

A REVIEW OF
INDIAN GASTEROSTOMES (TREMATODA)

By

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I. INTRODUCTION

Gasterostomes come under a single family Bucephalidae Poche, 1907, of digenetic trematodes. They are mostly found as adult parasites in the intestines of marine and freshwater fishes and larval stages in bivalve molluscs and encysted in nerves of fishes. Though enough work has been done on them in India but none has tried to work out their life-history, except Singh and Rai (1965) ; this is very essential to establish the proper status of various species and genera. First record of Gasterostomes in India was made by Verma (1936a & b). He described five new species in the genus *Bucephalopsis* (Diesing, 1855) Nicoll, 1914, viz. *B. fusiformis*, *B. garuai*, *B. magnum*, *B. confusus*, and *B. minimum* ; three species in the genus *Bucephalus* Baer, 1827, viz. *B. aoria*, *B. tridentacularia*, *B. jagannathai* ; and one species in the genus *prosorhynchus* Odhner, 1905 viz. *P. truncatus*. Bhalerao (1937) added *Bucephalopsis karvei*. Srivastava (1938) added one species to the genus *Bucephalopsis*, viz. *B. belonea* ; three species to the genus *Bucephalus*, viz. *B. indicus*, *B. gangeticus*, *B. barina* ; and two species to the genus *Proso-rhynchus*, viz. *P. manteri* and *P. arabiana*. Chauhan (1943) recorded the genera *Rhipidocotyle* Diesing, 1858 and *Neidhartia* Nagaty, 1937, for the first time from this country and added two species to the former, viz. *R. apapnllosum* and *R. ligulum* and one species to the latter genus, viz. *N. microrhyncha*, apart from two previously reported species. He also added one species to the genus *Bucephalopsis*, viz. *B. microrhynchus*. Dayal (1948) created two new genera, *Neobucephalopsis* with *N. bagarius* as its type and *Neoproso-rhynchus* with *N. purius* as its type, apart from adding three new species, viz. *Bucephalopsis sinhai*, *B. thapari*, *B. macronius*, to the genus *Bucephalopsis*. Gupta (1953) added three species to the genus *Neobucephalopsis*, viz. *N. eutropüchthis*, *N. pseudeu-*

tropici and *N. gauhatiensis*. Srivastava (1963) described three species under the genus *Bucephalus*, viz. *B. bagarius*, *B. tritenticularis* and *B. allahabadensis*. Kakaji (1969) described *B. octotenticularis* under the genus *Bucephalus*.

Chauhan (1954) has reviewed all the Bucephalids described from India till then and has pointed out the confused state of their systematics. In spite of excellent works of Eckmann (1932) and Nagaty (1937), available to most of the later workers, there appears much confusion with regard to the systematic position of various Indian species and genera enumerated above. Kniskern (1952) while stressing the need for the study of life-history for proper assessment of the systematics of this group has commented on the value of various structures to be taken into account. Nagaty (1937) and Gupta (1956) have also remarked about the variability in the structure and position of various organs in the individuals of the same species. Present authors had the opportunity to study a series of specimens, including original ones, of most Indian species and observe a wide range of variation in the individuals of the same species. Nature of the holdfast organ (anterior sucker) and location of ovary in relation to testes appear to be most valid characters for erecting a new genus. For evaluating a new species, length of cirrus sac in relation to body length ; number, location and nature of vitelline follicles ; host specificity based on the ecology of the host, giving due consideration to individual variations, may be taken into account. Shape and form of body, small variations in position and shape of gonads and extent and direction of caecum only should not form the basis for the purpose. Presence or absence of receptaculum seminis may also not form a strong character as it was found from the study of a large number of Verma's slides (including types) and many specimens collected by the authors that receptaculum seminis is present in some specimens, whereas, it is not discernible in other specimens of the same series due to factors like massive development of shell glands and thin transparent nature of the receptaculum seminis.

An attempt has been made here to examine systematic position of the Indian Gasterostomes, in the light of our study and observations, which may be found helpful by future workers on the group.

