

# Stomach contents of two Cuvier's beaked whales (*Ziphius cavirostris*) stranded in the Adriatic Sea

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*The stomach contents of two Cuvier's beaked whales (Ziphius cavirostris) stranded along the eastern Adriatic coast were examined. One was a male stranded in 2004 and the other was a newborn stranded in 2008. Milk was found in the newborn's stomach. The prey of the male was only cephalopods belonging mainly to the Teuthoidea. Five families and seven species were identified. Octopoteuthis sicula represented about 50% of estimated prey weight and Chiroteuthis veranyi was the most frequent species (estimated from the quantity of lower beaks). Three species are not listed in the Adriatic fauna, while the other species are found in middle and lower slope cephalopod assemblages in the southern Adriatic Sea.*

**Keywords:** Cuvier's beaked whale, diet, Adriatic Sea

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## INTRODUCTION

Cuvier's beaked whale (*Ziphius cavirostris* G. Cuvier, 1823) has a cosmopolitan distribution in all oceans except in high polar waters, but low encounter rates through most of its range (Heyning, 1989; MacLeod & Mitchell, 2006). It is the only species of the Ziphiidae family present in the Mediterranean Sea that may be isolated from the Atlantic population (Dalebout, 2005).

The Adriatic Sea is a semi-enclosed sea separated from the Ionian Sea by the Otranto Strait (780 m deep, 72 km length; Cushman-Rosin *et al.*, 2001) (Figure 1).

The southern basin, deeper than the northern one, reaches depths of 1223 m and according to Holcer *et al.* (2007) it is probably a suitable habitat for Cuvier's beaked whale, which dives regularly to depths greater than 800 m (Baird *et al.*, 2006). Dives deeper than 500 m are considered to be foraging dives (Tyack *et al.*, 2006). The diet of the species is described from patchy data only (Santos *et al.*, 2001). There are only four publications on stomach contents of Cuvier's beaked whale stranded in the Mediterranean Sea: two analysed from single strandings and two from mass strandings (Podestà & Meotti, 1991; Carlini *et al.*, 1992; Lefkaitou & Pouloupoulos, 1998; Blanco & Raga, 2000). No information is yet available on diet in the Adriatic Sea.

The aim of this paper is to provide the dietary data of this species in the Adriatic Sea by presenting the analysis of two stomach contents obtained from four specimens stranded along the Croatian coast, and if results are able to establish that the species feeds in this area.

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## MATERIALS AND METHODS

The gastro-intestinal tracks analysed in this study came from two whales stranded on Croatian coasts, between 17°00'E and 18°20'E; 42°30'N and 42°55'N (Figure 2): a male, quite decomposed, stranded on Mljet Island (on the southern shore) on 19 April 2004 and a newborn (estimated to be less than one week old according to H. Gomerčić) stranded on 11 June 2008 in Trstenica Bay near Orebić. Also a 5.10 m long male stranded on 2 February 2002 on Korčula Island but could not be considered for the study due to its very advanced state of decomposition. The two most distant strandings were 50 km apart.

The two decomposed carcasses had been identified using DNA analysis to confirm the identifications (Gomerčić *et al.*, 2006).

Cephalopod beaks were identified using published cephalopod guides (Clarke, 1986) and a reference collection of oceanic cephalopod beaks. The total number of prey items per species was estimated according to Clarke (1986) as the number of lower or upper beaks, whichever was higher. Rostral length (LRL) measurements of lower beaks were taken using calipers to an accuracy of 0.01 mm. Mantle length (ML) and body mass of prey were estimated using regression equations given by Clarke (1986). Overall diet composition was calculated expressing the proportion of each cephalopod species number and mass in the total of all prey species.

## RESULTS

Stomach contents were found in two whales: a newborn and one male.

The newborn had only milk in its stomach. The stomach of the male contained food remains consisting only of

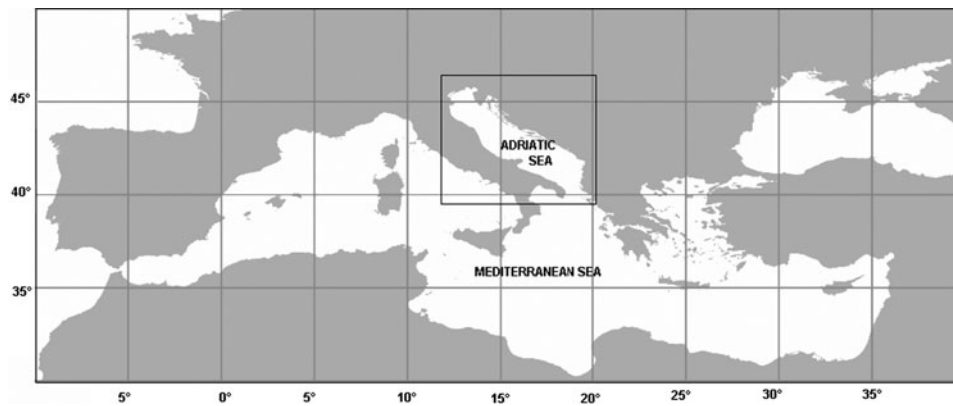


Fig. 1. The position of the study area (Adriatic Sea).

