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Food and feeding habits of *Helostoma temmincki* (Osteichthyes, Anabantidae), an introduced species, in a freshwater marsh in the wet zone of Sri Lanka

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Abstract

Helostoma temmincki (Cuvier and Valenciennes) is an introduced fish species in Sri Lankan freshwaters. It occurs in several freshwater habitats in Sri Lanka. However, hitherto no studies have been reported on food and feeding habits of this species from Sri Lankan freshwater habitats. Present study was carried out to investigate the food and feeding habits of *H. temmincki* in Iriyawetiya marsh of the wet zone of Sri Lanka.

In the stomach contents of *H. temmincki*, 14 genera of diatoms, 12 genera green algae, 3 genera of blue green algae, unidentified plant particles and detritus were present. The relative gut length is related to body size of *H. temmincki* according to a second order polynomial curve, which perhaps indicates that the digestive tract of this species is morphologically adapted for ontogenetic variations in feeding. The logarithmic relationship between the gastro-somatic index and body length in *H. temmincki* indicates its higher feeding efficiency in smaller size classes than in larger size classes. Ontogenetic variations in feeding habits and isometric growth of *H. temmincki* may be an indication of its efficient food utilization.

Introduction

Helostoma temmincki (Cuvier and Valenciennes) was introduced to Sri Lanka from Thailand in 1951 (Munro 1955). One hundred and fifty specimens of this species were first introduced to ponds in Kalutara (Western Province of the country) and it was reported that a few specimens were sold to the public (Anon. 1951). Pethiyagoda (1991) reported that this fish is found in the South-Western part of the country. As this species is easily adapted to the aquarium conditions and is usually peaceful towards other fish, there is a high demand for this species as an aquarium fish. A subsistence fishery exists in Iriyawetiya marsh (6°59` N; 79°54` E; Fig. 1) in the wet zone of Sri Lanka and *H. temmincki* is one of the dominant species in this fishery. Very little is known about the biology of *H. temmincki* in natural freshwater habitats in Sri Lanka. Nevertheless knowledge about the biology of exotic species in the natural waters, especially food and feeding habits is important because, such knowledge is useful to investigate the impact of introduced species on indigenous fish biodiversity. It is also thought that the studies on food

and feeding habits of an introduced species in the new habitats provide useful information on aquatic ecology. As such, the food and feeding habits of *H. temminckii* were investigated in Iriyawetiya marsh of the wet zone of Sri Lanka.

Materials and methods

Eighty-seven specimens of *H. temminckii* were collected from the Iriyawetiya marsh (Fig. 1) using a cast net during the period January – March 1997. Immediately after capture, 5% buffered formalin was injected to the body cavity through anus of each fish. Fish were taken to the laboratory for further analysis. In the laboratory, total length (TL) and body weight (W) of each fish were measured to the nearest 0.1 cm and 0.01 g respectively. The relationship between TL and W was determined by simple linear regression for log-transformed data. Each fish was dissected, the intestine was uncoiled carefully and the relative gut length (RGL = intestine length / TL) of each fish was determined. The stomach of each fish was dissected and the stomach contents were weighed to the nearest 0.1 mg to determine the gastro-somatic index [GASI = (Weight of stomach contents/W) x 100]. The relationship between GASI and TL was determined by regression analysis. Stomach contents of individual fish were diluted in a measuring cylinder and were mixed well. Three sub-samples of 1 ml volume were examined under a light microscope in a Sedgewick-Rafter cell. The food items were identified to the genus level using the keys given by Needham & Needham (1972), Abeywickrama (1979) and Abeywickrama *et al.* (1986). The quantitative analysis of stomach contents was performed by 'Points method' as described by Hynes (1950), by estimating relative biovolumes of food items in stomach. Relative importance of each food item was determined as percentages.

To study the size-dependent diet composition of *H. temminckii*, fish were grouped into 1 cm classes and stomach contents expressed as numbers (based on relative biovolume) per litre were quantified separately for each size class. The size categories of fish were clustered on the basis of relative biovolume of each food item per litre using Bray-Curtis similarity (Bray & Curtis 1957). Data were standardized using double square root in order to reduce the effect of most abundant food items on the results of the analysis. Bray-Curtis similarity analysis was performed using the 'PRIMER (Version 5.2)' software package (Clark & Gorley 2001).

