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FEEDING HABITS OF *BOLEOPHTHALMUS DUSSUMIERI* (CUV. & VAL.) FROM ULHAS RIVER ESTUARY NEAR THANE CITY, MAHARASHTRA STATE.

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Abstract:

It has envisaged to make available the information on a season-wise pooled data of the feeding habits of Boleophthalmus dussumieri (Cuv. & Val) studied along the Ulhas river estuary using point method during the period of two years from July 2004 to June 2006,. The qualitative and quantitative analyses of stomach content were carried out to calculate percentage frequency of occurrence of food items (F), *feeding index* (IA) *and vacuity index* (VI).. *Electivity analysis showed that the fish is herbivorous feeding mainly on diatoms and other species of algae.*

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Introduction:

The estuarine environment is rich in primary production and diverse due to edge effect. Therefore, many endemic and migratory fish share this habitat for feeding, breeding and shelter. Food and feeding habit of the fish in the estuary is of great importance to understand their niche, behavioral patterns, life history, growth and management of commercially important fisheries (Bal *et al*., 1984). Several experts have concentrated on the food and feeding habit of several fish *sp.* from different parts of the world (Mutsaddi, 1964; Qasim, 1972; Day, 1889; Tandel 1984 & 1986, Clayton, 1993; Connolly *et. al.*, 2004; Kitts *et. al.,* 2004). However, the literature on studies of the feeding and dietary contents of estuarine fish like mudskippers is scarce.

Herbivorous bottom feeder, *Boleophthalmus dussumieri* (Cuvier & Valencienne, 1837), is one of the important species from the Ulhas River estuary (URE) in the vicinity of Thane city. It is an amphibious, benthic and burrowing type of euryhaline fish found inhabiting the neretic mudflats of the URE. The mudskippers construct their burrows in the mud and browse on the mudflats. Although they often come out of water, but remain restricted nearby the water for breathing and other activities. The burrows are always found constructed in the limits of intertidal zone (Mutsaddi, et *al.* 1969; Zander, 1982; Chung *et al.* 1991; Clayton, 1993).

The separation of food items for counting, weighing or volumetrically quantifying in an individualized way is frequently impossible if the fish is small and food items are microscopic. This is an age-old problem. If diet analysis has to be done, alternative methods should be employed (Lima-Junior, 2000). Hynes (1950) discussed the Points Method which consists of inferring relative abundance of food items from the simple visual observations of the stomach contents. The method assumes the points attribution to food categories, based on their volume in relation to the stomach size. Such a methodological characteristic may give great importance to food items consumed by small fishes (Lima-Junior *et al.* 2000).

Material and methods:

A season wise pooled data was procured for food and feeding habit of *B. dussumieri*, using point

