DIET OF THE PINTADO PETREL *DAPTION CAPENSE* AT KING GEORGE ISLAND, ANTARCTICA, 1990/91

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SUMMARY

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During the Dutch King George Island Expedition of 1990/91, complete stomach contents of Pintado or Cape Petrels *Daption capense* were sampled by means of the stomach-flushing method. Food samples consisted of Antarctic Silverfish *Pleuragramma antarcticum* by 60% of mass. The remainder of the mass was made up mainly of amphipods (various Eusiridae, Lyssianassidae, Calliopidae, and Hyperiidea) and Antarctic Krill *Euphausia superba*. Previous studies of breeding Pintado Petrels have reported a diet dominated by crustacean prey with a fish component of less than 30% by mass. This discrepancy could be due to former studies being largely based on small quantities of regurgitated food, and not on complete stomach contents. From a small number of our samples it seems that nonbreeding birds may differ in diet from birds rearing chicks, but this could be influenced by local conditions. A major importance of fish throughout the nonbreeding seasons is indicated in recent literature. More research is required to estimate dietary requirements of Pintado Petrels in the Southern Ocean. Such work should focus on stomach-flushing methods and on diet of birds away from the breeding colonies.

INTRODUCTION

The Pintado or Cape Petrel *Daption capense* is an abundant seabird of the Southern Ocean, breeding at many localities along the Antarctic continent, the Antarctic Peninsula, and at sub-Antarctic Islands (Watson *et al.* 1971). The species is a fulmarine petrel, a group of tubenosed seabirds adapted to life in high polar latitudes, though some of them extend their range into more temperate climatic regions. Five species of fulmarine petrels breed around the Antarctic Continent, representing an important component of the Antarctic top predator community. Because of their importance in Antarctic food chains, dietary studies of fulmarine petrels were started in the long-term project on this bird group by the Netherlands Institute for Forestry and Nature Research (IBN-DLO). Investigations of diets were started in 1986/87 on Ardery Island in the Windmill Islands near the Australian base Casey (66°S, 110°E). Somewhat unexpectedly, the major constituent of food brought to chicks by the fulmarine petrels on Ardery Island proved to be fish, mainly Antarctic Silverfish *Pleuragramma antarcticum* (van Franeker &

Williams 1992). Less than 20% of the food consisted of crutaceans, dominated by Antarctic Krill *Euphausia superba*. Compared to the other fulmarine species, the Pintado Petrel on Ardery Island consumed a high proportion of krill, but fish nevertheless made up 60% of its diet. To check whether the dominance of fish in food of fulmarine petrels is a general phenomenon, it was decided to continue dietary studies on a wider temporal and geographical scale. Studies on Ardery Island were repeated in 1990/91. In the same year the first Dutch Antarctic Expedition to King George Island (Stichting Onderzoek der Zee 1990, van Bennekom *et al.* 1992) offered a possibility to investigate regional variation in the diet of Pintado Petrels. This paper reports on food samples taken from Pintado Petrels on King George Island in 1990/91.

METHODS

King George Island is one of the South Shetland Islands at the northwestern tip of the Antarctic Peninsula (Fig. 1). The Dutch Antarctic Expedition was based at the Polish Arctowski Station in Admiralty Bay from 7 December 1990 to 24 January 1991. A Pintado Petrel colony is situated around Demay Point at the western entrance to Admiralty Bay from Bransfield Strait. The colony had about 215 apparently occupied sites during a survey in early January. Field work at Demay Point was conducted by W.J. Wolff and T. van Spanje.

At the colony, birds were caught with a noose on a short pole. Birds with eggs or chicks were caught only if the partner was present at the site to avoid breeding failures. Some birds were caught at sea just in front of the colony using a hand net. Captured birds were weighed, measured and banded. Food samples were obtained using the stomach-flushing technique which involves inserting a tube in the bird's stomach to flush out contents with warm water (Wilson 1984, van Franeker & Williams 1992). Two flushings per bird were usually sufficient to obtain a complete sample as judged by clearness of the water returned after the second flushing. Occasionally more flushings were needed to obtain the complete contents of the large glandular stomach (proventriculus). Accumulations of hard food items from previous meals in the muscular stomach (gizzard) are unlikely to be flushed out by this method (Duffy & Jackson 1986). In addition, six whole stomach contents were obtained from Pintado Petrels collected for a monitoring study of organochlorine pollutants in Antarctic organisms.

