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# Studies on Feeding Ecology of Sailfin Molly (*Poecilia latipinna*) Dwelling in Wadi Haneefah Stream, Riyadh

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**Abstract:** Feeding ecology of sailfin molly (*Poecilia latipinna*), an introduced fish species, was studied. Food items recovered from the stomach of fishes exclusively indicated that it is a herbivorous fish. And according to data obtained there is not much difference in the type of food consumed by the fishes of different size groups. Frequency of occurrence of different food items in the diet of fishes of various sizes was high. The value of vacuity index also showed variation throughout the study period. The diet overlap index was high which shows the sharing of food items among the fishes of different size groups. The diet breadth index also showed variations among the fishes of various sizes and in different seasons.

**Key words:** *Poecilia latipinna*, feeding ecology, diet overlap index, diet breath index

## INTRODUCTION

Feeding studies are made to examine the diet of a fish population with a view to assess the species' nutritional status in context of the fish community. Such studies may consider seasonal variations in the diet and/ or dietary comparison either between the different subgroups of the same species or between different species living in the same habitat. Studies related to feeding of fishes in their natural environments are of prime importance for the management of their fishery and also for the environment (Al-Kahem *et al*., 1988, 1990). This also helps in understanding the role of fish in environments and its relation with other species of fish inhabiting in the same environment. A considerable number of literatures are available on this aspects (Ikomi and Odum, 1998; Cabral, 2000; Xie *et al*., 2000; Morte *et al*., 2001, 2002; Friedlander *et al*., 2002; Luckstadt and Reiti, 2002; Kavadias *et al*., 2003; Rikardsen *et al*., 2003; Sever *et al*., 2005).

A sparse fish fauna could be expected in Saudi Arabia in view of its arid environments. Almost nine species of fish were introduced in freshwater bodies of this country. The sailfin molly, *Poecilia latipinna*, is cosmopolitan in distribution inhabiting in surface water (Littoral zone) of streams, pools and other lentic or lotic water bodies. It is a native of America and has been introduced in many parts of the world. Despite its commercial and economic value, little is known about the feeding ecology of sailfin molly. Published information on its diet from the Saudi Arabia lists phytoplankton as major part and a small quantity of zooplankton (Al-Akel, 2003). In the present study an attempt was made to examine the feeding ecology of *Poecilia latipinna* in the field to determine type of food consumed, the selection of food displaced by it, its diet breadth index and diet overlap index among different size groups of this species.

## MATERIALS AND METHODS

Water samples for the phytoplankton and zooplanktons were collected from the same region from where the fish specimens were collected. For the zooplankton 100 L of water was filtered through plankton net made with cloths with a mesh size of 50 μm in a sampling bottle of 50 mL capacity. Preserved in 10% formaldehyde and kept for further investigations. For the phytoplankton 1 L of water from the surface was collected in a bottle and 10 mL of Lugols' solution was added for preservation. Qualitative and quantitative analysis of the phyto-and zooplankton were made in a known volume of water under the microscope and expressed as number of individuals per liter.

The specimens of sailfin molly, *Poecilia latipinna*, (total length from 39-97 mm and total weight 0.80-13.30 g) were collected from Wadi Haneefah stream, Riyadh at a fixed time (09.00 am+30.00 min) between 20 to 25 of each month. Immediately after catch fishes were weighed for the total weight and measured for total length. They were divided in three (I group from 40-60 mm,

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II group from 61-80 mm and III group from 81 to onward) on basis of their total lengths. The food canals of the fish specimens were removed weighed and preserved in 10% formaldehyde and kept for further analysis. The food contents of the gut of various fishes were analyzed according to the methods used by Jafri and Mustafa (1977) and Al-Kahem *et al.* (1990). Relative abundance of different food items in the gut of fishes of various sizes groups and in the environment was expressed on percentage basis.

Vacuity index (V) was measured with following formula:

$$V = \frac{\text{Number of empty stomsch}}{\text{Total number of stomach examined}} \times 100$$

Frequency of occurrence (F) of the food items were calculated on the basis of presence of a particular food item in the gut of the fishes of different size groups.

$$F = \frac{\text{Number of stomach with food}}{\text{Number of stomachs examined}} \times 100$$

Food preference (selection) by the specimens of different size groups in different seasons were calculated by the method described by Lazzaro (1987) which is as follows:

$$E = [ri/pi] \Big/ \left| \sum_{i=1}^{n} ri/pi \right|$$

E = Food selection index. ri and pi are the proportion of food type I in the fish's ration and in the environment, respectively.

