between populations of Siganus in the different sectors of the Red Sea and possibly also the Indian Ocean. The variability found in the other species, *P. plectocirra*, is associated with the different species of *Siganus* rather than with geographical divisions.

The author wishes to thank Dr. George Kissel for his help in identification of the fish. Thanks are extended also to Miss M. McComb for her help in the preparation of the manuscript.

**Literature Cited**


**Monogenea from Red Sea Fishes. II. Monogenea of Mullidae**

Ilan Paperna

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Abstract: In the course of an investigation of ectoparasitic infection of fish of the family Mullidae (goat fish) from the Gulf of Elat five species of monogenea were found: *Halioctroma alata* Yamaguti, 1942; *Halioctroma australa* Johnston and Tieg, 1922; *Halioctroma curviceps* sp. n.; *Halioctroma recurvata* Yamaguti, 1942; and *Gyrodactylus* sp. 1. Infection was heaviest in fish of the genus *Pseudupeneus*, while being mild or sporadic in *Upeneus* and *Mullolidichthys*. In *Upeneus* only *Gyrodactylus* were found.

Mullidae, or goat fish, are found in both the Indopacific zone and the Atlantic zone. In the Red Sea area representatives of the three genera—*Upeneus* Cuvier, *Pseudupeneus* Bleeker, and *Mullolidichthys* Whitley—are found and have been investigated in this study. Monogenea have been found on goat fish in Okinawa, Indonesia, Australia, and Hawaii.

* The field work was carried out in the Marine Biological Station, Eilat.
(Johnston and Tiegs, 1922; Yamaguti, 1942, 1953, 1968). The present study of Red Sea fish ectoparasites was sponsored by the Fauna Palaestinae Committee of the Israel Academy of Sciences and Humanities.

Collection Sites and Methods

Goat fish were obtained only from the Gulf of Eilat (Aqaba). From the sandy littoral in the northern Gulf fish were obtained by seine net. From the reef areas in the northwest they were caught in traps. The methods of collecting, mounting, and measuring the monogeneans are described elsewhere (Paperna, 1965, 1972). Measurements are recorded in microns unless otherwise stated.

Taxonomical Account

**Genus:** Haliotrema Johnston and Tiegs, 1922.

**Haliotrema alata** Yamaguti, 1942


Hosts and Localities: *Pseudupeneus barberinus* (Lacepede); northern and southwestern Gulf of Eilat (in the vicinity of Taba).

Remarks: Described earlier from Naha (Okinawa) from *Parupeneus chrysedros* and *P. multifasciata* (Yamaguti, 1942) and also from “some mullids” from Macassar (Yamaguti, 1953).

**Haliotrema australis** Johnston and Tiegs, 1922


Morphological variability: Morphological variability in the shape of the bars and the copulatory organ was observed among the examined specimens. This variability was observed even among specimens collected from...
Table 1. Host–parasite relationships between goat fish and Gerres sp. and their specific monogeneans.

<table>
<thead>
<tr>
<th>Fish species:</th>
<th>H. australis</th>
<th>H. recurvata</th>
<th>H. alata</th>
<th>H. curvipenis</th>
<th>Gyrodactylus sp.</th>
<th>No. of fish</th>
<th>Site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudupeneus:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P. barberinus</td>
<td>22</td>
<td>12</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>Eilat—North</td>
</tr>
<tr>
<td></td>
<td>34</td>
<td>10</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>Eilat—NW</td>
</tr>
<tr>
<td>P. pleurospilos</td>
<td>5</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Eilat—North</td>
</tr>
<tr>
<td>P. cyllostomus</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>Eilat—Aquarium</td>
</tr>
<tr>
<td>P. macronema</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Eilat—Aquarium</td>
</tr>
<tr>
<td>Upeneus:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U. tragula</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>10</td>
<td>Eilat—North</td>
</tr>
<tr>
<td>M. auriflamma</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>10</td>
<td>Eilat—North</td>
</tr>
<tr>
<td>Gerres sp.</td>
<td>4</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>Eilat N—NW</td>
</tr>
</tbody>
</table>

The same host. To a certain extent this variability, particularly that of the copulatory organ, is due to an artificial distortion of the delicate sclerotoid lamellae and vanes during the process of embedding.

Hosts and localities: Pseudupeneus barberinus; P. pleurospilos (Bleeker); P. cyllostomus (Lacepede); P. macronema (Lacepede) and also Gerres sp. (Gerridae); northwestern Gulf of Eilat (in the Eilat port area).

Remarks: Type was described from Upeneus signatus Günther, southeast Queensland, Australia.

**Haliotrema curvipenis** sp. n.

Description (from 7 specimens): Medium to large worms with the characters of the genus. In the prohaptor, posterior to the head organs and lateral to the pharynx, there are two large follicles of adhesive glands (cephalic glands). There are two eyes, but in some specimens they are absent. The copulatory organ consists of an elongated tubiform cirrus, originating from a funnel with a heavily sclerotized rim. The accessory piece is a flat plate partly enveloping the cirrus. A seminal vesicle is present; there is one large prostate reservoir and numerous smaller prostate glands. The vagina opens on the right side of the body through a muscular bulb. The opisthaptor is relatively small, the anchors have large roots and slender tips, and both bars are V-shaped.


