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SEPIOLINAE (MOLLUSCA, CEPHALOPODA) FROM THE LIGURIAN SEA

L. ORSI RELINI and M. BERTULETTI

Laboratori di Biologia Marina ed Ecologia Animale,
Istituto di Zoologia dell'Università, Via Balbi 5,
Genova, Italia

SEPIOLINAE
DISTRIBUTION
MATURITY
LIGURIAN SEA

ABSTRACT — A collection of 130 specimens of *Sepiolo (ligulata, robusta, rondeletii, intermedia)*, 115 *Rondeletiola minor*, 90 *Sepietta (obscura, neglecta)* and more abundant samples of *S. oweniana* obtained by trawl fishing in the Ligurian Sea are briefly illustrated in terms of depth distribution, sex ratio and maturity stages.

SEPIOLINAE
DISTRIBUTION
MATURITE
MER LIGURE

RÉSUMÉ — Une collection de 130 spécimens de *Sepiolo (ligulata, robusta, rondeletii, intermedia)*, 115 *Rondeletiola minor*, 90 *Sepietta (obscura, neglecta)* et des nombres plus importants de *S. oweniana* récoltés par chalutage en Mer Ligure sont étudiés au sujet de la distribution selon la profondeur, la sex-ratio, et les stades de maturité sexuelle.

INTRODUCTION

Among the Cephalopods, especially those of commercial value, the Sepiolinae (family Sepiolidae, order Sepioidea or Sepioloidea Fioroni, 1981) are one of the lesser known groups with regard to distribution and life history in the sea. However, in some of its species it has been possible to observe the entire life cycle in captivity (Boletzky *et al.*, 1971); to study the use and control of bacterial light (Herring *et al.*, 1981); to make detailed observations of embryology and comparative anatomy (Fioroni, 1981). In contrast to these specialized studies, our approach has more scope for field aspects; we identify the numerous species in the Ligurian Sea with the aim of recording their role, however small, in the fishing grounds.

Taking Naef (1923) as her source, Mangold-Wirz (1963) lists 15 species of Sepiolidae in the Western Mediterranean; Torchio (1968) lists 16, also taking into account *Heteroteuthis atlantis* G. Voss, 1955, which Voss himself (1955) reported at Messina. This last list has remained unchanged in the register of

Mediterranean Cephalopods which has recently been brought up to date by Bello (1986). The sub-family Sepiolinae in particular, which includes 11 of the 16 species of the family, has, as far as we know, never been studied in the Gulf of Genoa. In fact, one has to go back to Vérany (1851) to find a text which deals with this subject, and even that is limited to two varieties of *Sepiolo rondeletii*, a taxon which at that time included not only different species of *Sepiolo*, but also sepiolids belonging to other genera. Vérany states that « ... Les Sépioles vivent sur toutes nos plages ...; leur chair est délicate et estimée : elle porte le nom de Sponcia-courrenti et malnascui à Gènes ... ».

Naef gave the present status to the subfamily describing the genera *Sepietta* and *Rondeletiola* (1912a; 1916) and seven species (1912b, c; 1916). In the very abundant material which he examined he mentioned some specimens of *Sepietta oweniana*, *S. rondeletii* and *S. steenstrupiana* coming from Villefranche, i.e. from the western sector of the Ligurian Sea (Naef, 1923). For the description of the latter species Ligurian material was used both by Levy (1912) and by Naef (1912b) almost at the same time;

Table I. — Records of Sepiolineae in the Mediterranean subprovince.

| | GULF OF NAPLES | ADRIATIC | CATALAN COAST | N. TYRRHENIAN | ISRAEL AND CYPRUS | CADIZ | LIGURIAN SEA |
|------------------------------------|----------------|--|--|---------------|-------------------------------------|-------------|--|
| | Naef 1923 | Rudolph 1932 Lumare 1974 Bello & Motolese 1983 | Mangold Wirz 1963 Boletzky <i>et al.</i> 1971 Sanchez & Morales 1986 | Lumare 1970 | Ruby & Knudsen 1972 Knudsen 1981 | Guerra 1982 | Levy 1912 Naef 1923 Orsi & Bertuletti 1986 |
| <i>Sepiolo steenstrupiana</i> Lévy | + | + | | | + | | + |
| <i>Sepiolo aurantiaca</i> Jatta | + | | | | | | |
| <i>Sepiolo ligulata</i> Naef | + | + | + | + | | | + |
| <i>Sepiolo rondeletii</i> Leach | + | + | + | | + | + | + |
| <i>Sepiolo intermedia</i> Naef | + | + | + | + | | + | + |
| <i>Sepiolo affinis</i> Naef | + | + | + | + | | | |
| <i>Sepiolo robusta</i> Naef | + | + | + | | + | | + |
| <i>Rondeletiola minor</i> Naef | + | + | + | + | + | + | + |
| <i>Sepietta obscura</i> Naef | + | + | + | + | + | | + |
| <i>Sepietta neglecta</i> Naef | + | + | + | | + | + | + |
| <i>Sepietta oweniana</i> d'Orbigny | + | + | + | + | + | + | + |

by only a few days Levy's specific name gained priority (*).

Sepiolineae have been the objects of recent observations off the Catalan coast (Mangold-Wirz, 1963; Boletzky *et al.*, 1971; Sanchez and Morales, 1986), in the Tyrrhenian sea (Lumare, 1970), off the coasts of Israel and Cyprus (Ruby and Knudsen, 1972; Knudsen 1981), in the Gulf of Cadiz (Guerra, 1982) and in the Adriatic Sea (Bello and Motolese, 1983; Bello 1984); the species recorded in these areas are shown in Table I.

Recently we have had the opportunity of gathering information about this group thanks to a fishing programme (1982-1983) promoted by the « Ministero della Marina Mercantile » on the problems of the limits of trawl fishing and on the protection of the coastal strip. Catches were carried out at monthly intervals, at levels between 20 and 90 meters. The use of a tightly-meshed net, which was specifically designed as a commercial net for Cephalopod juveniles (*Eledone cirrhosa*, in particular), made it possible to collect good material, to which were added previous small collections also taken from trawl fishing carried out in the Ligurian Sea. Finally, more recently, further material was gathered

during the 1985 programme on the « Evaluation of Demersal Resources » financed by the « Ministero della Marina Mercantile » (Relini, 1985).

