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# A PRELIMINARY SURVEY OF 21 CEYLON LAKES*

# 3. Parasites and Predators, Food of Fish, and Marginal Fauna

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## 1. PARASITES AND PREDATORS

Our knowledge of the parasitic fauna of Ceylonese freshwater fishes is largely of very recent date. The earliest record is that of Fowke (1938) who found "Gyrodactylus" in young trout. Kulasiri and Fernando (1956) recorded a number of nematode species; Yeh (1960) using material collected by the present author added more nematode species to the list describing a new genus and a number of new species. Crusz and Sathananthan (1961) recorded a larval stage of a trematode. The most comprehensive works on the helminth fauna are those of Fernando and Furtado (1963*a*, 1963*b*), which deal with nematodes, cestodes and Acanthocephala and list all the species reported so far, and of Gussev (1963) who described 20 species of monogenetic trematodes of which 19 were new. Fernando (1964) has given a list of the helminth parasites which occur in our freshwater fishes and of the major groups so far unreported but likely to occur. Whilst the present knowledge of our fauna cannot be considered meagre yet there is no doubt that many species remain undescribed and unreported. A noteworthy gap in our knowledge is the Digenea.

As for crustacean parasites Mendis and Fernando (1962) list three species; and Ingle and Fernando (1963) record a single species with some remarks on taxonomy and ecology.

Mendis and Fernando (1962) list two species of ciliate protozoans parasitic on local species of fish.

In the present survey helminth and crustacean parasites were collected from some of the fish taken in experimental nets, and from fish obtained from fishermen. Only the alimentary canal and body cavity were examined in detail.

### Helminth parasites

The parasites found are listed in Table 1 together with their intermediate hosts. These parasites were either adults or larvae; the former occurring in the alimentary canal, the latter in the mesenteries and body cavity. The adults comprised Cestoda, Acanthocephala and Nematoda whilst the larval forms were nematodes. Since the gills and body surface were not examined the Monogenea, if present, have been missed. It is also likely that some of the smaller forms especially the trematodes were not recorded due to the rather cursory examination of the internal organs.

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* This Survey was carried out during March-May, 1962. The cost of employing a fisherman to operate the fishing gear used was generously borne by the F. A. O. which also paid for a part of the travelling of Dr. C. H. Fernando, then on home-leave from the University of Malaya in Singapore. All other expenses incurred and all facilities required were provided by the Fisheries Research Station, Ceylon. The lakes surveyed are indicated in the Map on page 2. (*Editor*).

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There were 3 cestode species *Bothriocephalus gowkongensis* Yeh (Bothriocephalidae), *Senga lucknowensis* Johri (Ptychobothriidae) and *Gangesia bengalensis* (Southwell) (Proteocephalidae). Only the last-named species was numerous in the hosts. All three species occurred in the small intestine. *Bothriocephallis gowkonensis* was found in a single *Puntius sarana* from Minneriya tank whilst *Senga lucknowensis* occurred in the only specimen of *Mastacembelus armatus* examined from Kantalai tank. *Gangesia bengalensis* was found in a number of *Wallago attu*. A notable absentee in the present survey is *Lytocestus*, common in the Indo-Malayan region. They are small and may have been missed if few were present.

Epizootics amongst wild fishes due to cestode infections have been noted in certain parts of the world by Dogiel *et al* (1958), though none have yet been recorded in Ceylon. However the occurrence of *B. gowkongensis* as a fish-parasite in Ceylon's waters must be viewed with considerable misgiving, for Yeh (1955) has reported it to cause serious mortality amongst grass-carp, *Ctenopharyngodon idellus*, in China. This parasite has probably been introduced into Ceylon with Chinese carp imported for stocking purposes during the 1950's.

Two species of Acanthocephala, *Neoechinorhynchus longinuchalis* Fern. and Furt. and *Pallisentis nagpurensis*, were found in intestines. Both were not numerous, varying from 1–10 in a single host. The former occurred in *Macrones vittatus* and the latter in *Ophiocephalus striatus*. Acanthocephala cause direct damage to the gut wall in which their anterior spiny proboscides are embedded.

