

# CEPHALOPODS IN THE DIET OF ELEPHANT SEALS AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS

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ABSTRACT. Cephalopod remains from 11 elephant seals (*Mirounga leonina* L.) collected at Signy Island, South Orkney Islands, consist mainly of 68 upper beaks (mandibles) and 50 lower beaks. The lower beaks were sorted and measured. Eight species in six families are present. *Gonatus antarcticus* contributing 42%, an unidentified teuthoid (20%), *Moroteuthis knipovitchi* (14%) and an octopod (10%) were the most numerous species. Estimates from beak lengths show that the octopus contributed 60% of the weight of cephalopod flesh represented by beaks in this collection, while *Gonatus antarcticus* contributed 15% and *Moroteuthis knipovitchi* 10%. The species most frequently eaten are *Gonatus antarcticus* (44% of samples containing lower beaks) and the unidentified teuthoid (56% of samples).

While it has long been known that adult southern elephant seals (*Mirounga leonina* Linnaeus 1758) eat cephalopods and fish almost exclusively (Laws, 1960; King, 1964) the digested remains have not been examined in detail. A small collection consisting of the cephalopod part of the stomach contents of 11 elephant seals killed at Signy Island, South Orkney Islands (lat. 60° 43' S, long. 45° 38' W) was made available to the authors by P. J. Tilbrook of the British Antarctic Survey. It included 50 lower beaks, which provide the first information on the species and sizes of cephalopods eaten by these seals. The period of collection, November to May, is during the long moulting fast in the summer and autumn months when very little food is found in the stomachs and the seals are reluctant to enter the water (Laws, 1960). The collection provides an interesting comparison with cephalopods from Antarctic sperm whales (Clarke, 1980) and Weddell seals (Clarke and MacLeod, 1982), although many of the latter were sampled in the winter months when elephant seals are dispersed at sea.

## MATERIAL AND METHODS

The cephalopod part of the stomach contents of 11 elephant seals killed at Signy Island were collected by P. J. Tilbrook during the period November 1962 to May 1963 and that of a single seal in January 1964. Details of these seals are given in Table I. The stomach contents included a few nematode worms, a mineral forming 'cement' (collectors' note), a 'bladder' the size of a small grape and remains of cephalopods. These remains consisted of a few pens and pieces of pens, a few spermatophores and lenses, a 'crown' of arms, one buccal mass and 68 upper and 50 lower beaks. Lower beaks were identified as far as possible by methods outlined elsewhere (Clarke, 1962a, b, 1980; Clarke and MacLeod, 1974, 1976, 1982; Clarke and others, 1976). Lower rostral lengths (LRLs) (Clarke, 1962b) were measured with vernier callipers to an accuracy of 0.005 cm. Weights of the squids represented were then estimated from the LRLs using published relationships (Clarke, 1962b, 1980).

## RESULTS

The 68 upper and 50 lower beaks contained in the seal stomachs were distributed among the samples as shown in Table I.

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Table I. Number and identity of cephalopod beaks collected from each elephant seal.

Ref. No.	Seal										
	1	2	3	4	5	6	7	8	9	10	11
	M	M	M	F	F	F	F	M	M	M	M
Sex	M	M	M	F	F	F	F	M	M	M	M
Age (years)	3	3	3	3	3	2	3	6	2	6	5
Date collected	4	28	15	27	6	13	14	22	28	6	6
	Nov	Nov	Dec	Dec	Jan	Jan	Feb	Feb	Mar	May	May
<i>Moroteuthis knipovitchi</i>	4	—	—	—	—	—	—	—	3	—	—
<i>Kondakovia longimana</i>	—	—	—	1	—	1	—	—	—	—	—
? <i>Psychroteuthis</i> sp.	—	2	—	—	—	1	—	—	—	—	—
<i>Alluroteuthis</i>	—	—	—	—	—	—	—	—	—	1	—
<i>Gonatus antarcticus</i>	—	—	—	2	—	1	16	2	—	—	—
<i>Galiteuthis</i>	—	—	—	—	1	—	—	—	—	—	—
Octopodid	—	—	—	—	—	—	—	5	—	—	—
Unidentified	1	—	—	2	1	4	2	—	—	—	—
Total											
Lower beaks	5	2	—	5	2	7	18	7	3	1	—
Upper beaks	7	1	1	6	3	9	25	9	2	4	1

## FAMILY ONYCHOTEUTHIDAE

Beaks of two species of this family are present in the samples and the family contribute 18% of the beaks (Table II).