Results

The size range of 89 specimens of *H. temminckii* investigated in the present study was 5.8 – 19.3 cm TL and 4 - 180.2 g body weight. Length-weight relationship was $W = 0.0168\ TL^{3.1102}$ (Fig. 2). The exponent of this relationship is not significantly different from the cube value ($t_{obs} = 0.0166$, $p > 0.05$) indicating that *H. temminckii* in Iriyawetiya marsh has an isometric growth.

In the stomach contents of *H. temminckii*, 14 genera of diatoms, 12 genera of green algae, 3 genera of blue green algae were present together with unidentified plant particles and detritus. Relative importance of the food items in the stomach contents in 10 different size classes is shown in Table 1.

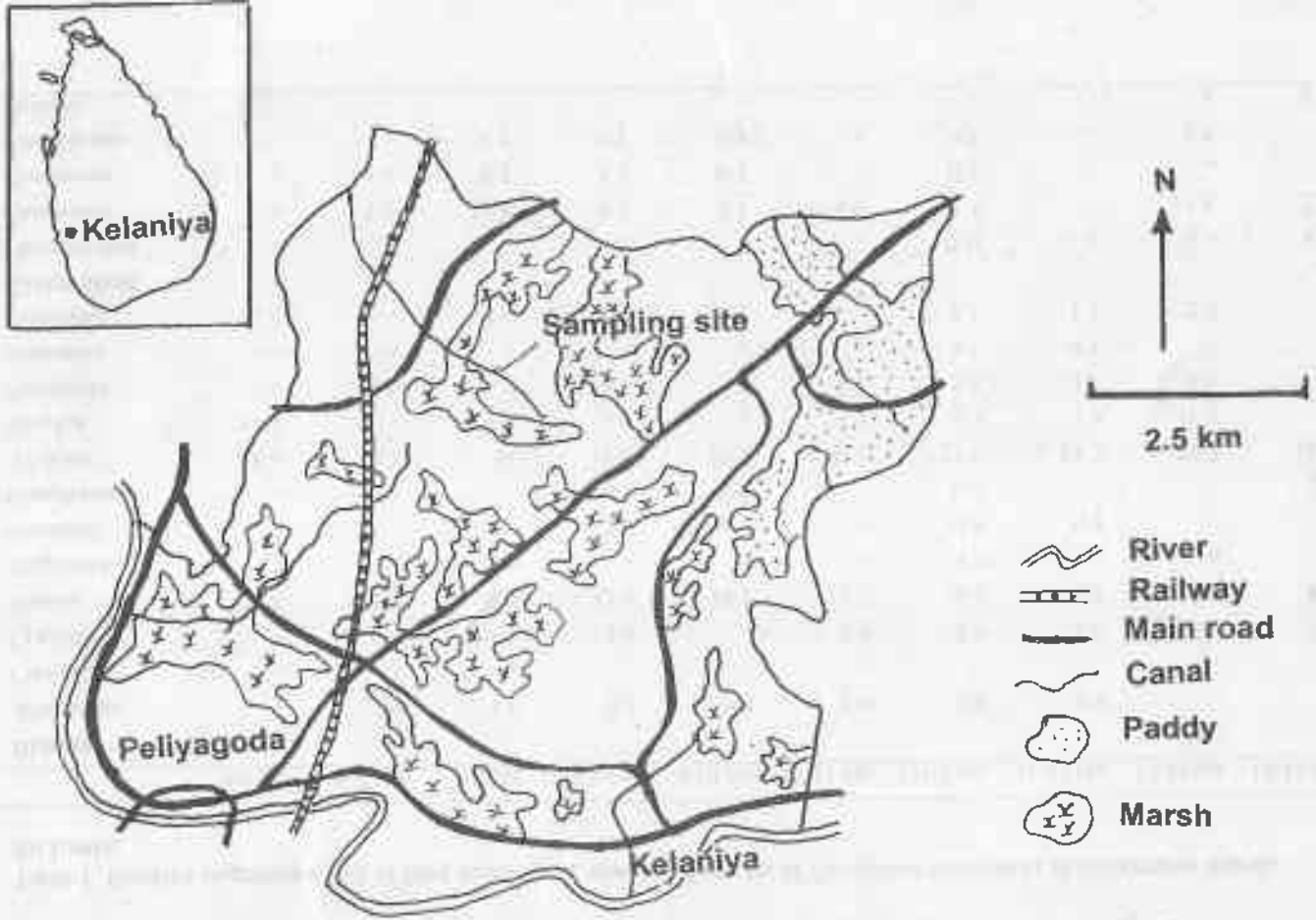

Fig. 1. Map of Kelaniya divisional secretariat showing study area. Inset shows location of the study area in Sri Lanka

Table 1. Relative importance (%) of food items in the stomach contents of *Helostoma temminckii* in Iriyawetiya marsh, Sri Lanka.

	5-6 cm	6-7 cm	7-8 cm	8-9 cm	9-10 cm	10-11 cm	11-12 cm	12-13 cm	13-14 cm	14-15 cm
Diatoms										
Achnanthes	-	7.9	1.1	3.2	0.8	2.0	2.4	0.9	-	-
Cyclotella	-	-	-	-	-	-	-	-	-	-
Cymbella	-	-	1.1	1.0	-	5.9	3.7	1.6	3.4	5.6
Eunotia	28.6	21.4	8.9	15.9	18.1	12.7	6.2	9.2	14.5	8.3
Fragilaria	-	-	1.1	-	-	-	0.7	-	0.6	-
