ASPECTS OF THE BREEDING BIOLOGY OF McCORMICK'S SKUA *CATHARACTA MACCORMICKI* AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS

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ABSTRACT. The recently established (1978) breeding population of McCormick's skua *Catharacta maccormicki* was studied at Signy Island, South Orkney Islands during 1981–82 and 1982–83. In 1982–83 nine pairs of *C. maccormicki* (and 143 pairs of *C. lonnbergi*) bred. McCormick's skua bred two weeks later than the brown skua and, as elsewhere where the two are sympatric, foraged at sea rather than in penguin colonies. The Signy population of *C. maccormicki* is similar to continental populations in nest dispersion, egg size, hatching interval, duration of incubation and rearing periods and chick growth. However, it showed very significantly greater breeding success due to the very high survival of the second chicks of broods, despite some evidence of sibling aggression. From analysis of the food samples, the fish *Pleuragramma antarcticum* was the main prey, and it is presumed that this species, which is not taken by other seabirds or seals at Signy, is sufficiently abundant to permit the skuas to fledge both chicks. As elsewhere in the area of sympatry with *C. lonnbergi*, a small number of mixed pairs occurred. Details of their breeding biology, in particular the growth of chicks, in comparison with *C. maccormicki* and *C. lonnbergi* are reported.

INTRODUCTION

The South Orkney Islands lie within the normal breeding range of the brown skua *Catharacta lonnbergi*, which is circumpolar in the Sub-antarctic and extends south along the islands of the Scotia Arc and the Antarctic Peninsula to about 65° S. McCormick's skua *Catharacta maccormicki* breeds mainly on the Antarctic continent but extends northwards on the Antarctic Peninsula to some of the South Shetland Islands at 62° S. The two species hybridize within the area of sympatry (Parmelee and others, 1977; Trivelpiece and Volkman, 1982).

Further north, *C. maccormicki* has been reported only as a non-breeding migrant or vagrant, e.g. at the Elephant and Clarence islands group (Furse, 1979) and at the South Orkney Islands (Valette, 1906; Clarke and others, 1913). Until 1977 there was only one record for Signy Island (Jones and Pinder, 1962) but since then it has been reported regularly, and breeding was first recorded in the austral summer of 1978–79.

This paper reports the establishment of a small breeding population of McCormick's skuas at Signy Island (60° 43′ S, 45° 38′ W) and some details of its breeding biology from a small-scale study in the summers of 1981–82 and 1982–83. It is hoped that these data will complement the more detailed work being carried out on sympatric brown and McCormick's skuas at Palmer Station, Anvers Island (64° 46′ S, 64° 03′ W) (Pietz and Maxson, 1980; Pietz, 1982) and on King George Island, South Shetland Islands (62° 10′ S, 58° 30′ W) (Trivelpiece and Volkman, 1982).

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Methods

The length and breadth of eggs were measured, within 48 hours of laying, to 0.1 mm with vernier calipers. Chicks were weighed (to 1 g on 'Pesola' spring balances) and measured (bill length from tip to base of feathering, bill depth to base of gonys and tarsal length all to 0.1 mm, and wing length (flattened, straightened wing) to 1 mm) at two-day intervals for the first two weeks after hatching and thereafter at approximately four-day intervals until they were able to fly. First and second chicks of a brood were distinguished by marking the tarsus with paint until they were large enough to be colour-ringed.

Twenty-five regurgitated food samples were collected from chicks opportunistically. After examination and identification of the fish component of the samples they were preserved in formalin and returned to UK for identification of the Euphausiids present. The earliest samples were from chicks five days after hatching and the latest from 25-day-old chicks. Chicks older than 25 days did not readily regurgitate.

Population Size and Distribution

During the 1981–82 summer, nine pairs of McCormick's skuas formed at Signy, of which seven laid eggs. In 1982–83 ten pairs (including one of the non-breeding pairs

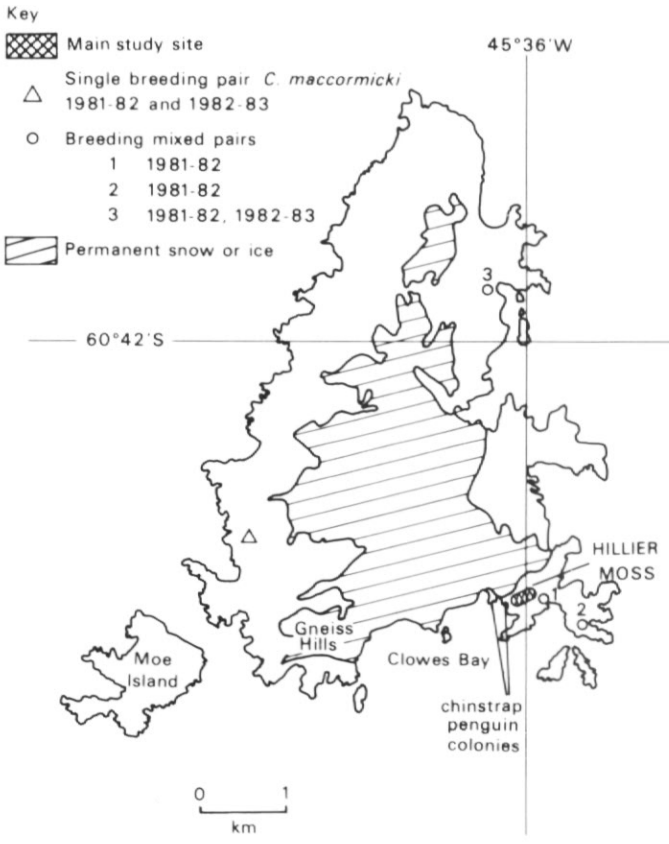

Fig. 1. Breeding sites of *Catharacta maccormicki* and mixed pairs at Signy Island 1981–82 and 1982–83.

of 1981–82) formed, of which nine bred. Additional single birds, totalling about a dozen, were present during both summers.

