

# Diet of South Polar Skua Chicks in Two Areas of Sympatry with Brown Skua

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**Abstract.**—The food provided to South Polar Skuas (*Stercorarius maccormicki*) chicks was determined at two Antarctic sites where South Polar Skuas breed sympatrically with Brown Skuas (*S. antarcticus*). At Harmony Point on Nelson Island, 16 samples of regurgitated stomach contents were analyzed, all contained remains of penguin chicks (mostly soft tissues), which constituted the bulk of the contents, while only two samples had fish or krill remains. These South Polar Skuas had access to penguin colonies, where they hunted chicks or fed on fresh carcasses. However, at Half Moon Island, only two out of nine samples contained minor amounts of penguin remains while fish were the major dietary resource. The high fish content in their diet may indicate a preference for marine rather than terrestrial resources or be the result of competition with Brown Skuas. The variability in food items evidenced by the differences in regurgitated stomach contents indicates that South Polar Skuas may have a trophic plasticity that allows them to change their feeding habits from one resource to another one according to availability. Such may make them less vulnerable to a reduction in the availability of a particular food item. Received 11 March 2011, accepted 27 August 2011.

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South Polar Skuas (*Stercorarius maccormicki*) breed on the Antarctic coast and islands (Ritz *et al.* 2006). They feed opportunistically, preying mainly on penguin eggs and chicks but also on other nesting birds, carrion and marine mammal placentas (Norman *et al.* 1994; Young 1994; Norman and Ward 1999; Reinhardt *et al.* 2000). Also, in some colonies, they exploit marine resources, such as fish and krill (Malzof and Quintana 2008; Montalti *et al.* 2009).

The wide array of prey reported for South Polar Skuas, has led some scientists to hypothesize that in areas where South Polar Skuas breed sympatrically with Brown Skuas (*S. antarcticus*) the latter monopolize terrestrial supplies and force South Polar Skuas to feed on marine resources (Pietz 1987; Pezzo *et al.* 2001; Hahn *et al.* 2008). However, in areas inhabited only by South Polar Skuas, they appeared to prefer and rely on terrestrial foods (Green 1986; Norman *et al.* 1994; Mund and Miller 1995). Where the two skua species occurred sympatrically, Brown Skuas bred more successfully than South Polar Skuas, supposedly because of their ability to make use of penguins more

readily, a reliable and, to a point, predictable food (Ritz *et al.* 2005; Hahn *et al.* 2007).

Studies on the diet of South Polar Skua chicks carried out in colonies where they bred in sympatry with Brown Skuas, evidenced that fish were also a food item given to chicks of South Polar Skuas (Hemmings 1984; Reinhardt 1997). As demographic fluctuations are marked in terrestrial resources, especially penguin colonies (see Carlini *et al.* 2009), it is reasonable to assume that South Polar Skuas could adapt to a reduced food supply in penguin colonies by exploiting marine resources, even if the later pose higher difficulty of access than the former.

The aim of this work was to characterize and quantify the food delivered to South Polar Skua chicks by their parents at two sites where they nest sympatrically with Brown Skuas, and to determine whether the same pattern of use of marine resources occurred as described for other locations.

## METHODS

Fieldwork was carried out at Half Moon Island (62°34'60" S, 59°55'60" W) and Harmony Point, Nel-

son Island (62°17'60" S, 59°15'0" W), South Shetland Islands, Antarctica. At both sites the two skua species breed sympatrically (Silva *et al.* 1998; García Esponda *et al.* 2000). At Half Moon Island, there were 103 pairs of South Polar Skua and 3 pairs of Brown Skua in 1996 (García Esponda *et al.* 2000). In 1995, 10 pairs of South Polar Skua and 61 of Brown Skua bred at Harmony Point (Silva *et al.* 1998). In terms of the penguin populations, in 1996, there were 3,342 pairs of Chinstrap Penguin (*Pygoscelis antarctica*) at Half Moon Island (García Esponda *et al.* 2000), and approximately 89,700 pairs of Chinstrap Penguin, and 3,347 pairs of Gentoo Penguin (*P. papua*) at Harmony Point in 1995 (Silva *et al.* 1998).

Single samples of stomach contents were collected from nine South Polar Skua chicks at Half Moon Island from January 12 to February 16 1996. Eight nests contained one chick and one had two chicks, of which only one of them was sampled. At the time of sampling, chicks were 15-25 days old. Another 16 samples were collected at Harmony Point from January 5 to 22 2004, from 13 nests with one chick and three with two chicks. The chicks were 10-20 days old at sampling. All samples of stomach content were obtained through stimulation of their regurgitation reflex by massaging the birds' abdomen, and the regurgitate in plastic bags was collect.

All samples were drained, weighed and the different food items were sorted and identified. Food items were categorized into several groups according mostly to their origin. The categories considered were: penguin (*Pygoscelis* sp.), other bird eggs, fish, krill (*Euphausia superba*), and stones. Penguin remains were categorized according to tissue type (feather, bone, egg and soft tissues, including internal organs and muscle). Egg shell remains were assigned to bird species on the basis of shell color. When otoliths were found, they were separated into left and right and used to determine the species, as well as the number, size and mass of the fish species (Hecht 1987).

