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ORIGINAL ARTICLE

**Analysis of the Diet of the *Liza abu* (Heckel, 1843) in Mond River in Bushehr seaport**

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ABSTRACT

During the fishing season, 765 *Liza abu* were collected from Mond River and the contents of their digestive system were examined. The minimum and maximum length of the collected fish was 45 and 350 mm, respectively. In addition, the gut length to body length ratio (RLG) of the one-year and five-year fish was 4 and 2.2, respectively. The highest frequency of nutrients in the river belonged to the Ephemeroptera, but the feeding preference of this fish was Plecoptera and Odonata in both rivers. The research results revealed that this fish is an omnivorous species given its feeding habits.

**Keywords;** *Liza abu*, Mond River, Diet

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**INTRODUCTION**

Bushehr seaport is located in the southwest of Iran on the banks of the Persian Gulf [1] with a geographical latitude of 28°48,30" N and longitude of 50°52,58" E. Therefore, given its geographical position, its special climate, and the long borders it shares with the Persian Gulf, this port owns a unique nature and ecological potential. The Mond River, which runs through this region and meets the sea, accounts for the special ecosystem of this area. As a result, the firths that are located within the boundaries of the protected zone and the estuary of the Mond River have the richest species diversity among the southern provinces of Iran. One of the most important ecological and economic qualities of these firths is the recruitment that normally occurs in these areas [2].

This river houses numerous species of fish, many of which are the native fish of Iran [3] and many others have economic values. *Liza abu*, which belongs to the Mugilidae family, is widely scattered in the southern rivers of Iran that flow into the Mond River. This fish is an omnivorous fish that feeds on aquatic plants and phytoplankton [4]. Studies have been carried out on the dispersion of this species in the south of Iran [3, 5, 6, 7]. However, no study has investigated the biological characteristics especially the nutritive and reproductive characteristics of this species. However, given the economic value of this species, it is necessary to obtain more information on the nutritive and reproductive characteristics of this fish. Therefore, a study was carried out to explore the diet of this fish.

**MATERIAL AND METHODS**

**Study area**

This research was carried out for 14 months (from January 2012 to February 2014). The length of the study path was 200 km and seven stations along the river were selected based on the river conditions and topography of the region (Fig. 1). It was tried to select several different stations along the river. During the study period, 1656 *Liza abu* were collected using gill nets with 5, 10, and 15 mm meshes.



Figure 1; The position of the study station in the Mond River

When it was possible to use stun guns in a station the preys were hunted using this device (stations 1 and 2). The preying was carried out on a monthly basis. During the fishing, samples of the demersal fish were also collected by a surber with a surface area of 900cm<sup>2</sup>. The ages of the fish were also determined based on the scales growth ring. After cleaning, the scales were fixed between two slides in warm water and the growth rings were counted using a stereoscope (10-20x). After measuring the total weight and length of the fish, the abdomens of the fish were cut using a scalpel and a blade so that the viscus could remain intact. Afterwards, the digestive tract of each fish was removed from the throat and was stored in 70% alcohol. The isolations were then transferred to a laboratory in order to study the contents of the digestive tract and the number of the different species was counted using a stereoscope (10-20x) [8]. The measures for counting the species were organs such as the head, chest, and abdomen of the eaten organisms [9] and the species were identified based on their specific features [8]. The genus of the contents of the digestive tract was identified and counted. The results of partitioning the intestinal contents must be always compared to the food available to the fish in the aquatic habitat of the fish. Therefore, the Ivlev (1961) formula was used to determine the selected food index.

$$E = (r_i - p_i) / (r_i + p_i)$$

Where  $r_i$  is the relative frequency of the nutrient in the intestines and  $p_i$  denotes the relative frequency of the nutrient in water.  $E$  varies between -1 and +1, and it is considered a positive selected index of the nutrient. A negative index reflects the rejection of the nutrient. The following formula was also utilized to

determine the relative frequency (%) of the nutrient:  $A_i = \sum S_i / \sum S_t \times 100$ . In this relation,  $A$  shows the relative frequency (%) of the given nutrient,  $S_i$  shows the quantity of the nutrient in the environment, and  $S_t$  stands for the total quantity of the nutrients.

