Records of Cestodes from Marine Fishes of New Zealand

By Edward S. Robinson

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Abstract

Twelve species of cestodes are recorded from New Zealand marine fishes. Eight adults and six larvae were found, including the larval and adult stages of two species. Tetraphyllidean or trypanorhynchian forms are recorded from the ten species of elasmobranchs examined. The adult of Hepatoxylon megacephalum (Rudolph, 1819) is described. The adult has been reported, but a detailed account of the anatomy has not previously been given. Most of the species of cestodes are found in the same or closely related hosts as those previously reported from other localities.

Introduction

There are few references in the literature to cestodes from New Zealand marine fishes. Hutton (1904), Leiper and Atkinson (1914) and Perrenoud (1931) have referred to material from New Zealand waters, but some host and parasite identifications are doubtful. In a second paper (Robinson, in MS), five new species will be described.

In this report twelve species are recorded from New Zealand marine fishes. All these species have previously been reported from other parts of the world from the same or closely related hosts. The majority of fish examined were collected during 1954 and 1955, either from the catch of commercial trawlers operating in Cook Strait or from dragnet fishing in Wellington Harbour.

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Material and Method

On a few occasions only the preserved gut of the host was obtained, but whenever possible the entire host was examined for larval stages. To remove the mucus which often adheres to worms after removal from the host gut, the parasites were placed for a short time in 0.1 M NaHCO₃. It is particularly desirable with trypanorhynchian forms to kill the parasites in a relaxed condition so that the proboscides are evaginated. Distilled water at 60°C was found to be a satisfactory relaxing agent. Specimens were fixed in hot 70% isopropyl alcohol and stained in acetic-alum carmine. Sections were stained in Ehrlich's haematoxylin and counter-stained with eosin in 95% alcohol.

For detailed examination of the proboscides, stain was not used. The proboscides were removed at their base, placed in a 10% solution of glycerine in 70% alcohol and mounted in glycerine jelly. In this way, material could be re-orientated if necessary by warming the glycerine jelly.

All outline drawings were made with a Watson camera lucida, the magnifications being determined with a calibrated ocular micrometer.

Order TETRAPHYLLIDEA van Beneden, 1849
   Family PHYLLOBOTHRIDAE Braun, 1900
   Genus PHYLLOBOTHRIUM van Beneden, 1849

Phyllobothrium lactuca van Beneden, 1850

Nine of the twelve specimens of Mustelus lenticulatus Phillips examined, were found to harbour this parasite in the spiral valve. Two specimens of Carcharodon carcharias (Linnaeus) caught in Tory Channel also contained this species in the spiral valve.

Great variation in size occurred amongst worms from the same host specimen. Frequently the scoleces of the larger worms were a pale orange colour and contrasted sharply with the cream-coloured strobila. The conspicuous scolex has four large, sessile bothridia, with their margins curled and crumpled.

The size of the scolex is considerably smaller than that recorded by many authors. Maximum length of scolex, 2.4 mm, maximum width, towards the posterior margin of the scolex, 3.6 mm.

The posterior proglottids contain uteri distended with eggs, which are discharged through a pore formed by the rupturing of the proglottis wall along the mid-ventral line.

Phyllobothrium dohrnii (Oerley, 1885)

P dohrnii has been recorded previously from Mediterranean, Japanese, American and British waters. An extremely detailed description of the British material has been given by Rees (1946).

Two specimens of Notorhynchus pectorosus (Garman) caught at Cape Palliser contained P dohrnii in the spiral valve. Many of the overseas host species which contain this parasite, as well as the one recorded here, belong to the family Hexanchidae.

The scolex is conspicuous, with four unarmed and distinctly pedunculated bothridia. On the inner surface of the anterior margin of each bothridium, situated in a slight depression is an accessory sucker. The internal anatomy of the proglottids is similar to that fully described by Rees.