Diet overlapping between size classes in different seasons is based on the overlap coefficient of Schoener (1970) and was calculated with the formula used by Morte *et al.* (2002) which is as follows:

$$a = 1 - 0.5\left( \sum_{i=1}^{n} |Pxi - Pyi| \right)$$

a = diet overlap co-efficient, n = types (no.) of food organisms, pxi and pyi are the numerical composition indices of prey (I) in the diet of size group x and y, respectively.

The diet breadth index was measured with Lavin's standardized index that was calculated by the formula:

$$Bi = (n-1)^{-1}[(\sum JPij^2)^{-1} - 1]$$

Bi = Lavin's standardized index for predator I, Pij = proportion of diet of predator I that is made up for prey j and n = number of prey categories. The value of it ranges from 0 to 1.

## RESULTS AND DISCUSSION

**Vacuity index (Emptiness index):** A Considerable variation in the values of this index was registered. Maximum value (13.33%) was noted in February and the index was zero in April (Fig. 1). Feeding intensity was seems to be low in winter season showing the index value higher than autumn, summer and fall seasons. The values of the index for this fish agrees with the observations made by previous researcher on other species of fish from different areas (Biagi *et al.*, 1992; Politou and Papaconstantinou, 1994; Gramitto, 1999; Morte *et al.*, 2002). The fact that sexual maturation commonly interfere with feeding activity among fishes may also partly explain the empty stomachs observed in mature fishes in the present study. Morphological and dietary specialization may be other contributing factors (Malmquist,1992; Amundsen *et al.*, 1995, Wainwright and Richard, 1995). The fast gastric evacuation may also be the other factor for high values of vacuity index (Cabral, 2000).

**Diet composition and variations with size and seasons:** The fish, *Poecilia latipinna*, is a surface dwelling with a diet that consists of primarily of four major groups (Table 1). Bacillariophyceae and Chlorophyceae constituted the major part of stomach contents of the fishes of different size groups in all the seasons. The other two groups, myxophyceae and desmidiaceae were less numerous than other two groups. The diet composition of the fish of different size groups did not vary considerably. Percentage of occurrence of food items differed among the fishes of different size groups but the frequency of occurrence did not show much variations (Table 3).

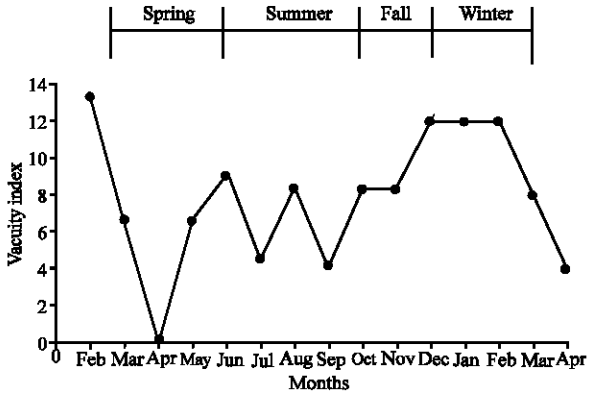


Fig. 1: Seasonal variations in the vacuity index of *P. latinna* in different size groups

Table 1: Occurrence of different food items (percent) in the stomach of *P. latipinna* in various seasons

