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Occurrence of *Squalus cubensis* Rivero, 1936, in the Western South Atlantic Ocean, and Incidence of its Parasitic Isopod *Lironeca splendida* sp. n.

Victor SADOWSKY and Plínio SOARES MOREIRA
(São Paulo)

ABSTRACT

The occurrence of *Squalus cubensis* Rivero, 1936, in the Western South Atlantic Ocean is reported. Taxonomic data are furnished for this dogfish species. The parasitic isopod *Lironeca splendida* sp. n. is described, and the incidence of infestation by this parasite discussed.

INTRODUCTION

The otter-trawling cruises carried out on the Oc/S "Prof. W. Besnard", of the Instituto Oceanográfico of the Universidade de São Paulo, in the years 1969 to 1973, over the continental shelf of southern Brazil (Lat. 24° to 35° S), captured a number of spiny dogfish *Squalus cubensis* Rivero, 1936, many of which were parasitized by the cymothoid isopod *Lironeca splendida* sp. n.

Since the taxonomic status of *S. cubensis* is still an open question, and since too little is known about the species occurring along the Brazilian coast, and as the mentioned parasitic isopod proved to be a species new to science, the authors publish the available informations on both the host and its parasite.

This paper reports a few meristic and morphometric data of *S. cubensis*, briefly points out the present taxonomic questions involving some closely related species of *Squalus*, and provides informations on the relationship of the spiny dogfish to their parasites as well as the description of the present parasitic isopod.

MATERIAL AND METHODS

The specimens caught were frozen onboard the ship. Later on at the IOUSP laboratory they were defrosted and studied in the way proposed by Sadowsky (1967). The total length of each specimen was taken following Sadowsky's methodology (1968). Bass's (1973) measuring method was not employed, since it is valid only for older individuals, which present a calcified, rigid caudal fin. It proved unfit for juveniles and young sharks.

At the laboratory each *S. cubensis* was carefully examined and the presence of *Lironeca splendida* recorded. The isopods were examined with a Wild stereomicroscope. Injuries caused by the parasites on the sharks were recorded when they were found.

RESULTS AND DISCUSSION

A total of 131 specimens of *S. cubensis* was captured from 1968-1973 on the continental shelf of southern Brazil in 60 to 90 meters depth. As reported earlier (Sadowsky, 1971, 1973), immature individuals were gathered in shallower depths.

Thirty two (24.43%) specimens were mature, 13 (40.62%) of which were females and 19 (59.38%) males. Adult females ranged from 53.0 to 71.6 cm, while adult males were from 41.0 to 55.0 cm total length. These figures show that females grow larger than males.

Ribeiro (1907, 1923) first reported spiny dogfish from Brazilian waters under the name of *Squalus blainvillei* (Risso, 1826). Bigelow & Schroeder in 1948 considered Ribeiro's specimens as *S. cubensis*.

Later investigations (Bigelow & Schroeder, 1957; Garrick, 1960; Springer, pers. comm.) pointed out the close relationship between *S. cubensis* and the Pacific Ocean species *S. megalops* (McLeay, 1882), and questioned the specific validity of *S. cubensis*.

Ledoux's (1975) report of the occurrence of *S. blainvillei* (considered synonymous to *S. fernandinus* by Garman, 1913) in the Mediterranean, as well as certain characteristics of these specimens, again raise the question of the taxonomic status of these species.

A point to be carefully considered is that the shape of the pectoral fins of the Mediterranean *S. blainvillei* shows the same taxonomic character (distal margin deeply concave with posterior angle distinctly pointed) of the group of *Squalus* represented by *megalops* and *cubensis* (Bigelow & Schroeder, 1948, 1957; Garrick, 1960; Manday, 1968; Bass, 1976).

The present state of the taxonomy of the aforementioned spiny dogfishes is confusing. A critical study is badly needed, based on extensive material of all closely related or synonymous species, in order to firmly establish the taxonomic identity of the species of the genus *Squalus* (Kreft & Tortonese, 1973).

The present paper does not intend to examine the taxonomy of all the species, or groups of species, of the genus *Squalus* in detail. It seems at present more appropriate to comment and to furnish a few informations on the spiny dogfish species from the continental shelf of southern Brazil, as background data for future investigations. Accordingly, data related to the most valuable characters for the recognition of *S. cubensis* are provided for 72 males and females.

