
SURFICIAL EMERGENCE OF *BOLEOPHTHALMUS DUSSUMIERI* (VAL., 1837) SYNCHRONIZED WITH TIDAL OSCILLATION ON THE SILTED INTERTIDAL MUDFLATS OF ULHAS RIVER ESTUARY

Sudesh Rathod, Abhay S. Morajkar and Pratipada H. LoharDepartment of Zoology, VPM's B. N. Bandodkar College of Science, Thane

ABSTRACT

Boleophthalmus dussumieri (Val., 1837) is a mudskipper species inhabiting, in abundance on the intertidal mudflats occurred on either banks of Ulhas River estuary. The present study scan and focal sampling method implied to record the lagged immergence of *B. dussumieri* on the surface during ebb-tide. The study revealed direct correlation with the declining water level and rate of exposure of the mudflat during the ebb-tide occurred at Kolshet creek along the west bank of the Ulhas River estuary. PCO obtained with Euclidean distance matrix represented 100% ordination of the samples depicting that the level of water defined the rate of surficial emergence of individuals.

Keywords: *Boleophthalmus dussumieri*, mudskipper, burrow, territoriality, Principal coordination analysis, PCO, tidal oscillation, Ulhas river estuary, surficial emergence, mudflats.

INTRODUCTION

Mudskippers are well-known for their amphibious and benthic-fossorial habit often found for courtship and feeding vigorously on the exposed mud flats of coastal waters (Clayton, 1993). They are studied variedly as important bio-indicators of the pollution status of their habitats (Ansari *et al.*, 2014). Their burrows are often open with slight elevation, sort of chimney and are located in the tiny pit-pools constructed of earth to retain water during low tide. They keep their tail immersed in this water for moistening their body surface so as to expedite the respiration through skin when they are exposed to air (Mutsaddi and Bal, 1973; Clayton, 1993; Yee, 1996). Ishimatsu and Graham (2011) recorded that mudskippers burrows are highly variable in structures even within a species.

Ulhas River estuary (URE) is located in the vicinity of Thane City near Mumbai, Maharashtra State, India. URE is well known for its rich and diverse fisheries from decades supporting a considerable fishermen population of the area. *Boleophthalmus dussumieri* is abundant species of mudskipper inhabiting on the intertidal mudflats of Ulhas River estuary (URE). *B. dussumieri* contribute to one of the important and highly priced fishery species along URE. Nevertheless *B. dussumieri* is highly threatened due to certain anthropogenic activities causing pollution in the URE since 2002 (Rathod, 2005). According to earlier study *B. dussumieri* have been observed to be highly sensitive to the environmental changes and responded accordingly in the polluted conditions of Ulhas River estuary and Thane creek through 2004 to 2006 (Rathod, 2016). However, there is no further confirmation on the changes in the behaviour of these mudskippers due to polluting conditions prevalent in the URE.

1. MATERIALS AND METHOD

Study envisages the bimonthly observations of various behavioral patterns of *B. dussumieri*, on the mudflats near 'Kolshet creek station' situated in the upper stretch of the Ulhas river estuary, lying between latitude 19°14'49"N and longitude 72°59'50" E from the months of July 2015 through June 2016 (Fig. 1).

A. SAMPLING AND ANALYSIS OF SURFICIAL EMERGENCE OF INDIVIDUALS

The behavioral observation of the *B. dussumieri* was accomplished using *scan and focal sampling* method (Altmann 1974; Bowden *et al.* 2008 and Gilby *et al.* 2010) during the ebbing and flooding phases of the tide at the foresaid study station for a period of four months. Minute behavioral patterns were recorded with help of 'Sony' Handy-cam (a movie-cum-photography camera) model: HDR-CX130E, to produce appropriate images and videos. The videos were used to support and revise the observations recorded on field. The ambient specimens were observed at the study site to record for their emergence from the burrow during the ebb tides. The number of individuals emerged (RIE) on the surface with the decline in water level (WLD), vertically, and rate of exposure of the mudflat (REM), horizontally, were recorded at an interval of 30 minutes each for an entire cycle of ebb tide (6 hrs.) on a mudflat of approx. 100 sq. m (10 m x10 m) area during period of the present study. The statistical analysis was carried by using Primer v6 software. Euclidean Distance resemblance was obtained after normalizing the data and was run for the hierarchical cluster analysis at group average mode. PCO (Principal Coordinates) ordination was obtained and the dendrogram was overlaid to show the relationship of water level decline with the number of individuals emerging on the mudflat surface (Fig. 4). Due to the

monsoon and the seasonality of *B. dussumieri* the observation was restricted from November 2015 to April 2016 only (Before and after these months the species was mostly lacking in the area).