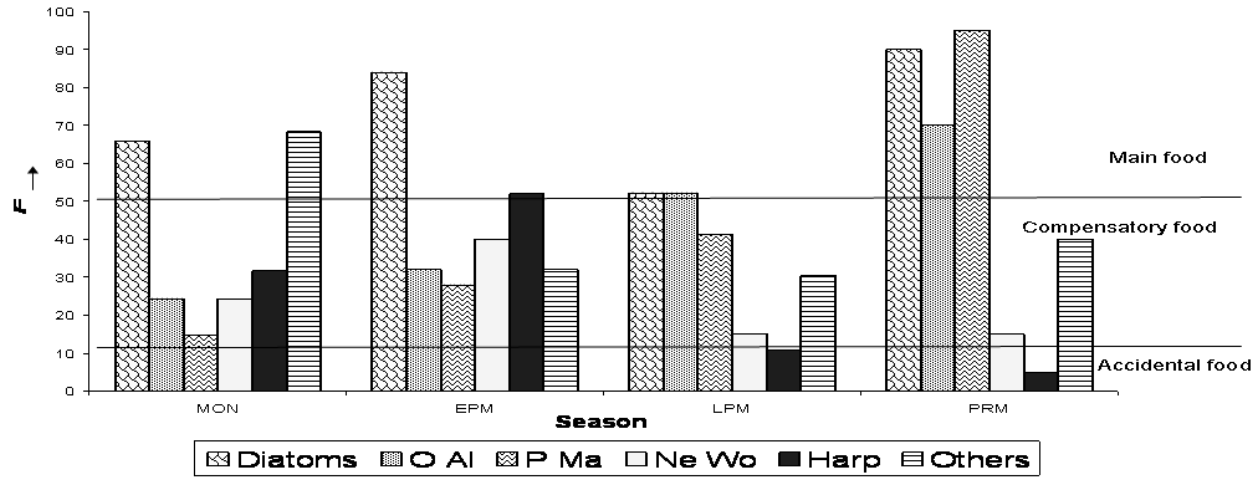

Fig. 2. Season wise %frequency of occurrence of food items of *B. dussumieri* (Cuv. Val.) from URE 2004-06.

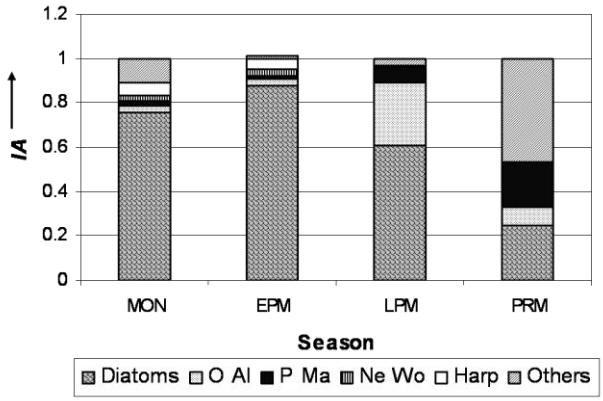

Fig. 3. Feeding index (*IA*) of *B. dussumieri* (Cuv. &Val.) from URE 2004-06.

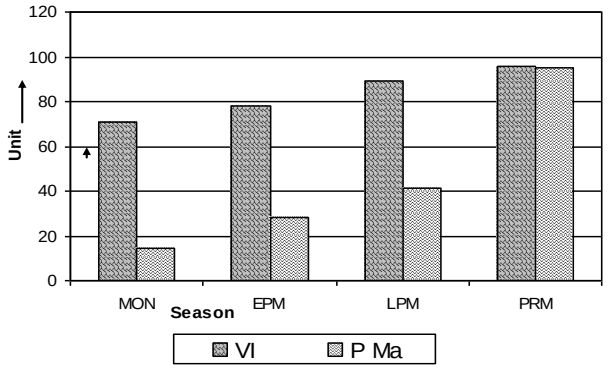

Fig.4. Relation between Vacuity index (*VI*) and plant material (Pl Ma) of *B. dussumieri* (Cuv. Val.) from URE 2004-06.

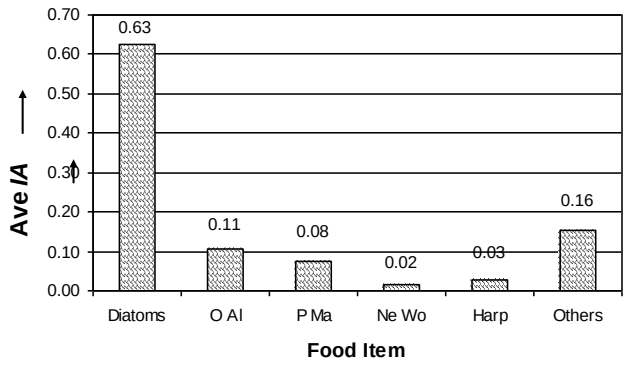

Fig. 5. Average feeding index (*IA*) of food items of *B. dussumieri* (Cuv.& Val.) from URE 2004-06.