Frustulia	-	-	-	2.0	0.5	-	0.8	0.2	-	-
Gomphonema	-	-	-	0.7	0.5	-	0.5	-	-	2.8
Navicula	28.6	54.3	40	31.8	25.7	40.2	27.0	23.7	22.7	13.3
Nitzchia	14.3	-	4.4	6.8	1.6	3.9	2.3	1.5	11.5	-
Pinnularia	-	2.1	-	2.9	5.3	3.9	2.3	4.2	2.9	-
Staurosura	-	-	-	-	-	-	0.5	0.5	-	-
Tabellaria	14.3	-	4.4	2.0	5.4	-	2.1	1.5	2.3	-
Green algae										
Closterium	-	-	-	0.2	-	-	2.9	1.7	4.4	9.4
Clasterium	-	7.9	14.4	8.3	3.3	4.9	2.3	-	1.6	2.8
Cosmarium	-	1.4	2.2	3.2	0.5	-	0.7	-	-	-
Gonatozygon	-	-	1.1	0.2	0.5	-	0.5	-	2.3	-
Melosira	-	-	-	-	-	-	-	-	1.1	6.7

Table 1 Relative importance (%) of food items in the stomach contents of *Helostoma temminckii* in Iriyaweriya marsh Sri Lanka(Continued)

	5-6 cm	6-7 cm	7-8 cm	8-9 cm	9-10 cm	10-11 cm	11-12 cm	12-13 cm	13-14 cm	14-15 cm
Opuntiastrum	-	-	4.4	-	-	-	0.2	0.9	1.7	5.6
Pediastrum	-	-	-	-	2.3	-	0.1	0.2	-	-
Pleurotaenium	14.3	2.1	2.2	-	-	-		-	-	-
Protococcus	-	-	1.1	-	-	-	-	-	-	-
Scenedesmus	-	-	-	-	17.4	-		1.2	-	-
Spirotaenia	-	1.4	1.1	-	2.5	2.0	0.1	1.5	2.3	-
Spondylosium	-	-	-	-	-	-		-	0.6	-
Staurastrum	-	0.7	-	-	1.6	-	0.1	0.5	0.5	-
Tetraedron	-	-	-	0.5	-	-	0.5	2.1	3.1	6.7
Blue green algae										
Anabaena	-	-	-	0.7	-	-		3.7	-	-
Oscillatoria	-	-	11.1	-	6.0	-	5.9	1.2	6.9	22.2
Spirulina	-	0.7	1.1	0.7	-	-	0.6	-	1.1	-
Detritus & plant matter	-	-	-	19.8	8.3	24.5	36.5	43.8	26.9	16.7