Genus ORYGMATOBOTHRIUM Diesing, 1863

Orygmatobothrium versatile (Diesing, 1854)

A single specimen of this parasite was found in the spiral valve of Mustelus lenticulatus Phillips caught at Petone Beach. The total length of the larva is 3.48 mm. The scolex has four mobile bothridia 0.86 mm x 1.16 mm. The margins of the oval bothridia are slightly thickened, but not thrown into folds. Anteriorly each bothridium bears a small accessory sucker 0.12 mm in diameter, and in the centre of each bothridium is a second larger and more muscular sucker 0.235 mm in diameter. The anterior extremity of the scolex does not bear an accessory sucker, and in this respect differs from the material described by Leiper and Atkinson (1914).

Genus CERATOBOOTHRIUM Monticelli, 1892

Ceratobothrium xanthocephalum Monticelli, 1892

Yamaguti (1934) described in detail an adult worm from Isurus glaucus (Mueller & Henle) from Japanese waters which he identified as this species.

Five immature specimens were collected from the spiral valve of Isurus glaucus (Mueller & Henle) caught at Russell, Bay of Islands. From the figures of Linton (1901), it appears that the material described here is at much the same stage of
Figs. 1–3—*Nybelia* (? *Syngenex*) sp postlarva 1—External features. 2—Internal anatomy 3—Proboscid Figs 4–5—*Hepatoxylen trichiuri* postlarva 4—Contracted postlarva. 5—Proboscides. Figs 6–8—*Hepatoxylen megacephalum* postlarva. 6—Surface view 7—Lateral view. 8—Proboscid.
development. Even in the most posterior proglottids there were no signs of reproductive organs.

The scolex is quadrangular with four sessile oblong bothridia. The four muscular bothridia are each divided into an anterior compartment 0 120 mm × 0 235 mm and a posterior compartment 0 365 mm × 0 295 mm. Projecting from the posterolateral edges of each anterior compartment is a pair of slightly curved horn-like appendages 0 052 mm long.

Order TRYPANORHYNCHA Diesing, 1863
Family TENTACULARIIDAE Poche, 1926, emended Dollfus, 1930
Genus NYBELINIA Poche 1926

Nybelinia (? Syengenes) sp Postlarva Figs 1–3

Leiper and Atkinson (1914) briefly described a postlarva found in Lepidopus caudatus (Euphrasen) from the Bay of Islands, New Zealand, but the measurements are of little use because of the obviously contracted state of the material. There appears to be an error in identification of the host species, since the parasites were recorded as coming from a “Barracouta” Lepidopus caudatus. The postlarva has not been found by the author in the body cavity of Lepidopus caudatus, but is a very common parasite of Thysites atun popularly known as the Barracouta. Dollfus (1942) compares with this postlarva, a preserved collection in the Paris Museum from an unknown host.

The postlarva has been found in the following teleost host species: Zeus faber Linnaeus, Trachurus novae-zealandiae Richardson, and Thysites atun (Euphrasen) all caught in Cook Strait.

Every specimen of Thysites atun (Euphrasen) examined contained large numbers of the postlarvae in the body cavity. The region of heaviest infestation was at the posterior end of the blind cardiac stomach, where together with large numbers of Stomachus marinus (Linnaeus), a larval nematode, they formed a solid mass up to 5.0 cm long. Larvae were seen at various stages of penetration of the blind cardiac stomach wall.

Maximum length of postlarva 2.45 mm, length of bothridium 0 55–0 83 mm, width of bothridium 0.42–0.64 mm, maximum width of pars bothridialis 1.34 mm, bulbs 0.36–0.41 mm × 0.13–0.16 mm; width of appendix base (at its origin in the velum) 0.42–0.56 mm. The length of the proboscides if completely evaginated is 0.66 mm.

The proboscide sheaths are slightly swollen before reaching the anterior border of the muscular bulbs. From the swelling extend well-developed extrinsic muscles. Posteriorly, the muscular bulbs extend almost to the anterior border of the appendix. A “U” shaped excretory bladder opens by a small pore at the posterior extremity of the appendix. The length of the velum exceeds slightly that of the bulbs and is between one-third and one-fourth the total length of the postlarva.

Family HEPATOXYLIDAE Dollfus, 1940
Genus HEPATOXYLON Bosc, 1811

Hepatoxyxylon trichiuri (Holten, 1802) Postlarva Figs 4–5

This widely distributed postlarva has been recorded from a wide variety of hosts, and an extensive synonymy has been listed by Dollfus (1942). pp 87–90.
The postlarva has been found in the following host species.