| | Seasons | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Winter (ri) | | | Spring (ri) | | | Summer (ri) | | | Fall (ri) | |
| | Size groups | | | Size groups | | | Size groups | | | Size groups | |
| Food items | I | II | III | I | II | III | I | II | III | II | III |
| Kirchneriella | 1.47 | 1.61 | 1.87 | 2.53 | 2.72 | 2.17 | 1.74 | 1.82 | 1.81 | 0.97 | 1.05 |
| Selenastrum | 0.00 | 0.12 | 0.17 | 0.00 | 0.78 | 0.94 | 1.32 | 1.43 | 1.09 | 0.00 | 0.00 |
| Ankestrodesmus | 0.67 | 1.19 | 1.36 | 1.27 | 1.36 | 1.28 | 1.29 | 1.43 | 0.91 | 0.87 | 1.05 |
| Scenedesmus | 0.00 | 0.00 | 0.00 | 0.63 | 0.00 | 0.00 | 0.59 | 0.50 | 0.18 | 0.00 | 0.00 |
| Ophiocytium | 0.67 | 0.83 | 0.34 | 2.53 | 1.17 | 0.77 | 0.11 | 0.13 | 0.00 | 0.00 | 0.00 |
| Protococcus | 6.16 | 0.26 | 6.61 | 13.29 | 10.89 | 12.62 | 6.99 | 10.61 | 11.41 | 14.02 | 11.84 |
| Crucigenia | 9.11 | 9.39 | 6.95 | 9.49 | 6.42 | 4.82 | 5.21 | 8.03 | 11.23 | 11.71 | 9.74 |
| Ulothrix | 1.07 | 1.00 | 1.19 | 2.53 | 2.33 | 2.17 | 2.60 | 1.74 | 1.27 | 3.64 | 5.00 |
| Microspora | 1.07 | 1.17 | 1.02 | 2.53 | 4.86 | 7.97 | 1.64 | 1.38 | 0.91 | 6.60 | 7.89 |
| Tetradesmus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| chlorophyceae | 20.23 | 15.56 | 19.50 | 34.81 | 30.54 | 32.74 | 21.50 | 27.08 | 28.80 | 37.81 | 36.58 |
| Merismopedia | 4.55 | 3.60 | 6.27 | 10.13 | 7.98 | 6.97 | 3.86 | 3.35 | 2.54 | 4.03 | 5.00 |
| Oscillatoria | 2.94 | 2.98 | 2.54 | 2.53 | 2.92 | 4.32 | 2.47 | 1.74 | 1.45 | 0.00 | 0.00 |
| Anabaena | 1.07 | 1.17 | 1.53 | 1.90 | 1.36 | 0.94 | 1.52 | 0.72 | 0.36 | 0.00 | 0.00 |
| Spirulina | 0.27 | 0.19 | 0.51 | 0.00 | 0.00 | 0.00 | 1.19 | 0.97 | 0.91 | 0.85 | 1.05 |
| Tetrapedia | 1.34 | 1.60 | 1.87 | 3.16 | 2.72 | 1.94 | 3.75 | 4.58 | 4.17 | 4.43 | 5.53 |
| Myxophyceae | 10.17 | 9.53 | 12.72 | 17.72 | 14.98 | 14.18 | 12.79 | 11.36 | 9.42 | 9.32 | 11.58 |
| Gonatozygon | 0.67 | 1.19 | 1.70 | 2.53 | 2.53 | 1.71 | 1.84 | 1.64 | 1.45 | 4.92 | 5.00 |
| Closterium | 0.53 | 0.92 | 0.85 | 1.90 | 1.17 | 0.77 | 1.81 | 1.51 | 0.91 | 1.10 | 1.32 |
| Penium | 0.67 | 0.47 | 0.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.70 | 1.05 |
| Cosmarium | 0.27 | 0.62 | 0.64 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Desmidiaceae | 2.14 | 3.20 | 3.70 | 4.43 | 3.70 | 2.48 | 3.65 | 3.15 | 2.36 | 6.72 | 7.37 |
| Cyclotella | 13.78 | 12.95 | 10.51 | 8.86 | 14.59 | 16.78 | 24.14 | 23.60 | 26.27 | 17.73 | 18.16 |
| Diatoma | 5.63 | 5.11 | 8.48 | 6.96 | 6.61 | 7.20 | 7.16 | 8.01 | 8.88 | 8.97 | 8.16 |
| Stauroneis | 12.85 | 17.15 | 12.38 | 10.76 | 10.70 | 11.47 | 13.81 | 14.50 | 13.59 | 7.84 | 6.84 |
| Nitzschia | 10.03 | 9.70 | 7.80 | 5.06 | 6.03 | 4.42 | 3.24 | 2.54 | 1.99 | 1.67 | 1.84 |
| Synedra | 7.49 | 7.67 | 9.16 | 6.96 | 7.78 | 7.36 | 4.80 | 2.30 | 1.45 | 1.16 | 1.32 |
| Navicula | 13.93 | 14.93 | 12.21 | 3.80 | 3.31 | 1.66 | 6.43 | 4.40 | 3.99 | 7.45 | 7.11 |
| Tabellaria | 2.41 | 2.28 | 1.87 | 0.00 | 0.78 | 0.94 | 0.90 | 0.50 | 0.18 | 0.00 | 0.00 |
| Campylodiscus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.90 | 1.45 | 0.00 | 0.00 |
| Eunotia | 0.81 | 0.94 | 0.85 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gomphonema | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cocconeis | 0.53 | 0.98 | 0.85 | 0.63 | 0.97 | 0.77 | 1.38 | 1.67 | 1.63 | 1.34 | 1.05 |
| Bacillariophyceae | 67.46 | 71.71 | 64.09 | 43.04 | 50.78 | 50.60 | 62.05 | 58.41 | 59.42 | 46.15 | 44.47 |

