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Short communication

Size-dependent dietary shifts in *Chitala ornata* (Osteichthyes; Notopteridae), an accidentally introduced exotic species in Sri Lanka

R.R.A. Ramani Shirantha

Inland Aquatic Resources & Aquaculture Division, National Aquatic Resources Research & Development Agency, Crow Island, Colombo 15, Sri Lanka

Corresponding author: rshirantha@yahoo.com

Abstract

Food and feeding biology and some morphological adaptation of an exotic fish species *Chitala ornata* in a riverine habitat in Sri Lanka was studied from March 2003 to July 2004 to investigate its size-dependent dietary shifts. The stomach contents of *C. ornata* were volumetrically analyzed and relative abundance of different food categories of different length groups was quantified. There is a marked dietary shift from predominantly herbivory during juvenile stage to piscivory at adult stage. Indigenous cyprinid species are prey organisms and as such, *C. ornata* possibly poses significant negative impacts on native fish populations as well as other aquatic fauna.

Keywords: freshwater biodiversity; indigenous species; invasive alien species; predation

Introduction

During the early 1990s the alien fish species *Chitala ornata* (Family: Notopteridae), which is native to the Mekong basin in Laos, Thailand, Cambodia and Viet Nam (Froese and Pauly 2015) has been accidentally introduced to few water bodies in the western province of Sri Lanka. It is believed that introduction of this fish species was through a negligence of aquarists and ornamental fish traders (Bambaradeniya 2000). This exotic species is now found in slow flowing riverine habitats, swamps, marshes, rice fields and mud pits within the undulating areas of the Diyawanna Oya and the Bolgoda Lake in the western province of the country (Amarasinghe

et al. 2004). *C. ornata* is considered as an invasive alien fish species in lowland wet zone in Sri Lanka (Bambaradeniya 2000). Although there are several definitions of invasive alien species, many disagreements are found and biogeographic and the impact criteria are frequently used (Valéry et al. 2008). This is particularly so because the invasiveness of an introduced species is said to be not sufficient to predict its impact (Ricciardi and Cohen 2007).

The impacts of *C. ornata* may possibly be through predation, which may lead to ecosystem modification and eventually population decline in native aquatic fauna. However, so far no exclusive study has been reported on possible impacts assessments of *C. ornata* in freshwater bodies in Sri Lanka together with ecological and biological studies, except for the study of its reproductive biology in the western province of Sri Lanka (Kumudinie 2004; Kumudinie and Wijeyaratne 2005). Present study reports the size-dependent dietary shifts of *C. ornata* as a contribution to the existing knowledge about biological aspects of this exotic species.

Materials and Methods

Fish samples were collected from the subsistence fishermen, who regularly fish in the streams draining into the Bolgoda South Lake in Bandaragama area (6° 43’ N, 79° 58’ E; Figure 1) in the western province of Sri Lanka, using cast nets and gillnets of different mesh sizes, and hook and line. These fish samples were preserved by injecting 10% formalin into the body cavity immediately after capture to prevent deterioration of stomach contents and then were packed in ice to take to the laboratory for further investigation.

In the laboratory, each fish was measured (total length and weight) and eviscerated. Some morphological features in the mouth, gill rakes, stomach and intestine were observed. Length of the alimentary canal was measured. The stomach contents were identified to the lowest possible taxa using the keys given in Fernando and Weerawardhana (2001) under a dissecting microscope. Then they were subjected to volumetrically analysis (Helawell and Abel 1971). The importance of food categories was described using pooled data of relatively volume (% volume) of particular food taxa within 5 cm length groups.

