SOME ASPECTS OF THE BIOLOGY OF BANDED JEWEL FISH, *Hemichromis Fasciatus* (PETERS, 1857) IN RIVER OROGODO, DELTA STATE, NIGERIA

MEYE, J.A.[1]* and **IKOMI, R.B.**[2]
*[1]Department of Fisheries Technology, Delta State Polytechnic, Ozoro
*[2]Department of Animal and Environmental Biology, Delta State University, Abraka

*Corresponding author: *meyeja@yahoo.com*

Abstract

The cichlid, *Hemichromis fasciatus* (Peters, 1857) commonly called banded jewel fish is an ornamental fish which occurs in various freshwater bodies in Africa. Some aspects of the ecology of this fish species was investigated in River Orogodo, Delta State, a first order stream, during the dry and rainy season, between January 2006 and December 2007. Fish samples caught, were preserved in 10% formalin, identified, and the morphometric measurements taken. The food and feeding habits were studied using the frequency of occurrence and point methods. *H. fasciatus* occurred in the entire stretch of the river throughout the year with peak abundance during the rainy season. It was a dominant cichlid (29.78% by number and 20.67% by biomass) in River Orogodo. Its standard length ranged from 3.10 to 14. 60 cm (*mean*=9.70 cm± 0.2) and weighed 6.10 to 81.00 g (mean=37.12 g ± 1.4). The growth pattern was negative allometric (b<3). Condition factor (K) ranged from 2.00 to 3.60 and increased with individual length of fish irrespective of sex. The adult size class (9.00-15.00 cm) had higher condition factor (K) in both sexes. The condition factor showed seasonal fluctuation with peak values in the rainy season months of May to August each year. Food items consumed included chironomid larvae, mosquitoe larvae, ephemeropteran nymph, fish fry and detritus. The species were fed at both day and night. Percentage of empty stomach showed maximum values (>5%) between January and February, November and December each year while feeding intensity was highest (>15%) between August and October. The dominant status of *H. fasciatus* in River Orogodo, which are its good condition and the wide food spectrum available to it could be harnessed for its improved fisheries management and conservation in the area.

Keywords: *Hemichromis fasciatus,* River Orogodo, food and feeding habits, growth.

Accepted: May 10, 2011.

Introduction

The cichlids form an important component of inland fisheries in Nigeria. With the exception of the common carp, *Cyprinus carpio,* members of this fish family are the most widely cultured finfish in the world (Ikomi and Jessa, 2003). Their importance in fish culture is due to their great adaptability, high fecundity and parental care. Members of this family are recognizable by their laterally compressed body covered with cycloid scales, one nostril on each side of the head and two incomplete lateral lines. Other published information available on the cichlids in West Africa, particularly on *Tilapia*, *Sarotherodon,* and *Oreochromis* species includes the works of Fryer and Iles (1972), Fagade (1971, 1978, 1982 and 1983), Babiker and Ibrahim (1979), Ikomi (1998), Ikomi and Jessa (2003) and Meye and Ikomi (2007) among others.

Preliminary field observation shows that *H. fasciatus* commonly called banded jewel fish flourish in River Orogodo in Niger Delta of Nigeria throughout the year. Detailed information on the ecology of this specie in the study-area is sparse. They are mainly piscivores (Ugwumba, 1998; Idodo-Umeh, 2003) and occur mainly at the upper reaches of East, West and Central African rivers (Teugels *et al,* 1992). This study investigates the feeding pattern, food habit and some growth parameters with a view to filling the gaps in existing knowledge of the specie.

Materials and methods

Study-area

River Orogodo (5°10′-6°20′ N and 6°10′-6°6′ E) (Figure 1b) is located in the mid-western Nigeria. It is an

oligotrophic freshwater river with its source at Mbiri, where it is fed principally by ground seepage from aquifer and secondarily by precipitation, municipal and surface run-off from the riparian communities (Ikomi and Owabor, 1997). It flows south-westerly for about 45 km through Agbor and Abavo, both in Ika South Local Government Area, Delta State, Nigeria to Obazagbon-Nugu and Evboesi both in Orhionmwon Local Government Area, Edo State. The river finally empties into a swamp near Abraka in Delta State. The lower course of the river usually dries up during dry season.