cephalopod beaks: 99 lower and 90 upper beaks belonging to five families and seven species (Table 1).

The higher weight percentage was obtained for *Octopoteuthis sicula* (Ruppel, 1844) and *Histioteuthis reversa* (Verrill, 1880) (Table 1); while *Chroteuthis veranyi* (Férussac, 1834) dominated in terms of prey numbers ( $N = 48$ ). The estimated ML ranged between 46 and 75 mm for *H. reversa* with a mode of 66; between 59 and 119 mm with a mode of 95 and 115 for *Histioteuthis bonnellii* (Férussac, 1834); and between 89 and 170 mm with a mode of 148 for *C. veranyi* (Figure 3).

## DISCUSSION

The prey items found in the stomach of the Mljet Island whale are pelagic cephalopods associated with middle and lower slopes.

*Histioteuthis reversa* and *Histioteuthis bonnellii* have been found in the southern Adriatic basin at depths between

296–567 and 116–787 m respectively, but are also present down to 1000 m deep (Voss *et al.*, 1998).

*Chroteuthis veranyi*, the main prey in number, has also been found in Jabuka Pit and the southern Adriatic basin (Bello, 1990; Krstulović Šifner *et al.*, 2005). The adults of this species are bathypelagic living deeper than 700 m, while the young individuals are found between 300 and 600 m deep (Kaspiris & Tsiambaos, 1984). The ML of *C. veranyi* in the male stomach was less than half of the maximum species size according to Voss *et al.* (1998).

*Octopoteuthis sicula*, the main prey in weight, is not listed in the Adriatic fauna (Bello, 1990), but was found in the eastern Mediterranean Sea (Salaman & Katağan, 2002). This species was also found in the stomachs of Cuvier's beaked whales mass stranding in the Ionian Sea (Lefkaditou & Pouloupoulos (1998).

*Galiteuthis armata* (Joubin, 1898), absent from the Adriatic Sea (Bello, 1990) is rarely found in the eastern Mediterranean Sea (Lefkaditou *et al.*, 2003) but was in both stomachs of the Adriatic whale and the two whales stranded on the Spanish Mediterranean coast (Blanco & Raga, 2000). They reported ten cephalopod prey species: five also found in the Adriatic male (*O. sicula*, *H. bonnellii*, *H. reversa*, *C. veranyi* and *G. armata*) and *Todarodes sagittatus* (Lamarck, 1798), *Chenpteryx sicula* (Vérany, 1851), *Ancistrocheirus lesueurii* (Orbigny, 1842), *Heteroteuthis dispar* (Rüppell, 1844) and *Ancistroteuthis lichtensteinii* (Férussac, 1835).

*Ancistroteuthis lichtensteinii* was found in both whales stranded on the west coast of Italy. Podestà & Meotti (1991)

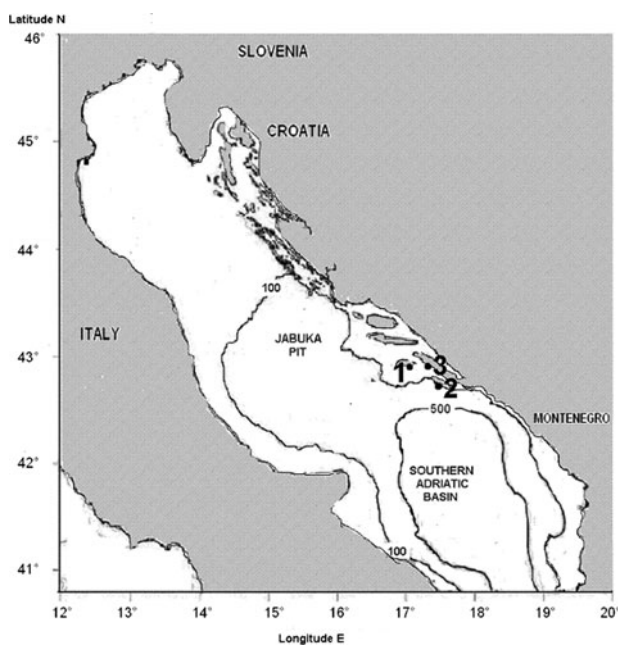


Fig. 2. Stranding locations of Cuvier's beaked whale in the eastern Adriatic Sea. (1) male, Korčula; (2) male, Mljet; (3) newborn.

