INSTITUT ZA OCEANOGRAFIJU I RIBARSTVO - SPLIT
SFR JUGOSLAVIJA

No. 39. BILJEŠKE - NOTES 1980.

On some zooplankton predators of plankton fish stages

O zooplanktontima predatorima larvalnih stadija riba

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Predators are well known to be one of the causes of mortality of plankton fish stages. However, the intensity of their activity has not been agreed upon. Ahlstrom (1954) helds the predators to be the main cause of mortality of fish larvae. However, their activity varies dependently on the density of larwae and on how long does the vulnerable stage of larvae last. After Hempel (1963), however, larval stages are too short to cause any considerable increase in the number of predators. Therefore, he takes that the quantity of available food in the period when larvae begin to feed actively, is likely to be more important for the survival than predator activity.

The Adriatic ichthyoplankton predators are reltively little known. It was found that the postlarvae of mackerel were the predators of sardine postlarvae (Karlovac, J., 1962). Sardine postlarvae fell a prey to the sole, *Solea vulgaris*, Quens., as well. *Sagitta* sp. of holoplankters and copepod *Candacia* sp. also attack sardine postlarvae (Karlovac, J. 1967). Vučetić (1963) finds that the food of the adult sardine includes the fish larvae as well.

Assuming that the knowledge of the as large number of species, which may be the ichthyoplankton predators, as possible may be of use for the further studies, we are going to give some additional information on the zooplankton species which attack fish larvae.

The data used in this paper originate from the material collected from the Kaštela Bay, Split Strait, Pelegrin, and Stončica (Central Adriatic) by the vertical hauls of plankton net of »Helgoland« type (Küne, 1933). The samples from the former two stations were collected monthly from 1970 to 1973, and those from the latter two stations between 1971 and 1973. Larvae and postarvae of

sardine and anchovy were predominant in the composition of inchytoplankton. However, the data on the attacked individuals of other species are going to be brought out since the sardine and anchovy are separately studied.

A total of 3987 of larvae and postlarvae of fish (without sardine and anchovy) were collected during the investigations. There were identified 65 species (without sardine and anchovy). In the material as a whole there were found eight larvae and postlarvae attacked by the five species of plankton organisms:

Phyllopoda

— *Podon intermedius* Lillj. One individual of 1.01 mm in length which attacked the *Gobius sp.* larva of 2.25 mm long was found on the Pelegrin Station on 19 April 1973 (Fig. 1).

Copepoda

— *Temora stylifera* (Dana). One individual of 1.31 mm in length attacked the *Gobius* sp. postlarva 2.44 mm long. It was found on the Pelegrin Station on 13 September 1973 (Fig. 2).

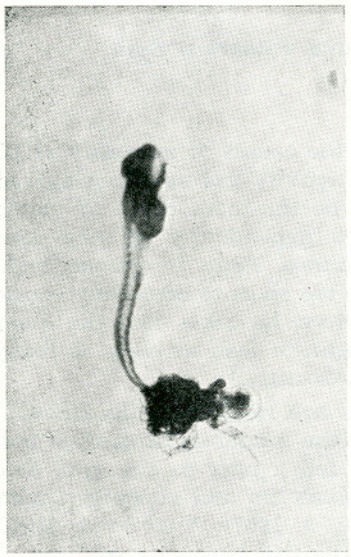

Fig. 1

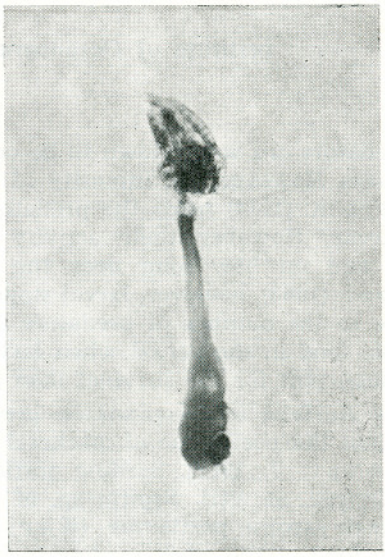

Fig. 2

— *Corycaeus flaccus* Giesbrecht. Postlarval *Electrona rissoi* (Cocco, 1829) of 4.37 mm in length attacked by the copepod of this species, 1.87 mm long, was recorded from Stončica on 16 February 1972 (Fig. 3).

