

Food and feeding of *Ehirava fluviatilis* (Osteichthyes, Clupeidae) in Rajanganaya Reservoir, Sri Lanka

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Abstract

Ehirava fluviatilis is of marine origin and has colonized some freshwater reservoirs of Sri Lanka. A small scale fishery of *E. fluviatilis* exists at the outflow LB canal of Rajanganaya reservoir. This study was carried out to investigate food and feeding habits of *E. fluviatilis* collected from this location. Sampling was done fortnightly from the landings. From the length-weight relationship, an allometric growth is evident. The theoretical weight of 50 mm *E. fluviatilis* calculated from length weight relationship was 928 mg, a comparable value to that of the estuarine population in Bolgoda Lake, Sri Lanka but a higher value than that of reservoir population in Parakrama Samudra, Sri Lanka, indicating that the population in Rajanganaya is as healthy as estuarine population. The highest index of relative importance in the stomach contents was recorded for diatoms. In addition, two genera of copepods, two genera of cladocerans, and two genera of rotifer, one genus each of insect larvae and crustaceans other than copepods and cladocerans were also present. Diatoms were also an important food item. As colonization success of *E. fluviatilis* in inland reservoirs seems to be due to the presence of their preferred food, micro-crustaceans, findings of the present analysis will be useful for investigating physiological advantages of being a stenophagous fish species.

Keywords: Clupeidae, micro-crustaceans, stenophagous, tropical reservoirs, zooplanktivorus

Introduction

The members of the family Clupeidae are marine fish species, which have secondarily colonized inland waters (Duncan 1998). Freshwater clupeids support productive fisheries in many parts of the world (Marshall 1995; Duncan 1998). They are known to occupy pelagic zones of lakes and reservoirs where they are present (Duncan 1998). Two clupeid species endemic to Lake Tanganyika (East Africa), *Limnothrissa miodon* and *Stolothrissa tanganicae*, introduced to Lake Kariba, a large reservoir located along the border between Zambia and Zimbabwe did increase the yield from 5.6 kg/ha in 1968-1969 to 31.7-34.2 kg/ha in 1985-1986

(Bell-Cross and Bell-Cross 1971; Marshall and Mubamba 1992). Thai river sprat, *Clupeichthys aesarnensis* supports profitable fisheries in Thai reservoirs [e.g., Ubolratana reservoir; (Sirimongkonthaworn and Fernando 1994) and Sirinthon reservoir (Jutagate et al. 2003).

In Sri Lanka, the Malabar sprat, *Ehirava fluviatilis* (Deraniyagala) has been reported to support a profitable fishery in Bolgoda Lake, an estuary on the west coast of Sri Lanka (Amarasinghe and Sriya 2002). This species is also reported to be found at least in two Sri Lankan reservoirs, namely Parakrama Samudra (Newrkla and Duncan, 1984) and Rajanganaya (Amarasinghe and Sriya 2002). The biological studies reported on *E. fluviatilis* in freshwater habitats are very limited, and the study by Newrkla and Duncan (1984) was based on lift net sampling in the northern basin of Parakrama Samudra during a very short time period from July to August in 1982. Although this preliminary study (Newrkla and Duncan, 1984) suggested that they could be as important in Parakrama Samudra fish community as cichlids according to the level of their biomass production, the importance of *E. fluviatilis* for fisheries production in the reservoir has not been properly recognized.

E. fluviatilis must have colonized the Rajanganaya reservoir from the associated river, Kala Oya before the construction of Neela Bemba. Although there are several major reservoirs in Kala Oya river basin, this species is reported to occur only in Rajanganaya reservoir. Interestingly, when this species is present in a particular reservoir of a given river basin, there is no evidence that it has colonized in adjacent reservoirs of the same river basin. For example in Mahaweli river basin, *E. fluviatilis* has been reported to occur only in Parakrama Samudra (Newrkla and Duncan 1984), but not in other reservoirs such as Giritale, Minneriya and Kantale which also receive water from the same river (De Silva 1988). Also in Kala Oya river basin, its presence is reported only in Rajanganaya reservoir but not in other reservoirs such as Angamuwa, Usgala Siyabangamuwa, Kala Wewa, Balalu Wewa in the same river basin.

