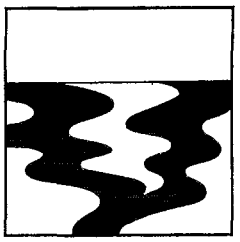

Observations on Liza grandisquamis *(Pisces : Mugilidae) in Bonny River, Nigeria*

Richard P. KING (1)

ABSTRACT

Aspects of the ecology of Liza grandisquamis, *with particular reference to food and feeding habits were studied in upper Bonny River at Port-Harcourt, in the Niger Delta of Nigeria over a one year period (November, 1982-December, 1983 inclusive). The fish which was available throughout the year was most commonly caught over muddy substratum particularly in mangrove environments. It constituted 20 % of artisanal fishermen catches.*

L. grandisquamis *fed most actively at night and reduced its feeding activity during the day. It fed primarily on detritus and secondarily on mud, sand grains, dialoms, bluegreen and green algae and higher plant tissues; red algae, microcrustaceans, foraminifera and free living nematodes were of incidental importance. It selectively ingested inorganic particles of 0.024 mm (mean size). There was a slight seasonality in the proportion of some of the items ingested. The feeding behaviour of* L. grandisquamis *involves body orientation at an obtuse angle to the bottom with head pointing downwards and slow swimming as it grubs through the bottom deposits.*

KEY WORDS : West Africa — Estuaries — Mugilids — *Liza grandisquamis* — Nigeria — Feeding habits.

RÉSUMÉ

OBSERVATIONS SUR *Liza grandisquamis* (PISCES : MUGILIDAE) DANS LA BONNY RIVER (NIGERIA)

Certains aspects de la biologie de Liza grandisquamis, *concernant en particulier la nourriture et le comportement alimentaire, ont été étudiés dans la Bonny River, dans le delta du Niger au Nigeria de novembre 1982 à décembre 1983. Ce poisson, présent toute l'année, a été capturé le plus souvent au-dessus de substrats vaseux en mangrove. Il constituait 20 % des prises des artisans pêcheurs.*

L. grandisquamis *se nourrit préférentiellement de nuit et moins le jour, ingérant essentiellement des détritus puis de la vase, des grains de sable, des diatomées, des algues vertes et bleues, et des fragments de végétaux supérieurs. Les algues rouges, les microcrustacés, les foraminifères et les nématodes sont occasionnels dans les contenus stomacaux. La taille moyenne des particules ingérées est de 0,024 mm. Les variations saisonnières du régime sont très faibles.* L. grandisquamis *adopte pour se nourrir une position très oblique par rapport au fond, la tête pointée vers le bas en avançant doucement.*

MOTS-CLÉS : Afrique de l'Ouest — Estuaires — Mugilidés — *Liza grandisquamis* — Nutrition — Nigeria.

INTRODUCTION

Liza grandisquamis (VALENCIENNES, 1836) which is one of the six mugilid species in the Bonny River (4°20′ N; 7°13′ E) (fig. 1), Niger Delta, Nigeria (KING, 1984) is an important brackishwater culture species in the area (PILLAY, 1965; BARDACH *et al.*, 1972; pers. observations). SIVALINGAM (1976) reviewed the biology of cultivable brackishwater and marine fin fish in Africa and inferred that *L. falcipinnis* and *L. grandisquamis* are the most common mugilid species in West Africa. FAGADE and OLA-

(1) *Department of Zoology and Fisheries, University of Cross River State, P.M.B. 1017, Uyo, Cross River State, Nigeria.*

