

## THE IMPORTANCE OF CEPHALOPODS TO TRAWL FISHERIES IN THE WESTERN MEDITERRANEAN

P. SARTOR\*, P. BELCARI\*, A. CARBONELL†, M. GONZALEZ‡, A. QUETGLAS†  
and P. SÁNCHEZ§

The aim of the study was to define the commercial importance of cephalopods caught by trawlers from five Italian and Spanish Mediterranean ports. From summer 1995 to spring 1996, samples of the catches of trawlers were taken on board. The type of fishing activity was recorded and data were collected from at least three commercial hauls for each port, season and bathymetric stratum (<150 m, 150–350 m and >350 m). The species composition and yield of the retained and discarded portions of the catch were noted for each port. From these data the commercial importance of each species was evaluated. Cephalopods were commercially important particularly in the shallower bathymetric stratum (<150 m), where they constituted 8.2–30.0% of the total commercially retained catch. Discarding of cephalopods was minimal by mass in all bathymetric strata, only 0.06–1.69% of the total catch or 0.10–5.23% of the total discarded catch. However, in terms of number of species, the discarded component was notable.

Cephalopods are becoming increasingly important in world fisheries (Boyle 1990), cephalopod landings increasing at a faster rate than total landings of all marine resources for the past few decades (Caddy 1983, Guerra 1992a, Pierce and Guerra 1994). Increased fishing intensity, technological advances in catching and marketing and the growing demand for non-conventional resources has allowed the introduction and acceptance of cephalopods on expanded markets, where they were not previously appreciated (Amarunga 1987). In the Mediterranean Sea, cephalopods have been fished since classical times. There are small fisheries all around the Mediterranean, but fishing effort is greatest in the western basin, where it is carried out by Italy and Spain (Rathjen and Voss 1987). Even if directed mainly at other resources, trawling is responsible for most commercial cephalopod catches in the Mediterranean. The present study therefore evaluates the commercial importance of the cephalopod species exploited by Spanish and Italian trawl fleets in the western Mediterranean.

### MATERIAL AND METHODS

This study was carried out by monitoring the activity of the commercial trawl fleets from five ports along the Italian and Spanish Mediterranean coasts (Fig. 1):

Porto Santo Stefano (northern Tyrrhenian Sea), Vilanova i la Geltrú (Catalan Sea), Fuengirola (Alboran Sea) and Palma de Mallorca and Alcudia (Balearic Sea). All fleets employ otter trawlers utilizing a cod end with a mesh size of about 40 mm.

Spanish and Italian researchers used the same methodology in terms of sampling design and data treatment. From summer 1995 to spring 1996, seasonal samples were collected directly on board trawlers. Fishing activity was monitored without any interference to the normal on-board *modus operandi* (e.g. allocation and duration of the haul, sorting of the catch).

Data were collected from at least three commercial hauls for each port, season and bathymetric stratum (Stratum A <150 m; Stratum B 150–350 m; Stratum C >350 m). The depth strata selected correspond to the fishing grounds of the most important target species, namely red mullet *Mullus barbatus*, hake *Merluccius merluccius* and Norway lobster *Nephrops norvegicus*.

At the five ports, data from a total of 326 commercial hauls, or about 1 000 hours of trawling, were analysed. The species composition of the catch, subdivided by the fishermen into commercially retained and discarded fractions, was determined for each haul in terms of number of individuals and total mass of each species. For each cephalopod species, catch data were standardized to mean catch per hour of trawling ( $\text{kg}\cdot\text{h}^{-1}$ ). This was analysed in relation to the different bathymetric strata.