*Moroteuthis knipovitchi* Filippova, 1972

Seven (14%) of the lower beaks belong to this species. The LRLs have a range of 0.57–0.70 cm. The squids from which the beaks came had an estimated mean weight of 601 g and contributed 9.6% to the weight of flesh represented by beaks in the collection. The presence of one buccal mass in the collection shows that the species lives close to Signy Island. The species was found in 22% of the seal stomachs containing lower beaks. The dates of collection are spread throughout the sampling period. These beaks fall within the size range eaten by sperm whales (Clarke, 1980).

Table II. Details of cephalopods eaten by 11 elephant seals collected at Signy Island.

Family	Species	No.	%	Estimated weight		
				Mean (g)	Total (kg)	%
Onychoteuthidae	<i>Moroteuthis knipovitchi</i>	7	14	601	4.2	9.6
	<i>Kondakovia longimana</i>	2	4	1 426	2.9	6.6
Psychroteuthidae	? <i>Psychroteuthis</i> sp.	3	6	695	2.1	4.8
Neoteuthidae	<i>Alluroteuthis</i>	1	2	111	0.1	0.2
Gonatidae	<i>Gonatus antarcticus</i>	21	42	312	6.6	15.0
Cranchiidae	<i>Galiteuthis</i> sp.	1	2	18	—	—
Octopodidae		5	10	5 259	26.3	59.9
Unidentified		10	20	171	1.7	3.9
Totals		50	100	878	43.9	100.0

*Kondakovia longimana* Filippova, 1972

Only two beaks, both with LRLs of 1.18 cm, belong to this species. The squids from which these beaks came had a weight estimated as 1426 g and contributed 6.6% to the weight of flesh represented by beaks in the collection. They fall at the lower end of the size range eaten by sperm whales (Clarke, 1980) and are barely mature.

## FAMILY PSYCHROTEUTHIDAE

*?Psychroteuthis glacialis* Thiele, 1921

Three beaks, having LRLs of 0.69, 0.72 and 0.75 cm, belong to a species also found in sperm whales and Weddell seals which is thought to be *Psychroteuthis glacialis* (Clarke, 1980). The present beaks are the same size as similar beaks from sperm whales. The squids from which they came had an estimated mean weight of 695 g and contributed 4.8% to the weight of flesh represented by beaks.

## FAMILY NEOTEUTHIDAE

*Alluroteuthis* sp.

Specimens of this type were formerly called '*?Crystalloteuthis*' by Clarke (1980) but more material has become available and now shows that this is very probably *Alluroteuthis*.

One beak, with a LRL of 0.6 cm, is within the size range of those from sperm whales.

## FAMILY GONATIDAE

*Gonatus antarcticus* Lönnerberg, 1898

Twenty-one (42%) of the lower beaks belong to this species (Table II). The LRLs have a range of 0.63–0.74 cm and the frequency distribution has a peak of 0.70–0.75 cm (Fig. 1). Estimates from the LRLs show that the squids from which the beaks came had a mean weight of 312 g and that they contributed about 15% of the weight of flesh represented by beaks in the collection (Table II). The presence of one buccal mass and six upper beaks with flesh attached in the collection shows that the species lives close to Signy Island. The species is present in 44% of the seals containing lower beaks but these were all collected between late December and late February.

A comparison with beaks of this species collected from stomachs of sperm whales caught off the South Orkneys with a peak LRL of 0.66–0.68 cm and a range of 0.60–0.74 cm shows that these seals eat similar sized squid to the sperm whale (Clarke, 1980).

## FAMILY CRANCHIIDAE

*Galiteuthis* sp.

One small beak with an LRL of 0.26 cm and having unpigmented wings belongs to this genus.

## UNIDENTIFIED TEUTHOID

Ten (20%) beaks belong to a species which cannot be identified at present. All have darkened wings and are similar to *Psychroteuthis* but are smaller than those

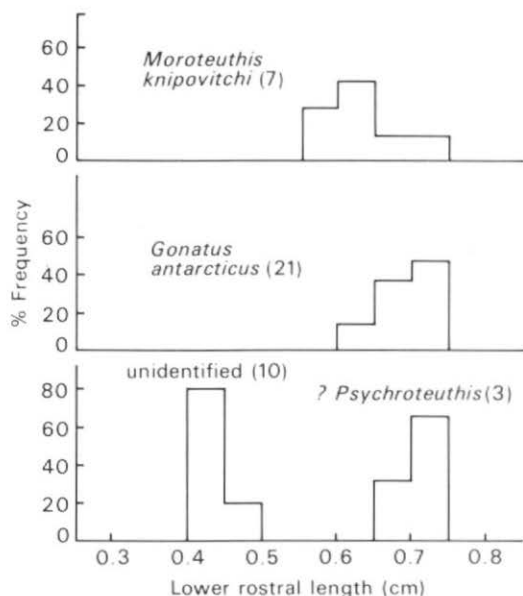


Fig. 1. Frequency histograms of the rostral lengths of the lower beaks of four types of cephalopod eaten by elephant seals.

from sperm whales or Weddell seals, having LRLs in the range 0.41–0.48 cm (Clarke, 1980). This species was in 56% of the seals which contained lower beaks (Table I) and was found from November to February.