B. ANALYSIS OF SOIL TEXTURE

Soil texture (clay, silt and sand) was analyzed using Buchanan's pipette method (1984). Soil samples on monthly basis were collected from three stations from mudflats along (1) head of the estuary near Kharegaon; (2) at study area at Kolshet creek and (3) from downstream of the estuary nearly 13.6 km away from study area at Ghodbunder sand landing centre (Fig. 1). Silt (%) was taken into consideration for the present study.

Fig.1: Satellite images of the Ulhas River estuary and Sampling Station



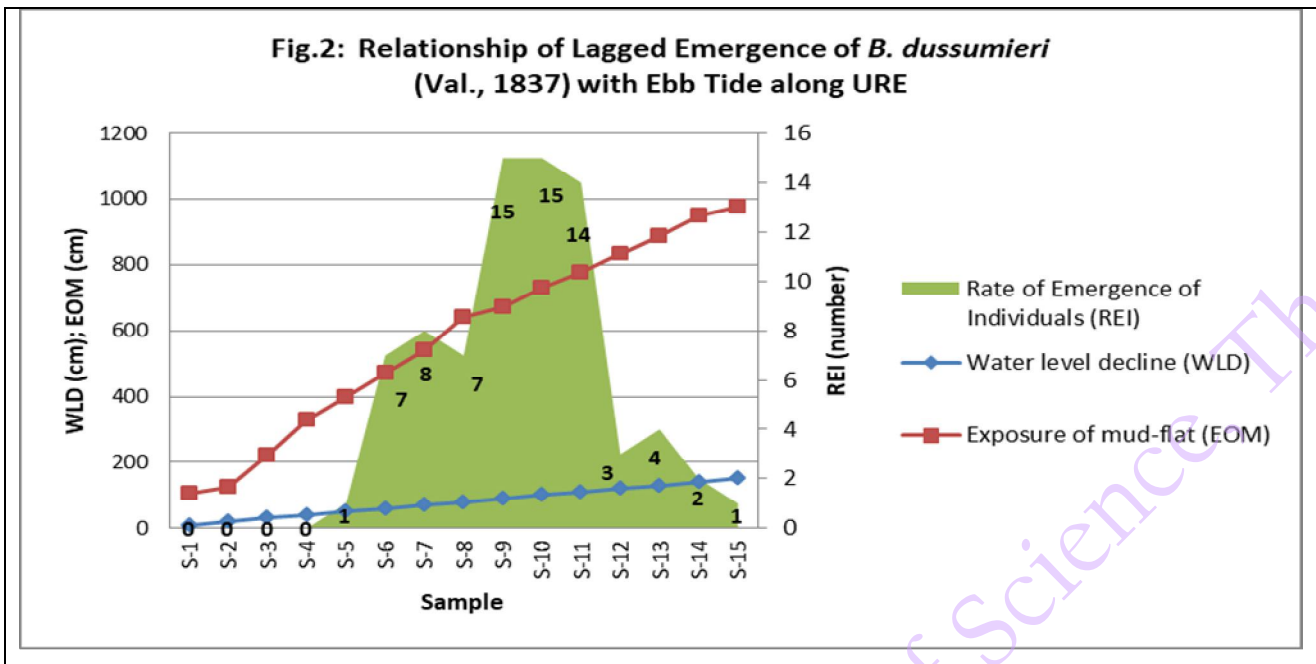
Ulhas River Estuary showing locations of two soil sampling stations-1, 2 & 3 at upper, middle and lower reaches respectively.