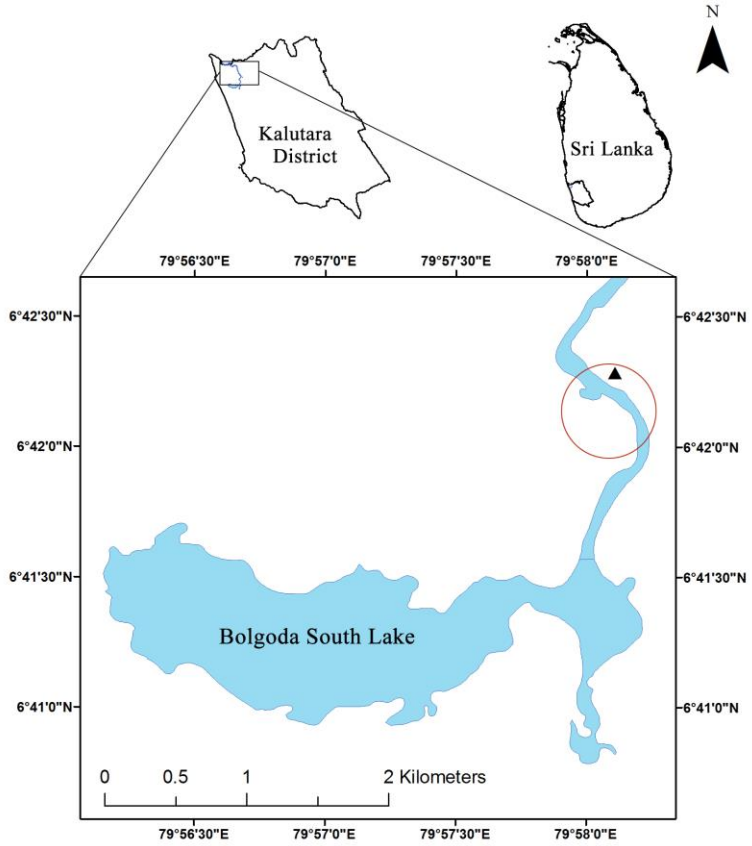

Figure 1 Map of Bolgoda South Lake and surroundings showing location of sampling site (circle). Inset shows geographic location of sampling site in Sri Lanka.

Results

The size range of *C. ornata* individuals studied ranged from 8 cm to 51 cm. There are 14 gill rakers in each gill arch which are hard, pointed and forward-directed projections from the inner margins of the gill arch (Figure 2). Each gill raker comprises of tiny teeth like processes, which provide mechanical support in predaceous habit. The mean ratio of intestine length to total length was 0.083. There is a significant negative logarithmic relationship ($p<0.05$) between relative gut length (=intestine length/body length) and total length (Figure 3). The qualitative make-up of diet composition is shown in Table 1. Length-wise gut contents (Figure 4) indicate that there was a clear size-dependent dietary shift. The most important food items in 30-35 cm length class were aquatic macrophytes (65.5%) followed by insects (22%). Fish of the size range 35-45 cm fed on aquatic insects, shrimp and also on fish. However, *C. ornata* of >45 cm

largely fed on other finfish. *Puntius amphibius*, *Dawkinsia singhala*, *Systomus sarana, P. vittatus, Devario malabarius* and *Rasbora daniconius* were the prey fish. Evidently *C. ornata* shifts from predominantly herbivorous feeding habits to piscivorous feeding habits at the size range of 35-40 cm, However, they remained omnivorous upto the size range of 45-40 cm and those which are above 50 cm in total length are exclusively piscivores.

