LIFE-CYCLE OF THE CESTODE WARDIUM CALUMNACANTHA (SCHMIDT, 1963) COMB. N. (HYMENOLEPIDIIDAE) FROM COMMON SNIPE, GALLINAGO GALLINAGO (L.)

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Abstract. Post-embryonic development of the cestode Wardium calumnacantha (Schmidt, 1963) comb. n., a parasite of common snipe, was studied by experimental infection of the oligochaetes Neascolex roseus Morev and Rhyncodrilus coccineus (Vejdosvky) carried out in Chukotka. The larvae of W. calumnacantha were ovoid and belonged to the morphological modification of cysticercoid-diploceyst. Two invaginations were observed during the larvogenesis. The first one occurred at the stage of scolexogenesis, when the body of larva was plunged into the external cyst formed by the walls of the primary cavity. Second invagination of the formed scolex and neck into the internal cyst was the final stage of cysticercoid formation.

The cestode species dealt with in the present paper (Fig. 1) was described by Schmidt (1963) from Gallinago gallinago delicata (Ord.) from Colorado under the name Hymenolepis calumnacantha. Almost simultaneously this parasite was described also by Oshtomin (1963) from G. gallinago L. from Primorye Territory as a new species, Wardium paraclavicularis.

With regard to the morphology of this cestode (ten hooks of alopokaryoid type and three testes) it should be placed in the genus Wardium Mayhew, 1925. Because the paper by Schmidt appeared somewhat earlier than Oshtomin's book, the valid name of this species is Wardium calumnacantha (Schmidt, 1963) comb. n.

Rybiecka (1958) determined the cestodes from common snipe from Poland as Hymenolepis capellae Baer, 1940. Deblock (1964) elevated this form to the rank of an independent species, H. rybiecii. In 1965, however, the species H. rybiecii was synonymized by Deblock and Tran-Van-Ky with H. calumnacantha. Bondarenko (1969) found this cestode in the same host in the lower reaches of the Yenisey River and assigned it to W. paraclavicularis. Consequently, the synonyms of W. calumnacantha (Schmidt, 1963) comb. n. are Hymenolepis capellae sensu Rybiecka, 1958, nec Baer, 1940; W. paraclavicularis Oshtomin, 1963; H. rybiecii Deblock, 1964.

W. calumnacantha has been reported from North America (Colorado), Asia (Primorye Territory, Chukotka, the Lower Yenisei) and Europe (France, Poland), which indicates that it is a widely distributed parasite of G. gallinago.

The post-embryonic development of W. calumnacantha was studied by experimental infection of its intermediate hosts, oligochaetes. The experiments were carried out in Chennai station (North-West Chukotka) in summer 1975 and the results are presented in this paper.
MATERIAL AND METHODS

Gravid proglottids of *W. caluanaeathua* from *G. gallinago* were used in our experiments. Mature “eggs” released into water were kept at the room temperature for 8—20 hours. Then they were transferred to Petri dishes with water where the oligochaetes were also placed. The oligochaetes were collected in tundra water reservoirs and before the experiment they were examined by microscope to exclude a spontaneous infection. The contact of the oligochaetes with “eggs” lasted 12 hours, then they were thoroughly washed, placed into jars with water and moss and kept at the temperatures of 20—22 °C.

Examinations and photography of developing cysticeroids were carried out mostly in a live oligochaete placed under cover glass which enabled us to examine the same larva several times. Cysticeroids studied at later stage of development were sometimes extracted from the oligochaete and placed into 3% solution of NaCl in which the larvae remained alive for a long time and their internal structure was almost unchanged.

Three species of oligochaetes, namely *Lumbriculus* sp., *Neoscolex roseus* Morov (in press), fam. Lumbriculidae, and *Rhynocorilus coccineus* (Vejdovsky), fam. Tubificidae, were applied in our experiments. We succeeded in infecting 21 (35%) of 60 *N. roseus* and 20 (15.3%) of 131 *R. coccineus* specimens. No *W. caluanaeathua* infection was obtained in 100 specimens of *Lumbriculus* sp.