*Poecilia latipinna* is an introduced species and is flourishing well in the Wadi Haneefah stream . It prefers to live in the shallow littoral zone of the stream. This adaptation may be partly influenced by the distribution of planktonic food items, which constitute the food of this fish. It has a superior and big mouth opening which indicate that it is well adapted to feed mainly from the surface water. It is a herbivorous fish and prefers to feed on green and blue green algae as reflected from the food selection index (Table 2). Food items from animal origin were not encountered. The published information (Al-Akel, 2003) does not agree with the present findings. According to him the fish also feeds on zooplankton but in a very low proportion. It can be concluded that the fishes of different size groups and in different seasons feed mostly on common food, hence, competition for food resources among them is possible. Feeding activity of a fish is affected in number of ways i.e., availability of food in the environment, access ability of fish to the food, its tastefulness and lastly the cost of capture of food (Mustafa, 1976; Strauss, 1979; Lazzaro, 1987; Al-Kahem *et al*., 1988; Mills *et al*., 1989; Shamsi *et al*., 1995; Al-Akel, 2003). The fish is forced to feed and thrive on some available food sources if the scarcity of certain preferred food item goes down to a critical level (Al-Akel, 2003). Generally, feeding activity is dropped down at low temperature but in the present investigation the feeding level remain high in winter compared to other seasons.

Most of the fish, especially large and commercially important, display ontogenic shift in feeding like smaller fish feeds either on zooplankton or on smaller aquatic animals and switch over on fishes and other large aquatic animals as adult. The fish studied here did not show changes or switching over from one category of food to other. Seasonal variations in food ingestion are related to fluctuations in the density of food items in the

Table 2: Food selection index of different size groups of *Poicilia latipinna* in different seasons

| | Seasons | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Winter | | | Spring | | | Summer | | | Fall | |
| | Size groups | | | Size groups | | | Size groups | | | Size groups | |
| Food items | I | II | III | I | II | III | I | II | III | II | III |
| Kirchneriella | 0.02 | 0.02 | 0.02 | 0.03 | 0.04 | 0.03 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 |
| Selenastrum | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.00 | 0.00 |
| Ankestrodesmus | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 |
| Scenedesmus | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| Ophiocytium | 0.01 | 0.02 | 0.01 | 0.08 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Protococcus | 0.04 | 0.00 | 0.04 | 0.11 | 0.10 | 0.11 | 0.05 | 0.07 | 0.07 | 0.11 | 0.09 |
| Crucigenia | 0.20 | 0.20 | 0.15 | 0.15 | 0.11 | 0.08 | 0.08 | 0.12 | 0.16 | 0.13 | 0.10 |
| Ulothrix | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.05 | 0.06 |
| Microspora | 0.02 | 0.02 | 0.02 | 0.04 | 0.08 | 0.13 | 0.03 | 0.02 | 0.01 | 0.15 | 0.17 |
| Tetradesmus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chlorophyceae | 0.03 | 0.02 | 0.03 | 0.05 | 0.04 | 0.05 | 0.03 | 0.04 | 0.04 | 0.05 | 0.05 |
| Merismopedia | 0.04 | 0.03 | 0.06 | 0.10 | 0.08 | 0.07 | 0.03 | 0.02 | 0.02 | 0.02 | 0.03 |
| Oscillatoria | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.06 | 0.03 | 0.02 | 0.02 | 0.00 | 0.00 |
| Anabaena | 0.02 | 0.02 | 0.03 | 0.02 | 0.01 | 0.01 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 |
| Spirulina | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.02 | 0.03 | 0.03 |
| Tetrapedia | 0.01 | 0.02 | 0.02 | 0.07 | 0.07 | 0.05 | 0.07 | 0.08 | 0.07 | 0.04 | 0.05 |
| Myxophyceae | 0.03 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.02 | 0.02 |
| Gonatozygon | 0.01 | 0.01 | 0.02 | 0.04 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.06 | 0.06 |
| Closterium | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| Penium | 0.03 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 |
| Cosmarium | 0.01 | 0.03 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Desmidiaceae | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 |
| Cyclotella | 0.17 | 0.15 | 0.12 | 0.05 | 0.08 | 0.10 | 0.15 | 0.14 | 0.16 | 0.13 | 0.13 |
| Diatoma | 0.09 | 0.08 | 0.13 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.06 | 0.05 |
| Stauroneis | 0.10 | 0.13 | 0.09 | 0.11 | 0.12 | 0.12 | 0.19 | 0.19 | 0.18 | 0.09 | 0.08 |
| Nitzschia | 0.05 | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 |
| Synedra | 0.05 | 0.05 | 0.06 | 0.04 | 0.05 | 0.05 | 0.06 | 0.03 | 0.02 | 0.01 | 0.02 |
| Navicula | 0.03 | 0.03 | 0.02 | 0.01 | 0.01 | 0.00 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 |
| Tabellaria | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Campylodiscus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.00 | 0.00 |
| Eunotia | 0.02 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gomphonema | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Cocconeis | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.03 | 0.04 | 0.04 | 0.03 | 0.02 |
| Bacillariophyceae | 0.04 | 0.04 | 0.03 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.03 | 0.02 |

