Research Journal of Animal Sciences 6 (4-6): 79-84, 2012
ISSN: 1993-5269

Abundance and Condition Factor of African carp: *Labeo parvus* Boulenger, 1902 (Pisces: Cyprinidae) in the Oueme River, Benin

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Abstract: The distribution, relative abundance and condition factor (Kn) of *Labeo parvus* in the Oueme river (Benin) are described from monthly data which were collected between April, 2005 and March, 2006. Fish were captured using gill nets set in the late afternoon and retrieved the following morning. The abundance and distribution of *L. parvus* decrease from Northern to Southern basin. *L. parvus* was observed to be more abundant in two sampling stations: Beterou and atchakpa situated in rocky habitat in the upper river. The lower abundance was observed in the two stations situated in the downriver basin. Maximum catches occurred in June, July and December. The mean condition factor (Kn) of *L. parvus* in the different stations from the Oueme river varies from 0.91 (in Agonlin-Lowe) to 1.14 (in Atchakpa) with a significant difference between the stations. The condition factor shows a definite seasonal cycle and that the fluctuations in respect of the females are sharp, especially during May to August although the trend in both sexes is more or less same. The fluctuations in Kn values in both the sexes can be attributed to spawning cycle as well as feeding intensity.

Key words: Distribution, condition factor *Labeo parvus*, Oueme river, Benin, spawning cycle

INTRODUCTION

In Benin, the inland fisheries exploit various streams and lakes and are aimed mainly for local consumption. The production is limited to 40,000 tons year^{-1}. The Oueme is the largest river basin in Benin, comprising 50,000 km^2 catchment area around the 510 km long river, stretching from the Taneka mountains in the North to the Eastern side of Lake Nokoue. The main targeted species are cichlids, catfishes and cyprinids which can survive in different habitats of river. These species support the thriving of commercial fisheries in many villages. Due to the increase of the demand for fish and fish products, the over-exploitation and the habitat degradation have already been recognized in main fisheries of the Oueme river. Fish yields in the Oueme river are generally declining. There seems to be the dilemma that human use of fishes is opposed to conservation of biodiversity. However, sustainable exploitation of these resources will ensure the future of the artisanal fishing. In this situation, it is necessary to have data on the ecology, biology, habitat preference and level exploitation of the principal exploited fishes in the Oueme river in order to supply the basis for formulating management and conservation strategies for the fisheries.

Labeines fishes are important ichthyofaunal component in the Oueme river and contribute significantly to fish yields. *Labeo parvus*, Boulenger, 1902 is one of three common Labeo in Beninese water and also the more popular fish for food. This medium-sized carp like other African carps, breeds in inundated rivers during the flood period. The spawning habits of this fish have been studied by Montchowui *et al.* (2009, 2011a, b) and its life-history. The characters for identification of the larval and post-larval stages of the species have been described by Montchowui *et al.* (2012a). Some observations on the maturation and the induced breeding of Beninese *L. parvus* have been done by Montchowui *et al.* (2012b). However, there is a paucity of published information on the various aspects of ecology such as the habitats preferences, the distribution, the abundance and the condition factor of this fish in the Oueme river. According to Campbell *et al.* (2002), the conservation of fish species against the increased

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anthropogenic influence requires the knowledge of the species demographic including the abundance, the spatial distribution and the behaviour. The aim of the present study is to examine the distribution, the relative abundance and the condition factor of *L. parvus* in the Oueme river. The study is also aimed to quantifying the relative importance of this species in the local fisheries. These data will provide a basis on formulating management and conservation strategies for the fisheries in Benin.

MATERIALS AND METHODS

Study site and fish sampling: The Oueme is the largest river basin in Benin, comprising 50,000 km^2 catchment area around its 510 km length, stretching from the Taneka mountains in the North to the Eastern side of Lake Nokoue. The peak of discharge occurs in August and September. Due to its geographic location, this river is influenced by two distinct climates. In the North, the climate is characterised by a tropical trend of alternate dry (November to March) and rainy (April to October) seasons with wide-ranging temperatures (10-40°C). Furthermore, the Harmattan, a dry, hot wind which blows from the North to the South from November to April, accentuates the thermal and the hygrometric amplitudes. The rainy season extends from May to September. The Southern part of the basin is influenced by a sub-equatorial climate with two rainy and two dry seasons. The long rainy season from April to July has its highest rainfall in June. The short rainy season starts in September and ends in October. Temperatures range from 18-35°C.

Fish were sampled at four stations along the river (Fig. 1). Station 1, at Beterou (09°11′N, 02°16′E) was in a rocky zone with swift currents. Station 2, at Atchakpa (08°04′N, 02°22′E) was also in a rocky zone. Station 3, at Toue (07°12′N, 02°17′E) was on the Zou tributary fairly near its confluence with the Oueme which marks the transition between the zones of swift-flowing water and the delta. Station 4, at Agonlin-Lowe (06°39′N, 02°28′E) was within the Oueme Delta.