\* Università di Pisa, Dipartimento di Scienze dell'Uomo e dell'Ambiente, Via Volta 6, 56126 Pisa, Italy. Email: belcari@discat.unipi.it

† Instituto Español de Oceanografía, Centro Oceanográfico de Baleares, Palma de Mallorca, Spain

‡ Instituto Español de Oceanografía, Centro Oceanográfico de Fuengirola, Fuengirola, Spain

§ Consejo Superior de Investigaciones Científicas, Instituto de Ciencias del Mar, Barcelona, Spain

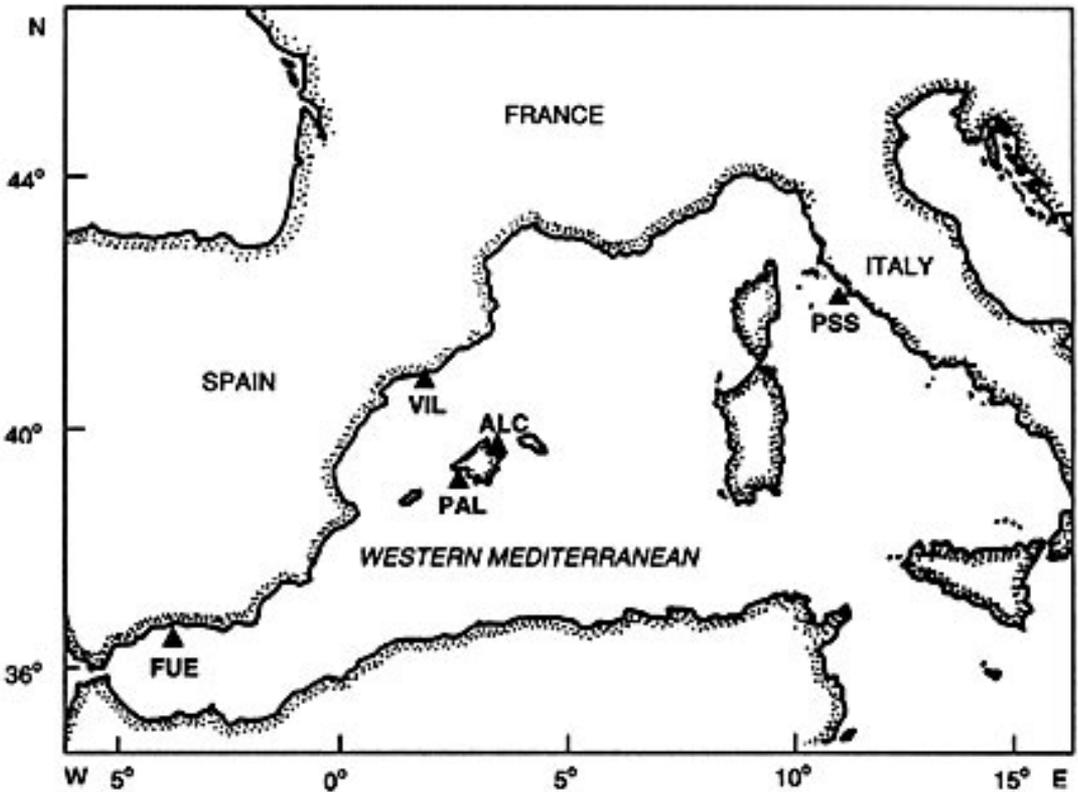


Fig. 1: Map of the study area showing the different sampling ports (PSS = Porto Santo Stefano, VIL = Vilanova i la Geltrú, PAL = Palma de Mallorca, ALC = Alcudia, FUE = Fuengirola)

## RESULTS

At all ports cephalopods represented a commercially important resource, especially in the shallowest bathymetric stratum (<150 m), where their biomass constituted 8.2–30.0% of the commercially retained catch. Catch rates ranged from 3.7 to 18.6 kg·h<sup>-1</sup>. Very few cephalopods were discarded, almost always <1 kg·h<sup>-1</sup>. Discard percentage of cephalopods ranged from 0.06 to 1.69% of the total catch and from 0.10 to 5.23% of the total discards (Table I).

The discard rate of cephalopods increased with depth (Fig. 2), owing to the prevalence of species with little or no commercial value at greater depths (>150 m). That trend was much more evident at Fuengirola. For all ports combined, 0.5–2.9% of the cephalopod catch was discarded in Stratum A, 2.2–33.1% in Stratum B and 8.7–37.6% in Stratum C.