The relationship between RGL and TL of *H. temmincki* represents a second order polynomial curve (Fig. 3A), which perhaps indicates that the digestive tract of this species is morphologically adapted for ontogenetic variations in feeding. The logarithmic relationship between the GASI and TL in *H. temmincki*

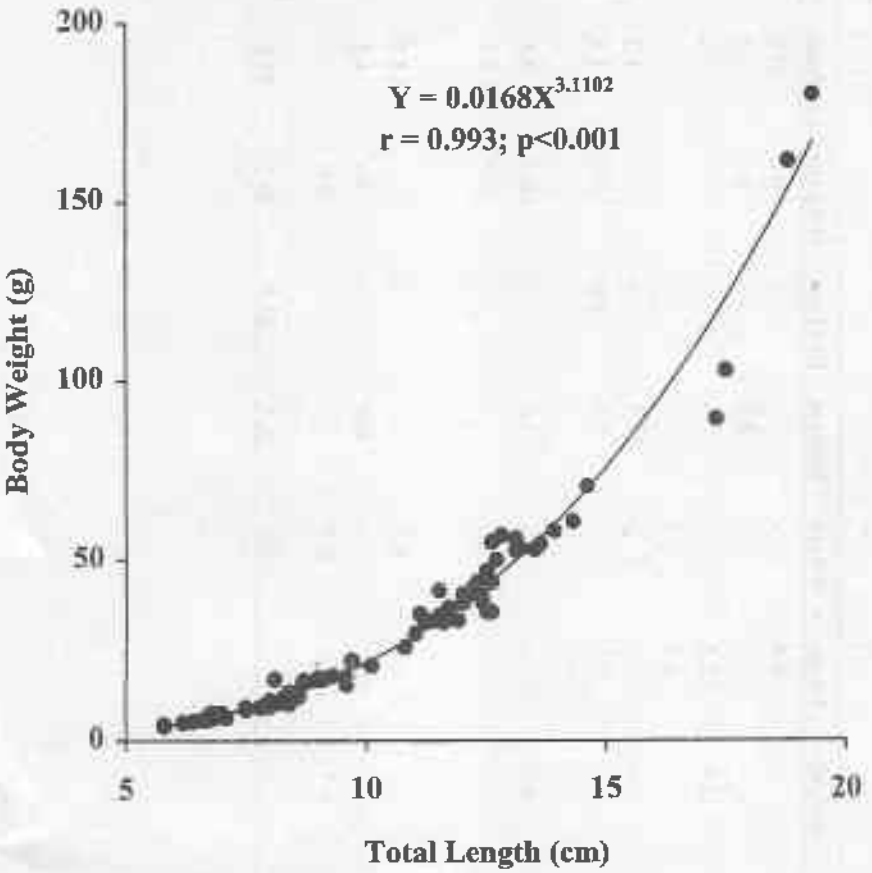

Figure 2. Length-weight relationship of *H. temmincki* in Iriyawetiya marsh, Sri Lanka.

(Fig 3B) indicates its higher feeding efficiency in smaller size classes than in larger size classes.

There appears to be an appreciable difference in food types present in the fish of different sizes (Table 1). According to Bray-Curtis similarity analysis (Fig 4), four distinct clusters could be identified in the food habits among the 10 size classes of fish studied.