**TELEOSTEI**

<table>
<thead>
<tr>
<th>Host</th>
<th>Locality</th>
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<tr>
<td><em>Cyttus novae-zealandiae</em> (Arthur)</td>
<td>Palliser Bay</td>
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<tr>
<td><em>Macrourus novae-zealandiae</em> (Hector)</td>
<td>Cape Campbell</td>
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<tr>
<td><em>Leptopus caudatus</em> (Euphrasen)</td>
<td>Castle Point</td>
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<tr>
<td><em>Genypterus baoae</em> (Bloch &amp; Schn)</td>
<td>Kapiti Island</td>
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**ELASMOBRANCHII**

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<th>Host</th>
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<tr>
<td><em>Squalus lebruni</em> (Vallant)</td>
<td>Cape Campbell</td>
</tr>
<tr>
<td><em>Prionace glauca</em> (Linnaeus)</td>
<td>Kapiti Island</td>
</tr>
<tr>
<td><em>Isurus glaucus</em> (Mueller &amp; Henle)</td>
<td>Bay of Islands</td>
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<tr>
<td><em>Deania kaikourae</em> Whitley</td>
<td>Kaikoura Coast</td>
</tr>
<tr>
<td><em>Torpedo farcildi</em> Hutton</td>
<td>Cape Campbell</td>
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The most common site of the parasite is in the body cavity of the host. In a specimen of *Leptopus caudatus* (Euphrasen), nine postlarvae were found in the body cavity, five in the pericardium, two in the swim bladder, and one deep in the flesh. In addition to the live postlarvae, eight dead specimens were found attached to the various mesenteries. The dead parasites were small, calcified and brown in colour, except for the proboscids, which remained white.

A postlarva of *H. trichuri* which had bored through the peritoneum of *Macrourus novae-zealandiae* was removed from the host and placed in Tyrode's solution. With daily changes of medium the postlarva remained alive for 87 days. This appears to be the longest recorded period a cestode has been kept alive *in vitro*, under aseptic conditions.

A detailed account of the anatomy of this species has been given by Dollfus (1942). The proboscids are broad, claviform or rounded, but never long. The proboscide hooks from anterior extremity to tip measure 0.235 mm to 0.250 mm, and the length of the basal insertion is 0.180 mm.

**Hepatoxyylon megacephalum** (Rudolphi. 1819)

A) Postlarva Figs 6–8

This postlarva was found in the body cavity of *Galeorhinus australis* Macleay, from Cook Strait, *Notorhynchus pectorosus* (Garman), from Dusky Sound, and *Dolichorhynchus biceps* (Bonnaterre) from Kaikoura. In contracted material when the proboscides are not evaginated, it is difficult to distinguish this species from *H. trichuri*.

The proboscides of an extended specimen are conical or cylindrical. The proboscide hooks are in obliquely transverse rows and are the same size for two-thirds the length of the proboscide but become rapidly smaller towards the base. For the larger hooks, the length is 0.140 mm to 0.155 mm with the hooks at the base reduced to 0.035 mm. Smaller hook size together with the shape of the proboscide are the most satisfactory characteristics for distinguishing this postlarva from that of *H. trichuri* (Dollfus, 1942).

B) Adult Figs 9–17

The adult was found in *Carcharodon carcharias* (Linnaeus) taken in Tory Channel near the breastwork of the whaling station. Four specimens were brought to Wellington in a contracted state preserved in formalin, and the location given as the spiral valve.