In all, 31 species of cephalopod were found in the catch at the five ports and four taxa were not identified

to species (Fig. 3). Although small in terms of mass, the discarded cephalopod fraction was notable in terms of number of species.

Although there were some minor differences by port and fishing area, there was general consistency across the whole area in terms of species retained for sale. Seven species (*Eledone cirrhosa*, *E. moschata*, *Illex coindetii*, *Octopus vulgaris*, *Loligo vulgaris*, *L. forbesi* and *Sepia officinalis*) were landed almost entirely, their discard percentage usually being <10%. However, practically the entire catch of 13 other species (*Abralia veranyi*, *Ancistroteuthis lichtensteini*, *Bathypolypus sponsalis*, *Brachioteuthis riisei*, *Chiroteuthis veranyi*, *Ctenopteryx sicula*, *Heteroteuthis dispar*, *Histioteuthis bonnellii*, *H. reversa*, *Onychoteuthis banksi*, *Pteroctopus tetracirrhus*, *Rondeletiola minor* and *Sepiolla ligulata*) was discarded. These species, representing more than one-third of the total number of species collected, have no commercial interest in the western Mediterranean and were discarded systematically. The other cephalopod species found (*Alloteuthis media*, *A.*

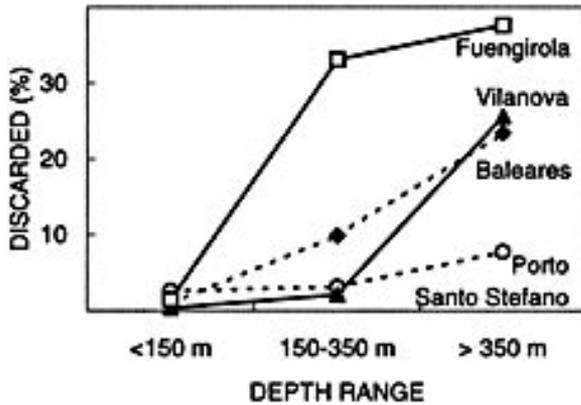


Fig. 2: Percentage of cephalopods discarded in relation to the total cephalopod catch

*subulata*, *Neorossia caroli*, *Octopus salutii*, *Rossia macrosoma*, *Scaevurgus unicolor*, *Sepia elegans*, *S. orbignyana*, *Sepietta oweniana*, *Todarodes sagittatus* and *Todaropsis eblanae*) were not discarded at a uniform

rate, but sometimes with sizeable differences between the fishing areas. For example, the discard percentage of *O. salutii*, *N. caroli* and *R. macrosoma* in the different ports ranged from 0 to 100%.

Figure 4 shows the commercial yield and discards of the most marketable categories in each stratum of the five studied areas. Catch rates were greatest shallower than 150 m. Further, with the exception of Porto Santo Stefano, *O. vulgaris* accounted for the largest catch rate of cephalopods, notably so in the cases of Palma de Mallorca and Fuengirola, where catch rate reached 14.4 and 17.8 kg·h<sup>-1</sup> respectively. At depths of 150–350 m, *E. cirrhosa* and such squid species as *I. coindetii* and *T. eblanae* were dominant in the cephalopod catch. Deeper than 350 m, cephalopod catch rates were low and mostly of species with little or no commercial value.

