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FEEDING ECOLOGY OF A MUGILID FISH, *LIZA ABU* (HECKEL) IN BASRAH, IRAQ

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Feeding ecology of few fishes have been properly delineated. This delineation is a prerequisite for an understanding of interspecific relations, proper management and future studies in secondary productivity. As stated by Hela and Laevastu (1961), there is often a positive correlation between the quantity as well as the specific type of plankton and abundance of fish. Some food species can also be used as indicators of the abundance of fish.

The mullets (Mugilidae) with their tasty and rich flesh are valued commercially. Some species of the mullets are also adapted for cultivation in brackish water ponds. Mookerjee *et al.* (1946), working on the food of Indian mullet, *Mugil parsia*, made a suggestion to culture it in fresh water ponds Fagade and Olaniyan (1973) studied the food and feeding interrelationships of some other Mugilid species (*Liza falcininuis*, *L. grandisquamis*, *L. dumerilii*, *Mugil banaensis*, *M. cephalus*, and *M. curema*). But our knowledge on the feeding ecology of *Liza abu* which abounds in the fresh waters of Iraq is very meagre, and little attention has been devoted to the subject in Iraq. The present work, therefore, is an attempt to determine the types of food eaten by *Liza abu* and some of the ecological conditions which may influence the feeding of the species.

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MATERIALS AND METHODS

Samples of the fish were taken during the months of December, 1975, February and April, 1976 by cast nets from a station, Nahar Jasim at the Salihiya channel of the Shatt al-Arab River. Shatt al-Arab is virtually the tidal estuary of two great rivers of Iraq, the Tigris and the Euphrates, flowing down to the Arab Gulf. The waters of these rivers, as found by Saad and Kell (1975), are biologically different. Shatt al-Arab is also influenced by tides from the Arab Gulf to which it flows.

A total of 51 fish were collected. Ecological data viz., time of day, air and water temperatures and water transparency were recorded during each sampling. Water samples for dissolved oxygen and chlorosity were collected by a standard water sampler (Casella No. 16700 made in England) from a depth of 1 meter. Samples for oxygen were duly fixed soon after collection. Temperatures were measured with a simple thermometer graduated to 0·2°C, and the water transparency was determined with a white enamelled Secchi disc 25 cm in diameter. Fish samples collected were taken to the laboratory and frozen in order to reduce posthumous digestion to the minimum, for later examination.

The standard length in mm of all fish collected were determined in the laboratory. The stomachs were then removed and preserved in 5 percent formalin. The chemical analyses of the water samples were completed the same day on return from the field trip. The Winkler method was followed for determination of dissolved oxygen. The chlorosity was determined by the ordinary Mohr's method. Contents of the gizzard — like stomach were analysed both qualitatively and quantitatively. The "points" method of Hynes (1950), slightly modified by Sarker (1973), was followed. Data analyses were based on occurrence, average index of fullness of the stomachs, average number of points per stomach and four categories of the stomach contents. All the points for each category were added up and converted into percentages of the total number of points allotted for all categories in different months. Food items were identified as far as possible with the help of an inverted microscope.

RESULTS AND DISCUSSION

The results of the present study have been summarized in Tables 1 to 3. Fish ranged in standard length from 83 to 140 mm. Only three of the 51 stomachs examined were found empty. The principal groups of stomach contents found in this study were phytoplankton, aquatic plant parts, sand grains and organic detritus. Of these four categories, sand grains and organic detritus comprised the bulk of the stomach contents, and they occurred in almost equal proportions, as shown by average points per fish and percentage of total points (Table 1). Acquatic plant parts and phytoplankton, on the other hand, were found to rank nearly equal in importance as food of the species, when judged by both average number of points and percentage of total points. In respect of percentage of occurrence, both phytoplankton and organic detritus ranked equally important and, therefore, may be tied for first position, sand grains standing a close second. The relative importance of the various categories may, however, be seen from the mean percentage composition of the stomach contents for whole period of investigation (Organic detritus 42·8, sand grains 41·2, phytoplankton 8·6 and aquatic plant parts 7·4). Sand grains are not considered as food of the

Table 1. General pattern of feeding of *L. abu* by food catego-ries (based on 51 fish examined)

	Food Categories			
	Phytoplankton	Aquatic plant parts	Sand grains	Organic detritus
Occurrence	48 (94·1%)	40 (78·4%)	47 (92·2%)	48 (94·1%)
Average points per fish	3·6	3·3	17·0	17·7
Percentage of total points	8·6	7·4	41·2	42·8

species. They may have been ingested while the fish was searching for food on the detritus. The fish, therefore, fed mainly on organic detuitus. The next preferred food was phytoplankton, as many as 37 types belonging to three classes of algae (Cyanophyceae, Bacillariophyceae and Chlorophyceae) shown in Appendix — 1. The list of phytoplankton has been prepared after Prescott (1970).