We have already provided a table which summarises our finds of Sepiolineae (Orsi Relini and Bertuletti, 1986); here we shall give the essential details of the material examined.

METHODS AND MATERIALS

In 1982-83 samples were taken at monthly intervals from the trawlable bottoms situated on the Eastern Riviera roughly off the coast at Chiavari. Professional equipment hired for the purpose from the Santa Margherita fishing fleet was used: a trawler of 18 tons gross tonnage, equipped with a 150 Hp engine, echo-sounding gear and radar and a 3-man crew. The net was an otter-trawl, belly 400 meshes of 25 mm; lower body 120 meshes of 30 mm; wings 200 meshes of 45 mm; cod end 420 meshes of 6 mm side; lower and upper edge each 70 meshes of 35 mm; sweep lines of 200 m; warps of 250-1000 m; otter board of 100 x 170 cm.

Each monthly sampling consisted of one-hour effective trawls carried out during day-light hours at four different depths: 20, 30, 50 and 90 m. Other occasional samples were taken at the same depth during the night and at depths of 10, 85 and 300 m.

Minor samples were also taken on board trawlers which were engaged in commercial trawl fishing in various part of the Ligurian Sea; these included: a) samples obtained during the four seasons in 1975-76

* Levy (1912) also mentioned *S. desvigniana* from Villefranche-sur-Mer and *S. atlantica* from Nice. It is very difficult to establish the identity of the former species (named *S. desvigniana* in the original description by Gervais and van Beneden, 1838). The latter species is well identified by the number of rows of suckers on the ventral arms. On the basis of this work (Levy, 1912) *S. atlantica* seems to belong to the Mediterranean fauna; however, since then no other record has appeared in the literature.

on the neritic bottoms between Genoa and Portofino at depths between 30 and 180 m; b) samples obtained from red shrimp fishing between 500 and 700 m on the Eastern and Western Riviera.

During the Programme « Evaluation of Demersal Resources (1985) », the trawlable bottoms situated between Arenzano and the mouth of the Magra and depths between 0 and 700 m were explored using 56 hourly trawls. These were divided into 5 layers by the depths 50, 100, 200, 450 m in numbers proportional to the extension of each layer. The net had 500 meshes at the mouth and 500 at the cod end of 7.5 mm side.

The materials listed were fixed on board in 10 % formalin in sea water, with the exception of the last samples (1985), which were frozen.

Systematic identification was made according to the suggestions of Naef (1912b, c, 1916, 1923), i.e. mainly by observing the hectocotylied arm of the male and the visceral mass of the female in which the extension and the profile of the empty bursa is critical. At the Zoological Station of Naples, some of Naef's collections of *S. atlantica*, *S. intermedia*, *S. affinis*, *S. robusta*, *S. ligulata*, *Sepietta oweniana*, *S. obscura* and *Rondeletiola minor* were also examined.

Naef gained such wide experience both in fresh and fixed Sepiolid species that he was able to recognize the species simply on the basis of general external features and colour. His collections include numerous small undissected specimens. Unfortunately, by now these materials have become colourless and very deformed by the fixatives; however, they may still be useful in recognizing the main anatomical characteristics mentioned above.

With regard to our collections, as we had specimens which were subjected to different kinds of fixation and for varying length of time, we were not able to use distinctive features based upon colour patterns.

In listing the examined material we give the dorsal mantle length measured as indicated by Mangold-Wirz (1963). The zone of fishing refers to the locality on the coast off which the trawl was effected (generally parallel to the shore). The notes about the maturity stage are based upon the storage of spermatophores in the males (few sp. = maturing; abundant sp. = ready to spawn) and the diameters of eggs in the females, as suggested by Mangold-Wirz (1963) (for the sake of comparison we recall that this author gives the following size for eggs in advanced maturation: *Sepiola rondeletii* 2.5-3 mm; *Sepietta oweniana* 2.1-2.6 mm).

All measurements were effected on specimens preserved in formalin.

RESULTS

Sepiola

Sepiola ligulata

The identification of this species on the basis of the hectocotylied arm and of the *bursa*, respectively, is straightforward. In our material the portion of *bursa* that extends on the right side beyond the central mantle *septum* is sometimes almost as large as the left portion.

S. ligulata is one of the smallest species of Mediterranean sepiolids and its records are generally scarce. Only in the Adriatic has a group of 45 specimens been obtained in a single haul (Lumare, 1974). In the laboratory the embryonic development, the hatching and the growth to a final length of about 9 mm ML were observed by Boletzky *et al.* (1971). Our records indicate a sexual maturity at only 11 mm ML in the male and 14 mm ML in the female.

The depth range was 65-125 m in the Adriatic (Lumare, 1974) and 50-90 m in the Ligurian Sea.

Sepiola robusta

On the characteristic features of the hectocotylied arm is the great enlargement of one of the three basal suckers. The small suckers in the fourth and fifth rows above the copulatory apparatus give the appearance of a central narrowing of the arm, which in Naef's figure is not shown.

The female *bursa* may be larger than that represented by Naef, and sometimes leans on the central *septum* (it does not however, extend to the right side, as in *S. rondeletii*).

This « large » species is well known in many aspects of its biology having been the object of long and exhaustive observations by Boletzky which he summarizes in his review on this subject (Boletzky, 1983). In captivity female spawning was observed at about 170 days after birth and at a ML of 17 mm; males are mature at a slightly smaller size. The present field data confirm the same minimum spawning size. The depth range here observed (60-90 m) appears restricted compared to that of the Catalan coast (from a few meters to about 100).

Sepiola rondeletii

Our material is composed only of small females. We have considered critical for the identification the presence of a protrusion of the *bursa* on the right side, passing across the ventral *septum*, but not in the form of a hernia as in *S. ligulata*.

As important samples of *S. rondeletii*, including adult males and females, have been obtained in

shallow water and also in lagoons, this species is considered strictly littoral (Mangold-Wirz, 1963). However, Guerra (1982) recently obtained two immature females at 190 m. Since also the present specimens, fished at the least between 20 and 50 m, are all immature, a greater dispersal of young may be supposed.