A single camallanid nematode, *Procamallanus confusus*, was found in *Heteropneustes fossilis*. Camallanids usually occur in very small numbers (Fernando and Furtado, 1963*a*), and are unlikely to cause much damage to their hosts. Two larval forms, *Hedruris* sp. (Spiruroidea-Hedruridae) and *Eustrongylides* sp. (Dioctophymidae) were also found. The former species was found in *Wallago attu*, *Ompok bimaculatus*, *Heteropneustes fossilis* and *Glossogobius giuris*. It was numerous in its hosts, as many as 50 occurring in a *Wallago attu* about 5 lbs. in weight, and seems to be directly responsible for fish mortality. In Ridiyagama tank large numbers of *Glossogobius giuris* heavily infected with this parasite were found dead, presumably from the infection. As its hosts are amongst the more voracious feeders, cropping excess of Tilapia, an epizootic infestation by *Hedruris* could have important effects on the population balance and hence on the size of *Tilapia*. *Eustrongylides* occurred in *Wallago attu*, *Ompok bimaculatus* and *Heteropneustes fossilis*. The number found in the single host was 1–10.

## Life Histories

Practically all the helminths recorded have an arthropod as the first intermediate host (Table 1). The Camallanidae have in addition " Carrier hosts " which are small fishes (Kulasiri and Fernando 1956). In the Proteocephalidae the second intermediate host has been eliminated. This probably applies to *Gangesia* whose life history is not known. The second intermediate hosts include molluscs, aquatic insects, crustaceans and small fishes. In the case of *Hedruris* and *Eustrongylides* the first intermediate host is not known although Baylis (1939) placed a larval form found in prawns provisionally in the genus *Eustrongylides*. The final host in the case of *Hedruris* is likely to be a reptile, although some species occur in fishes and amphibians in the adult condition. In the large irrigation reservoirs the reptiles include tortoises, water monitors, crocodiles and snakes. In some of the reservoirs crocodiles are extremely common, e.g., Minneriya, and the parasite is common in the fish in this reservoir. The fishermen at Minneriya stated that they had killed about 200 crocodiles (probably an overestimate) during the last two years.

The adults of *Eustrongylides* are found in birds. A possible host for the species recorded here is the common cormorant *Phalacrocorax niger* which is perhaps the commonest bird in the large reservoirs. It is a voracious feeder on fishes.

## Crustacean Parasites

Only a single ectoparasitic isopod *Alitropus typus* Milne Edwars was recorded, a single specimen being found in *Ompok bimaculatus* caught in Giant's Tank, Murunkan.

As in the case of the helminths it is under pond culture conditions that crustacean parasites could be a serious menace. Secondary infections after parasitisation can seriously harm fish in addition to direct effects.

## Protozoan and Leech parasites

Leeches and protozoans were not recorded during the course of this survey.

## Predators

In the early stages fish are preyed upon by a variety of predatory insects. The most voracious are the bugs *Lethocerus indicus*, *Anisops* spp ; the beetles *Cybister* spp ; *Hydaticus* sp. and many others ; and dragonfly larvae ; and during the survey an abundance of these predatory insects was noted in the natural habitats studied.

The most important predators of fish are large fish. Of these the common larger and more important ones are *Wallago attu*, *Ophiocephalus striatus* and *Glossogobius giuris*. The former two species are however absent from the reservoirs of the Southern Province fed by the Walawe Ganga. Other predatory species include *Ophiocephalus marulius*, *O. maculatus*, *Ompok bimaculatus*, *Anabas testudineus*, *Macrones* spp., *Clarias teysmanni* and *Heteropneustes fossilis*. During the survey gut contents of a number of these predators were scrutinised at fishing sites where they were being cut up prior to drying. *Tilapia* was common in the guts of *Wallago* whilst fish remains were found in all the other species mentioned. The occurrence of over ten piscivorous species in an indigenous fish fauna of 55 species must be considered quite high. That they also occur in considerable numbers is also an indication of the abundance of the fish they prey on. The latter belong mainly to the family Cyprinidae (Carps).

Fish of all sizes are also fed upon by other types of vertebrates which are either aquatic or live and feed near water. In the large irrigation reservoirs the commorant *Phalacrocorax niger* is perhaps the most important. Hundreds of these birds were seen " fishing " in the tanks at the same time. Flocks estimated at 3,000–10,000 birds were seen at Minneriya and over one thousand were noted at Giritale and Parakrama Samudra. It would be interesting to find out to what extent they are responsible for the mortality at different stages of both economically important and coarse fishes. For in Africa Cott (1952) found that *Phalacrocorax* spp., feed mainly on the smaller fish ; and high mortalities in the young of fish may cause important changes in fish production especially in our tanks (relatively small as compared with African lakes) where large bird populations are involved.

The crocodiles *Crocodilus palustris* and *C. porosus* are abundant in some of the large reservoirs like Minneriya, Soraborawewa, Tabbowa and Kandalama and are major cause of loss of nets. In Tabbowa no fishing is done at night (when catches are usually larger) due to crocodiles. In a single specimen about 10 ft. long (from snout to tail tip) captured from Minneriya the gut was found to contain one *Tilapia*, one *Puntius sarana* and a tortoise.