The main differences distinguishing *S. cubensis* from *S. megalops*, according to Bigelow & Schroeder (1957, p. 37), are the shape of both the pectoral and caudal fins, the relatively longer 1st spine of the dorsal fin, and the rearward position of the ventral fins relative to the dorsal onès (in *S. megalops* they are placed "a little nearer to the rear end of the base of the first dorsal than to the origin of the second dorsal").

Our data show that the distal margin of the pectoral fin of *S. cubensis* is proportionaly shorter than that of *S. megalops*, according to measurements taken from both the illustration provided by Bigelow & Schroeder (1957) and from the examined *S. megalops* specimen borrowed from the Sydney Museum, Australia. On the other hand, Bigelow & Schroeder's figure (1957) shows the caudal fin of *S. cubensis* clearly narrower than that of both *S. megalops* from Australia and *S. cubensis* from Brazil, comparing specimens of similar size and sex.

Regarding the position of the ventral fins in the Brazilian *S. cubensis*, the midpoint of their bases is always nearer to the rear end of the base of the first dorsal than to the origin of the second dorsal fin, contrary to what was pointed out by Bigelow & Schroeder (1957) as one of the main differences distinguishing *S. cubensis* from *S. megalops*.

Large variations were observed in the proportional length of the first spine of the dorsal fin. The criterion established to define this variation was the lenght of the spine in relation to the height of the dorsal fin. The Brazilian specimens show variations ranging from 65 to 77%. Probably these variations result form the wear out of the spine, since it is used as a weapon, as reported by Bigelow, Schroeder & Springer (1953) in NW Atlantic specimens. In the *S. cubensis* holotype (Rivero, 1936), the index is close to 100%. However, it varies greatly also in specimens collected from the holotype area, according to measurements performed on drawings provided by a few authors: 80% (Manday, 1968), 73% (Aguirre, 1965) and 70% (Thompson & Springer, 1965).

In *S. megalops* similar variations occur in the proportional length of the spine of the 1st dorsal fin. In *S. megalops* from Australia (Garrick, 1960) they reached 55%, in Taiwan specimens (Chen, 1968) they are higher, and in individuals from South Africa (Bass et al., 1976) they fall into the variations encountered in specimens of *S. cubensis* from Brazil and from the NW Atlantic.

The number of precaudal vertebrae is commonly used to characterize species of *Squalus*, since it appears not to vary with the age of the sharks.

Precaudal vertebrae counts in 72 examined specimens of *S. cubensis* ranged from 81 to 87, with a mean of 83.5 vertebrae. The total number of vertebrae varies from 104 to 115, averaging 110.6.

Data on the numbers of precaudal vertebrae for both *S. cubensis* and *S. megalops* from different areas are given as follows:

Species	Area	No.	Mean	Range	Source of data
S. cubensis	NW Atlantic	4	84.8	82-87	Springer & Garrick, 1964
	SW Atlantic	72	83.5	81-87	present study
S. megalops	S. Africa	156	81.0	78-84	Bass et al., 1976
	NW Pacific	8	79.9	78-82	Springer & Garrick, 1964
	Australia	1	79.0	—	present study

The number of vertebrae in the specimens of *S. cubensis* from the NW Atlantic is higher. There are 38 to 41 monospondylous vertebrae, averaging 40. The single specimen of *S. megalops* from Australia shows the same number of monospondylous vertebrae.

The most common tooth counts in 72 jaws were 24-26 (54.0%). However, the number of teeth in both upper and lower jaws varies, respectively, from 24 to 28, and from 22 to 26. In the examined specimen of *S. megalops* the symphysial tooth in both upper and lower jaws is lacking, contrary to what was registered by Bass et al. (1976) in specimens from South Africa.

HOST/PARASITE RELATIONSHIP

Of the 131 collected individuals of *S. cubensis*, 22 (16.79%) were parasitized by *Lironeca splendida*. Nine parasitized *S. cubensis* were adult, while 13 were immature.

Reports on the infestation of Chondrichthyes by isopod crustaceans are relatively scanty (Moreira & Sadowsky, 1978), considering the amount of available informations related to Teleostei (Richardson, 1905; Schiödte & Meinert, 1884; Trilles, 1964; Roman, 1970).

The occurrence of parasitic isopods on species of *Squalus* has been mentioned previously (Capapé & Pantoustier, 1976), but no detailed data have been published on the incidence of infection in *S. cubensis*.

