INTERNATIONAL JOURNAL OF NATURAL AND APPLIED SCIENCES (IJNAS), VOL. 2, NO. 2(2007);P. 38 – 45, 4 TABLES.

Observations on the feeding ecology of *liza grandisquamis* in Imo river estuary in southeastern Nigeria

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ABSTRACT

The feeding ecology of *Liza grandisquamis* from Imo River estuary (IRE) east of the Niger delta (Nigeria) was studied over a period of one year and collections were made from catches landed by fishers at Uta Ewa, Iko and Down Below fishing terminals. Analysis of stomach contents was undertaken using the relative frequency and points methods. The trophic spectrum showed that *L. grandisquamis* fed on a wide assortment of food resources. Index of relative importance (IRI) showed that *L. grandisquamis* primarily ingested diatoms, fine particulate organic matter (FPOM), diatoms, mud and sand and secondarily fed on coarse particulate organic matter (CPOM), preyfish, green algae and blue green algae. Macrophytic matter, free living nematodes, microarthropods and dinoflagellates were incidentally consumed. The spectrum of food dominance rank order gave: algae > detritus> sediments > macrofauna/meiofauna. *L. grandisquamis* exhibited considerable monthly/seasonal plasticity in dietary preferences with no significant differences in feeding intensity. Monthly dynamics in food richness depicted by the number of food items (Nf) showed minimum food richness in March and July (Nf = 24) and maximum in December (Nf = 35); FPOM, mud and diatoms were primary dietaries throughout the year. Seven major dietaries (CPOM, FPOM, mud, sand, diatoms, green algae and prey fish) constituted constant dietaries consumed monthly throughout the year while six dietaries (blue-green algae, red algae, dinoflagellates, micro -arthropods, free living nematodes and macrophyte matter) formed occasional dietaries consumed only in certain months. The consumption of a wide variety of food substances by *L. grandisquamis* shows high trophic flexibility and can be assigned to the algivore - detritivore – deposit trophic guild.

INTRODUCTION

Some mullets including *Mugil cephalus, M. dumssumierri, M. capito, M. macrolepis, Liza grandisquamis, L. falcipinnis* and *L. dumerili* have been categorized as good aquaculture candidates (Hora and Pillay, 1962; Bardach *et. al.* 1972; Schmittou, 1973; Ugwumba, 1988). A number of workers including Bardach *et. al.* (1972), Schmittou (1973) and King (1988a) have confirmed that mullets possess several characteristics desirable in a fish for pond culture, some of which include high quality flesh, rapid growth rate, hardiness, high market value and food habits. They also readily accept supplementary food and show wide temperature and salinity tolerance – a characteristic particularly desirable in a fish species to be cultured in a brackish water environment.

The importance of mullets for artificial rearing was indicated at the First International Symposium on Aquaculture of grey mullet in Haifa (Oricha, 1985). Mullets are raised in ponds in several parts of the world (Bruslé, 1981). This is because they now play important role in fish culture in a number of regions notably the Mediterranean and southern Asia. The culture of mullet species if embarked upon in Nigeria and Africa, in general, will contribute immensely towards meeting the increasing demand for fish as animal protein source. This is imperative because fish supply in Nigeria and most African countries is grossly inadequate. his paper presents data on aspects of the trophic ecology of *Liza grandisquamis* in Imo River estuary

MATERIALS AND METHODS

Study area

The Imo River ($6^0$5` - $7^0$40`E; $4^0$25` - $6^0$25`N (Fig. 1) originates in the vicinity of Okigwe (Imo State, Nigeria) and takes a southerly course until it empties into the Atlantic Ocean in the Bight of Bonny. It drains an area of 9,100km^2 with a relatively small flood plain area of 160km^2 (Udo, 1994). The Imo River basin is situated in the tropical rain forest belt with an equatorial climate regime which comprises two major seasons: a short dry season (November – March) characterised by the prevalence of hot, dry north-easterly winds from the Sahara desert and a long wet season (April – October) characterised by the prevalence of moist south-westerly winds from the Atlantic Ocean. Precipitation is heavy with mean monthly range of 361 – 615mm and a double maxima in July and September. The relative humidity is high (over 80%) because of the warm wet air masses that prevail during the period.