According to previous studies (Newrkla and Duncan 1984; Amarasinghe and Sriya 2002), this species shows stenophagous feeding habit so that it can further be hypothesized that restricted distribution of *E. fluviatilis* in Sri Lankan reservoirs may be governed by its feeding habits. This paper therefore focuses on the investigation of food and feeding of *E. fluviatilis* in Rajanganaya reservoir.

Materials and methods

Possibly due to its small body size, presence of *E. fluviatilis* in Rajanganaya reservoir (8°8' N; 80°13' E), Sri Lanka has remained unnoticed for the fishers. A villager has devised a fine mesh surrounding net for catching this fish early 1980s, and as a result, a small-scale fishery was developed for *E. fluviatilis* (pers. comm. with villagers). *E. fluviatilis* is caught by fishers at the outflow canal near the left bank sluice of Rajanganaya reservoir (Figure 1), using fine mesh (1.5 mm) surrounding net of 2 m height and 13 m length. The fishing net is operated by two fishers at about shoulder deep water. Major portion of the landing is sold fresh. A single fishing operation lasts for about 2.5 hours and fishing commences only when

the sluice gate is partially opened. After sluice gate opening, the fishing season lasts for about 3 months.

E. fluviatilis samples were collected from the landings of fishers once in two weeks from January 2010 to December 2010 representing all size classes caught by small mesh (1.5 mm) encircling nets. They were preserved in 5% buffered formalin and were taken to the laboratory for further studies.

In the laboratory, total length (TL) of each specimen in the samples was measured to the nearest 0.1 mm using a vernier caliper. Weight of the fish was determined to the nearest 0.001 g using an electronic balance. Six hundred and forty specimens of *E. fluviatilis*, which ranged from 14.2 mm to 46.5 mm in TL and 11 mg to 732 mg in total weight, were analyzed to determine the length–weight relationship and to study their feeding habits. Length–weight relationship of *E. fluviatilis* was determined using the least square linear regression analysis for the log transformed data.

To investigate feeding habits of fish, whole gut content was examined under a light microscope. Food items were identified to the genus level using keys given by Mendis and Fernando (1962), Ling and Tyler (1986) and Witty (2004). Size ranges and the number of food items present in each genus were counted and recorded. Index of Relative Importance (IRI) which incorporates percentage by number (N), volume (V) and frequency of occurrence (F) (Hyslop 1980) and Relative Gut Length (RGL) (Kramer and Bryant 1995) were calculated using the following equations.