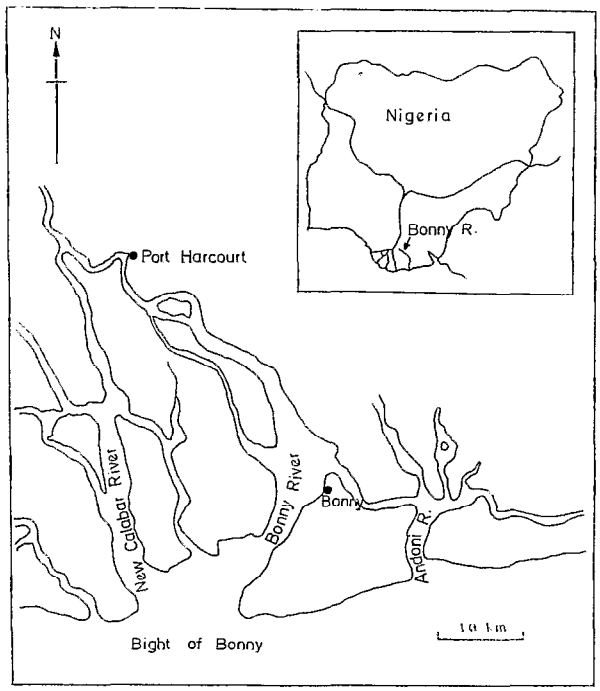

FIG. 1. — Map of Bonny River showing the location of the study area (Port-Harcourt). Inset: map of Nigeria illustrating the approximate position of the Bonny River.
Carte de situation.

NIYAN (1973) gave a brief account of the feeding habit of *L. grandisquamis* in their report on the food and feeding interrelationship of fishes in Lagos lagoon, Nigeria. Ecological studies on *L. grandisquamis* and other mugilids in estuaries in Sierra Leone have also been documented (PAYNE, 1976; WILSON, 1977).

Not much has been reported on the ecology of *L. grandisquamis* in the Bonny system and Niger Delta as a whole. Available literature are the works of KING (1984) and OLANIYI (1984). This dearth of ecological information on the species stimulated the present study which involved inter alia, its distribution, relative abundance, food and feeding regime. Knowledge of these aspects of the ecology of the fish is important in view of its value as food for the riparian communities and the ever increasing interest in its culture in brackishwater ponds.

THE STUDY AREA

The study area was the upper reaches of the Bonny River at Port-Harcourt (4°25′ N; 7°3′ E) (fig. 1). The water is brackish throughout the year; mean high and low tide salinities are 16.3 ‰ (range 11.5-22.4 ‰) and 10.2 ‰ (range 5.0-15.6 ‰) respectively and mean surface temperature is 29.5 °C (range 27-30 °C) (SCOTT, 1966). Monthly variations in salinity and temperature are presented in figure 2. Tidal range is 2.15 m (WOKOMA and EZENWA, 1982). The vegetation of the intertidal zone is dominated by *Rhizophora harrizonii*, *R. mangle*, *R. racemosa*, *Avicennia nitida*, *Laguncularia racemosa*, *Nypa fruticans* and *Phoenix* sp.

