Reproductive biology of *Catla catla* in the Udawalawe reservoir, Sri Lanka

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Abstract

The reproductive biology of *Catla catla* (Hamilton–Buchanan) in the Udawalawe reservoir was studied from June 2007 to December 2008. Samples of eggs from Indian major carp *C. catla* were collected from fish landed in the reservoir and analysed in the laboratory to assess the reproductive characteristics. *C. catla, Cirrhinus mrigala*, exotic Cichlids and *Labeo rohita* accounted for 62.2%, 21.0%, 12% and 1.0% respectively of the total landings in the Udawalawe reservoir during the study period. Gonads of *C. catla* were collected in the field and examined in the laboratory to determine the stage of maturity and fecundity. Data on fish length and gonad weight were collected to estimate the gonado-somatic indices (GSI). Landed catches were also examined in the field to determine the sex ratio of *C. catla* in the catch and was found to be 1:5.6 male to female. Results of fecundity estimates revealed that *C. catla* females in the Udawalwe reservoir were fully mature in June and October of the year. From the monthly variation of GSI, two recruitment pulses per year were evident. The length of the body at first maturity in female *C. catla* in the Udawalwe reservoir was estimated to be 74.2 cm.

Keywords: reproductive biology, *Catla*, fecundity, Gonado Somatic Index, Udawalawe

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Introduction

Introduction of exotic fish species is a world-wide enterprise for enhancing fisheries production (Welcomme, 1996; Cowx 1998). In Sri Lanka, since the latter part of the 19th century, at least 21 exotic species have been introduced into the freshwaters with a view to establishing reservoir fisheries (De Silva, 1998; Amarasinghe and Weerakoon, 2009). They include three species of Indian major carps, *Catla* (*Gibelion*) *catla* (Hamilton), *Cirrhinus mrigala* (Bloch) and *Labeo rohita* (Hamilton), introduced in 1982. De Silva (1988) pointed out that there had not been any evidence for the establishment of self-recruiting populations of Indian major carps south of 11° 25′ N latitude. Since their introduction in the early 1980s, therefore, the reservoirs in the country had been regularly re-stocked with hatchery-reared fingerlings of these Indian carps. This practice, however, was discontinued during 1990-1994 period when the government patronage for inland fisheries and aquaculture development ceased following a politically-inspired policy decision (Amarasinghe, 1998). Stocking of inland reservoirs with fingerlings of Chinese and Indian major carps was resumed only in 1998, following a reversal of the policy and after rehabilitation of the state-owned fish hatcheries. Although reservoirs had not been stocked with fingerlings of major carps, juvenile Indian carps have been captured regularly in commercial landings in some reservoirs located in the river basins of southern Sri Lanka. It was reported that during 1995-1997 in the Udawalawe reservoir (6° 27′ N; 80° 50′ E; 3413 ha), three Indian carp species formed about 14.5% of the total landings (Athukorala and Amarasinghe, 2010). This evidence suggests that self-recruiting populations of Indian major carps may have established in the Udawalwe reservoir. In the present study, therefore, the reproductive biology of *C. catla* in the Udawalawe reservoir was investigated to obtain information about the reproductive performance of this species in the reservoir habitat.

Materials and Methods

Fish catches from the Udawalawe reservoir represented by the fish being sold to consumers at the fish stalls close to the reservoir were used for the study. The total length, standard length and total body weight of *Catla catla* were recorded monthly during the period June 2007 to December 2008. The total length of fish was measured to the nearest 0.5 cm and the total weight and gutted weight determined to the nearest 10 g using a spring balance. The sex of the fish was determined by visual observation of external body characteristics and appearance of the gonad. The gonad samples of *C. catla* were collected from individual fish at the fish stalls after fish vendors had eviscerated the fish prior to sale to consumers. The weight of gonads of each fish was measured to the nearest 0.1 g using a field electronic balance. The fish gonads were examined using a maturity key (Table 1) to determine the stage of maturity of each. The gonads of *C. catla* were then collected and preserved in Gilson's fluid and taken to the laboratory for further analysis (Agger *et al.*, 1974). A total of 192 gonad samples were collected and studied in this manner.