To determine the diet, the RLG value is easily obtained as the gut length to body length ratio [10].

$$RLG = \text{gut length} / \text{body length}$$

The index of fullness of the digestive system (IF) is calculated by the following formula [11].

$$I.F = W_1 \cdot 10^4 / W_2$$

Where,  $W_1$  and  $W_2$  denote the digestive system contents and the fish weight, respectively. The following formula is used to study the biodiversity of the fish [12].

$$H = - \sum P_i \ln P_i$$

In the above formula,  $H$  is the Shanon index and  $P_i$  is the relative frequency of the  $i$  species individuals in the sample.

## RESULTS

During the sampling the characteristics of the species were recorded in each station as presented in Table (1). As seen, the characteristics of the species in the station no. 1 differ significantly from those of the stations no. 5, 6, and 7.

Considering the frequency percentage of each organism it was found that the *Barbus luteus* species mostly prefers to feed on *Coleoptera*, *Hemiptera*, *Odonata*, *Trichoptera* and *Plecoptera* and it does not prefer other organisms (Table 2).

The RLG (gut length to body length ratio) and IF (index of fullness) were calculated for different age groups of the species and it was realized that both of these factors decrease as the species ages. The RLG results also imply that this species has an omnivorous diet (Table 3).

According to the index of fullness (IF) values calculated in different stations indicated that the intestines of the fish were fuller in the upstream stations (Table 4).

A comparison was drawn between the benthos diversity indices of the stations, and the indices were calculated by month for each station as shown in Figure (1). According to this figure, stations no. 1, 2, and 3 have the highest diversity whereas the lowest biodiversity was recorded in the downstream stations such as stations no. 6 and 7. The benthos diversity in these two rivers was higher during the warm seasons (i.e. spring and summer) as compared to the other seasons and the same condition was almost observed in all stations.

Table 1; The average annual value of some of the characteristics of each station in Mond River

Station	Water temperature (°C) $\bar{X} \pm SD$ (minimum - maximum)	Altitude (m)	Irrigation (m <sup>3</sup> /sec) $\bar{X} \pm SD$ (minimum - maximum)	Average depth (m) $\bar{X} \pm SD$ (minimum - maximum)	River width (m) $\bar{X} \pm SD$ (minimum - maximum)	Bed type
1	21±6.1 (11-24)	165	10.9±3.3 (5.4-16)	0.6±0.5 (0.45-1.1)	12±5 (7-17)	Rubble
2	21.6±6.4 (13-28)	95	11.7±3.4 (6.1-16.7)	0.8±0.5 (0.49-1.3)	12.5±4 (8.5-17)	Rubble
3	22±5.4 (13-31)	80	14.2±4.1 (8.7-19)	0.68±0.42 (0.66-1.85)	15±4 (11-19)	Rubble - gravel
4	22.2±5.3 (14-32)	65	15.6±4.3 (9-21)	0.88±0.4 (0.78-1.92)	16±3 (13-19)	Sand
5	22.8±4.6 (16-35)	45	29.6±4.5 (19-38)	1.2±0.6 (0.92-2)	28±6 (22-32)	Sandy loam
6	23.7±5.6 (16-37)	15	34.6±7.6 (22-48)	2±0.5 (1.5-2.8)	35±6 (29-41)	Sandy-clay loam
7	23.8±5.4 (16-37)	3	34.9±7.6 (21-48)	2±0.6 (1.3-2.8)	38±7 (31-45)	Sand clay loam

Table 2; The feeding preference and frequency percentage of different nutrient groups in the digestive tract of the *Liza abu* and in the environment.