All but one pair of McCormick's skuas bred at Hillier Moss near the south-west corner of the island (Fig. 1). The remaining pair bred on the western side of the island. Investigation was largely confined to the birds at Hillier Moss where they nested adjacent to the biological research site known as Signy Island Reference Site 2, described by Tilbrook (1973).

In 1982–83, 143 pairs of brown skuas bred on Signy, distributed widely over the ice-free parts of the island, albeit with some concentration near penguin colonies. Three mixed pairs (in which a brown skua was paired with a McCormick's skua) formed and bred in 1981–82. Only one mixed pair re-formed and bred in 1982–83. From observations of courtship and feeding and presence at the nest immediately before or after egg laying, it appears that in all these mixed pairs the female was *C. lonnbergi* and the male *C. maccormicki*. This was also reported to be the case at Anvers Island (Pietz and Maxson, 1980; Neilson, 1983) and at King George Island (Trivelpiece and Volkman, 1982).

Breeding Biology

Breeding timetable

The recorded dates for the return of the first adult after the winter, first egg laid, first egg hatched and first chick flying in the seasons 1981–82 and 1982–83 are shown in Table I for both *C. lonnbergi* and *C. maccormicki*. It appears that McCormick's skua breeds about two weeks later than the brown skua. Adult return was 26 days later, first egg 12 days later and first hatching 12–13 days later. For *C. maccormicki* there was no significant difference in the timing of laying and hatching between the two seasons, and the spread was similar in both years (Table II). Similar data are not

Table I. Comparison of breeding timetable of *C. maccormicki* and *C. lonnbergi* in 1981–82 (1) and 1982–83 (2).

		C. maccormicki	*C. lonnbergi*
First adults returned	(1)	—	15 Oct. 81
	(2)	31 Oct. 82	5 Oct. 82
First eggs found	(1)	10 Dec. 81	28 Nov. 81
	(2)	by 20 Dec. 82	27 Nov. 82
First chick found	(1)	7 Jan. 82	26 Dec. 81
	(2)	2 Jan. 83	20 Dec. 82
First chick flying	(1)	by 7 Mar. 82	14 Feb. 82

Table II. Hatching and laying dates for *C. maccormicki* at Signy Island.

		1981–82	*1982–83*	*Both seasons*
First egg laid*	No.	6	7	13
	Mean	19 Dec.	20 Dec.	19 Dec.
	SD in days	11	13	12
	Range	10 Dec.–9 Jan.	5 Dec.–13 Jan.	5 Dec.–13 Jan.
First chick hatched	No.	5	7	12
	Mean	19 Jan.	17 Jan.	18 Jan.
	SD in days	12	13	12
	Range	7 Jan.–6 Feb.	2 Jan.–10 Feb.	2 Jan.–10 Feb.

* Laying dates for all but three clutches in 1981–82, whose dates are known, are calculated from known hatching dates using a mean incubation period of 29 days.

Table III. Breeding timetable for mixed pairs.

		Pair number		
		1	*2*	*3*
	Chick	1981–82	1981–82	1982–83
Laying date	A	8 Dec	—	—
	B	12 Dec.	—	—
Hatching date	A	7 Jan.	8 Jan.	5 Jan.
	B	9 Jan.	9 Jan.	8 Jan.
Flying	A	by 7 Mar.	23 Feb.	—
	B	by 7 Mar.	—	—

available for *C. lonnbergi*, but most breeding pairs have eggs by the end of the first week in December.

At both Anvers Island and King George Island brown skuas breed before McCormick's. The mean date for the start of egg laying for *C. lonnbergi* at both sites is 2 December; for *C. maccormicki* it is 10 December at Anvers Island (Neilson, 1983) and 21 December at King George Island (Trivelpiece and Volkman, 1982). Hybrid pairs had a similar schedule to *C. maccormicki* at both these sites, and at Signy Island (Table III).

Nest spacing

The mean distance between the nests of the eight pairs of *C. maccormicki* at Hillier Moss in 1981–82 was 25 m (range 12–42 m), much closer than normally reported for brown skuas. Burton (1968) reported that brown skua nests at Signy were at least 50 m apart and some over 300 m from the nearest neighbour. With the increase in the brown skua population since then, some nests, especially in areas near penguin colonies, are now less than 50 m apart (Hemmings, unpublished data).