Table 1. Maturity scale of *Catla catla*

State	Maturity Level	Description	
		Male	Female
Stage I	Immature	Testis transparent and thread-like.	Ovary strip-like and transparent.
Stage II	Maturing	Testis whitish, translucent, thread-like and about 1/3 of body cavity.	Ovary greyish, translucent and about 1/3 of the body cavity. Ova not visible
Stage III	Maturing	Testis pinkish white, strip-like and about 1/2 of body cavity.	Ovary dull greyish, granular and about 1/2 of the body cavity.
Stage IV	Mature	Testis whitish and band-like	Ovary greyish and about the size of the entire body cavity. Transparent ova visible.
Stage V	Spent	Testis shrunken	Ovary pinkish brown and shrunken to about 1/2 of the body cavity.

For estimating fecundity, only stage III and stage IV ovaries were considered. The gonads preserved in glass containers containing Gilson's fluid were stored in the dark for about 2 weeks prior to analysis. The gonad samples were shaken vigorously from time to time to facilitate separation of preserved eggs from gonad membranes. The weight of eggs was then measured and a sub-sample of eggs was taken on to egg counting chambers. At least 5 sub-samples were taken from each gonad to determine the mean number of eggs per gram.

The absolute fecundity (AF) representing the total number of maturing eggs was determined by raising the mean number of eggs per gram to the total weight of eggs as follows (Agger *et al.*, 1974):

$$AF = N * (GW/SW)$$

where,
N = number of matured eggs in the gonad sample
SW = gonad sample weight in grams
GW = weight of the whole gonad in grams

The relative fecundity (RF), which is the number of eggs per unit of body weight, was calculated according to the formula (Kosior *et al.*, 2001)

$$RF = AF/TW$$

where,
TW = total weight of gutted fish in grams
The Gonado Somatic index (GSI) was determined for individuals using the following equation (Kreiner *et al.*, 2001),

$$GSI = GW / TW * 100$$

where,
GW = gonad weight in grams
TW = total weight of the gutted fish in grams
The mean GSI was determined for each month and the seasonal variation in the monthly mean for GSI was used to determine the reproductive seasonality of fish. Length at first maturity for female *C. catla* was determined from a plot of percentage maturity against total length (i.e., length at 50% maturity). For this purpose, fish in stage II and above were considered as mature fish (Kosior *et al.*, 2001).

Results

Seasonal variations of mean absolute fecundity and mean relative fecundity of *C. catla* female in the Udawalwe reservoir are shown in Fig. 1 and seasonal variations of GSI values of *C. catla* females in the reservoir are presented in Fig. 2. The higher values for GSI appear with two peaks in June and October of each year.

