SCI. MAR., 61 (3): 389-396 SCIENTIA MARINA 1997

Morphometric and biological data on *Ancistrocheirus lesueurii* (Orbigny, 1842) from the middle-eastern Mediterranean Sea*

G. D'ONGHIA, P. MAIORANO and A. TURSI

Department of Zoology, University of Bari, Via Orabona, 4, 70125 Bari, Italy.

SUMMARY: The occurrence of adult specimens of *Ancistrocheirus lesueurii* in the Ionian Sea and the first finding through bottom trawling in the Mediterranean is reported in this paper. Ten females were collected in June 1995 during an experimental survey and in July of the same year from commercial fishing. The specimens were caught during daylight hours at depths between 500 and 580 m. Their size ranged from 175 to 250 mm DML. Morphometric indexes were recorded: FLI was beteween 83.3 and 93 while FWI ranged from 76.4 to 92. Nine individuals had ripe ovaries with exclusively vitellogenic eggs. The largest egg size was 2.6 x 1.91 mm in diameter. Potential fecundity was estimated as 22,205 ± 12,532 eggs.

Key words: Cephalopoda, *Ancistrocheirus lesueurii,* biology, Mediterranean Sea.

RESUMEN: DATOS MORFOMÉTRICOS Y BIOLÓGICOS DE *ANCISTROCHEIRUS LESUEURII* (ORBIGNY, 1842) DEL MEDITERRÁNEO ORIENTAL. – Se recolectaron diez ejemplares hembra de *Ancistrocheirus lesueurii* durante una campaña de pesca de arrastre en el mes de junio de 1995 y de otras pescas comerciales durante el mes de julio de 1996. Los ejemplares fueron capturados en horas diurnas entre 500 y 580 m de profundidad. Las tallas de los ejemplares oscilaron entre 175 y 250 DML. Los índices morfométricos se calcularon para cada estación: FLI entre 83.3 y 93 y FWI entre 76.4 y 92. Ocho individuos presentaron los ovarios maduros con todos los huevos vitelogenéticos. La fecundidad potencial se estimó en 22205 ± 12532 huevos.

Palabras clave: Cefalópodos, *Ancistrocheirus lesueurii,* Mediterráneo.

INTRODUCTION

The fact that marine mammals represent the best sampler of pelagic cephalopods is widely recognized (Clarke, 1966; Clarke and MacLeod, 1974; Clarke *et al.,* 1976; Clarke, 1977). Indeed several species which are considered the main food of sperm whales and abundant in the water column worldwide, are rarely caught with marine biological sampling techniques or conventional fishing gears.

One of these species is *Ancistrocheirus lesueurii* (Orbigny, 1842) (Teuthoidea: Enoploteuthidae, Ancistrocheirinae) whose presence and abundance has been recorded from beaks in the stomachs of cetaceans (Clarke and MacLeod, 1974; Clarke, 1977, 1980; Martin and Clarke, 1986) and sharks (Dunning *et al.,* 1993). The species was mainly found in the juvenile stage, originally described as *Thelidioteuthis alessandrini* (Clarke, 1966), while the capture of adult forms is rare (Joubin, 1900; Hoyle, 1906; Okutani, 1976; Bello *et al.,* 1994).

*Received September 26, 1996. Accepted March 11, 1997.

