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CEPHALOPODS IN THE DIET OF SPERM WHALES CAUGHT COMMERCIALLY OFF DURBAN, SOUTH AFRICA

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A collection from stomach contents of 30 sperm whales *Physeter catodon* comprised a total of 46 cephalopods belonging to six families. Nine species were identified, including *Ommastrephes bartramii,* which is recorded for the first time in the diet of sperm whales caught off South Africa, and *Todarodes filippovae*, which has only previously been identified from whale stomachs to genus. Sexed individuals of all species were female and most were gravid. Comparisons are made with a much larger collection of beaks from the same source and the species identity of some of these can now be established or confirmed.

The diet of sperm whales caught commercially off Durban was studied by Clarke (1980). The work was based mainly upon identification of the chitinous lower mandibles or "beaks" which usually permitted identification to family, genus and often species. From their sizes, it was also possible to estimate the relative contribution to the diet by mass. Supplementary collections of complete cephalopods from the same source were made during each of the years 1970–1973 by scientific personnel at Sea Fisheries, Cape Town (Dr P. B. Best and Mr M. A. Meÿer) and were stored at the South African Museum, Cape Town. A visit to that museum by the first author in 1992 made possible this study of that material by the current authors. They provide additional information and comparisons that confirm or permit identification of lower beaks that were given provisional names in 1980.

MATERIAL AND METHODS

Stomach contents were sampled haphazardly from sperm whales caught commercially off Durban in the years 1970–1973. Any cephalopods which were reasonably complete and not too digested to be identified were collected and stored in formalin and later transferred to ethyl alcohol. During collection there was no intentional selection according to species. In 1992, species, sex, stage of maturity, dorsal mantle length (*DML*), lower rostral length (*LRL*, see Clarke 1980, 1986) and wet mass of each cephalopod specimen was recorded.

RESULTS

The percentage composition of the food items by number and by wet mass are shown in Table I and data on each specimen are given in Table II.

Two species of ommastrephid, *Ommastrephes bartramii* and *Todarodes filippovae,* constituted 52% of the collection by number. The more common of these two, *T. filippovae,* were all females (Table II), of which one was spent (*DML* 315 mm), 16 were gravid (320–530 mm), two were mature or almost so (445–475 mm), and three were maturing (350–500 mm). Their *LRL*s were 9.1–14.1 mm. Wet masses were 557 g for the spent individual and 652–2 337 g for the others. Of the two *Ommastrephes bartramii* identified, one was gravid (*DML* 540 mm, mass 2 709 g, *LRL* 13.3 mm) and one was possibly mature (*DML* 470 mm, mass 1 748 g, *LRL* 12.5 mm) – see Table II.

Two histioteuthids, *Histioteuthis bonnellii corpuscula* and *H. miranda,* constituted another 17% of the collection. The seven for which sex could be determined were female. The *H.b.corpuscula* had *DML*s of 65–75 mm, masses of 120–215 g and *LRL*s of 4.8–5.0 mm. The *H. miranda* had *DML*s of 190–220 mm, masses of 485–574 g and *LRL*s of 6.1–6.8 mm.

Ancistrocheirus lesueuri was represented by five gravid females and two of indeterminate sex, having *DML*s of 250–405 mm, masses of 818–2 935 g and *LRL*s of 7.2–9.0 mm.

Of the octopoteuthids, two *Octopoteuthis rugosa* (*DML* of 190 and 210 mm, mass 274 and 390 g, *LRL* 10.5 and 10.8 mm) were found. One of these could

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Table I: Numbers and wet mass of the species from sperm whale stomachs examined here