Close nesting is typical of *C. maccormicki*. At Pointe Géologie, Terre Adélie, 40% of nests were under 20 m apart and 89% under 50 m (Le Morvan and others, 1967); at Cape Royds most were 27–45 m and some only 18 m apart whilst even closer spacing was recorded at Cape Hallett, where 11 m or less separated over half the pairs and few were further apart than 24 m (Young, 1963*a*). At Anvers Island nests are often only 15–20 m apart (Parmelee and others, 1977).

Eggs

Egg dimensions are summarized in Table IV. The eggs of *C. maccormicki* are approximately 15% smaller by volume than those of *C. lonnbergi*. *C. maccormicki* eggs from Signy Island are not statistically different in size from those at other localities (Table V).

Two-dimensional discriminant analysis of *C. maccormicki* and *C. lonnbergi* egg lengths and breadths generated a line having the equation

$$ax+by-k=0,$$

and a discriminant value of 15.78, such that 84% of *C. maccormicki* eggs fall below the discriminant and 83% of *C. lonnbergi* eggs lie above it (Fig. 2). The eggs of mixed pairs are also plotted in Fig. 2; they fall within the area of overlap between the two species, although they all lie above the discriminant, that is on the *C. lonnbergi* side

Table IV. Measurements of skua eggs at Signy Island.

		Length (mm)			*Breadth (mm)*			*Internal volume* (cm^3)*		
	No.	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*	*Mean*	*SD*	*Range*
C. maccormicki	27	71.3	2.4	66.7–76.4	49.6	1.3	47.1–52.1	84.2	6.1	72.4–95.3
C. lonnbergi	39	73.8	2.4	69.1–80.1	52.3	1.4	48.8–54.6	97.0	6.6	79.0–114.6
Hybrids	6	73.8	3.8	70.9–79.6	51.8	0.4	51.2–52.2	95.2	5.9	88.5–104.1

* Internal egg volumes calculated using the equation $V = 0.00048\ L\ B^2$ (Coulson and others, 1969; used in Furness, 1983).

Table V. Measurements of McCormick's skua eggs.

			Length (mm)		*Breadth (mm)*		
Locality	*Reference*	*No.*	*Mean*	*Range*	*Mean*	*Range*	*Volume (cm^3)*
Signy	This study	27	71.3	66.7–76.4	49.6	47.1–52.1	84.2
Pointe Géologie	Le Morvan and others, 1967	13	71.0	65.0–74.0	50.7	48.2–52.1	87.6
Cape Denison	Falla, 1937	12	70.6	55.0–78.0	51.5	49.6–54.7	89.9
Antarctic Peninsula*	Gain, 1913	10	71.9	65.5–75.0	49.0	41.0–52.0	82.5
McMurdo Sound	Wilson, 1907	11	70.9	66.0–76.5	49.7	49.0–51.0	84.1

* At Wiencke, Goudier and Petermann islands.

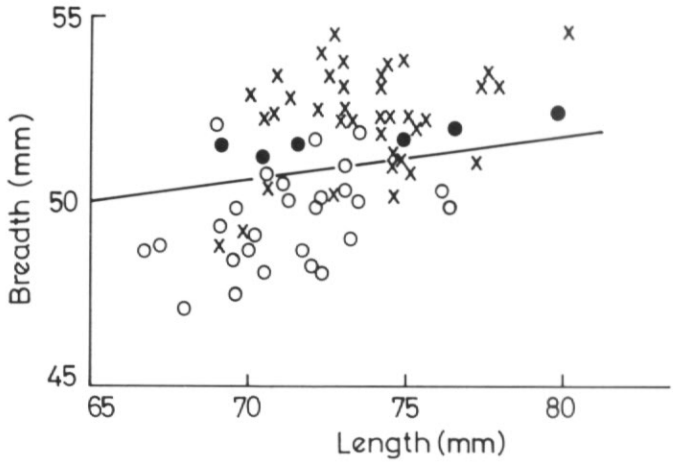

Fig. 2. Relationship between egg length and breadth for *C. maccormicki* (○), *C. lonnbergi* (×) and mixed pairs (●) at Signy Island. Line plotted gives best discrimination between eggs of *C. maccormicki* and *C. lonnbergi*.

of the line. This might be expected if the females in mixed pairs are brown skuas, as suggested earlier.

There were no significant differences in egg length, breadth or volume between first- and second-laid eggs of *C. maccormicki*.

Incubation period

For *C. maccormicki*, with only four eggs in two clutches where both laying and hatching dates are known accurately, the incubation periods were 29 and 28 days in one pair, 30 and 27 days in the other, with the longer incubation periods in both cases being for the first egg. This is typical of the species elsewhere. At Cape Royds, Young (1963*a*) reported 90% of eggs hatching after 28 or 29 days, at the Windmill Islands 93% hatched after 29 or 30 days (Eklund, 1961). Slightly greater variation in the incubation period was reported from Cape Hallett (26–33 days) but the mean was 29.5 days (Reid, 1966).

With the mixed pairs data are available only for pair 1, with first and second eggs incubated for 30 and 28 days respectively. For 16 brown skua pairs at Signy, Burton (1968) reported a mean incubation period of 30.5 days, range 29–31 days.