The main channel and creeks of the estuarine zone are fringed by mangrove swamp forests on tidal mudflats.

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The substrate of the saline swamp consists of peaty fibrous mud called “chikoko” (Udo, 1994). The macrophytes are dominated by the native red mangroves *Rhizophora harrizonii, R. mangle, R. racemosa;* the white mangrove *Avicennia africana* and the exotic nipa palm *Nypa fructicans* Wurmb which are prominent and aggressively replacing the mangroves.

Collection of fish samples and stomach content analysis

Samples of *L. grandisquamis* were collected monthly over a 1 - year period (August, 1999 – July 2000) from catches landed by artisanal fishers at Uta Ewa, Iko and Down Below fishing terminals in Imo River Estuary. Fishing was done by the fishers mainly by the use of cast nets (10 – 25mm mesh size) operated from traditional dug-out canoes (7 – 12m LOA) some of which were motorised (with 15 – 40 HP outboard motors). Soon after collection, the specimens were transported to the laboratory in ice chests. After draining water from the buccal cavity and blot-drying the body of the fish with absorbent paper, the total lengths (TL) were measured to the nearest 0.1cm and fish were weighed to the nearest 0.1g. The specimens were then preserved for 24 hours in 10% formalin awaiting further analysis. The specimens were later dissected and the stomachs removed, slit open and the degree of stomach fullness estimated. The food assessment of 308 specimens was undertaken based on stomach content analysis. The point volume of food in the stomach (Hyslop, 1980; Olatunde, 1978; King, 1989; King *et al*., 1991) was used to evaluate feeding intensity based on the assumption that feeding intensity positively correlates with the amount of food in the stomach. The state of distention of, and amount of food in each slit stomach was noted and assigned a number of points proportional to its degree of fullness according to an arbitrary 0 - 20 scale. Thus 0, 5, 10, 15 and 20 points were scored for empty (ES), ¼ full, ½ full, ¾ full (partially filled, PS) and full or distended stomachs (FS) respectively. Intermediate points were scored where necessary. Average points per stomach (Average Stomach Fullness, ASF) was calculated to give an index of mean feeding intensity. Stomach repletion index (SRI) which is the percentage occurrence of non-empty stomachs was also used as a measure of feeding activity (King, 1988 a, b). The contents of each stomach were placed in a petri dish, aggregates were dispersed with distilled water and sub-samples taken for macroscopic and microscopic (x40 – 100) examinations. The dietaries were sorted, identified and categorised. Food richness (Nf) was regarded as the number of food items in the diet (King, 1989).

The analyses of food composition and relative importance were undertaken using two methods: the relative frequency (RF) and the percentage points (PP) methods, the latter being a modification of Hyslop method (1980) by King (1988 a, b). In the points method, the 0 – 20 points previously allotted to each stomach regardless of the fish size were shared among the various contents taking cognizance of their relative abundance in the stomach. The total points scored by each food item was computed and expressed as a percentage of overall total points scored by all food items (King, 1988a). This gave the percentage composition or the bulk contribution of each item to total food composition. The relative frequency (RF) of the variety of items in the stomach was computed from the formula:-

$$RF = \left(\frac{fi}{\Sigma fi}\right) 100 \qquad (1)$$

where fi = frequency of item i. Food preference was assessed by an index of relative importance (IRI) computed as the summation of PP and RF of each item (King, 1988a). As proposed by the author, PP and RF are percentages each ranging from 0 – 100%, therefore IRI ranges between 0 – 200%. The items with IRI $\geq$ 20% were arbitrarily considered as primary dietaries while those with IRI 1 – 19.90 as secondary and items with IRI < 1.0 as incidental. The use of IRI to establish food preference is considered adequate since it incorporates the PP and RF data thereby minimizing the bias characteristic of cases in which results from different analytical methods are independently interpreted (King, 1988a). The monthly percent composition was also computed to obtain the seasonal values.