Taxon	Number	% number by genus	% number by family	Total wet mass (g) per species (this study)	% mass by species (this study)	% mass by family (this study)	Mean mass (g) per species (this study)	Mean mass (g) from beaks (Clarke 1980, Table 10)
Ommastrephidae			52.2			64.0		
Ommastrephes	2	4.4		4 457	7.9		2 229	
Todarodes	22	47.8		31 594	56.1		1 436	2 056
Onychoteuthidae			2.2			2.3		
Moroteuthis	1	2.2		1 298	2.3		1 298	1 373
Ancistrocheiridae			15.2			16.7		
Ancistrocheirus	7	15.2		9 397	16.7		1 342	1 317
Histioteuthidae			17.4			4.9		
Histioteuthis bonnellii	4	8.7		593	1.1		148	152
H. miranda	4	8.7		2 176	3.9		544	608
Octopoteuthidae			10.9			11.8		
Octopoteuthis	2	4.4		664	1.2		332	338
Taningia?	3	6.5		5 998	10.6		1 999	4 803
Lepidoteuthidae			2.2			0.3		
Lepidoteuthis	1	2.2		190	0.3		Condition too poor	
All species	46	100.0	100.0	56 367	100.0	100.0	1 225	

be identified as female. Of the three *Taningia danae,* one was a spent female with a *DML* of 540 mm, a mass of 3 096 g and a *LRL* of 15.9 mm. The other two were too damaged to determine the sex, but one was of similar size to the better specimen.

A single *Moroteuthis robsoni*, which was in very good condition, was a maturing female with a *DML* of 560 mm, a mass of 1 298 g and a *LRL* of 8.5 mm.

Finally, one *Lepidoteuthis grimaldii* was identified, but it was in a very poor condition and could not be accurately measured nor its sex determined.

Clarke (1980) tentatively named and described several kinds of beaks which later systematic work has identified positively. Some of these were discussed by Clarke (1986), but others are listed here for the first time. In the 1980 paper, *Moroteuthis ingens* beaks were called "*Moroteuthis* A", *Alluroteuthis antarctica* beaks were called "*Crystalloteuthis glacialis* Chun, 1906", *Discoteuthis laciniosa* Young & Roper, 1969 beaks were called "?*Discoteuthis*", and *Discoteuthis discus* Young & Roper, 1969 beaks were called "?Large *Psychroteuthis*".

DISCUSSION

The present collection consists entirely of maturing, mature or gravid female squid. This supports the finding of Clarke (1980) that the whales are feeding mainly on, or close to, the spawning grounds of the squid in the vicinity of Durban. However, the present collection shows several pertinent differences from that of the earlier work, which contained no *Ommastrephes bartramii* specimens among the flesh samples and no evidence that any ommastrephids other than *Todarodes* were present among the beak samples. However, their presence in the earlier collection cannot be excluded because the beaks of maturing *O. bartramii* are much the same size and shape as *Todarodes,* although in *O. bartramii* the mature and gravid females are often considerably larger (Clarke 1962, 1986). The unimodal *LRL* peak at 12–13 mm suggests that the majority of ommastrephid beaks belonged to *Todarodes,* as previously suggested, and the present collection shows them to be *T. filippovae* (identified to species on the basis of number and size of median manus suckers on the tentacular clubs and the number of teeth in the rings of these same suckers). The difference between the contribution of *Todarodes* to the diet of whales indicated by flesh remains (31%, see Table 5 of Clarke 1980) and lower beaks (3%) was taken as indicative that the muscular nature of this species slows its digestion relative to other species in the diet, which have soft tissues. The large proportion (48%) in the present flesh collection is probably also attributable to this probability.

The *Moroteuthis robsoni* female was larger than those previously collected from whales off South Africa (*DML* 295–500 mm). *Ancistrocheirus lesueuri* specimens were similar to the previous specimens in size range and sexual condition and did not disagree with the *LRL* to *DML* and wet mass relationships previously published.