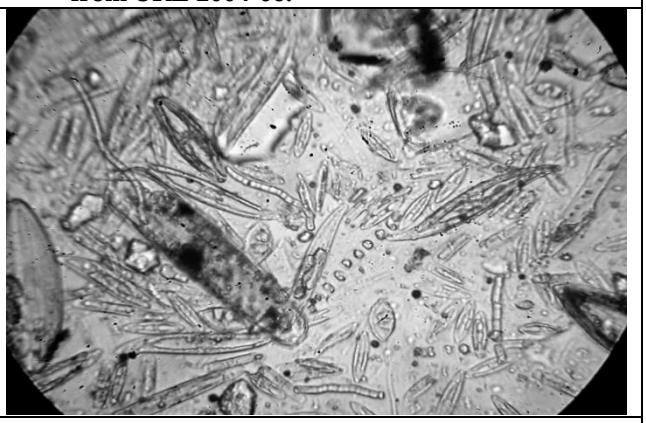

Fig. 6. Dominance of diatoms in food items of *B. dussumieri* (Cuv. & Val.).

method. The year was divided into four seasons viz. monsoon (MON; from July – September); early post monsoon (EPM; from October – December); late post monsoon (LPM; from January – March) and pre-monsoon (PRM; from April – May) and data was obtained for two years from July 2004 to June 2006.

Sample collection:

Freshly caught mudskipper specimens, as far as possible proportionate to the mother catch were selected season-wise from the fish landing centers or from fishermen directly in live condition. The collection was brought to laboratory in ice-box; abdomen was opened with an incision and preserved immediately in 10% (v/v) formaldehyde solution prepared in creek water for future investigations.

Laboratory investigations:

Fishes were washed and the total length (nearest 1mm) and total weight (nearest 0.01 g) of the individual specimen were measured. Stomachs of *B. dussumiri* were dissected out intact and classified into gorged, full, ¾ full, ½ full, ¼ full, barely full and empty (Fig.1).

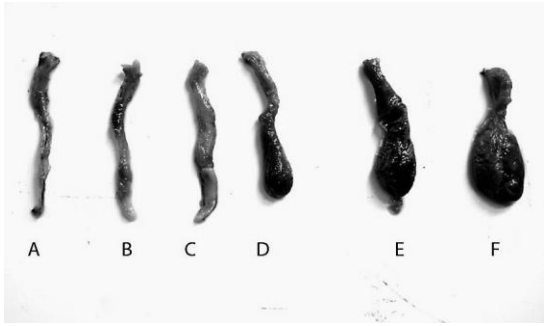

Fig. 1. Status of stomach fullness: A-empty; B-barely full; C- Onefourth; D-half; E-threefourth and F-gordged

Specimens with gorged, full, ¾ full & ½ full were considered as actively fed and those under the category of ¼ full, barely full & empty were considered to be poorly fed (Shanti Prabha *et al.*, 2008).

Stomachs were opened individually and food items were collected in petridishes. The food items were identified to the generic level following the keys of Pennak (1953), Sars (1896 & 1921) & Tomas (1997) under microscope. Food items were classified into six categories viz. Diatoms, Other algae (O Al), plant materials (P Ma), nematode worms (Ne Wo), harpacticoid copepod (Harp) and others. Others included detritus, sand, mud, fish scale, ova, unidentified food items etc.).

Analysis:

The point method was implied to obtain volume percentage (V); percentage frequency of occurrence (*F*), feeding index (*IA*) and Vacuity index (*VI*) (Hynes, 1950; Hyslop, 1980; Cortes, 1997; Gurgel *et al.*1999; Lima-Junior, 2001; Pasquaud *et al.*, 2004; and Fehri-Bedoui *et al.*, 2008).

I. Volume percentage (V %):

Points were allotted to gorged, full, ¾ full, ½ full, ¼ full, barely full and empty stomachs as 10, 8, 6, 4, 2, 1 & zero respectively. The total number of points of a stomach was then defined as 100%, being distributed among the various feeding items according to their degree of abundances in relation to the total content of the stomach observed. The points of each food item were recorded and percentage volume for each food item was calculated using SW (Std. Weight of stomach) as described by Lima-Junior *et al*. (2001).