Ivlev index	Digestive system frequency (%)	Percent of frequency of the nutrient in the environment	Nutrient group
-0.166	5	7	<i>Bivalvia</i>
0.547	6	2	<i>Coleoptera</i>
-0.185	11	16	<i>Diptera</i>
-0.21	16	24	<i>Ephemeroptera</i>
-0.176	7	10	<i>Gasteropoda</i>
0.142	4	3	<i>Hemiptera</i>
-0.142	3	4	<i>Mesogasteropoda</i>
0.625	13	3	<i>Odonata</i>
-0.047	10	11	<i>Oligochata</i>
0.636	9	2	<i>Plecoptera</i>
-0.444	5	13	<i>Polychata</i>
0.333	10	5	<i>Trichoptera</i>

Table 3; RLG and the index of fullness of the *Liza abu* at different ages

	One year	Two years	Three years	Four years	Five years
RLG					
$\bar{X} \pm SD$ (quantity)	3.77±1.41 (239)	3.41±1.28 (412)	3.11±0.88 (338)	2.91±1.08 (181)	2.22±0.71 (98)
Index of fullness					
$\bar{X} \pm SD$ (quantity)	24.1±12.3 (81)	23.15±11.12 (188)	22.5±11.4 (338)	19.11±11 (167)	18.81±15.2 (73)

Table 4; The index of fullness of *Liza abu* samples in different stations

Station	1	2	3	4	5	6	7
Index of fullness							
$\bar{X} \pm SD$ (Quantity)	27±15.2 (161)	26.5±15.6 (182)	20.1±11.5 (178)	19.1±11.1 (149)	18.1±12.1 (155)	16.3±7.8 (168)	15.33±10.61 (132)

## DISCUSSION

The number of the studies conducted on this fish is not enough to analyze and compare our results with the previous research results, but research has been carried out on similar species of this order. For instance, [5] carried out a study on the shabout and introduced this fish as omnivorous species. The nutrients found in the digestive tracts of this fish included plant fiber, planktons, animals, and the polychaete as well as crushed meat pieces, vertebrate fish, insects, and larvae. No trace of vertebrate fish or other animals was observed in the *Liza abu* species, and it was obviously clear that this fish likes macrobenthos similar to shabout because they were widely present in the digestive tracts of the samples. The gut length to body length ratio (RLG) decreases with an increase in the fish age. Therefore, it increases from 3.77 at the age of one to 2.22 at the age of 5. This finding indicates that this fish is an omnivorous species. Other researchers have also stated that this fish inclines towards the omnivorous habit at higher ages [13]. The length of the intestine of an animal depends on the food consumed by that animal. In other words, the intestine length increases with an increase in the herbal contents of the diet. Moreover, RLG not only varies by species but also does vary by age in a single species [14]. This fish is also phytophagous in the beginning but it becomes omnivorous over time. However, due to the presence of plant particles in the fish it was not possible to identify a distinct omnivorous trend at higher ages. The IF percentage was also calculated at different ages, and it was found that the IF percentage decreased from the age of 1 to 5. Based on the IF results, the *Liza abu* showed higher indices of fullness in the colder stations as compared to the warmer stations. In other words, station no. 1 had the highest index of fullness (=27) and stations 6 and 7, which had higher annual temperatures, had the smallest index of fullness (=16). This can be attributed to the higher temperature, metabolism, digestion, and energy absorption in these areas which reduce the food retention time [15].

The feeding preference and frequency percentage of the different nutrient groups in the digestive tract of *Liza abu* and in the environment suggest that based on the resulting Ivlev indices, this fish is extremely interested in *Odonata*, *Coleoptera*, *Plecoptera*, *Hemiptera* and *Trichoptera* in the Mond River of Bushehr seaport. This feeding preference, which was calculated based on the frequency (%) of the nutrients in the digestive tract of this fish and the environment, had not been previously studied or calculated [13].

Therefore, depending on the salinity and temperature tolerance ranges [13] this species is found in all water resources with varying ecological features including fresh water, salty water, and estuaries. In addition to the salinity and temperature, the herbivorous tendencies of this fish it is considered an important characteristic.

According to the results of the research on this fish, it seems the *Liza abu* has all of the characteristics of the omnivorous diet, which is caused by the wide range of the plant and animal groups that are included in the diet of this fish. The investigation results also suggest that the digestive system of the *Liza abu* in all of the water resources under study was often full and it was rarely empty. To explain this emptiness it could be stated that the samples had not been fed prior to the fishing or the contents of the digestive system had been digested in the period between the preying and the examinations [5, 16, 17].

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