In the field, food samples were drained of excess water and stored in 70% ethanol for transport and analysis in the Netherlands by S. Creet and J.A. van Franeker. In the laboratory, the samples were rinsed with water, sieved and blotted dry with paper towels. The material was then weighed (drained mass - DRM) and sorted into recognizable fish, crustacean, squid and other components and weighed separately. For sorting, identifying and measuring prey items, a binocular microscope with an eyepiece graticule was used. Almost all fish and krill remains could be identified directly. Formulas from Williams & McEldowney (1990) were used to estimate fish sizes from otolith measurements. Krill sizes were determined according to Hill (1990). Other crustaceans, mainly amphipods, were only identified down to family level.

RESULTS

During December and the first half of January, six samples were taken from nonbreeding birds or birds attending sites with eggs. Quantities of food obtained from these birds were small and further sampling was postponed until after hatching of the chicks which started around 15 January. In the remaining days before departure of the expedition, 12 food samples were obtained from birds returning to their sites to feed young chicks.

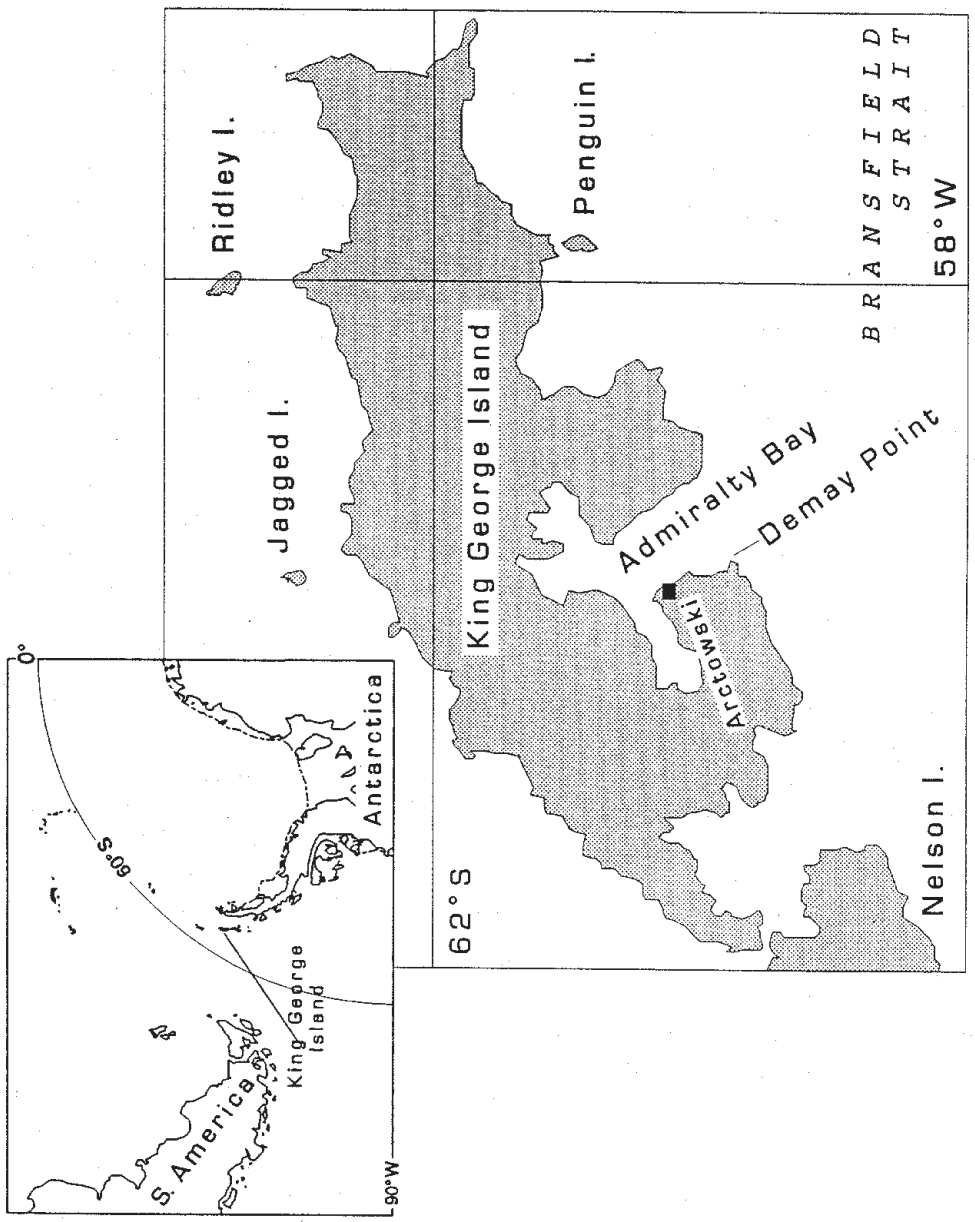

Figure 1

Demay Point, King George Island

All samples combined resulted in 401 g of drained mass (n=18, mean DRM 22.3 ± 17.6 g; range 1.3-56.3 g). In some cases, birds were weighed before and after stomach flushing so as to record the original mass of food plus liquids (stomach oil and water) removed. On average the DRM food mass represented about 67% of the original stomach contents (n=12). The maximum mass of removed stomach contents was 90 g, approximately 20% of the body mass of an adult Pintado Petrel. By mass, over 60% of the food in the samples consisted of fish, over 38% of crustacean prey, the remainder being a few squid remains and non food items such as small stones (Fig. 2).

All identifiable fish remains were Antarctic Silverfish *Pleuragramma antarcticum*. Otoliths indicate that fishes ingested usually had measured 100 to 150 mm in total length and had weighed between 8 to almost 30 g.