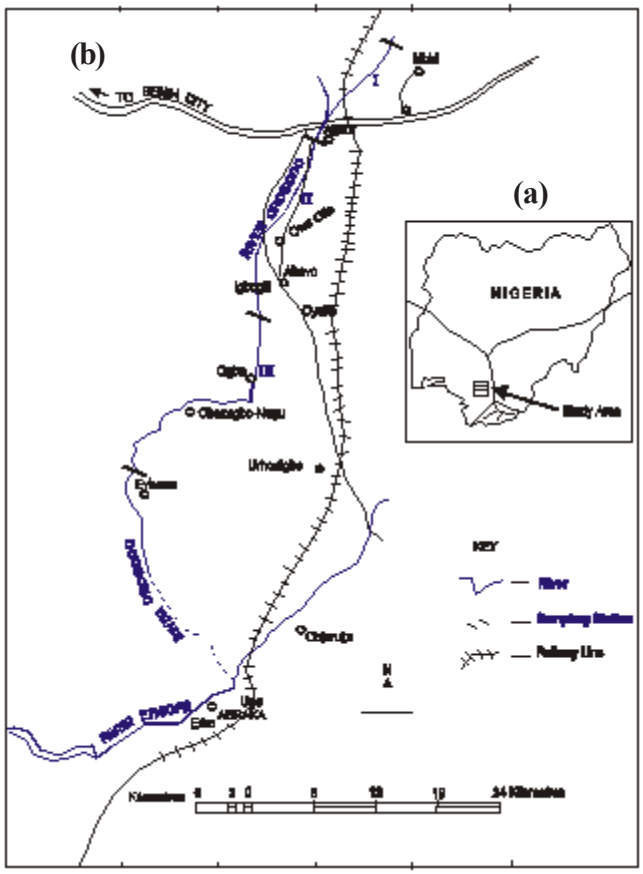


Figure 1a and **1b:** The study-area:
(a) Nigeria showing the location of Agbor.
(b) Study stretch showing the location of the sampling stations.

Source: Directorate of Lands and Surveys, Governor's Office, Asaba (2000).

In the study-area, two climatic seasons prevailed, namely: the wet season (May-October) and the dry season (November-April). Some key physico-chemical variables of the river during the wet and dry seasons are: water temperature (20.10-32.70°C), dissolved oxygen (3.80-9.40 mgl^{-1}), conductivity (18.00-200.30 $mscm^{-1}$), transparency (40.00-124.10 cm) and BOD_5 (1.4-14.40 mgl^{-1}) (Meye, 2010). The study stretch was demarcated into three sampling stations based on human settlement and drainage characteristics of the river, namely; Station I (upstream), Station II (midstream) and Station III (downstream) (Figure 1b).

Station I was located at Mbiri, the source of the river. It covers a distance of about 5 km with an average width and depth of 3.50 m and 1.37 m respectively. Station II, called the midstream of the study-stretch, spans from Agbor Municipal to Owa-Ofie, about 2 km downstream of Station I. Station III was located at Abavo about 11 km downstream of Station II. It is heavily shaded and bordered by marginal vegetations such as bamboo trees *(Banbusa sp)* and raffia palms. Relevant human activities in the river included fishing, abattoir, commercial sand dredging and discharge of domestic effluents.

Fish sampling, identification and examination

Routine sampling of fish from the study-site was conducted on a monthly basis for 24 months, from January 2006 to December 2007. Sampling was conducted both day and night. Five methods of fish capture were regularly used: drag nets (1.50-2.50 cm stretch mesh size) gill nets (0.50-10.20 cm stretch mesh size), the traditional basket traps (25.00 cm in diameter and 80.00 cm deep), hook and line (nos. 1-4) and hand nets. The fish specimens were preserved in 10% formalin solution prior to examination in the laboratory. Each fish was weighed to the nearest 0.10 g and the total length was determined to the nearest 0.10 mm.

Stomachs were removed by dissection and stomach fullness of each fish was assessed on a point scale from 0 to 4. Thus, 0 for empty stomach, 1 point for ¼ full stomach, 2 points for ½ full stomach, 3 points for ¾ full stomach, and 4 points for full stomach (Ugwumba *et al* 1990). The stomach contents were removed and examined under a binocular microscope. Food organisms were identified to the generic level where possible. Analysis of the stomach content was by frequency of occurrence and point method (Hynes, 1950; Hyslop, 1980).