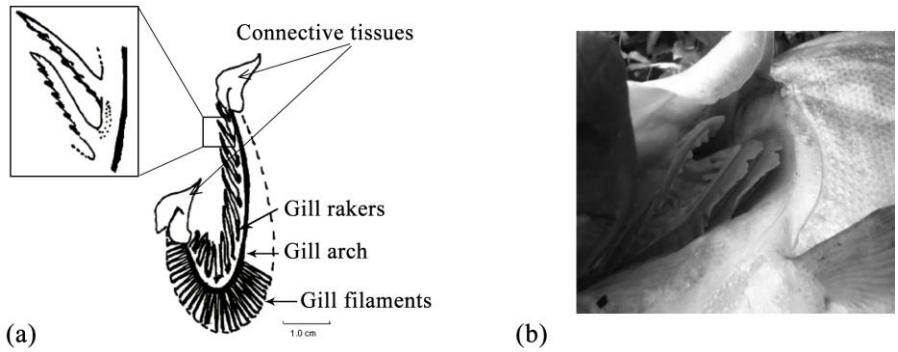

Figure 2. Gill rakers of *C. ornata* (a) Line diagrams; (b) Photograph

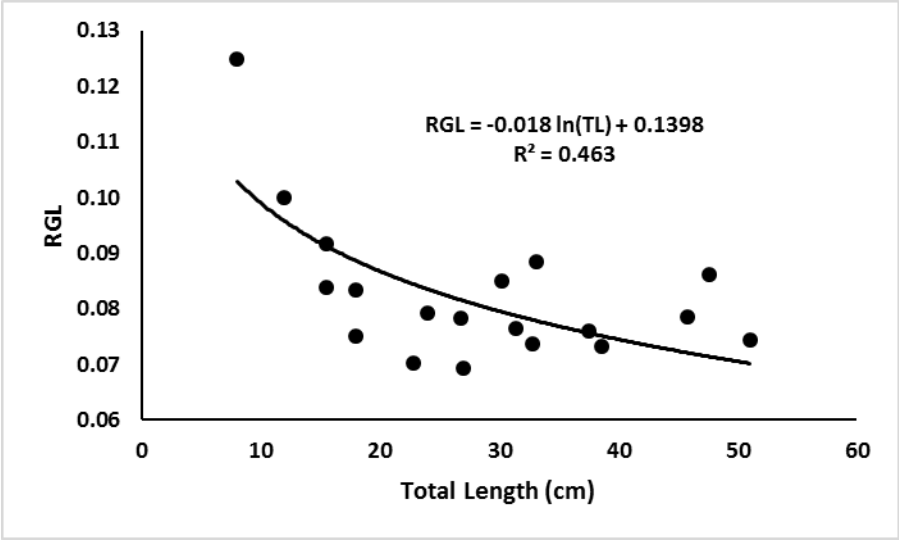

Figure 3. Relationship between relative gut length (RGL) and body length of *C. ornata*.

Table 1. Qualitative make-up of food items found in the stomach contents of different length classes of *Chitala ornata* in Bolgoda Lake.

Food item	Length classes (cm)				
	30-35	35-40	40-45	45-50	50-55
Aquatic macrophytes					
Salvinia molesta	+	+			
Annoa glabra seeds		+	+		
Grasses	+	+	+	+	
Unidentified plant matter	+	+	+	+	
Insects					
Cybister larvae	+	+	+	+	
Water beetle	+	+	+	+	+
Dragonfly nymph	+	+	+	+	
Insect parts	+	+	+	+	+
Shrimps		+	+	+	+
Fish scales		+	+	+	+
Fish					
Dawkinsia singhala		+	+	+	+
Systomus sarana				+	+
Puntius amphibians		+	+	+	+
P. vittatus	+	+	+		
Devario malabaricus		+	+	+	+
Rasbora danconius		+	+	+	+

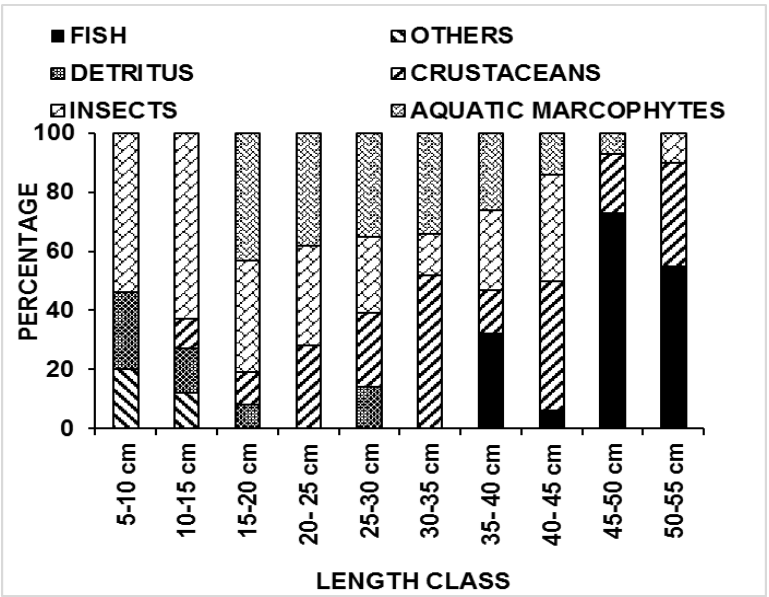

Figure 4. Diet composition of different length classes of C*hitala ornata* in Bolgoda lake.

Discussion

The dietary requirements and feeding behaviour of most of fish greatly undergo changes during their life usually related to ecological changes and their capability of handling different food particles (Lévêque 1997). When ontogenetic shifts occur, fish almost always engage with larger prey (Werner 1986). In the present study, it is evident that the exotic *C. ornata* in Sri Lankan waters switch its feeding habits from predominantly herbivory during juvenile stage to piscivory during adult stage. No studies have been reported on the dietary habits of *C. ornata* even in its natural range in Mekong River basin, except for a few reports with regard to ornamental fish industry (Froese and Pauly 2015). According to Garcìa-Berthou (2002), who has studied ontogenetic dietary shifts of largemouth bass (*Micropterus salmoides*) introduced into a Mediterranean lake, feeding habits were different from the counterparts in its native range in North America.

Reduced relative gut length in relation to size of fish, as evident from the present analysis also indicates that there has been a pre-adaptation of *C. ortana* for shifting to carnivorous feeding habits with age. As this exotic fish species exclusively feeds on indigenous fish species in Sri Lankan waters, its negative impact on the ichthyofaunal biodiversity in Sri Lankan freshwaters is needed to be considered very seriously in the national strategies for biodiversity conservation.

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