II. SYSTEMATIC ACCOUNT

The classification of the family Bucephalidae mostly followed

is as given by Nagaty (1937) and Dawes (1946). Yamaguti (1958) created three new subfamilies *viz.*, Neoprosorhynchinae, Neidhartinae and Dolichoenterinae, which appear to be unnecessary and require further study. Skrjabin (1962) followed Yamaguti, but maintained Paurorhynchinae Dickermann, 1954 as a separate subfamily.

Family BUCEPHALIDAE Poche, 1907

Subfamily BUCEPHALINAE Nicoll, 1914

Genus 1. **Bucephalus** Baer, 1827

1. **Bucephalus aoria** Verma, 1936

1936. *Bucephalus aoria* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 87.

Verma (1936a) described this species from *Macrones aor* (= *Mystus aor*) from Allahabad. The number of processes or fimbriae in this species vary from 12 to 22 instead of 14 to 22 as given by Verma.

2. **Bucephalus tridentacularia** Verma, 1936

1936. *Bucephalus tridentacularia* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 84.

1938. *Bucephalus indicus* Srivastava, *Indian J. vet. Sci.*, **8**: 317-340.

Verma (1936a) described this species from *Macrones aor* (= *Mystus aor*) and *Aoria seenghala* (= *Mystus seenghala*) from Allahabad. Srivastava H. D. (1938) described it from the same host as *B. indicus*. Srivastava C. B. (1963) synonymised the two species on the basis of his study of Verma's original specimens and other specimens collected by him from the type host and locality. Kakaji (1969) tried to revalidate *B. indicus* disregarding the fact that the synonymy was based on the study of Verma's original specimens and not only literature.

3. **Bucephalus jagannathai** Verma, 1936

1936. *Bucephalus jagannathai* Verma, *Proc. natn. Acad. Sci. India*, **6**(3): 252.

This species was collected from the intestine of *Cymbium guttatum* from Puri. The nature of tentacles distinguish this species from other species of the genus having the same number of tentacles.

4. *Bucephalus gangeticus* Srivastava, 1938

1938. *Bucephalus gangeticus* Srivastava, *Indian J. vet. Sci.*, **8**: 321.

This species was described for *Macrones seenghala* (= *Mystus seenghala*) from Allahabad.

5. *Bucephalus barina* Srivastava, 1938

1938. *Bucephalus barina* Srivastava, *Indian J. vet. Sci.*, **8**: 323.

This species was collected from *Sactophagus argus* at Puri.

6. *Bucephalus bagarius* Srivastava, 1963

1963. *Bucephalus bagarius* Srivastava, *Indian J. Helminth.*, **15**(1): 36.

The species was recorded from the intestine of *Bagarius bagarius* (Ham.) from Allahabad.

7 *Bucephalus tritentacularis* Srivastava, 1963

1963: *Bucephalus tritentacularis* Srivastava, *Indian J. Helminth.*, **15**(1): 38.

The species was collected from the intestine of *Bagarius bagarius* (Ham.) from Allahabad. The species is unique in having only three tentacles.

8. *Bucephalus allahabadensis* Srivastava, 1963

1963. *Bucephalus allahabadensis* Srivastava, *Indian J. Helminth.*, **15**(1): 40.

This species was collected from *Bagarius bagarius* (Ham.) from Allahabad.

9. *Bucephalus octotentacularis* Kakaji, 1969

1969. *Bucephalus octotentacularis* Kakaji, *Indian J. Helminth.*, **21**(1): 52.

This species was collected from the intestine of *Wallagonia attu* (= *Wallago attu*) from Lucknow. The number of tentacles in this species are eight.

Genus 2. *Prosorhynchoides* Dollfus, 1929

Syn. Bucephalopsis Nicoll, 1914 *nec* Diesing, 1855

Neobucephalopsis Dayal, 1948

Bucephaloides Hopkins, 1954 *syn. nov.*

Diesing (1855) erected the subgenus *Bucephalopsis* under the genus *Bucephalus* Baer, 1827 for the cercaria *Bucephalus*

haimeanus Lacaze-Duthiers, 1854, since the digestive system in this cercaria was different from that of cercaria *Bucephalus polymorphus* Baer, 1827. Nicoll (1914) raised the subgenus *Bucephalopsis* to generic rank, with *Bucephalopsis gracilescens* (Rudolphi, 1819) as the type species, assuming that the cercaria *Bucephalopsis haimeanus* develops into adult of *Bucephalopsis gracilescens*.