The occurrence of food items was expressed as a percentage of the total number of stomach containing food. In the point method, each non-empty stomach was assigned 20 points which were shared among the variety of food items, taking into consideration their relative proportion by volume. The mean point gained by each food item was determined and expressed as a percentage of the total point gained by all food items in the stomachs examined during the month. Feeding intensity (FI) of the species for each month was computed as described by Fagade (1983):

$$FI = \frac{\text{Mean weight of stomach content}}{\text{Mean weight of fish}} \times 100$$

The length-weight relationship of the fish as described

by Le Cren (1951) was adopted as shown by the equation:

$$W = al^b$$

Where, *W,* is weight in grams, l is standard length in centimeters, and a and b are regression constants. The logarithmic transformed data gave the straight line relationship:

$$\text{Log } W = a + b \log l.$$

The condition factor for each specimen was calculated using the method of Bagenal and Tesch (1978):

$$K = \frac{100W}{L^b}$$

W = weight of the fish in grammes and L = standard length of fish in centimeter and b is the regression coefficient of weight against length.

Results

Abundance

During sampling, 1914 cichlids were captured from the taxa: *H. fasciaatus* (Peters), *Chromidotilapia guentheri* (Sauvage), *Tilapia zillii* (Gervais), *Tilapia mariae* (Boulenger), *Hemichromis bimaculatus* (Gill), *Tilapia dageti* (Thys Van de Audenaede), *Oreochromis aureus* (Steindachner), *Sarotherodon macrocephala* (Blecker) and *Oreochromis niloticus* (Linnaeus) (Table 1). Of these, *H. fasciaatus* accounted for 570 or 29.78% by number and 20.67% by biomass. The seasonal variation in abundance showed a significantly ($p<0.05$) higher catch of this species during the rainy than dry season.

Length-weight relationship

The standard length of *H. fasciatus* ranged between 3.1 and 14.6 cm while the weight ranged from 6.10-81.00 g. The males have standard length and weight ranges of 4.20-14.00 cm and 9.10-81.00 g respectively, while the corresponding figures for the females were 3.10-14.60 cm and 6.10-78.80 g.

The relationship between the log-length and log-weight of the species is described by the following linear regression equations:

$$\text{Male: Log } W = 2.693\text{LogL} + 0.4482$$
$$R^2 = 0.3418, \text{n} = 323$$
$$\text{Female: Log } W = 2.7076\text{LogL} + 0.7945$$
$$R^2 = 0.2898, \text{n} = 220$$

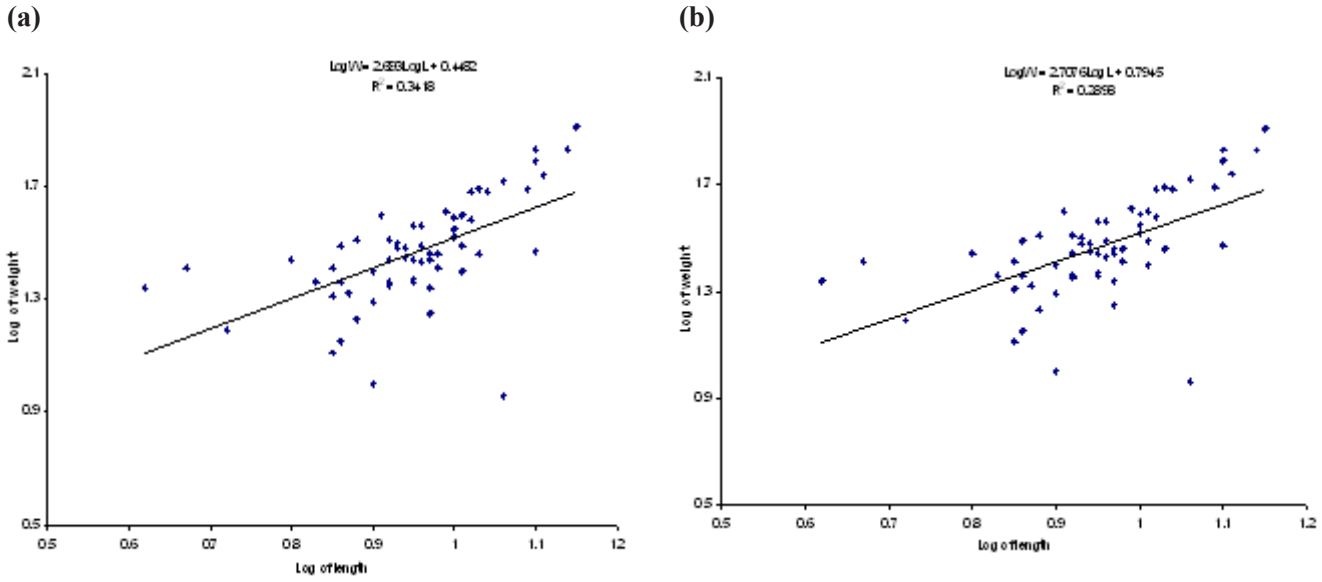
From the regression equations, the length exponent b for both sexes (male, $b = 2.693$; female, $b = 2.7076$) was less than 3, the cubic value showing an allometric growth pattern in both sexes of the species. The *b*-values tested for significance using ANOVA indicated a significant regression for the females ($p<0.05$), while the males were not significant ($p>0.05$). The correlation (r) between increase in length and gain in weight was not significant for both sexes ($p>0.05$). The log plot of the relationship between the length and weight is shown in Figure 2a and 2b.

