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SHORT NOTE

# Diet of the Leopard Seal *Hydrurga leptonyx* at the Danco Coast, Antarctic Peninsula

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**Abstract** A total of 14 scats of the Leopard Seal were collected on ice floes close to Cierva Point, Danco Coast, Antarctic Peninsula, during February and March 2000. Krill was the most frequent and numerous prey and also constituted the bulk of the diet; penguins and fish followed in importance by mass. Among fish, *Gobionotothen gibberifrons* was the most frequent prey and also predominated by mass whereas the myctophid *Gymnoscopelus nicholsi* was the most numerous prey. The results are compared with previous studies and the differences in the composition of the diet observed among the Leopard Seal and other seals at the study area are discussed.

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## Introduction

The Leopard Seal *Hydrurga leptonyx* is a top and generalist predator that presents a circum-Antarctic distribution at latitudes between 50 and 80°S (Rogers et al. 2005). Despite its wide range of distribution and its population size (between 220,000 and 440,000 individuals, Laws 1984), together with the Crabeater (*Lobodon carcinophagus*) and the Ross (*Ommatophoca rossii*) seals, the Leopard Seal is one of the least studied Antarctic seals. Information available indicates that this seal forages on a variety of prey including other seals, birds, fish, cephalopods and crustaceans (Green and Williams 1986; Costa and Crocker 1996, among others) and that the composition of its diet varies according to seasons and locations (Laws 1984) and probably according to sex or age classes (Walker et al. 1998). Given that it is difficult to access and positively identify Leopard Seal scats the information on the diet of this seal is yet sparse and fragmentary and usually based on a scarce number of samples, which imply that more studies are still required to understand its foraging behavior. This study provides information obtained in an unstudied area, the Danco Coast, based on the opportunistic collection of Leopard Seal feces.

## Material and methods

A total of 14 scats of the Leopard Seal were collected on ice floes close to Cierva Point (64°09′S; 60°57′W), Danco Coast, Antarctic Peninsula, during February and March

2000. The facts that during the study period the Leopard Seal was the only seal that was seen resting on ice floes and that the scats were obtained only from ice floes where individuals of this species were resting let us positively assign the samples to Leopard seals. The samples were individually washed through graded sieves (minimum mesh 0.54 mm) and the prey remains were sorted to the lowest taxonomic level possible. The approximate number of individuals of the Antarctic krill *Euphausia superba* present in each sample was estimated from the dry weight of the total of the carapaces present in the sample according to the technique described by Casaux et al. (1998). The mass of the individuals was estimated by comparison with entire specimens recovered from the study area. According to reference material the squids represented in the samples were tentatively identified as *Psychroteuthis glacialis* and the mass of the individuals was determined by considering the rostral length of the lower beak and applying the relationship described in Gröger et al. (2000). The number of bivalves represented in the scats was indicated by the number of valves present in the samples and the mass was estimated by comparison with reference material (Casaux et al. 1997). Otoliths and eye lenses indicated the presence of fish in the samples. The sagittal otoliths were identified to species level using our own reference collection and illustrations and descriptions in Williams and McEldowney (1990). The otoliths belonging to specimens of each species were sorted into right and left and the most abundant of these was considered as the number of fish present in each sample. Otolith length was measured to 0.01 mm and fish body length and mass were estimated using the equations in Williams and McEldowney (1990) and in Casaux et al. (2003a). The mass of the specimens that remained unidentified was assumed to be similar to the mean mass estimated for the specimens identified. For the estimation of the number and mass of penguins represented in the samples we followed the methodology described in Casaux et al. (2003b). According to the penguin availability at the study area (Favero et al. 2000) the remains represented in the scats (feathers and viscera) might belong to *Pygoscelis antarctica* or *P. papua*.

**Table 1** The composition of the diet of the Leopard Seal *Hydrurga leptonyx* at the Danco Coast, Antarctic Peninsula, as reflected by the analysis of scats ($n = 14$) collected during February and March 2000

| | *F%* | *N%* | *M%* |
|---|---|---|---|
| Krill ($n = 38{,}966$) | 100.00 | 99.88 | 83.12 |
| Bivalves ($n = 1$) | 7.14 | 0.00 | 0.00 |
| Squids ($n = 6$) | 14.29 | 0.01 | 0.41 |
| Fish ($n = 38$) | 50.00 | 0.10 | 3.65 |
| Penguins ($n = 2$) | 14.29 | 0.01 | 12.82 |

Percentage frequencies of occurrence (*F%*), number (*N%*) and mass (*M%*)

## Results

Antarctic krill, followed by fish, was the most frequently occurring and numerous prey (Table 1). This crustacean constituted the bulk of the diet whereas penguins and fish followed in importance by mass. Among fish, *Gobionotothen gibberifrons* was the most frequent prey and also predominated by mass whereas the myctophid *Gymnoscopelus nicholsi* was the most numerous prey (Table 2). The size of the fish represented in the samples ranged from 5.99 cm (*Electrona antarctica*) to 30.25 cm (*G. gibberifrons*).