The percentage of parasitized *S. cubensis* occurring off southern Brazil ranges from small to moderate, but it is higher than that reported by Capapé & Pantoustier (1976) for 8 Mediterranean species of Chondrichthyes (ranging from 0.15 to 6.43%). However, these figures are lower if compared with accounts on the infestation of Teleostei by isopods. The incidence of parasitism in *Spicara smaris* and *S. chryselis* is about 19%, and in *S. moena* it is about 53% (Trilles, 1972). In *Gymnothorax eurostus* from the Hawaiian Islands it ranges from about 15% to 70% (Bowman, 1960). In *Chloroscombrus orqueta* it ranges from 37% to as high as 80.7% (Menzies, Bowman & Alverson, 1955).

Literature data show that specimens of Teleostei may carry one or more parasites (Bowman, 1960; Trilles, 1972). Roman (1970) has reported on a single *Boops boops* a total of 5 isopods attached to different parts of the animal. Collected data show that *S. cubensis* bears from 1 to 3 parasitic isopods.

Commonly, when several parasites are present on the host, they are in different stages of development. Usually, a male and a female are found together (Montalenti, 1948), and one or more juveniles may also be present for a short time before they leave the host for a free-swimming period (Inouye, 1941). The data concerning the number of parasitic isopods in *S. cubensis* are:

11 specimens with only 1 parasite (female),
8 specimens with 2 parasites (a male and a female), and
3 specimens with 3 parasites (a female, a male and a juvenile).

Most of the *L. splendida* specimens were found in the mouth of *S. cubensis* (Fig. 1). Very exceptionally, some were found on the anterior wall of the branchial chamber. Probably, these individuals were wandering males or juvenils (unfortunately, the sex of these specimens was not recorded) that moved from their original attachment place after the death of the host.

All but a few (Figs. 2 and 3) *L. splendida* females were attached with their head outwards (Figs. 1 and 4). When the male was present, it was usually attached close to the female (Figs. 4 and 5).

Both male and female, but especially the female parasites, are attached very firmly to the mouth of the host, with the dactylus of the anterior pereopods embedded deeply in the tissues. The surface of the mouth was darkened in the

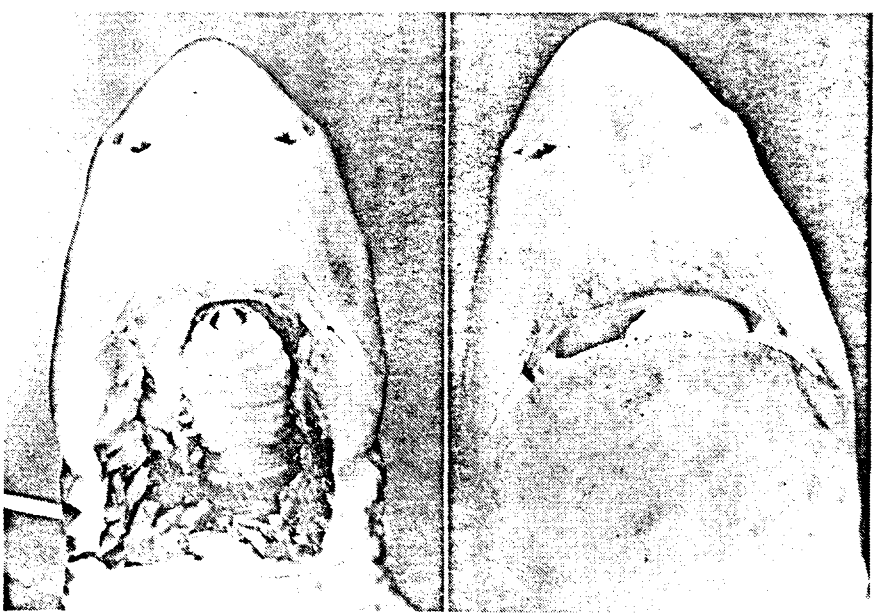


Fig. 1. *Squalus cubensis*, ventral view of anterior part of head, with lower jaw removed to show parasitic isopod attached with head outwards.

Fig. 2. *Squalus cubensis*, ventral view of anterior part of head, mouth partially open, showing parasitic isopod (only rear end of telson visible) attached with head rearwards.