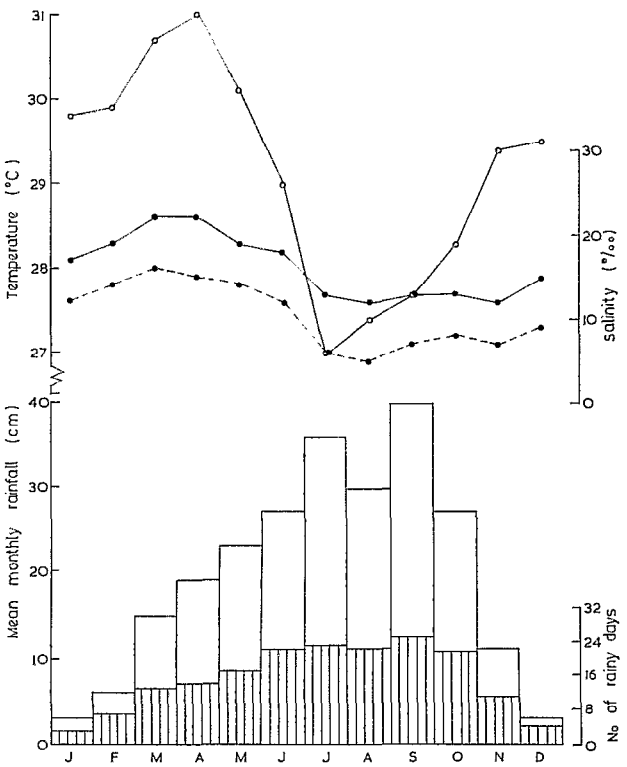

FIG. 2. — Seasonal variation in rainfall (open bars), number of rainy days (striped bars), Bonny River surface temperature (o—o) and salinity high tide (•—•); low tide (•---•) at Port-Harcourt.
Variations saisonnières de la pluie (en clair), et du nombre de jours de pluie par mois (hachuré). Température de l'eau (o—o), salinité à marée haute (•—•), à marée basse (•---•) dans la R. Bonny.

The climate of the area (see TAHAL, 1979) comprises two major seasons (dry and wet) influenced by the type of prevailing winds and rainfall regime. The dry season (November-April) is characterized by the prevalence of hot-dry northeasterly winds from the Sahara desert; mean monthly rainfall ranges between 3 and 19 cm during this season. The wet season (May-October) is characterized by the prevalence of moist southwesterly winds from the Atlantic Ocean and

heavy precipitation with mean monthly rainfall of 23-40 cm with a double maximum in July and September. Mean total annual rainfall is 240 cm with 182 rainy days (fig. 2). More detailed description of the study area is given by NEDECO (1961) and SCOTT (1966).

MATERIALS AND METHODS

Monthly samples of *L. grandisquamis* were collected from the main channel and creeks of the River between December, 1982 and November, 1983 inclusive, using cast nets (1.0-2.5 cm mesh size). These gears, augmented by field observations, provided information on distribution. Estimation of abundance (by number) was based on an analysis of artisanal fishermen catches (KING, 1984). The total lenghts (TL) of 153 randomly selected specimens were measured prior to preservation in 10 % formalin.

They were later dissected and the degree of stomach fullness (by volume) of 44 specimens caught during the day and 30 caught at night was determined (KING, 1984) to evaluate the diel feeding activity of the fish. Food assessment of specimens was based on stomach contents analysis (with the aid of a binocular microscope) using 'occurrence' method and a 'points' scheme similar to that suggested by HYNES (1950). In the occurrence method, the number of stomachs in which each food category occurred was expressed as percentage of all non-empty stomachs examined. This was also calculated for each season. When using the points scheme, each stomach was alloted 20 points regardless of fish size and these were shared amongst the various contents, taking account of their relative proportions by volume. Ten microscope fields of view were examined per stomach and the mean points gained by each food category determined. Total mean points gained by each food category was computed and expressed as percentage of the grand total points gained by all stomach contents. This percentage composition was also determined on seasonal basis.

Items contributing 20 % and over to food composition were regarded as primary diets; those contributing 1-19.9 % were regarded as secondary diets while those with less than 1 % contribution to food composition were classified as incidental diets. The points scheme gives an indication of bulk contribution of each food category to the food composition. The advantages and disadvantages in the use of the above two methods in fish food analysis have been discussed by HYSLOP (1980). The contents of the posterior intestines were examined to assess the digestion of the preferred food items.

Particle size selection by *L. grandisquamis* was determined by measuring the sizes of inorganic materials (mostly silica granules) ingested by 32 specimens (8-20 cm TL) using a stage micrometer calibrated against an eye piece graticule and the mean particle size calculated.

RESULTS AND DISCUSSION

Distribution and abundance

The monthly occurence of *L. grandisquamis* in samples showed that it was available in the area throughout the year. This is contrary to the situation in the Black Johnson estuary, Sierra Leone, where the species was very infrequently caught (PAYNE, 1976). *L. grandisquamis* was most commonly found over muddy substratum and in mangrove environments. This is in conformity with earlier findings of WILSON (1977) in estuaries in Sierra Leone. It was very common in creeks and often moved over inundated mudflats. *L. grandisquamis* was particularly abundant in the area, constituting 20 % of artisanal fishermen catches. It is next to *L. falcipinnis* (the most abundant mugilid) on the hierarchy of mugilid abundance based on canoe landings in the Bonny River (KING, 1984).