$$\text{IRI} = (\%N + \%V) * \%F \quad (1)$$

$$\text{RGL} = \frac{\text{Gut Length}}{\text{TL}} \quad (2)$$

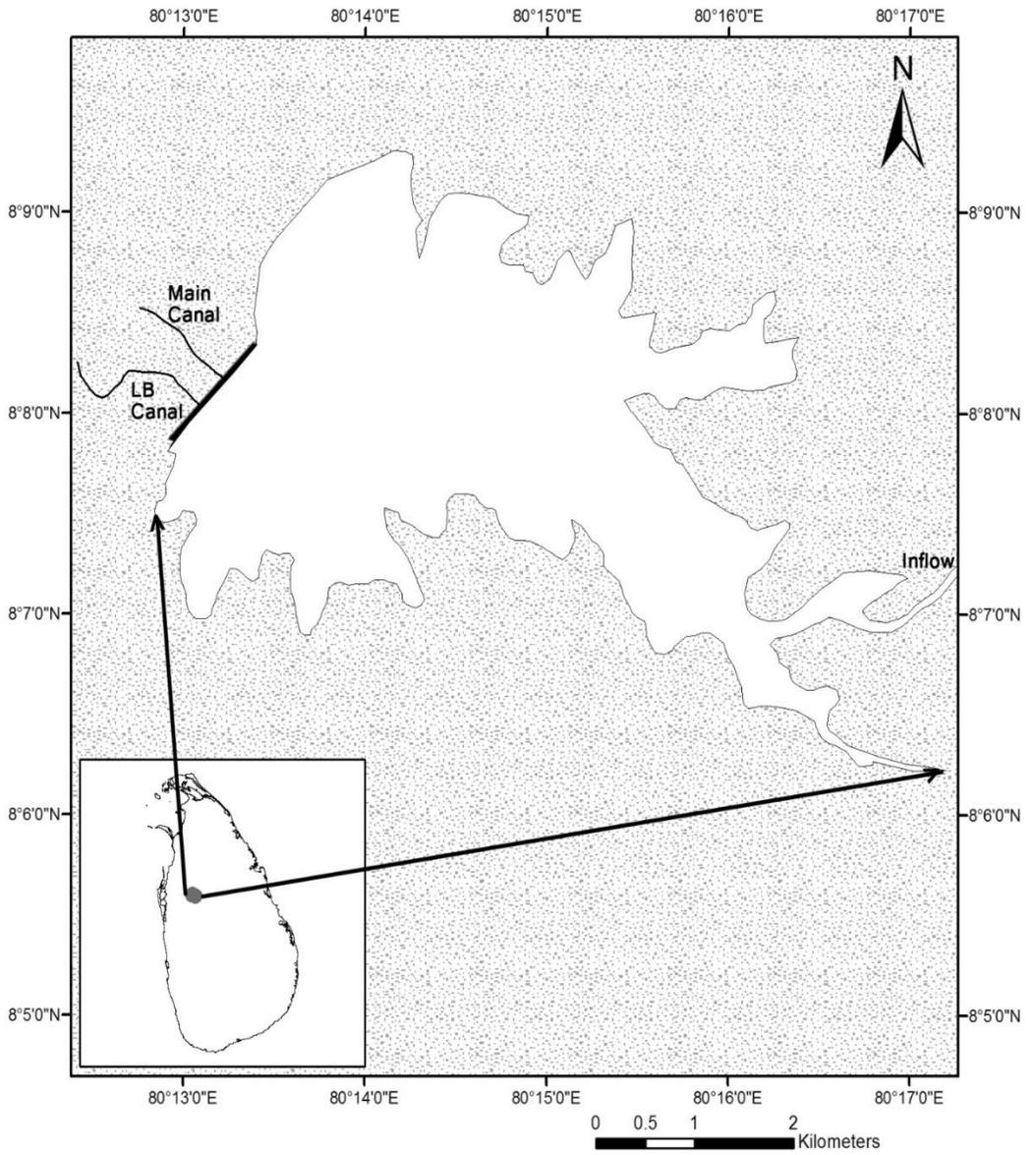


Figure 1. Map of Rajanganaya reservoir and its location in Sri Lanka.

Results

The length-weight relationship of fish as $W = 0.0015 TL^{3.4088}$ ($R^2 = 0.957$; $p < 0.0001$) where W in mg and TL in mm (Figure 2). The slope of the relationship (3.41) was found to be significantly different from cube ($t = 243.10$; $p < 0.05$) indicating a positive allometric growth. The mean body condition factor of the fish was estimated to be $0.0062 \text{ mg mm}^{-3}$ ($SE = 0.038 * 10^{-3}$). The theoretical weight of 50 mm fish (W_{50}) estimated from length-weight relationship was 928 mg.

The RGL of *E. fluviatilis* determined from both gut length and TL in mm, was 0.65. In the stomach contents of *E. fluviatilis*, two genera of copepods, two genera of cladocerans, two genera of rotifers, one genus of diatom, one genus each of insect larva and crustacean other than copepods and cladocerans were present. Diatoms were also an important food item. The temporal variation of dietary composition of *E. fluviatilis* expressed as IRI is shown in Figure 3.