Sepiola intermedia

A very characteristic feature of the hectocotylized arm is the presence of two large suckers above the copulatory apparatus. The enlarged suckers are the median first and second or, in some cases, the median second and the third. this is the commonest species of the genus *Sepiola* in our material, probably because of its eurybathic distribution. In the present collection we have registered its presence in the range 20-135 m, but other data taken from the « Evaluation of demersal resource » programme now in progress (1986) extend the range to 220 m. We obtained a maximum of 15 specimens per hour of trawling during the night.

This species seems to have a patchy distribution in the Mediterranean; Naef quoted only specimens from Naples. Lumare, in extensive surveys on the Tyrrhenian coast, found it only south of Rome. E. Mauris (pers. comm.) found it at Banyuls-sur-Mer.

Sanchez and Morales (1986) recently obtained a single specimen from the Catalan coast. The record of Guerra (1982) at Cadiz seems questionable, since that specimen has a different hectocotylus. The biology of this species is poorly known. We have registered an overall sex-ratio in favour of males (1 to 0.7). Adults in spawning condition are present throughout the year. Minimal spawning sizes were 11 mm ML in the male and 17 mm ML in the female.

Rondeletiola

Rondeletiola minor

This species is easily recognized by its peculiar luminous organs. In the trawl catches taken in the Ligurian Sea it is usually associated with *Sepietta oweniana*; in number it represents a maximum of 10 % and in weight a maximum of 5 %. In the eastern sector it was registered at deep circalittoral and epibathyal levels, in the western sector also at 500-700 m, perhaps due to sleeker bottoms. The overall sex-ratio was 1 male : 1,4 female. Maturity may be reached at only 12 mm ML in the male and at 12 mm ML in the female. The present data suggest a long reproductive season (at least from April to December).

Sepietta

Within this genus, a separation of the group *oweniana-neglecta* from *S. obscura* is generally made by the number of suckers at the base of the copulatory apparatus, that is four and three, respectively. However, we have noted frequent variations in this characteristic. In *Sepietta oweniana*, the most abundant of the three species, the number of basal suckers may be one, two, three, four, five, six with a total incidence of anomalous forms of 7 % compared to those bearing four suckers. The anomalous forms have the following incidence (counted in 212 males captured in one haul of 60 minutes duration) : 1 basal sucker in 1.4 % of the males; 2 b.s. in 2.3 %; 3 b.s. in 1.4 %; 5 b.s. in 0.94 %; 6 b.s. in 0.94 %. However, the distinction of *S. obscura* is also based on other morphological characteristics such as the club structure.

Recent descriptions of the distinctive features of female and male *S. neglecta* have been given by Bello and Motolese (1983) and by Sanchez and Morales (1986).

Sepietta obscura

S. obscura was studied in captivity by Boletzky *et al.* (1971) who observed its development, hatching and growth to a final length of 24 mm ML in two males.

Table II. — Distribution of Sepiolineae in the Ligurian Sea for each month of the year : 1 *Sepiola intermedia*, 2 *S. robusta*, 3 *S. ligulata*, 4 *S. rondeletii*, 5 *Rondeletiola minor*, 6 *Sepietta oweniana*, 7 *S. neglecta*, 8 *S. obscura*. Blanks represent absence of species in the trawl samples, broken lines are for periods and depths at which no sampling was done. Bare numbers represent the respective species taken in day samples, underlined numbers those taken in night samples.

| | J | F | M | A | M | J | J | A | S | O | N | D |
|-----------|-----|-----|-----|---|----------|-----|-----|----------|----------|-----|-----|----------|
| 20 m | 8 | 1 | | | <u>4</u> | 1 | | <u>1</u> | | | | 8 |
| | | 8 | | | | 8 | | <u>8</u> | | | | |
| 30 m | 1 | 1 | 1 | 1 | <u>1</u> | 8 | | <u>1</u> | | | | |
| | | 7 | | 8 | <u>4</u> | | | <u>8</u> | | | | |
| | | | | | <u>8</u> | | | <u>1</u> | | | | |
| 50 m | | 1 | 1 | 1 | <u>8</u> | 1 | 1 | <u>1</u> | 1 | 1 | 1 | 1 |
| | | 4 | 8 | 8 | | 2 | 8 | <u>6</u> | <u>8</u> | 8 | 8 | 7 |
| | | | | | | | | <u>8</u> | | | | <u>8</u> |
| 90 m | 1 | 7 | | 1 | | | 1 | <u>6</u> | <u>1</u> | 2 | 1 | 1 |
| | 2 | 8 | | 8 | | | 2 | 7 | 6 | 2 | 8 | 7 |
| | 3 | | | | | | 5 | 8 | 8 | 3 | 7 | 5 |
| 100-200 m | --- | --- | --- | 5 | | --- | --- | 5 | 5 | --- | --- | --- |
| | | | | 6 | | | | 6 | 6 | --- | --- | --- |
| | | | | | | | | 7 | | | | |
| 200-300 m | --- | --- | --- | 5 | 5 | 6 | 5 | 5 | 5 | --- | --- | --- |
| | | | | 6 | 6 | 7 | 6 | 6 | 6 | --- | --- | --- |
| | | | | 7 | | | | | | | | |
| 300-450 m | --- | --- | --- | 6 | | --- | --- | 5 | 6 | --- | --- | --- |
| | | | | | | | | 6 | | | | |
| 450-700 m | --- | --- | --- | 6 | | --- | 5 | 6 | 6 | --- | --- | --- |
| | | | | | | | 6 | | | | | |

Table III. — List of specimens taken of each species in chronological order, with indication of individual size, fishing zone, depth of trawling, and stage of sexual maturation in both males and females. ab. sp. = abundant spermatophores; f. sp. = few spermatophores; imm. = immature; l.e.d. = largest egg diameter in mm; mat. = mature.