Dollfus (1929) erected the genus *Prosorhynchoides* with *P. ovatus* (Linton, 1900) as its type species. Nagaty (1937) synonymised the genus *Prosorhynchoides* with the genus *Bucephalopsis*.

Dayal (1948) erected a new genus *Neobucephalopsis* with *N. bagarius* Dayal, 1948 as its type species, and separated it from the genus *Bucephalopsis* (Diesing, 1855) Nicoll, 1914 on the basis of the presence of receptaculum seminis in the former. In our study we find that presence or absence of receptaculum seminis is not an important character (*vide supra*) and the genus *Neobucephalopsis* Dayal, 1948 should be congeneric with the genus *Bucephalopsis*. (See also Chauhan, 1954).

Hopkins (1954) pointed that the cercaria *Bucephalopsis haimeanus* Lacaze-Duthiers, 1854 may or may not develop into the adult of *Bucephalopsis gracilescens* (Rud., 1819) and obviously Nicoll (1914) was not justified to treat the other adult species and cercaria *Bucephalopsis haimeanus* in a single genus *Bucephalopsis*, until the experimental life-history is worked out establishing the connection between cercaria *B. haimeanus* and the adult *B. gracilescens*. Therefore, Hopkins (*op. cit.*) restricted the genus *Bucephalopsis* for the cercaria *B. haimeanus* and transferred all the adult species to his newly erected genus *Bucephaloides*. This system was followed by most of the subsequent workers.

Nagaty (1937) was apparently right in treating *Prosorhynchoides* with type species *P. ovatus* (Linton, 1900) and *Bucephalopsis* with type species *B. gracilescens* (Rud., 1819) congeneric, but gave priority to the latter genus.

We agree with Hopkins (1954) that the genus *Bucephalopsis* should be tentatively retained for *B. haimeanus* till experimental work connects the cercaria *B. haimeanus* with adult stages showing generic characters with *Bucephalopsis gracilescens*. His genus *Bucephaloides*, with type species *Bucephaloides gracilescens*, to accommodate all the known adult species named as *Bucephalopsis*, is, however, untenable, since an earlier name

Prosorhynchoides Dollfus, 1929, is available which is congeneric with species of *Bucephalopsis* for which Hopkins has erected this new genus. The name *Bucephaloides*, therefore, is treated as a junior synonym of *Prosorhynchoides*. All the species now included under *Bucephaloides* are transferred under the genus *Prosorhynchoides* Dollfus, 1929 with *P. ovatus* (Linton, 1900) as type species.

10. ***Prosorhynchoides garuai*** (Verma, 1936) n.comb.

1936. *Bucephalopsis garuai* Verma, *Proc. natn. Acad. Sci. India*, 6(1): 72.

1948. *Bucephalopsis sinhai* Dayal, *Indian J. Helminth.*, 1(1): 53. Syn. nov.

Verma (*loc. cit.*) described this species from *Pseudeutropius garua* (= *Clupisoma garua*) from Allahabad. Srivastava (1938) collected it from *Silonia silondia*. Present authors have collected this from *Eutropiichthys vacha* in addition to the two previously reported hosts. Kakaji (1969) collected it from *Wallago attu*. On studying a series of specimens the authors find that there are considerable variations with regard to position of various organs. Testes vary from symmetrical, diagonal to tandem position, from near cirrus sac to the pharynx; vas deferens is well developed and in some specimens it is as wide as the vesicula seminalis, before opening into it; cirrus sac varies from a straight to curved sickle shaped structure, reaching almost 1/5 to 1/4 or more of the body length. Receptaculum seminis is well developed in some specimens and can be traced, along with Laurer's canal, whereas, in others it is completely obliterated due to its thin transparent nature and massive development of shell gland. The same variation is met with in Verma's specimens also, which the authors had the opportunity to examine. Two characters are very consistent, *viz.*, club-shaped or bilobed nature of vitelline follicles and sufficiently smaller size of ovary in relation to testes. These, in the opinion of the authors, should form the distinguishing characters of this species. Kniskern (1952) pointed that 'Y' shaped nature of excretory bladder, as suggested by Verma, is actually tubular with slight indentation at the anterior borders. The present authors are in agreement with this view.