Other vertebrate predators in the large reservoirs are *Varanus salvator*, and *Lutra ceylonensis*, neither of them very common. Water snakes may take large number of fish at the edges of the lakes. They seldom venture into deep water.

Predators are an important component of the fauna of any habitat, and their role in our tank fisheries still remains to be assessed. Their possible detrimental effect has already been referred to. In the large irrigation reservoirs where the fish production has increased due to the introduction of *Tilapia*, the role of predators may even be one of special usefulness. *Tilapia* being an extremely prolific fish is known to increase in numbers to such an extent as to cause the fish to be of small size and even stunted due to competition. Whether this happens in any particular habitat will depend on a number of factors one of which is predator pressure. Comparative studies can be made between reservoirs in the North-Central Province and the Southern Province since the latter lack the most voracious predators *Wallago* and *Ophiocephalus striatus*.

**Summary**

Three nematodes, two acanthocephalans and three cestodes were collected by dissecting 15 species of fish.

Of these parasites only *Hedruris* sp. a larval nematode is responsible directly for the death of fish. Since it is found in predatory species a reduction of these might prove of considerable consequence to fish production. *Bothriocephalus gowkonensis*, a cestode probably introduced from China with Chinese carp, was recorded in an indigenous carp *Puntius sarana*. This parasite causes heavy mortality in grass carp in China and is a potential danger to local species.

A single crustacean parasite was recorded. It is likely that they are widespread. No protozoa were recorded but there can be little doubt that they occur in local freshwater species and may be of considerable importance in fisheries.

Several predators (insects, fish and other vertebrates) were recorded and are doubtless of considerable importance. However, the role of parasites and of predators (especially fishes) in relation to the productivity of fisheries can hardly be assessed at present and needs further study.

**Referenees**

BAYLIS, H. A. (1939). *The fauna of British India*, Nematoda, Vol. 2, 274 pp. Taylor and Francis, Lond.

COTT, H. B. (1952). Fish-eating Birds. *Rep. E. Afr. Fish Org. Nairobi for 1952.*

CRUSZ, H. and SATHANANTHAN, A. H. (1960). Metacercaria of *Transversotrema patialense* in the freshwater fish *Macropodus cupanus*. *J. Parasit.*, 46, p. 613.

DOGIEL, V. A. et al (1958). *Parasitology of Fishes* (English trans. Z. Kabata (1961), Oliver and Boyd, Lond. 384 pp.).

FERNANDO, C. H. (1963*a*). Some studies on helminth parasites of freshwater fishes. *Proc. First UNESCO symposium Sci. know. Trop. Parasitology Singapore*, (1962), pp. 293–302.

——— (1963*b*). A Study of some helminth parasites of freshwater fishes in Ceylon. *Z. Parasitenk.* 23, pp. 141–163.

——— (1964). A guide to the freshwater fauna of Ceylon, Suppl. 2. *Bull. Fish. Res. Stn. Ceylon*, 17, pp. 177–211.

FOWKE, P. (1938). Trout culture in Ceylon. *Ceylon J. Sci.* (*C*), 6, pp. 1–78.

GUSSEV, A. V. (1963). New species of Monogenoidea from fishes of Ceylon. *Bull. Fish. Res. Stn. Ceylon*, 16, 53–83.

INGLE, R. W. and FERNANDO, C. H. (1963). Miscellaneous notes on some fresh and brackish water crustaceans from Ceylon. *Crustaceana*. 6, 101–109.

KULASIRI, C. and FERNANDO, C. H. (1956). Camallanidae parasitic in some Ceylon fish. *Parasitology*, 46, 420–424.

MENDIS, A. S. and FERNANDO, C. H. (1962). A guide to the freshwater fauna of Ceylon. *Bull. Fish. Res. Stn. Ceylon*, 12, 160 pp.

YEH, L. S. (1955). On a tapeworm *Bothriocephalus gowkongensis* n. sp. (Cestoda : Bothriocehpalidae) from a freshwater fish in China. *Acta Zool. Sinica* 7, 69–74 (Chinese with English summary).

——— (1960). On a collection of Camallanid nematodes from freshwater fishes in Ceylon. *J. Helminth.* 34, 107–116.