Statistical analysis

The seasonal and spatial variations in food and the ASF were evaluated by t-test. Differences in SRI was analysed by d-statistic. Correlation coefficient was carried out to assess the relationship between the IRI of the dietaries.

RESULTS

Food composition

A total of 308 specimens of *L. grandisquamis* (15.4 – 26.0cm TL) was examined from Imo River estuary (IRE) and the monthly distribution showed that it occurred throughout the year in the estuary.

The overall trophic spectrum of *L. grandisquamis* (Table 1) shows the utilization of a wide assortment of food resources. Thirteen major food items constituted the diet of *L. grandisquamis* from IRE including coarse particulate organic matter (CPOM) (= coarse detritus), fine particulate organic matter (FPOM) (= fine detritus), mud, sand, Bacilliariophyceae (diatoms), Cyanobacteria (blue-green algae), Chlorophyceae (green algae), Dinophyceae (dinoglagellates), microarthropods, prey fish, nematodes (free-living) and macrophyte matter. The IRI indicates that *L. grandisquamis* (Table 1) primarily ingested diatoms (65.05%), FPOM (51.41%), mud (36.08%) and sand (23.72%); secondarily CPOM (8.63%), prey fish (6.69%), green algae (3.83%) and blue-green algae (2.02%) while macrophytic matter (0.19%), free living nematodes (0.60%), microarthropods (0.50%) dinoflagellates (0.35%) and macro-red algae (0.21%) were incidentally consumed.

Monthly variation

The monthly dynamics in food richness (Table 2) showed that the food richness in *L. grandisquamis* in IRE were high (ranged from Nf = 24 to Nf = 35) and occurred every month throughout the study. Minimum food richness (Nf = 24) occurred in March and July, while maximum richness (Nf = 35) was evidenced in December.

Monthly rhythms in the IRI of the dietary components of *L. grandisquamis* from IRE (Table 3) shows that FPOM, mud and diatoms were primary dietaries throughout the year. CPOM and prey fish were of secondary dietary importance every month; sand was encountered in the stomachs all the year-round and formed primary content in August, November – March, June and July and secondary content in September and October and April and May. Blue-green algae were secondary dietaries in all months except in January/March when they were not consumed and in November when they formed incidental components. Red algae were of secondary dietary value in January and of incidental value in December and February; these were the only months they were consumed. Dinoflagellates constituted incidental dietaries in each of the six months (September – December, March and July) that they were consumed.

Microarthropods were secondary dietaries in October, November, February and April and incidental dietaries in December and March. Free-living nematodes formed incidental dietary components in August, November, December and February and secondary components in April – June. Macrophyte matter occupied secondary dietary status in October, December, January, May, June but played incidental role in August, September and March. Seven major dietaries (CPOM, FPOM, mud, sand, diatoms, green algae and prey fish) constituted constant dietaries consumed on a year-round basis while six dietaries (blue green algae, red algae, dinoflagellates, microarthropods, free-living nematodes and macrophyte matter) formed occasional dietaries, ingested only in certain months.

Seasonal Variation

The seasonality in the dietaries of *L. grandisquamis* from IRE (Table 1) showed that the dry season food richness (Nf = 41) was slightly higher than the wet season value (Nf = 39). The composite data for the dry and wet seasons showed that *Surirella*, *Diatoma* and *Bacteriastrium* (diatoms) and *Bostrychia* (red algae) were not consumed during the wet season, while *Fragillaria* (diatom) and *Ulothrix* (green algae) were excluded from the dry season dietaries. *L. grandisquamis* in IRE fed more on CPOM, FPOM, blue-green and green algae in the wet season than in the dry season. Conversely, the IRI of mud, sand and diatoms were higher in the dry than wet season.

Feeding Intensity: The monthly regimes in the stomach fullness conditions of *L. grandisquamis* in IRE are presented in Table 2. All the monthly samples collected from IRE had food in their stomachs (SRI = 100% in each month). Maximum ASF (19.032 $\pm$ 3.271) occurred in December and minimum (17.50 $\pm$ 4.89) in November suggesting that highest feeding occurred in December.