Dayal (*loc. cit.*) separated *Bucephalopsis sinhai* from *Prosorhynchoides garuai* (Verma, 1936) on the basis of vesicula seminalis externa. It appears from his figure that he has confused vas deferens with vesicula seminalis externa. Variations in

vas deferens have been pointed above. Present authors, therefore, consider it as synonym of *P. garuai* (Verma, 1936) as has already been pointed out by Chauhan (1954).

11. **Prosorhynchoides magnum** (Verma, 1936) n. comb.

1936. *Bucephalopsis magnum* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 77.
 1936. *Bucephalopsis confusus* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 89.
 1936. *Bucephalopsis minimus* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 82.
 1953. *Neobucephalopsis eutropiichthis* Gupta, *Indian J. Helminth.*, **5**(1): 3. Syn. nov.
 1953. *Neobucephalopsis pseudeutropei* Gupta, *Indian J. Helminth.*, **5**(1): 6. Syn. nov.

Verma (*loc. cit.*) described this species from *Pangasius buechanani* (= *P. pangasius*) from Allahabad. Srivastava (1938) and Gupta (1956) collected it from *Silonia silondia* from Allahabad and Lucknow respectively. We have collected it from *Clupisoma garua* and *Eutropiichthis vacha* apart from the above hosts.

The cirrus sac varies from 1/3.5 to 1/8 of body length. The size of ovary in relation to testes is also variable; in some it is equal, slightly smaller or slightly bigger. Receptaculum seminis is discernible in some specimens. The vitelline follicles are small, round, 13 to 18 in number on either side of body anterior to caecum.

Bhalerao (1937) regarded it as synonym of *Prosorhynchoides garuai* (Verma, 1936). Nagaty (1937), Srivastava (*loc. cit.*), Chauhan (1943, 1954), Dawes (1946) and Gupta (*loc. cit.*) accepted it as valid species. We are in agreement with this view.

Bhalerao (*loc. cit.*) and Srivastava (*loc. cit.*) considered *Bucephalopsis confusus* Verma, 1936 and *B. minimus* Verma, 1936 synonymous to *Prosorhynchoides garuai*, whereas, Nagaty, Chauhan and Dawes consider them synonymous to the present species. We support this view.

Gupta (*loc. cit.*) described *Neobucephalopsis eutropiichthis* and *N. pseudeutropei* from *Eutropiichthis vacha* and *Pseudeutropius garua* respectively. There does not appear much difference in these two species and *P. magnum* (Verma, 1936). They have been treated as synonyms. The measurements of receptaculum seminis in *B. pseudeutropei* as given by Gupta appear to be incorrect.

12. **Prosorhynchoides fusiformis** (Verma, 1936) n. comb.

1936. *Bucephalopsis fusiformis* Verma, *Proc. natn. Acad. Sci. India*, **6**(1): 68.
 1948. *Bucephalopsis thapari* Dayal, *Indian J. Helminth.*, **1**(1): 56. Syn. nov.
 1948. *Bucephalopsis macronius* Dayal, *Indian J. Helminth.*, **1**(1): 58. Syn. nov.

Verma (*loc. cit.*) collected these parasites from *Eutropiichthys vacha* from Allahabad. Srivastava (1938) and present authors have collected many specimens from the same host. A receptaculum seminis could not be discerned in this species. Vitelline follicles, 7 to 18 in number, are small, round bodies, grouped together on either side of body in the region of anterior sucker. Cirrus sac is $1/4$ to $1/2$ of the body length.