Chaetognatha

— *Sagitta enflata* Grassi. A total of four individuals of this species was found. One individual of 12 mm in length which swallowed a larva which could

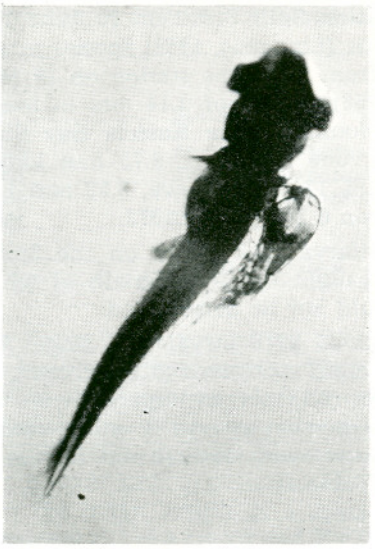

Fig. 3

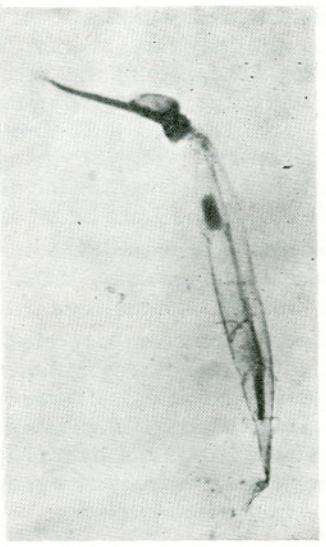

Fig. 5

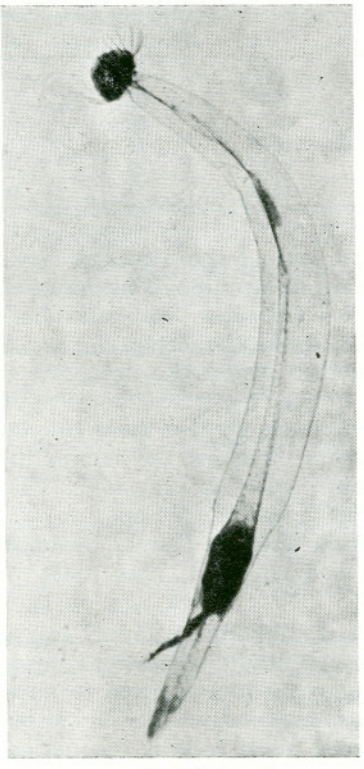

Fig. 4

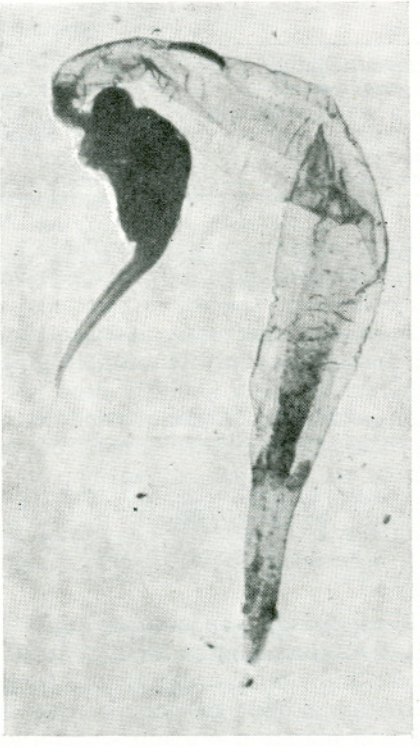

Fig. 6

not be determined, was found on the station Split Strait on 10 June 1971 (Fig. 4). A 3.26 mm long postlarva of *Coris julis* (Linnaeus, 1758) species attacked by *S. enflata,* 8.26 mm long was recorded from the same station on 17 May 1972. Larva of *Serranus hepatus* (Linnaeus, 1758) species of 2.14 mm in length, also attacked by *S. enflata* (5.81 mm), was found on the Kaštela Bay Station on 19 September 1972 (Fig. 5). In addition, one specimen, 9.75 mm long, which attacked *Cepola macrophthalma* (Linnaeus, 1758) postlarva, 3.52 mm long (Fig. 6) was found on the Split Strait Station on 6 November 1972.