The least contracted specimen is 101.5 cm long, and was considerably longer when first removed from the host. Being contracted, the strobila is very broad and thick. At a distance of 2.5 cm behind the scolex, the strobila is 9.0 mm wide and 4.5 mm thick in the middle region of the strobila the measurements are 22.5 mm wide by 5.5 mm thick. The scolex is rounded anteriorly and clearly delimited from the strobila, measuring 8.5 mm long, 9.0 mm broad and 8.2 mm thick. In lateral view the scolex appears oval, with the widest point at the level of the posterior bothridial border. Each bothridial cavity is deep and narrow posteriorly but shallow and wider anteriorly, with the median longitudinal ridge reduced due to contraction.
9—Scolex, lateral view
10—Scolex, anterior view
11—Proscordle
12—Proscordle hooks
13—TS proglottis at level of ovary
14—TS proglottis at level of genital atrium
15—Female genital structures
16—Egg
17—Entire worm
The proboscides are conspicuous macroscopically and are whitish in colour, compared with the more creamy scolex and strobila. None of the proboscides was completely evaginated. The largest has a length of 1.95 mm. The widest region of the proboscide is close to the base and measured 0.82 mm. The proboscide tapers gradually to a width of 0.40 mm near the distal extremity. The armature is home-acanthous—i.e., the hooks are approximately alike in size and shape, and are arranged over the proboscide in about 22 obliquely transverse rows. Proximally the hooks are rudimentary with a very reduced shaft, but they become larger approaching the widest region of the proboscide where they reach maximum size. Maximum length of hook (i.e., from the tip to the anterior extremity), 0.157 mm; length of base of implantation 0.128 mm, distance from point to the posterior extremity 0.065 mm. The anterior extremity of the base of implantation is strongly pointed but is broad and rounded posteriorly.

Proglottids are distinct approximately 9.0 cm behind the scolex. Throughout the length of the strobila the proglottids are always many times broader than long, and strongly craspedote. At the extreme posterior end of the strobila the proglottids split along the mid-line into two segments, each containing a complete set of genitalia.

The surface of the strobila is bounded by a thick cuticle 0.028 mm thick. Immediately internal to the cuticle are found the subcuticular muscle fibres. The longitudinal muscle fibres are arranged in bundles in the cortex near the junction of the cortex and the medulla. Maximum width of bundles 0.042 mm, maximum depth 0.094 mm. Longitudinal bundles are also present in the medulla lateral to the nerve trunks. Internal and external to these bundles are found circular muscle fibres. The longitudinal fibres are continuous throughout the length of the strobila, whereas the circular muscles are not present at the anterior and posterior extremity of each proglottis. Transverse muscle fibres are also found in the cortex extending between the longitudinal bundles into the medulla.

The excretory system consists of four longitudinal canals, arranged in pairs near the lateral margins of the medulla. Each pair consists of an extremely large, thin-walled, ventral canal measuring up to 0.358 mm deep by 0.125 mm wide, and a small, rounded, thick-walled, more medial dorsal canal, with a diameter of 0.066 mm. The two ventral canals are joined by a large transverse canal in the posterior region of the proglottis. Throughout the medulla are scattered several (usually 6 to 9) excretory canals, which are anastomosing side branches of the main longitudinal excretory canals.

The nerve trunks occur immediately lateral to the ventral excretory canals in the medulla. They are large, almost circular in cross section with a diameter of 0.082 mm.

The two sets of genitalia in each proglottis are separated except for the vitellaria and testes. Compared with *H. trichiurs*, the testes are more numerous, and are not distinctly separated into dorsal and ventral fields. They do not extend posterior to the ovary or to the extreme anterior end of the proglottis. The vas deferens is a thin-walled, voluminous, coiled duct, occupying almost the whole depth of the medulla before it enters the vesicula seminalis. At the distal extremity the vas deferens becomes relatively wide and thick-walled, and finally terminates at the vesicula seminalis by a papilla which is lined on both surfaces with cilia. The vesicula seminalis is globose and opens distally into the ejaculatory duct, which coils once then opens into the receptaculum cirri. The internal wall of the invaginated cirrus (which is the external wall when evaginated) is strongly wrinkled.

The vagina is slightly posterior to the ejaculatory duct. Distally it is surrounded by a very thick muscular wall, which is much thicker than that of the ejaculatory duct. A sphincter present in *H. trichiurs* at the opening of the vagina into the genital atrium is not present in this species. The sphincters are present, however, one at the proximal extremity of the muscular wall of the vagina and a second less
well-developed sphincter a short distance from the muscular wall. Between these
two sphincters the vagina is expanded. Proximal to the sphincters, the vagina passes
laterally, coils round the uterine pore and proximally expands as a large receptaculum
seminis dorsal to the ovarian isthmus. The ovary is compact, with two lobes posterico-
dorsal to a broad ventral isthmus. The receptaculum seminis gives rise to a short
thick-walled fertilization duct with a small lumen which projects slightly into the
receptaculum by a small papilla. The oocyst gives rise to a broad oviduct which
receives the fertilization duct and then the long vitelline reservoir. After several
convolutions in the shell gland the oviduct gives rise to the uterine duct which is
long, voluminous and coiled, and finally gives rise to a large uterine sac. The uterine
pore is situated about a quarter the width of the proglottis from the lateral margin.
The almost colourless, non-operculated eggs have a thick wall which is drawn out
into a projection at one pole.