Hatching inverval

The hatching interval with mixed pair 1 was four days. For 14 *C. maccormicki* clutches the mean interval was 2.1 days (SD = 1.4, range < 1–4 days). At Cape Royds, Young (1963*a*) reported a mean of 2.3 days ($N = 16$, SD = 0.7, range 1–3.5 days). For brown skuas at Signy, Burton (1968) reported an interval of two days, at Marion Island, Williams (1980*a*) recorded a hatching interval of 2.1 days ($N = 10$, SD = 0.7, range 1.3 days) for *C. lonnbergi*.

Sibling aggression

Sibling aggression was observed with *C. maccormicki* only once. It was not observed with hybrid chicks or those of *C. lonnbergi*, nor did Burton (1968) observe it in his

study of the brown skua. A three-day-old McCormick's skua chick was seen to attack its two-day-old sibling in the manner described by Young (1963*a*), chasing and pecking until it had driven the younger chick some 3 m from the nest. The older chick at this time weighed 103 g, compared with 68 g for the younger chick, and was larger in all body measurements. Subsequently the second chick could not be found for eight days, but both chicks fledged.

Chick growth

McCormick's skua chick growth is presented in Fig. 3. Wing length increases at the same rate for the first and second chicks in a clutch but, for any given age until

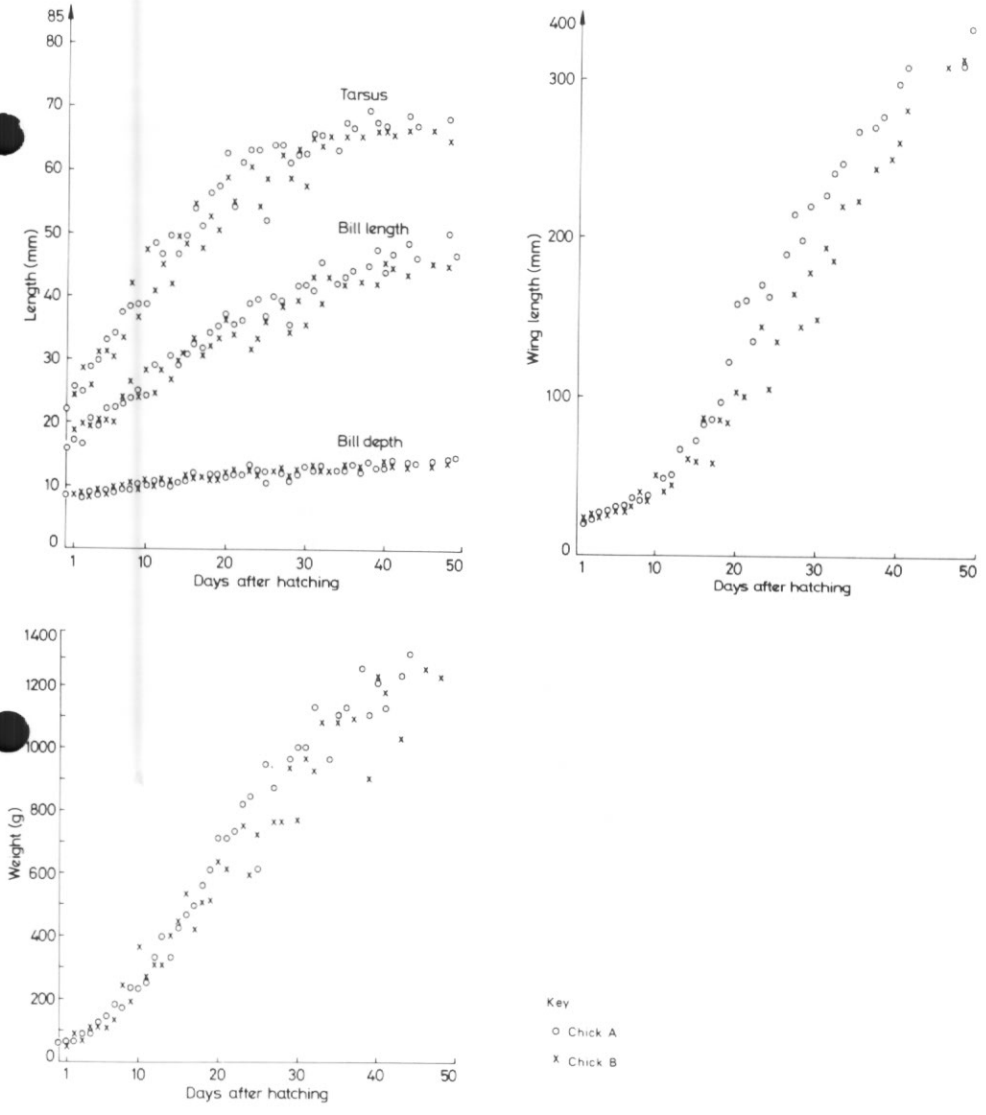

Fig. 3. Growth of *C. maccormicki* chicks at Signy Island ($N = 21$).