Condition factor

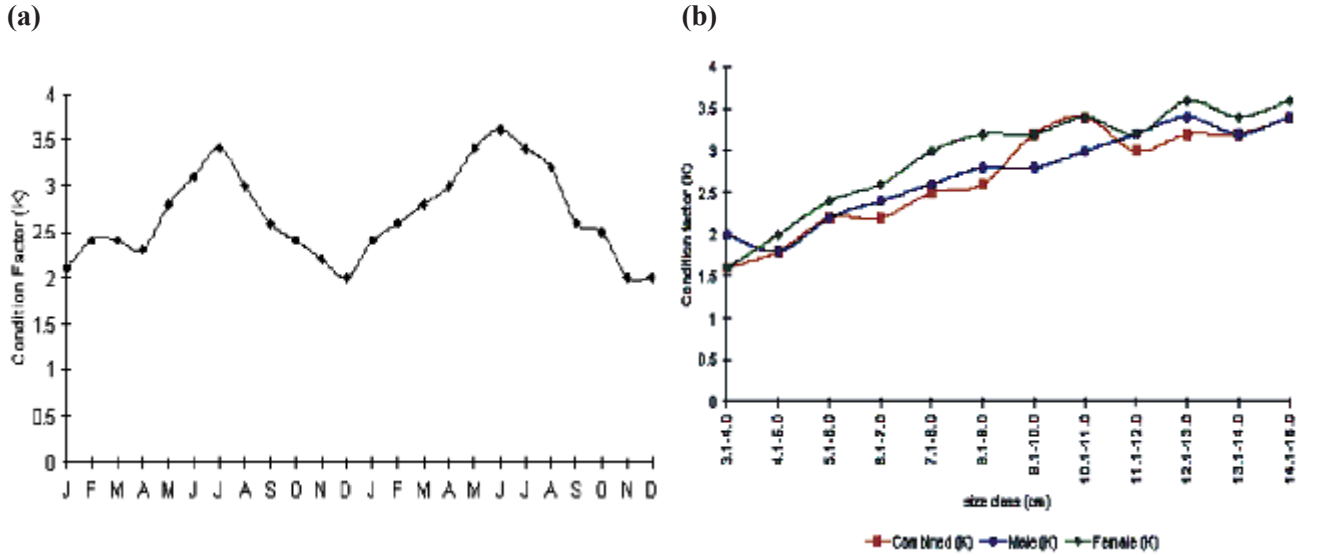
The condition factor for *H. fasciatus* ranged between 2.00 and 3.60. The monthly variation of *k*-values (Figure 3a) showed a distinct seasonal pattern as the rainy season values were higher than the dry season. The *k*-values showed a unimodal phase, in each year. The first year consists of a uniform gradual increase from January with a peak in June and July. This was accompanied by a gradual decrease in *k*-values between September and December. The second year trend commenced in January again with a gradual increase until it peaked between May and July. Finally, there was a sharp drop

Table 1: Species composition of Cichlidae in River Orogodo.

S/N	Species Cichlidae	Number	%	Biomass (g)	%
1	*Hemichromis fasciatus*	570	29.78	18,391.60	20.67
2	*Chromidotilapia guentheri*	509	26.59	20,205.50	22.71
3	*Tilapia mariae*	250	13.06	13,579.40	15.26
4	*Tilapia. zillii*	253	13.22	12,028.40	13.52
5	*Oreochromis aureus*	128	6.69	8,790.50	9.88
6	*Hemichromis bimaculatus*	134	7.00	1,398.90	1.57
7	*Tilapia dageti*	48	2.40	1,2959.30	14.56
8	*Sarotherodon macrocephala*	13	0.68	1,380.90	1.55
9	*Oreochromis niloticus*	11	0.58	253.40	0.28
	Total	**1,914**	**100**	**88,987.9**	**0.28**



Figures 2a and **2b:** Regression of log weight on log length of *Hemichromis fasciaatus,* A = male, B = female in River Orogodo.