Diel feeding pattern

Of 30 specimens caught during the night and examined for stomach fullness, all had more than half of their stomachs distended with food whereas of the 44 specimens caught during the day, 20 had more than half of their stomachs filled while 24 had less than half of their stomachs filled with food. This preliminary observation suggests that though *L. grandisquamis* feeds during day and night, it has a higher feeding activity at night. This nocturnal feeding periodicity probably accounts for its being most abundantly caught between dusk and dawn by local fishermen. This result contrasts with those of ODUM (1970), BLABER (1976), MORIATY (1970) and DE SILVA and WIJEYARATYNE (1977) who all asserted that the mugilid species they studied have a higher feeding intensity during the day.

The food of *L. grandisquamis* (8-20 cm TL)

All the specimens examined had food in their stomachs. Table I shows the trophic spectrum of the fish. The major stomach contents on points basis were detritus, algae and sediments (mud and sand grains); others included higher plant tissues and minute animals (microcrustaceans, foraminifera and free living nematodes). Detritus was of primary importance; mud, sand grains, Bacillariophyceae (diatoms), Cyanophyceae (bluegreen algae), Chloro-

TABLE 1

Seasonal variations and trophic spectrum of *L. grandisquamis* in the Bonny River at Port-Harcourt (% composition C; % occurrence O).

Variations saisonnières du trophisme alimentaire de L. grandisquamis *dans la R. Bonny (% composition C; % occurrence O).*

Dietary items	Dry season C	Dry season O	Wet season C	Wet season O
Detritus	62.4	100.0	72.4	100.0
Mud	11.1	84.4	4.4	81.4
Sand grains	2.3	31.1	0.8	20.3
Bacillariophyceae	10.9	100.0	12.7	100.0
Cyanophyceae	4.5	86.6	3.3	61.1
Chlorophyceae	6.4	75.5	4.7	70.3
Rhodophyceae	0.1	8.8	0.1	12.9
Higher plant tissues	1.6	35.5	0.7	32.4
Foraminifera	0.3	4.4	0.6	4.6
Microcrustaceans	0.2	8.8	0.2	4.6
Nematoda	0.2	13.3	0.2	13.8
Number of specimens	n = 45		n = 108	

phyceae (green algae) and higher plant tissues were of secondary importance while Rhodophyceae (red algae), microcrustaceans (mostly ostracods and harpacticoid copepods), foraminifera and nematodes were of incidental importance. Food predilection by occurrence (table 1) also shows that it fed largely on detritus, mud, diatoms, bluegreen and green algae and higher plant tissues, all of which occurred in over 30 % of the stomachs.

In Lagos lagoon, FAGADE and OLANIYAN (1973) noted the stomach contents of *L. grandisquamis* together with *L. dumerili* and *Mugil curema* as comprising diatoms, sand grains and detritus. OLANIYI (1984) reported on the food of this species from a creek at Port-Harcourt as consisting basically of detritus while diatoms constituted the secondary diet; other stomach contents included algae, ostracods, copepods, nematodes and foraminifera. These findings are in concordance with the present results.

Apart from quantitative differences, there were no variations in the food of different sizes of *L. grandisquamis*. This is comparable to the absence of changes in diet according to length in *L. macrolepis* and *M. cephalus* in Natal estuaries (BLABER, 1977). Variations in diet according to size have however been reported in *M. cephalus* and *M. curema* in South Carolina (CAIN and DEAN, 1976) and *M. cephalus* in Negombo lagoon, Sri Lanka (DE SILVA and WIJEYARATYNE, 1977).

L. grandisquamis may be described as a 'detritivore' by virtue of the high proportion and occurrence of detritus in its diet. Iliophagy (detritus feeding) is also known to constitute the major feeding habit of many other mugilids (PILLAY, 1953; ODUM, 1970; FAGADE and OLANIYAN, 1973; PAYNE, 1976; RAMANATHAN *et al.*, 1980; KING, 1984; OLANIYI, 1984).

