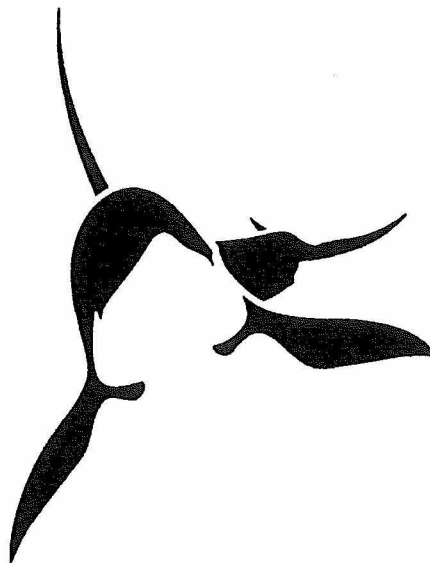


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STOMACH CONTENTS FROM SPERM WHALES STRANDED IN DENMARK

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INTRODUCTION Diets of sperm whales stranded in the North Sea and adjacent areas have previously been described by Lick *et al.* (1995), Santos *et al.* (1995, 1996) and Clarke (in press).

On the 27 March 1996, a group of 16 sperm whales stranded at Rømø Island, in the Danish Wadden Sea. To date, this is one of the largest mass strandings in the North Sea and is the largest number of whales ever found beached on the Danish coastline.

The present paper describes the findings from dietary analysis on these animals, together with stomach contents from three other whales stranded in previous years in Denmark. Results from Danish strandings are compared with results from previous mass and single strandings in Scotland.

MATERIALS AND METHODS The group of 16 sperm whales stranded at Rømø Island was discovered several days after the whales had beached and was therefore in an advanced stage of decomposition. All of the whales were measured and samples of blubber, skin and teeth were collected. Food remains, consisting mainly of cephalopod beaks and a fish bone in one case, were collected from four whales. It was not possible to obtain more samples or to examine the entire digestive tract in any of the cases. The remaining three samples were collected from single animals stranded in Denmark in previous years:

- a single whale stranded near Nymindegab on 17th November 1990
- a single animal stranded near Fanø on 1st December 1991
- a single stranding near Skagen on 25th January 1996

All the stomach contents collected were returned to the laboratory, washed clean, and stored in 70% alcohol. Cephalopod beaks were identified using reference collections and published guides (Clarke, 1980, 1986). Standard measurements (rostral length for squid species; Clarke, 1986) were taken on both upper and lower beaks using a binocular microscope fitted with an eyepiece graticule. Mantle length and body weight of the animals were estimated using regressions from Clarke (1986). The relative importance in the diet for each prey type was estimated as proportion of total prey weight.

Whale weight was estimated from whale length using a published regression (Lockyer, 1976). The quantity of food required by each sperm whale per day was calculated using the figure 3.0-3.5% of body weight per day (Lockyer, 1981). The number of days feeding represented by food remains in the stomachs was estimated by comparing these numbers with the estimated prey weight.

RESULTS All the whales were males, 11-13 m in length. The age of the whales from the mass stranding ranged from 20 to 34 years. The age of the remaining animals has not yet been estimated.

RESULTS All the whales were males, 11-13 m in length. The age of the whales from the mass stranding ranged from 20 to 34 years. The age of the remaining animals has not yet been estimated.

Of the cephalopod remains found in the whales from the mass stranding (1,170 upper beaks and 619 lower beaks), the squid *Gonatus* sp. (probably *Gonatus fabricii*) was the most important prey item (Table 1) making up 99.78% of the diet by weight. Beaks of other oceanic species such as *Teuthowenia megalops* and *Histioteuthis bonnellii* were also found. In two cases, fish remains were found (a fish bone and an eye lens). *Gonatus* sp. was the only prey identified in the single strandings.