## DISCUSSION

From the results, it is clear that few cephalopods are discarded from trawlers plying the western Mediter-

Table I: Mean yield per hour of the landed and discarded fractions of the catch, by port and bathymetric stratum

Port	Parameter	Mean yield					
		<150 m		150–350 m		>350 m	
		kg·h <sup>-1</sup>	%	kg·h <sup>-1</sup>	%	kg·h <sup>-1</sup>	%
Porto Santo Stefano	Landed cephalopods	3.74	11.87	3.51	8.45	2.84	12.29
	Discarded cephalopods	0.11	0.35	0.38	0.90	0.27	1.17
	Landed "others"*	18.61	59.08	29.75	70.60	15.10	65.38
	Discarded "others"†	9.04	28.70	8.45	20.05	4.89	21.16
	Total catch	31.5	100.00	42.14	100.00	23.10	100.00
Villanova i la Geltrù	Landed cephalopods	10.36	15.63	3.12	3.66	0.61	1.23
	Discarded cephalopods	0.04	0.06	0.07	0.08	0.21	0.43
	Landed "others"*	22.74	34.30	70.49	82.80	38.09	77.10
	Discarded "others"†	33.16	50.01	11.45	13.45	10.49	21.24
	Total catch	66.30	100.00	85.13	100.00	49.40	100.00
Palma de Mallorca + Alcudia	Landed cephalopods	15.90	8.24	1.76	1.12	0.93	3.94
	Discarded cephalopods	0.08	0.04	0.21	0.13	0.23	0.97
	Landed "others"*	93.69	48.41	63.46	40.50	18.17	77.00
	Discarded "others"†	83.82	43.31	91.26	58.24	4.27	18.08
	Total catch	193.53	100.00	156.70	100.00	23.60	100.00
Fuengirola	Landed cephalopods	18.57	29.97	1.17	2.92	0.83	2.80
	Discarded cephalopods	0.28	0.45	0.58	1.45	0.50	1.69
	Landed "others"*	15.65	25.26	18.29	45.75	16.23	54.52
	Discarded "others"†	27.45	44.32	19.94	49.88	12.20	40.99
	Total catch	61.94	100.00	39.98	100.00	29.77	100.00

\* Essentially finfish and crustaceans

† Finfish, crustaceans, echinoderms, gastropods, algae, etc.

