

Cephalopod prey of two *Ziphius cavirostris* (Cetacea) stranded on the western Mediterranean coast

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The stomach contents of two Cuvier's beaked whales (*Ziphius cavirostris*), male and female, stranded on the western Mediterranean coast were analysed. Food consisted exclusively of hard cephalopod remains. The character of this teuthophagous diet agrees with the offshore and deep diving behaviour of *Z. cavirostris*.

Data on the diet of *Ziphius cavirostris* Cuvier, 1823 (Desportes, 1985; Heyning, 1989) and, in general, other members of the Ziphiidae (Dixon et al., 1994; Clarke, 1996; Sekiguchi et al., 1996; Lick & Piatkowski, 1998) are very scarce due to the low frequency of strandings.

In the Mediterranean Sea, only three specimens of *Z. cavirostris* have been analysed thus far for diet composition (Desportes, 1985; Podestá & Meotti, 1991; Würtz et al., 1993). The aim of this note is to provide new information about the feeding habits of this species in the western Mediterranean.

An immature female (3.83 m long) of *Z. cavirostris* was found stranded on 25 February 1996, in Chilches (39°47'N 00°09'W); an immature toothless male (5.10 m long) appeared the following day at Pinedo (39°24'N 00°19'W). Methodology for collection, storage and identification of diet items is described in Blanco et al. (1995). Furthermore, the collection of cephalopod beaks of the Department of Animal Biology of the University of Valencia

was used for comparison. Weight and mantle cephalopod length (ML) were estimated (Clarke, 1986a; Würtz et al., 1992).

Stomach contents comprised 526 cephalopod lower beaks of ten species belonging to nine families (Table 1). *Ctenopteryx sicula* (Vérany, 1851) and *Ancistrocheirus lesueurii* (Férussac & Orbigny, 1835) are new prey species for *Z. cavirostris*; species of Ctenopterygidae, Enoploteuthidae and Cranchiidae had not been reported previously from this cetacean species in the Mediterranean (Clarke, 1996). Squids of the latter family have been recorded as prey in Alaskan (Fiscus, 1997) and Atlantic waters (Clarke, 1996; Santos et al., 1996) and are considered common food items for other ziphiids (Clarke, 1996; Sekiguchi et al., 1996).

There are reports of crustaceans and fish in the diet of *Z. cavirostris* (Goodall & Galeazzi, 1985; Heyning, 1989), the latter, which, on occasion, may represent important prey in other ziphiids (Santos et al., 1994). In spite of the differences of prey

Table 1. Diet composition of two *Ziphius cavirostris*, male and female, in western Mediterranean.

	N		LRL range	ML mean		ML max		% N		% W	
	♂	♀		♂	♀	♂	♀	♂	♀	♂	♀
Ommastrephidae:											
<i>Todarodes sagittatus</i>	24	9	6.2–13.2	413.3	438.8	533.8	487.1	6.2	6.4	36.2	39.9
Octopoteuthidae:											
<i>Octopoteuthis sicula</i>	10	16	4.5–13.6	149.8	129.7	235.1	249.2	2.6	11.3	1.8	5.8
Histioteuthidae:											
<i>Histioteuthis bonnellii</i>	29	17	2.4–10.6	114.0	106.5	241.7	206.5	7.5	12.1	34.6	40.0
<i>Histioteuthis reversa</i>	243	18	1.9–5.6	80.7	78.1	124.0	108.0	63.1	12.8	24.4	4.3
Chiroteuthidae:											
<i>Chiroteuthis veranyi</i>	7	23	5.3–2.0	158.9	160.5	171.1	182.3	1.8	16.3	0.6	5.4
Cranchiidae:											
<i>Galiteuthis armata</i>	36	35	2.0–4.4	156.9	153.3	194.1	185.1	9.4	24.8	1.3	3.1
Ctenopterygidae:											
<i>Ctenopteryx sicula</i>	21	18	1.3–2.0	68.0	67.0	79.1	75.2	5.5	12.8	0.5	1.1
Enoploteuthidae:											
<i>Ancistrocheirus lesueurii</i>	13	3	3.1–4.5	119.2	91.6	144.9	101.7	3.4	2.1	0.6	0.2
Sepiolidae:											
<i>Heteroteuthis dispar</i>	2		1.1–1.2	25.3		28.1		0.5		0.0	
Onychoteuthidae:											
<i>Ancistroteuthis lichtensteini</i>		2	2.6–2.8		75.8				1.4		0.2
TOTAL	385	141		149.8	129.7						