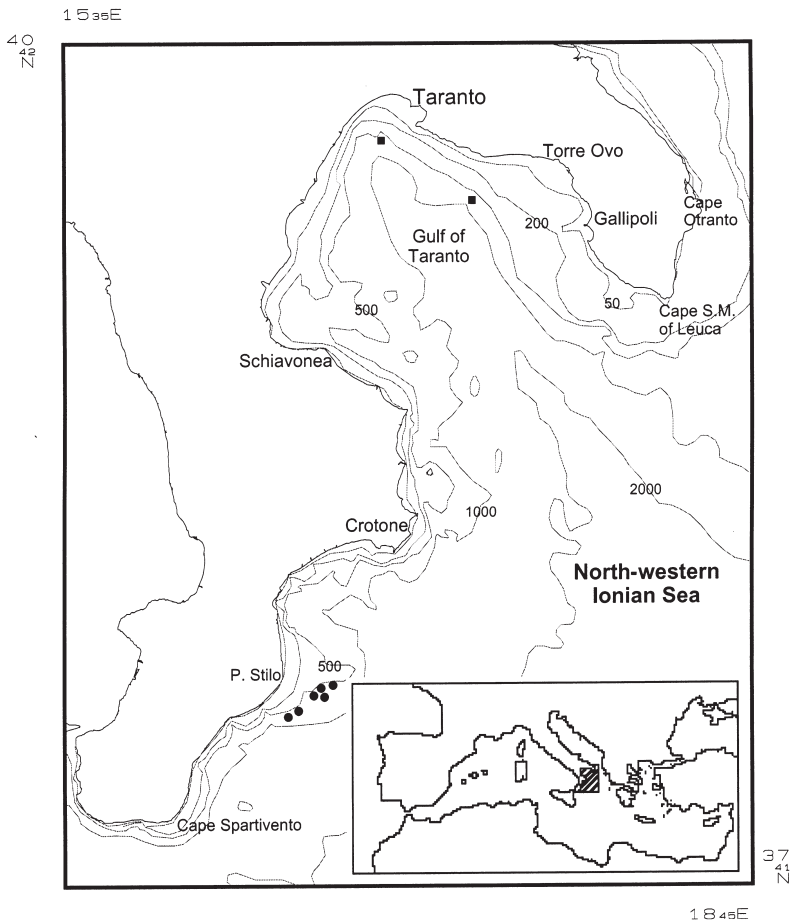

FIG. 1 - Map of the study area in the north-western Ionian Sea, with indication of the commercial (1) and experimental (n) hauls where *Ancistrocheirus lesueurii* was caught in June and July 1995.

In the Mediterranean the first adult specimen was found recently in the Straits of Messina (Bello *et al.*, 1994) although marine faunal studies have long been conducted using various sampling gears. The presence of the species in the eastern Mediterranean, was confirmed by the finding of a beak in the stomach of a swordfish (Bello, 1991). The capture of ten adult specimens by bottom trawl in the Ionian Sea (middle-eastern Mediterranean) is reported in this paper.

MATERIALS AND METHODS

A trawl survey was carried out between 10 and 800 m of depth during June 1995 and some commercial hauls in the upper slope were made during July of the same year in the north-western Ionian Sea (38°12' - 40°20' N; 16°15' - 17°31' E) (Fig. 1).

A commercial vessel of 105 tons gross tonnage, equipped with a nylon experimental otter trawl net, with stretched mesh of 20 mm in the codend, was used during the trawl survey in June. The horizontal and vertical net opening, measured by means of the SCANMAR sonar system and depending on various factors (depth, warp length, towing speed, etc.), ranged from 12.46 to 23.89 m and from 2.89 to 3.69 m respectively (Fiorentini *et al.*, 1994). The same vessel equipped with an Italian type commercial net with stretched mesh of 40 mm in the codend was used for capture of specimens during July.

The station plan adopted for the trawl survey was random. A total of 74 hauls, for one hour (in waters shallower than 200 m) and half an hour (at depths greater than 200 m), were carried out during daylight. Commercial trawls were towed for three hours on average on red shrimp (*Aristaeomorpha foliacea* and *Aristeus antennatus*) grounds.