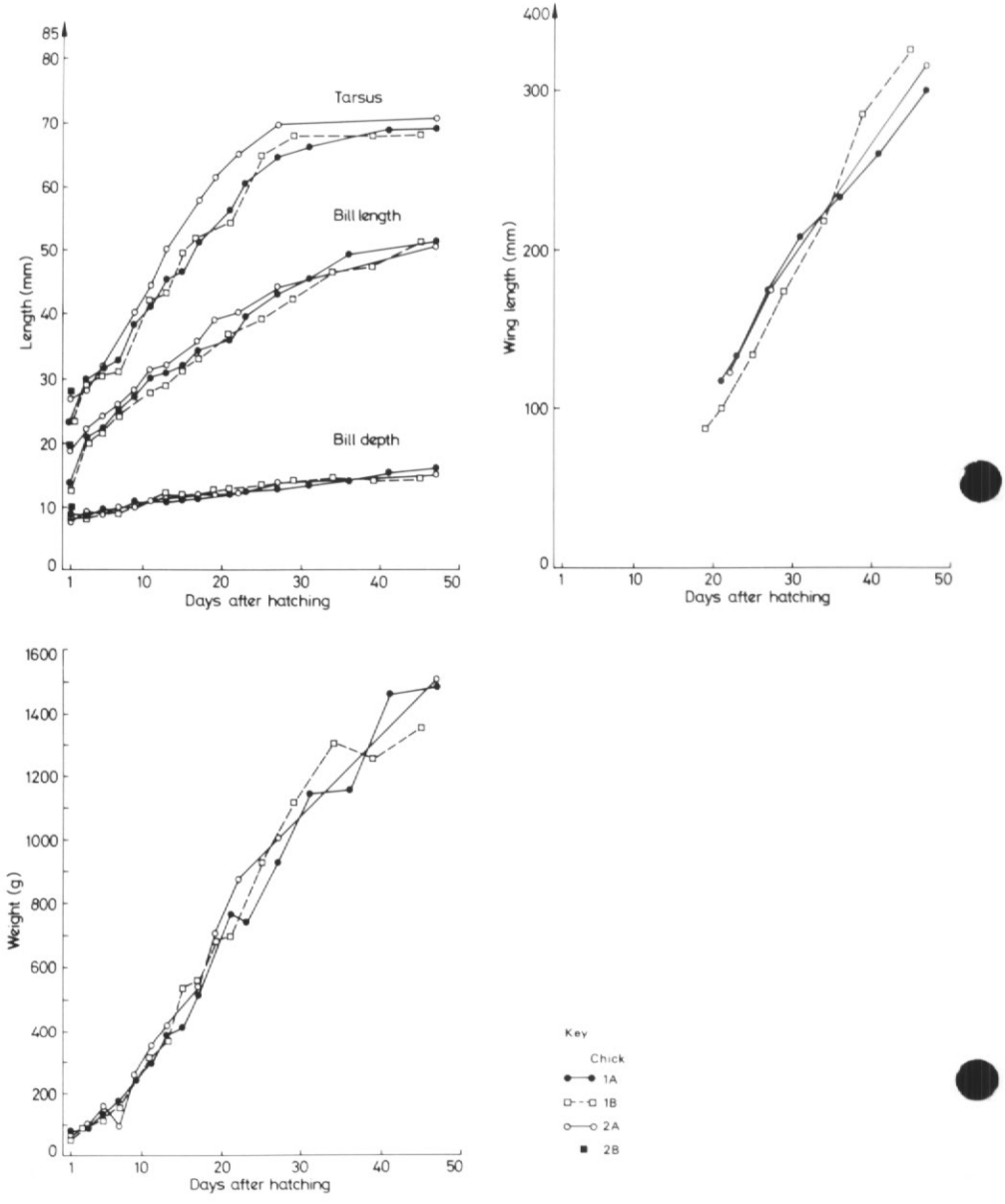

Fig. 4. Growth of F1 hybrid chicks at Signy Island.

fledging, the first chick has longer wings. First and second chicks show a slight difference in body weight from about 17 days until fledging, the first chick being heavier; otherwise there appear to be no significant differences between them with regard to bill length, bill depth and tarsus length.

Data for the three hybrid chicks measured are shown in Fig. 4. Only bill length is consistently greater in the first chick than in the second. The second chick is heavier than the first through most of its development. The single chick shows a longer tarsus