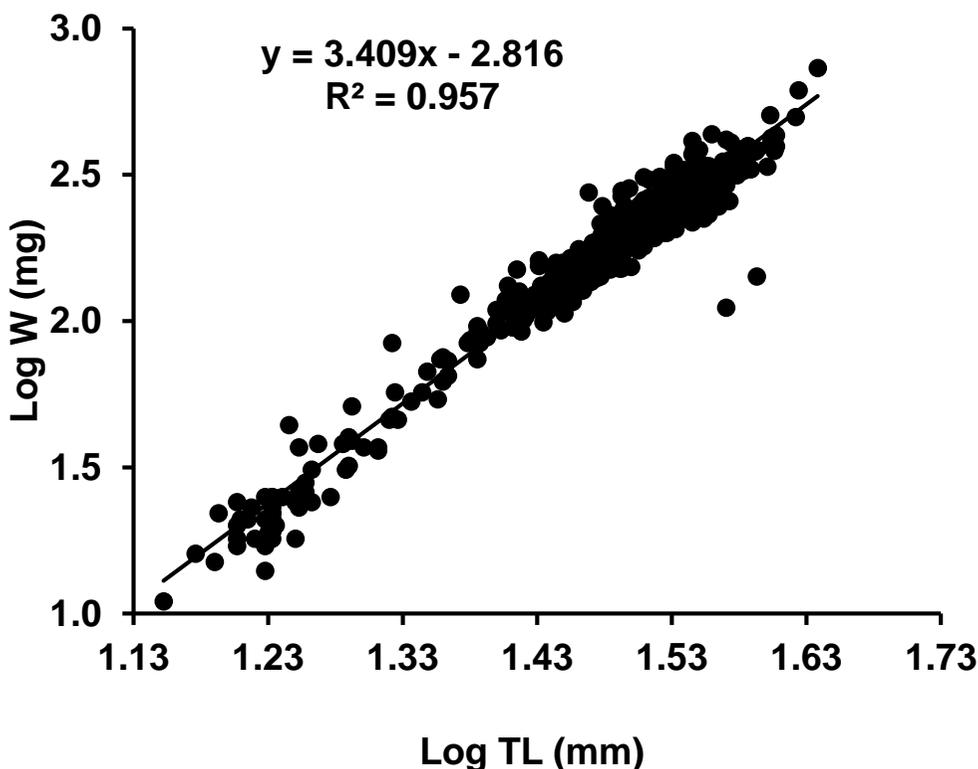


Figure 2. The total length and weight relationship of *E. fluviatilis* in Rajanganaya reservoir.

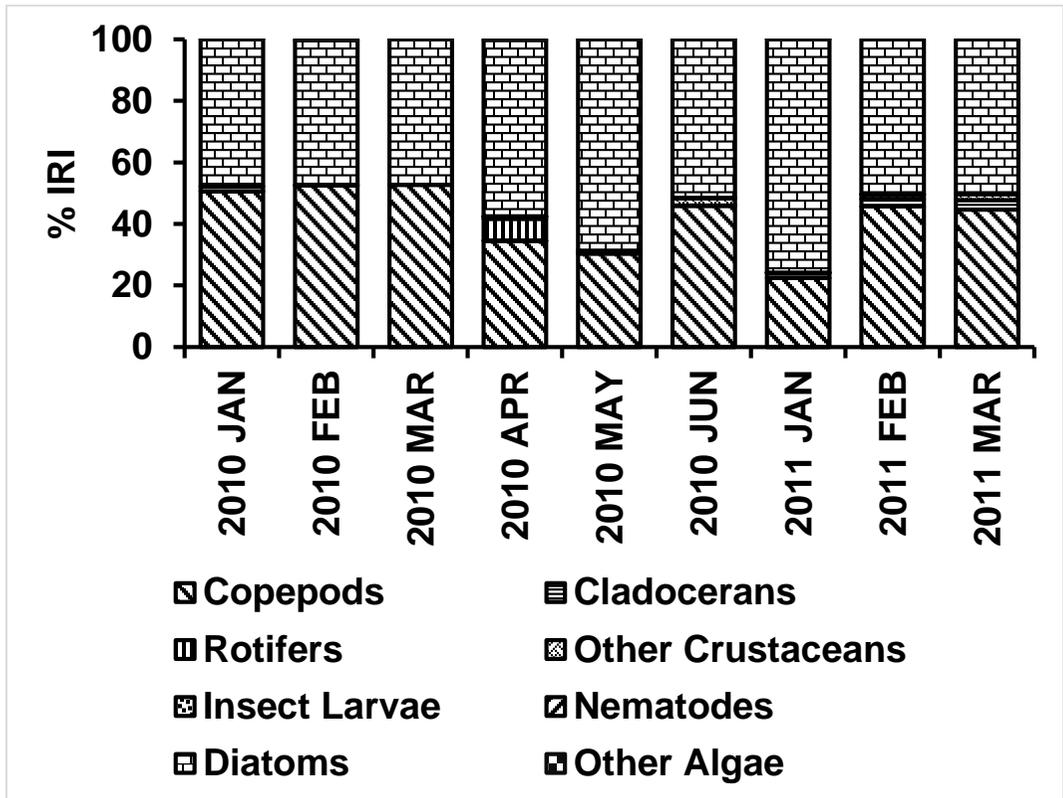


Figure 3. Percentage IRI of food items in *E. fluviatilis* in Rajanganaya reservoir during the study period.