| n° | dorsal mantle length mm | date | zone | depth m | reprod. stage |
|---------------------------------------|-------------------------|----------|----------|---------|----------------|
| <i>Sepiolo ligulata</i> Naef, 1912 | | | | | |
| males | | | | | |
| 1 | 13 | 23.09.76 | Camogli | 50 | ab. sp. |
| 1 | 12 | 26.01.83 | Chiavari | 90 | ab. sp. |
| 1 | 11 | 08.12.83 | Chiavari | 75 | ab. sp. |
| females | | | | | |
| 2 | 14 | 26.01.83 | Chiavari | 90 | l.e.d. 3.2-3.5 |
| 1 | 10 | 14.09.83 | Chiavari | 90 | imm. |
| <i>Sepiolo robusta</i> Naef, 1912 | | | | | |
| males | | | | | |
| 1 | 13 | 29.01.82 | Chiavari | 90 | imm. |
| 1 | 18 | 12.08.82 | Chiavari | 90 | f. sp. |
| night | | | | | |
| 1 | 12 | 03.11.82 | Chiavari | 90 | imm. |
| 2 | 17;22 | 26.01.83 | Chiavari | 90 | f. sp. |
| 1 | 20 | 19.07.83 | Chiavari | 90 | ab. sp. |
| 2 | 11 | 14.09.83 | Chiavari | 90 | imm.; f. sp. |
| 2 | 15;17 | 14.09.83 | Chiavari | 90 | ab. sp. |
| females | | | | | |
| 1 | 14 | 04.08.75 | Camogli | 50-100 | imm. |
| 1 | 24 | 25.10.75 | Camogli | 50 | l.e.d. 3.5 |
| 1 | 11 | 23.09.76 | Camogli | 50 | imm. |
| 1 | 17 | 22.02.78 | Camogli | 50 | mat. ^ |
| 1 | 23 | 12.08.82 | Chiavari | 90 | l.e.d. 4.5 |
| night | | | | | |
| 1 | 9 | 19.07.83 | Chiavari | 90 | imm. |
| 1 | 20 | 14.09.83 | Chiavari | 90 | l.e.d. 5 |
| <i>Sepiolo rondeletii</i> Leach, 1817 | | | | | |
| females | | | | | |
| 1 | 14 | 04.08.75 | Camogli | 50-100 | imm. |
| 1 | 13 | 23.09.76 | Camogli | 20-50 | imm. |
| 1 | 15 | 18.05.82 | Chiavari | 30 | imm. |
| night | | | | | |
| 1 | 15 | 18.05.82 | Chiavari | 20 | imm. |
| night | | | | | |
| ^ poorly preserved eggs | | | | | |
| <i>Sepiolo intermedia</i> Naef, 1912 | | | | | |
| males | | | | | |
| 3 | 15;17;17.5 | 04.08.75 | Camogli | 50-100 | ab. sp. |
| 1 | 14 | 09.10.75 | Camogli | 50-100 | ab. sp. |
| 2 | 10;14 | 23.09.76 | Camogli | 20-50 | ab. sp. |
| 1 | 13 | 24.11.76 | Camogli | 100-150 | ab. sp. |
| 1 | 16.5 | 10.03.78 | Camogli | ab. sp. | ab. sp. |
| 5 | 13;14;15;16;17 | 29.01.82 | Chiavari | 90 | ab. sp. |
| 1 | 20 | 24.03.82 | Chiavari | 90 | ab. sp. |
| 1 | 12 | 28.04.82 | Chiavari | 30 | ab. sp. |
| 1 | 11 | 18.05.82 | Chiavari | 30 | ab. sp. |
| night | | | | | |
| 3 | 15;15;18 | 29.06.82 | Chiavari | 50 | ab. sp. |
| 1 | 10 | 29.07.82 | Chiavari | 50 | imm. |
| 1 | 17.5 | 12.08.82 | Chiavari | 70 | ab. sp. |
| night | | | | | |
| 5 | 14;14;15;16;16 | 12.08.82 | Chiavari | 30 | ab. sp. |
| night | | | | | |
| 4 | 12;15;17;17 | 12.08.82 | Chiavari | 30 | ab. sp. |
| night | | | | | |
| 2 | 14;15 | 12.08.82 | Chiavari | 50 | f. sp. |
| night | | | | | |
| 4 | 13;16;16;17 | 04.10.82 | Chiavari | 50 | f. sp. |
| 4 | 8;8;9;13 | 04.10.82 | Chiavari | 50 | imm. |
| 1 | 13.5 | 04.10.82 | Chiavari | 90 | f. sp. |
| 3 | 15;16;16 | 03.11.82 | Chiavari | 50 | ab. sp.;imm. |
| 1 | 13 | 03.11.82 | Chiavari | 90 | ab. sp. |
| 1 | 10 | 24.02.83 | Chiavari | 30 | imm. |
| 1 | 11 | 24.02.83 | Chiavari | 50 | ab. sp. |
| 2 | 9;14 | 02.06.83 | Chiavari | 20 | imm.; f. sp. |
| 1 | 15 | 19.07.83 | Chiavari | 50 | imm. |
| 2 | 11;17 | 19.07.83 | Chiavari | 90 | imm. or spent? |
| 1 | 9 | 10.08.83 | Chiavari | 90 | imm. |
| 2 | 12;13 | 14.09.83 | Chiavari | 50 | imm.; ab. sp. |
| 2 | 10;13 | 14.09.83 | Chiavari | 90 | imm. |
| 4 | 16;16;18;18 | 08.12.83 | Chiavari | 90 | ab. sp. |
| 1 | 17 | 08.12.83 | Chiavari | 75 | ab. sp. |