Straight comparison of the percentage of species between this and the previous collection is not likely

Table II: Cephalopods from the stomachs of sperm whales off Durban, 1970–1973

Catalogue number	Sex	Maturity	*DML* (mm)	Mass (g)	Beak *LRL* (mm)	Condition	Whale	Date caught	Position of capture	Whale data	
										Length (ft)	Sex
						Ancistrocheirus lesueuri					
SAM S2583	?	?	260	1 023	7.4		U73/103	11/3/1973	30°05′S, 32°43′E	35	♂
–	♂	Gravid	350	1 861	7.2	Good	?				
SAM S2587	♂	Gravid	350	818	7.5	Poor	U71/9	2/3/1971	30°23′S, 31°52′E	33	♂
SAM S2582	?			[558, head]	7.6	Head only, *HL* c. 85 mm	U73/1420	16/7/1973	31°16′S, 30°53′E	40	♀
SAM S2584	♂	Gravid	400	2 935	8.0	Very good; some skin missing	U71/2099	17/8/1971	30°30′S, 31°07′E	33	♀
SAM S2586	♂	Gravid	405	1 461	8.0		U70/1565	5/8/1970	30°16′S, 31°40′E	41	♀
SAM S2585	♂	Gravid	405	1 299	9.0		U73/565	17/4/1973	29°57′S, 32°43′E	37	♂
						Octopoteuthis rugosa					
SAM S2597	?		190	274	10.8	Poor	U73/649	25/4/1973	30°22′S, 31°36′E	31	♂
SAM S2598	♂	Mature?	210	390	10.5	Good; nidamental gland length 80 mm	U73/710	27/4/1973	30°44′S, 30°45′E	33	♀
						Taningia danae					
SAM S2589	♂					Mantle + part of head only	U73/1420	16/7/1973	31°16′S, 30°53′E	40	♀
–	?		c. 520	2 902	16.0	*HL* c. 120 mm	?				
–	♂	Spent	540	3 096	15.9	Spermatophores on mantle; *HL* 140 mm	?				
						Moroteuthis robsoni					
SAM S2588	♂	Maturing	560	1 298	8.5	Nidamental gland length 75 mm	U73/1363	7/7/1973	30°38′S, 31°39′E	39	♀
						Lepidoteuthis grimaldii					
SAM S2596	?		c. 440	[190, mantle]		Poor; mantle only, empty; *FLI* 48% *ML*	U73/11	5/3/1973	31°26′S, 32°47′E	41	♀
						Histioteuthis bonnelli corpuscula					
SAM S2591	♂	?	65	120	4.9		U73/103	11/3/1973	30°05′S, 32°43′E	35	♂
SAM S2590	♂		65	128	4.8		U73/900	12/5/1973	30°15′S, 32°31′E	34	♂
SAM S2591	?		65	130	4.8		U73/103	11/3/1973	30°05′S, 32°43′E	35	♂
SAM S2590	♂	Mature	75	215	5.0		U73/900	12/5/1973	30°15′S, 32°31′E	34	♂
						Histioteuthis miranda					
SAM S2595	♂	Maturing?	190	551	6.1	Nidamental glands lost?	U73/103	11/3/1973	30°05′S, 32°43′E	35	♂
SAM S2592	♂	Maturing?	200	574	6.2	Nidamental glands lost?	U73/710	27/4/1973	30°44′S, 30°45′E	33	♀
SAM S2593	♂	Gravid?	c. 200	566	6.7	Nidamental gland and oviducal gland present, large	U73/293	2/4/1973	29°26′S, 32°44′E	33	♂
SAM S2594	♂	Mature?	220	485	6.8	Head + body, *HL* 70 mm; nidamental gland lost; large eggs in ovary	U70/1135	18/6/1970	30°25′S, 31°00′E	34	♀
						Ommastrephes bartramii					
SAM S2580	♂	Mature?	470	1 748	12.5		U73/618	23/4/1973	30°13′S, 32°43′E	32	♀
SAM S2581	♂	Gravid	540	2 709	13.3	*FLI* 48.2% *ML*	U73/21	6/3/1973	29°57′S, 33°53′E	33	♀

(Table II: *continued*)