#### FAMILY OCTOPODIDAE

##### *Eledoninae* sp. B

Five (10%) of the beaks having crest lengths of 1.7, 2.37, 3.13, 3.52 and 3.91 cm belong to a species in this family. They are probably from a species of the *Eledoninae*, possibly of the genus *Pareledone*. These are large beaks and the rather poor information available (Clarke, 1962b) suggests that they came from octopods which averaged over 5 kg in weight. They contributed an estimated 60% to the weight of flesh represented by beaks. All five beaks, however, were taken from one seal and consumption of this species may not be very common. Four beaks of this species were taken from Weddell seals (Clarke and MacLeod, 1982) but the other *eledonid*, found in great abundance in the Weddell seals, is absent from this collection.

#### DISCUSSION

While the present collection is very small it does indicate that *Gonatus antarcticus* and an unidentified teuthoid are regular components of the seals' diet and the former is important in the diet. All other species were found in less than 22% of the seals which contained lower beaks but the larger species, particularly the octopod, *Moroteuthis knipovitchi* and *Kondakovia longimana*, may be very important in the diet at times.

The mean weight of the squids represented by beaks is estimated as 391 g while that of the octopods is 5259 g. Clearly, the seals would benefit by catching the large, high-protein octopods when available and perhaps the small percentage in the diet may indicate that they are infrequently encountered in the inshore waters round Signy Island.

The proportion and occurrence of *Gonatus antarcticus* in the diet is greater than in the sperm whale and Weddell seal diets to which it contributes only about 3% (Clarke, 1980) and 1% (Clarke and MacLeod, 1982), respectively. The elephant seal diet also differs most clearly from that of the Weddell seals studied in having far fewer *Moroteuthis knipoviichi* (14% compared with 31%) and no *Brachioteuthis*, while including the unidentified teuthoid species. Some of these differences, such as the numerical abundance of the small octopods (33%) in Weddell seals, may be the result of a difference in the season of sampling. However, the overlap in seasonal coverage is sufficient to suggest that there is a real difference between the teuthoids eaten by the Weddell and elephant seals. They are from different localities, which may account for the absence of *Brachioteuthis* in the elephant seals and the unidentified teuthoid in the Weddell seals. Both *Moroteuthis knipoviichi* and *Gonatus antarcticus* are living in the seas around the two island groups so that the difference in the diets of the two seals may indicate a real preference by the seal species.

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#### REFERENCES

- CLARKE, M. R. 1962a. Stomach contents of a sperm whale caught off Madeira in 1959. *Norsk Hvalfangsttidende*, **51**, 173-91.
- CLARKE, M. R. 1962b. The identification of cephalopod 'beaks' and the relationship between beak size and total body weight. *Bulletin of the British Museum (Natural History)*, **8**, 419-80.
- CLARKE, M. R. 1980. Cephalopoda in the diet of sperm whales of the southern hemisphere and their bearing on sperm whale biology. *'Discovery' Report*, **37**, 1-324.
- CLARKE, M. R. and MACLEOD, N. 1974. Cephalopod remains from a sperm whale caught off Vigo, Spain. *Journal of the Marine Biological Association of the U.K.*, **54**, 959-68.
- CLARKE, M. R. and MACLEOD, N. 1976. Cephalopod remains from sperm whales caught off Iceland. *Journal of the Marine Biological Association of the U.K.*, **56**, 733-49.
- CLARKE, M. R. and MACLEOD, N. 1982. Cephalopod remains in the stomachs of eight Weddell seals. *British Antarctic Survey Bulletin*, No. 57, 33-40.
- CLARKE, M. R., MACLEOD, N. and PALIZA, O. 1976. Cephalopod remains from the stomachs of sperm whales caught off Peru and Chile. *Journal of Zoology, London*, **180**, 477-93.
- KING, J. E. 1964. *Seals of the world*. London, British Museum, 154 pp.
- LAWS, R. M. 1960. The southern elephant seal at South Georgia. *Norsk Hvalfangsttidende*, **49**, 466-76.