Amphistomes of Vietnamese vertebrates (Trematoda: Amphistomida)

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ABSTRACT. An examination of the amphistomes of Vietnamese vertebrates, based on original test material, revealed 28 species. Four of them were found in fishes, two in amphibians and 22 in mammals. Surface topography, histomorphological structure of the muscular organs of certain species have been studied and a parasite/host and a host/parasite check-list have been compiled.

KEY WORDS. Amphistomes, Vietnamese vertebrates, scanning electron microscopy, histomorphology of muscular organs, parasite/host and host/parasite check-lists.

Reviewing relevant literature data referring to the amphistomes of Viet Nam or the neighbouring area previously called Indochina, one experiences that varying interest has been rayed to the study of amphistomes of lower and higher vertebrates. While numerous reports have been published on the amphistomes of mammals (BARROIS, 1908; RAILLIET, 1924; HOUDEMER, 1938; DOLLFUS, 1963; DROZDZ and MALCZEWSKI, 1967; SEGAL et al., 1968; THAN THÉ VIET et al., 1977; SEY, 1980, 1983, 1985), there are few on the amphistomes of fishes and amphibians (HA KI, 1969; ODENING, 1968; SEY, 1986a). These studies revealed 42 species: Amurotrema dombrowkajae Achmerow, 1959; Neocladorchis multilobularis Sey, 1986; Platycladorchis microacetabularis Sey, 1986; P. macroacetabularis Sey, 1986; Diplodiscus amphichrus Tubangui, 1938; D. mehraï Pande, 1937; Watsonius noci (Barrois, 1908); Hawkesius hawkesi (Cobbold, 1875); Homalogaster palonial Poirrier, 1883; Gastrodiscoides hominis (Lewis et McConnel, 1876); Paramphistomum cervi (Zeder, 1790); P. epidictyum Fischoeder, 1904; P. ichikawai Fukui, 1922; P. gotoi Fukui, 1922; P. hircus Fischoeder, 1901; Callicophoron callicophorum (Fischoeder, 1901); C. microbothrioides (Price et McIntosh, 1944); C. caullorrhis (Stiles et Goldberger, 1910); C. ijimai (Fukui, 1922); C. papillosum (Stiles et Goldberger, 1910); Orthocoelium scoiocoelium (Fischoeder, 1901); O. orthocoelium (Fischoeder, 1901); O. dicranocoelium (Fischoeder, 1901); O. streptocoelium (Fischoeder, 1901); O. dinniki Eduardo, 1982; O. saccocoelium Sey, 1980; Cotylophoron cotylophorum (Fischoeder, 1901); C. indicum Stiles et Goldberger, 1910; Explantanum explanatum (Creplin, 1847); E. anisocotyle (Faust, 1920); E. bathycotyle (Fischoeder, 1901); Gigantocotyle formosanum (Fukui, 1929); G. fraternal (Stiles et Goldberger, 1910); Carverius spatiosus (Brandes, 1896); C. bulbosus Sey, 1985; C. synethes (Fischoeder, 1901); Gastrothylax crumenifer (Creplin, 1847); G. glandiformis Yamaguti, 1939; G. minutus Fischoeder, 1901; Fischoederius cobboldi (Poirrier, 1883); P. elongatus (Poirrier, 1833); F. japonicus Fukui, 1922. With a few exceptions (SEY, 1983, 1985) these examinations were mainly based on gross morphological observations, whereas it is generally accepted that modern diagnosis of amphistomes cannot be accomplished without a knowledge of the structure of the muscular organs.

Our examinations, which have also been extended to histomorphological traits, confirmed, on the one hand, the occurrence of the majority of the previously described species, and on the
other hand further new information on the amphistomes of Vietnamese vertebrates are presented.