Less than one-third of the crustacean material consisted of krill *Euphausia* sp. (10.6% of total DRM). Most krill remains were very digested but all identifiable specimens were Antarctic Krill *E. superba* with carapace lengths of mostly 10 to 15 mm, indicating total lengths of *c.* 40 to 50 mm (Hill 1990) and body masses around 0.5 g (Morris *et al.* 1988). The largest proportion of the crustaceans (27.8% of total DRM) were amphipods. Benthic shallow water amphipods from the Eusiridae (for example *Gondogeneia antarctica*) and Lysianassidae (for example *Lepidepecreum cf. carinatum*) were most abundant, but also pelagic amphipods of the Hyperiidae were frequently encountered. Other crustacean remains included a few copepods, a decapod shrimp and a *Thysanoessa*. Remains of one small salp and an unidentified squid beak were found.

Major differences were found not only in the quantity, but also in the composition of the stomach contents of birds feeding chicks as compared to nonbreeding or egg-attending birds (Fig. 2). With 66.7% of DRM, fish dominated in the diet of chick-feeding birds. In the smaller-sized stomach samples of other birds, over 85% of the food mass consisted of crustaceans, mainly amphipods. Table 1 makes a further distinction between birds attending sites with an egg and nonbreeding birds. In the latter group, amphipods were especially abundant because two of the three nonbreeders were caught while feeding on amphipods surfacing just off the beach in front of the colony. Table 2 summarizes the frequency of occurrence of various prey groups in the food samples. The dissected birds were all non- or failed breeders carrying very little food. Food remains were mainly found in their gizzard, biasing results towards accumulated hard prey items (squid beaks, otoliths). For this reason, data on mass of prey types in these dissected birds were omitted from Table 1.

Included in Table 2 is the occurrence of anthropogenic floating debris, mostly plastic items. Threadlike materials from synthetic nets, ropes and fishing lines were most frequent, but also fragments of moulded plastics and raw industrial plastic granules were found. In 22% of stomach-flushed samples such materials were present. Undigestable items accumulate in the gizzard, and were therefore more abundant in stomach samples of dissected birds. Similar frequencies of plastics in stomachs of Pintado Petrels were reported by van Franeker & Bell (1988) and Ainley *et al.* (1990). Higher plastic loads were observed in Pintado Petrels occurring in temperate waters off southern Africa (Ryan 1987).

DISCUSSION

The results support the findings of a study on Ardery Island which showed a predominance of fish in the diet of Antarctic fulmarine petrels during the breeding period. Pintado Petrels feeding chicks on Ardery Island consumed over