**TABLE 1**

**Helminth parasites recorded and their intermediate hosts**

| Parasite / Host | Puntius sarana | Heteropreustes Fossilis | Mystus vittatus | Ompok bimaculatus | Wallago attu | Ophiocephalus striatus | Glossogobius giuris | Mastacembelus armatus | INTERMEDIATE HOSTS |
|---|---|---|---|---|---|---|---|---|---|
| **NEMATODA** | | | | | | | | | |
| Procamallanus Confusuo | | + | | | | | | | Copepoda, small fishes |
| Hedruris sp. (Larva) | | | | + | + | | + | | Unknown |
| Enstrongylides sp. (Larva) | | + | | + | + | | | | Prawn ? |
| **ACANTHOCEPHALA** | | | | | | | | | |
| Zelanechinorhynchus longinuchalis | | | + | | | | | | Crustaecae, aquatic insects, molluses |
| Pallisentis nagpurensis | | | | | | + | | | Crustaecae, aquatic insects, small fishes |
| **CESTODA** | | | | | | | | | |
| Senga lucknowensis | | | | | | | | + | Copepoda, small fishes ? |
| Gangesia bengalensis | | | | + | + | | | | Copepoda, No second intermediate host |
| Bothriocephalus gowkonensis | + | | | | | | | | Copepoda |

## 2. FOOD OF FISH

The only work which deals specifically with the food of Ceylonese freshwater fishes is that of Fernando (1956), but the food habits of many species that occur in India too have been studied by workers in that country. Of these studies the most comprehensive is that of Menon and Chacho (1956) who have given a detailed analysis for 59 species, 20 of which occur in Ceylon. Schuster (1952) has listed the food of many South-East Asian species with special reference to species used for culture and introduction to other countries. The food of *Tilapia mossambica*, the most important fish commercially in Ceylon has been well studied elsewhere (Chimits 1955), the herbivorous nature of its gut being clearly demonstrated by Kamal Pasha (1964).

In the present study 15 species of fish of importance as food were studied. Though numbers examined were small my findings are of value when taken together with previous work referred to above. Gut contents were removed into petri-dishes and examined both by eye and under the low power of the microscope.

### Results and Discussion

The results of the gut examination are shown in Table 2. Taking each family of fishes separately we find that the Cyprinidae are as a whole largely herbivorous. *Labeo dussumieri* and *Puntius dorsalis* feed on algae ; *Puntius dorsalis, P. sarana* and *Tor khudree longispinis* feed on higher plants. Three species had insect remains in the gut namely *Puntius sarana, Tor khudree longispinis*

and *Labeo dussumieri*. The only species which had fish remains in the gut was *Puntius sarana*. *Puntius dorsalis* seems to be a herbivore with a bias towards plankton, and *Labeo dussumieri* is similar. These two species are the most abundant of our local carps and occupy an important food niche.

Amongst the Cichlidae, *Etroplus suratensis* feeds on a wide variety of food which includes filamentous algae, higher plants, insects and decaying organic matter together with mud and sand. The abundance of this species in many of the large tanks is indicative that it utilizes a rich source of food.

*Tilapia mossambica* had in its gut higher plants, a few entomostraca and filamentous algae. In subsequent examinations I have noticed an abundance of mud and sand together with decaying organic matter. Since there are a number of complaints that *Tilapia* eats the young of local species it is appropriate to refer at greater length to the food of this species. Neither *Tilapia mossambica* nor any one of the many related species in Africa is known to be piscivorous (see Chimits, 1955). My own examination of guts has not given a single instance of fish remains. Further Kamal Pasha (1964) has shown conclusively the herbivorous nature of the gut of *Tilapia mossambica*. It has been stated however by Menon and Chacko (1956) that when raised in small ponds with fry *Tilapia mossambica* takes these. The weight of evidence clearly points to a herbivorous food habit for *Tilapia mossambica* and any fish remains taken should be considered as accidental.

Of the five species of Siluroidea examined two can be considered carnivorous, namely *Wallago Attu* and *Ompok bimaculatus*. The higher plants recorded in their gut came presumably from the herbivorous fishes they had eaten. Indigenous carps and *Tilapia* were found in their gut. The other three species are omnivorous, eating a wide range of foods. Mollusca were common in the gut of *Heteropneustes fossilis*. This makes it an important fish utilizing an abundant source of animal protein in some of the large irrigation reservoirs like Minneriya, Parakrama Samudra and Tabbowa.

*Ophiocephalus striatus* is a carnivorous fish, colonial algae in its gut probably coming from its prey. So is *Glossogobius giuris* which being a bottom feeder had mud and sand in its gut too. The single *Mastacembelus armatus* examined had its stomach full of dragon-fly larvae, indicating perhaps a predominently insectivorous habit.