Table 1. Main prey species of the Danish sperm whales (Whale A: stranded 11/90 near Nymindegab, B: stranded 12/91 near Fanø, C: stranded 1/96 near Skagen, 1, 5, 12: mass stranding 3/96; UB: upper beaks, LB: lower beaks)

PREY SPECIES	SINGLE STRANDINGS			MASS STRANDINGS			
	Whale A	Whale B	Whale C	Whale 1	Whale 5	Whale 8	Whale 12
<i>Gonatus</i> sp.	279 UB 121 LB	1 LB	670 UB 642 LB	-	98 UB 19 LB	1 UB	1064 UB 594 LB
<i>Histioteuthis bonnellii</i>	-	1 LB	-	-	-	-	2 LB
<i>Teuthowenia megalops</i>	-	-	-	-	-	-	4 LB
Unidentified cephalopod	-	-	-	-	2 UB	-	5 UB
Fish remains	-	-	-	fish (?) bone	-	-	1 eye lens

The days food represented by the prey found never surpassed 1 day (Table 2). The dorsal mantle length estimated of the majority of *Gonatus* varied between 185-275 mm (Fig. 1).

DISCUSSION Over the last few decades, there has been an apparent increase in the number of sperm whales stranded in the North Sea. Some authors suggest that this increase could be due to a recovery of population numbers of sperm whales after the cease of whaling for this species in 1985 (Smeenk, in press).

The squid *Gonatus* was the main prey recorded in several other strandings of sperm whales in the North Sea (Table 3). In the Scottish strandings other species such as the deep-sea octopus *Haliphron atlanticus* were also found, together with the coastal species *Loligo forbesi* and the octopus *Eledone cirrhosa*.

Table 2. Food consumption of the Danish sperm whales (D5, D12: whales from the mass stranding, DA: 17/11/90 near Nymindegab, DC: 25/1/96 near Skagen)

WHALE CODE	TOTAL LENGTH (M)	WHALE WEIGHT (TONS)	DAILY FOOD INTAKE (KG)	WEIGHT PREY (KG)	DAILY RATIONS
D5	12.95	21.87	710.84	24.95	0.03
D12	12.15	18.36	596.88	246.88	0.41
DA	11.85	17.15	557.36	60.55	0.11
DC	13.10	22.57	733.62	162.26	0.22

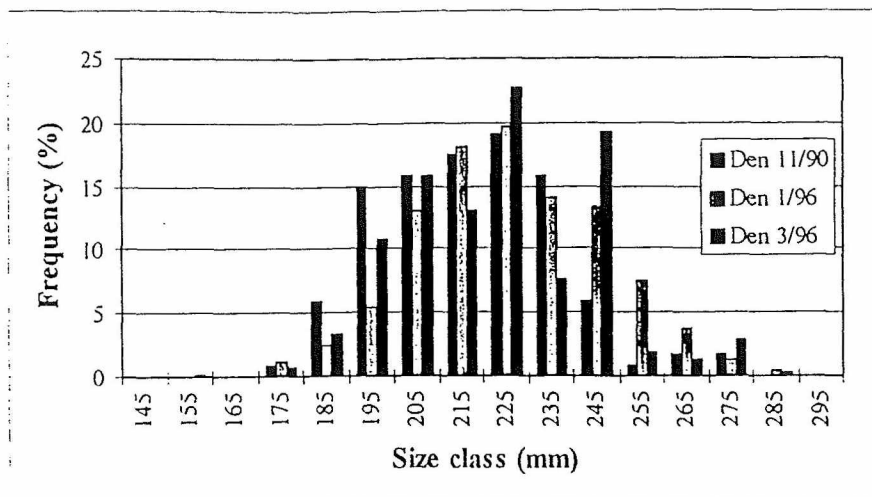


Fig. 1. Size distribution for *Gonatus* sp. (Den 11/90: single stranding on November 1990, Den 1/96: single stranding on January 1996, Den 3/96: mass stranding on March 1996).

Gonatus fabricii is a schooling squid species considered to be the most abundant squid in the Arctic and Subarctic area of the North Atlantic (Kristensen, 1983). Juvenile squid (mantle length < 50 mm) are caught in the surface layers. At mantle length of 50-70 mm *Gonatus* disappears from the surface, probably moving to deeper waters. At a pen length of about 200 mm, and 2 years of age, the males are probably mature. Females mature at about 2-3 years and mantle length larger than 200 mm. Females probably die after spawning while males could survive one spawning and breed twice. The main spawning period takes place from December to April. Areas of spawning have not been identified (Kristensen, 1983, Bjørke, 1995).

