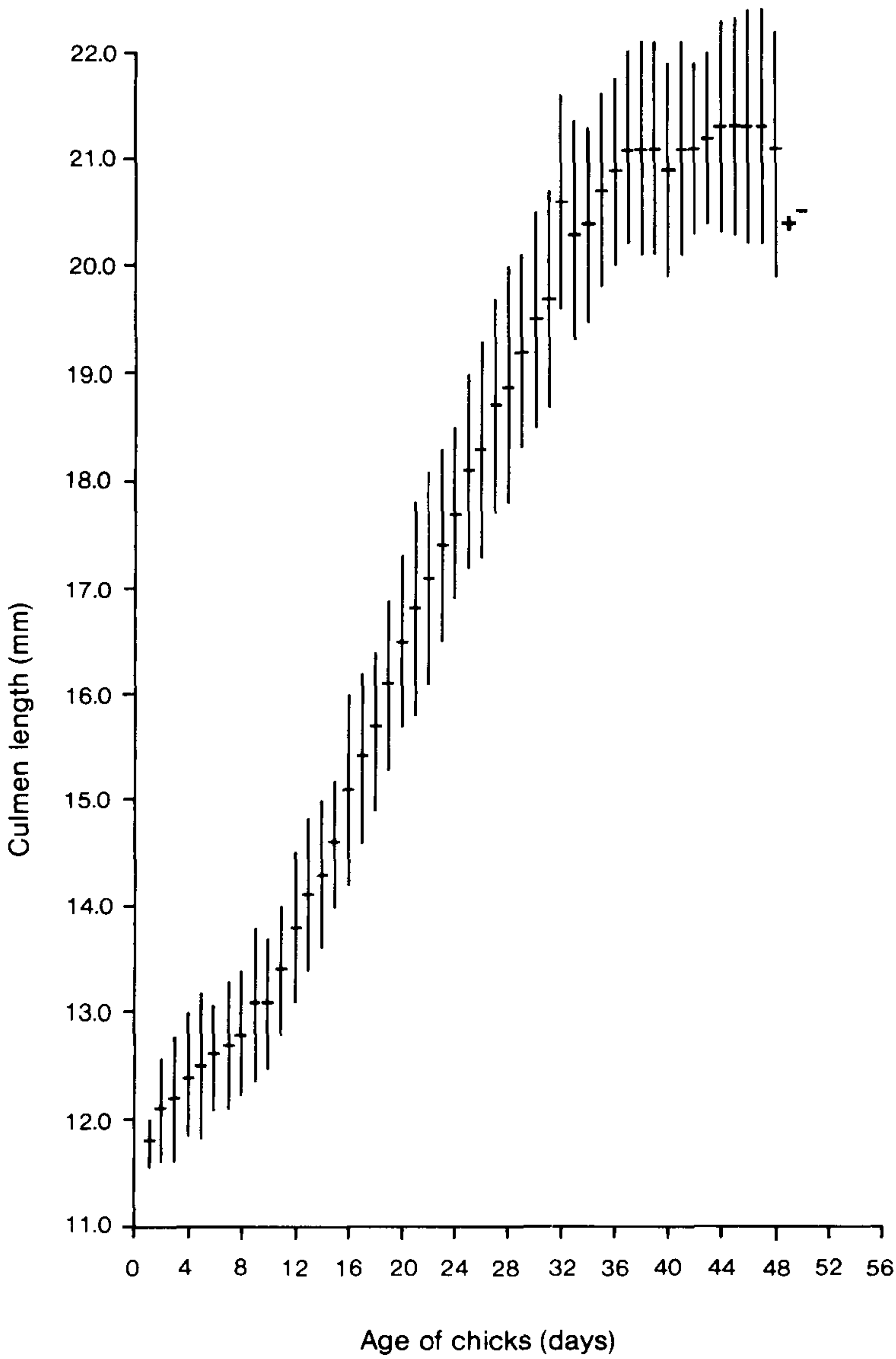

FIGURE 3 — Change in culmen length with age in *P. turtur* chicks at Bird Island, South Georgia. Values shown are mean ± 1 SD (n = 4)

Antarctic krill (*Euphausia superba*) dominated the samples. Copepods (39%) and amphipods (22%) were both important numerically, but only the amphipod *Themisto gaudichaudii* was a significant component (16%) by weight.

