

# Feeding habits of rabbit fish *Chimaera monstrosa* (Linnaeus, 1758) in deep waters of the Gulf of Cadiz (SW Spain)

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## INTRODUCTION

Little is known about feeding ecology of deep-sea fish species inhabiting the Spanish waters of the Gulf of Cadiz. Such information is useful in better understanding the food web structure within an ecosystem-based framework for fisheries management. Fishing practices such as discarding could be affecting trophic interactions and consequently causing changes in the community structure. Because it is frequently discarded in the Gulf of Cadiz, the rabbit fish *Chimaera monstrosa* is a particularly important species to study.

This study aims to investigate the diet of this species for the first time in the Gulf of Cadiz (SW Spain) to contribute to the knowledge and understanding of the trophic flows in the Gulf of Cadiz marine food web.

**STUDY AREA:** Samples were collected from four ARSA bottom trawl surveys conducted by the IEO in the Gulf of Cadiz from 2008 to 2011. These surveys are focused on the assessment of the most important demersal resources following a stratified random sampling design with daytime hauls at depths ranging from 15 to 800 m (Fig. 1). All surveys were carried out on board the research vessel 'Cornide de Saavedra' (Fig. 2).

**SAMPLING:** From each haul, at least 10 individuals of *Chimaera monstrosa* were chosen at random and set aside for diet analyses. All specimens were measured to the nearest 0.5 mm. The length and weight measurements were the pre-supra caudal fin length (DL, mm) and the wet weight (W, g). Sex, maturity stage and stomach fullness were also recorded. In cases where the stomach was full of food, each prey was separated and identified at the highest taxonomic resolution possible. Besides, the state of digestion of the prey was noted according to an empirical scale (1-3) and whenever possible its total length of prey (mm) was also documented. Finally, the total volume of the stomach content was measured using a trophometer designed by Olaso in 1990 (Fig. 3).

**FEEDING INDICES:** The importance of each food component was measured using the volume percentage (%V) of each prey item:  $%V = V_p / V_t * 100$ , where  $V_p$  was the volume ( $cm^3$ ) of the prey item  $p$  and  $V_t$  was the total prey volume ( $cm^3$ ). When it was not possible to identify the digestive tract contents of rabbit fish the stomachs were excluded from the analyses. Only full stomachs were taken into account in this study. Feeding intensity was evaluated using the vacuity index (%VI) as the percentage of empty stomachs divided by the total number of stomachs examined. Finally, statistical comparisons were made between different sex, size and season groups of *Chimaera monstrosa* using ANOSIM analyses on Bray-Curtis similarity matrices (PRIMER 6.0).