RESULTS

The “eggs” released into water are clustered in groups adhering one to another by their external envelopes (Plate I, Fig. 1), but they are easily separated. A tuberculate intermediate envelope is visible in mature “eggs” between the external envelope and the embryophore surrounding the oncosphere. The “eggs” are spherical and measure 0.066—0.086 mm. The embryophore measures 0.037—0.040 × 0.030—0.033 mm and the oncosphere 0.029—0.033 × 0.025—0.027 mm. The length of embryonal hooks is 0.012 mm. Mobile oncosphere (Plate I, Fig. 2). The oncosphere released from the embryonic envelopes in the intestine of oligochaete progresses with the help of active movement of embryonal hooks up to its common site of location—body cavity of the host. A feeble movement of hooks continues for some time, but in two-day-old oncospheres it is no more observed. At this stage, the size of the oncosphere is almost unchanged (0.029 to 0.033 × 0.031—0.037 mm).

GROWING LARVA (Plate I, Fig. 3). Four days after infection the diameter of larva increases to 0.053 mm. An eccentric cavity measuring 0.016—0.020 mm appears inside it. After six days the size of larva is doubled, its diameter being 0.11 mm. Also the primary body cavity enlarges up to 0.05 mm in diameter.

ELONGATED LARVA (Plate I, Fig. 4). At the age of 6—8 days the larva is elongated, linguiform or pyriform. Its posterior, widened part is occupied by primary cavity which penetrates like a wedge into the anterior part in some larva. The size of larva varies from 0.14 × 0.04 to 0.25 × 0.11. The cavity measures 0.065 × 0.035—0.15 × 0.07 mm.

DIFFERENTIATING LARVA (Plate II, Fig. 1). After 10—12 days the anterior segment of larva starts to separate. From this segment will later arise the scolex, neck and internal capsule. A large part of the posterior segment is occupied by the enlarged primary cavity. At the same time, on the anterior segment begins the formation of the rostellum, rostellar sheath complex and suckers. The total length of larva is 0.32—0.42 mm, the anterior segment measuring 0.22—0.24 mm and the posterior 0.11—0.18 mm. The scolex anlage measures 0.13—0.14 × 0.09—0.092 mm. The neck and internal capsule are not yet differentiated, the length of this part of larva is 0.08—0.10 × 0.072—0.075 mm.

Scolexogenesis and first invagination (Plate II, Figs. 2—6). This stage of development is characterized by combination of two processes: scolexogenesis and elongation of anterior segment of larva inside the envelope formed by posterior segment. Later this envelope will become the external cyst of the formed cysticeroid. At the beginning of this process, the anterior and posterior wall of the primary cavity approach to one another.
and between them form fibres which seem to serve for evagination of the anterior segment of larva inside the external envelope. The slit between the internal walls of the primary cavity gradually fills up with cells and becomes indiscernible, while the envelope keeps growing around the forming larva. At the moment when the blade of hooks is formed, and sometimes later, at the end of scolexgenesis, the external envelope entirely surrounds the scolex, neck and internal capsule. At this stage, the excretory pore of the external cyst is not yet filled with cells and the scolex may move out of the cavity at a pressure on the larva.

The scolexgenesis begins by isolation of the rostellum-rostellar sheath complex. The anterior end of larva elongates, reaching the size of 0.050—0.077 × 0.043—0.055 mm, becomes mobile and may extract or rise the apical part of the complex. Then the rostellum separates from the rostellar sheath. The hooks are not formed at the top of rostellum, but 0.028 mm from its anterior end at the place where the integumentary tissues of the rostellar sheath unite with the tissues of rostellum. Numerous hair-like setae visible on the surface of tegument disappear and instead of them develop the blades of hooks.

The suckers appear like distinct protuberances at the boundary of rostellum-rostellar sheath complex before formation of blades. At the time of hook formation, excretory vessels and isolated calcareous bodies are already visible in the neck of larva. Completely developed hooks were found on 19th day.

![Fig. 1. Wardia calumnacantha (Schmidt, 1963). A — cirrus, B — rostellar hook.](image)

![Fig. 2. Cysticercoid of W. calumnacantha. A — cysticercoid, B — hook.](image)

Simultaneously with the development of scolex proceeds the separation of neck from internal capsule and formation of the tissues lining it. The excretory vessels in the capsule run along the margins of the cavity up to the external cyst.