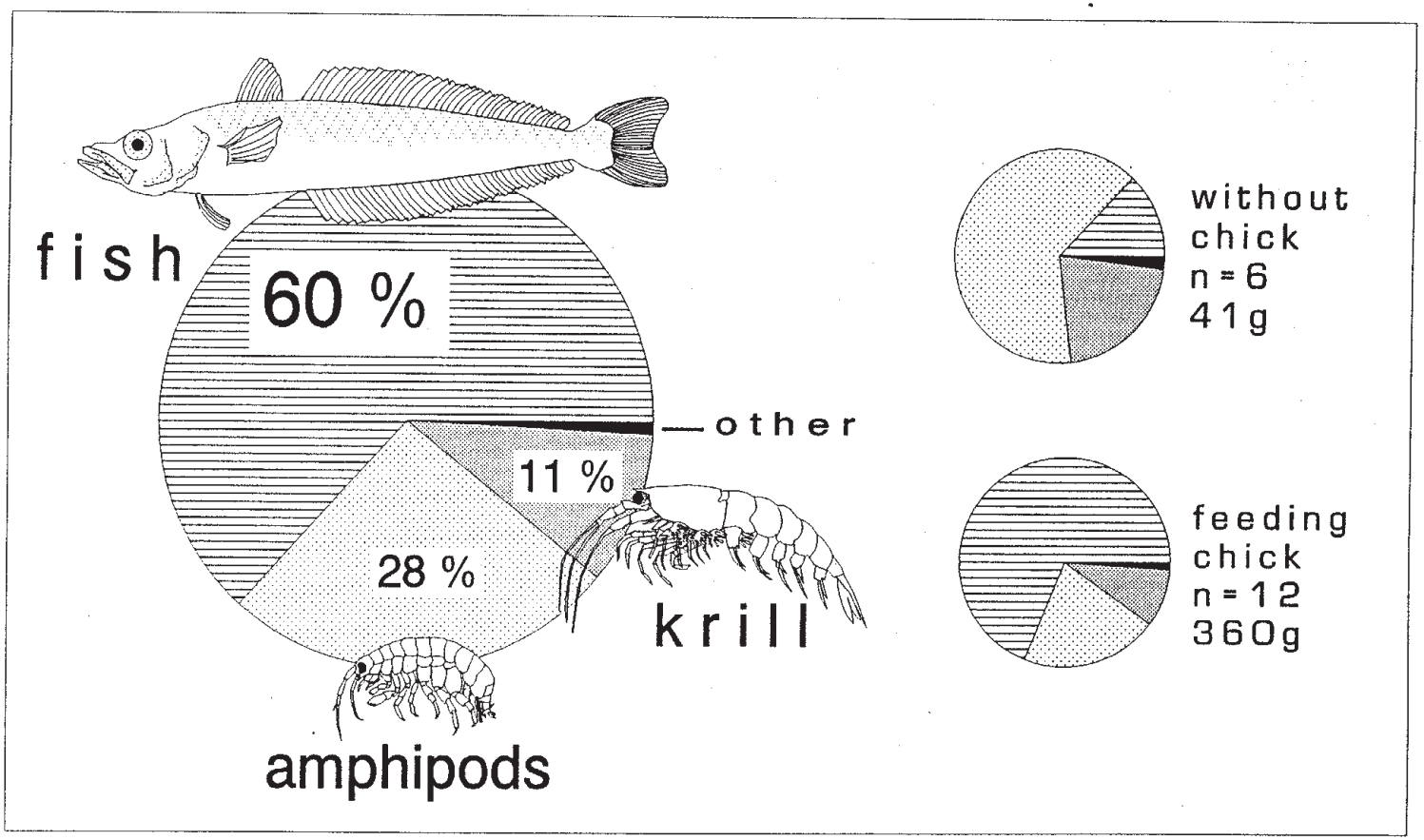

Figure 2

Diet composition by mass of stomach-flushed Pintado Petrels, Demay Point, King George Island, 1990/91.

TABLE 1

SAMPLE SIZES AND RELATIVE ABUNDANCE BY MASS OF MAIN PREY CATEGORIES IN FOOD OBTAINED BY STOMACH-FLUSHING PINTADO PETRELS, DEMAY POINT, KING GEORGE ISLAND, 1990/91

Status	n	Total DRM (g)	Average DRM ± S.D. (g)	% drained mass			
				Fish	Amphipods	Krill	Squid
Nonbreeders	3	20.9	7.0± 4.0	1	97	1	0
With eggs	3	19.8	6.6± 4.5	24	33	41	0
With chicks	12	359.9	30.0±16.6	67	23	9	+a
Total	18	400.6	22.3±17.6	60	28	11	+a

a present, but less than 1% of DRM

TABLE 2

FREQUENCY OF OCCURRENCE OF MAJOR PREY CATEGORIES IN THE DIET OF PINTADO PETRELS, DEMAY POINT, KING GEORGE ISLAND, 1990/91