Figures 3a and **3b:** Variations in condition factor *K* of *H. fasciatus:* **a:** monthly variations and **b:** variations according to size and sex in River Orogodo, 2006-2007.

to a minimum in December. The variation in *k*-values according to size and sex is shown in Figure 3b. The combined sex showed a progressive increase in *k*-values as the fish size increases. The *k*-values ranged between 1.60 and 3.40. Minimum values were observed in the small sized groups (immature) ranging between 3.00 and 7.00 cm while the peak values occurred in the large sized or adult groups (9.00-15.00 cm). The males and females also showed similar trend of increase in *k*-value with increase of fish size. The *k*-values for the males ranged between 1.80 and 3.40 while that of females ranged between 1.60 and 3.60.

Food of *Hemichromis fasciatus*

The summary of food items in the stomach of *H. fasciatus* is presented in Table 2. Out of a total of 569 stomach samples examined, 492 or 86.47% had food while the remaining 77 or 13.53% were empty. By occurrence method, chironomid larvae, detritus and ephemeropteran nymph were the dominant food items constituting about 95.53%, 85.37% and 84.35% respectively. Fish fry, mosquito larvae and coleoptera occurred in 63.40%, 56.91% and 50.81% of the stomach respectively. Other food items such as plant seeds, shrimps, fish scales, blue green algae (*Oscillatoria* and

Nostoc sp) filamentous green algae (*Zygnema*), diatoms (*Navicula*) and plant leaves which appeared to be of secondary importance ranged from 8.13% to 34.55%.

By point method, detritus was the dominant food item as it amounted to 31.71%. Other food items which were of importance were chironomid larvae (14.28%), ephemeropteran nymph (10.87%), fish fry (10.93%) and plant leaves (10.37%). Other food items gained points which ranged between 0.61% and 6.71%.

Table 2: Summary of food habits of H*emichromis fasciatus.*

Food Item	Occurrence Method		Point Method	
	Freq.	%	Points	%
Detritus	420	85.37	3,120	31.71
Blue green algae				
Oscillatoria sp	70	14.23	140	1.42
Nostoc sp	80	16.26	118	1.20
Filamentous green algae				
Zygnema	60	12.20	300	3.05
Diatoms				
Navicula	56	11.38	60	0.61
Macrophytees				
Plant leaves	170	34.55	1,020	10.37
Plant Seeds	70	8.13	70	0.71
Insecta				
Mosquito larvae	280	56.91	150	1.52
Chironomid larvae	470	95.53	1,405	14.28
Coleoptera	250	50.81	302	3.07
Ephemeroptera nymph	415	84.35	1,070	10.87
Crustacea				
Shrimps	45	9.15	350	3.56
Fish fry	312	63.41	1075	10.93
Fish scales	120	24.39	660	6.71

No. of stomachs examined = 569.
No. of stomachs with food = 492.
No. of empty stomachs = 77.

Monthly variation in the feeding intensity of H. fasciatus

The seasonal or monthly variation in feeding intensity of the species is shown in Figure 4. The highest mean feeding intensity (>10%) was recorded between August and October of both years. The lowest mean feeding intensity was recorded in February (4.20%) and March (5%) of the two sampling years respectively. The mean feeding intensity was generally higher in the rainy season than the dry season of both years of study. The mean feeding intensity rose sharply from a minimum (4.2%) in February in the first year to a peak (18.1%) in October of the same year. Thereafter, it gradually slopes down to a minimum (8.00%) in March the following year and finally reached its maximum value again (20.50%) in August.

The monthly variation in the percentage of empty stomach is shown in Figure 5. There were no empty stomachs in March, April and August in the first year and also between June and October of the following year. The highest percentage (12.99%) of empty stomach was recorded in January 2006 while the least (1.30%) was recorded in June of the same year. There was generally more empty stomach in the dry season months than the rainy seasons in both years of study. The percentage of empty stomach dropped from a maximum value (13.0%) in January of the first year to its minimum values between June and August. It gradually rose to another maximum value (11.0%) in December and slopes down again, with no record of empty stomach between the rainy season months of June and October the following year. Thereafter, there was another sharp rise in the percentage of empty stomach in November and December.