environment (Morte *et al*., 2002). Variations in the feeding also depend upon the range depth at which fish prefer to live.

**Frequency of occurrence:** Data embodied in Table 3 indicate that the most of the food items eaten by the *Poecilia latipinna* of different size groups are common. Few genera like *Scenedesmus, Ankistrodesmus*, *Selenastrum* and *Ophiocytium* have low frequency of occurrence. Food items belonging to Bacillariophyceae groups were registered in the stomach of all fishes of different size groups showed high occurrence frequency (Table 3). Likely a competition between the fishes of different sized groups is expected due to high frequency of occurrence of food items. According to Hyslop (1980) if the frequency of occurrence is more that 25% in two or more predators competition is likely. The high frequency of occurrence of food items in different seasons can be related upto some extent to the level of feeding. Fish of different size groups live at the same range depth and feed on the same level, hence, show a very high frequency of occurrence of different food items in various seasons and in all group of fishes. The frequency of occurrence may also depend upon their abundance in the environment.

**Diet overlapping:** The dietary similarity of *P. latipinna* among different size groups in various seasons was quantified by index of diet overlap. It was observed that high dietary overlap index existed between close size groups than non-consecutive groups (Table 4). The index values registered in winter, spring and summer for all groups exceeded to 0.60. The diet overlap index has a minimum value of 0 when no food items are shared and a maximum value of 1 when all the food items are shared.The diet overlap is considered significant when its value exceeded to 60% (0.60) (Wallace, 1981). Biologically significant diet overlap was observed among the different size groups of *P. latipinna*, consistent with major similarities in food utilization among these three groups (Table 4). Fishes of all size school together and feed at the

Table 3: Frequency of occurrence of different food items in the fishes of different size groups in all seasons