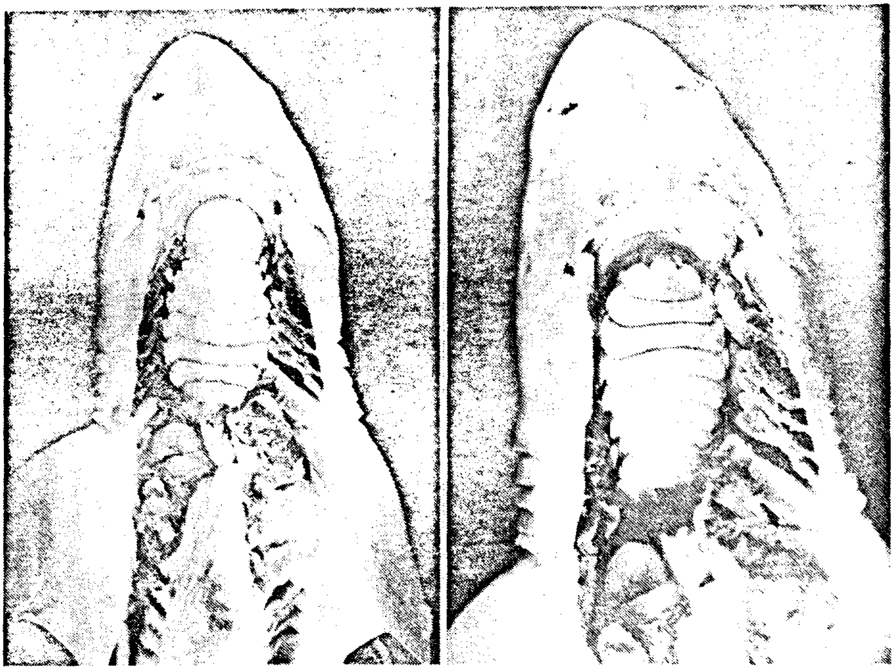


Fig. 3. *Squalus cubensis*, ventral view of anterior part of head, with lower jaw removed to show parasitic isopod attached with head rearwards. Note as the parasite fits well to the shark's mouth.

Fig. 4. *Squalus cubensis*, ventral view of anterior part of head, with lower jaw removed to show male and female parasitic isopod attached with head outwards. Note that the male is much smaller than female and it is attached close to the anterior part of female's body.

area of the attachment of the dactylus, as well as in the area around the mouth of the parasite (Fig. 6). However, fresh wounds were not observed, and probably the darkened tissue represents regenerated tissue of old wounds. Adult males and females of *L. splendida* probably do not feed, similarly to what has been reported for other isopod species (Hansen, 1905; White, 1970; Moreira, 1973, 1974).

The ovigerous female parasites reach up to 48.0 mm in length. About $^1/_2$ to $^2/_3$ of the host's buccal cavity is occupied by the parasite, and this must have some influence on the host's activity, possibly reducing the ability of the fish to feed, and diminishing the current of respiratory water. However, despite the large size of the female parasites, the hosts were still able to close their mouth fully, and the infected fishes cannot be distinguished externally from the non-infected ones. Further studies will elucidate open questions regarding the host/parasite relationship.

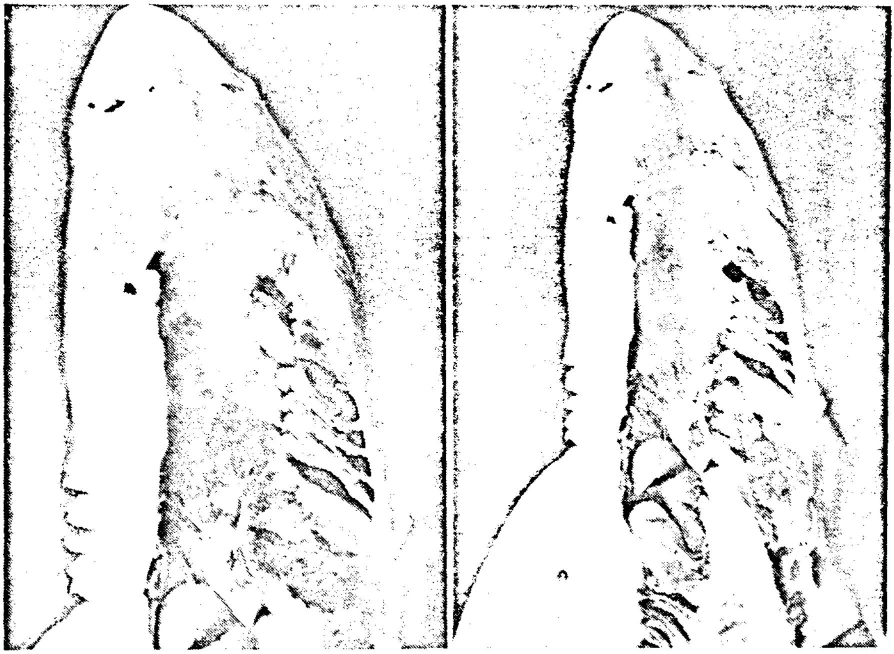


Fig. 5. *Squalus cubensis*, ventral view of anterior part of head, with the lower jaw and the female parasitic isopod removed to show the attachment of the male parasite.