**Discussion**

Up till now the adult has not been described. According to Dollfus, Monticelli
(1893) mentioned an adult found at Spezia (Italy) in *Carcharodon carcharias* that
may have been this species. Some adults in the Berlin Museum collected by Parona
from the same host species in Mediterranean waters and mentioned by Pintner
(1930) may belong here. Dollfus (1942) found in a bottle amongst the collection
made by the “Talsman” some *Hepatoxyton* adults from *Carcharias glaucus*
(Rond.) Muell & Henle, which were destroyed accidentally, and which Dollfus thinks
may have been *H. megacephalum*.

This species differs from *H. trichuri* in the shape of the proboscides, the smaller
size of the hooks, the position of the vaginal sphincters, and the greater number of
testes.

Family *Lacistorhynchidae* Guaita, 1927, emended Dollfus, 1935
Subfamily *Lacistorhynchinae* Joyeux & Baei, 1934, emended Dollfus, 1942

Genus *Lacistorhynchus* Pintner, 1913

*Lacistorhynchus tenuis* (van Beneden, 1858)

(A) Pleurocerus

The larval form of this species was found in *Zenopsis nebulosus* (Schlegel), from
Cape Campbell, *Agnostomus forsteri* (Cuv. & Val.), from Waikanae and *Thysites
atun* (Euphrasen) from Petone Beach. Although the usual site of the pleurocerus
is the body cavity, in two specimens of *Thysites atun* (Euphrasen) several larvae
were found in the flesh at the ventral extremity of the anterior ribs. These pleuroceri
contained many calcareous bodies in the anterior swollen region, which contains
the invaginated scolex, and also in the long narrow tail.

(B) Adult

Three adults were found in the anterior portion of the spiral valve of *Galaxo-
hinus australis* Macleay from Cook Strait. Dollfus (1942) has given a detailed
description of this species.

Subfamily *Grillotinae* Dollfus, 1942
Genus *Grillotia* Guat, 1927

*Grillotia heptanchi* (Vauttegeard, 1899)

Three adults were found in the spiral valve of *Notorhynchus pectorosus* (Garman)
caught in Cook Strait. This parasite has been recorded from several other host
species belonging to the family *Hexanchidae*.

Family *Gymnorhynchidae* Dollfus, 1935
Genus *Gymnorhynchus* Rudolphi, 1819

*Gymnorhynchus* (Mollicola) *horridus* (Goodsir, 1841)

Two species of *Mola mola* Linnaeus were found to harbour this parasite in
large numbers in the liver. The pleurocerus of *G. (M.) horridus* (Goodsir) is a
Figs 18-22 — *Anchistrocephalus microcephalus* 18—Scolex 19—TS at level of ovary 20—TS at level of uterus 21—Scolex hooks 22—Female genital apparatus Figs 23-26 — *Bothriocephalus scorpius* 23—Scolex 24—TS curus pouch 25—Female genital apparatus 26—TS proglottis
well-known parasite which is always found encysted. It has been reported as a parasite of the liver of *Mola mola* from practically all oceans.

Order PSEUDOPHYLLIDEA Carus, 1863, emended Luhe, 1910
Family TRIAENOPHORIDAE Loennberg, 1889, emended Wardle & McLeod, 1952

Genus Anchistrocephalus Monticelli, 1890

Anchistrocephalus microcephalus (Rudolphi, 1819) Figs 18–22

This species is a very common parasite of *Mola mola* Linnaeus. In the two specimens of *Mola mola* Linnaeus examined, the gut contained this parasite in large numbers. Yamaguti (1934) states that *A. microcephalus* is a very common parasite of the intestine of *Mola mola* in Japanese waters, but in the specimens examined by the author, the great majority were found in the stomach.