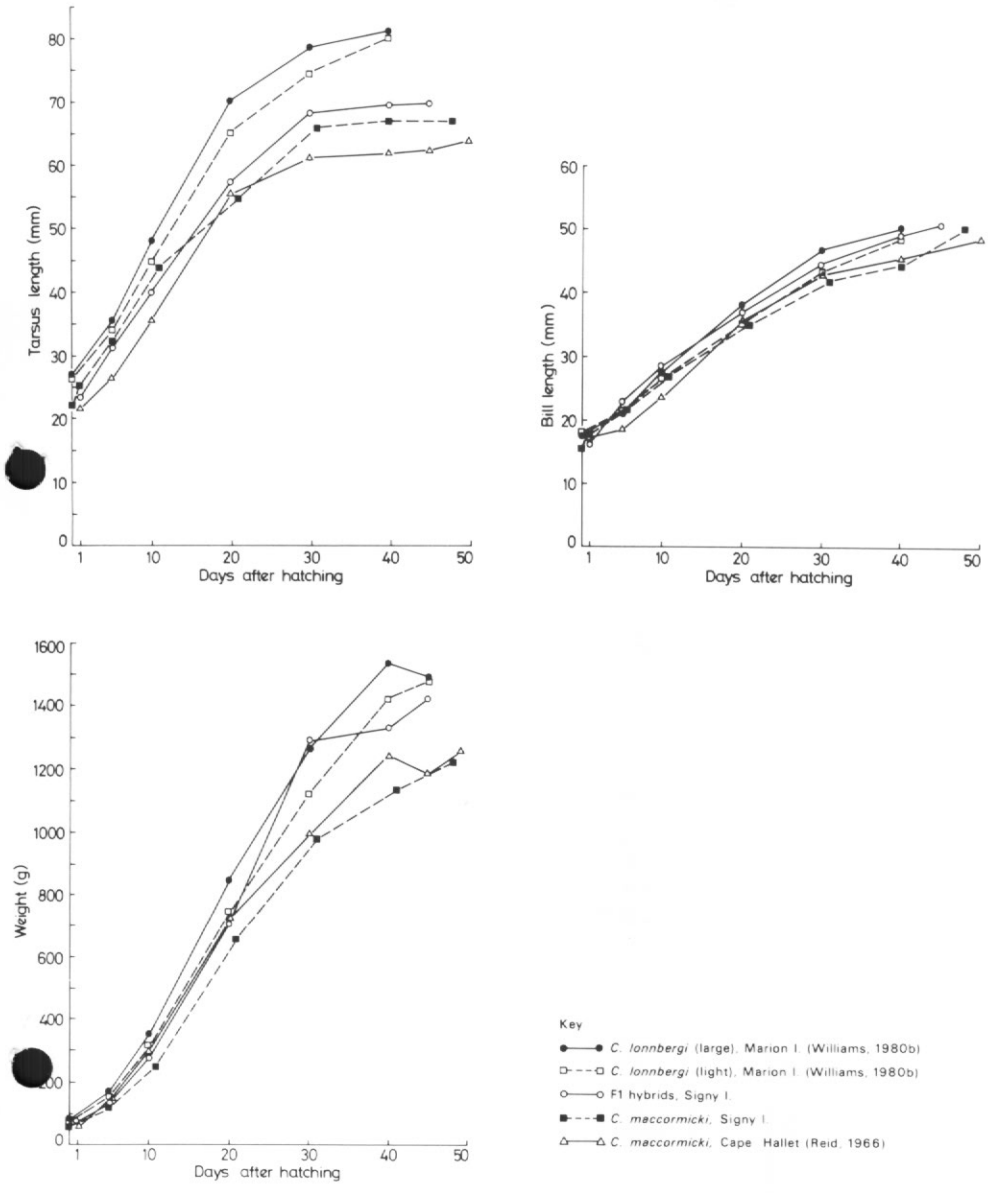

Fig. 5. Comparison of *C. maccormicki*, *C. lonnbergi* and hybrid chick growth.

for a given age than the other chicks, otherwise all three have similar growth rates for all measured parameters.

Average values for McCormick's and hybrid skua chicks at Signy are compared with published data for brown and McCormick's skua chicks elsewhere in Fig. 5. Unfortunately no data are available for *C. lonnbergi* chicks at Signy. For the three parameters shown in Fig. 5, the hybrid chicks generally fall between *C. lonnbergi* and *C. maccormicki*, the former being substantially larger throughout development.

Table VI. Breeding success of skuas at various localities.

Locality	Reference	No. pairs	Year	Hatching success (%)		Fledging success (%)		Overall breeding success (%)	
				per year	per locality	per year	per locality	per year	per locality
C. maccormicki									
Signy I.	This study	6	1981–82	63	76	100	90	73	71
		9	1982–83	89	—	85	—	69	—
Anvers I.	Neilson, 1983	65	1974–75	88	64	88	53	77	46
		28	1975–76	87	—	89	—	78	—
		44	1976–77	82	—	34	—	28	—
		44	1977–78	0	—	0	—	0	—
Cape Royds	Young, 1963	67	1959–60	80	71	29	41	23	30
	Spellerberg, 1971	62	1963–64	74	—	54	—	40	—
		57	1964–65	58	—	52	—	42	—
		57	1965–66	71	—	28	—	16	—
Cape Hallett	Reid in Young, 1963	—	—	—	50	—	72	—	21
Windmill I.	Eklund, 1961	40	1957–58	61	61	77*	77*	47*	47*
Pointe Géologie	Jouventin and	29	1965–66	69	60	—	—	63	54
	Guillotin, 1979	40	1976–77	51	—	—	—	45	—
C. lonnbergi									
Signy I.	This study	15	1981–82	79	69	—	—	—	—
	Burton, 1968	23	1963–64	72	—	96	90	70	59
		32	1964–65	69	—	91	—	62	—
		26	1965–66	57	—	81	—	46	—
Mixed pairs									
Signy I.	This study	4	1981–83	—	100	87	87	87	87
Anvers I.	Neilson, 1983	3	1974–75	83	83	100	83	83	72
		5	1975–76	100	—	100	—	100	—
		3	1976–77	67	—	50	—	33	—

* At end of study, approximately one month post hatching.