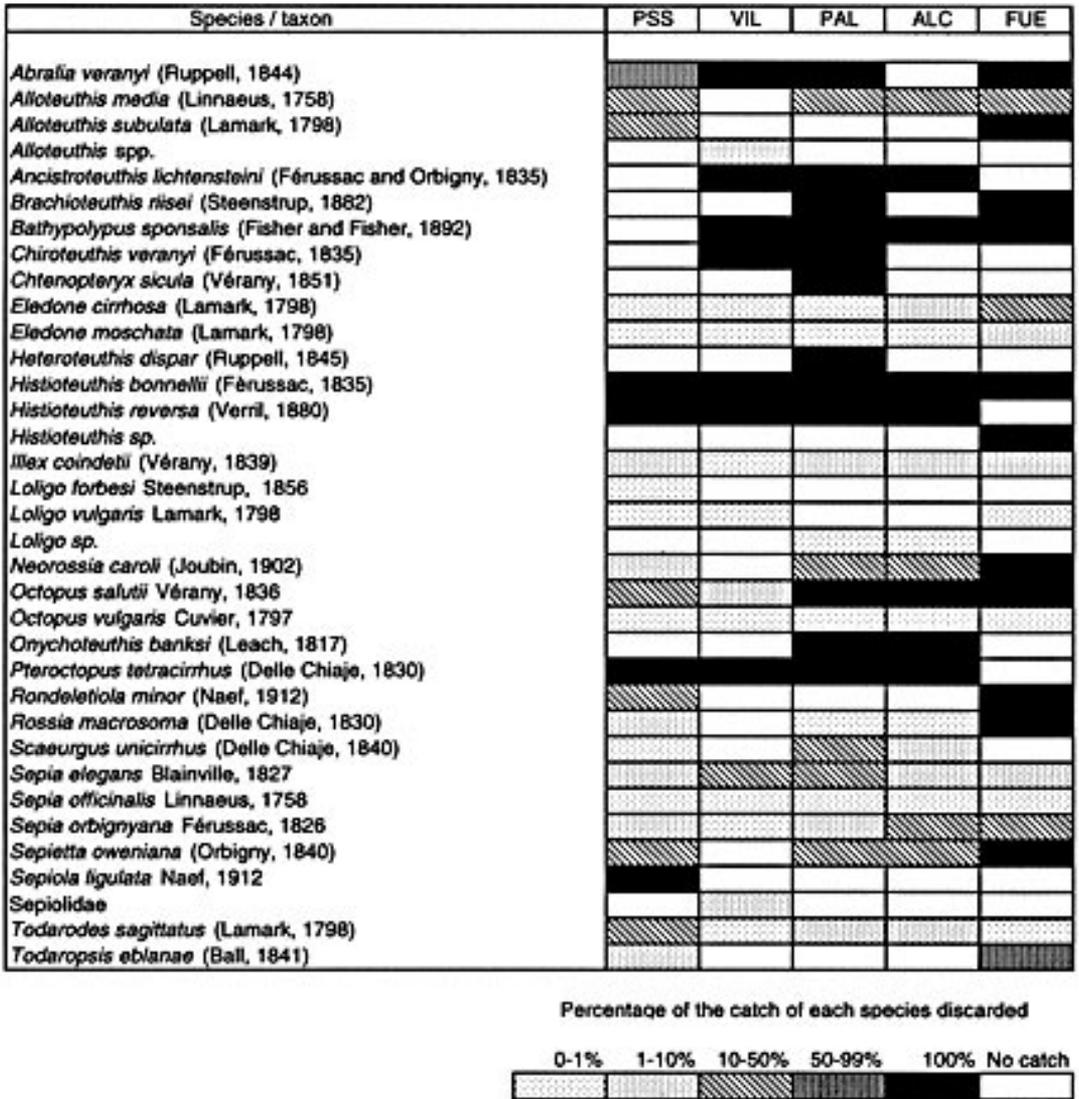


Fig. 3: List of the captured species and their percentage discarded in the studied ports (PSS = Porto Santo Stefano, VIL = Vilanova i la Geltrú, PAL = Palma de Mallorca, ALC = Alcúdia, FUE = Fuengirola); systematic nomenclature according to Guerra (1992b)

anean and that there is a substantial homogeneity of catch and discard behaviour between the fleets of the different ports investigated.

In terms of commercial importance, the current findings agree with some preliminary observations made in the Sicilian Channel by Jereb and Ragonese (1990) and Ragonese and Jereb (1990). Cephalopods

in the Mediterranean represent a resource of great commercial value. This may well be attributable to cultural factors, because cephalopods have been consumed in large quantities by Mediterranean populations since ancient times.

A few species of significant economic importance account almost exclusively for most of the cephalo-