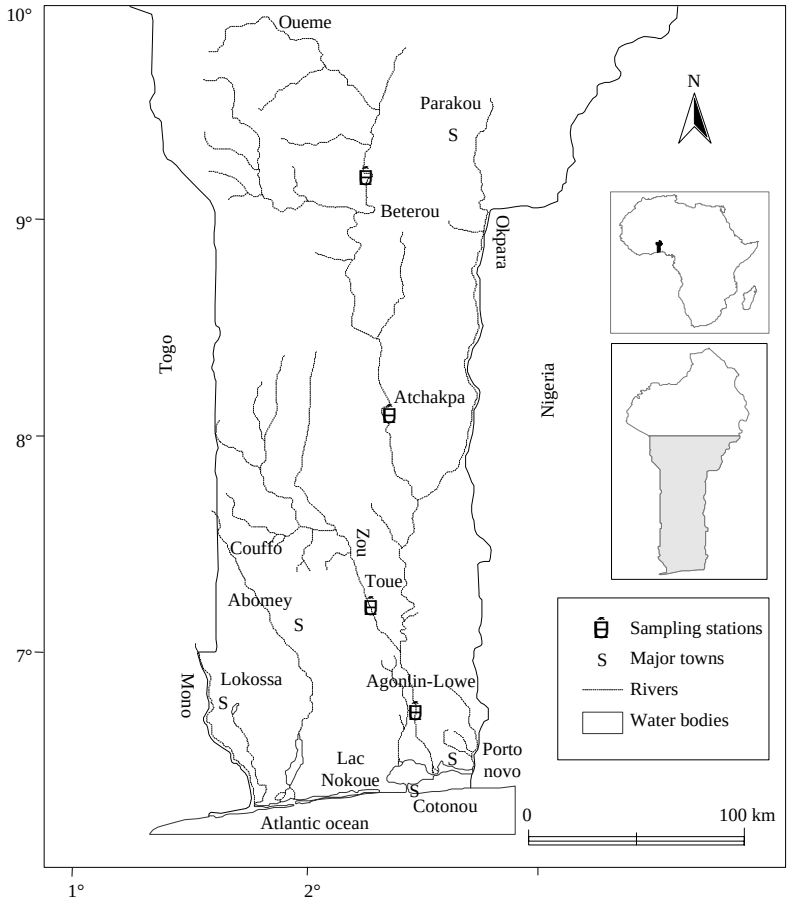

Fig. 1: Map of the Oueme river, Benin showing locations the four sampling stations

Fish were captured monthly between April 2005 and March 2006 using gill nets which were set in the late afternoon and retrieved the following morning. Fish weight was recorded to the nearest 0.01 g using an electronic balance (Kern Company, Germany, 0.01 g sensitivity) and Total Length (TL) and Standard Length (SL) were measured to the nearest centimetre. The specimens were dissected, the gonads were removed and weighed to the nearest 0.01 g and the sex was determined by macroscopic examination of the gonads.

Data treatment and analysis: Fish abundance was presented as number and catch weight. The abundance of *L. parvus* was calculated in each sampling station and presented as histogram. This was determined by calculating the percentage of each station represented in the total catch of *L. parvus*. The condition factor (Kn) was calculated using the equaton:

$$Kn = 100\ WL^{-3}$$

In which:

Kn = The relative condition factor
W = The total weight (g)
L = The Total Length (TL cm)

This parameter was calculated for fish in each station and for the fish sex. Analysis of Variance (ANOVA) one factor was used to test for statistical differences between the means of the condition factor (Kn) in the different stations and between sexes.

RESULTS

Distribution and relative abundance of *L. parvus*: A total of 1088 *L. parvus* were examined from all the four stations during the 12 months sampling period and they represented total weight of 74095.2 g. The percentage of captures in each station is shown in the Table 1. The relative abundance and the distribution of *L. parvus* have decreased from the Northern to the Southern basin (Fig. 2). The number and weight of *L. parvus* in Beterou were significantly higher than in other locations ($p<0.05$). *L. parvus* was observed to be more abundant at two sampling stations: Beterou and Atchakpa. About >50% of the captures have been gotten in the station of Beterou. Seasonal variations in number and biomass are shown in Fig. 3. Maximum catches occurred in June, July and December.