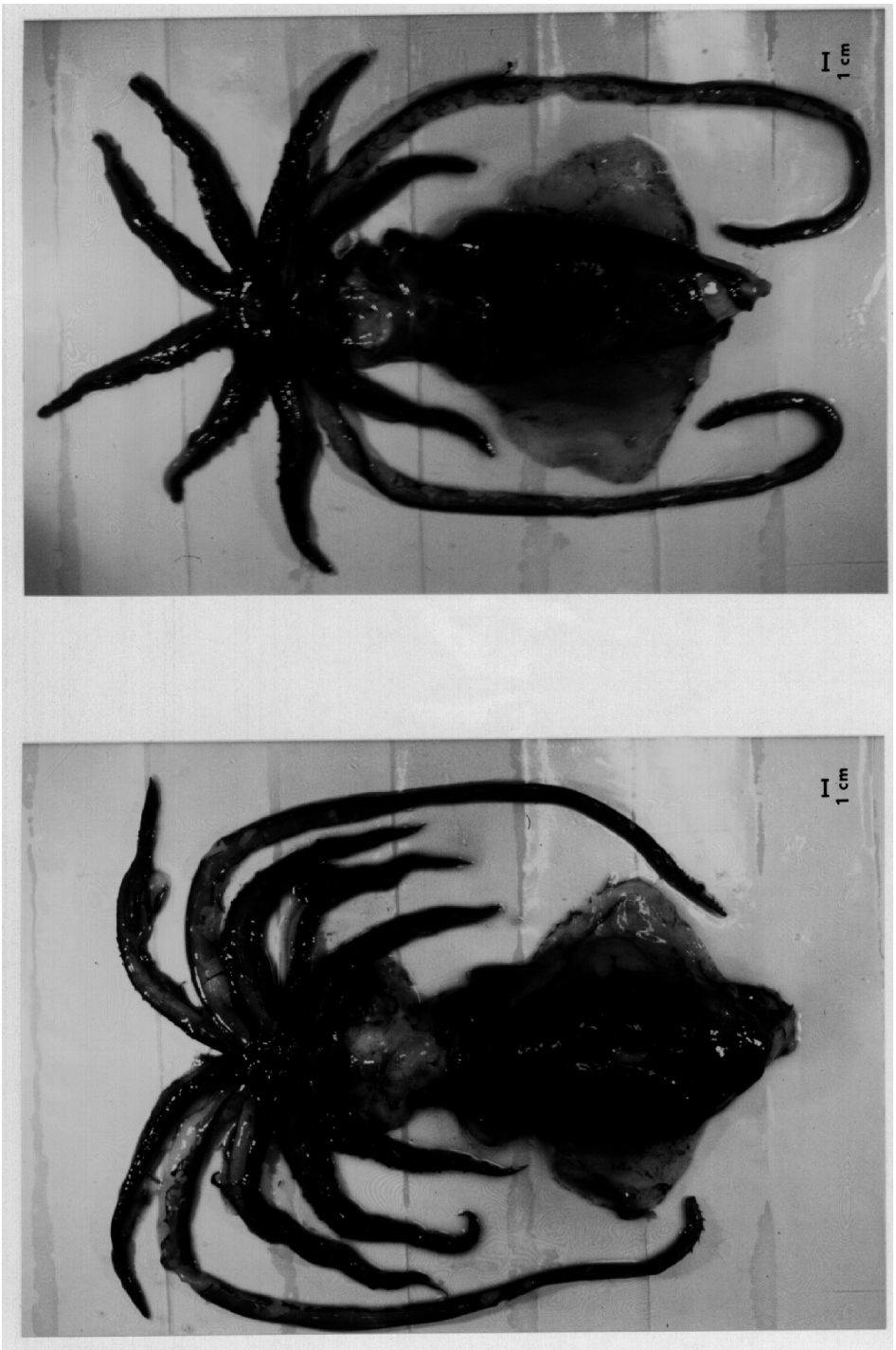

FIG. 2. – Dorsal view (down) and ventral view (up) of a specimen of *Ancistrocheirus lesueurii* caught in the north-western Ionian Sea (middle-eastern Mediterranean) during July 1995.

The species was identified on the basis of the characteristics described by Okutani (1976). Measurements of dorsal mantle length (DML), ventral mantle length (VML), total length (TL), mantle width (MW), head width (HW), fin length (FL), fin width (FW), nidamental gland length (NGL) and nidamental gland width (NGW) were carried out to the nearest mm and body weight (BW) and ovary weight (OW) to the nearest 0.1 g. Morphometric indexes (given measurement as a percentage of dorsal mantle length) of fin length (FLI), fin width (FWI), mantle width (MWI) and head width (HWI) were computed.