II. Percentage frequency of occurrence (*F*):

Percentage frequency of occurrence (*F*) of a prey (food) item 'i' was calculated as under:

where,

Ndi = no. of stomachs containing food item 'i',
Nnv = total number of non-empty stomachs,

The different values of index *F* allow separation of the prey items into three categories:

If *F*>50% the prey are dominant and characteristic of main food of predator, known as 'Main' food.

If 50%>*F*>10% the prey occurs if the main food is lacking, known as 'Compensatory' food.

If *F*<10% the prey are eaten accidentally, known as 'Accidental' food or 'Emergency' food.

III. Feeding Index (*IA*):

Feeding Index (IA_i) was calculated as under :

where,

F_i = frequency of occurrence (%) of given food item 'i'.
V_i = volume percentage of given food item 'i'.

Feeding index helps to evaluate variation in the diet and to understand the predominance of the food item 'i' in the stomach content.

IV. Vacuity Index (*VI*):

where,

Nv = number of empty stomachs,
Ne = Total number of examined stomachs,
Vacuity index (*VI*) gives an estimate of the voracity of the predator fish; the more voracious fish species, the lower percentage of empty stomachs (Mohammadi *et al*., 2007).

Result and discussion:

Total numbers of stomachs observed seasonwise were 58, 45, 69 and 23 in MON, EPM, LPM and PRM respectively. The food items of *B. dussumieri* in URE were represented by diatoms, other algae, plant materials (mangrove Spongy tissue, water storage tissue, palisade cells and salt glands), nematode worms, harpacticoid copepod and others (detritus, sand, mud, fish scales etc.).

The occurrence of the food organisms varied seasonwise (Fig.2). The gut content of in *B. dussumieri* in present study comprised predominance of diatoms (*Navicula spp. Pleurosigma spp., Mastogloea spp, Surirella spp., Nitzschia spp., and Gyrosigma spp.);* algae (*Oscillatoria spp., Thallasiocera spp., Ulothrix spp.*); harpacticoid sp. and nematode worms. (Fig. 6)

Diatoms were the most selected food constituting 84% and 90% by occurrence '*F'* during the EPM and PRM seasons respectively (Table 1). Dominance of diatoms in URE was recorded by Mishra (2002) is in agreement with the present observation since fishes select the abundant food in the surrounding. Individuals having the gorged or full stomach were found foraging predominantly on diatoms. Mutsaddi *et al.* (1969) recorded only diatoms in the gut of *B. dussumieri* in relation to food availability. The overwhelming dominance of diatoms in the diet of *B. dussumieri* agreed with the fact that the dominant food item in the habitat was diatoms (Yee, 1996; Hunt, 1998).

Table 1. Percentage frequency of occurrence (*F*) of *B. dussumieri* (Cuv. & Val.) from URE 2004-06.

	MON	EPM	LPM	PRM
Diatoms	65.85	84	52.17	90
O Al	24.39	32	52.17	70
P Ma	14.63	28	41.3	95
Ne Wo	24.39	40	15.22	15
Harp	31.71	52	10.87	5
Others	68.29	32	30.43	40

Table 2. Feeding Index (IA) of food items of *B. dussumieri* (Cuv. & Val.) from URE 2004-06.

	MON	EPM	LPM	PRM	Ave
Diatoms	0.76	0.88	0.61	0.25	0.63
O Al	0.03	0.03	0.28	0.08	0.11
P Ma	0.02	0.01	0.07	0.2	0.08
Ne Wo	0.02	0.03	0.01	0	0.02
Harp	0.06	0.05	0	0	0.03

Others	0.11	0.01	0.03	0.47	0.16

Table 3. Vacuity Index (*VI*) in *B. dussumieri* (Cuv. & Val.) from URE 2004-06.