Condition factor: The mean condition factor (Kn) of *L. parvus* in different stations of the Oueme river has varied from 0.91±0.15 (in Agonlin-Lowe) to 1.14±0.14 (in Atchakpa). There is a significant difference between the mean condition factors observed in the stations Beterou, Atchakpa and Toue and Agonlin-Lowe ($p<0.05$) against no significant difference in the condition factor calculated between Beterou, Atchakpa and Toue. The higher values of the condition factor were observed in the two sampling stations Beterou and Atchakpa situated in rocky zone. The low value of the condition factor was registered in Agonlin-Lowe in the Oueme river valley. These results suggest that *L. parvus* has a preference for the rocky environments.

Table 1: Number and weight of *L. parvus* caught at sampling station (April 2005-March 2006)

Sampling stations	No.	Total no. of fish (%)	Total weight (g)	Total weight of fish (%)
Agonlin-Lowe	178	16.4	450.1	0.6
Toue	34	3.1	1901.1	2.6
Atchakpa	389	35.8	33314.9	45.0
Beterou	487	44.8	38429.1	51.9
Total	1088	100.0	74095.2	100.0

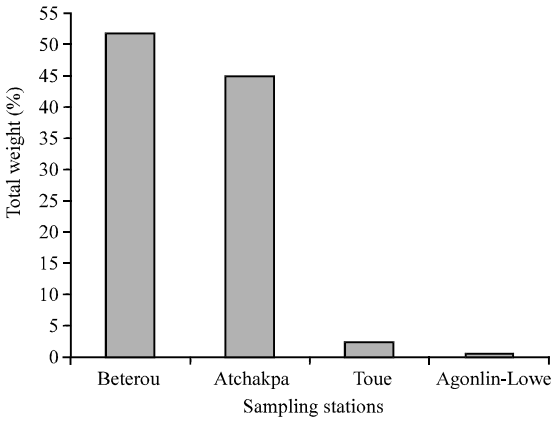

Fig. 2: Abundance of *L. parvus* in sampling stations (April 2005-March 2006)

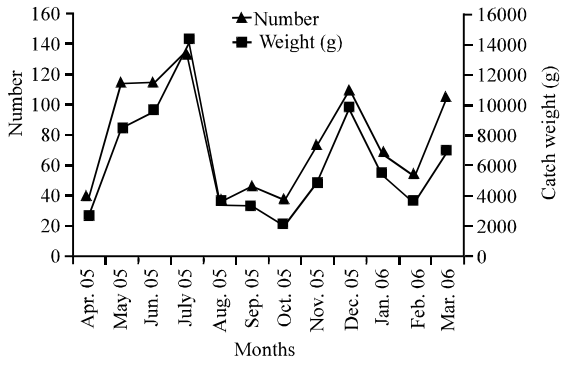

Fig. 3: Change in seasonal abundance of *L. parvus* in Oueme river basin (April 2005-March 2006)

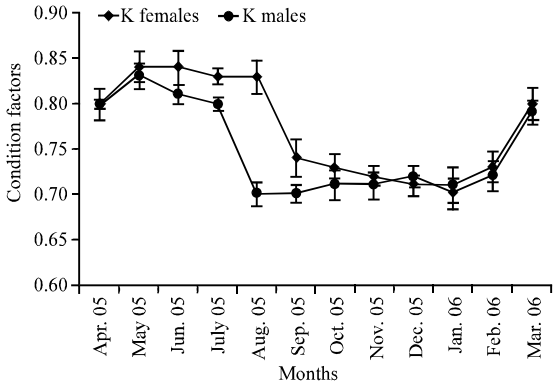

Fig. 4: Monthly variation in the condition factor of *L. parvus* in Oueme river basin (April 2005-March 2006)

The condition factor for males and females was found out separately (Fig. 4). It is seen from the Fig. 4 that the condition factor shows a definite seasonal cycle and that the fluctuations in respect of the females are sharp, especially during May to August although the trend in both sexes is more or less same. The value which is least in December shows a rapid increase from March, readies the peak in May and is maintained at a slightly lower level in June. Thereafter, it shows a gradual fall. There is a significant difference between the mean condition factor in both sexes ($p<0.05$).

DISCUSSION

Labeo parvus was reported to be distributed in all parts of the Oueme river. The present study showed that this species is concentrated in the upper and middle part of the river with different abundance. *L. parvus* was found in the lower part and valley of the river during the flood season. The majority of the specimens captured in the valley of the river during this period were larvae and juveniles stemming from the reproduction of the year. This observation indicates that *L. parvus* uses the Oueme river valley as a reproduction site. Montchowui *et al.* (2011b) reported that *L. parvus* migrates from upper and middle Oueme to the valley river during the flood season for spawning.