— *Serranus hepatus* (3.62 mm) postlarva was found on the Split Strait Station on 7 October 1970. Its tail was caught by Chaetognath of which only the head was left behind, thus that it could not be determined.

As it may be seen, out of the total of 3978 larval fish stages collected during the period of investigations, only eight specimens (0.20 percent), and out of 65 identified species, not more the six (9.23 percent) species were attacked by plankton predators. This relation is somewhat altered if either each species or each genus is taken speerately for the relevant station and for the year in which the attacked specimen was found (Table 1).

Table 1. Percent of the attacked larvae as related to the number of specimens of the same species recorded from one station in the same year

Species	Station	Year	Total number of individuals	% of attacked
Serranus hepatus	Kaštela Bay	1972	21	4.70
Serranus hepatus	Split Strait	1970	82	1.22
Cepola macrophthalma	Split Strait	1972	34	2.94
Coris julis	Split Strait	1972	34	2.94
Gobius sp.	Pelegrin	1973	22	9.09
Electrona rissoi	Stončica	1972	1	100.00

As it may be seen from Table 1., the percent of the attacked larval fish stages was low even if the species only were taken into consideration. The *Electrona rissoi* species is the only exception. However, we held that these results do not adeqautely describe the actual activity of these predators. Therefore, the table is only tentatively given. The fact is that the predators caught by the net are very likely to drop the prey. In the first place this is applicable to the species which cannot swallow the larvae but only bite them *(Phyllopoda, Copepoda).* On the other hand, from the moment of taking the sample into the bottle to the moment of fixation, the plankton density is very high. This high density makes the attack more likely to occur. Owing to the spasms occurring during the fixation of the material, some larvae may be caught by organisms vhich otherwise do not attack them (L e b o u r, 1922). This must not be neglected.

Even though the number of the attacked individuals found was rather small, the mean lengths for individual species at individual stations, where the attakced individuals were found, were calculated. Thus we tried to determine as close as possible the length of larvae and postlarvae which fell the prey of the found plankton predators. Afterwards these mean lengths by species were compared with the lengths of the attacked larvae (Table 2).

Table 2. Relation of lengths of attacked larvae to the average lengths of their species

Station	Species	Range of lengths	$\bar{X}$	Length of attacked individuals
Kaštela Bay	*Serranus hepatus*	1.91—4.08	2.61	2.14
Split Strait	*Serranus hepatus*	2.14—6.37	3.34	3.67
Split Strait	*Cepola macrophthalma*	1.95—6.45	3.25	3.52
Split Strait	*Coris julis*	2.14—4.57	2.87	3.26
Pelegrin	*Gobius* sp.	2.25—9.56	3.24	2.25, 2.44
Stončica	*Electrona rissoi*	4.57—4.87	4.72	4.87

From Table 2. the size of the attacked larval stages appears to be close to the mean lengths of their species. They are far below the upper limits of length ranges (with the exception of *Electrona rissoi* species). Even though the available material was rather poor, this still may be an indication that, due to that they are less active, younger plankton fish stages are more vulnerable to predation by zooplankton organisms. The proportions of lengths of attacked individuals to the mean length of a species agree well with the results obtained by experiments (Lillelund and Reuben, 1971).

The largest number of larval fish stages caught by predators (four out of eight) was recorded from the Split Strait Station, where the highest concentration of ichthyoplankton was recorded during the period of investigation (Regner, S. unpublished data).

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Received: October 24, 1979.

O ZOOPLANKTONTIMA PREDATORIMA LARVALNIH STADIJA RIBA

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KRATAK SADRŽAJ

Na osnovi analiza napadnutih larvi i postlarvi riba u ihtioplanktonskom materijalu sakupljenom tokom četiri godine (1970—1973) na četiri postaje u srednjem Jadranu, identificirane su četiri vrste zooplanktonskih organizama koji bi mogli biti predatori ribljih larvi i postlarvi. To su *Podon intermedius* Lillj. (Phyllopoda), *Temora stylifera* (Dana) i *Corycaeus flaccus* Giesbrecht (Copepoda), te *Sagitta enflata* Grassi (Chaetognatha). Čini se da ovi planktonti napadaju pretežno mlađe planktonske stadije riba, koji su, u pravilu i manje pokretni.