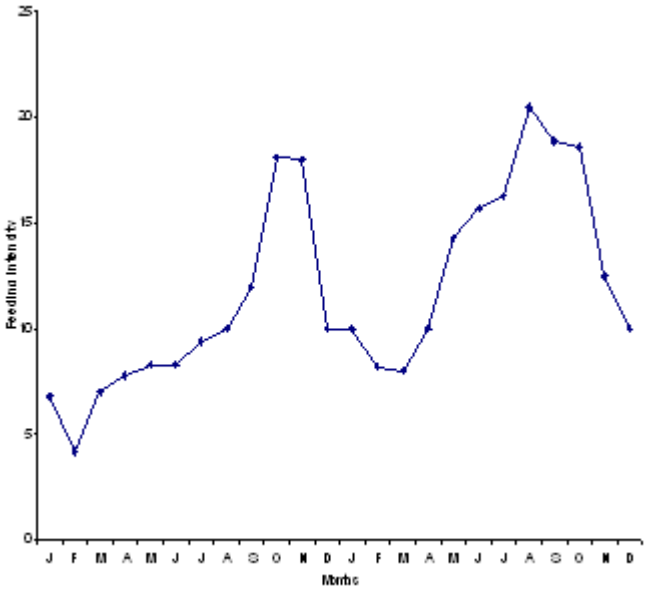


Figure 4: Monthly variations in mean feeding intensity of *Hemichromis fasciatus*.

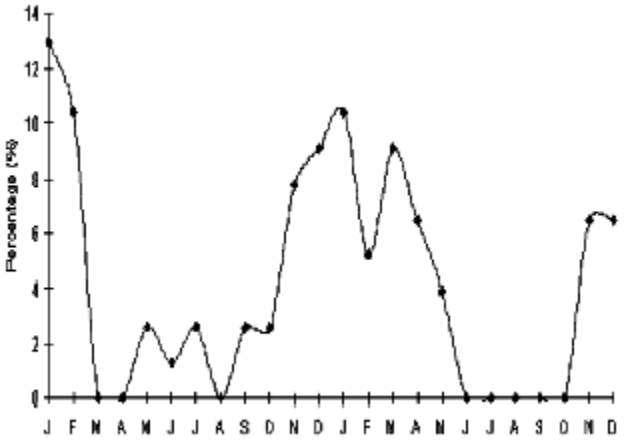


Figure 5: Monthly variation in the percentage empty stomach of *Hemichromis fasciatus* in River Orogodo 2006-2007.

Diel variations in feeding habits

The diel variations in the diets of *H. fasciatus* is shown in Table 3. Two hundred and seventeen samples were captured during the day and three hundred and fifty-two during the night. Of the day samples, 187 or 86.18% had food while of the night samples; the corresponding figure was 305 or 86.65%. The number of samples that fed in the night were significantly higher ($X^2 = 28.30$; $p<0.05$) than those that fed in the day. The diel food spectrum (Table 3) shows that all the 13 food items were ingested during both day and night. The occurrence of diatoms, plant leaves, seeds, mosquito larvae, chironomid larvae, coleoptera and ephemeropteran nymph in the diet of the fish species was significantly higher ($p<0.05$) at night than the day. On the other hand, the occurrence of shrimps, fish fry and fish scales were significantly more ($p<0.05$) during the day than the night while there was no significant difference ($p>0.05$) in the occurrence of detritus, blue-green algae and filamentous algae in both day and night samples. The points gained by the various

Table 3: Diel variations in food habits of *H. fasciatus* from River Orogodo, 2006-2007.
The values shown for day and night are actual frequencies and points gained.

Food Items	Methods: Occurrence			Point		
	Day	Night	X^2	Day	Night	X^2
Detritus	202	218	0.61	1,545	1,575	0.29
Blue green algae	70	80	0.67	122	136	0.76
Filamentous green algae	25	35	1.67	130	170	5.33*
Diatoms	16	40	12.52*	14	46	17.07*
Plant leaves	60	110	14.70*	260	760	245.10*
Seeds	10	30	10.00*	20	50	12.86*
Mosquito larvae	110	170	12.86*	60	90	6.00*
Chironomid larvae	205	265	7.66*	550	855	66.21*
Coleoptera	105	145	6.40*	124	178	19.31*
Ephemeroptera nymph	142	273	41.35*	335	735	149.53*
Shrimps	40	5	27.22*	250	100	64.29*
Fish fry	185	127	10.78*	640	435	39.09*
Fish scales	75	45	7.50*	460	200	102.42*

Significant level (p) is <0.05 *indicate significant values.

food items also followed the same pattern as the occurrence except that filamentous algae gained significantly higher points ($p<0.05$) at night than in the day.