The length estimated of the majority of *Gonatus* corresponded with the size of mature, possibly spawning animals. Similar results were found for the two mass strandings in Scotland (Fig. 2).

Table 3. Main prey species in the stomach contents of sperm whales stranded in the North Atlantic

Stranding	1 whale	1 whale	1 whale	11 whales	1 whale	1 whale	6 whales	16 whales
Date	17 Nov 90	3 Nov 94	4 Nov 94	7 Dec 94	1 Mar 95	25 Jan 96	28 Jan 96	27 Mar 96
Place	Denmark	Holland	Germany	Scotland	Scotland	Denmark	Scotland	Denmark
Sample size	1	1	1	4	1	1	5	4
<i>Gonatus</i> sp.	670	2000	186	17 - 4260	1439	279	72 - 1432	0 - 1064
Other prey	-	-	-	Fish egg capsule	-	-	Fish lens, egg capsule	Fish bone + eye lens
<i>Teuthowenia megalops</i>	-	7	-	1 - 3	60	-	1 - 31	0 - 4
<i>Histioteuthis bonnellii</i>	-	-	1	1 - 3	2	-	0 - 84	0 - 2
<i>Todarodes sagittatus</i>	-	-	-	-	-	-	3 - 10	-
<i>Haliphron atlanticus</i>	-	3	5	1 - 3	3	-	1 - 5	-
Source	This paper	Clarke, in press	Lick <i>et al.</i> , 1995	Santos <i>et al.</i> , 1995	Santos <i>et al.</i> , 1995	This paper	Santos <i>et al.</i> , 1996	This paper

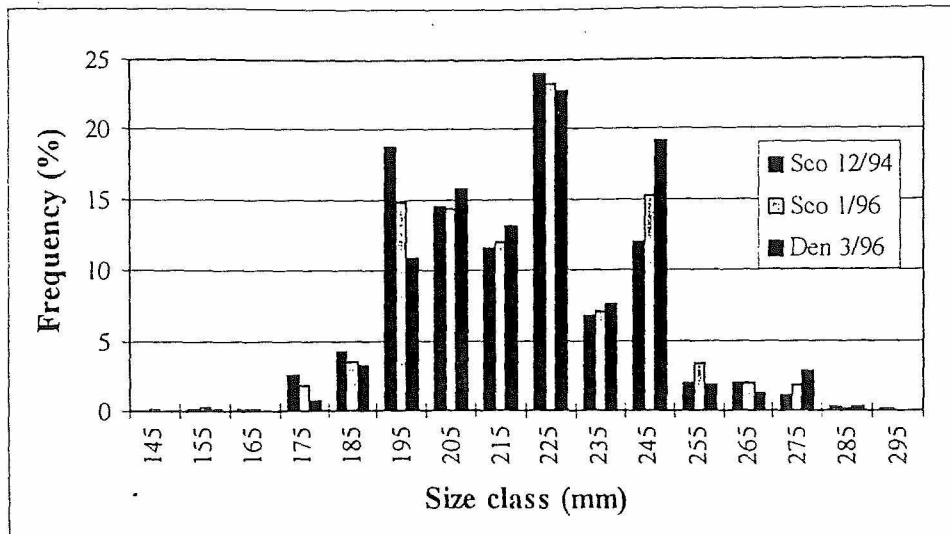


Fig. 2. Size distribution for *Gonatus* sp. (Sco 12/94: mass stranding in Scotland on December 1994, Sco 1/96: mass stranding in Scotland on January 1996, Den 3/96: mass stranding in Denmark on March 1996)

All the stomach contents analysed from sperm whales stranded in the North Sea have contained beaks of mature *Gonatus* sp., and very little else. Most of the strandings have taken place during the winter months. This seems to suggest that sperm whales are feeding on *Gonatus*, probably on spawning aggregations, just prior to their migratory trip back to the breeding grounds. On their way south, instead of following their normal migratory route west of the British Isles, following the deep basin in the North Atlantic they come into the North Sea. Waters in the North Sea are too shallow for this species (in the southern section of the North Sea less than 50 m depth; Smeenk, in press), making it difficult to navigate, which may account for the strandings.

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