## Conclusions

From previous work and the present study the fishes examined can be divided into three categories as regards food habits ; Herbivores, which include *Tilapia mossambica, Puntius dorsalis, Labeo dussumieri* and *Osphronemus goramy ;* ominovores which include *Etroplus suratensis, Puntius sarana, Macrones keletius, M. vittatus, Heteropneustes fossilis* and *Tor khudree longispinis* and carnivores, *Wallago attu, Ompok bimaculatus, Ophiocephalus striatus* and *Glossogobius giuris*. However strict categorization of fish into these three groups is seldom possible and the present results are no exception.

## References


Chimits, P. (1955). Tilapia and its culture, *F. A. O., Fish Bull.*, 8, pp. 1–33.

Fernando, C. H. (1956). On the food of four freshwater fishes of Ceylon. *Ceylon J. Sci. (C)*. 7, pp. 201–217.

Kamal Pasha, S. M. (1964). The anatomy and histology of the alimentary canal of the herbivorous fish *Tilapia mossambica* (Peters), *Proc. Indian Acad. Sci. (B)*, 59, pp. 340–349.

Menon, M. D. and Chacko, P. T. (1956). Food and feeding habits of some freshwater fishes of Madras State. *J. Bombay Nat. Hist. Soc.* 55, pp. 117–124.

Schuster, W. H. (1952). A provisional survey of the introduction and transplantation of fish throughout the Indo-Pacific region. *Proc. Indo-Pacif. Fish. Counc.* pp. 187–196.

**TABLE 2**

**Gut Contents of Fishes Examined**

| Species / Gut Contents | No. of Specimens | Unicellular algae | Colonial algae | Flamentous algae | Higher plants | Entomostraca | *Caridina* | Insects | Molluscs | Fish | Mud and sand with decaying org. matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cyprinidae** | | | | | | | | | | | |
| Puntius dorsalis (Jerdon) .. | 6 | + | + | + | + | | | | | | + |
| Puntius sarana (Ham. Buch.) .. .. | 26 | | | + | + | + | + | + | | + | |
| Tor khudree longispinis (Gunther) .. .. | 3 | | | | + | | | + | | | |
| Labeo dussumieri (Val.) .. | 8 | + | + | + | | | | + | | | + |
| Cichlidae : | | | | | | | | | | | |
| Etroplus Suratensis Block .. .. | 4 | | | + | + | | | + | | | + |
| Tilapia mossambica Peters .. .. | 8 | | | + | + | + | | | | | |
| Anabantidae : | | | | | | | | | | | |
| Osphronemus goramy Lacepede .. .. | 2 | + | | | + | | | | | | + |
| Siluroidea : | | | | | | | | | | | |
| Heteropneustes fossilis (Block) .. .. | 15 | | | | + | | | | + | + | + |
| Macrones keletius (Val.) .. .. | 1 | | | | + | + | + | + | | | + |
| Macrones vittatus (Block) .. .. | 2 | | | | + | + | + | + | + | + | |
| Wallago attu (Block and Schneider) .. | 11 | | | | + | | | | | + | |
| Ompok bimaculatus (Block) .. .. | 2 | | | | + | | | | | + | |
| Ophiocephalidae : | | | | | | | | | | | |
| Ophiocephalus striatus Block .. .. | | | | | | | | | | | |

## 3. MARGINAL FAUNA

The invertebrate fauna of aquatic habitats is of great importance in fish production. The benthos of the deeper waters of these 21 lakes has been dealt with by Mendis (1965) and the present study is restricted to the fauna in the shallow water near the shores. In all the irrigation reservoirs surveyed, collections were made with a pond net having 22 meshes per inch, fauna from the water, the vegetation and the bottom being caught. The animals were picked off the net directly and from the vegetation and mud placed in shallow trays with a little water. The actual time spent collecting varied from about half an hour to one hour ; more time being spent if the fauna was poor.

### Results

The animals collected are listed in tables 3–5. They include all the usual groups of aquatic invertebrates, with arthropoda, mainly insects, predominating. Aquatic Hemiptera were the most numerous in species and occurred in 20 of the 21 lakes studied, the one exception being the Castlereagh

reservoir in the hill country. 36 species were identified whilst a number, specially larvae, were not identified to species. The next in numbers of species come the aquatic Coleoptera, which are represented by 21 identified species and many unidentified ones. None was collected from Castlereagh, Sorabora weva, Senanayake Samudra and Magalle weva, but subsequent visits have shown an abundant coleopteran fauna in Senanayake Samudra. Insect larvae were numerous in many of the catches, Odonata larvae predominating because being large they were more easily detected.