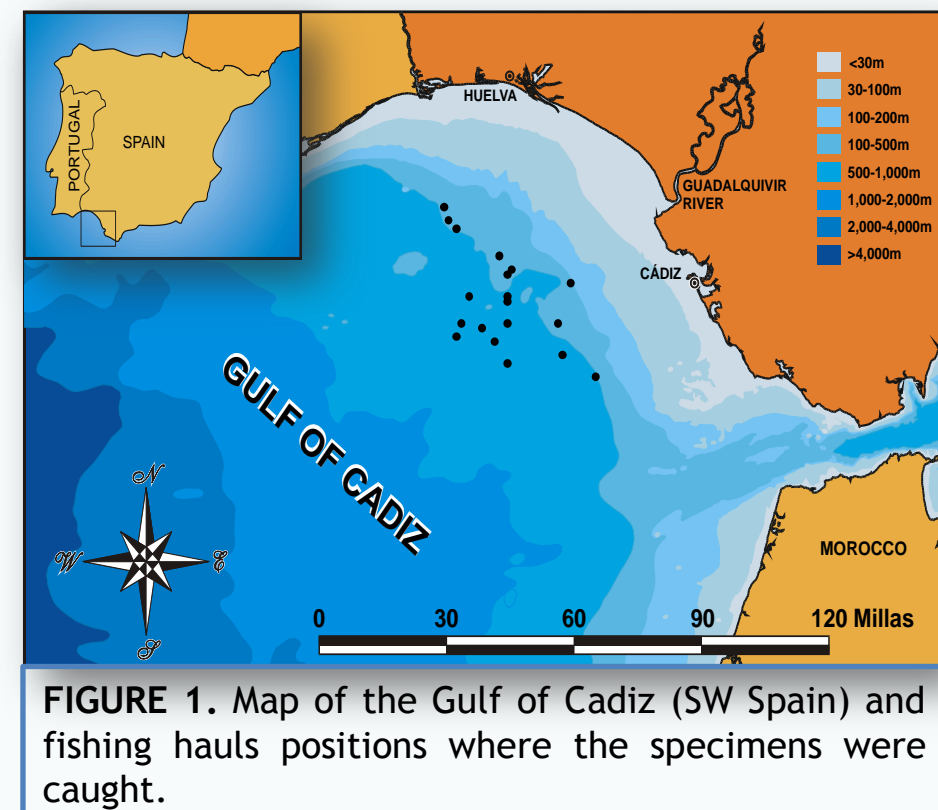


FIGURE 1. Map of the Gulf of Cadiz (SW Spain) and fishing hauls positions where the specimens were caught.



FIGURE 2. Research vessel Cornide de Saavedra (IEO).