The abundance of *L. parvus* decreases from the Northern to the Southern part of the Oueme basin. The peaks of abundance are observed in two stations located in upper Oueme river: Beterou and Atchakpa (Fig. 2). These stations are situated in a rocky zone with rapids and falls which provide substrata particularly favourable for the colonization of *L. parvus*. These observations confirm those which have been reported by Albaret in the alternating riffles and pools of rivers in Ivory coast where *L. parvus* represents often >50% of the ichthyomass. *Labeo parvus* is a rheophilous species and characteristically prefers running water in rocky habitats (Reid, 1985). It is interesting that this species was found in higher numbers in Beterou and Atchakpa, the only two sites which presented those characteristics. In the upper and middle part of Oueme river, *L. parvus* contributes an unquantified but significant proportion to the fishery of the river.

The seasonal variation in the number and weight of the caught *L. parvus* are most likely in relationship with several factors which can be interrelated: fishing activities, changes in the behaviour of the fish, rainy season and recruitment. High catches during March and July corresponds to the beginning of the rainy season when food availability is highest due to the flood-introduced nutrients and the mixing of water body with the rapid currents. Such ecological conditions are favourable for the fish and incite them to leave their hiding place which makes them vulnerable of fishing activities. The increase of the fish abundance which is due to the combination of physico-chemical properties and the presence of food items has already been reported by Fagade and Olaniyan (1974) for the lagos lagoon in Nigeria.

In the case of *L. parvus*, this period of high catches corresponds the moment when the spwaners start the reproduction migration to floodplains (Montchowui *et al.*, 2011b) and they become be more vulnerable of the fishing activities. In July, the abundance of the vulnerable fishes reached its maximum. This situation can justify the level of catches obtained during that month. The fish stock decreaseed in August due to the high intensity of fishing activities. In addition, this diminution of *L. parvus* abundance was noticed when the water is in its highest level.

A new augmentation was noticed between November and January. It can be associated with a decrease in fishing vulnerability due to the increased water body size allowing the species to disperse and hide during spawning. Catch rates started increasing progressively in December when the water level and the surface area decreased. Delaney *et al.* (2007) reported similar seasonal variations in abundance of *Labeo cylindricus* in the lower Mnembo river in Malawi-Mozambique. Decrease in abundance after flooding may be due to the decrease of the river margins suitable for feeding and for spawning (Hakanson and Boulion, 2002).

The augmentation in abundance is highly correlated with recruitment success. The viability of the species may be largely enhanced by the reproductive behaviour and the enhancing survival due to the high reproductive rates.

Concerning the condition factor (Kn), the results show that *L. parvus* in the Oueme river has high values of this parameter in the three stations (Atchakpa, Beterou and Toue). These values were superior to 1. Only Agonlin-Lowes station has registered a Kn value inferior to 1. According to Le Cren (1951), Kn >1 indicates a general good condition of fish. Based on these results, *L. parvus* is in good condition in all part of the river excepted in Agonlin-Lowe. The stations which are situated in rocky environments (Beterou and Atchakpa) appear to offer a better condition for *L. parvus* in Oueme river. The difference of the condition factor in Agonlin-Lowe and the other stations can be attributed to the feeding rhythms, the age and the physiological state of *L. parvus*. According to Kurup (1990), Kalita and Jayabalan (1997) and Pandey and Sharma (1997), the difference in the condition factor of many fishes are in relation to the feeding rhythms, the physico-chemical factors of the environment, the age, the physiological state of the fish and some other unknown factors. In the case of *L. parvus* in Agonlin-Lowe, the feeding rhythms, the age and the physiological state explain the difference within the stations; it is because the majority of *L. parvus* captured in Agonlin-Lowe during the 12 month sampling period were juveniles which size and weight vary respectively 4.1-12.6 cm TL and 0.35-19.3 g.

The sex-wise analysis of Kn values revealed that the mean Kn value in the female (0.96) was higher than that of the male (0.91). It revealed also that the condition factor shows a definite seasonal cycle in both sexes. This can be explained by the *L. parvus* maturity cycle. Earlier studies have observed that the fluctuations in the condition factor are related to the fish maturity cycle (Narejo *et al*., 2002; Laleye *et al*., 2006; Dar *et al*., 2012). This is also found to be true in the case of *L. parvus* as its condition factor is maximum from April to August when the majority of fishes are mature (Montchowui *et al*., 2012b) and the value declines from September onwards when the resorption of the gonad starts (Fig. 4). Thus, it appears that the reproductive cycle of *L. parvus* is related to the variation of the condition factor.

CONCLUSION

The present study showed that *Labeo parvus* is concentrated in the upper and middle part of the Oueme river with different abundance. The abundance and distribution of *L. parvus* decrease from Northern to Southern basin. *L. parvus* was observed to be more abundant in two sampling stations: Beterou and Atchakpa situated in rocky habitat in the upper river. The study revealed also that the condition factor shows a definite seasonal cycle and that the fluctuations in respect of the females are sharp, especially during May to August although the trend in both sexes is more or less same. The fluctuations in Kn values in both the sexes can be attributed to spawning cycle as well as feeding intensity.

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