Amongst the crustacea only *Caridina* can be considered common. It is often very abundant amongst aquatic vegetation and submerged roots of land plants. The only two lakes where it was not collected were Kande-ela and Castlereagh.

Mollusca although generally not as common as the Arthropoda were nevertheless quite common, even abundant, in some lakes; for example Horowapatana Wewa. Subsequent observations on the dry portions of the beds of Minneriya, Parakrama Samudra and Tabbowa showed an abundance of *Lamellidens*, *Bellamya* and *Melanoides*.

Other fauna recorded were the Hydracarina which were common, and leeches which were found only on one occasion.

As a whole the marginal fauna was much more abundant in the low-country reservoirs than in the hill-country reservoirs studied.

## Discussion

The greater abundance of invertebrate fauna at the shallow edges of low-country reservoirs seems to be correlated with the higher fish productivity of these lakes. This is not surprising for many species of fish feed in shallow waters of the lake-edge during the early stages of their life. Some even of the large fish do this. Yet hardly anything is known about this fauna, neither its seasonal changes in abundance, which are likely to be very marked, nor the factors controlling these, nor the ecology of any of the constituent species. A more detailed study of this fauna of lake margins should be started and will benifit fishery management. Such little information as there is has been documented in Mendis and Fernando (1962), Fernando (1963, 1964).

## Summary

A study of the fauna found at the shallow edges of 21 irrigation reservoirs showed an abundance of fauna in the low-country reservoirs whilst the up-country reservoirs had a poor fauna.

The fauna showed Insects, Crustacea and Mollusca in this order of abundance. The presence of insect and mollusc feeding fish in our fauna shows that these rich sources of food are being utilized.

## References

Fernando, C. H. (1963). A guide to the fresnwater fauna of Ceylon. Suppl. 1, *Bull. Fish. Res. Stn. Ceylon* 16, pp. 29–38.

——— (1964). A guide to the freshwater fauna of Ceylon. Suppl. 2, *Bull. Fish. Res. Stn. Ceylon* 17, (2), pp. 177–211.

Mendis, A. S. and Fernando, C. H. (1962). A guide to the freshwater fauna of Ceylon. *Bull. Fish. Res. Stn. Ceylon*, 12, 160 pp.

Mendis, A. S. (1965). A Preliminary Survey of 21 Ceylon lakes. 2. Limnology and fish production potential. *Bull. Fish. Res. Stn. Ceylon*, 18 (1).

**TABLE 3**

| Species | Tank or Reservoir | Parakrama Samudra | Giritale | Minneriya | Moragaswewa | Kantalai | Kandalama | Nachchaduwa | Horowapathana | Tabbowa | Ridiyagama | Wirawila | Hambegamuwa | Nalanda | Kande-ela | Castlereagh | Horaborawewa | Senanayake Samudra | Giants tank | Padaviya | Iranamadu | Magalle Wewa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MOLLUSCA** | | | | | | | | | | | | | | | | | | | | | | |
| Melanoides tuberculata (Muller) | .. | | | + | | + | | + | + | + | + | + | | | | | + | | | | + | + |
| Thiara scabra (Muller) .. | .. | | + | | | | | | | | + | | | | | | | | | | | |
| Bithynia inconspicua (Dohrn) | .. | + | + | | | | | | + | | + | + | | | | | | + | + | + | + | |
| Bellamyia ceylonica (Dohrn) | .. | | + | | | | | | + | | + | + | | | | | + | + | + | + | + | |
| Pila globosa (Swainson) | .. | | | | | | | | | | | | | | | | | | | + | | |
| P. virens (Mull.) .. | .. | + | | + | | | + | | + | | | | | | | | | + | | | | |
| Lymnaea luteola Lamarck | .. | | | | | | | | | | | | | | | | | + | | | | |
| Gyraulus saigonensis .. | .. | | | | | | + | | + | | + | | | | | | | + | | | | |
| Indoplanorbis exustus (Desh.) | .. | | + | | | | | | + | | | | | + | | | | + | | | + | |
| Lamellidons marginalis (Lamarck) | .. | | + | | | | | + | + | | | | | | | | | | | | | |
| Parreysia corrugata (Mull.) | .. | | | | | | | + | + | | | | | | | | | | | | | |
| **CRUSTACEAE** | | | | | | | | | | | | | | | | | | | | | | |
| Paratelphusa ceylonensis Fern. | .. | | | + | | | | | + | | | | | | | | | | | | | |
| Macrobrachium sp. .. | .. | | | | | | | | | + | | | | | | | | | | | | |
| Caridina nilotica simoni Bouvier | .. | + | + | + | + | + | + | + | + | + | + | + | + | + | | | + | | + | + | + | + |
| C. fernandoi Arud. & Costa | .. | + | + | + | | + | + | + | + | | + | + | | | | | + | | + | + | + | |
| Cylestheria hislopi (Baird) | .. | + | + | + | | + | + | | | | | | | | | | | | | | | |
| Ostracoda .. | .. | | | | | | | | | | | | | | | | | | | | | |
| Leeches .. | .. | | | | | + | | | | | | | | | | | | | | | | |
| Hydracarina .. | .. | + | + | + | + | + | + | + | + | | | + | | | | | | | | + | + | + |