Each category of food was weighed and the percentage of the total mass of regurgitated food was calculated. In some cases the feathers and muscle tissue could not be separated into their individual components. Means are given with ± 1 SD.

RESULTS

The mass of stomach contents varied at both study sites. Mean weights were 10.5 ± 9.9 g (range 2.1-33.2 g) and 12.4 ± 19.1 g (range 2.0-79.5 g) for Half Moon Island and Harmony Point, respectively.

All samples from Half Moon Island contained fish remains and three also contained krill (Table 1). Four samples comprised otoliths of nine individuals of *Electrona antarctica* (length: 67 ± 5 mm, mass: 4 ± 1 g) and two of *Pleuragramma antarcticum* (length: 128 and 139 mm, mass: 14 and 18 g). Penguin re-

Table 1. Mean percentual mass of food items found in each regurgitated stomach content of South Polar Skua (*Stercorarius maccormicki*) chicks, at two breeding areas, sympatric with Brown Skua (*S. antarcticus*). + indicates minimum amounts.

	Penguin									
	Soft Tissue	Feather	Muscle + Feather	Bone	Eggs	Other bird eggs	Fish	Krill	Stone	
Half Moon Island (n = 9)	Mean	—	—	—	—	+	95.1	14.8	—	
	SD						—	18.9		
	n	2				1	9	3		
Harmony Point (n = 16)	Mean	85.6	13.8	99.8	23.4	11.8	0.6	1.1	5.9	
	SD	31.8	26.5	0.6	18.0	11.1	0.5	0.1	—	
	n	12	5	4	2	2	2	2	1	

mains occurred in two samples and skua eggshells in another, both in minimal amounts.

At Harmony Point, all stomach samples contained remains of penguin chicks, which also made up the greatest percentage of total mass in all cases (Table 1). At this site, soft tissue (internal organs and muscle) of chicks made up the greatest proportion of penguin remains by weight (Table 1). In three samples, soft tissues were the only item present, and three other samples consisted only of soft tissue and feathers of penguin chicks. In 14 out of 16 stomach samples, soft tissue and feathers represented > 93% of the sample mass. In the other two samples, the remaining mass after removal of the penguin chick remains was composed of remains of egg shell of other birds and/or stones. Egg shell remains corresponded to penguins, skuas and Southern Giant Petrels (*Macronectes giganteus*). One stone (0.15 g) and some moss were found in two separate stomach samples. Two samples included fish and another two krill (Table 1). Prey items of marine origin constituted only approximately 1% of the total mass of the stomach contents of the samples in which they were found.

#### DISCUSSION

As evidenced by our stomach content analysis, South Polar Skuas at Harmony Point had access to penguin colony resources to feed their chicks, which contrasts with results found in other studies (Hemmings 1984; Pletz 1987; Hahn *et al.* 2008). The abundance of soft tissue of penguin chicks in samples from this site may suggest that the parental South Polar Skuas accessed penguin colonies, where they either hunted or fed on carcasses of recently deceased birds rather than ingesting remains of carcasses already eaten by Brown Skuas. Had they fed on carcasses abandoned by Brown Skuas, the samples would likely have contained a higher proportion of skin and feathers. Bone remains were few, and we found no evidence of difficulty digesting structures such as feet. Similarly, the diet of Brown Skua chicks is comprised mainly of internal organs and other soft tissues of penguins (Reinhardt 1997).

The fish in the samples from Half Moon Island matched in size and mass to those found in the diet of adult South Polar Skuas from the same population; in both adults and chicks, the dominant fish prey was *E. antarctica* (Montalti *et al.* 2009). Also at Signy and King George Islands, both sites where the two skua species are sympatric, the diet of South Polar Skua chicks was based mainly on fish (Hemmings 1984; Reinhardt 1997).

While our sample size is too small to draw firm conclusions, South Polar Skuas at Half Moon Island appeared to feed their chicks mainly marine resources. Here, only three Brown Skua pairs coexisted with 103 South Polar Skua pairs in 1996 (García Esponda *et al.* 2000). However, penguin remains were hardly represented in chick stomach contents, and fish was the principal food given to chicks, in agreement with the results for adult South Polar Skuas at the same site (Montalti *et al.* 2009). The use of fish in chicks' diets at Half Moon Island could be a real preference, or may be forced by the low availability of penguins (approximately 3,400 pairs) compared to Harmony Point (approximately 93,000 pairs) and the indirect action of Brown Skuas, that may use up resources from the penguin colony. In turn, the low availability of penguins could also explain the low numbers of nesting Brown Skuas at Half Moon Island given that their population may be limited by this resource.

In comparison, results from Harmony Point show that the predominant use of marine resources by South Polar Skuas in the presence of Brown Skuas, is not a rule applicable to all areas of these species' sympatric nesting distribution (Graña Grilli and Montalti 2011). In areas such as Harmony Point on Nelson Island, where penguin colonies are large, South Polar Skuas manage to gain enough resources from penguins as to constitute the main food source for their chicks, despite of presence of Brown Skuas.

If there is a capacity of South Polar Skuas to adapt to different food resources, it could allow them to compensate for the low availability of one resource by changing their feeding habits and favoring the use of another. In this way, South Polar Skuas could

reduce the effect that a decrease in the food availability of one kind of resource (e.g. penguins) could have on their populations.

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