MATERIALS AND METHODS

The majority of the test material of fishes, amphibians and turtles (Testudo elongata, T. impressa, Triopax steindachneri) were collected from hosts deposited in formaline in the Department of Vertebrate Zoology, Hanoi University, and the lesser part of it was bought at the Hanoi market. The test material of mammalian hosts is deposited at the Department of Parasitology, Vietnamese Scientific Research Center, Hanoi, collected from Bos primigenius f. taurus, Bubalus arnee f. bubalis, Capra aegargus f. hircus, Cervus unicolor, Muntiacus muntjak and Sus crofa f. domestica. Whole mounts were stained in carmine, median sagittal sections were prepared by the usual method and the technique applied for examination of surface topography was the same as described by the author elsewhere (SEY, 1985b).

RESULTS AND DISCUSSION

Amphistomes were recovered from all of the vertebrate groups except reptiles (turtles).

AMPHISTOMES OF FISHES

Helminth parasites of freshwater fishes have been infrequently investigated (Oshmarin, 1965; HI KI, 1969; SEY, 1969a). Of the trematodes described, one species of amphistome, Amurotrema dombrowskiae was recorded by HA KI (1969) from Spinibarbigthys denticulatus. I have found this species in the same host. Histomorphological examination of its muscular organs showed that it had a new type of pharynx, Amurotrema (characterized by primary pharyngeal sacs longer than the pharynx itself, as well as by the presence of a moderately developed middle circular layer, Fig. 13). The acetabulum is of a Cleptodiscus-type (SEY, 1986b).

Further three fish amphistomes (Neocladorchis multilobularis, Platycladorchis microacetabularis, P. macroacetabularis) have been described elsewhere (SEY, 1986a).

AMPHISTOMES OF AMPHIBIANS

Two species of amphistomes (Diplodiscus amphichrus Tubangui, 1933 and D. mehrai Pande, 1937) were found in frogs and salamanders. The former species was described for the first

Legend to figures

Figs 1-12: Scanning electron microscopy of surface topography: 1-3 Gastrodiscoides hominis (1= general view of oral opening, X54; 6-7 genital opening, 6= X190, 7= X695); 4-7 Orthocoelium saccocoelium (4-5 general view of oral opening, 4= X81, 5= X196, 6-7 genital opening, 6= X85, 7= X180); 8-10 Gastrothylax crumenifer (8-9 general view of oral opening, 8= X78, 9= X266, 10= genital opening, X73); 11-12 Carmyerius syneithes (general view of oral opening, 11= X186, 12= X990).

Figs 13-30: Median sagittal sections of muscular organs: Amurotrema dombrowskiae (13= pharynx), Diplodiscus amphichrus (14= pharynx), D. mehrai (15= pharynx), Hawkesius hawkesi (16= pharynx, 17= genital opening, 18= dorsal and 19= ventral halves of acetabulum), Paramphistomum ichikawai (20= genital opening, 21= dorsal half of acetabulum), Calicophoron microbothrioides (22= oesophagus, 23= genital opening, 24= dorsal half of acetabulum), Orthocoelium dinniki (25= oesophagus, 26= genital opening), O. saccocoelium (29= pharynx, 30= genital opening, 27= dorsal and 28= ventral half of acetabulum).
time by ODENING (1968) from Rana tigrina rugulosa and the latter one was recovered from Rana limnocharis and Paramesotriton deloustaull. The findings of D. mehrai represent new hosts and locality records.

Since a great number of specimens were available for study, it was possible to examine the structure of the muscular organs in both species. These examinations revealed a solid ground for the validity of the species in question and lead to a discovery of the specific traits which can be used in their differentiation. Accordingly, the structure of the pharynx (Subclavatus in D. amphichrus, Fig. 14; and Megalodiscus in D. mehrai, Fig. 13), the position of the genital opening (post-bifurcal in D. amphichrus and bifurcal in D. mehrai) and the arrangement of the vitelline follicles (discontinuous at the middle part of each lateral region in D. amphichrus and continuous in D. mehrai) are the most important specific characters.