**TABLE 4**

| Species | Tank or Reservoir | Parakrama Samudra | Giritale | Minneriya | Moragaswewa | Kantalai | Kandalama | Nachchaduwa | Horowapathana | Tabbowa | Ridiyagama | Wirawila | Hambegamuwa | Nalanda | Kande-ela | Castlereagh | Horaborawewa | Senanayake Samudra | Giants tank | Padaviya | Iranamadu | Magalle Wewa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mesovelia orientalis Kirk .. | .. | + | | + | + | | + | | | | | + | | | | | | | | | | |
| Microvelia longicornis Bueno | .. | | | | | | | | | | | + | | | | | | | | | | |
| M. douglesi Kirk .. | .. | | + | + | | | | | | | + | | | | | | | | | | | |
| Perittopus breddini Kirk | .. | | + | | | | | | | | + | + | | | | | | | | | + | |
| Timasius sp. .. | .. | | + | | | | | | | | + | + | | | | | | | | | | |
| Hydrometra greeni Kirk .. | .. | | | + | | + | + | | | | | | | | | | | | | | | |
| Laccotrephes grossus (Fabr.) | .. | | | + | | | | | | | | | + | | | | | | | | | |
| L. maculatus (Fabr.) .. | .. | + | + | + | | | | | | | | + | + | + | | | | | | + | + | |
| Ranatra elongata Fabr. .. | .. | | | | | | | | | | | | + | | | | | | | | | |
| R. longipes Stal. .. | .. | | | + | | + | | | | | | + | | + | | | | | + | | | |
| R. varipes Stal. .. | .. | + | | | | | + | + | + | | | | | | | | | | + | | | |
| Cercometus strangulatus Mont. | .. | + | | | | | | | | | | | | | | | + | | | | | |
| Sphaeordema rusticum (Fabr.) | .. | | | + | | | | | | | | | | | | | | | | + | | |
| Naucoris scutellaris Stal. | .. | + | | + | + | — | + | + | + | | | | | | | | | | | + | | |
| Heleocoris bengalensis Mont. | .. | | | | | | | | | | | | | + | | | | | | | | |
| Anisops bouvieri Kirk. .. | .. | | | | | | | | | | | + | + | | | | | | | | | |
| A. breddini Kirk .. | .. | | | + | + | | | | | | | | | | | | | | | | + | |
| A. batillifrons Lundb. .. | .. | + | + | + | + | | | | | | | | | | | | | | | + | + | |
| Anisops sp. (Nymphs) .. | .. | + | + | + | | + | | | | | | | | | | | | | | + | | |
| Enithares sp. .. | .. | + | | | | | | | | | | | | | | | | | | | | |
| Helotrephes kikaldyi Esaki and China | .. | | | + | | + | | | | | | | | | | | | | | | | |
| Plea frontalis Dist. .. | .. | | | + | | + | + | | | | + | + | | | | | | | | + | | |
| Plea liturata Kirk. .. | .. | + | | + | | | | | | | + | | | | | | | | | | | |
| Micronecta albifrons Motsch. | .. | + | | + | + | + | | + | + | | | | | | | | | | | | | |
| M. punctata Fieb. .. | .. | + | + | + | | | | + | | | | | | | | | | | | | | |
| M. quadristragata Braddin | .. | + | | + | | | + | + | | | + | | + | | | | | | + | + | + | |
| M. scutellaris (Stal.) .. | .. | + | | | | | | | | | | | + | | | | | | | + | | |
| Tropocorixa pruthiana Hutch | .. | | | | | | | | | | | | | + | | | | | | | | |
| Cylindrostethus *prodactus* Spin. | .. | + | + | + | | | | | | | + | | | | | | | | | | | |
| Gerris adelaidis Dohrn .. | .. | + | + | + | + | + | | + | | | | | | | | | | | | + | | + |
| G. pectoralis Mayr. .. | .. | + | | | + | + | | | | | | | | | | | | | | | | |
| Limnogonus fossarum (Fabr.) | .. | | | + | | | | | | | | | | + | | | | | | + | | |
| L. nitidus Mayr. .. | .. | + | | + | + | + | | + | | | | | | | | | | | | | + | |
| L. parvulus Stal. .. | .. | | | | + | | | + | | | | | | | | | | | | | | |
| Rhagodotarsus kraeplini Breddin | .. | | | | | | | | | + | | | | | | | | | | + | | |
| Unidentified Hemiptera .. | .. | + | + | + | + | + | + | + | + | + | + | | | | | | | | + | + | + | |