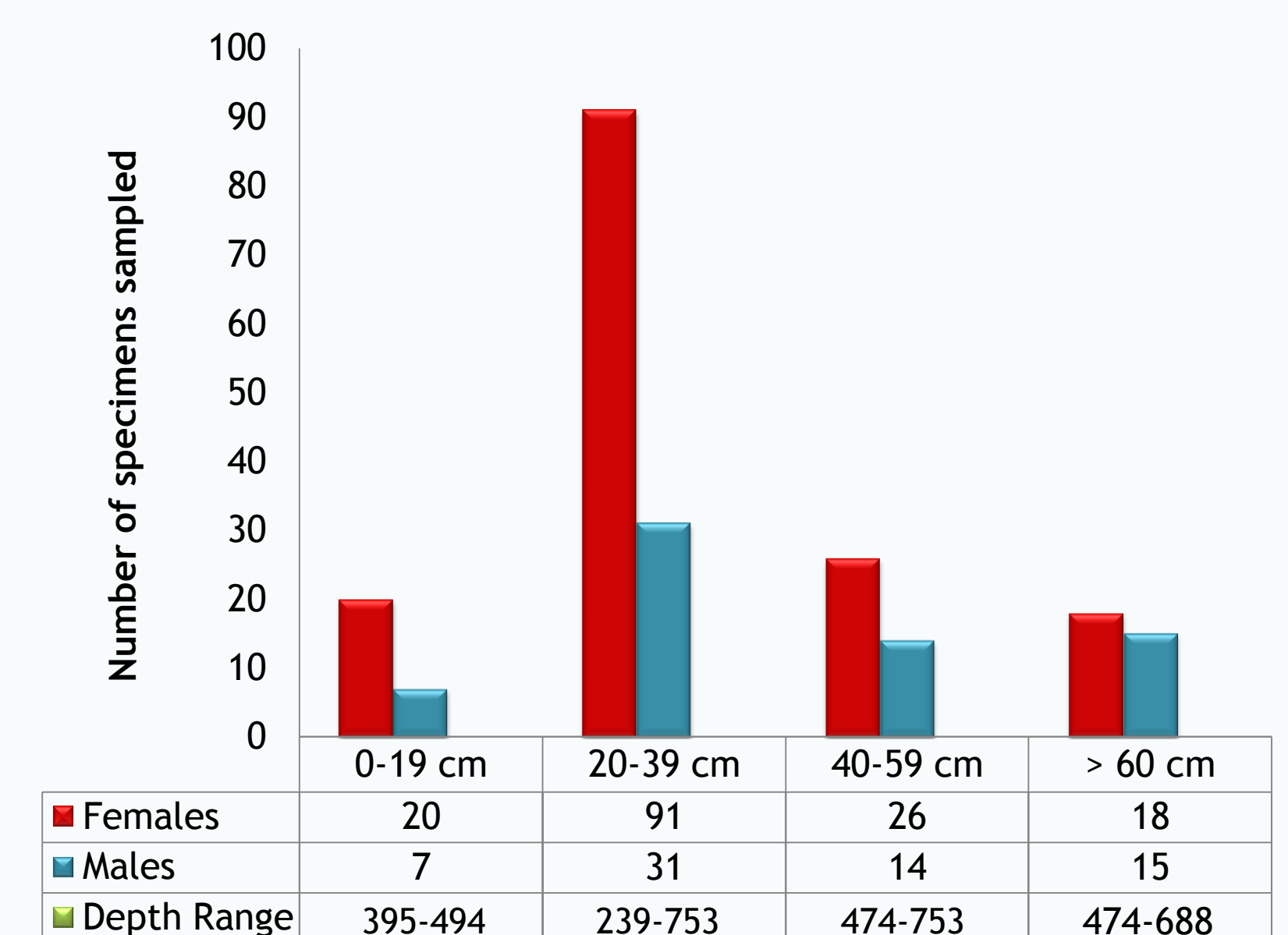


FIGURE 3. Trophometer used to measure the stomach contents.

## RESULTS AND DISCUSSION

The stomach contents of 224 *Chimera monstrosa* specimens were examined. All specimens sampled ranged between 9 and 99 cm (DL) in a depth range of 239 to 753 m (Fig. 4). Most specimens studied ranged between 20 and 40 cm (DL) and the majority were females. The vacuity index was also analyzed in order to estimate feeding intensity. The index value was 13.4 %, indicating that a high number of specimens examined were full, and that *Chimera monstrosa* likely feeds continuously throughout the day, without a particular rhythm.

FIGURE 4. Number of specimens sampled in the diet analyses by size range.



In total, 34 prey categories were identified in the digestive tracts of rabbit fish. The diet of this species was composed mainly of crabs, particularly the angular crab *Goneplax rhomboides* which comprises nearly half of the diet by volume. This crab is the most common species found by Moura et al (2005) in the stomachs of *Chimaera monstrosa* in nearby waters, although it is important to note that those results were based on frequency of occurrence rather than volume percentage. Besides crabs, ophiuroids, echinoids, crinoids, amphipods, polychaetes, cnidarians, and other medium-sized benthic prey such as shrimps, isopods and euphausiids were also components of the *Chimera monstrosa* diet within the study area (Fig. 5). Results reveal that this chimaeroid species feeds primarily on benthic organisms, showing a very close relationship with the sea bed in its feeding habits and the ventral orientation of its mouth, which agrees with most authors (Macpherson, 1980; Moura et al., 2005; Saldanha et al., 1995).

No sex differences were found in the diet of this species in the study area. However, seasonal and ontogenetic significant changes were observed.