Fig. 6. *Squalus cubensis*, ventral view of anterior part of head, with the lower jaw and the male and female parasitic isopod removed to show both the darkened tissue and the scars produced by the parasites mouth appendages and dactylus of the anterior pereopods.

Description of Lironeca splendida sp. n.

Holotype: Ovigerous female, 40.0 mm long. In mouth of "cação bagre" (*Squalus cubensis* Rivero, 1936). *Allotype:* adult male, 23.0 mm. *Paratypes:* 1 immature female, 42.0 mm long, deposited at National Museum of Natural History, Smithsonian Institution, USA (Prof. Dr. Thomas E. Bowman). 1 ovigerous female, 47.0 mm long; 1 adult male, 19.0 mm long.

Type locality: Oc/S "Prof. W. Besnard" St. 2403. Lat. 23° 27'S, Long. 43° 20'W. 104-108 m depth. November, 1975. Otter-trawl trawling.

Etymology: The species name is derived from the Latin word *splendidus* = magnificent.

Description: Holotype ovigerous female. Body (Fig. 7) elongate, only slightly twisted to one side, about 1.9 times longer than wide. Greatest width of the

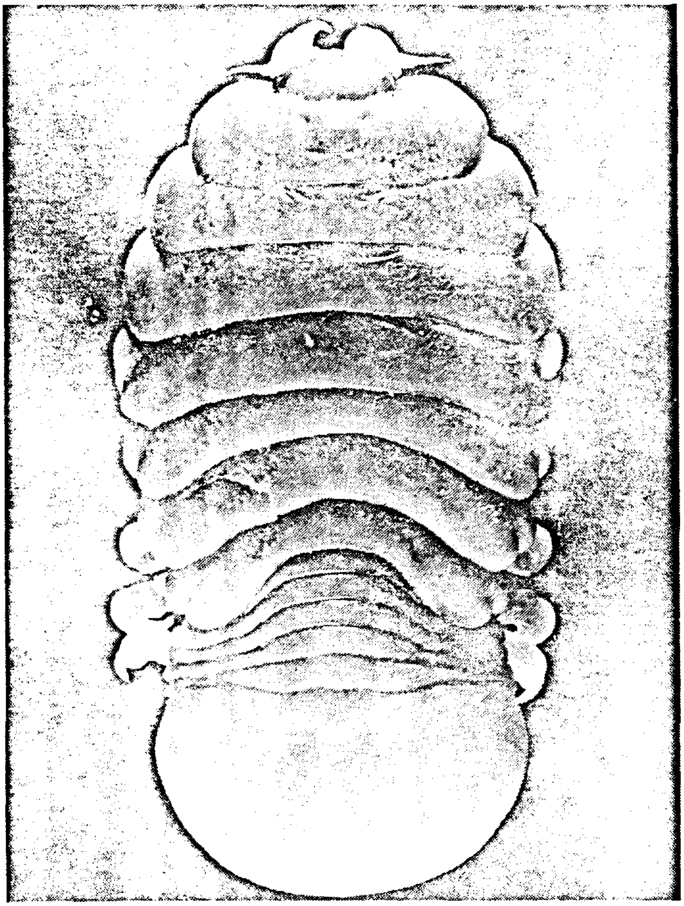


Fig. 7. *Lironeca splendida* sp. n., holotype female 40.0 mm long, body, dorsal.

body across pereonite IV. The surface of the body is smooth, with small dorsally visible scars placed especially on the sides of the pereonites and along the distal portion of the head. Color (in alcohol) yellowish.

Head: Triangular, apex roundly pointed and deflected downward, separating basal joints of the antennae 1, dorsal surface excavated distinctly close to apex. Eyes elongate, slightly black, not prominent, placed in the posterolateral angles of the head, anteriorly separated by a distance larger than length of one eye.