| n° | dorsal mantle length mm | date | zone | depth m | reprod. stage |
|--------------------------------------|-------------------------|----------|---------------------|---------|---------------------|
| 2 | 15;18 | 01.04.85 | Camogli | 50 | ab. sp. |
| 4 | 7;16;16;19 | 01.04.85 | Tigullio | 26 | ab. sp. |
| 1 | 12 | 29.08.85 | 5 Terre | 40 | ab. sp. |
| 1 | | 20.03.86 | P. Manara | 135 | |
| 1 | 16 | 21.03.86 | 5 Terre | 119 | ab. sp. |
| 1 | 16 | 02.05.86 | Camogli | 50 | ab. sp. |
| females | | | | | |
| 1 | 19 | 04.08.75 | Camogli | 50-100 | l.e.d. 3 |
| 1 | 21 | 25.10.75 | Camogli | 50-100 | l.e.d. 3 |
| 4 | 11;16 ; 17;20 | 18.05.82 | Chiavari | 30 | imm.;l.e.d. 2.5 |
| night | | | | | |
| 1 | 14 | 29.07.82 | Chiavari | 50 | imm. |
| 2 | 14;14 | 12.08.82 | Chiavari | 30 | imm.;l.e.d. 2.5 |
| night | | | | | |
| 2 | 7;11 | 12.08.82 | Chiavari | 50 | imm. |
| night | | | | | |
| 1 | 16 | 03.12.82 | Chiavari | 50 | l.e.d. 3.5 |
| 2 | 14;17 | 26.01.83 | Chiavari | 30 | l.e.d. 2.5;l.e.d. 3 |
| 1 | 18 | 24.02.83 | Chiavari | 20 | l.e.d. 3 |
| 1 | 12 | 24.02.83 | Chiavari | 50 | imm. |
| 1 | 17.5 | 02.06.83 | Chiavari | 20 | l.e.d. 3 |
| 3 | 9;14;17 | 19.07.83 | Chiavari | 50 | 2 imm;l.e.d. 3 |
| 5 | 10;13;13;14.5;15 | 19.07.83 | Chiavari | 90 | imm. |
| 1 | 15 | 10.08.83 | Chiavari | 90 | imm. |
| 3 | 9;10;17 | 14.09.83 | Chiavari | 50 | 2 imm;l.e.d. 3 |
| 4 | 13;14;15;16 | 14.09.83 | Chiavari | 90 | 3 imm.; l.e.d. 3 |
| 1 | 17 | 08.12.83 | Chiavari | 75 | mat. |
| 4 | 16;17;20;21 | 01.04.85 | Tigullio | 26 | mat. |
| 1 | 19 | 01.04.85 | Camogli | 50 | mat. ^ |
| 2 | 20;21 | 01.04.85 | Tigullio | 85 | mat. ^ |
| 1 | 19 | 29.08.85 | 5 Terre | 62 | l.e.d. 3 |
| 1 | 11.5 | 31.08.85 | Tigullio | 30 | imm. |
| 1 | | 20.03.86 | P. Manara | 135 | |
| 3 | 16;19;20 | 02.05.86 | Camogli | 50 | l.e.d. 3 |
| ^ poorly preserved eggs | | | | | |
| <i>Rondeletiola minor</i> Naef, 1912 | | | | | |
| males | | | | | |
| 1 | 17 | 11.08.75 | Camogli | 100-150 | ab. sp. |
| 1 | 13 | 19.07.83 | Chiavari | 90 | ab. sp. |
| 1 | 14 | 19.07.83 | Chiavari | 300 | ab. sp. |
| 1 | 13 | 10.08.83 | Chiavari | 300 | ab. sp. |
| 4 | 12;13;14;14 | 14.09.83 | Chiavari | 90 | ab. sp. |
| 5 | 10;11;11;15;17.5 | 08.12.83 | Chiavari | 90 | ab. sp. |
| 2 | 9;9 | 08.12.83 | Chiavari | 90 | imm. |
| 2 | 15;17.5 | 01.04.85 | P. Manara | 180 | ab. sp. |
| 5 | 12;16;16;17;19 | 26.04.85 | La Spezia | 220 | ab. sp. |
| 2 | 16;18 | 27.07.85 | Ventimiglia 550-700 | | spent? |
| 1 | 14 | 27.07.85 | Ventimiglia 550-700 | | f. sp. |
| 1 | 12 | 29.08.85 | Deiva | 190 | imm. |
| 4 | 14;16;16 ; 17 | 29.08.85 | Deiva | 190 | ab. sp.; spent? |
| 4 | 14;16;17;18 | 29.08.85 | Tigullio | 322 | ab. sp. |
| 1 | 15 | 29.08.85 | Portofino | 380 | ab. sp. |
| 3 | 15;20;20 | 09.09.85 | Magra estu. | 117 | ab. sp. |
| 3 | 16 ; 17;18 | 09.09.85 | Magra estu. | 117 | spent? ; ab. sp. |
| 4 | 18;18;18;18 | 12.09.85 | Cinque Ter. | 225 | ab. sp. |
| 3 | 16;17;17 | 12.09.86 | Cinque Ter. | 225 | ab. sp. |
| females | | | | | |
| 2 | 16;19 | 11.08.75 | Camogli | 100-150 | l.e.d. 2;2.5 |
| 1 | 13 | 19.07.83 | Chiavari | 90 | imm. |
| 1 | 19 | 19.07.83 | Chiavari | 300 | l.e.d. 2 |
| 3 | 12;13;15 | 19.07.83 | Chiavari | 300 | imm. |
| 1 | 18 | 10.08.83 | Chiavari | 300 | l.e.d. 2 |
| 3 | 12;12;16 | 14.09.83 | Chiavari | 90 | imm. |
| 4 | 12;13;13;15 | 14.09.83 | Chiavari | 90 | l.e.d. 2 |
| 3 | 15;17;17 | 08.12.83 | Chiavari | 90 | l.e.d. 2 |
| 3 | 14;15;19 | 08.12.83 | Chiavari | 90 | l.e.d. 2 |
| 4 | 17.5;18;18;18 | 01.04.85 | P. Manara | 180 | l.e.d. 2 |
| 4 | 14;17;20;22 | 01.04.85 | P. Manara | 180 | l.e.d. 2 |
| 1 | 19 | 26.04.85 | P. Mesco | 220 | l.e.d. 2 |
| 2 | 15;17 | 26.04.85 | La Spezia | 220 | imm. |
| 6 | 17;18;21;21;21;21 | 27.04.85 | Levanto | 240 | l.e.d. 2.5 |
| 2 | 15;16 | 27.04.85 | Levanto | 240 | imm. |
| 1 | 16 | 04.05.85 | Portofino | 250 | l.e.d. 2.5 |
| 1 | 14 | 27.07.85 | Ventimiglia 550-700 | | imm. |
| 3 | 19;20;21 | 29.08.85 | Deiva | 190 | l.e.d. 2.5 |
| 1 | 17 | 29.08.85 | Deiva | 190 | imm. |
| 1 | 12 | 29.08.85 | Chiavari | 322 | l.e.d. 2.5 |
| 1 | 18 | 09.09.85 | La Spezia | 240 | l.e.d. 2 |
| 1 | 12 | 09.09.85 | Magra estu. | 117 | imm. |
| 4 | 17;17;17;20 | 09.09.85 | Magra estu. | 117 | l.e.d. 2 |
| 1 | 21 | 09.09.85 | Magra estu. | 117 | l.e.d. 2.5 |
| 4 | 16;16;22;22 | 12.09.85 | Cinque Ter. | 225 | l.e.d. 2 |
| 4 | 17;19;20;20 | 12.9.85 | Cinque Ter. | 225 | l.e.d. 2.5 |
| 3 | 15;17;18 | 12.09.85 | Cinque Ter. | 225 | l.e.d. 2 |
| 1 | 15 | 20.03.86 | Levanto | 82 | l.e.d. 2 |
| 3 | | 20.09.86 | P. Manara | 135 | |