N, prey number; LRL, lower rostral beak length; ML, estimated mantle length; W, weight.

digestibility, our data suggest that the diet of *Z. cavirostris* might be mainly teuthophagous, at least in the Mediterranean (see also Podestá & Meotti, 1991; Würtz et al., 1993). All cephalopod species found in this study are known to be oceanic and meso- or bathypelagic (Guerra, 1992), which is in agreement with the offshore and deep diving behaviour of Cuvier's beaked whale.

Members of the Histioteuthidae are numerically prominent in the diet of Mediterranean *Z. cavirostris* (Podestá & Meotti, 1991; Würtz et al., 1993), which is consistent with our results (Table 1). Ammoniacal species represent 87.5% and 71.6% of the number, and 63.2% and 56.8% of total biomass of the prey found in the male and the female, respectively. However, *Todarodes sagittatus* (Lamarck, 1798) is an important energy source probably because of its size (up to 3.2 kg of maximum estimated weight) and particularly its muscular body composition, which contrasts with the ammoniacal body of species of *Histioteuthis* (Clarke et al., 1979). Many of the squids consumed (93.5% by the male and 85.8% by the female, which correspond to 63.7% and 57.9% of the total prey mass, respectively) bear photophores. The high representation of bioluminescent squids may simply reflect the abundance of these species in the habitat where *Z. cavirostris* feed. However, bioluminescent squids seem attracted by the lightly pigmented floor mouth of deep-diving cetaceans (Heyning & Mead, 1996), which, in turn, seem able to detect luminescence (Clarke, 1986b). This raises the possibility that *Z. cavirostris* may select bioluminescent prey.

A relatively high number of specimens of the deep-sea families Cranchiidae, Ctenopterygidae and Chiroteutidae occurred in the stomachs of *Z. cavirostris*. This contrasts with the rarity of these families in commercial or scientific trawling in the Mediterranean (Tursi et al., 1994) and, therefore, their life cycles are poorly known (Guerra, 1992). Thus, indirect sampling through diet analysis may assist in the elucidation of the biology of these species. For instance, the high number of *Histioteuthis reversa* (Verrill, 1880) found in the stomach of the male contrasts sharply with trawling where only single captures of these cephalopods normally occur (Tursi et al., 1994); this might suggest the gregarious character of this squid; the suction mechanism of feeding beaked whale described (Heyning & Mead, 1996) would be advantageous in this small cephalopod capture.

The cephalopod prey size from these cetacean specimens shows a wide range (22–533 mm estimated mantle length) but 80–90 mm was the most frequent distribution in both cases. Due to the low number of samples, differences in the diet between male and female are difficult to establish.