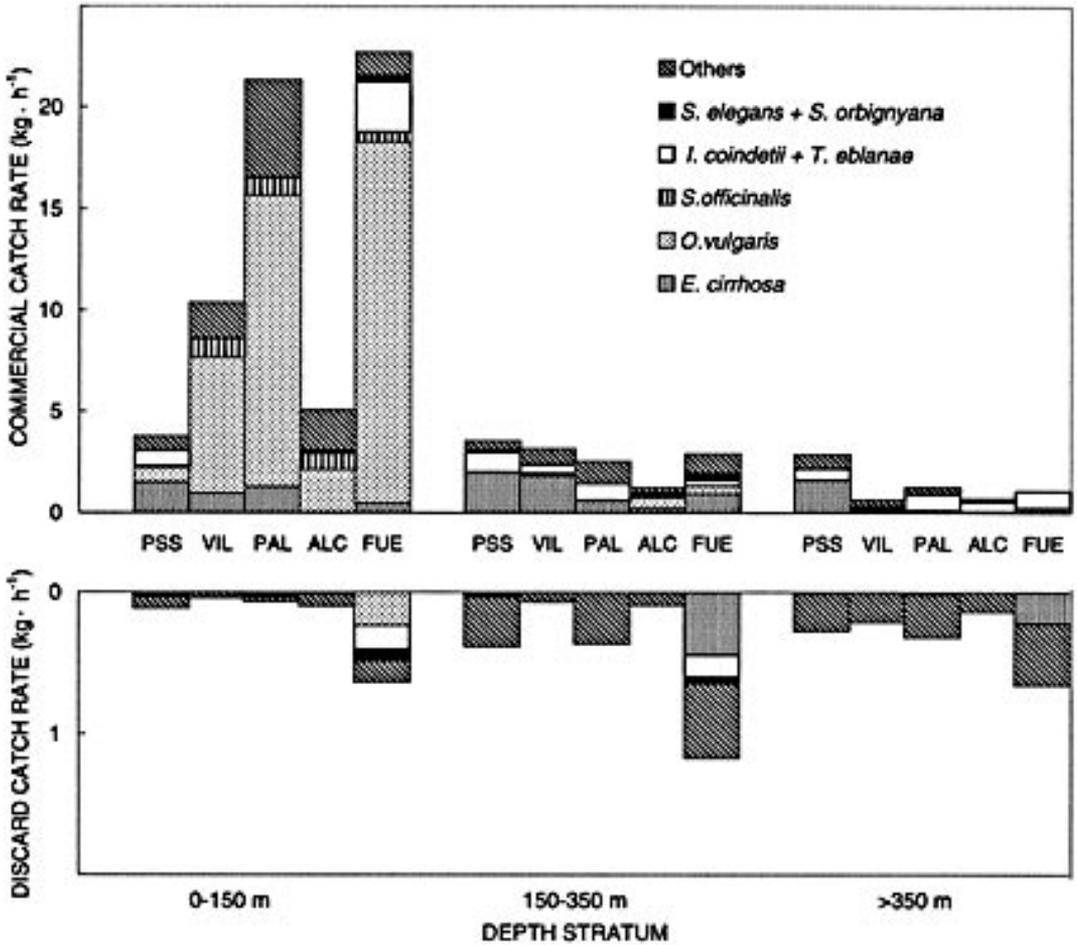


Fig. 4: Commercial yields and discards of the main commercial categories by depth strata and port (PSS = Porto Santo Stefano, VIL = Vilanova i la Geltrú, PAL = Palma de Mallorca, ALC = Alcudia, FUE = Fuengirola)

pod caught by trawl, as revealed by experimental surveys and investigations on landings carried out in the study areas (Belcari and Sartor 1993, Sánchez and Martín 1993, Belcari *et al.* in press). Those species, such as the octopuses *O. vulgaris* and *E. cirrhosa*, the cuttlefish *S. officinalis* and the squid *L. vulgaris*, *L. forbesi* and *I. coindetii*, are almost entirely of commercial interest and very little, if anything, is discarded.

Even if this study was not directed at assessing the cephalopod biomass, it confirms already reported information on the sizeable biomass of *O. vulgaris* off Spain (Sánchez and Martín 1993, Gil de Sola 1994, Gonzales *et al.* 1998) and the considerable

biomass of *E. cirrhosa* in the northern Tyrrhenian sea (Belcari and Sartor 1993). Biomass estimates of the latter species carried out along the western Italian coast identified maximum values in this area (Würtz *et al.* 1992).

In terms of commercial importance of the different species, three groups can be identified in broad outline: species that are almost entirely of commercial interest, species that are always rejected, and species for which the discard percentages in the different ports or even in the same port are variable. *A. media*, *A. subulata*, *S. unicirrhus*, *S. elegans*, *S. orbignyana*, *S. oweniana* and *T. eblanae* are of variable commercial interest, with discard values ranging from 10 to 50%. Their

variable discard rate may well be simply accidental or the result of such local factors as daily market trend. Indeed, specimens of some small species (e.g. *Allo-teuthis* spp. and sepiolids), seem to be discarded accidentally during the fast sorting operations on deck. Only for a few species does the commercial importance vary greatly and constantly between the different areas. Such species are *O. salutii*, *N. caroli* and *R. macrosoma*, considered of fair interest in some ports are of no value in others. In this case, commercial retention depends upon market demand.