| n° | dorsal mantle length | date | zone | depth m | reprod stage | n° | dorsal mantle length | date | zone | depth m | reprod stage |
|--|----------------------|----------|------------|-----------|-------------------|----------------|----------------------|----------|-------------|----------|---|
| <i>Septietta obscura</i> Naef, 1916 | | | | | | | | | | | |
| males | | | | | | | | | | | |
| 1 | 11.5 | 23.09.76 | Camogli | 25-50 | ab. sp. | 73 | 17-31 | 14.09.83 | Chiavari | 300 | |
| 2 | 13;13 | 29.01.82 | Chiavari | 90 | ab. sp. | 1 | 25 | 08.12.83 | Chiavari | 90 | |
| 4 | 12;13;16;17 | 18.05.82 | Chiavari | 30 | ab. sp. | 14 | 18-25 | 01.04.85 | Nervi | 180 | |
| | | night | | | | 8 | 14-26 | 27.04.85 | Genoa | 240 | |
| 1 | 10 | 18.05.82 | Chiavari | 30 | imm. | 5 | 22;23;24;26;28 | 04.05.85 | Portofino | 250 | |
| | | night | | | | 1 | 21 | 13.05.85 | Sanremo | | |
| 2 | 13;15 | 12.08.82 | Chiavari | 30 | ab. sp. | 3 | 17;22;22.5 | 30.05.85 | La Spezia | 455 | |
| | | night | | | | 34 | 16-23 | 31.05.85 | La Spezia | 430 | |
| 5 | 16;17;18;18;19 | 12.08.82 | Chiavari | 50 | ab. sp. | 4 | 17;18;22;22 | 03.08.85 | Cinque Terr | | |
| | | night | | | | 4 | 22;22;22;29 | 17.08.85 | Portofino | 430-700 | |
| 1 | 16 | 03.12.82 | Chiavari | 50 | imm. | 131 | 14-28 | 22.08.85 | Cinque Terr | 425 | 14-16 imm. |
| 1 | 15 | 26.01.83 | Chiavari | 20 | ab. sp. | | | | | | 15-20 f. sp. |
| 1 | 17.5 | 24.02.83 | Chiavari | 20 | ab. sp. | | | | | | 17-28 ab. sp. |
| 1 | 11 | 24.02.83 | Chiavari | 50 | ab. sp. | 123 | 14-30 | 22.08.85 | Cinque Terr | 468 | 14-16 imm. |
| 1 | 9 | 02.06.83 | Chiavari | 20 | imm. | | | | | | 15-20 f. sp. |
| 1 | 18 | 19.07.83 | Chiavari | 50 | ab. sp. | | | | | | 17-28 ab. sp. |
| 2 | 9;9 | 10.08.83 | Chiavari | 50 | imm. | 1 | 20 | 22.08.85 | Cinque Terr | 520 | |
| 1 | 12 | 14.09.83 | Chiavari | 90 | ab. sp. | 1 | 25 | 22.08.85 | Sestri L. | 500 | |
| 1 | 11 | 14.09.83 | Chiavari | 90 | imm. | 36 | 18-27 | 22.08.85 | Cinque Terr | 520 | |
| 1 | 11 | 08.12.83 | Chiavari | 50 | imm. | 212 | 16-29 | 22.08.85 | La Spezia | 470 | |
| 1 | 15 | 01.04.85 | Tigullio | 26 | ab. sp. | 3 | 20-23-26 | 23.08.85 | Chiavari | 530 | |
| 2 | 14;14 | 20.03.86 | Levanto | 82 | ab. sp. | 1 | 22 | 23.08.85 | Chiavari | 530 | imm. |
| | | | | | | 2 | 22;23 | 29.08.85 | Chiavari | 190 | |
| females | | | | | | | | | | | |
| 1 | 12 | 04.08.75 | Camogli | 50-100 | imm. | 23 | 16-25 | 29.08.85 | Portofino | 322 | ab. sp. |
| 2 | 15-17 | 29.01.82 | Chiavari | 90 | imm. | 1 | 19 | 31.08.85 | Recco | 235 | imm. |
| 1 | 15.5 | 18.05.82 | Chiavari | 50 | imm. | 12 | 15-18 | 09.09.85 | La Spezia | 117 | |
| | | night | | | | 80 | 14-29 | 09.09.85 | La Spezia | 240 | |
| 1 | 22 | 18.05.82 | Chiavari | 30 | l.e.d. 3 | 36 | 18-29 | 09.09.85 | La Spezia | 465 | ab. sp. |
| | | night | | | | 18 | 17-21 | 12.09.85 | Cinque Terr | 225 | |
| 4 | 12 ; 15;15;18 | 18.05.82 | Chiavari | 30 | imm. l.e.d. 2 | 2 | 25;27 | 12.09.85 | P. Mesco | 425 | ab. sp. |
| 1 | 23 | 29.06.82 | Chiavari | 50 | mat. ^ | 4 | 19-20 | 08.05.86 | La Spezia | 220 | ab. sp. |
| 1 | 19 | 12.08.82 | Chiavari | 20 | l.e.d. 2.5 | females | | | | | |
| | | night | | | | 1 | 32 | 04.08.75 | Camogli | 50-100 | l.e.d. 3 |
| 2 | 16;19 | 12.08.82 | Chiavari | 30 | l.e.d. 3 | 2 | 18;23 | 11.08.75 | Camogli | 100-180 | imm. |
| | | night | | | | 3 | 23;24;28 | 15.01.76 | Camogli | 100-180 | l.e.d. 3 |
| 2 | 15;18 | 12.08.82 | Chiavari | 30 | l.e.d. 2 | 1 | 18 | 15.01.76 | Camogli | 100-180 | |
| | | night | | | | 1 | 22 | 18.02.76 | Camogli | 50-100 | l.e.d. 3.5 |
| 6 | 15;15 ; 17;17;19;19 | 12.08.82 | Chiavari | 90 | imm. l.e.d. 2.5 | 2 | 26;37 | 18.02.76 | Camogli | 100-180 | l.e.d. 3 |
| | | night | | | | 3 | 20;22;24 | 30.06.76 | Camogli | 300 | 2 imm.; l.e.d. 2 |
| 1 | 15 | 26.01.83 | Chiavari | 90 | imm. | 1 | 26 | 20.08.76 | Camogli | 100-L80 | l.e.d. 3.5 |
| 3 | 13;15;18 | 19.07.83 | Chiavari | 50 | imm.; 2 l.e.d. 2 | 2 | 18;26 | 22.02.78 | Camogli | 100-180 | l.e.d. 3 |