Pereon: Pereonite I about 1.6 times as wide as pereonite IV, with lateral margins rounded and pronouncedly converging mid-anteriorly, enclosing posterior portion of head; anterolateral angles roundly pointed, extending to about distal third of eyes; anterior margin well convex, slightly produced medially; dorsal surface with 4 divergent pits placed characteristically as shown in Fig. 7, of which the two anterior ones are marked more strongly.

Hind margin of pereopods II to VII gradually becoming more excavated posteriorly. Posterolateral angles of pereonites II and III roundly pointed, those of IV to VII expanded and broadly rounded, those of pereonite VII covering sides of pleonite 1.

Coxal plates distinctly separated on pereonites II to VII. Coxal plates of pereonites II and III narrow, elongate, reaching the posterolateral angles of their respective segments, those of pereonites IV to VII becoming shorter posteriorly, not reaching posterolateral angles of their pereonites.

Pleon: All five pleonites free, sub-equal. Last pleonite longer, with distal margin produced into a slight, median, rounded point flanked on either side by a shallow excavation. Pleonites characteristically divergent posteriorly, each one from 1 to 5 wider than the preceding one. Pleotelson slightly convex, about 2 times wider than long, and as wide as or slightly wider than 5th pleonite; dorsal surface roundly prominent anteriorly, with two shallow excavations, one on either side of a slight, short, mid-longitudinal carina; posterior margin semilunar, slightly twisted to one side; smooth, lacking setae.

Antenna 1: 8-segmented, without setae, except a few at apex of the terminal article.

Antenna 2: 12-segmented, without setae.

Mandible (Fig. 8): Incisor produced into a stout, sclerotized, apically blunt tooth (Fig. 9); a shallow depression (Fig. 10) separating incisor from molar, which is entire, blade-like, expanded and prominent; setal row and lacinia mobilis lacking; palp with three joints devoid of setae, the first being the longest, the third rounded at apex, and exceding tip of the incisor; cuticle of the three articles with distinct, irregular tubercle-like prominences (Fig. 8).

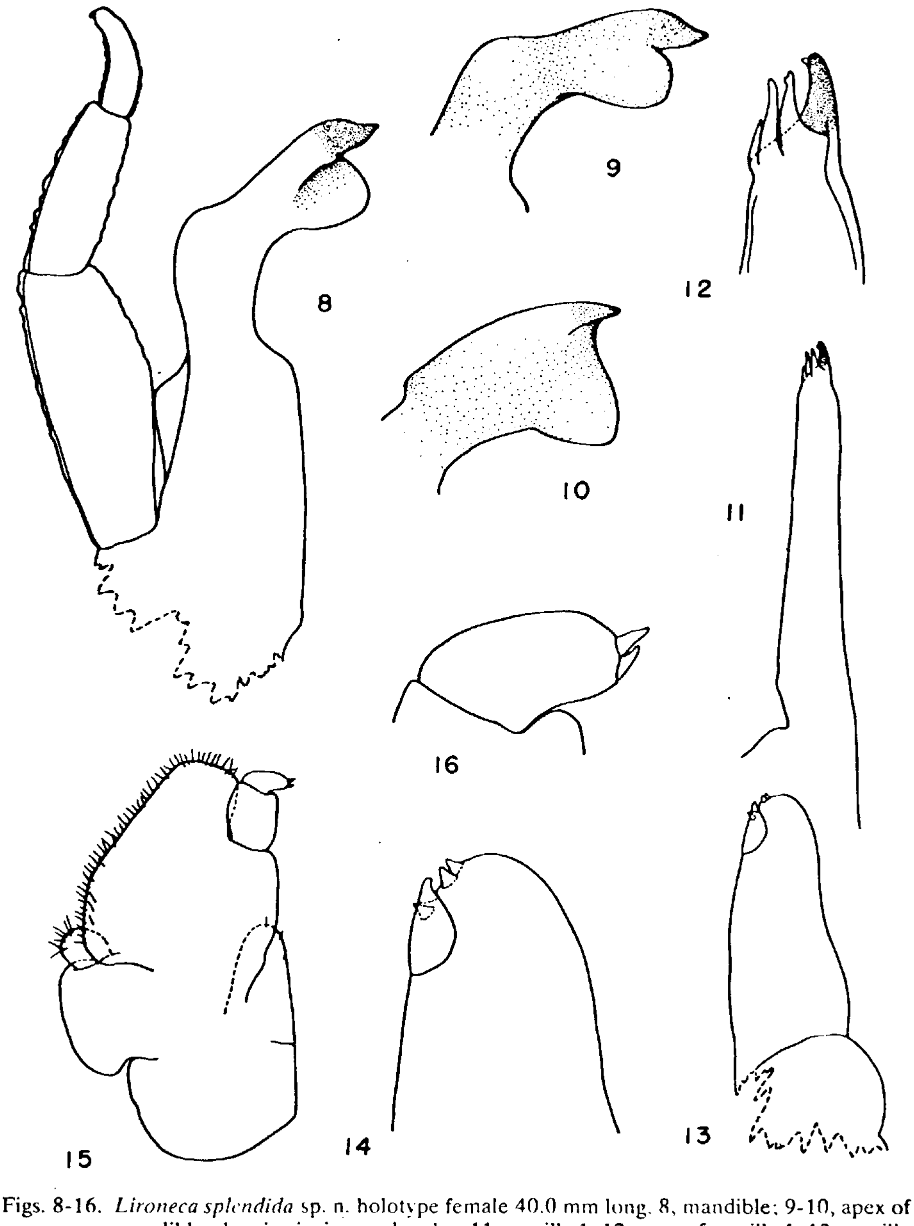
Maxilla 1 (Fig. 11): Slender, narrowing distally, tip with one large and 3 smaller spines; large spine and one of the smaller spines are toothed (Fig. 12).