The diatoms (Bacillariophyceae) alone comprised 50% of the phytoplankton while the blue green algae (Cyanophyceae) and green algae (Chlorophyceae) accounted for 14% and 36% respectively. If the numberical abundance method had been applied in analysis, the diatoms could have formed the bulk of the food organisms. This finding of the present study is thus in agreement to that of Fagade and Olaniyan (*op. cit.*) who worked on the closely related *L. falcininnis*. Again, in our study, the Pennales accounted for about 74% and the Centrales about 26% of the diatoms.

Of the aquatic plant parts, broken and fragmented leaves of *Vallisneria* were most freqquently encountered in the stomachs. Leaves and stems of other aquatic plants, namely *Potamogeton* and *Polygonum*, were also found in the stomachs, but these items occurred only rarely, and the consumption of these plant parts may be regarded as accidental.

Monthly Patterns of Feeding :

The monthly feeding patterns in the fish have been shown in Table 2 and Figure 1. Judged by the frequency of occurrence of various categories, it can be seen that three of the four categories viz., phytoplankton, sand grains and organic detritus occurred in 100% of fish collected in April and in 93·3% of fish collected in February (Table 2). In December, the per-

Table 2. Monthly patterns of feeding of *L. abu* by food categories (N = number of fish examined, P = number of total points, Occurrence = number of fish in which occurred).

		Phytoplankton	Aq. plant parts	Sand gains	Organic detritus
December	Occurrence	15	13	14	15
1975	% occurrence	88·2	76·4	82·4	88·2
N=17, P=454	Av. points/fish	3·6	1·6	10·6	10·4
	% total points	13·3	6·0	40·7	40·0
February	Occurrence	14	11	14	14
1976	% occurrence	93·3	73·3	93·3	93·3
N=15, P=455	Av. point/fish	1·9	2·3	12·5	13·6
	% total points	6·2	7·7	41·3	44·8
April	Occurrence	19	16	19	19
1976	% occurrence	100	89·5	100	100
N=19, P=1199	Av. point/fish	4·9	5·0	26·1	27·2
	% total points	7·8	7·9	41·3	43·0

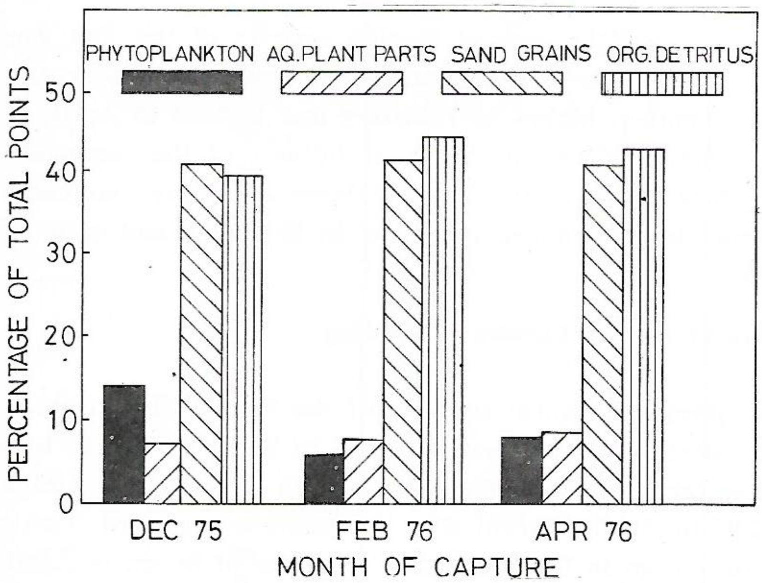

Fig. 1. Percentage contribution of the different categories of Stomach contents in *L. abu* by months.

centage of occurrence for phytoplankton and organic detritus was similar and was higher than those for other categories. Based on both average points and percentage of total points, organic detritus was found to be the most important article of diet during February and April. In December, the data were erratic, probably because, small fish were the dominant size class, and large fish were fewer in this collection. The percentage composition of the various categories showing the variation in the groups comprising the stomach contents and their relative importance during different months may be seen in Figure 1. The pattern of feeding on aquatic plants as shown by percentage of total points was lowest in December, higher in February and highest in April.