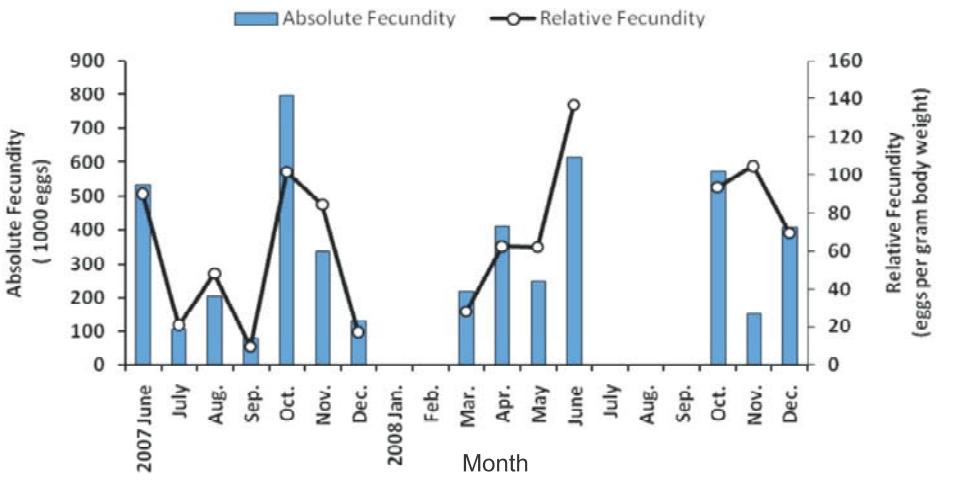

Fig. 1. Monthly variations of mean absolute fecundity and mean relative fecundity for *C. catla* females in the Udawalawe reservoir

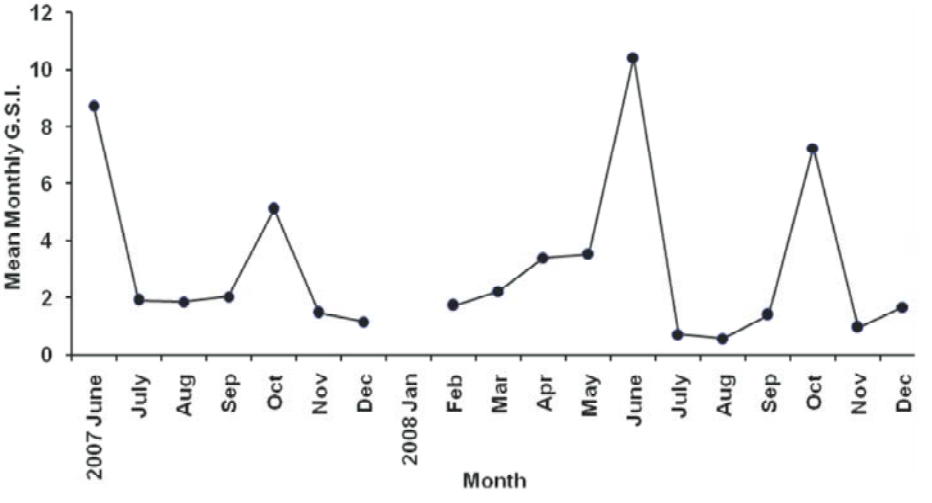

Fig. 2. Seasonal variation in Gonado Somatic Index of *Catla catla* females in the Udawalawe reservoir

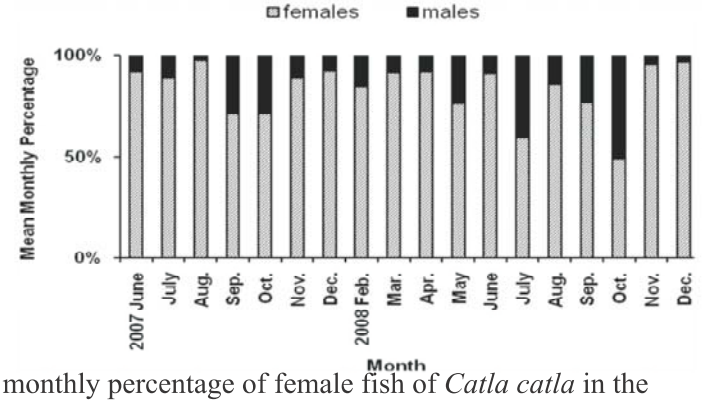

Fig. 3. Mean monthly percentage of female fish of *Catla catla* in the Udawalawe reservoir during the study period.

Of the 626 fishes studied, there were 531 females and 95 males showing that a majority of *C. catla* landed in Udawalawe reservoir during the study period consisted of female fish (Fig. 3). Overall percentage of females in the landings was 84.8 % and the sex ratio of male to female was 1:5.6 during the study period.