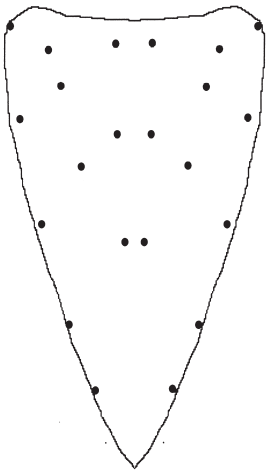

FIG. 3. – Diagram of the photophores distribution on ventral mantle side of *Ancistrocheirus lesueurii* caught in the north-western Ionian Sea.

Fecundity measurements were made from weighed ovary subsamples of 5-10 g. The subsamples were weighed and manually dissected to free the vitellogenic oocytes from the ovarian stroma. All vitellogenic oocytes were counted manually and the total potential fecundity calculated from the number of oocytes per gram times total ovarian weight.

The Spearman nonparametric test (Conover, 1980) was used to evaluate correlation between various parameters.

RESULTS

Three adult specimens of *Ancistrocheirus lesueurii* were found during two experimental hauls carried out in June and seven from commercial fishing, with six different tows, during July. All specimens were collected between 500 and 580 m.

The measurements of the ten specimens are reported in the Table 1.

The specimens show the typical body shape, the conical mantle tapering posteriorly with the fin very broad and rhomboid in outline (Figs. 2 and 3). The consistency was gelatinous, flabby and subject to distortion. Both arms and tentacles were often broken at various distances from their attachment and generally the brownish purple skin of the mantle was stripped off on various parts of the body.

Circular photophores about 4 mm in diameter were present on the ventral and lateral surface of the mantle. As many as 22 photophores were counted on the ventral side of the mantle. Although the position of these light organs was generally in rows of two or four, as in the scheme presented in Fig. 3, it varied from one specimen to another as a consequence of the particular body consistency, dehydration and mobility of the muscular tissue.

Similar light organs were also present on the head whereas on the tentacular stalk they were smaller, up to 12 of them being counted on one specimen.

Hooks covered by muscular hoods arranged in a zig-zag row and suckers closely set in two lines were found respectively on the proximal and distal part of the arms, as shown by Bello *et al.* (1994).

TABLE 1. – Measurements related to each specimen of *Ancistrocheirus lesueurii* caught in the north-western Ionian Sea during June and July 1995.

Month	June '95				July '95					
Specimen	1	2	3	4	5	6	7	8	9	10
DML (mm)	185	245	242	210	250	200	220	210	202	175
VML (mm)	168	225	223	185	230	175	210	181	174	149
TL (mm)	480	602	590	485	595	-	495	-	480	365
MW (mm)	66	77	77	70	78	70	76	74	71	68
HW (mm)	53	65	62	59	68	57	62	59	56	53
FL (mm)	172	222	220	180	220	172	184	175	180	148
FW (mm)	168	220	210	175	215	170	168	163	176	161
NGL (mm)	58	95	90	75	94	69	80	68	80	-
N G W (mm)	15	28	23	20	27	24	22	20	24	-
BW (g)	529.2	1012.9	953.2	608.3	1199.5	788.2	815.2	692.7	577.5	376.6
OW (g)	9.4	91.6	46.6	45.2	120	108.4	74.6	66	89.8	-

TABLE 2. – Morphometric indexes related to each specimen of *Ancistrocheirus lesueurii* caught in the north-western Ionian Sea during June and July 1995.

Month	June '95					July '95				
Specimen	1	2	3	4	5	6	7	8	9	10
FLI	93	90.6	90.9	85.7	88	86	83.6	83.3	89.1	84.6
FWI	90.8	89.8	86.8	83.3	86	85	76.4	77.6	87.1	92
MWI	35.7	31.4	31.8	33.3	31.2	35	34.5	35.2	35.1	38.9
HWI	28.6	26.5	25.6	28.1	27.2	28.5	28.2	28.1	27.7	30.3

In two specimens it was possible to recognize the arm formula which was:

III >IV = II >I.