Dayal (*loc. cit.*) described *Bucephalopsis thapari* and *B. macronius* from *Pseudeutropius taakree* and *Macrones seenghala* respectively from Lucknow. He did not compare his specimens with the present species. Differences between these species are of minor nature and may be considered as intra-specific variations. *B. thapari* and *B. macronius* have, therefore, been treated as synonym of *Prosorhynchoides fusiformis* (Verma, 1936).

13. **Prosorhynchoides karvei** (Bhalerao, 1937) n. comb.

1937. *Bucephalopsis karvei* Bhalerao, *J. Helminth.*, **15**: 98.
 1938. *Bucephalopsis belonea* Srivastava, *Indian J. vet. Sci.*, **8**:325.

Bhalerao described this species from *Belone cancila* (= *Xenentodon cancila*) from Poona. Manter and VanCleave (1951) consider it synonymous to *B. magnacetabulum* Nagati, 1937 Chauhan (1943, 1954), Gupta (1956) and Manter (1963) regard it as valid. Present authors support its validity.

Srivastava (*loc. cit.*) described *Bucephalopsis belonea* from *Belone strongylina* from Puri. Chauhan (*loc. cit.*) considered it synonymous to *Bucephalopsis southwelli* Nagaty, 1937 Gupta (*loc. cit.*) made it synonym to *B. karvei*. Present authors agree with this latter synonymy.

14. **Prosorhynchoides microcirrus** (Chauhan, 1943)

1943. *Bucephalopsis microcirrus* Chauhan, *Proc. Indian Acad. Sci.*, **B**, **17**(4): 98.

Chauhan (*loc. cit.*) described this species from *Sciaena belengeri* from Bombay. The species is characterised by its

long slender body and short cirrus sac. It also possesses cystogenous glands just below the anterior sucker. This form appears to form a connecting link between the genera *Prosorhynchoides* and *Rhipidocotyle*.

15. ***Prosorhynchoides bagarius*** (Dayal, 1948) n. comb.

1948. *Neobucephalopsis bagarius* Dayal, *Indian J. Helminth.*, 1(1): 51.

1953. *Neobucephalopsis gauhatiensis* Gupta, *Indian J. Helminth.*, 5(1): 9. Syn. nov.

Dayal (*loc. cit.*) described this species from *Bagarius bagarius* from Lucknow and made it the type of his new genus *Neobucephalopsis*, which has now been treated as synonym of the genus *Prosorhynchoides*. Gupta (*loc. cit.*) described *N. gauhatiensis* on a single specimen from *Pseudeutropius garua*, and differentiated it from the former species on the basis of the position of testes and length of cirrus sac. Variations in these structures in this group of parasites have already been pointed out. The differences are of minor nature and may be taken as individual variations. *Neobucephalopsis gauhatiensis* has been treated as synonym of *Prosorhynchoides bagarius* (Dayal, 1948).

This species comes very close to *Prosorhynchoides fusiformis* (Verma, 1936) but differs from it in the possession of a receptaculum seminis.

Genus 3. ***Rhipidocotyle*** Diesing, 1855

16. ***Rhipidocotyle ligulum*** Chauhan, 1943

1943. *Rhipidocotyle ligulum* Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 105.

This species was described from the intestine of *Arius falcarius* from Bombay.

17. ***Rhipidocotyle apapillosum*** Chauhan, 1943

1943. *Rhipidocotyle apapillosum* Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 107.

This species was collected from the intestine of *Clupea* sp. from Bombay.

18. **Rhipidocotyle septapapillata** Krull, 1934

1934. *Rhipidocotyle septapapillata* Krull, *Trans. Am. Micr. Sci. Soc.*, **53**: 408.
 1943. *Rhipidocotyle septapapillata*: Chauhan, *Proc. Indian Acad. Sci.*, B. **17**(4): 110.

Chauhan (1943) collected this species from *Chrysophrys berda* from Bombay, extending the distribution of this species to Arabian Sea.