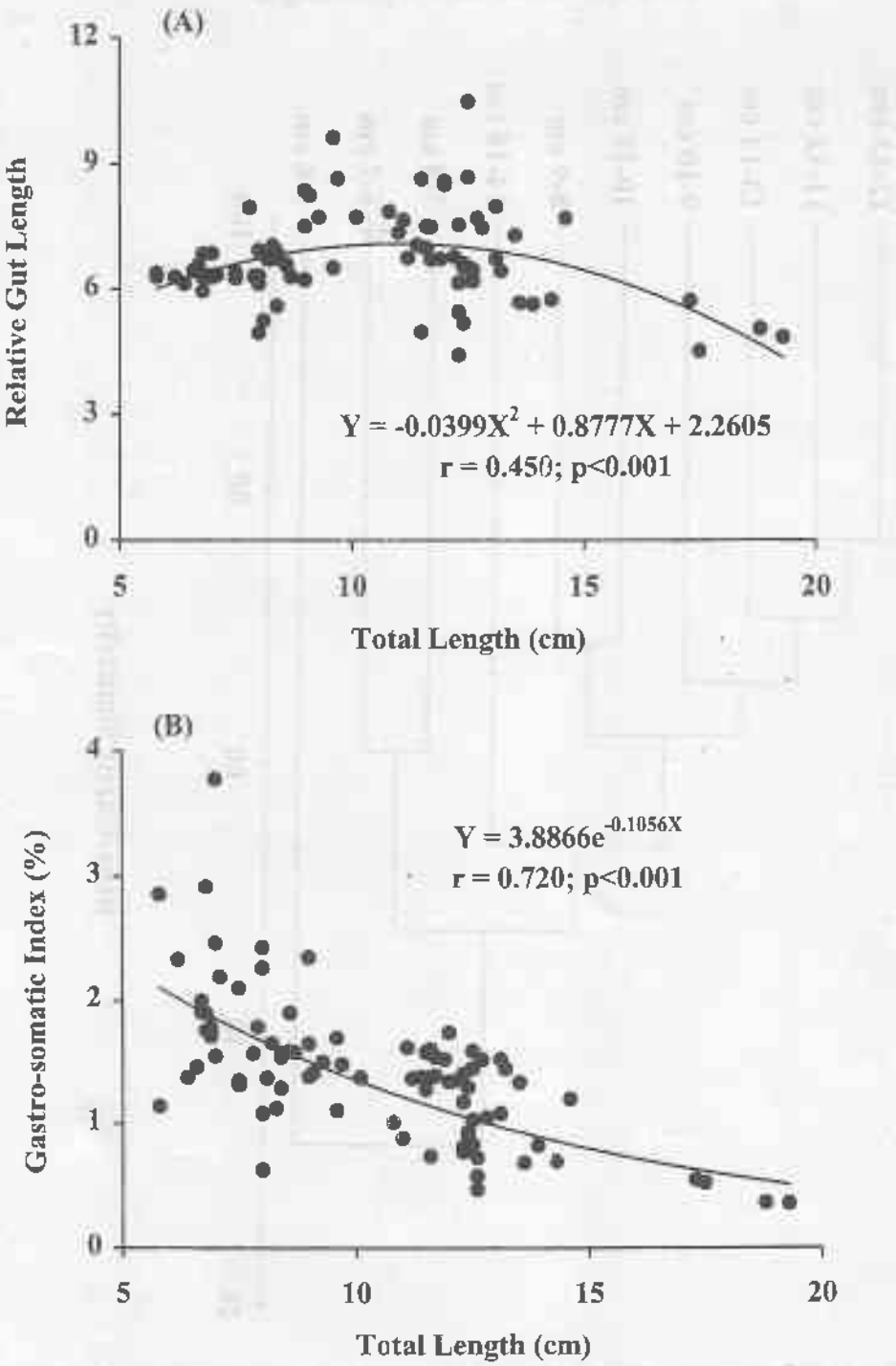

Fig 3 (A) The relationship between Relative Gut Length and Total Length of *H. temminckı*. (B) The relationship between the Gastro-somatic Index and Total length in *H. temminckı*