Morphometric indexes are reported in the Table 2.

The specimens were all females and except specimen 1 (185 mm DML) they had ripe ovaries with exclusively vitellogenic eggs. The largest egg size was 2.6x1.91 mm in diameter. Some specimens presented two different maturation stages in the ovary. The smallest eggs measured about 1.3x0.91 mm. The ova appeared roughly spherical and translucent in a yellowish stroma.

The fecundity estimates ranged from 12,031 to 46,154 eggs with an average value of 22,205±10,532 eggs. No correlation was found between fecundity and ovary weight ($r_{Spearman} = 0.57$; $P = 0.139$) or ovary weight and body weight ($r_{Spearman} = 0.48$; $P = 0.233$), whereas the correlation between fecundity and body weight was significant ($r_{Spearman} = 0.76$; $P < 0.05$).

No correlation was observed between length of nidamental glands and ovary weight ($r_{Spearman} = 0.54$; $P = 0.130$), whereas the correlation between dorsal mantle length and length of nidamental glands ($r_{Spearman} = 0.87$; $P<0.01$) and between length and width of nidamental glands ($r_{Spearman} = 0.81$; $P<0.01$) were highly significant.

DISCUSSION

Although Nesis (1978) reported that there are two species in the genus *Ancistrocheirus* and Young *et al.* (1992) suggested that the genus *Ancistrocheirus* might include more than one species, recently Bello (1992) stated that *Ancistrocheirus lesueurii* is the valid name to be applied to the only known species of the genus *Ancistrocheirus*.

The presence of juveniles of *Ancistrocheirus lesueurii* in the Mediterranean Sea (Clarke, 1966) suggests that reproduction of this species occurs in situ (Bello *et al.*, 1994). But the records of adult specimens are extremely rare in comparison to those of other pelagic cephalopods. This is the third report of the occurrence of adult *Ancistrocheirus lesueurii* in the Mediterranean Sea and the first resulting from bottom trawling. Trawling is not considered very suitable for sampling pelagic cephalopods (Roper, 1991). In fact, investigations using this kind of sampling were frequently made in the Mediterranean without catching adult specimens of *Ancistrocheirus lesueurii*.

Okutani (1976) collected one specimen with an ORI-net during an oblique haul from 850 m and Clarke (1980) found several individuals in the stomachs of sperm whales which dive deeper than 1000 m for food.

Considering that the recent captures of adult specimens (Okutani, 1976; Okutani *et al.*, 1987; Bello *et al.*, 1994; present paper) are all mature females, the spawning would make the species, particularly the females, more vulnerable to the catch. This could be the consequence of a probable reduction in swimming speed of these specimens.

The specimens found in the north-western Ionian Sea were collected by an experimental net with a wide horizontal and vertical opening and by means of a commercial net with a vertical opening of less than 1.0 m. This fact suggests that the physiological condition of species plays the main role in their capture, more than the kind of net, which is conventionally used for monitoring cephalopod species composition, number and size of specimens (Roper, 1977).

TABLE 3. – Comparison of morphometric indexes recorded in *Ancistrocheirus lesueurii* by other authors and those computed for the specimens caught in the north-western Ionian Sea during June and July 1995. (Indication of size and size range related to each record is reported as DML in mm).

	Hoyle (1906)	Okutani (1976)	Okutani *et al.* (1987)	Bello *et al.* (1994)	Present paper (x ± s.d.)
FLI	70.0	84.0	80.0	83.3	87.48 ± 3.35
FWI	80.0	76.0	70.0	72.9	85.48 ± 5.20
MWI	27.5	30.0	-	-	34.21 ± 2.36
HWI	27.5	27.6	-	-	27.88 ± 1.27
DML (mm)	200	250	166 - 257	288	175 - 250

Male individuals could be less accessible to the trawl than females. They might have a marked meso-bathypelagic character being less linked to the bottom than females. The only occurrence of males, two immature specimens, were reported by Okutani and Tsuchiya (1991).