Discussion

The maximum standard length of *H. fasciatus* recorded in this study was 14.6 cm. This value compares favourably well with 12.1 cm recorded by Meye and Ikomi (2007) in Urie Creek and 9.3 cm by Idodo-Umeh (2003) in River Ase. On the other hand, it is much lower than 25 cm maximum standard length by Lewis (1974) in Lake Kainji. Variations in the environmental conditions of the water bodies as well as the limitations imposed by the fishing gear selectivity and techniques are responsible for the different sizes of fish species recorded in different water bodies. The regression coefficient Figures 2a and 2b recorded for both sexes of the species was also less than 3, suggesting an allometric growth pattern. There was however a significant regression coefficient for the females while both sexes recorded non-significant correlation between length and weight.

The condition factor *K* calculated for *H. fasciatus* in River Orogodo ranged between 2.0 and 3.6 with a mean of 2.7. The fishes were generally in good condition since *K*-values were greater than one. The monthly fluctuations in *K*-values showed a peak in the rainy season months (May-July) for each year of study. Variations in *K*-values according to size and sex indicate a positive relationship between the condition factor and fish size in both sexes of the species and the sexes combined.

In River Orogodo, *H. fasciatus* could be regarded as a carnivore, feeding mainly on insect larvae, (chironomid, coleopteran, dipteran and ephemeropteran). Detritus, fish fries and aquatic plant parts were also important. According to Holden and Reed (1972) species of the genus *Hemichromis* are voracious carnivores, feeding on the young of all species including their own, as well as insects and their larvae. It seems likely that this species is predominantly carnivorous in feeding habits but can switch over to other food items during period of scarcity. The preponderance of detritus, various forms of algae, insect larvae, fish fries and scales suggests that the species feed throughout the water columns, utilizing food resources in the different columns of the water. This also supports the non-specialist mode of feeding of the species as it can switch over to other food items and at the different water columns when the primary food items are scarce. And it also supports the claims of Ugwumba and Ugwumba (2007) that when a fish is feeding, it is the most available food item that it mostly feeds on.

Various authors have reported that *H. fasciatus* was piscivorous. For example, Fagade and Olaniyan, (1978) reported that it fed mainly on fish especially clupeids in the Lagos Lagoon. Ugwumba (1988) also reported this species to be a piscivorous predator in Lagos Lagoon utilizing mostly *Tilapia* fry as a major prey organism. Teugels *et al* (1992) affirmed that *H. fasciatus* is a predatory species whose banding pattern apparently mimics that of *Tilapia mariae* whose young ones is often its prey. In River Ase, Idodo-Umeh (2003) observed that *H. fasciatus* fed on young fish especially those of *Tilapia*, *Brycinus* and *Epiplatys* species.

The temporal food habits showed a seasonal trend. Though the major food items were consumed throughout the study period, the abundance of these items in the diet of the species was however higher in the rainy season. Such secondary food items as detritus and various forms of algae were consumed more during the dry season when the primary food sources were probably in short supply. This seasonal trend could actually suggest the variation in the availability of the various food sources in the habitat.

The feeding intensity as expressed by the mean point gained per fish and percentage of empty stomach indicated a seasonal pattern. The highest mean point gained was recorded mostly during the rainy season while the percentage of empty stomach was also lowest during this period.

The diel variations in food habits showed that *H. fasciatus* in the study-area feed both at day and night. However, the result showed that the feeding intensity was higher at night as the consumption of most food items was significantly higher at night than day. This perhaps explains their higher abundance in the night time samples, as it seems reasonable to assume that more fish are caught when active than during periods of inactivity. This result probably suggests also that light is not a limiting factor in the search for food by this species.

Conclusion

This study has shown that *H. fasciaatus* occurs in River Orogodo throughout the year and in the entire stretch of the river. Its wide range of dietary items resulting in better condition accounted for its success in the study area.

References

Babiker, M.M. and Ibrahim H. 1979. Studies on the biology of reproduction in the cichlid, *Tilapia nilotica* (L): gonadal maturation and fecundity. *Journal of Fish Biology. 14:* 437-448.

Bagenal, T.B. and Tesch, F.W. 1978. Age and growth. In: pp. 101-136, Bagenal, T.B. (ed). *Methods of assessment of fish production in freshwater,* Oxford, Blackwell Scientific Publication.