**TABLE 5**

| Species | Tank or Reservoir | Parakrama Samudra | Giritale | Minneriya | Moragaswewa | Kantalai | Kandalama | Nachchaduwa | Horowapathana | Tabbowa | Ridiyagama | Wirawila | Hambegamuwa | Nalanda | Kande-ela | Castlereagh | Horaborawewa | Senanayake Samudra | Giants tank | Padaviya | Iranamadu | Magalle Wewa |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HYDROPHILIDAE** | | | | | | | | | | | | | | | | | | | | | | |
| Sternolophus rufipes Fabr. | .. | | | + | | | | | | | | | | | | | | | | | | |
| S. brachyacanthus Reg. | .. | | + | | | | | | | | + | | + | | | | | | | | | + |
| Berosus indicus Motsch. | .. | + | + | | + | + | | | | | + | + | + | + | | | | | + | + | | |
| B. pulchellus MacL. .. | .. | | | | | | | | | | | + | | | | | | | + | + | | |
| Helochares anchonalis Sharp. | .. | | | | + | + | | | | | | | | | | | | | | | | |
| H. pallens MacL. .. | .. | | | + | | | | | | | | | | | | | | | | | | |
| Enochrus esuriens (Wall.) | .. | | + | + | + | | | | | | | | + | | | | | | | | | |
| Regimbartia attenuata Fabr. | .. | | | | | | | | | | | + | | | | | | | | + | | |
| Amphiops gibbus Ill. .. | .. | | | | | | | | | | | | | + | | | | | | + | | |
| Amphiops sp. .. | .. | | | + | | | | | | | | | | | | | | | | + | | |
| Unident. Hydorphilidae | .. | + | + | + | + | + | + | + | + | + | + | + | + | | | | | | | + | + | + |
| **DYTISCIDAE** | | | | | | | | | | | | | | | | | | | | | | |
| Cybister tripunctatus Ol. | .. | | | + | | | | | | | | | | | | | | | | | | |
| Hydraticus vittatus Fabr. | .. | | | | | | | | | | | | | | + | | | | | | | |
| Laccophilus ceylonicus Zimm. | .. | | + | | + | | | | | | | | | | | | | | | | | |
| L. chinensis inefficens Walk. | .. | | + | | | | | | | | | + | + | | | | | | | | | |
| Hydrovatus confertus Sharp. | .. | | | + | | | | | | | | | | | | | | | | | | |
| Hydrovatus sp. .. | .. | | | + | | | | | | | | | | | | | | | | | | |
| Canthydrus luctuosus Aube | .. | | | | + | + | | | | | | | | | | | | | | | | |
| C. lactabilis Walk. .. | .. | | | | + | + | + | | | | | | | | | | | | | | | |
| Unident. Dytiscidae .. | .. | + | + | + | + | + | + | + | + | + | + | + | + | | | | | | + | + | + | |
| **HALIPALIDAE** | | | | | | | | | | | | | | | | | | | | | | |
| Haliplus pulchellus Clark | .. | | | | + | | | | | | | | | | | | | | | | | |
| **GYRINIDAE** | | | | | | | | | | | | | | | | | | | | | | |
| Orectoeheilus Sp. .. | .. | + | | | | | | | | | | | | | | | | | | | | |
| Dineutes Sp. .. | .. | | | | | | | | | | | | | | | | | | | | | |
| **INSECT LARVAE** | | | | | | | | | | | | | | | | | | | | | | + |
| Odonata .. | .. | + | + | + | + | + | + | + | + | + | + | — | + | | + | | + | | + | + | + | + |
| Ephermeroptra .. | .. | + | + | + | + | + | + | + | + | | | | | | | | | | | + | + | |
| Trichoptera .. | .. | + | | | + | | | | | | | | | | | | | | | | | |
| Chironomidae .. | .. | + | + | + | | + | + | | + | | | + | + | | | | | | + | + | + | |
| Ceratopogonidae .. | .. | + | | + | | | | | | | | | + | | | | | | | + | | |
| Other Diptera .. | .. | + | | | | + | | | | | | | | | | | | | | | | |