AMPHISTOMES OF MAMMALS

Until recently 36 species of amphistomes have been shown to occur in mammals. We have, however, found the following 22 species in the samples available for examination: Homalogaster paloniae, Hawkesius hawkesi, Gastrodiscoides hominis, Paramphistomum epichilum, P. gotoi, P. ichikawai, Calicophoron calicophorum, C. papillosum, C. microbothrioides, Explanatum explanatum, Gigantocotyle formosanum, Orthocoelium dicranocoeleum, O. dinnik, O. saccocoelium, O. scolicoelium, Gastrothylax crumenifer, Carmyerius bulbosus, C. spatiosus, C. synethes, Fischoederius cobboldi, F. elongatus and F. japonicus.

Of the species discovered on the basis of our examinations Paramphistomum ichikawai, Calicophoron microbothrioides, Orthocoelium saccocoelium and O. dinnik were described for the first time from Viet Nam, thus represent new locality records.

An examination of the surface topography of the species, Gastrodiscoides hominis (Figs 1-3), O. saccocoelium (Figs 4-7), Gastrothylax crumenifer (Figs 8-10) and Carmyerius synethes (Figs 11-12) by scanning microscopy revealed three types of papillae (dome to conical non-ciliated papilla, Figs 7,9), crateryform papilla (Figs 11, 12); short and stumpy papilla, sitting on a tegumental elevation (Fig. 5), which are similar to that described previously by EDUARDO (1982) and SEY (1984b).

Of the species recorded for the first time in Viet Nam, Paramphistomum ichikawai has a Calicophoron-type of pharynx, an Ichikawai-type of genital opening (Fig. 20) and a Plasm-type of acetabulum (Fig. 21); the same organs in Calicophoron microbothrioides are: Calicophoron with oesophagus having muscular thickening (Fig. 22), Microbothrium (Fig. 23) and Plasm (Fig. 24); in Orthocoelium saccocoelium: Saccocoelium (Fig. 29), Papillogenitalis (Fig. 30) and Streptocoelium (Figs 27-28), in O. dinnik: Calicophoron with oesophagus having muscular thickening along the posterior half (Fig. 25), Papillogenitalis (Fig. 26) and Streptocoelium.

The samples of Hawkesius hawkesi rendered an examination of the structure of the muscular organs possible for the first time for this species. The pharynx is characterized by the presence of a moderately developed pharyngeal bulb and well-developed secondary pharyngeal sacs. The pharynx itself is poorly developed and similar to that of the Homalogater (SEY, 1984) and Pseudodiscus (NASMARK, 1937) types, but differs from them by having a moderately developed middle circular and well-developed inner longitudinal layers. I regard this as a new type, named Hawkesius (Fig. 16).

The genital opening is moderately developed, characterized by the presence of genital papillae, absence of circular musculature and the existence of a definitive fibre layer, delimiting the genital opening from the surrounding tissue, like to genital sucker. There is a short hermaphroditic duct. It represents a new type of genital opening, named Hawkesius (Fig. 17).
It is most similar to the Balanorchis-type (EDUARDO, 1982) but differs from it in the absence of sphincter papillae.

The acetabulum is characterized by a poorly developed marginal longitudinal muscle layer and the number of muscle units found in DE (42-45, Fig. 18) and VE (22-25, Fig. 19). It is similar to that of the Gastrodiscoides (SEY, 1986b) and the Homalogaster-types but differs from them in having lesser muscle units in the DE and VE muscle layers. It is regarded as a new type, named Hawkesius.

Of the amphistomes previously described from Viet Nam, fourteen species (Watsonius noci, Paramphistomum cervi, P. hircis, Calicophoron cauliorchis, C. ijimai, Orthocoelium orthocellum, O. streptocoellum, Cotylphoron cotylophorum, C. indicum, Gigantocotyle anisocotyle, G. bathycotyle, G. fraternum, Gastrothylax glandiformis and G. minutus) have not been revealed during our examinations. The clarification of their real position, presence or absence should be the subject of further studies.