Status	n	Frequency of occurrence %				
		Fish	Amphipods	Krill	Squid	Anthropogenic material
Stomach-flushed samples						
nonbreeders	3	67	100	33	0	33
with eggs	3	67	67	67	0	0
with chicks	12	100	58	83	8	25
Total	18	89	67	72	6	22
Dissected birds						
nonbreeders	6	100	33	33	33	50

60% fish in both 1986/87 and 1990/91 (van Franeker & Williams 1992, J.A. van Franeker unpubl. data). Chick-feeding Pintado Petrels of Demay Point, King George Island, had 67% fish in their diet. In both regions the fish diet was strongly dominated by the Antarctic Silverfish. The major difference in the diet between the two localities seems to be the crustacean part of the diet, which at Ardery Island is almost exclusively krill, but predominantly amphipod at King George Island. This is surprising because the area around the South Shetland Islands is known for its numerous swarms of Antarctic Krill (Miller & Hampton 1989). The abundance of amphipods may be a local phenomenon caused by high densities of amphipods at the watersurface along the beach in front of the Demay Point colony.

The dominance of Antarctic Silverfish in the diet of chick-feeding Pintado Petrels is in contrast with published information (Marchant & Higgins 1990). At various continental locations, krill has been reported as the principal component in the diet of breeding Cape Petrels. Crustacean prey represented 64% to 86% of the mass in diets studied at Prydz Bay (Green 1986, Arnould & Whitehead 1991), Haswell Island (Starck 1980) and Terre Adélie (Ridoux & Offredo 1989). The fish component in these diets was always less than 30% of the food mass. In more sub-Antarctic conditions, Croxall *et al.* (1985) and Croxall & Prince (1987) estimated that during the breeding season, Pintado Petrels of the Scotia Sea and South Georgia consume about 85% Antarctic Krill and 15% squid or fish by mass.

Reasons for these differences with published literature on breeding diet of the Pintado Petrel are not quite clear. Evidently, there may be variability in diet depending on availability of particular prey at different locations or times. However, the similarity between the Ardery and King George Island samples as opposed to other studies suggests that differences in sampling techniques may be important. All previous data seem to originate from regurgitations of Pintado Petrels or their chicks and not from complete stomach samples as obtained by stomach flushing. Because regurgitations will only be a part of the stomach contents, there could be a bias towards smaller or lighter prey items. Arnould & Whitehead (1991) stated that this could have caused an overestimate of krill in their results for Pintado Petrels. Our data support the possibility of such bias and emphasize the importance of obtaining complete stomach samples.

Our small samples of nonbreeding and egg-attending birds suggest that diets may change with breeding status, but this could be influenced by local phenomena. For nonbreeding Pintado Petrels, dietary data as summarized by Marchant & Higgins (1990) indicate frequent occurrence of krill but also a diverse diet with very variable proportions of other crustaceans, fish, squid, salps, jellyfish, anomurans and offal. Most studies refer to the occurrence of prey items in small samples of dissected stomachs of collected birds. These data show that the Pintado Petrel is an opportunistic surface feeder, but give little insight in the relative importance of various prey groups. For example, Ainley *et al.* (1984) suggested an almost exclusive squid diet for Pintado Petrels in the Ross Sea area, but derived this from the occurrence of three squid jaws in a sample of four nearly empty stomachs. However, Ainley *et al.* (1992) recently published the first comprehensive study on diets of Antarctic seabirds during autumn, winter and spring. The 77 Pintado Petrels collected by them in the Weddell-Scotia Confluence region had eaten almost 70% fish, 20% squid, and only a few per cent crustacean prey by mass. The inclusion of fresh-looking fish otoliths and squid beaks from gizzards to calculate the original food mass may have caused some overestimate of these prey types. Nevertheless, their study clearly indicates the importance of fish for Pintado Petrels throughout the annual cycle.

It is concluded that fish may be a more important prey item for Pintado Petrels than hitherto assumed. Discrepancies between different studies show that much work remains to be done before a full quantitative understanding of the annual food requirements of Pintado Petrels in the Southern Ocean is attained. The Pintado Petrel has been selected as a monitoring species by the Scientific Committee of the Commission for the Conservation of Antarctic Marine Living Resources (SC-CCAMLR 1991). In future studies it seems important to obtain complete food samples by stomach-flushing and to put efforts into the development of methods for catching live birds at sea for nondestructive dietary studies of nonbreeding birds.

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