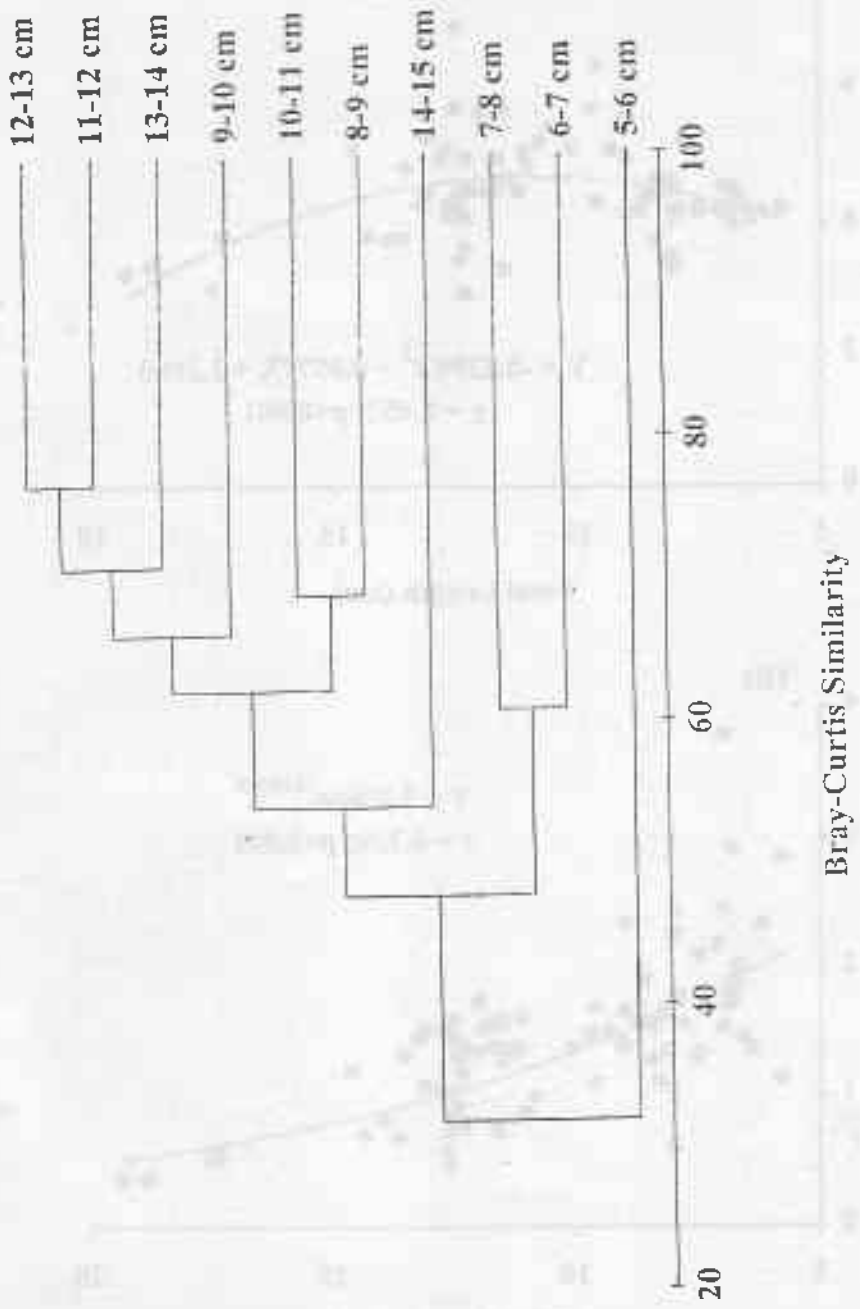

Fig. 4. Bray-Curtis similarity of feeding habits of different size classes of *H. temminckii* in Iriyaweliya marsh.

Discussion

Being a continental island, diversity of freshwater fish is depauperate in Sri Lanka (De Silva 1987). Introduction of exotic species may therefore have a significant impact on trophic dynamics of freshwater ecosystems. On the other hand, inter-specific competition of alien species with indigenous fish species, especially for food resources may also occur, which may be detrimental to indigenous fish biodiversity. As no information is hitherto available on the biological aspects of introduced *H. temmincki* in Sri Lanka, the present study appears to be a useful contribution to the knowledge about food and feeding habits of this species in the country. Such knowledge is of particular importance because there is an emphasis on the compilation of global information on fish and fisheries biology in the form of an easily accessible database called FISHBASE (Froese & Pauly 1998). Although length-weight relationship determined in the present study is not directly relevant to the aspects on food and feeding except for its importance as a measure of isometric growth, this estimate is useful for information accummulaion processes in the fisheries science (Pauly 1993).