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REFERENCES

- Blanco, C., Aznar, J. & Raga, J.A., 1995. Cephalopods in the diet of the striped dolphin *Stenella coeruleoalba* from the western Mediterranean during an epizootic in 1990. *Journal of Zoology*, **237**, 151–158.
- Clarke, M.R., 1986a. *A handbook for the identification of cephalopod beaks*. Oxford: Clarendon Press.
- Clarke, M.R., 1986b. Cephalopods in the diet of odontocetes. In *Research on dolphins* (ed. M.M. Bryden and R. Harrison), pp. 281–321. Oxford: Clarendon Press.
- Carke, M.R., 1996. Cephalopods as prey. III. Cetaceans. *Philosophical Transactions of the Royal Society B*, **351**, 1053–1065.
- Clarke, M.R., Denton, E.J. & Gilpin-Brown, J.B., 1979. On the use of ammonium for buoyancy in squids. *Journal of the Marine Biological Association of the United Kingdom*, **59**, 259–276.
- Desportes, G., 1985. *La nutrition des odontocetes en Atlantique Nord-Est (Côtes Françaises. Iles Feroë)*. PhD thesis, Université de Poitiers, France.
- Dixon, J.M., Frigo, L. & Moyle, R.L.C., 1994. New information on the southern bottlenose whale, *Hyperoodon planifrons* (Cetacea: Ziphiidae), from a recent stranding in Victoria, Australia. *Australian Mammalogy*, **17**, 85–95.
- Fiscus, C.H., 1997. Cephalopod beaks in a Cuvier's beaked whale (*Ziphius cavirostris*) from Amchitka Island, Alaska. *Marine Mammal Science*, **13**, 481–486.
- Goodall, R.N.P. & Galeazzi, A.R., 1985. A review of the food habits of the small cetaceans of the Antarctic and Sub-Antarctic. In *Antarctic nutrient cycles and food webs* (ed. W.R. Siegfried et al.), pp. 566–572. Berlin: Springer Verlag.
- Guerra, A., 1992. *Mollusca. Cephalopoda. Fauna Ibérica*, vol. 1. (ed. M.A. Ramos et al.). Madrid: Museo Nacional de Ciencias Naturales, CSIC.
- Heyning, J.E., 1989. Cuvier's beaked whale *Ziphius cavirostris* G. Cuvier, 1823. In *Handbook of marine mammals*. Vol. 4. *River dolphins and the larger toothed whales* (ed. S.H. Ridgway and R. Harrison), pp. 289–308. New York: Academic Press.
- Heyning, J.E. & Mead, J.G., 1996. Suction feeding in beaked whales: morphological and observational evidence. *Contributions in Science. Natural History Museum of Los Angeles County*, **464**, 1–12.
- Lick, R. & Piatkowski, U., 1998. Stomach contents of a northern bottlenose whale (*Hyperoodon ampullatus*) stranded at Hiddensee, Baltic Sea. *Journal of the Marine Biological Association of the United Kingdom*, **78**, 643–650.
- Podestá, M. & Meotti, C., 1991. The stomach contents of a Cuvier's beaked whale *Ziphius cavirostris*, and a Risso's dolphin *Grampus griseus*, stranded in Italy. In *Proceedings of the Fifth Annual Conference of the European Cetacean Society, Sandefjord, 21–23 February 1991. European Research on Cetaceans-5* (ed. P.G.H. Evans), pp. 58–61. Cambridge.
- Santos, M.B., Pierce, G.J., López, A., Barreiro, A. & Guerra, A., 1996. Diets of small cetaceans stranded NW Spain 1994–95. *International Council for the Exploration of the Sea (Marine Mammal Committee)* CM 1996/N:11, 6 pp.
- Santos, M.B., Pierce, G.J., Ross, H.M., Reid, R.J. & Wilson, B., 1994. Diets of small cetaceans from the Scottish coast. *International Council for the Exploration of the Sea (Marine Mammal Committee)* CM 1994/N:11, 16 pp.
- Sekiguchi, K., Klages, N.T.W. & Best, P.B., 1996. The diet of strap-toothed whales (*Mesoplodon layardii*). *Journal of Zoology*, **239**, 453–463.
- Tursi, A., d'Onghia, G., Matarrese, A., Panetta, P. & Maiorano, P., 1994. Finding uncommon cephalopods (*Ancistroteuthis lichtensteini*, *Histioteuthis bonnelli*, *Histioteuthis reversa*) and first record of *Chroteuthis veranyi* in the Ionian Sea. *Cahiers de Biologie Marine*, **35**, 339–345.
- Würtz, M., Podestá, M. & Pulcini, M., 1993. The food of Cuvier's beaked whale (*Ziphius cavirostris* Cuvier, 1823) in the Mediterranean Sea. *European Research Cetaceans*, **7**, 1–13.
- Würtz, M., Poggi, R. & Clarke, M.R., 1992. Cephalopods from the stomachs of a Risso's dolphin (*Grampus griseus*) from the Mediterranean. *Journal of the Marine Biological Association of the United Kingdom*, **72**, 861–867.

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