Species of no current interest to fisheries all belong to the bathyal fauna. Some of them do have inferior meat quality, whereas others, owing to their large size and the consistency of their flesh, are believed to be a potential resource.

### ACKNOWLEDGEMENTS

We thank the crews of the vessels for their assistance during on-board sampling. The work forms part of a research project financed by the European Community on discards of the trawl fishery in the western Mediterranean (Contract ref. DG-XIV, MED/94/027). We are also grateful to the two anonymous referees whose comments and suggestions greatly improved the manuscript.

### LITERATURE CITED

- AMARATUNGA, T. 1987 — Population biology. In *Cephalopod Life Cycles. 2. Comparative Reviews*. Boyle, P. R. (Ed.). London; Academic Press: 239–252.
- BELCARI, P. and P. SARTOR 1993 — Bottom trawling teutho-fauna of the northern Tyrrhenian Sea. *Scientia Mar., Barcelona* **57**(2-3): 145–152.
- BELCARI, P., SARTOR, P. and S. DE RANIERI (in press) — I cefalopodi nello sbarcato commerciale con reti a strascico del mar Tirreno settentrionale. *Biol. Mar. Medit.*
- BOYLE, P. R. 1990 — Cephalopod biology in the fisheries context. *Fish. Res.* **8**(4): 303–321.
- CADDY, J. F. 1983 — The cephalopods: factors relevant to their population dynamics and to the assessment and management of stocks. In *Advances in Assessment of World Cephalopod Resources*. Caddy, J. F. (Ed.). F.A.O. Fish. tech. Pap. **231**: 416–452.
- GIL DE SOLA, L. 1994 — Ictiofauna demersal de la plataforma continental del mar de Alborán (Mediterráneo suroccidental ibérico). *Boln Inst. esp. Oceanogr.* **10**(1): 63–79.
- GONZALES, M., TORRES, P. and L. GIL DE SOLA 1998 — Preliminary data on the bathymetric distribution of cephalopods in the northern Alboran Sea. *Rapp. Comm. int. Mer Medit.* **35**: 444–445.
- GUERRA, A. 1992a — Cephalopod resources of the world: a present day view. In *Proceedings of the 2nd World Cephalopod Conference, Madrid, November 1991*. London; Agra Europe: 1–13.
- GUERRA, A. 1992b — Mollusca. Cephalopoda. In *Fauna Ibérica 1*. Ramos, M. A. et al. (Eds). Madrid; Museo Nacional de Ciencias Naturales, CSIC: 327 pp.
- JEREB, P. and S. RAGONESE 1990 — Sui Cefalopodi di scarso o nullo interesse commerciale nel Canale di Sicilia. *Oebalia, Suppl.* **16**(2): 689–692.
- PIERCE, G. J. and A. GUERRA 1994 — Stock assessment methods used for cephalopod fisheries. *Fish. Res.* **21**(1–2): 255–285.
- RAGONESE, S. and P. JEREB 1990 — Sulla teutofauna di interesse commerciale del Canale di Sicilia. *Oebalia, Suppl.* **16**(2): 745–748.
- RATHJEN, W. F. and G. L. VOSS 1987 — The cephalopod fisheries - a review. In *Cephalopod Life Cycles. 2. Comparative Reviews*. Boyle, P. R. (Ed). London; Academic Press: 253–275.
- SÁNCHEZ, P. and P. MARTÍN 1993 — Population dynamics of the exploited cephalopod species of the Catalan Sea (NW Mediterranean). *Scientia Mar, Barcelona* **57**(2–3): 153–159.
- WÜRTZ, M., MATRICARDI, G. and P. BELCARI 1992 — Distribution and abundance of the octopus *Eledone cirrhosa* in the Tyrrhenian Sea, central Mediterranean. *Fish. Res.* **13**(1): 53–66.