A KEY TO SPECIES OF VIETNAMESE AMPHISTOMES

| 1) Ventral pouch absent | 2 | 2) Pharynx with primary pharyngeal sacs | 3 | 3) Parasites of fishes | 4 | 4) Cirrus pouch normally developed | 5 | 5) A) Testes spherical | 6 | 6) A) Pharynx Subclavatus-type | 7 | 7) A) Genital opening Noci-type | 8 | 8) Pharynx Calicophoron-type | 9 | 9) Genital opening Papillogenitalis | 10 | 10) A) Acetabulum Streptocoellum-type |
|------------------------|---|--------------------------------------|---|----------------------|---|-------------------------------|---|------------------------|---|--------------------------------|---|-----------------------------|---|-------------------------|---|------------------------|
| Ventral pouch present | 14 | Pharynx with pharyngeal bulb and secondary pharyngeal sacs | 7 | Parasites of amphibians | 6 | Cirrus pouch strongly developed | 5 | B) Testes strongly lobed | 12 | B) Pharynx Dicranocoelium-type | 13 | B) Genital opening Epiclitum-type | 13 | C) Genital opening Calicophoron-type | 12 | A) Genital opening Scoliocoelium-type | 11 | B) Genital opening Gracile-type |
|                        |    | Pharynx without primary pharyngeal sacs, pharyngeal bulb and secondary pharyngeal sacs | 8 |                        |    | Platycladorchis microacetabularis | 6 | C) Testes with some lobes, acetabulum big | 11 | B) Genital opening Microbothrium-type | 12 | D) Genital opening Microbothrium-type | 12 | D) Genital opening Microbothrium-type | 11 | Orthocoelium dinniki |
|                        |    |                                                         |    |                        |    |                                | 5 |                        | 6 |                            | 10 |                            | 12 | Orthocoelium dinniki |
|                        |    |                                                         |    |                        |    |                                | 6 |                        |    |                            | 10 |                            |    | Orthocoelium microulloides |
|                        |    |                                                         |    |                        |    |                                | 5 |                        |    |                            | 11 |                            |    | Orthocoelium microulloides |
|                        |    |                                                         |    |                        |    |                                | 4 |                        |    |                            | 10 |                            |    | Orthocoelium microulloides |
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|                        |    |                                                         |    |                        |    |                                | 1 |                        |    |                            | 11 |                            |    | Orthocoelium microulloides |
13) A) Genital opening Explanatum-type Explanatum explanatum
   B) Genital opening Microbothrium-type Gigantocotyle formosanum
14) Uterus in dorsal median field along its length 15
   - Uterus crossing from one side of body to other near middle, Gastrothylax crumenifer
15) Testes symmetrical, one on each side of median line 16
   - Testes tandem in median line 18
16) A) Oesophagus without oesophageal musculature 17
   B) Oesophagus with oesophageal thickening Carmyerius bulbosus
17) A) Genital opening Gracile-type Carmyerius spatiosus
   B) Genital opening Synethes-type Carmyerius synethes
18) A) Genital opening Elongatus-type Fischoederius elongatus
   B) Genital opening Microbothrium-type Fischoederius cobboldi
   C) Genital opening Microbothriopapillatus-type Fischoederius japonicus

PARASITE/HOST CHECK-LIST

Amurotrema dombrowskajae
   Spinibarbichthys denticulatus
Neocladorchis multilobularis
   Spinibarbichthys denticulatus
   Platycladorchis microacetabularis
   Spinibarbichthys denticulatus
   Platycladorchis macroacetabularis
   Lissochilus kremphi
Diplodiscus amphichirus
   Rana tigrina rugulosa
Diplodiscus mehraii
   Rana limnocharis
   Paramesotriton deloustali
   *Watsonius nocii
   Macaca mulatta
Homalogaster palonae
   Bos primigenius f. taurus
   Capra aegargus f. hircus
   Muntiacus muntjak
Gastrodiscoides hominis
   Sus scrofa f. domestica
   Homo sapiens
Hawkesius hawki
   Elephas maximus
Paramphistomum gotol
   Bubalus arnee f. bubalis
Paramphistomum ichikawai
   Bubalus arnee f. bubalis
   *Paramphistomum cervi
   Bos primigenius f. taurus
   Bubalus arnee f. bubalis
   Bubalus arnee f. bubalis
   *Refers to literature data.