Maxilla 2 (Fig. 13): Unequally bilobed at apex, with each lobe bearing 2 short recurved spines (Fig. 14); inner lobe subapical and much smaller than outer one.

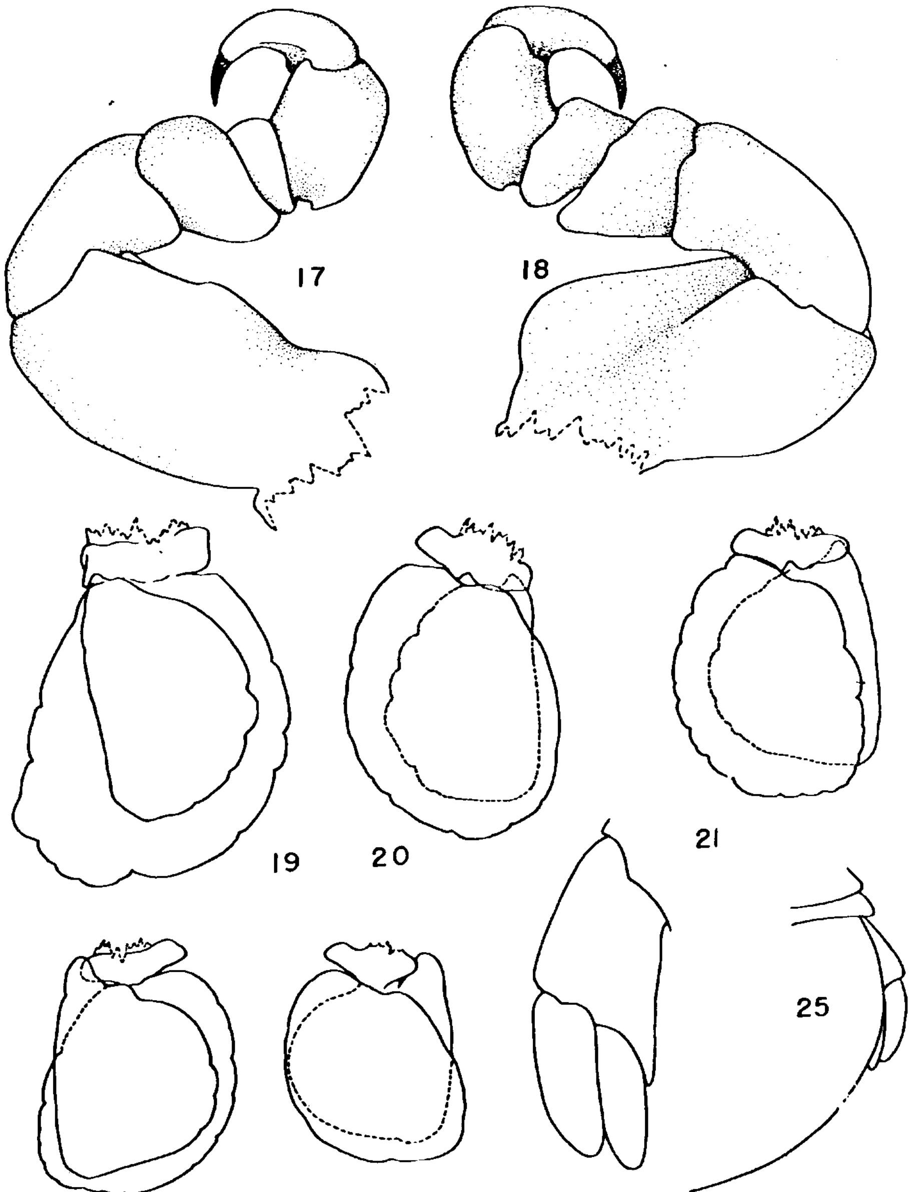
Maxilliped (Fig. 15): Endite expanded, laminar, not exceding length of palp distally, free margin bordered all along by short setae; palp 2-jointed, distal joint narrower, curved and bearing 2 stout spines at apex (Fig. 16); epipod small, rounded, fringed by short setae.