| 1 | 15 | 10.08.83 | Chiavari | 50 | imm. | 1 | 29 | 10.05.78 | Camogli | 100-180 | l.e.d. 3 |
| 1 | 12 | 10.08.83 | Chiavari | 90 | imm. | 32 | 29.07.82 | Chiavari | 90 | l.e.d. 3 | |
| 2 | 12;18 | 14.09.83 | Chiavari | 50 | imm. | 5 | 12;18;18;19;21 | 02.06.83 | Chiavari | 300 | |
| 1 | 17.5 | 14.09.83 | Chiavari | 90 | mat. | 53 | 10-34 | 19.07.83 | Chiavari | 300 | |
| 4 | 10;11;14;17 | 14.09.83 | Chiavari | 90 | imm. | 16 | 15-28 | 10.08.83 | Chiavari | 300 | |
| 1 | 10 | 08.11.83 | Chiavari | 20 | imm. | 50 | 16-34 | 14.09.83 | Chiavari | 300 | |
| 1 | 12 | 08.11.83 | Chiavari | 50 | imm. | 6 | 18-31 | 01.04.85 | Nervi | 180 | l.e.d. 3.5 in 27-31 |
| 2 | 17;23 | 01.04.85 | Tigullio | 26 | l.e.d. 3 | 3 | 24;26;28 | 26.04.85 | Cinque Terr | | |
| 1 | 17 | 01.04.85 | Camogli | 50 | imm. | 3 | 23 ; 24;28 | 26.04.85 | La Spezia | 220 | l.e.d. 3 ; 4 |
| 1 | 19 | 01.04.85 | Tigullio | 85 | l.e.d. 3 | 1 | 23 | 26.04.85 | La Spezia | 220 | |
| 1 | 17 | 24.08.85 | | 70 | imm. | 6 | 22-30 | 27.04.85 | Genoa | 240 | |
| 1 | 20 | 02.05.86 | Camogli | 50 | l.e.d. 3 | 2 | 24;27 | 04.05.85 | Portofino | 250 | |
| 1 | 16 | 02.05.86 | Camogli | 50 | imm. | 1 | 26 | 13.05.85 | Sanremo | | |
| <i>Septietta neglecta</i> Naef, 1916 | | | | | | | | | | | |
| males | | | | | | | | | | | |
| 2 | 17;20 | 30.04.76 | Camogli | 50-100 | ab. sp. | 1 | 26 | 17.05.85 | Cinque Terr | 423 | |
| 1 | 21 | 26.01.83 | Chiavari | 90 | ab. sp. | 1 | 30 | 17.05.85 | Cinque Terr | 439 | |
| 1 | 14 | 24.02.83 | Chiavari | 30 | f. sp. | 3 | 18;25;28 | 30.05.85 | La Spezia | 455 | |
| 1 | 22 | 19.07.83 | Chiavari | 90 | ab. sp. | 33 | 15-25 | 31.05.85 | La Spezia | 430 | l.e.d. 3-3.7 in 22-25 |
| 1 | 21 | 08.12.83 | Chiavari | 75 | ab. sp. | 1 | 20 | 03.08.85 | Cinque Terr | | |
| 1 | 14 | 26.04.85 | La Spezia | 220 | imm. | 3 | 21;29;31 | 17.08.85 | Portofino | 430-700 | |
| 1 | 15 | 09.09.85 | Magra estu | 117 | imm. | 86 | 10-32 | 22.08.85 | Cinque Terr | 425 | 10-22: imm. 22-27: l.e.d. 3 25-30: l.e.d. 3.5 14-25: imm. 18-25: l.e.d. 2.5-3 24-30: l.e.d. 3.5 12-26: imm. 20-32: l.e.d. 3 23-32: l.e.d. 4 |
| females | | | | | | | | | | | |
| 1 | 14 | 04.10.82 | Chiavari | 90 | imm. | 2 | 26;26 | 22.08.85 | Sestri L. | 500 | |
| 1 | 12 | 28.12.82 | Chiavari | 50 | imm. | 37 | 14-29 | 22.08.85 | Cinque Terr | 520 | |
| 5 | 14;14;18;17;17 | 26.01.83 | Chiavari | 90 | imm. 2 l.e.d. 2.5 | 3 | 23;23;27 | 23.08.85 | Chiavari | 530 | |
| 1 | 17 | 02.06.83 | Chiavari | 300 | l.e.d. 2.5 | 1 | 24 | 23.08.85 | Chiavari | 530 | imm. |
| 1 | 12 | 08.11.83 | Chiavari | 90 | l.e.d. 2 | 1 | 31 | 24.08.85 | Cinque Terr | 110 | l.e.d. 4 |
| 1 | 17 | 08.12.83 | Chiavari | 90 | l.e.d. 3 | 2 | 16;21 | 29.08.85 | Chiavari | 190 | |
| ~ poorly preserved eggs | | | | | | | | | | | |
| <i>Septietta oxynilava</i> d'Orbigny, 1835 | | | | | | | | | | | |
| males | | | | | | | | | | | |
| 1 | 23 | 11.08.75 | Camogli | 100-180 | ab. sp. | 4 | 20;27;29;29 | 29.08.85 | Portofino | 322 | mat. |
| 4 | 16;18;18;18 | 11.08.75 | Camogli | 100-180 | imm. | 5 | 20-23 | 29.08.85 | Portofino | 322 | |
| 1 | 28 | 15.01.76 | Camogli | 100-180 | ab. sp. | 2 | 26;26 | 31.08.85 | Recco | 450 | |
| 1 | 15 | 15.01.76 | Camogli | 100-180 | imm. | 15 | 13-28 | 09.09.85 | La Spezia | 117 | |
| 1 | 26 | 18.02.76 | Camogli | 100-180 | f. sp. | 21 | 12-24 | 09.09.85 | La Spezia | 240 | |
| 4 | 20;22;24;25 | 18.02.76 | Camogli | 100-180 | ab. sp. | 18 | 22-33 | 09.09.85 | La Spezia | 465 | |
| 3 | 22;23;26 | 30.06.76 | Portofino | about 300 | ab. sp. | 13 | 14-35 | 12.09.85 | Cinque Terr | 225 | |
| 1 | 17 | 22.12.76 | Camogli | 100-180 | imm. | 1 | 34 | 12.09.85 | P. Mesco | 425 | mat. |
| 1 | 21 | 22.02.78 | Camogli | 100-180 | ab. sp. | | | | | | |
| 6 | 19-29 | 02.06.83 | Chiavari | 300 | | | | | | | |
| 90 | 14-32 | 19.07.83 | Chiavari | 300 | mat. fr 20 mm ML | | | | | | |
| 37 | 16-29 | 10.08.83 | Chiavari | 300 | mat. fr 20 mm ML | | | | | | |