As to the vertical distribution of *Ancistrocheirus lesueurii* the depths at which the specimens were caught confirm the meso-bathypelagic habit of the species (Voss, 1967). However, the information reported in the literature, both for juveniles and adults, indicates a wide bathymetric distribution of the species (Hoyle, 1906; Degner, 1925; Clarke, 1966, 1980; Okutani, 1976; Bello *et al.,* 1994) suggesting diel vertical migration for juvenile stages (Roper and Young, 1975; Lu and Roper, 1979). Furthermore, considering that Bello *et al.* (1994) caught by squid jig one adult at 70 m of depth in the evening, the present data would indicate a deeper distribution for adults during the daytime than during the night; nevertheless the specimens could have been collected in the water column.

Although the ten adult specimens represent an interesting sample of *Ancistrocheirus lesueurii* they are as yet too few to allow conclusions on the morphometry of the species, especially because of the high variability occurring in the measurements of such animals. Moreover, previous morphometric data on this cephalopod are limited to very few adult specimens and almost exclusively, as in this case, to mature females.

However, the data presented here give higher average FLI, FWI and MWI than those reported in the literature (Tab. 3). The higher values of FLI indicate a wide extension of the fin base, namely this is very close both to the superior and inferior margin of the mantle. The coefficient of variation of this index was 3.83%.

FLI was generally higher than FWI and the difference between these two indexes was not as large as reported by Okutani (1976), Okutani *et al.* (1987) and Bello *et al.* (1994). The total width of the fin attained on average 97.7% of the length and in one case (specimen N. 10) FWI was higher than FLI according to the measurement recorded by Hoyle (1906). In fact the bodies of these specimens appeared almost as wide as long. The coefficient of variation of FWI was 6.09%.

The high values of this index in some cases was linked to a wider mantle (high MWI) whereas in others, such as for the 2nd, 3rd and 5th specimens, wide fin (high FWI) with smaller mantle width were observed. In fact, in these specimens MWI was comparable to that reported by Okutani (1976) whereas in the others it was clearly higher. However, there was no correlation between FWI and mantle width (MW) ($r_{Spearman} = 0.32$; $P = 0.372$).

The average HWI were of the same magnitude as those computed by Hoyle (1906) and Okutani (1976).

The number of light organs on the ventral mantle is in agreement with Nesis (1978) who reported that *Ancistrocheirus lesueurii* bears 22 photophores. However, according to Clarke (1980) their number can range from 18 to 24. This latter number of photophores was counted by Bello *et al.* (1994). The fact that the maximum number of such organs for the specimens collected in the Ionian Sea was 22 could be due both to the variability of this character within the species and the partial stripping of the skin observed in each of them.

The number of photophores counted on the tentacular stalk is in agreement with Okutani (1976). Okutani *et al.* (1987) indicated the presence of up to 28 photophores on the aboral surface.

As far as fecundity was concerned, apart from some Ommastrephids, very little is known in oegopsid species. A wide range of egg numbers has been estimated for various species: e.g. 360,000 in *Ommastrephes bartramii* (Clarke, 1966); 70,000 in *Todarodes pacificus* (Lim, 1967); 100,000-650,000 in *Dosidicus gigas* (Nesis, 1970); 52,618-186,461 in *Ommastrephes pteropus* (Hixon *et al.,* 1980); 10,000 in *Gonatus fabricii* (Kristensen, 1981).

The high variability in the estimates of the fecundity could be the result of invidual variability, egg sizes, estimation methods or spawning period of the species (Mangold, 1987).

The fecundity is largely dependent upon egg size. Lazzeretti *et al*. (1995) estimated 128,000±32,000 eggs whose sizes ranged from 0.4 to 1.0 mm in diameter in a female measuring 195 mm in DML of *Histiotheuthis bonnelli,* while Kristensen (1980) estimated 25,000 eggs 2.3 mm in diameter for a mature ovary in a female measuring 300 mm in DML of the same species. This latter number and size, although a different species, may indicate that the average fecundity reported here for *Ancistrocheirus lesueurii* is reliable. However, the low number of specimens prevents any inference on fecundity of the Mediterranean population and any relations between it and other characters.