The seasonal variations in the indices of stomach fullness of *L. grandisquamis* from IRE showed no significant seasonal variation in SRI ($p > 0.05$, d – test). Similarly, no significant seasonal variation was detected in ASF indicating no differences in feeding activity between dry and wet seasons (Table 4).

Table 1. The overall trophic spectrum and seasonality in the diets of *L. grandisquamis* in Imo River estuary (Nigeria) (August 1999 to July 2000).

FOOD ITEM	Wet season			Dry season		
	RF	PP	%IRI	RF	PP	%IRI
CPOM	5.29	4.50	9.79	3.64	3.27	6.91
FPOM	29.06	36.20	65.26	13.90	16.69	30.59
MUD	13.23	15.29	28.22	21.11	26.36	47.47
SAND	9.78	10.90	20.68	12.58	15.73	28.31
DIATOMS (Bacillariophyceae)						
Navicula sp	7.26	7.83	15.45	10.32	9.61	19.93
Nitzschia sp	7.17	5.91	13.08	7.88	6.34	14.22
Coscinodiscus sp	4.93	4.75	9.68	5.69	5.60	11.29
Stephanodiscus sp	2.87	1.91	4.78	2.98	2.26	5.24
Gyrosigma sp	1.39	0.78	2.17	1.32	0.83	2.15
Pleurosigma sp	1.75	1.29	3.04	1.72	1.08	2.80
Cyclotella sp	3.23	2.44	5.67	3.84	3.36	7.20
Melosira sp	0.85	0.50	1.35	0.73	0.40	1.13
Amphora sp	0.05	0.01	0.06	0.80	0.36	1.16
Frustulia sp	0.36	0.28	0.64	0.40	0.18	0.58
Triceratium sp	0.94	0.60	1.54	0.73	0.43	1.16
Pinnularia sp	0.58	0.46	1.04	1.46	1.01	2.47
Chaetoceros sp	0.18	0.06	0.24	0.60	0.34	0.94
Surirella sp	-	-	-	0.66	0.38	1.04
Biddulphia sp	0.31	0.18	0.49	0.26	0.18	0.44
Rhizosolenia sp	-	-	0.20	0.07	0.20	0.09
Bacillaria sp	0.14	0.06	0.20	0.46	0.22	0.68
Diatoma sp	-	-	-	0.13	0.09	0.22
Bacteriastrium sp	-	-	-	0.07	0.02	0.09
Fragillaria sp	0.14	0.07	0.21	-	-	-
Sub-total			59.93			72.83
BLUE GREEN ALGAE (Cyanobacteria)						
Anabaena sp	0.54	0.29	0.83	0.13	0.09	0.22
Microcystis sp	0.14	0.09	0.23	0.13	0.07	0.20
Nostoc sp	0.67	0.43	1.10	0.40	0.36	0.76
Oscillatoria sp	0.22	0.15	0.37	0.07	0.04	0.11
Sub-total			2.53			1.29
GREEN ALGAE (Chlorophyceae)						
Spirogyra sp	0.40	0.40	0.80	0.20	0.13	0.33
Netrium sp	1.43	1.01	2.44	0.73	0.52	1.25
Euglenids sp	0.04	0.03	0.07	0.26	0.16	0.42
Closterium sp	0.90	0.62	1.52	0.13	0.09	0.22
Ulothrix sp	0.05	0.01	0.06	-	-	-
Sub-total			4.89			2.22
RED ALGAE (Rhodophyceae)						
Bostrychia sp	-	-	-	0.33	0.20	0.53
DINOFLAGELLATES (Dinophyceae)						
Ceratium sp	0.22	0.10	0.32	0.26	0.11	0.37
MICROARTHROPODS						
Calanoid copepod	0.09	0.06	0.15	0.13	0.09	0.22
Harpacticoid copepod	0.05	0.03	0.08	0.13	0.09	0.22
Copepod nauplii	-	-	0.12	-	-	-
Ostracods	0.13	0.04	0.17	0.13	0.09	0.22
Sub-total			0.52			0.66
PREY FISH						
Fish remnant	1.12	0.87	1.99	1.52	1.43	2.95
Fish scales	2.33	1.00	3.33	2.38	1.03	3.41
Unid. shrimp remnants	0.58	0.28	-	0.73	0.36	-
Sub-total	0.45	0.25	5.30	0.33	0.11	6.36
NEMATODES (Free living)	0.45	0.25	0.70	0.33	0.11	0.44
MACROPHYTE MATTER	0.63	0.26	0.89	0.66	0.27	0.93
Total	100	100	200	100	100	200

Table 2. Monthly fluctuations in the stomach repletion index (SRI) and average stomach fullness of L. grandisquamis in Imo River estuary, Nigeria (August 1999 to July 2000).