Breeding success

Hatching, fledging and overall breeding success are shown in Table VI with data from other studies. The mean breeding success of *C. maccormicki* at Signy is the highest yet recorded. Hatching success is slightly better at Signy than elsewhere but it is in fledging success that the difference between localities is most striking. Of 21 chicks hatched in 12 clutches, 19 fledged. All the chicks that hatched in 1981–82 fledged and in 1982–83 the two post-hatching fatalities occurred in the same brood when both chicks were killed by non-breeding *C. lonnbergi* from a club adjacent to the *C. maccormicki* territory.

In general chick survival appears better at the more northerly sites than at those on the Antarctic continent, the failure at Anvers Island in 1977–78 being due to adverse sea ice conditions (Parmelee and others, 1978).

The breeding success of mixed pairs at Signy (and at Anvers Island) is high and as good as that of typical pairs of either species.

Diet and feeding habits

Burton (1968) found that penguin eggs and chicks were the main food source for brown skuas at Signy, although small petrels were also taken. Marine organisms, including fish, were seen to be delivered to the chicks, but he did not see how the adults obtained these. During 1981–82 and 1982–83 only avian material was recovered in samples regurgitated by brown skua chicks. The only sample obtained from hybrid chicks consisted solely of penguin muscle.

By contrast, the diet of McCormick's skua at Signy, as revealed by food brought to the chicks, consisted almost entirely of fish throughout the breeding season. The fish was *Pleuragramma antarcticum*, a pelagic nototheniid with a circumpolar distribution. The material normally recovered consisted of small sections of the fish with scales still attached. There is no evidence of any other fish species being caught. Of 25 samples examined in detail, 18 consisted solely of *Pleuragramma*. Small numbers of Antarctic krill *Euphausia superba* occurring with the fish in a further three samples were probably fish prey items rather than independently obtained by the skuas, since intact *Pleuragramma* guts contained similar material. Six intact *Pleuragramma* found by the scrape of one pair were each approximately 150 mm long, and therefore adult fish. Parents usually broke up fish of this size into sections 30–50 mm in length before feeding to the chicks.

In particular samples, other material was found in addition to fish: the leg of a Wilson's storm petrel *Oceanites oceanicus*, the foot of a dove prion *Pachyptila desolata* and assorted pieces of vegetation. The petrel remains were old and, like the vegetation, probably debris picked up incidentally as the chicks fed near the nest. Only one sample contained a small quantity of penguin muscle.

Despite having two small chinstrap penguin *Pygoscelis antarctica* colonies within 300 m (Fig. 1), McCormick's skuas were not seen to take any eggs or chicks, whereas neighbouring brown skuas regularly foraged there.

The duration of adult foraging trips was not investigated, but birds were often away from the territory for an hour or more. On a number of occasions late in chick development, both parents would be off territory for at least an hour before returning with fish. Foraging McCormick's skuas always flew west from the Hillier Moss site, heading south around Gneiss Hills before being lost to sight. They were never seen to fly to the east. Soviet trawlers were catching very large quantities of krill 6–8 km west of Signy Island in February 1983, and as *Pleuragramma* feeds mainly on krill

(DeWitt and Hopkins, 1977; Permitin and Tarverdiyeva, 1978) it may have been associated with krill swarms (Chlapowski and Krzeptowski, 1978) in surface waters and thus accessible to foraging skuas.

Despite the proximity of a large colony (770 pairs) of blue-eyed shags *Phalacrocorax atriceps* 1 km west of Hillier Moss, no kleptoparasitism was observed, in contrast to the report of Maxson and Bernstein (1982) at Anvers Island. Since a detailed study of the shag population (Shaw, 1984) was under way simultaneously, such behavior is unlikely to have been overlooked.

Mixed pairs

During 1981–82 three mixed pairs bred. All three pairs laid and hatched two eggs but one pair lost the second chick within a few days of hatching. The remaining five chicks fledged. Only one mixed pair re-formed and bred in 1982–83, rearing two chicks.

The failure of mixed pair 1 to reform in 1982–83 is straightforward. At the start of the 1982–83 summer the corpse of the McCormick's skua in the pair was found close to the territory. From its condition, death had occurred before the winter. The brown skua had paired with a conspecific by 17 November. This new pair laid one egg by 14 December (paired with a McCormick's skua in 1981–82, eggs were laid on 8 and 12 December) and fledged one chick.

Mixed pair 2 returned to territory at the start of the 1982–83 season, the McCormick's skua being first sighted there on 31 October. However, the pair failed to re-form, the brown skua pairing with another brown skua in the same territory and breeding successfully. Only one egg was found but this hatched and, probably, fledged. Mixed pair 2 had fledged one chick in the previous year. It is not clear why the mixed pair failed to re-form in 1982–83, although in 1981–82 the McCormick's skua appeared to do appreciably less brooding and guarding than its brown skua mate (Table VII), which may have been a contributory factor.

Table VII. Parental attendance at two mixed-pair nests 1981–82.

Pair	*No. observations post hatching**	*Parent birds in attendance*		
		Both	*Brown only*	*McCormick's only*
1	16	5	4	7
2	11	5	6	0

* Visits of approximately 15 minutes duration.

Discussion

The establishment of a small breeding population of McCormick's skua at Signy Island is a recent, well-documented event. Why has this occurred and how has colonization been possible in the face of an indigenous population of the brown skua, whose population is also increasing?