The method employed here to estimate fecundity may give reliable information if the species lays all its eggs either in one single spawning or in several spawnings completed in a short period of time (Voss, 1983). A short spawning period implies that all the eggs contained in the ovary are mature or very close to maturity at about the same time (Mangold, 1987) as observed in these specimens of *Ancistrocheirus lesueurii*. In this respect these specimens could have been caught during their migration towards particular spawning areas in the Ionian Sea, so that the egg counts in such females approaching spawning may yield realistic figures on the fecundity and also provide an indication that the species could be a one-time spawner (Mangold, 1987) or more precisely a uniseasonal-iteroparous spawner (Boletzky, 1986).

ACKNOWLEDGMENTS

The authors wish to thank Prof. T. Okutani for critically reading the draft and providing literature.

REFERENCES

Bello G. – 1991. Role of cephalopods in the diet of the swordfish, *Xiphias gladius,* from the eastern Mediterranean. *Bull. Mar. Sci.,* 49: 312-324.

Bello G. – 1992. On the validity, authorship and publication date of the specific name *Ancistrocheirus lesueurii* (Cephalopoda: Ancistrocheiridae). *Veliger,* 35: 141-145.

Bello G., A. Potoschi and A. Berdar. – 1994. Adult of *Ancistrocheirus lesueurii* caught in the Straits of Messina (Cephalopoda: Anchistrocheiridae). *Boll. Malacologico,* 29: 259-266.

Boletzky, S.V. – 1986. Reproductive strategies in Cephalopods: variation and flexibility of life-history patterns. *Adv. Invertebrate Reprod.*, 4: 379-389.

Clarke, M.R. – 1966. A review of the systematics and ecology of oceanic squids. *Adv. Mar. Biol.,* 4: 99-300.

Clarke, M.R. – 1977. Beaks, nets and numbers. *In The Biology of Cephalopods* (M. Nixon & J.B. Messenger eds), Academic Press London, pp. 89-126.

Clarke, M.R. – 1980. Cephalopods in the diet of sperm whales of the southern hemisphere and their bearing on sperm whale biology. *Discovery Rep.*, 37: 1-324.

Clarke, M.R. and N. MacLeod. – 1974. Vertical distribution of cephalopods at 30° N 23° W in the North Atlantic. *J. mar. biol. Ass. U. K.,* 54: 969-984.

Clarke, M.R., N. Macleod and O. Paliza. – 1976. Cephalopod remains from the stomach of sperm whales caught off Peru and Chile. *J. Zool., Lond.* 180: 477-493.

Conover, W.J. – 1980. *Practical nonparametric statistics,* John Wiley & Sons, New York: 493 pp.

Degner, E. – 1925. Cephalopoda. *Rep. Dan. Oceanogr. Exped. Medit. Adjacent Seas,* Kobenhavn, 2, C (1): 1-94.

Dunning M.C., M.R. Clarke and C.C. Lu C.C. – 1993. Cephalopods in the diet of oceanic sharks caught off eastern Australia. In T. Okutani, R.K. D'Dor and T. Kubodera (eds.). *Recent Advances in Cephalopod Fisheries Biology*. Tokai Univ. Press, Tokyo,pp. 119-131.

Fiorentini L., G. Cosimi, A. Sala and V. Palumbo. – 1994. Caratteristiche e prestazioni delle attrezzature a strascico impiegate per la valutazione delle risorse demersali in Italia. *Biol. Mar Medit.* 1(2): 115-134.

Hixon R.F., M.J. Solis Ramirez and M. Villoch. – 1980. Aspects of morphometrics and reproduction of the squid *Ommastrephes pteropus,* Steenstrup 1885 in the western Gulf of Mexico. *Bull. Am. Malac. U.*: 54-60.

Hoyle, W.E. – 1906. The Cephalopoda. *In: The fauna and geography of the Maldive and Laccadive Archipelago*. 2: 1-1079

Joubin, L. – 1900. Céphalopodes. *Résult. Camp. scient. Prince Albert* I, 17: 1-135.