In the analysis of length at first sexual maturity for *C. catla* female from the Udawalawe reservoir it was found that half of the *C. catla* females which attained a length of 67.2 cm were mature (Figure 4). The relationship between absolute fecundity (AF) and total weight (TW) for *C. catla* females was found to be:

$$RF = 118.9\ TW - 187.1\ (R^2 = 0.54,\ p < 0.05,\ n = 39).$$

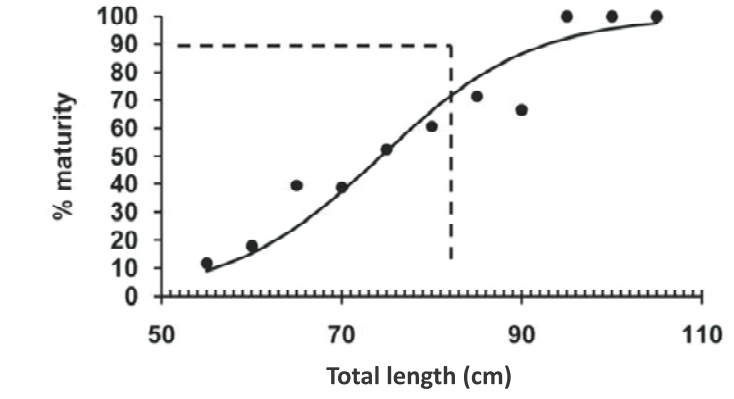

Fig. 4. Percentage of mature females in each length group of *C. catla* in the Udawalawe reservoir

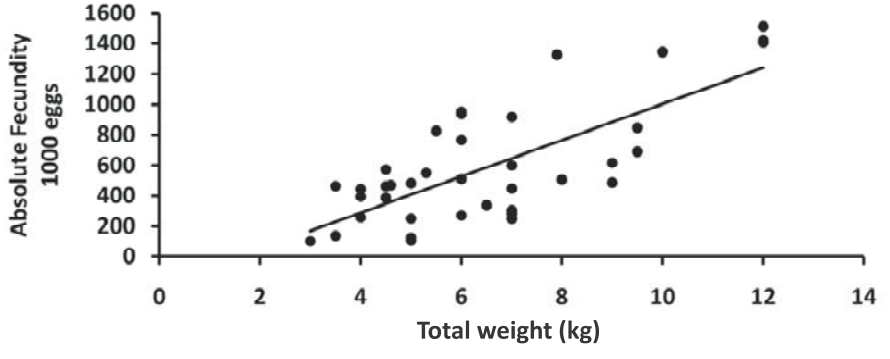

Fig. 5. Relationship between absolute fecundity and total weight of *C. catla* females in the Udawalawe reservoir

Discussion

The Indian carp, *C. catla* was first introduced to Sri Lanka in 1942 and subsequently in 1982 (De Silva 1988). From 1982, three species of Indian major carps, namely, *C. Catla, C. mrigala* and *L. rohitha* were artificially bred in government fish breeding centres and the fingerlings used to stock reservoirs. In spite of the discontinuation of this practice of stocking fingerlings in reservoirs during the period 1990-1994, Indian carp species including *C. catla* continued to be captured in significant proportions from the Udawalawe reservoir. Presently *C. catla* contributes around 62% to the annual catch in this reservoir.

The monthly GSI values obtained in the present study indicate a bi-cyclic breeding habit of *C. catla* in the Udawalawe reservoir with peak periods of breeding occurring in the months of June and October of the year. The dominance of females of *C. catla* in fish catches may be due to the reason that females are more vulnerable to be caught in gill nets due to their larger body size relative to males. As can be seen from Fig. 4, heavier females have larger gonads and as such they may be caught more easily in large mesh gill nets.

Results from this study indicate that a natural gonad maturity cycle of *C. catla* takes place in the Udawalawe reservoir. Further studies are needed to investigate the larval abundance in associated riverine habitats to confirm whether *C. catla* has established self propagating populations in the reservoir. The length at first sexual maturity of female *C. catla,* estimated in the present study to be 67.2 cm, can be useful in managing this fishery.

Acknowledgements

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