Table 1. Prey species found in the stomach of Cuvier's beaked whale stranded at Mljet (Croatia) in 2004.

Prey family	Species	N	% N	% estimated weight
Chroteuthidae	<i>Chroteuthis veranyi</i>	48	48.5	17.7
Cranchiidae	<i>Galiteuthis armata</i>	9	9.1	8.0
	<i>Taonius pavo</i>	1	1.0	0.2
Histioteuthidae	<i>Histioteuthis bonnellii</i>	9	9.1	14.6
	<i>Histioteuthis reversa</i>	12	12.1	20.1
Octopoteuthidae	<i>Octopoteuthis sicula</i>	19	19.2	39.1
Sepiolidae	<i>Rossia macrosoma</i>	1	1.0	0.2
Total		99	100	100

Number of individuals (N) and percentages by number (% N) and by wet weight (% wt) in the sample for each prey species (sample size:  $N = 99$ ).

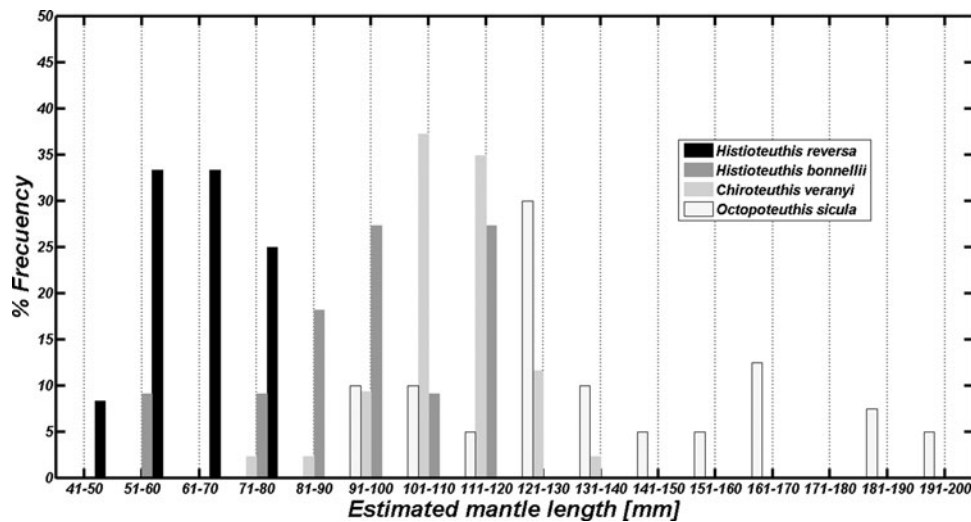


Fig. 3. Frequency distribution of estimated size (dorsal mantle length) of *Histoteuthis bonnellii*, *Histoteuthis reversa*, *Chiroteuthis veranyi* and *Octopoteuthis sicula* eaten by the Mljet Cuvier's beaked whale.

also found *Histoteuthidae* and *Cranchiidae*, and the only octopod found in stomachs of Cuvier's beaked whales stranded in the Mediterranean: *Eledone* sp.

Prey of other specimens stranded in the same area were *H. bonnellii*, *H. reversa*, *T. sagittatus*, *A. lichenstenii*, *O. sicula*, *C. veranyi* and *Heteroteuthis dispar* (Rüppell, 1844), *Ommastrephes barramii* (LeSueur, 1821) (Carlini *et al.*, 1992).

*Histoteuthis bonnellii* had been found in Cuvier's beaked whales' stomachs from all stranding locations in the Mediterranean Sea where stomach contents were examined, suggesting that this species, found in the whole of the Mediterranean Sea (Bello, 1990; Salaman & Katağan, 2002; Lefkaditou *et al.*, 2003), could be an important prey of Cuvier's beaked whale in the area. *Octopoteuthis sicula*, the most important species in weight in the Adriatic whale, was absent only in one whale stranded in Italy.

*Octopoteuthis sicula* and *G. armata*, both species being absent in the Adriatic Sea, their stomach content quantity suggests that the whale fed before entering the Adriatic Sea. However, as the distribution of the deep sea cephalopods is insufficiently known, we cannot exclude feeding in the Adriatic Sea.

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