Paramphistomum epiclitum
   Bubalus arnee f. bubalis
   *Paramphistomum liorchis
   Bos primigenius f. taurus
   Bubalus arnee f. bubalis
   Capra aegargus f. hircus
Calicophoron calicophorum
   Bubalus arnee f. bubalis
   Capra aegargus f. hircus
   Cervus unicolor
   Muntiacus muntjak
Calicophoron papillosum
   Bubalus arnee f. bubalis
   Bos primigenius f. taurus
   *Calicophoron cauliorchis
   Capra aegargus f. hircus
   *Calicophoron ijimai
   Bos primigenius f. taurus
Calicophoron microbothrioides
   Bos primigenius f. taurus
   Cervus unicolor
   Muntiacus muntjak
Orthocoelium scoliocoelium
   Bos primigenius f. taurus
   Bubalus arnee f. bubalis
   Capra aegargus f. hircus
   Muntiacus muntjak
   *Orthocoelium orthocoelium
   Bos primigenius f. taurus
   Bubalus arnee f. bubalis
Orthocoelium dicranocoelium
Bos primigenius f. taurus

Orthocoelium dinniki
Bos primigenius f. taurus
Bubalus arnee f. bubalis
Cervus unicolor

Orthocoelium saccoceolium
Cervus unicolor

*Orthocoelium streptocoelium
Bubalus arnee f. bubalis

*Cotylophoron cotylophorum
Bos primigenius f. taurus
Bubalus arnee f. bubalis

*Cotylophoron indicum
Bos primigenius f. taurus

Explanatum explanatum
Bos primigenius f. taurus
Bubalus arnee f. bubalis

Gigantocotyle formosanum
Bubalus arnee f. bubalis

*Gigantocotyle anisocotyle
Bubalus arnee f. bubalis

*Gigantocotyle bathycotyle
Bos primigenius f. taurus
Bubalus arnee f. bubalis

*Gigantocotyle fraternum
Bubalus arnee f. bubalis

Gastrothylax crumenifer
Bos primigenius f. taurus
Bubalus arnee f. bubalis
Capra aegargus f. hircus
Ovis ammon f. aries

*Gastrothylax glandiformis
Bubalus arnee f. bubalis
Capra aegargus f. hircus

*Gastrothylax minutus
Bubalus arnee f. bubalis

Carmyerius spatiosus
Bubalus arnee f. bubalis
Bos primigenius f. taurus
Muntiacus muntjak

Carmyerius bulbosus
Bubalus arnee f. bubalis

Carmyerius synethes
Bos primigenius f. taurus
Bubalus arnee f. bubalis
Capra aegargus f. hircus
Cervus unicolor

Fischoederius cobboldi
Bos primigenius f. taurus

Fischoederius elongatus
Bos primigenius f. taurus
Bubalus arnee f. bubalis
Muntiacus muntjak

Fischoederius japonicus
Bos primigenius f. taurus
Bubalus arnee f. bubalis
Cervus unicolor
Muntiacus muntjak

HOST/PARASITE CHECK-LIST

Lissoclithus kreffti
Platycladorchis macroacetabularis

Spinibarbichthys denticulatus
Platycladorchis microacetabularis
Amurotrema dombrowskajae
Neocladorchis multilobularis

Rana tigrina rugulosa
Diplodiscus amphichirus

Rana limnocharis
Diplodiscus mehraii

Paramesotriton deloustatii
Diplodiscus mehraii

*Macaca mulatta
Watsonius noei

*Homo sapiens
Gastrodiscoides hominis
Sus scrofa f. domestica
Gastrodiscoides hominis

Elephas maximus
Hawkesius hawkesi

Bos primigenius f. taurus
Homalogaster paloniae
Paramphistomum cervi
P. epiclitum

*Refers to literature data.
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**SEY, O.: A vietnami gerinces állatok amfisztómumai**

*(Trematoda: Amphistomida)*

A szerző vizsgálta a vietnami gerinces állatok amfisztomum élősködőit. Négy fajt halakból, két fajt kétéltűekből és huszonkét fajt emlősökből mutatott ki. A dolgozatot parazita/gazda és gazda/parazita jegyzék egészíti ki.
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