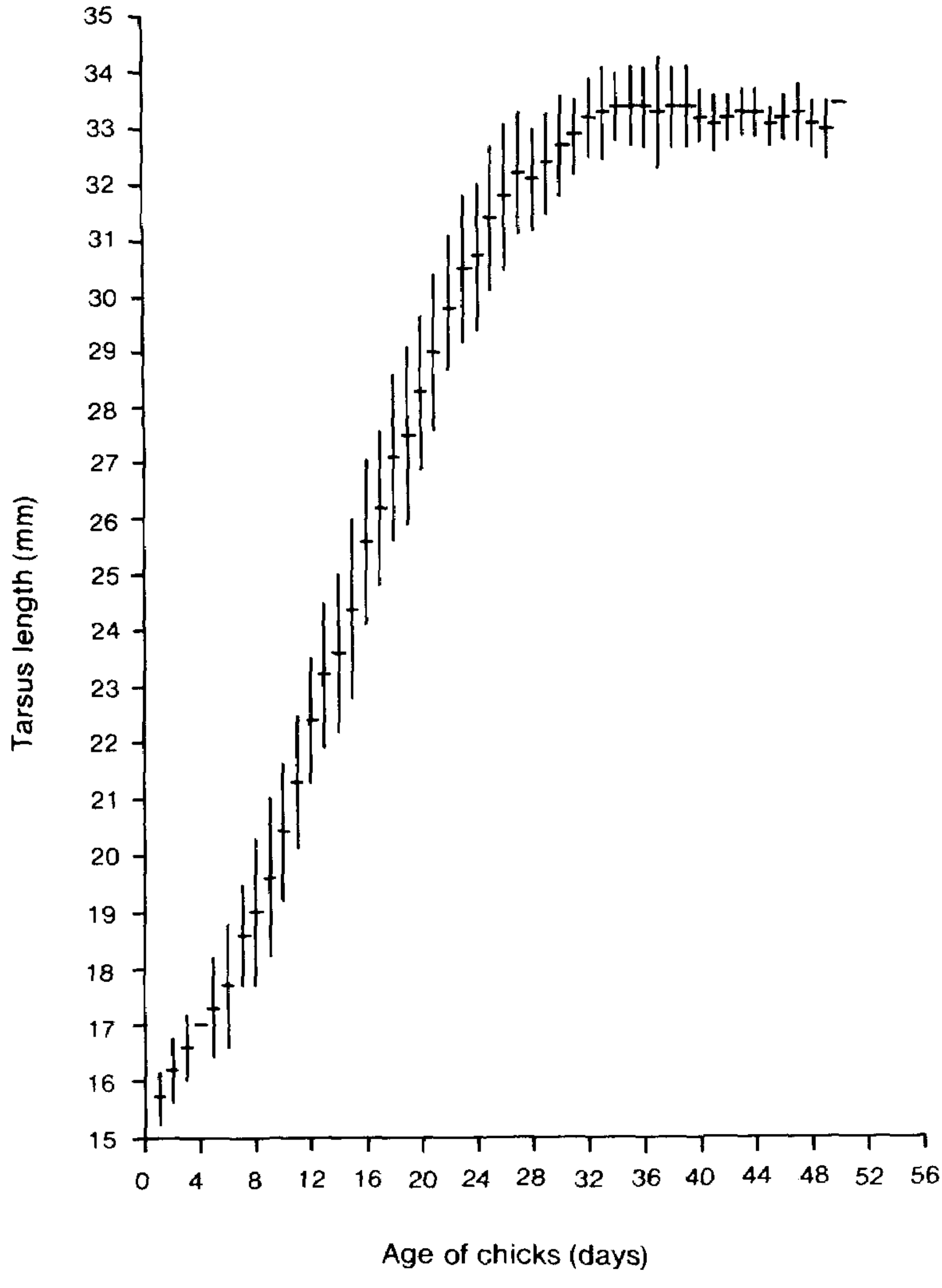

FIGURE 4 — Change in tarsus length with age in *P. turtur* chicks at Bird Island, South Georgia. Values shown are mean ± 1 SD (n = 4)

DISCUSSION

The only other dietary data come from northern New Zealand, where the Fairy Prion feeds almost exclusively on *Nyctiphanes australis* (Harper 1976). This euphausiid is abundant around northern New Zealand and is common also in the diet of other seabirds (Prince & Morgan 1987) but does not occur in subantarctic waters.