Pereopods I - VII. All similar morphologically, devoid of setae, tubercles or hooks, increasing in length posteriorly. The basic features presented by pereopod I are repeated in the remaining ones. However, the relative size of the joints changes from pereopod I to VII, and some features are slightly modified (although retaining the basic original shape). The comparison of the illustrated pereopods II and VI shows the main mentioned modifications in size and features of joints.

Pereopod II (Fig. 17): Basis, the strongest joint of the pereopod; dorsal surface with a longitudinal, slightly irregular groove, into which remaining



Figs. 8-16. *Lironeca splendida* sp. n. holotype female 40.0 mm long. 8, mandible; 9-10, apex of mandible, showing incisor and molar; 11, maxilla 1; 12, apex of maxilla 1; 13, maxilla 2; 14, apex of maxilla 2; 15, maxilliped; 16, detail of 2nd article of the palp of maxilliped.



Figs. 17-25. *Lironeca splendida* sp. n., holotype female 40.0 mm long. 17, pereopod II; 18, pereopod VI; 19, pleopod 1; 20, pleopod 2; 21, pleopod 3; 22, pleopod 4; 23, pleopod 5; 24, uropod; 25, dorsal view of part of the pleon/pleotelson, showing the relative position of the uropod.

joints (except dactylus) fit; outer edge of groove blade-like and higher than inner edge, which is widely rounded; ventral margin broadly convex. Ischium, second largest joint of pereopod; ventral margin convex but almost straight in middle. Merus with lateral margins converging dorsally to a curved, blade-like edge produced at distal angle; ventral margin rounded, slightly prominent. Carpus, smallest joint; dorsum with a shallow excavation into which the posterior portion of the propodus fits. Propodus strong, higher than carpus, produced into a small posterior process; portion below process fitting into shallow depression of carpus. Dactylus strong, ending in an acute, sclerotized, curved claw, tip reaching anterior margin of merus.

Pereopod VI (Fig. 18): Basis, dorso-longitudinal groove deep; outer edge of groove blade-like, well developed, strongly prominent at proximal corner; inner edge of groove rounded proximally but blade-like in its distal portion; proximal portion of ventral margin truncate, distal one slightly rounded. Ischium, lower margin broadly rounded. Merus, dorsodistal angle strongly produced into a roundly pointed process. Carpus, dorsal margin convex and well prominent. Propodus and dactylus retaining the basic stout shape.

Pleopods 1-5 (Figs. 19-23): All expanded, laminar, fleshy, without marginal setae and pleated surface, decreasing in size posteriorly. Proximal inner angle of endopod of all pleopods produced into a roundly pointed process, especially prominent at pleopods 4 and 5.

Uropods (Fig. 24): Peduncle projected distally at inner angle, setae on outer and inner margins lacking. Exo- and endopod short and narrow, both rami without setae; exopod a little longer than endopod, reaching posteriorly to about level of middle of pleotelson (Fig. 25).

REMARKS – *Lironeca splendida* sp. n. is easily distinguished from the other species of the genus, especially from *Lironeca raynaudi* Milne Edwards, 1840, its closest related species, by the general shape of body and pleotelson, by size, shape and development of the coxal plates, and by the four well marked dorsal pits on pereonite I (absent in *L. raynaudi*).

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Address of the Authors:
Instituto Oceanográfico
Universidade de São Paulo
Cidade Universitária
Butantã 05508 São Paulo, SP
Brazil