Successful colonization by *C. maccormicki* would appear to result from two factors: the availability of a food source not exploited by the brown skua at Signy and tolerance of closer territory packing than is generally the case with *C. lonnbergi*.

McCormick's skua at Signy feeds almost exclusively on *Pleuragramma*, a fish not previously reported in the diet of any seabird or seal studied at Signy. At Antarctic Peninsula sites where brown and McCormick skuas are sympatric, the latter also

forage largely at sea (Parmelee and others, 1977; Trivelpiece and Volkman, 1982). *Pleuragramma* is the main component of the diet of McCormick's skuas at Anvers Island (Nielson, 1983) and may constitute over 90% of the diet during part of the summer (Pietz, pers. comm.). As at Signy Island, McCormick's skua was not seen foraging within penguin colonies on King George Island (Trivelpiece and others, 1980), whereas brown skuas there, at Anvers Island and at Signy Island fed largely within pygoscelid penguin colonies.

Pleuragramma has been recorded in the diet of McCormick's skua on the Antarctic continent at Cape Royds (Young, 1963*b*) and at Pointe Géologie (Le Morvan and others, 1967); however, at continental sites many also feed on Adélie penguin *Pygoscelis adeliae* eggs and chicks for at least part of their breeding season.

Thus, in areas of sympatry with *C. lonnbergi*, the availability of *Pleuragramma* is of particular importance because *C. maccormicki* switches to an almost total dependence on it. It may be that the expansion in range of McCormick's skua is associated with an increase in the abundance of this fish. *Pleuragramma* feeds largely on krill (DeWitt and Hopkins, 1977) and may, like other krill-feeding species (Croxall and others, 1981), have benefited from an increase in its availability over the last few decades. Further range expansion by *C. maccormicki* may well be constrained by the distribution of *Pleuragramma*.

Brown skua territories at Signy appear to be of two types: small breeding territories adjacent to penguin rookeries (with the skuas foraging within the rookeries), and larger feeding and breeding territories away from the rookeries (where the skuas prey on small petrels). The size of these larger feeding and breeding territories may limit the number of breeding pairs of brown skuas that the island can support. However, McCormick's skua, which forages at sea and thus only requires a breeding territory, may be able to find space at the edge of, or in gaps between, these large brown skua territories. If this is the case, then the population of McCormick's skua at Signy, if it is not otherwise constrained, might increase quite substantially. During 1982–83 up to a dozen non-breeding McCormick's skuas were found on Signy, a further three breeding pairs were known on the south coast of Coronation Island (immediately north of Signy Island) and it would seem reasonable to assume they are present elsewhere in the South Orkney Islands.

The only important difference between the breeding biology of *C. maccormicki* at Signy Island and those sites on the Antarctic continent is the much higher breeding success at Signy. Breeding success is usually similarly high at Anvers Island (Neilson, 1983), and at both sites it is largely due to the survival of most second-hatched chicks, which normally perish at continental sites.

Young (1963*a*) identified four factors causing mortality in McCormick's skua chicks: unfavourable weather, disease or injury, predation by skuas and starvation. Proctor (1975) suggested that hunger released the aggressive behaviour usually shown by the first chick towards its younger sibling and that this behaviour predisposed the chick to the other mortality factors.

The climate at Signy is not generally as severe as that at continental localities. None the less, difficult ice conditions at the South Orkney Islands in particular years could have the kind of effect on breeding seen at Anvers Island in 1977–78 (Parmelee and others, 1978). No diseases have been reported at Signy and predation does not appear to be severe.

The critical difference would seem to be in food availability. For McCormick's skua, food resources at Signy Island are apparently abundant. The population of *C. maccormicki* is small and seemingly not in competition with any other species for its major food source, *Pleuragramma*. The usual proximate cause of chick mortality –

starvation – does not seem to operate at Signy Island, despite some evidence of sibling aggression. Comparisons of first- and second-chick growth rates throughout development show that there are no substantial differences in weight or body dimensions, further evidence that the food supply is abundant. High breeding success has also been reported for *C. maccormicki* at continental sites where food availability was increased artificially by station garbage (Jouventin and Guillotin, 1979).

At Signy, as elsewhere where brown and McCormick's skuas breed sympatrically (Parmelee and others, 1977; Trivelpiece and Volkman, 1980), there were a number of mixed pairings, producing intermediate-sized eggs and chicks.

Plumage characteristics, size and subsequent breeding success with conspecifics suggest that the brown skuas (presumptive females) in these mixed pairs were not first-time breeders. It would appear that, given their earlier breeding schedule, *C. lonnbergi* females that fail to pair with a conspecific can still breed successfully paired with a male *C. maccormicki*. Similarly at South Georgia, mixed pairings between sympatric giant petrels *Macronectes halli* and *M. giganteus* are always between females of the earlier breeding species (*M. halli*) and males of the later breeding species (*M. giganteus*) (Hunter, 1983). Neilson (1983) has reported that, an Anvers Island, male *C. maccormicki* return before most of the female *C. maccormicki* and, he suggests, this may facilitate pairings with the earlier-arriving *C. lonnbergi* females. A comparable difference in breeding timetable between the two species is found at Signy, and *C. maccormicki* in mixed pairs (presumptive males) were certainly amongst the earliest McCormick's skuas to return.

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