The scolex shows variation in form depending on the degree of contraction. The two deep, boat-shaped bothria have rounded margins which are free posteriorly. When the scolex is not contracted, the apex is dome-shaped, but if the scolex is fixed when contracted the apex is flattened with a flap projecting over the region which is armed with hooks, forming a terminal disc. The hooks are arranged in rows around the scolex just anterior to the cavities of the bothria. There are several more rows of hooks on the bothrial surfaces than the lateral surfaces, but the number of rows varies considerably on both surfaces in different individuals. Yamaguti (1934) states there are about ten alternating rows on the bothrial surfaces. In the specimens examined by the author, the number of rows of hooks varied between 5 and 11. The hooks are rose-thorn shaped with a rather massive, rounded base and a long, tapering, slightly curved point. Anteriorly, the hooks measure up to 0.085 mm in length, rapidly diminishing in size posteriorly to 0.015 mm.

Family Bothriocephalidae Blanchard, 1849, emended Wardle & McLeod, 1952

Genus Bothriocephalus Rudolphi, 1808, emended Luhe, 1899

Bothriocephalus scorpii (Mueller, 1776) Figs 23–26

This parasite was collected from the intestine of several specimens of *Physiculus bachus* (Bloch & Schn.) from Cape Campbell and Kapiti Island, Cook Strait. Apart from a median black region in the posterior portion of the strobila formed by the accumulation of eggs in the uterus, the worm is a distinct cream colour.

The scolex is extremely variable in shape when preserved, with the apical disc poorly developed, but when the worm is alive, the apical disc is clearly visible. In preserved scolecites, the anterior extremity is pointed, in others bluntly rounded. The shallow bothria occupy most of the length of the scolex, especially when contracted.

In total length, the worms measure up to 43.0 cm with a maximum width of 3.0 mm. The most anterior proglottids of the strobila which are situated immediately behind the scolex are wedge-shaped, but a short distance behind the scolex they become subdivided. Further subdivisions of each original proglottis occur posteriorly.

This species has been described in detail by Cooper (1918) and Hilmy (1929). Cooper gives a long list of references by European writers to this common form. Wardle (1932) records this species from North-eastern Pacific waters and indicates certain minor differences from European material. The material examined in the present study differed in the less conspicuous apical disc of preserved material.

**Discussion**

As would be expected, host specificity is more marked in adults than in larval stages. Elasmobranchs proved to be heavily infested hosts. As larval or adult cestodes
were present in all ten species of elasmobranchs examined. *Notorhynchus pectorosus*, a member of the family Hexanchidae, contained two species of adult cestodes—viz., *Phyllobothrium dohrni* and *Gillotta heptanchi*, both of which have been reported from other members of the Hexanchidae at various localities. The parasites recovered from widely distributed host species such as *Isurus glauces* and *Carcharodon carcharias* have already been reported from these hosts.

By comparison teleosts were lightly infested. However an examination of a larger number of teleost species would reveal a more varied cestode fauna. The cosmopolitan *Mola mola* Linnaeus contained two cestodes recorded from the same host in other regions. Because of the preliminary nature of this study geographical affinities are not clear.

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E S ROBINSON,
Department of Zoology,
The University of Nebraska,
Lincoln 8, Nebraska, U.S.A.

**ABBREVIATIONS USED IN TEXT-FIGURES**

A—appendix
B—bothrium
CP—cirrus pouch
CU—cuticle
DE—ductus ejaculatorius
DEX—dorsal excretory canal
EM—extrinsic muscle
EV—excretory vesicle
FD—fertilization duct
HH—homeoanthus hook
LG—longitudinal groove
LM—longitudinal muscle
MB—muscular bulb
MS—muscular sphincter
NT—nerve trunk
OC—oocyst
OD—oviduct

OV—ovary
P—proboscide
FAP—papilla
PB—pseudobothrium
FS—proboscide sheath
RS—receptaculum seminis
SH—shell gland
T—testis
UT—uterus
UTD—uterine duct
V—vagina
VD—vas deferens
VEX—ventral excretory canal
VIT—vitellaria
VR—vitelline reservoir
VTD—vitelline duct
YC—yolk cell