Months	N	n	SRI (%)	ASF + S.D.	Food Richness Nf
August	31	31	100	18.548 ± 3.695	25
September	25	25	100	18.400 ± 3.929	31
October	35	35	100	18.143 ± 4.864	30
November	24	24	100	17.500 ± 4.890	26
December	31	31	100	19.032 ± 3.271	35
January	24	24	100	17.708 ± 4.996	26
February	19	19	100	18.421 ± 3.991	26
March	25	25	100	17.800 ± 5.115	24
April	23	23	100	18.043 ± 4.601	21
May	18	18	100	18.611 ± 4.251	26
June	30	30	100	18.667 ± 3.457	25
July	23	23	100	18.478 ± 3.470	24

N = Total number of stomachs examined; n = Number of stomachs containing food

DISCUSSION

The overall stomach contents of *L. grandisquamis* in Imo River estuary showed a high dietary complexity involving the utilisation of a wide variety of food resources.

This is consistent with reports for the same species in other river estuaries within the Niger Delta viz. Cross River estuary (Akpan and Ubak, 2004a) and Qua Iboe River estuary (Akpan and Ubak, 2004b). The trophic spectrum of the fish can be categorised into four main groups in order of importance on the basis of IRI as reported by King (1988a) and Akpan and Ubak (2004a,b) on the same species viz:

(i) algae (diatoms: benthic/centric and pennate forms; green algae, blue-green algae, dinoflagellates; IRI = 71.25%); (ii) detritus (FPOM + CPOM; IRI = 60.04%);

(iii) sediments (mud + sand; IRI = 59.80%); (iv) macrofauna/meiofauna (macrofauna: prey fish, microarthropods, nematodes; IRI = 7.23%.

The spectrum of food dominance can therefore be summarised as algae > detritus > sediments > macrofauna/meiofauna. The primary dietaries of *L. grandisquamis* from Imo River estuary were algae, detritus, and sediments while the macrofauna/meiofauna were of secondary importance.

This is consistent with the reports of King (1986, 1988a) and Akpan and Ubak (2004a, b) on the same species in Bonny River and Cross River/Qua Iboe River estuaries respectively. However, the order of food preference differed markedly in that while the Bonny River population preferred detritus, algae and sediments in that order, the Cross River population preferred sediments, detritus and algae while the Qua Iboe River population preferred detritus, sediments and algae. *L. grandisquamis* in IRE can therefore be described as algivore-detritivore – deposit feeder because of the predominance of algae, detritus and sediments in the diet.

Fagade and Olaniyan (1973) noted the diet of *L. grandisquamis* from Lagos lagoon as comprising mainly diatoms, sand and detritus. In Nembe Waterside, Port Harcourt, the species fed principally on detritus while diatoms, algae, ostracods, copepod, nematodes and foraminiferans were of subsidiary importance (Osunsanya, 1984). In the brackish water fish ponds in Buguma near Port Harcourt, the fish ingested mainly detritus while diatoms, organic matter, blue green algae, zooplankton, filamentous and non-filamentous algae were of subsidiary importance (Oricha, 1985).

Table 3. Monthly variations in the index of relative importance (IRI) of dietaries of L. grandisquamis in Imo River estuary (August 1999 to July 2000).