Catalogue number	Sex	Maturity	*DML* (mm)	Mass (g)	Beak *LRL* (mm)	Condition	Whale	Date caught	Position of capture	Whale data	
										Length (ft)	Sex
						Todarodes fillippovae					
SAM S2578	♂	Spent	315	557	9.3	Gelatinous	U71/2099	17/8/1971	30°30′S, 31°07′E	33	♀
SAM S2575	♂	Gravid	320	652	9.1	*SD-T* 13.7 mm = 4.3% *ML*	U70/1135	18/6/1970	30°25′S, 31°00′E	34	♀
SAM S2569	♂	Maturing	350	843	11.6		U73/926	13/5/1973	29°44′S, 32°14′E	36	♀
SAM S2576	♂	Maturing	360	942	11.7		U71/11	2/3/1971	31°41′S, 31°00′E	34	♂
SAM S2572	♂	Gravid	370	1 235	11.7		U73/418	10/4/1973	31°38′S, 30°41′E	34	♀
SAM S2566	♂	Gravid	385	1 229	12.3	Arms and suckers good	U73/612	23/4/1973	30°13′S, 32°43′E	35	♀
SAM S2577	♂	Gravid	390	1 892	14.1	Spermatophores on buccal membrane	U70/478	9/4/1970	29°55′S, 32°13′E	38	♀
SAM S2577	♂	Gravid	395	1 654	13.6	Spermatophores on buccal membrane	U70/478	9/4/1970	29°55′S, 32°13′E	38	♀
SAM S2574	♂	Gravid	415	1 610	11.9	Head + body	U73/249	26/3/1973	29°27′S, 34°04′E	35	♂
–	♂	Gravid	425	1 152	12.4	Both clubs damaged; lower rostral tip worn	?				
SAM S2567	♂	Gravid	435	1 519	12.0	Good; lower rostral tip worn; 9 teeth in median manus suckers	U72/9	4/3/1972	30°23′S, 31°18′E	35	♂
SAM S2570	♂	Gravid	445	1 700	12.2	Good; round spermathecae on lip	U73/293	2/4/1973	29°26′S, 32°44′E	33	♂
SAM S2573	♂	Mature?	445	1 185		Head + body, beak missing; poor; mantle almost empty	U71/134	9/3/1971	31°29′S, 30°41′E	37	♂
–	♂	Gravid	455	1 491	13.4	Poor	?				
SAM S2568	♂	Gravid	460	2 337	12.0	Lower rostral tip damaged	U70/556	19/4/1970	30°41′S, 32°32′E	38	♀
SAM S2565	♂	Gravid	470	1 650	12.8	Poor; jaw angle not recessed	U73/136	16/3/1973	30°04′S, 32°49′E	32	♀
SAM S2564	♂	Almost mature	475	1 615	11.3		U73/595	23/4/1973	29°57′S, 32°43′E	35	♀
SAM S2571	♂	Gravid	490	2 128	12.0	10 teeth in median manus suckers	U73/26	6/3/1973	29°57′S, 33°47′E	34	♂
SAM S2569	♂	Maturing	500	1 120	13.1	Jaw angle deeply recessed	U73/926	13/5/1973	29°44′S, 32°14′E	36	♀
SAM S2564	♂	Gravid	515	2 160	12.1	10–11 teeth in median manus suckers	U73/595	23/4/1973	29°57′S, 32°43′E	35	♀
SAM S2565	♂	Gravid	530	2 113	12.6		U73/136	16/3/1973	30°04′S, 32°49′E	32	♀
						Todarodes ?filippovae					
SAM S2579	♂	Gravid	340	810		Lower rostrum damaged; both clubs damaged	U71/2325	21/9/1971	30°52′S, 30°36′E	27	♀

HL = Head length
FLI = Fin length index as % of mantle length *ML*
SD-T = Sucker diameter of tentacle

to be meaningful because of the haphazard nature of the collection of specimens, the differences in size of the whales and the dates collected. However, it is worth noting that, except for *Taningia danae* and *Todarodes filippovae,* the mean wet masses of the species in the present collection are remarkably similar to those for the same species calculated from *LRL*s of all the beaks in 1980 (Table I). For *Taningia* the difference in size is not likely to be meaningful, owing to the very small number of individuals in the current collection. The 25% difference for *Todarodes* may be accounted for by some of the beaks in the previous collection being misidentified as *Ommastrephes bartramii*, which attains greater mass.

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