A picture of the general feeding activity of the fish has been given in Table 1. The intensity of feeding was generally low in December, higher in February and highest in April, as indicated by both average index of fullness of the stomachs and average food points. The incidence of empty stomachs was two in December, only one in February and none in April.

Relation of Abiotic Factors to Feeding :

The physico-chemical features of the fish habitat at times of fish collections have been indicated in Table 3. Water temperatures ranged from 14·8°C minimum in December to a high of 26·2°C in April. Secchi disc transparency ranged from a low value 32 cm in December to a high one of 64 cm in April. The extinction co-efficient (K values) ranged from 2·65 to 5·3. Dissolved oxygen levels ranged from a minimum of 6·0 mg/l in April to a high of 7·4 mg/l in December. The chlorosity content of the habitat water varied from 0·28 g/l minimum in February to 0·33 g/l in April.

The ecological conditions of the study area as indicated above seemed to have no adverse effects on feeding of the fish. The food organisms found among the stomach contents were mainly phytoplankton. According to Saad (personal communication) who worked on the influence of environmental conditions on phytoplankton populations, most of the dominant species of phytoplankton inhabiting the Shatt al-Arab are eurythermic forms, tolerating a wide range of temperature variations. The difference between the absolute maximum and minimum average values of water temperatures as recorded by him during four different seasons of the year was about 16·0°C. In the present study, the difference in the range was 11·4°C.

Table 3. Some physico — chemical features of the study site at times of fish collection.

Date of collection (Time 10 : 00)	Temperature° C Air *	Water **	Transparency Depth (cm)	K	Dissolved Oxygen (mg/l)	Chlorosity (g/lCl)
18 Dec. 1975	18·6	14·8	32	5·3	7·4	0·30
25 Feb. 1976	19·2	16·0	64	3·0	6·8	0·28
19 Apr. 1976	29·5	26·2	57	2·65	6·0	0·33

* 1 m above the water surface ; ** Surface

The transparency of water at the site of collection was found to be quite high and was, therefore, congenial to the growth and survival of phytoplankton groups. The extent of photosynthetic zones at times of fish collections at the study site as calculated after Vatova (1961), on multiplying the secchi disc readings by 3·3, reached values of 1·06 m, 1·9 m and 2·1 m in December, February and April respectively. The depth of fish collections never exceeded these photosynthetic zones. Saad and Kell (1975), working on environmental conditions and phytoplankton blooms in the Rivers Tigris, Euphrates and Shatt al-Arab, concludes that photosynthetic depth values of 1·65 m in Tigris and Shatt al-Arab are favourable for phytoplankton blooms. Alto dissolved oxygen generally showed normal concentrations that account for the availability of phytoplankton in the investigated area.

The data on chlorosity indicate that the study area is a typical fresh water habitat, little influtnctd by the tidal currents and hence by the salinity of the Arab Gulf. As would be expected, the phytoplankton and other aquatic vegetation found in the stomachs are, therefore, typical fresh water forms.

As to the major contribution of the diatoms to the diet among the phytoplankton, our findings approximate those of Kell and Saad (1975) who worked on the phytoplankton and some environmental parameters of the Shatt al-Arab. In their study, the share of the diatoms in the total number of cells amounted to 68%, that of green algae comprised 19% and the blue greens 13%.

SUMMARY

The mean percentage composition of the stomach contents for the whole period of investigations was as follows : organic

detritus 42·8, sand grains 41·2, phytoplankton 8·6 and aquatic plant parts 7·4. In respect of percentage of occurrence, organic detritus and phytoplankton ranked equally important. The diatoms alone comprised 50% of the phytoplankton as food organisms. The Pennales accounted for about 74% and the Centrales about 26% of the diatoms. Aquatic plant parts and phytoplankton ranked nearly equal in importance as food of the fish when judged by both average number of points and percentage of total points. Sand grains might have been unavoidably ingested while the fish fed on bottom food.

Among the food categories, organic detritus formed the highest percentage of food volume in all months of capture. As indicated by both average index of fullness of the stomachs and average food points, the intensity of feeding was generally low in December, higher in February and highest in April.