The Ligurian specimens were fished both on infralittoral and circalittoral bottoms. Minimum spawning sizes were 12 mm ML in the male and 16 mm ML in the female (fixed spec.); the sex-ratio was in favour of females (1.4 : 1); the spawning season was long (at least April-September).

Sepietta neglecta

S. neglecta was kept in the aquarium from hatching to a final length of 15 mm ML by Boletzky *et al.* (1971). We have occasionally fished this species from infralittoral to bathyal grounds, as could be expected from recent records in the Adriatic (30-50 m), in the Gulf of Cadiz (70-475 m) and off Taragona (315-363 m).

Minimum spawning sizes were 17 mm ML in the male and 17 mm ML in the female.

Sepietta oweniana

Mangold-Wirz (1963) and Bergstrom and Summers (1983) give exhaustive accounts of the life-cycle of *S. oweniana* on the basis of many observations made both in the field and in the laboratory.

S. oweniana is very abundant in some fishing grounds of the eastern sector of the Ligurian Sea, where we have recorded a maximum of 395 individuals per hour of trawling. The denser samples were obtained at 400-500 m at a distance from the coast of about 20-25 miles.

Males range from 14 to 30 mm ML and females from 10 to 35 mm ML (fixed specimens). Minimum spawning sizes are 18 and 20, respectively, in male and female. Mature animals are present throughout the year. In contrast, the bathyal population is not stable, because the spring sampling gave a number of animals corresponding to only 10% of the summer sampling. A peak of hatching and/or a migration toward deeper waters takes place in the late spring or at the beginning of the summer.

DISCUSSION

Considering the Mediterranean records (Table I), three species, *S. affinis*, *S. steenstrupiana* and *S. aurantiaca*, are found missing in this collection of Sepiolineae from the Gulf of Genoa.

We suppose that our sampling methods were not suitable for the capture of *S. affinis*, which lives « at depth of a few metres on sandy bottoms » (Naef, 1923). One of us has ascertained its presence in the Gulf of Genoa by examining the small sepiolids, generally labelled as *S. rondeletii*, which form the collection of the Museum of Natural History in Genoa (M.N.H.G.). Out of a total of 35 specimens of *Sepiola*, 14 are *S. affinis*; the Ligurian records of

this species extend from 1905 to 1966, but are mainly from the oldest time period, when artisanal coastal fisheries were probably more common than now. Therefore, this species can be definitely added to the cephalopods of the Ligurian Sea and considered quite common.

S. steenstrupiana, described on the basis of specimens from Villefranche, was found also in the Gulf of Salerno and near Naples (Naef, 1923) in the Adriatic (Rudolph, 1932) and in Haifa Bay (Knudsen, 1981). Considering these few records, it seems a rare species which lives at infralittoral levels (5-20 m in the Adriatic; 47 m in Haifa Bay on sandy mud). No Ligurian records are to be found at the M.N.H.G.

S. aurantiaca was described by Jatta (1896). Naef (1923) saw only preserved specimens coming from Naples and the Atlantic coasts (Roscoff, Firth of Forth, Bergen, North Sea); he stated that it probably lived in deep waters at about 200-400 m, although it is not clear on which observations he based this remark. This species seems the rarest in the Mediterranean, with no records after Naef, and it represents the only species actually lacking till now in the Ligurian Sea.

From the data collected in our area the ecological distribution of the five commoner species of *Sepiola* may be summarized as follows :

- a) shallow water species : *S. rondeletii*, *S. affinis*
- b) circalittoral species : *S. robusta*, *S. ligulata*
- c) eurybathic species : *S. intermedia*

The scarce records of *S. steenstrupiana* have so far suggested that it belongs to group a). On the other hand, if Naef's supposition proves correct, *S. aurantiaca* will be the only species of *Sepiola* living entirely along the slope.

The distribution of *S. robusta* in areas different from the Ligurian Sea seems larger than that above indicated. Data of Mangold-Wirz (1963) and Boletzky (1983) state its presence on infralittoral bottoms along the Catalan coast, i.e. in the same zone where the absence (or a very scarce presence) of *S. intermedia* was registered. An enlargement of the niche of *S. robusta* in this particular case may perhaps be supposed.

In general, the species of the genus *Sepietta* seem to be even more eurytopic than *Sepiola*. *S. obscura* lives in neritic waters, from the shore to about 100 m, exposed to a range of temperatures and other environmental factors similar to *S. intermedia*. *S. neglecta* has a larger range, reaching bathyal levels. *S. oweniana* is well known for its presence from about 50 to more than 900 m (Mangold-Wirz, 1963).

The eight species in our collection are all found in a belt between the depths of 50 and 100 m (Table II). In this particular range the temperature is almost constant (13-14°C) from December to April, and variable with the thermocline (13-19°C) from May to

November. If egg laying takes place here, different clusters of eggs laid at slightly different depths in spring, may hatch at very different times. This fact may help to maintain a continuity of spawning conditions during the year in shortlived semelparous species.

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