Richdale's (1965) data on chick growth at Whero Island suggest that Bird Island chicks receive more food. Whero Island Fairy Prion chicks reached

TABLE 2 — General composition and weight (g) of Fairy Prion food samples

Weight of	Mean	SD	Range	Total Weight	%
Food samples	12.1	5.9	2.37-27.64	485.52	-
Liquid	3.25	2.61	0.21- 9.15	159.47	33
Identified material	5.95	4.28	0.33-15.17	241.44	50
Unidentified material	2.70	1.69	0.19- 5.0	84.61	17

TABLE 3 — Composition by weight, frequency of occurrence and number of individuals of identifiable material of 40 food samples regurgitated by Fairy Prions at Bird Island, South Georgia

Group	Frequency of Occurrence %	Individuals		Weight	
		Number	%	Total	%
Crustaceans	10.0	4627	97.5	231.81	96.0
Fish	12.5	117	2.5	6.36	2.7
Squid	2.5	1	0.1	3.27	1.3
Total		4745		241.44	

an average peak weight of 155 g (range 115–199 g) at 37–40 days of age. By comparison, chicks on Bird Island averaged 181 g (range 154–214 g) at the same age and had reached peak weights averaging 187 g (range 152–221 g) 5–6 days earlier. This suggests that they were receiving more food or that the food was of greater nutritional value. Wing, tarsus and culmen growth are generally similar in the two studies.

In Table 5, we compare the diet of the Fairy Prion at South Georgia with previously published (Prince 1980) data on two other species of similar size and biology (but much greater abundance), the Antarctic Prion and Blue Petrel *Halobaena caerulea*. The chick rearing period of Fairy Prions overlaps the second half of chick rearing in Blue Petrels (which fledge their chicks before Antarctic Prions hatch) and the first half of Antarctic Prions. At South Georgia *E. superba* formed the bulk of the weight of food delivered to Antarctic Prion chicks, although copepods were also important. Blue Petrels took a wider variety of crustaceans but also preyed extensively on fish. Six species of amphipods were represented in the diet of the Antarctic Prion and, as with the Fairy Prion, *Themisto gaudichaudii* was the most abundant.

The bills of Antarctic Prions are longer (28.7 ± 1.1 mm, n = 32) and wider (14.7 ± 0.5 mm) than those of Fairy Prions (length 22.1 ± 1.8 mm, and width 10.6 ± 0.5 mm, n = 21, Table 1). Their palatal lamellae, which help them capture tiny prey such as copepods, are much better developed.

TABLE 4 — Composition of crustacean element of Fairy Prion food samples

	Species	Frequency of Occurrence		Individual Items		Weight	
		No.	%	No.	%	No.	%
Euphausiacea	Euphausia superba	38	95.0	1747	37.75	185.66	80.10
Amphipoda	Themisto gaudichaudii	31	77.5	1010	21.83	36.30	15.66
	Vibilia antarctica	1	2.5	1	0.02	0.04	0.02
	Cyllopus lucasii	4	10.0	4	0.09	0.17	0.07
Copepoda	Rhincalanus gigas	6	15.0	1093	23.62	7.31	3.15
	Calanoides acutus	3	7.5	637	13.77	2.14	0.92
	C. similis)	1	2.5	93	2.01	0.10	0.04
	C. propinquus)	3					
Cirripedia	Lepas sp.	3	7.5	42	0.91	0.09	0.04

At South Georgia, Prince (1980) recorded Antarctic Prions feeding in inshore waters but saw few Blue Petrels. Twice-daily weighings of chicks of both species seemed to show that Blue Petrels spent more time at sea on each foraging trip and had the potential to forage further offshore. Because we have only daily weighings for Fairy Prions, we can make interspecies comparison (Table 6) only on this basis, which greatly underestimates the true feeding frequency because it makes no allowance for small feeds or rapid digestion.

Antarctic Prion chicks are fed on 61% of nights (22% underestimate, based on twice daily weighings; Prince 1980), whereas Blue Petrel chicks are fed on 51% of nights (13% underestimate; Prince 1980). The Fairy Prion, which feeds almost entirely on crustaceans and so has a diet which is more like that of the Antarctic Prion than the Blue Petrel, feeds its chicks on 52% of nights. Fairy Prions may therefore travel further to collect food or spend longer collecting it than Antarctic Prions do and so are more similar in this respect to Blue Petrels. This is also supported by the liquid fraction in the delivered meals. The amount of liquid in the food may be related to the time birds have spent at sea between visits to the chicks, and partly to the nature of the diet. Prince (1980) showed that samples from Antarctic Prions and Blue Petrels contained 19.5% and 35.5% liquid by weight, respectively. In the Fairy Prion samples, 33% of the total weight (Table 2) was liquid, similar to the Blue Petrel values.