## Discussion

Previous studies have indicated that the Leopard Seals prey on a variety of warm-blooded species (mainly seals and penguins but also some petrels), as well as on fish, cephalopods, and crustaceans (Hoffman et al. 1977; Lowry et al. 1988; Siniff 1991; Walker et al. 1998; Costa and Crocker 1996; Hall-Aspland and Rogers 2004, among others). The diet of this seal varies with seasons and locations (Laws 1984) and probably according to sex or age classes (Walker et al. 1998). The predation on penguins by the Leopard Seal during summer is extensive and well documented (Penney and Lowry 1967; Hunt 1973; Laws 1981; Bester and Roux 1986; Kooyman et al. 1990; Rogers and Bryden 1995, among others). Interestingly, Green and Williams (1986)

**Table 2** Fish represented by the otoliths found in scats ($n = 14$) of the Leopard Seal *Hydrurga leptonyx* collected at the Danco Coast, Antarctic Peninsula, during February and March 2000

| | *F%* | *N%* | *M%* | Total length |
|---|---|---|---|---|
| *Electrona antarctica* ($n = 3$) | 7.1 | 7.9 | 1.2 | 6.8 ± 1.0 (5.99–7.95) |
| *Gymnoscopelus nicholsi* ($n = 29$) | 7.1 | 82.8 | 43.7 | 13.4 ± 2.1 (8.86–17.49) |
| *Gobionotothen gibberifrons* ($n = 3$) | 14.3 | 7.9 | 55.1 | 27.8 ± 3.7 (23.53–30.25) |
| Unidentified ($n = 3$) | 21.4 | 7.9 | 76.3 | – |

Percentage frequencies of occurrence (*F%*), number (*N%*), mass (*M%*) and total length (mean in cm ± standard deviation and range)

reported that during winter-spring, prior to the arrival of penguins to the vicinity of Davis Station, East Antarctica, fish were the main prey of the Leopard Seal. Siniff and Stone (1985) and Lowry et al. (1988) observed at the Antarctic Peninsula that krill was the main prey during winter. Differently, at Antarctic fur seal breeding localities such as South Georgia, this seal is the main component in the diet of Leopard seals (Walker et al. 1998).

As observed during winter also in the Antarctic Peninsula region (Siniff and Stone 1985; Lowry et al. 1988), krill was largely the most important prey of the Leopard Seal at the Danco Coast. However, considering previous information (see above) and given that during the study period at the Danco Coast Leopard seals defended territories around penguin colonies (R. C. unpublished data) and that in following seasons seals were frequently seen hunting penguins (M. Santos personal communication), the scarce contribution of these birds to the seals diet is unexpected. The low occurrence of penguin remains in the scats analyzed in this study might be explained by the comparatively low availability of these birds in the study area (Favero et al. 2000). Differently, Penney and Lowry (1967) indicated that for some Leopard seal populations penguins are considered a temporary resource. Perhaps, in seasons when krill is present and abundant at foraging areas close to the Danco Coast Leopard seals concentrate their foraging effort on this crustacean, penguins being an alternative resource. The absence of remains of the Antarctic fur seal in our samples is consistent with the fact that the Danco Coast is far from Cape Shirref, South Shetland Islands, the closest fur seal breeding locality.

Regarding fish, Green and Williams (1986) reported that *Pleuragramma antarcticum*, followed by demersal species (probably *Trematomus* sp.), was the main prey of Leopard seals at East Antarctica, whereas in samples from Kerguelen and the Southwest Atlantic Øritsland (1977) identified remains from *Chaenichthys* sp. and *Paralepis atlantica,* respectively. In our study the benthic-demersal *G. gibberifrons* was the main fish prey and the pelagic myctophids *G. nicholsi* and *E. antarctica* followed in importance. Given that the Leopard Seal is a generalistic top-predator, and in agreement with Green and Williams (1986), the differences in the fish consumed might be reflecting differences in fish availability among localities. In this sense and according to our results and those reported by Green and Williams (1986) and Øritsland (1977), the absence or the low abundance of *P. antarcticum* and Channichthyid species at the Danco Coast during the study period might be expected. Interestingly, as reflected by the analysis of scats collected also at the Danco Coast concurrently with the samples considered in this study, *P. antarcticum* and channichthyids were the main fish prey of Antarctic fur seals (Casaux et al. 2003b) and Weddell seals (Casaux et al. 2006) which invalidate that hypothesis. This finding suggests that, perhaps as a mechanism to reduce the predation risk or the inter-specific competition for food, these seals partitioned the use of the feeding area or the fish resources.

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