Subfamily b. PROSORHYNCHINAE Nicoll, 1914

Syn. Neoprosorhynchinae Yamaguti, 1958

Neidhartinae Yamaguti, 1958

Yamaguti (1958) created subfamily Neoprosorhynchinae for the reception of the genus *Neoprosorhynchus* Dayal, 1948. Present authors do not agree with the creation of this subfamily as the genus *Neoprosorhynchus* is closely allied to the genus *Prosorhynchus*, and can well be accommodated under the subfamily Prosorhynchinae, where it was originally placed by its author. Subfamilies Neoprosorhynchinae Yamaguti, 1958 and Neidhartinae Yamaguti, 1958 are dropped.

Genus 4. **Prosorhynchus** Odhner, 1905

19. **Prosorhynchus truncatus** Verma, 1936

1936. *Prosorhynchus truncatus* Verma, *Proc. natn. Acad. Sci. India*, **6**(3): 257.

Verma (*loc. cit.*) collected this species from *Arius jalius* from Puri, Bay of Bengal.

20. **Prosorhynchus manteri** Srivastava, 1938

1938. *Prosorhynchus manteri* Srivastava, *Indian J. vet. Sci.*, **8**: 333.

This species was collected by Srivastava (*loc. cit.*) from *Tetraodon oblongus* from Puri, Bay of Bengal.

21. **Prosorhynchus arabiana** Srivastava, 1938

1938. *Prosorhynchus arabiana* Srivastava, *Indian J. vet. Sci.*, **8**: 336.

Srivastava (*loc. cit.*) collected this species from *Synaptura orientalis* from Karachi (now in Pakistan).

22. **Prosorhynchus** sp. Chauhan, 1943

1943. *Prosorhynchus* sp. Chauhan, *Proc. Indian Acad. Sci.*, B, **17**(4): 117.

Few specimens of this species were collected by Chauhan (*loc. cit.*) from the intestine of *Serranus lanceolatus* from Bombay.

Genus 5. *Neoprosorhynchus* Dayal, 1948

23. *Neoprosorhynchus purius* Dayal, 1948

1948. *Neoprosorhynchus purius* Dayal, *Indian J. Helminth.*, 1(1): 48.

Dayal (*loc. cit.*) described this species as the type of his newly erected genus *Neoprosorhynchus* from *Epinephelus lanceolatus* from Puri.

Genus 6. *Neidhartia* Nagaty, 1937

Nagaty (1937) described the genus *Neidhartia* to accommodate his two new species, *N. neidharti* and *N. ghardagae* under the subfamily Prosorhynchinae. Dawes (1946) considered this genus as a synonym of the genus *Prosorhynchus* Odhner, 1905. Chauhan (1954) and Manter (1963) consider it as a valid genus. Yamaguti (1958) created new subfamily Neidhartinae for this genus. Present authors support the validity of the genus but do not agree with the creation of a new subfamily for it.

24. *Neidhartia microrhyncha* Chauhan, 1943

1943. *Neidhartia microrhyncha* Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 112.

Chauhan (*loc. cit.*) described this species from *Psettodes erumei* from Bombay.

25. *Neidhartia neidharti* Nagaty, 1937

1937. *Neidhartia neidharti* Nagaty, *Publ. Fac. Med. Egypt Univ.*, 12: 118.

1943. *Neidhartia neidharti*: Chauhan, *Proc. Indian Acad. Sci.*, B, 17(4): 116.

Chauhan (*loc. cit.*) collected this species from *Belone* sp. from Bombay, extending the distribution of this species to the Arabian Sea.

III. SUMMARY

The systematic position of the Indian Gasterostomes has been reviewed in the light of the studies made by the authors

from their own gasterostome collections and the collections of Verma.

Genus *Bucephaloides* Hopkins, 1954 has been treated as synonym of the genus *Prosorhynchoides* Dollfus, 1929 and all the species included under the former genus have been transferred to the latter genus.

Subfamilies Neoprosorhynchinae Yamaguti, 1958 and Neidharantinae Yamaguti, 1958 have been considered synonyms of the subfamily Prosorhynchinae Nicoll, 1914.

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