At the end of this stage the external capsule measures 0.13—0.18 × 0.08—0.010 mm, the internal cyst 0.060—0.075 × 0.055—0.066 mm. Size of neck is 0.07—0.08 × 0.03 to
0.04 mm, of scolex 0.09—0.12 × 0.07—0.08 mm and suckers measure 0.040—0.044 mm in diameter. The calcareous bodies are not numerous.

**Second invagination** (Fig. 3.A.). As soon as the development of scolex is completed, the scolex and neck start to invaginate into the cavity of the internal cyst. The process passes quickly, lasting probably some minutes, and we have not managed to observe it. Some oligochaetes contained both larvae before invagination and those which had already finished it. The rostellarum of larvae before invagination was most frequently pushed forward which made an impression that its invagination into the rostellar sheath occurred already after invagination of the scolex and neck in the cavity of internal capsule.

**Cysticercoid** (Figs. 2, 3B, C). In young cysticercoids which have completed the invagination the excretory pore on the external capsule is still opened, but in the larva studied by us, the apical end of the excretory canal was filled with rapidly distributed cells and few fibres on 39th day of the development.

![Fig. 3. Postembryonic development of *W. calumnacantha*. A. Second invagination. B—C. Mature cysticercoids. Postembryonic development of *W. calumnacantha*.](image)

The developed cysticercoids are rather small (0.18—0.24 × 0.11—0.16 mm) and keep the ovoid shape. The internal capsule measures 0.12—0.13 × 0.08—0.010 mm, scolex 0.06—0.09 × 0.06—0.07 mm, suckers 0.033—0.040, rostellarum 0.03—0.04 × 0.02 to 0.03 mm, and rostellar sheath 0.08—0.03 mm. Calcareous bodies are numerous, measuring 0.006—0.008 mm in diameter.

**DISCUSSION**

Larvocysts of two types have already been described in the cestodes of the genus *Wardium*: cercocyst in *W. aequabile* and *W. paraporale* developing in crustaceans (*Jarecka 1960, Podesta and Holmes 1970*), and ramicercus in *W. chaunense* developing in oligochaetes (*Bondarenko and Kontrimavichus 1977*). A larva of diplocyst type was recorded in *W. calumnacantha* also employing oligochaetes as intermediate hosts. The differentiation of intermediate hosts and polymorphism of larvae within
a small cestode genus is an interesting phenomenon, the biological significance of which may be elucidated by further studies of the life-cycles, ecology and morphogenesis of other cestodes of this genus.

It is of interest that in the larvocests of cercocyst and ramicercus type the scolex develops externally and is invaginated into the cyst cavity after completion of scolexogenesis. In *W. calumniacantha* the later stages of scolexogenesis take place under the protection of the external cyst-like in cestodes belonging to *Aploparaksis* (Demshin 1965; our unpublished results).

The relationship of larvocests of *Wardium* and *Aploparaksis*, developing in the same intermediate hosts (Bondarenko and Kontrimovich 1976) was confirmed already by Spassky and Spasskaya (1972) who placed these two genera in the same subfamily Aploparaksinae.

**REFERENCES**


OSHMARIN P. G., Paraziticheskie chervy me-kopitayushehikh i ptsis Primorskogo kraya (Parasitic worms of mammals and birds of the Primorsk Territory). (Vladivostok), 1–320, 1963. (In Russian).


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Fig. 1. Group of “eggs”.
Fig. 2. Mobile oncosphere in body cavity of N. roseus.
Fig. 3. Growing larva in body cavity of N. roseus.
Fig. 4. Elongated larva in body cavity of N. roseus.
Postembryonic development of Wardium calumnacantha.
Fig. 1. Differentiating larva in body cavity of *S. opisthothecus*.
Fig. 2. Early selexogenesis and beginning of first invagination of larva in *N. roseus*.
Figs. 3—6. Selexogenesis and first invagination in larvae recovered from intermediate hosts.