Host and localities: M. auriflamma (Forskal); northern Gulf of Eilat; Pseudupeneus cyllostomus (one specimen); northwestern Gulf of Eilat; this specimen was kept for a few weeks in the aquarium of the Marine Biological Station in Eilat.

Remarks: Differs from other species of Haliotrema in the structure of the copulatory organ, anchors, and bars. According to its morphological affinities it is allied to H. recurvata Yamaguti, 1942; H. upenei Yamaguti, 1953; and H. spirophallus Yamaguti, 1937 included by Young (1968) in Haliotrema species group no. 3.

**Haliotrema recurvata** Yamaguti, 1942


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**Hosts and Localities:** *Pseiidupenetis barberinus; P. pleurospilos; and P. macronema,* as well as *Genes sp.* (Gerridae); northwestern Gulf of Eilat (Taba and Port of Eilat).

**Remarks:** Type was described from *Parupeneus chryseodros* Naha, Okinawa. Specimens from Naha are much larger (800–1,230 long, 160–280 wide) than those presently described.

**Genus:** *Gyrodactylus* Nordmann, 1832.

**Gyrodactylus** sp. 1

**Description** (from 4 specimens): Small-size worms with the characteristics of the genus. The two prohaptoral anterior lobes are prominent. The pharynx consists of large basal cells and elongated apical cells embedded in the apical membranous cone. A glandular area can be observed lateral and posterior to the pharynx. The cirrus was not traceable, or else it is unarmed. The anchors have distinct, long roots with thickened rims. The ventral bar has a large membrane. In the marginal hook the sickle filament loop (terminology according to Malmberg, 1970) reaches half the length of the handle; the spike of the sickle base is prominent and pointed backwards.

**Measurements:** Total length 260–312, width 80–90, opisthaptor 50–62 × 50–70, pharynx 13 × 14, pharyngeal processes length 7–8, anchors 40–44, root 10–12, shaft 30, tip 18, dorsal bar 16, ventral bar 19 × 5, membrane 9 × 8, hooklets 22–31, sickle 7, sickle filament loop 10.

**Hosts and Localities:** *Upeneus tragula* Richardson; northern shores of the Gulf of Eilat in three out of 10 fish studied.

**Remarks:** Since only fixed specimens were available, the detailed structure of the excretory system could not be studied. Furthermore, the structure of the cirrus remained obscure. In the absence of information on these two important criteria (Malmberg, 1970) the taxonomic status of this *Gyrodactylus* species cannot be determined.

* Detailed measurements could be obtained only from one specimen.
Table 2. Distribution pattern of *Haliotrema* spp. associated with goat fish.

<table>
<thead>
<tr>
<th></th>
<th>North Red Sea</th>
<th>Indonesia</th>
<th>Japan</th>
<th>Australia</th>
<th>Hawaii</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>H. alata</em> Y., 1942</td>
<td>+</td>
<td>+</td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><em>H. australis</em> J. &amp; T., 1922</td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><em>H. curvipennis</em> sp. n.</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>H. japonensis</em> Y., 1934</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>H. recurvata</em> Y., 1942</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><em>H. spirophallus</em> Y., 1937</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><em>H. upeneus</em> Y., 1953</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>H. spiralis</em> Y., 1968</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><em>H. minutospinula</em> Y., 1968</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
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</tr>
<tr>
<td><em>H. curvirostris</em> Y., 1968</td>
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<td></td>
<td></td>
<td>+</td>
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</tr>
<tr>
<td><em>H. bifurcorurus</em> Y., 1968</td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

Host–Parasite Relationship and Geographical Distribution

Young (1968) suggested that the species of *Haliotrema* described from goat fish be included in a separate infragenic grouping within the genus *Haliotrema* (species group 4). Of the species found in the Red Sea, only one is unknown from elsewhere, while the remaining three have been found in goat fish from the Far East Pacific zone. Out of the four species found in goat fish in the Gulf of Elat, three were found only in fish of the genus *Pseudupeneus*, while the fourth species was found mainly in *Mulloidichthys*. *Upeneus* was infected only with *Gyrodactylus*. On the other hand, the two common species of *Haliotrema* (*H. australis* and *H. recurvata*) were found also on nonmullid fish, on *Gerres* sp. (Gerreidae). Out of the four species of *Haliotrema*, two were numerous and heavily infected their respective hosts; the other two occurred only in small numbers (one of these species was found mainly on *Mulloidichthys auriflamma*). All the fish of the genus *Pseudupeneus* were found to be heavily infected, while infection in the other two genera appeared to be more sporadic.

Acknowledgments: I wish to thank Dr. George Kissel of the Marine Biological Laboratory, Elat, for his help in identifying the fish.

Literature Cited