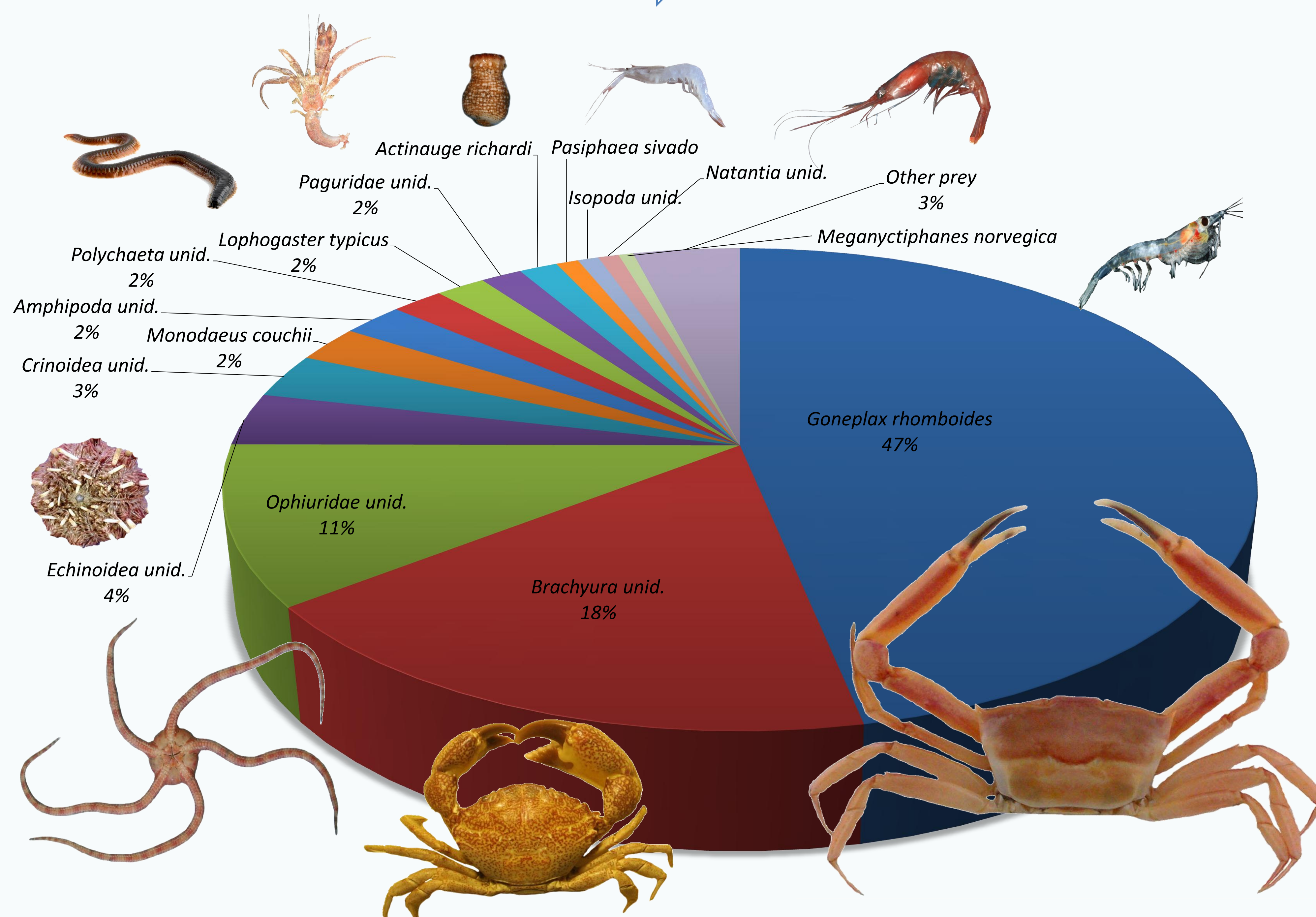


FIGURE 5. Volume percent distribution of identified prey for *Chimaera monstrosa* analyzed in the Gulf of Cadiz (SW Spain). Prey items without percentages comprise less than 2% of the diet.

## REFERENCES

- Macpherson, E. 1980. Food and Feeding of *Chimaera monstrosa*, Linnaeus, 1758, in the Western Mediterranean. Journal Du Conseil 39 (1), 26-29.
- Olaso, I. 1990. Distribución y abundancia del megabentos invertebrado en fondos de la plataforma cantábrica. Publ. Espec. Inst. Esp. Oceanogr. n° 5, 128 pp.
- Moura, T., Figueiredo, I., Bordalo-Machado, P., Gordo, L.S., 2005. Feeding habits of *Chimaera monstrosa* L. (Chimaeridae) in relation to its ontogenetic development on the southern Portuguese continental slope. Marine Biology Research 1(2), 118-126.
- Saldanha, L., Almeida, A.J., Andrade, F., Guerreiro, J. 1995. Observations on the Diet of Some Slope Dwelling Fishes of Southern Portugal. Internationale Revue Der Gesamten Hydrobiologie 80 (2), 217-234.

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