Fagade, S.O. 1971. The food and feeding habits of *Tilapia species* in the Lagos Lagoon. *Journal of Fish Biology 3:* 151-156.

Fagade. S.O. 1978. On the biology of *Tilapia guinensis* (D) from Lekki Lagoon, Lagos State Nigeria. *Nigerian Journal of Science*, *12:* 73-87.

Fagade, S.O. 1982. The food and feeding habits of *Sarotherodon galilaeus* from small lake. *Archive für Hydrobiologia*, 93(2): 256-263.

Fagade, S.O. 1983. The Food and Feeding Habits of the Fishes of Lower River Benue (Nigeria). *Bulletin de l'L.F.A.N.T.* 45. *SER. (3-4)*. 316-341.

Fagade, S.O. and Olaniyan, C.I.O. 1978. The Food and Feeding Inter-relationship of the Fishes in the Lagos Lagoon. *Journal of Fish Biology. 5:* 105-225.

Fryer, G. and Iles, T.D. 1972. *The cichlid fishes of the great lakes of Africa. Their biology and evolution*. Oliver and Boyd, Edinburgh. 641pp.

Holden, M. And Reed, W. 1972. *West African freshwater Fish*. *2nd Ed.* Longman, London. 68pp.

Hynes, H.B.N. 1950. The Foods of Freshwater Stickle Backs (*Gasterosteus aculeatus* and *Pygostens pungitius*) with a Review of Methods Used in Studies of the Food of Fishes. *Journal of Animal Ecology. 19:* 36-38.

Hyslop, E.J. 1980. Stomach Content Analysis: A review of methods and their applications. *Journal of Fish Biology. 17:* 411-429.

Idodo-Umeh, G. 2003. *Freshwater Fishes of Nigeria*. *(Taxonomy, Ecological Notes, Diet and Utilization)*. Idodo-Umeh Pub. Ltd, Benin-City, Nigeria, p. 232.

Ikomi, R.B. 1998. Observation on the dwarf cichlid *Pelvicachromis taeniatus* in River Ethiope, Niger Delta, Nigeria. Nigerian *Journal of Science and Environment, 1(1):* 31-39.

Ikomi, R.B. and Jessa, H.O. 2003. Studies on Aspects of the Biology of *Tilapia mariae* (Boulenger, 1899) (Osteichthys; Cichlidae) in Ethiope River, Niger Delta, Nigeria. *African Zoology. 38(2):* 255-264.

Ikomi, R.B. and Owabor, N. 1997. The Status and Seasonality in the Physiochemical Hydrology of River Orogodo at Agbor, Nigeria. *Bulletin of Science Association of Nigeria. 21:* 169-175.

Lewis, D.S.C. 1974. The effects of the formation Lake Kainji, Nigeria, upon the indigenous fish population. *Hydrobiologia. 45:* 281-301.

Meye, J.A. 2010. *Studies on the Ecology of The Fish Communities of River Orogodo, Delta State, Nigeria.* Ph.D Thesis Delta State University, Abraka, Nigeria. 433pp.

Meye, J.A. and Ikomi, R.B. 2007. Observations on some aspects of the ecology of cichlid fishes in Urie Creek, Niger Delta Nigeria. *Journal of Agricultural Research and Policy. 2(2):*39-45.

Teugels, G.G., Reid, G.M. and Kings, R.P. 1992. Fishes of the Cross River Basin (Cameroon-Nigeria). Taxonomy, Zoogeography, Ecology and Conservation. Musee Royal De L'Afrique Centrale. Tervaren, Belgique, *Annals Sciences Zoologiques*. Vol. 266.

Ugwumba, A.A. 1988. Food and feeding habits of juveniles of some culturable fish species in Nigeria. *NIOMR Technical Paper. 31*: 1-24.

Ugwumba, A.A.A. and Ugwumba, A.O. 2007. *Food and Feeding Ecology of Fishes in Nigeria.* Crystal Publishers, Lagos, Nigeria. 91pp.

Ugwumba, A., Ugwumba, A. and Mbu-Oben, A. 1990. Feeding Ecology of the Mormyrids of Lekki Lagoon, Nigeria, *Nigerian Journal of Natural Sciences 5(1&2):* 38-46.

Meye, J.A. and Ikomi, R.B.
© *The Zoologist, 9:*17-24 (2011), ISSN 1596 972X.
Zoological Society of Nigeria.