Discussion

In this study, food and feeding habits of *E. fluviatilis* were investigated in order to understand their colonization success in Rajanganaya reservoir. It is evident from many freshwater clupeid populations throughout the world, that freshwater clupeids are stenophagous and mainly feed on zooplankton (Duncan 1998). In marine environments, many fish species, especially clupeids feed on microcrustaceans to assimilate essential fatty acids as they lack enzymes to synthesize essential fatty acids compared to freshwater fish species (Professor S.S. De Silva, pers. comm.). It can therefore be hypothesized that freshwater clupeids of marine origin such as *E. fluviatilis* also rely on their food to assimilate essential fatty acids.

The length (TL) in mm weight (W) in mg relationship of *E. fluviatilis* in Rajanganaya reservoir was $W = 0.0015 TL^{3.4088}$. According to Amarasinghe and Sriya (2002) length-weight relationship of *E. fluviatilis* in Bolgoda Lake was $W = 0.0004 TL^{3.7505}$ (W in mg, TL in mm). The theoretical weight of 50 mm fish (W50) in Rajanganaya reservoir was estimated to be 928 mg. In Bolgoda Lake, it was 942

mg (Amarasinghe and Sriya 2002). Amarasinghe and Sriya (2002) also estimated W_{50} of *E. fluviatilis* in Parakrama Samudra as 540 g based on the length-weight relationship reported by Newrkla and Duncan 1984). In Parakrama Samudra, major food items of *E. fluviatilis* were large rotifers such as *Trichocerca similis* and *Brachionus caudatus*, and microcrustaceans occurred in lesser extent. This indicates that the reservoir population in Rajanganaya is as healthy as the estuarine population, in contrary to the reservoir population in Parakrama Samudra. This can be due to the differences in the dietary composition and the environmental conditions. The estuarine population in Bolgoda lake and reservoir population in Rajanganaya has the ability to divert more food energy to somatic growth compared to the population in Parakrama Samudra.

The estuarine population of *E. fluviatilis* in Bolgoda Lake feeds on microcrustaceans (Amarasinghe and Sriya 2002). All these studies suggest that *E. fluviatilis* generally depends on zooplankton and food items that are of animal origin, however in the present study it was observed that *E. fluviatilis* in Rajanganaya reservoir greatly depend on the diatoms present in the water column other than the micro-crustaceans. Nevertheless when considering the Relative Gut Length (RGL), it was 0.65 for *E. fluviatilis* and it lies within the RGL range for carnivore fishes according to the values given by Kramer and Bryant (1995). Therefore it can be suggested that although *E. fluviatilis* in Rajanganaya reservoir feeds upon diatoms, it can be due to the variation of the abundance of food items present in the environment but when other preferred zooplankton are present they tend to feed upon those food items similarly to diatoms.

The present findings indicate that restricted colonization of *E. fluviatilis* in reservoirs of Sri Lanka with extensive pelagic zones may be due to lack of recruitment of this species from associated rivers and non-availability of preferred food. In Sri Lankan reservoirs, a general paucity of zooplankton is reported (Fernando 1984). It is therefore worthwhile attempting translocation of *E. fluviatilis* into large reservoirs with extensive pelagic zones such as major reservoirs of Mahaweli development project to establish a subsidiary fishery as in Lake Kariba, East Africa where introduced *Limnothrissa miodon* supports a productive fishery (Marshall and Mubamba 1992). Appropriate fishing methods are also needed to be developed to establish a fishery for this species for differential exploitation without harming existing reservoir fishery in reservoirs. It has been reported that in Ubolratana reservoir (Sricharoendham et al. 2008) and in Sirinthorn reservoir (Jutagate et al. 2003) in Thailand a small clupeid species, *Clupeichthys aesarnensis* is caught using lift nets.

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