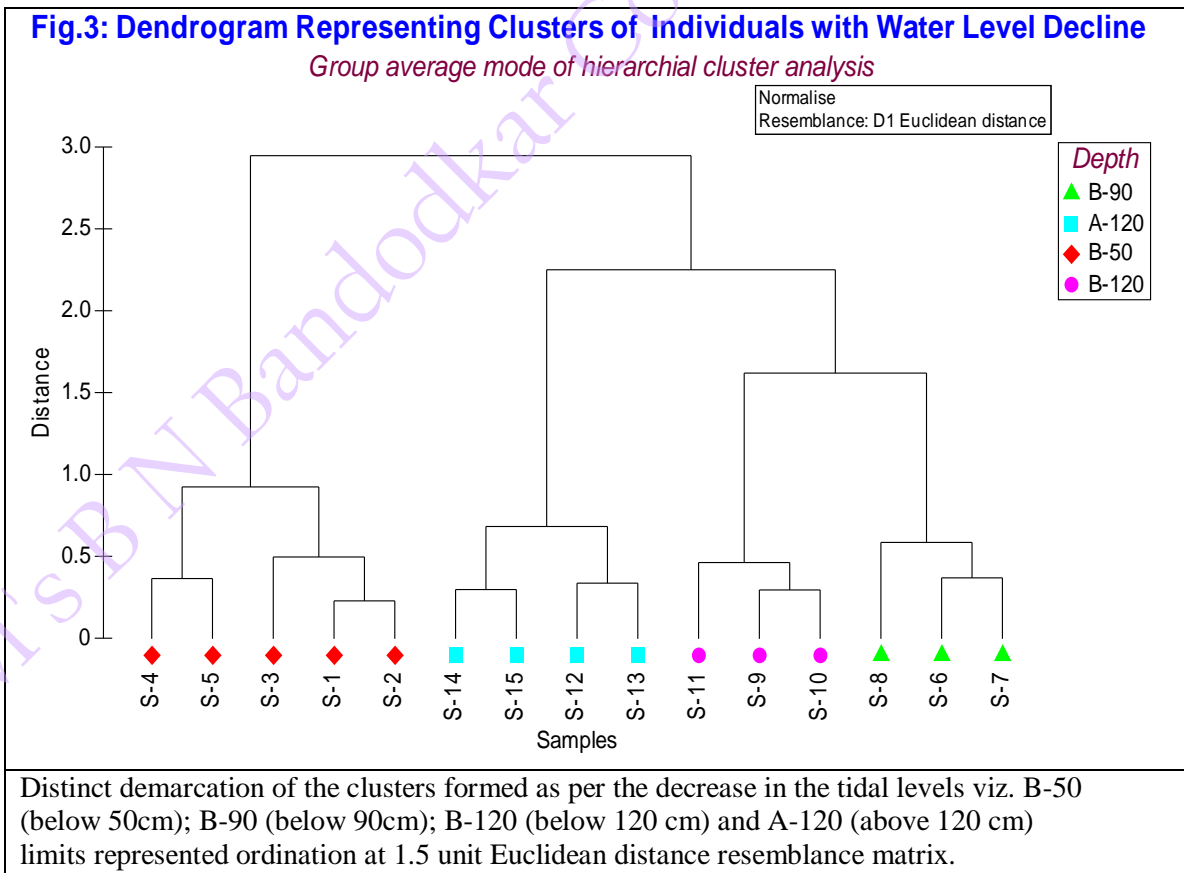
Kolshet Creek located near Thane City of Maharashtra State in India, between Latitude 19.228794N and Longitude 72.982963E on the world map showing the study station where *B. dussumieri* on the mudflats are of common site.

2. RESULT AND DISCUSSION

The behaviour of the *B. dussumieri* on the selected mudflat during the present study viz. observation of emergence pattern of the *B. dussumieri* on the study mudflat with the tidal movement was related to depth of water receded during low tide. The rate of exposure of the mudflat (EOM) was steady and was concomitant to the decline in water level (WLD). This might be due to the evenness in the slope of the ambient mudflat at sampling station. However, the rate of emergence of individuals (REI) was varied with the WLD (Fig.2). The emergence of *B. dussumieri* on the surface of mudflat did not occur immediately after a considerable time of the onset of low tide until the level dropped to below 50cm. Further, the rate of emergence of individuals (REI) i.e. number of individuals emerged out with time, increased with the declining level of water (Fig. 3). About 89% of the individuals appeared on the mudflat surfaces when the water-level declined from 90 cm to 120 cm during low tide depicting the highest rate of surficial emergence of individuals. With the further decline in water level, rate of emergence was lower (Fig. 2).



It is evident from this observation that the individuals did not appear on the surface, until the available water in their burrows supported their respiration. As the water receded, they were forced to rush out of their burrows to breathe fresh air. It is important to mention that younger individuals appear first on the surface. It was however, observed in earlier study that smaller individuals have greater dependence on cutaneous rather than branchial respiration in *Periophthalmus chrysospilos* (Low *et al.*, 1990). This lagged emergence of *B. dussumieri* on the surface depicted that their burrows, existing on present study station, were ranged from 90 to 120 cm in depth, approximately (Fig. 4).



After emergence from the burrows individuals remained entirely engaged in feeding, courtship and protection of their territories during which they remained highly alert and vigilant in such exposed condition. The burrows were actively protected by the owners from their neighbors. Pit-pools were found refuge and source of water for various needs during exposed condition.