Food item	Months											
	A	S	O	N	D	J	F	M	A	M	J	J
CPOM	5.70	8.73	14.47	7.71	8.57	5.28	4.29	7.61	10.06	10.14	8.66	9.90
FPOM	70.90	54.23	59.44	31.81	24.69	29.70	31.30	38.41	66.69	68.17	69.41	08.89
MUD	25.59	27.56	35.18	45.71	40.98	52.73	47.88	53.41	32.18	19.52	27.63	27.32
SAND	24.98	19.68	16.33	26.68	25.79	29.53	34.00	27.97	19.50	18.46	24.80	20.21
DIATOMS												
Navicula sp	16.49	13.81	14.13	21.34	23.59	19.76	14.16	17.89	14.25	16.33	16.32	17.23
Nitzschia sp	13.63	15.49	10.42	15.77	16.75	15.35	10.58	10.99	10.68	15.45	11.62	16.07
Coscinodiscus sp	8.83	10.31	8.76	11.97	10.47	8.88	13.3	12.69	10.44	10.16	10.69	9.02
Stephanodiscus sp	4.00	6.15	5.97	5.53	7.35	3.24	7.15	3.29	3.95	6.23	3.11	4.24
Gyrosigma sp	3.00	4.01	1.84	1.96	2.45	2.29	2.58	1.48	1.71	1.52	1.20	1.70
Pleurosigma sp	3.53	4.12	2.84	2.45	3.07	3.61	2.58	2.04	2.58	3.79	2.93	1.44
Cyclotella sp	6.23	7.20	2.84	7.45	8.68	6.84	5.86	6.35	2.70	4.25	6.32	6.88
Melosira sp	1.45	1.37	5.27	0.62	1.18	1.08	3.15	-	1.84	2.42	20	1.09
Amphora sp	-	-	0.69	-	1.54	0.61	2.58	-	-	-	-	0.49
Frustulia sp	-	1.27	1.69	1.23	0.30	0.49	-	0.90	-	0.61	0.46	-
Triceratium sp	1.08	2.21	2.84	1.84	0.39	2.29	-	1.48	1.11	0.76	0.46	1.81
Bacillaria sp	-	0.53	-	-	1.41	-	1.85	-	-	1.22	-	-
Pinnularia sp	0.37	2.35	1.27	2.08	3.16	2.65	1.99	2.04	1.11	0.61	0.92	0.61
Chaetoceros sp	-	0.84	-	1.23	1.09	0.97	1.43	-	-	-	0.74	-
Surirella sp	-	-	-	-	2.67	0.49	1.29	-	-	-	-	-
Biddulphia sp	1.27	1.05	0.31	-	0.79	1.20	-	-	0.62	-	-	-
Diatoma sp	-	-	-	-	0.79	-	-	-	-	-	-	-
Bacteriastrium sp	-	-	-	-	-	-	-	0.45	-	-	-	-
Rhizosolenia sp	-	1.37	-	-	-	0.49	-	-	-	-	-	-
Fragillaria sp	-	1.48	-	-	-	-	-	-	-	-	-	-
Sub-total	59.88	73.55	56.72	72.47	85.68	70.24	68.50	59.60	50.99	63.35	55.97	60.58
CYANOBACTERIA												
Nostoc sp	1.99	0.95	-	-	1.75	-	1.72	-	-	0.61	1.83	2.30
Microcystis sp	-	-	2.21	-	0.70	-	-	-	-	0.76	-	-
Anabaena sp	0.45	2.21	1.05	0.62	0.39	-	-	-	0.62	0.76	-	-
Oscillatoria sp	-	1.05	4.21	-	-	-	0.72	-	0.62	-	-	0.61
Sub-total	2.44	4.21	2.68	0.62	2.84	-	2.44	-	1.24	2.13	1.83	2.91
GREEN ALGAE												
Spirogyra sp	-	1.27	0.84	1.23	0.39	-	-	-	1.47	-	1.10	0.84
Netrium sp	1.10	2.01	4.84	2.81	0.70	1.08	-	1.70	1.96	4.09	1.38	1.58
Ulothrix sp	0.37	-	-	-	-	-	-	-	-	-	-	-
Closterium sp	1.36	1.90	1.47	-	-	-	0.72	0.56	1.72	2.28	0.83	1.44
Euglena sp	-	-	-	0.62	0.70	-	-	0.56	-	0.76	-	-
Sub-total	2.83	5.18	7.15	4.66	1.79	1.08	0.72	2.82	5.15	7.13	3.31	3.86
RED ALGAE												
Bostrychia sp	-	-	-	-	0.70	1.32	0.57	-	-	-	-	-
DINOFLAGELLATES												
Ceratium sp	-	0.95	0.69	0.99	0.30	-	-	0.56	-	-	-	0.48
MICROARTHROPODS												
Ostracods	-	-	0.92	-	-	-	1.43	-	-	-	-	-
Calanoid copepod	-	-	0.39	-	0.39	-	-	0.56	1.62	-	-	-
Harpacticoid copepod	-	-	-	1.23	-	-	-	-	0.62	-	-	-
Sub-total	-	-	1.31	1.23	0.39	-	1.43	0.56	2.24	-	-	-
NEMATHELMINTHES	0.91	-	-	0.99	0.62	-	0.57	-	1.84	1.52	1.11	-
MACROPHYTE MATTER	0.73	0.95	1.29	-	1.24	2.18	-	0.90	-	2.13	1.21	-
PREY FISH												
Fish remnant	2.28	1.70	1.69	2.81	2.41	3.48	3.58	3.28	2.95	1.82	1.92	1.70
Fish scale	2.57	2.10	2.29	3.82	2.95	3.38	3.29	3.86	4.82	5.63	3.69	3.65
Unid. Shrimp remnant	1.19	1.16	0.76	0.50	1.32	1.08	1.43	1.02	1.84	-	0.46	0.49
Sub-total	6.04	4.96	4.74	7.13	6.41	7.94	8.30	8.16	9.61	7.45	6.07	5.84
GRAND TOTAL	200	200	200	200	200	200	200	200	200	200	200	200