Kristensen, T.K. – 1980. Large mature female of *Histioteuthis bonnellii* (Férussac, 1835) (Mollusca: Cephalopoda) recorded from the Davis Strait, West Greenland. *Steenstrupia,* 6: 75-79.

Kristensen, T.K. – 1981. First record of a mature female of the squid *Gonatus fabricii* (Lichtensteini, 1818) (Cephalopoda: Teuthoidea). *Steenstrupia,* 7: 101-108.

Lazzeretti, A., A. Voliani and A. Zucchi. – 1995. Note su un esemplare di *Histioteuthis bonnellii* (Cephalopoda: Histioteuthidae) pescato nell'alto Tirreno. *Biol. Mar. Medit.,* 2: 493-494.

Lim, J.Y. – 1967. Ecological studies on common squids, *Ommastrephes sloani pacificus* in the eastern water of Korea. *Rep. Res. Fish. Develop. Agency,* 7: 41-49.

Lu, C.C. and C.F.E. Roper. – 1979. Cephalopods from Deepwater Dumpsite 106 (Western Atlantic): Vertical Distribution and Seasonal Abundance. *Smiths. Contr. Zool.,* 288: 1-36.

Mangold, K. – 1987. Reproduction. *In: Cephalopod life cycles* (P.R. Boyle, ed.) vol. II, Academic Press (London): 157-200.

Martin, A.R. and M.R. CLARKE. – 1986. The diet of sperm whales (*Physeter macrocephalus*) captured between Iceland and Greenland. *J. mar. biol. Ass. U. K.,* 66: 779-790.

Nesis, K.N. – 1970. Biology of the Peru-Chilean giant squid *Dosidicus gigas. Okeanology,* 10: 140-152.

Nesis, K.N. – 1978. Podsemejstvo Ancistrocheirinae (Cephalopoda, Enoploteuthidae). *Zool. Zh.,* 57: 446-450.

Okutani, T. – 1976. Rare and interesting squid from Japan. – V. A gravid female of *Anchistrocheirus lesueurii* (d'Orbigny, 1839) collected in the Kuroshio Area (Oegopsida: Enoploteuthidae).

Jap. Jour. Malac. (VENUS), 35: 73-81.
Okutani, T., M. Tagawa and H. Horikawa. – 1987. Cephalopods from continental shelf and slope around Japan. *Publ. Japanese Fisheries Resource Conservation Association,* Tokyo,
Okutani T. and K. Tsuchiya. – 1991. Cephalopods. In: Seikai National Fisheries Research Institute, (ed.). Fishes collected from around Okino-Torishima Island. *Survey Report on Fisheries Resources around Okino-Torishima Island,* 154 pp.
Roper, C.F.E. – 1977. Comparative capture of pelagic cephalopods by midwater trawls. *Symp. Zool. Soc. Lond.,* 38: 61-87.
Roper, C.F.E. – and R.E. Young. – 1975. Vertical distribution of pelagic Cephalopods. *Smiths. Contr. Zool.,* Washington, 209: 1-51.
Roper, C.F.E. – 1991. World-wide squid fisheries: a summary of landings and capture technics. *J. Cephalopod Biol.,* 2: 51-63.
Voss, G.L. – 1967. The biology and bathymetric distribution of deep-sea cephalopods. *Stud. Trop. Oceanogr.,* 5: 511-535.
Voss, G.L. – 1983. A review of cephalopod fisheries biology. *Mem. Natl. Mus. Victoria,* 44: 229-241.
Young, R.E., K.M. Mangold and M. Vecchione. – 1992. The Enoploteuthid Group of Families. *In* M.J. Sweeney, C.F.E. Roper, K.M. Mangold, M.R. Clarke and S.v. Boletzky (eds.), *"Larval" and Juvenile Cephalopods: A Manual for Their Identification. Smiths. Contr. Zool.,* 513: 55-66.

Scient. ed.: J.M. Gili