| | Seasons | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Winter | | | Spring | | | Summer | | | Fall | |
| | I | II | III | I | II | III | I | II | III | II | III |
| Food items | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) | F (%) |
| Chlorophyceae | | | | | | | | | | | |
| Kirchneriella | 88.89 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 83.33 | 97.50 | 100.00 | 82.61 | 100 |
| Selenastrum | 0.00 | 11.54 | 25.00 | 0.00 | 40.00 | 79.17 | 72.92 | 95.00 | 100.00 | 0.00 | 0 |
| Ankestrodesmus | 55.56 | 86.54 | 100.00 | 50.00 | 70.00 | 95.83 | 77.08 | 97.50 | 100.00 | 82.61 | 100 |
| Scenedesmus | 0.00 | 0.00 | 0.00 | 25.00 | 0.00 | 0.00 | 37.50 | 55.00 | 25.00 | 0.00 | 0 |
| Ophiocytium | 55.56 | 65.38 | 25.00 | 100.00 | 60.00 | 50.00 | 8.33 | 12.50 | 0.00 | 0.00 | 0 |
| Protococcus | 100.00 | 100.00 | 25.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Crucigenia | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Ulothrix | 88.89 | 5.77 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Microspora | 77.78 | 88.46 | 100.00 | 100.00 | 100.00 | 100.00 | 91.67 | 97.50 | 100.00 | 100.00 | 100 |
| Tetradesmus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Myxophyceae | | | | | | | | | | | |
| Merismopedia | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Oscillatoria | 88.89 | 88.46 | 100.00 | 100.00 | 100.00 | 100.00 | 91.67 | 95.00 | 100.00 | 0.00 | 0 |
| Anabaena | 66.67 | 13.46 | 100.00 | 75.00 | 70.00 | 50.00 | 70.83 | 95.00 | 25.00 | 0.00 | 0 |
| Spirulina | 22.22 | 17.31 | 75.00 | 0.00 | 0.00 | 0.00 | 75.00 | 80.000 | 100.00 | 76.09 | 100 |
| Tetrapedia | 100.00 | 96.15 | 100.00 | 100.00 | 90.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Desmidiaceae | | | | | | | | | | | |
| Gonatozygon | 44.44 | 92.31 | 100.00 | 100.00 | 100.00 | 100.00 | 93.75 | 97.50 | 100.00 | 100.00 | 100 |
| Closterium | 44.44 | 76.92 | 100.00 | 75.00 | 60.00 | 54.17 | 95.83 | 100.00 | 100.00 | 78.26 | 100 |
| Penium | 55.56 | 50.00 | 75.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 47.83 | 100 |
| Cosmarium | 22.22 | 57.69 | 75.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Bacillariophyceae | | | | | | | | | | | |
| Cyclotella | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Diatoma | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Stauroneis | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100 |
| Nitzschia | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 97.83 | 100 |
| Synedra | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 84.78 | 100 |
| Navicula | 77.78 | 88.46 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 97.50 | 100.00 | 100.00 | 100 |
| Tabellaria | 100.00 | 96.15 | 75.00 | 0.00 | 40.00 | 41.67 | 56.25 | 65.00 | 25.00 | 0.00 | 0 |
| Campylodiscus | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 6.25 | 45.00 | 75.00 | 0.00 | 0 |
| Eunotia | 66.67 | 78.85 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Gomphonema | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| Cocconeis | 44.44 | 78.85 | 100.00 | 25.00 | 50.00 | 58.33 | 75.00 | 85.00 | 100.00 | 91.30 | 100 |

Table 4: Seasonal variations in the index of diet overlap of *P. latipinna*

| | Seasons | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Winter | | Spring | | Summer | | Fall | |
| Size groups | I | II | I | II | I | II | I | II |
| II | 0.91 | | 0.88 | | 0.90 | | 0.50 | |
| III | 0.89 | 0.84 | 0.81 | 0.90 | 0.84 | 0.92 | 0.50 | 0.93 |

Table 5: Seasonal variations in the Levins' index of diet breath of *P. latipinna*

| | Size groups | | |
|---|---|---|---|
| Seasons | I | II | III |
| Winter | 0.347 | 0.312 | 0.402 |
| Spring | 0.423 | 0.413 | 0.359 |
| Summer | 0.279 | 0.280 | 0.236 |
| Fall | - | 0.32 | 0.345 |

same water level, hence, a similarity in feeding habit is obvious and competition would be expected. Investigation into demersal fish communities have shown an increased food overlap due to the opportunistic utilization of super abundant food resources (Macpherson, 1981; Targett, 1981; Delbeck and Williams, 1987; Morte *et al*., 1999a, b; Pelicice and Agostinho, 2006).

**Diet breath:** Diet breath index varied from 0.236 to 0.423 in different seasons and different size groups of *P. latipinna* (Table 5). The lowest value was recorded in summer and highest in spring. In fall and winter the index value did not change remarkably. The low index value in summer indicate that the fish's diet dominated by few food items and high values in spring show generalist diet. This line of reasoning was also given in the past (Gibson and Ezzi, 1987; Krebs, 1989).

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