Of the algae ingested by *L. grandisquamis*, diatoms were most important, occurring in all the stomachs and accounting for 12 % of the food composition. They were dominated by the pennate forms *(Bacillaria, Navicula, Gyrosigma, Pleurosigma, Nitzschia* and *Surirella)* while the centric forms (mostly *Coscinodiscus, Stephanodiscus* and *Cyclotella*) were poorly represented in the stomachs. Diatoms were apparently digested as evidenced by the presence of their empty frustules in the recta. The bluegreen algae (dominated by *Oscillatoria* and *Spirulina*) and green algae (mainly *Closterium, Penium, Cosmarium* and euglenids) each category of which occurred in over 70 % of the stomachs were utilised to some extent as suggested by the presence of their fragments with ruptured walls, some distorted/empty cells and filaments in the recta. Fish with intact cells and filaments of these algae in the recta were also common in the sample. A similar observation on the digestion of bluegreen algae by other mugilids has been reported by PAYNE (1976). The macro-red algae *(Bostrychia* and *Calaglossa)* occurred in very few stomachs and could not be identified in rectal contents; they were probably digested.

Ostracods, copepods, foraminifera and nematodes which may have been accidentally ingested while grubbing through bottom deposits are probably of some nutritional value. Together, they contributed less than 1 % to the food composition and each occurred in less than 20 % of the stomachs. The presence of microcrustacean fragments in rectal contents suggested their digestion. Intact foramini-

fera tests were however apparent in rectal contents while nematodes could not be identified thus suggesting their being digested.

Particle size selection

L. grandisquamis selectively ingested particles of 0.024 mm (mean size). The significance of fine particle selection by mugilids has been discussed by ODUM (1970), PILLAY (1972), MARIAS (1980) and BRUSLE (1981). It includes the fact that fine particles are richer in adsorbed organic matter, bacteria, protozoa and other microorganisms (which are of great potential food value) than coarser ones.

Interspecific differences have been reported in particle size selected by mugilids (BLABER, 1976, 1977; MASSON and MARIAS, 1975; MARIAS, 1980; PAYNE, 1976; KING, 1984). Differential particle size selection by allied sympatric mugilid species with overlapping trophic niches may minimise competition (BLABER, 1976, 1977; KING, 1984).

Seasonal variation in feeding pattern

The seasonality in the feeding regime of the fish is shown in table 1. The increase of about 10 % in the proportion of detritus taken during the wet season is probably associated with the increase in allochthonous input from adjacent terrestrial land and mangrove swamps as well as a decrease in the abundance of other major dietary items. The occurrence of the dietary items on seasonal basis (table 1) follows a similar pattern as above but shows an increase in the occurrence of bluegreen algae during the dry season. PAYNE (1976) observed a similar trend in the occurrence of bluegreen algae in the food of other mugilids. The occurrence of sand grains and microcrustaceans also increased by 10 and 4 % respectively during the dry season while on the contrary, that of red algae increased by over 4 % during the wet season.

Feeding behaviour

L. grandisquamis feeds in schools from the shallow banks of the river and creeks. It orientates itself roughly at an obtuse angle to the bottom with head facing downwards and moving slowly as it feeds at the bottom. This seems to be an effective technique for ingesting bottom deposits with associated phyto — and zoobenthos. On the contrary, FAGADE and OLANIYAN (1973) observed that mugilids in Lagos lagoon feed on bottom deposits by first stirring up the bottom and then filtering the particles brought into suspension with the aid of their gill rakers.

CONCLUSION

In the upper reaches of the Bonny River estuary, *L. grandisquamis* appears to have a distribution in muddy and mangrove environments which may be correlated with its food preference. This distribution may account for the variety of items ingested, the uniformity in the food composition and feeding pattern of different sizes of the fish.

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