The data on physico-chemical conditions as found in this study accounted for the availability in the habitat of the food organisms eaten by the fish. Temperatures of water ranged from a minimum of 14·8 in December to a maximum of 26·2°C in April. The range of extinction co-efficient was 2·65 to 5·3. Dissolved oxygen concentrations ranged from 6·0mg/l in April to 7·4mg/l in December and chlorosity content from 0·28g/l in February to 0·33g/l in April.

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APPENDIX 1

LIST OF PHYTOPLANKTON FOUND AMONG THE STOMACH CONTENTS OF *L. ABU*.

CYANOPHYCEAE

Order-Oscillatoriales : *Lyngbya* sp., *Microcoleus* sp., *Oscillatoria* sp., *Phormidium* sp.,

Order Nostocales : *Anabaena* sp.,

BACILLARIOPHYCEAE

Order-Centrales : *Biddulphia* sp., *Coscinodiscus* sp., *Cyclotella* sp., *Melosira* sp., *Rhizosolenia* sp.

Order Pennales : *Amphora* sp., *Asterionella Japonica, Cyclophora tenuis, Diatoma elongatum, Epithemia* sp., *Fragillaria* sp., *Gyrosigma acuminatum, Meridion* sp., *Navicula halophila, Nitzschia spectabilis N. closterium, Pinnularia angulatum, Pleurosigma* sp., *Surirella ovata, Synedra* spp.

CHLOROPHYCEAE

Order-Tetrasporales : *Tetraspora* sp

Order Chlorococcales : *Ankistrodesmus gracilis, Closteriopsis* sp.

Order Ulotrichales : *Ulothrix* sp.

Order Zygnematales : *Closterium* sp., *Cosmarium* sp., *Gonatozygon* sp.,*Mesotaenium* sp., *Mougeotia* sp., *Netrium* sp., *Penium* sp., *Spirotaenia* sp.

الخــلاصــة

كانت النسبة المئوية لمحتويات معــد الاسماك (*Liza abu*) طوال فترة البحث هي/الفتات العضوية ٨ر٤٢ ، الحبيبات الرملية ٢ر٤١ ، الهوائم النباتية ٦ر٨ ، النباتات المائية ٤ر٧ ان الدياتومات كاحياء غذائيــة كانت تؤلف ٥٠٪من مجموع الهوائم النباتية حيث كانت الدياتومات الريشية٧٤٪ والقرصية ٢٦٪ ٠

وجد أن اجزاء النباتات المائية والهوائم النباتية متساوية في الاهمية كغذاء للاسماك ٠ لاتدخل الحبيبات الرملية في عملية الهضم عندما تقتــات الاسماك على الغــذاء القاعي ٠ كونت الفتات العضوية من بيــن مجموعات الغذاء النسبة العليا من حجم الغذاء خلال اشهر الصيد ٠

كانت درجة حرارة الماء تتراوح بين نهاية صغرى في كانــون الاول (٨ر١٤ م) ونهاية عظمى في نيسان (٢ر٢٦ م) ومعامل درجة نقاء المــاء تتراوح بين ٦٥ر٢ الى ٣ر٥ ٠ امــا تركيز الاوكسجين المذاب فتراوح بين ٦ ملغم/اللتر في نيسان و ٤ر٧ ملغم/اللتر في كانون الاول ٠

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SOME OBSERVATIONS ON *SOME* PHYSICO-CHEMICAL FEATURES OF TWO SIDE BRANCHES OF THE SHATT-AL-ARAB RIVER

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Limited limnological works have been done on the Shatt-Al-Arab river and its branches. Some hydrographical characteristics of the Shatt-Al-Arab and its adjacent areas were reported by Arndt and Al-Saadi (1975). Mohammad (1965) published his preliminary observations on some environmental conditions of the Shatt-Al-Arab based on a short term data. Keel and Saad (1975) studied the phytoplankton and some environmentatl parameters of the Shatt-Al-Arab. But our knowledge of the environmental factors of the side branches of the Shatt-Al-Arab is still scarce. The present paper, therefore, deals with the physico-chemical features of the two side branches (Sarraji and Mehejran) of the Shatt-Al-Arab river. Such ecological investigations on aquatic habitats are needed for solving agricultural and fisheries problems. Further these water bodies harbour numerous fauna and flora which are influenced by the physico-chemical conditions of these habitats.

STUDY AREA

The Sarraji and Mehejran are two side branches of the Shatt-Al-Arab. The width of the Sarraji at the upper portion is 23m, and at the lower portion 12m. It has a mean depth of