Food habits of *H. temmincki* in Iriyawetiya marsh indicate that this species mainly feeds on diatoms and detritus. As these food items are available in abundance in freshwater habitats of Sri Lanka it is unlikely that this introduced fish species would pose any threat to indigenous freshwater fish biodiversity, at least through inter-specific competition for food resources. Present analysis also indicates that detritus is of little importance in the food of small individuals of *H. temmincki* whereas in larger individuals, detritus and blue-green algae play a major role as food items. As shown by Bray-Curtis similarity, food habits of this fish species are slightly different among size classes, which indicate that the intraspecific competition for food is relaxed to a certain extent. As such it is possible that this species is able to perform well in natural freshwater habitats in Sri Lanka where their preferred food items are available.

However, the present study is based on the specimens of the size range 5.8 – 19.3 cm TL. Therefore the food habits of juveniles (<5.8 cm TL) are still unknown in Sri Lankan habitats. As such further studies are needed to reach a conclusion regarding the impact of *H. temmincki* on indigenous freshwater fish species in the form of interspecific competition for food.

It has been well established that relative gut length (RGL) is a good index of digestive demand in fish (De Silva *et al.* 1980; Zihler 1982; Vergina 1991). The second order polynomial relationship between RGL and TL may be due to ontogenetic variations in feeding habits in *H. temmincki* in Iriyawetiya marsh. As shown by Gastrosomatic Index (GASI), feeding efficiency of smaller individuals of *H. temmincki* appears to be higher than that of larger individuals. Isometric growth of this species in Iriyawetiya marsh may also be an indication of relative well-being of fish population (Bolger & Connolly 1989).

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References

Abeywickrama B.A. 1979
The Genera of the Freshwater Algae of Sri Lanka. Part I. National Science Council of Sri Lanka. Colombo. 103 pp.

Abeywickrama B.A., L. Abeywickrama, P. Arulgnanam and M.A.B. Jansen 1986
The Genera of the Freshwater Algae of Sri Lanka. Part II. National Science Council of Sri Lanka. Colombo. 103 pp.

Anon. 1951.
Administrative report of the Acting Director of Fisheries. Ministry of Fisheries. Colombo.

Bolger T. & P.L. Connolly 1989
The selection of suitable indices for the measurement and analysis of fish condition. Journal of Fish Biology. 34: 171-182.

Bray J.R. & J.T. Curtis 1957
An ordination of the upland forest communities of Southern Wisconsin. Ecological Monograph 27: 325-349.

Clark K.R. & R.N. Gorley 2001.
PRIMER v5: User Manual/Tutorial. PRIMER-E Ltd., Plymouth. 91 p.

De Silva S.S. 1987.
Impact of exotics on the inland fishery resources of Sri Lanka. Archiv für Hydrobiologie 28: 273-293.

De Silva S.S., P.R.T. Cumaranatunga & C.D. De Silva 1980
Food, feeding ecology and morphological features associated with feeding of four co-occurring cyprinids (Pisces, Cyprinidae). Netherlands Journal of Zoology. 30: 54-73.

Froese R. & D. Pauly 1998.
FishBase 98: Concepts, design and data sources. ICLARM, Manila.

Hynes H.B.N. 1950.
The food of freshwater sticklebacks (*Gasterosteus aculeatus* and *Pygosteus pungitius*) with a review of methods used in studies of the food of fishes. Journal of Animal Ecology 19. 36-58.

Munro I.S.R. 1955.
The Marine and Freshwater Fishes of Ceylon. Department of External Affairs, Canberra. 351 p.

Needham C. & F. Needham 1972.
A Guide to the Study of Freshwater Biology. Fifth Edition. Holdden-Day Inc., San Francisco. 108 p.

Pauly D. 1993. Editorial. Fishbyte section. NAGA. The ICLARM Quarterly 16(2-3): 26.

Pethiyagoda R. 1991.
Freshwater Fishes of Sri Lanka. Wildlife Heritage Trust. Colombo. 362 p.

Vergina I.A. 1991.
Basic adaptations of the digestive system in bony fishes as a function of diet. Journal of Ichthyology 31. 8-20.

Zihler F. 1982.
Gross morphology and configuration of the digestive tracts of Cichlidae (Teleoistei, Perciformes): Phylogenetic and functional significance. Netherlands Journal of Zoology 32. 544-571.