Ugwumba (1988) described the food of 60 specimens of juvenile *L. grandisquamis* from an Ikoyi fish pond as comprising predominantly diatoms and unidentified organic debris whereas blue green algae (*Spirulina merismopedia*) and green algae (Spirogyra) occurred in small proportions. King (1988a) noted the food of *L. grandisquamis* in Bonny River as comprising primarily of FPOM, mud and diatoms while CPOM, sand, blue green algae, dinoflagellates, microarthropods, foraminiferans and free living nematodes were of secondary importance. These reports are partly in concordance with present results, except variations in the order of relative importance of the dietaries and the wider variety of items consumed by *L. grandisquamis* from Imo River estuary.

Table 4. Seasonal variations in indices of stomach fullness of *L. grandisquamis* in Imo River estuary, Nigeria.

Season	*N*	*n*	*SRI(%)*	*d-statistic*	*ASF ± S.D.*	*t-test*
Dry	*104*	*102*	*98.08*	-	*17.892 ± 4.362*	-
Wet	*157*	*156*	*98.09*	*0.005*	*17.890 ± 4.270*	*0.008*

N = Total number of stomachs examined; n = Number of stomachs containing food

The wide food spectrum of the mugilid in IRE (Tables 1 and 3) demonstrates high trophic flexibility of the species which facilitates effective utilization of available food resources and the ability of these species to easily switch from one food category to another in response to fluctuations in their abundance and availability (King, 1989). Another selective advantage of a euryphagic strategy (heterotrophy) is that it reduces competition for food (King, 1994). The abundance of this mullet in Imo River estuary should therefore not be limited by food resources but by other ecological factors. The wide distribution of *L. grandisquamis* in IRE and their wide trophic spectra agree with Lowe-Mc Connel's (1987) opinion that euryphagy is a trait of ubiquitous species.The present study confirms an earlier assertion by Bruslé (1981) that mugilids are able to utilize two main energy pathways: the direct grazing food chain in which algae and macrophytes are primary energy sources and detrital food chain in which dead and decaying organic matter is the energy source. The adaptive significance of ability to utilize two major food chains is that they are able to utilise one or both energy sources in any given situation. This trophic position is also an asset in pond culture because it enables mugilids to respond well to inexpensive fertilization as well as supplementary feeding (Bardach *et al.*, 1972).

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