TABLE 5 — Comparison of crustacean diets delivered to chicks by Blue Petrels, Antarctic Prions and Fairy Prions at Bird Island, South Georgia. Values are proportion (%) by weight

Taxon	Blue Petrel	Antarctic Prion	Fairy Prion
Euphausiacea	85.9	58.7	80.1
Euphausia superba	95.3	99.5	80.1
Thysanoessa macrura	4.7	0.5	-
Mysidacea	3.5	0.8	-
Decapoda	4.3	-	-
Amphipoda	4.9	8.2	15.8
Themisto gaudichaudii	10.2	56.1	99.4
Hyperia macrocephala	2.0	1.2	trace
Hyperoche medusarum	38.8	4.9	trace
Hyperiella antarctica	10.2	20.7	-
Vibilia antarctica	24.5	6.1	-
Cyllopus lucasii	10.2	11.0	-
Copepoda	1.4	32.3	4.1
Cirripedia	-	-	trace

TABLE 6 — Frequency with which *P. turtur* chicks are fed, based on proportion of nights with increases in weight

	Blue Petrel	Antarctic Prion	Fairy Prion
Number of chicks	10	15	6
Number of chick-days	476	772	283
Overnight increases	243	479	148
Nights fed (%)	51.0	62.0	52.3

In conclusion, we suggest that the diet of Fairy Prions at South Georgia is more like that of Antarctic Prions than of Blue Petrels but that their rate of chick feeding is more like that of Blue Petrels. They do not seem to show dietary specialisation and so their having to compete for food and foraging areas with two similar and abundant species might be the reason for their comparative rarity at South Georgia.

ACKNOWLEDGMENTS

We thank J.P. Croxall for assistance in the field and in preparing the manuscript and B.D. Heather and an anonymous referee for further helpful suggestions.

LITERATURE CITED

BROTHERS N.P. 1984. Breeding, distribution and status of burrow-nesting petrels at Macquarie Island. Aust. Wildl. Res. 11:113–131.
COX, J.B. 1980. Some remarks on the breeding distribution and taxonomy of the prions (Procellariidae:*Pachyptila*). Rec.S.Aust.Mus. 18(4):91–121.
FULLAGAR, P.J. 1972. Identification of Prions *Pachyptila* spp. Aust. Bird Bander 10:36–39.
HARPER, P.C. 1976. The breeding biology of the Fairy Prion (*Pachyptila turtur*) at the Poor Knights Islands, New Zealand. NZ J. Zool. 3:351–371.
HARPER. P.C. 1980. The field identification and distribution of the prions (genus *Pachyptila*) with particular reference to the identification of storm-cast material. Notornis 27: 235–286.
HUNTER, I.; CROXALL, J.P.; PRINCE, P.A. 1982. The distribution and abundance of burrowing seabirds (Procellariiformes) at Bird Island, South Georgia: I. Introduction and Methods. Bull. Brit. Antarct. Surv. 56:49–68.
JEHL. J.R. JR.; TODD, F.S.; RUMBOLL, M.A.; SWARTZ, D. 1979. Notes on the avifauna of South Georgia. Le Gerfaut 68: 534–550.
KINSKY, F.C.; HARPER, P.C. 1968. Shrinkage of bill width in skins of some *Pachyptila* species. Ibis 110: 100–102.
PRINCE, P.A. 1980. The food and feeding ecology of Blue Petrel (*Halobaena caerulea*) and Dove Prion (*Pachyptila desolata*). J.Zool., Lond. 190:59–76.
PRINCE, P.A.; CROXALL, J.P. 1983. Birds of South Georgia: New records and re-evaluations of status. Bull. Brit. Antarct. Surv. No 59: 15–27.
RICHDALE, L.E. 1965. Breeding behaviour of the Narrow-billed Prion and the Broad-billed Prion on Whero Island, New Zealand. Trans. Zool. Soc. Lond. 31:87–155.
SMITH R.I.L.; PRINCE, P.A. 1985. The natural history of Beauchene Island. Biol. Linn. Soc. 24:233–283.
STRANGE, I.J., 1968. A breeding colony of *Pachyptila turtur* in the Falkland Islands. Ibis 110:358–359.

P.A. PRINCE and P.G. COPESTAKE, *British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road, Cambridge CB3 OET, United Kingdom*