	MON	**EPM**	**LPM**	**PRM**
VI	70.69	77.77	89.33	95.65
P Ma	14.63	28	41.3	95

The high frequency of occurrence of nematode worms and harpacticoid copepod indicate their availability in the ambient water in MON whereas plant materials dominated in PRM in the diet of *B. dussumieri.*

On the basis of '*F'* value different food items were placed in different categories of food during the seasons (Table 1). Diatoms were the main food of *B. dussumieri.* Other algal species and plant material were found to be compensatory food items. Occurrence of harpacticoid and nematode worms were least amongst the food items in LPM and PRM seasons proving to be accidental food (Fig.2).

Feeding index (*IA*) in *B. dussumieri* ranged from zero to 0.88. Average *IA* was found *to be* very high for diatoms which indicate status of diatoms as the main food items (Fig. 5). *IA* in present study revealed that *B. dussumieri* were well fed in MON and EPM, while facing relatively starvation in LPM and PRM. Further, other algae appeared to be compensatory to diatoms in different seasons except PRM (Fig. 3). The observation is in agreement with the earlier findings of Tandel (1984). *B. dussumieri* was observed to be shifting from diatom to algae during LPM, whereas in PRM most of the individuals were found to be foraging on decayed plant and other food material referred to as ilio-feeding (Gurgel, 1999).

In the present study, low vacuity index (*VI* - 70.69) of the MON season increased gradually to its highest value (95.65) towards PRM (Table 3). From the present results an inference could be drawn that individuals were well-fed in MON, moderately fed in EPM and starving in the LPM and PRM seasons. The *VI* showed direct relationship with plant material intake (Fig. 4). Thus, it indicates that the fish turn to ilio-feeding only when it is starving in URE. It also indicates non-availability of diatoms and other algae in PRM in the ambient habitat.

Normally feeding activity of fish is high in summer than in winter (Islam, 2004). However, the food intake by *B. dussumieri* was very low in PRM (Fig. 4). The vacuity index (*VI*) values over the observed period could be attributed to seasonal variation than reproduction as is usually found in demersal fish (Fehri-Bedoui *et al.***,** 2008). The high empty stomach % and ilio-feeding in seasons other than that of breeding relates to the stress factors involved in the niche of the species.

The earlier studies have revealed that the URE is highly affected by anthropogenic activities (Mishra, 2002; Rathod, *et al.*2002; Rathod, 2005). The habitat harbors pollution tolerant genera of diatoms and algae like *Nitzschia spp., Navicula spp., Oscillatoria spp., Cyclotella spp. and Oedogonium spp.* with low diversity and conspicuous dominance of these diatoms indicate the organic pollution (Mishra, 2002). In an earlier study Bajpai *et al.,* (2001) have reported similar flora as indicator of pollution. It has been already reported that diatoms are one of the important food items of *B. dussumieri* from URE (Mutsaddi, 1964; Mutsaddi *et al*, 1969 & Rathod, 2005). The results of present study on gut content of *B. dussumieri*, indicate that food of this species in URE has predominance of diatoms (*Navicula spp. Pleurosigma spp., Mastogloea spp, Surirella spp., Nitzschia spp., and Gyrosigma spp.);* algae (*Oscillatoria spp., Thallasiocera spp., Ulothrix spp.*), harpacticoid spp. and nematode worms. These observations are in agreement with earlier research on this subject.

Conclusion:

1. *B. dussumieri* (Cuv. & Val.) in URE was found to be herbivorous fish feeding predominantly on diatoms and other algae.
2. Diatoms were found main food item of *B, dussumieri* (Cuv. & Val.) in URE. Other algae were second important food item and plant material as alternative food during starvation thus they are categorized as compensatory food items. Harpacticoids and

nematode worms being accidental or emergency food in diet of *B, dussumieri* (Cuv. & Val.) in URE.

3. *VI* increases gradually from MON towards PRM exhibiting starvation in the fag end of the years where fish starts with ilio-feeding due to non-availability of the main food
4. Presence of pollution tolerant spp. of food items reveal the pollution status of the URE.

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