Fig. 4: Emergence of Number of Individuals in Relation to the Decline in Water Level

The rate of number emergence of individuals (REI) was greater between 90 cm to 120 cm of water decline level

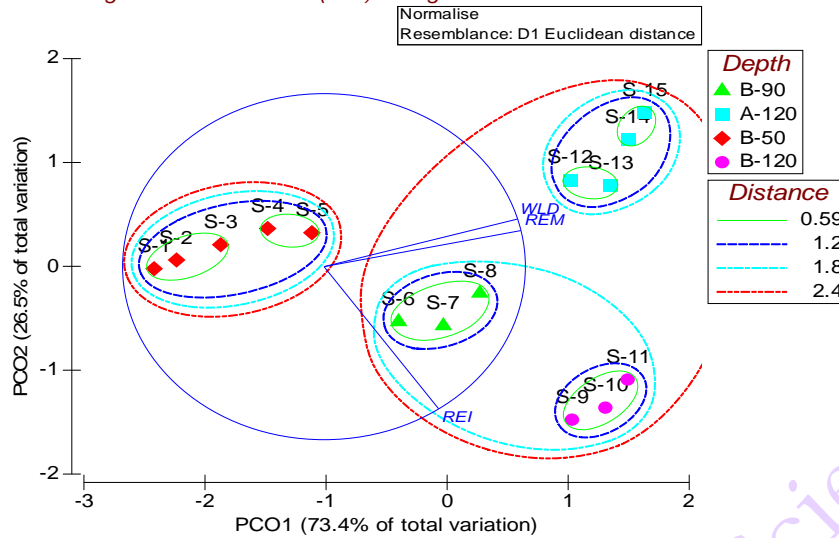


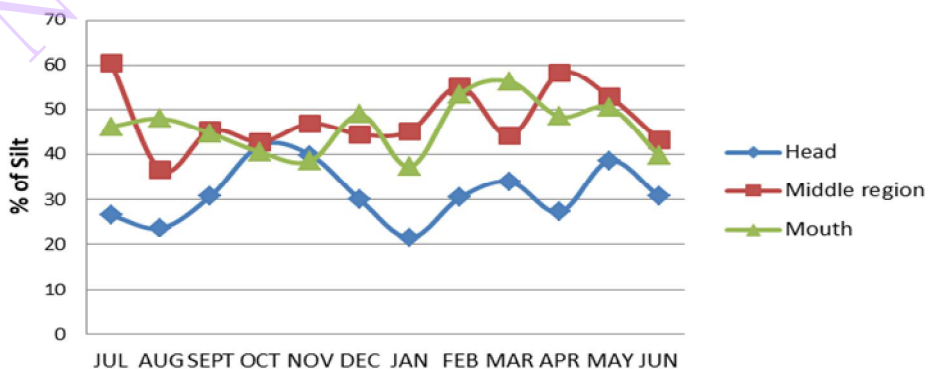
Fig. 4: Rate of emergence of individuals (*B. dussumieri*) increased with the receding water level. The number of mudskippers increased until water declined to 120 cm (B-120) below the high-tide level but suddenly decreased above 120 cm (A-120) level of depth. The ordination of samples between below 90cm (B-90) and below 120 cm (B-120) comprised about 89.7% of the individuals standing in a single cluster at 1.8 Euclidean distance level.

(Labels:- Instantaneous water level decline is depicted as B-50 = below 50 cm; B-90 = below 90 cm; B-120 = below 120 cm and A-120 = above 120 cm. REI = rate of number of individuals appearing on the surface with water level decline; REM = rate of exposure of mudflat and WLD = water level declined).

I. SILTATION AND ITS IMPACT ON THE BURROWING BEHAVIOUR

Siltation was profound in URE towards mouth and middle region during present study. However, the siltation was near 31.26 % at head of the estuary which exceeded on an average 47.92% and 45.99% in the middle and lower regions of the URE respectively. This is probably was pertaining to the higher sand-dredging activities in the particularly from the month of January to May in middle and lower regions during the study period (Rathod, 2016). It has been observed that the present siltation hindered the construction of burrows. Consequently, the mature individuals in the study area were found to confine their burrows to upper intertidal limits (above the line of daily tidal levels which occasionally covered during spring tide only) during the study period. This might be for securing the burrow from getting demolished by tidal current.

Fig. 5: Monthly Silt Regime Towards Head, Study area (middle) and Mouth of the URE



CONCLUSION

Delayed appearance of the individuals was probably related to the water levels in their burrows. It seems that they remained in the burrow until the water was available to support their respiration. As soon as the water receded to about one meter below high tide level (90 to 120cm), the mature individuals were forced to emerge on the mudflat. This indicated that the burrows of *B. dussumieri* are nearly one meter in depth. Thus it is evident

from the present study that lagged emergence of the individuals on the surface during low tide was respiration related. Young ones appeared first after water receding below 50 cm. The early emergence of the young ones indicated their burrows were shallower or they were unable to construct burrows due to siltation in URE.

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