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Disappearance of *Branchiostoma lanceolatum* (Pallas) from Pulicat lake area, Tamil Nadu, India

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Abstract

Pulicat lake is the second largest brackish water ecosystem on the East coast of India, 60 km north of Chennai city, Tamil Nadu, India and is supposed to be one of the habitats for Amphioxus (*Branchiostoma lanceolatum*). The cephalochordate Amphioxus (lancelet) is considered to be the closest relative to invertebrates. It has key vertebrate characteristics viz., a notochord, a dorsal nerve cord, segmented muscles, pharyngeal gill slits and a post anal tail. This interesting organism which was once found in abundance along the shores of the Pulicat lake area up to the late 1970's has disappeared from this habitat. Changes in the topography of the lake area and pollution from various sources may be the possible causes.

Keywords: *Branchiostoma lanceolatum*, cephalochordate, Amphioxus, lancelet, Pulicat lake

1. Introduction

The 18,440 hectare Pulicat lake is the second largest brackish water ecosystem of the country and is situated on the Coromandel coast of Southeastern parts of the Indian subcontinent (13°24' - 13°47'N, 80°03' - 80°18'E) [1]. It is approximately 60 km to the north of Chennai city, Tamil Nadu, India. The lake has a length of 60 km and a breadth of 0.2 to 17.5 km. It has a high and low water spread area of 460 and 250 sq. km. respectively. It is a shallow lake with an average depth of one metre, and is connected with an estuary mouth with a width of 200 m [2]. Pulicat Lake is drained by four rivers, the Swarnamukhi, the Kalangi, the Araniar and the Royyala Kalava apart from many minor inflows. This lake is estimated to be about a million years old [3] (Fig 1). The lagoon is known to support 160 species of fish, 25 species of polychaetes, 12 species of penaeid prawns, 29 species of crabs and 19 species of molluscs [4]. It is also known to support rich growth of algae and high populations of invertebrate fauna, including annelids, coelenterates, molluscs, crustaceans and echinoderms [5]. The International Union for the Conservation of Nature and Natural Resources (IUCN) has declared the Pulicat lagoon system a Ramsar site of international importance and the World Wide Fund for Nature (WWF) declared it a protected area [6].

The Subphylum Cephalochordata of the Phylum Chordata consists of approximately 25 living species of lancelet (=Amphioxus) [7], which are widely distributed in tropical and temperate seas. Cephalochordates are probably the closest living invertebrate relatives of vertebrates [8] and have long occupied a key place in discussions on the origin of vertebrates [9]. Amphioxus, *Branchiostoma lanceolatum* once found in plenty along the coast of the Pulicat lagoon now seemed to have disappeared totally. In the present study, investigations were made over a period of fifteen years without success to locate the lancelet.

2. Materials and Methods

2.1 Study site and sample collection

Six sampling stations were identified along the shore of the Pulicat lagoon area. Three stations were located to the North of the estuary mouth and three South to it. Each station was situated about one kilometer away from the other (Fig. 1). Samplings were done in the intertidal to subtidal zone at a depth of 0.5 to 1.0 m about 30 to 50 m off the shore. Approximately 10 kg of sand was collected using an improvised hand-held dredger. The collected sand was sieved through a 0.5 mm mesh screen using sea water to rinse the sand. Sample collections were done twice a year during the months of January and July from 2000.

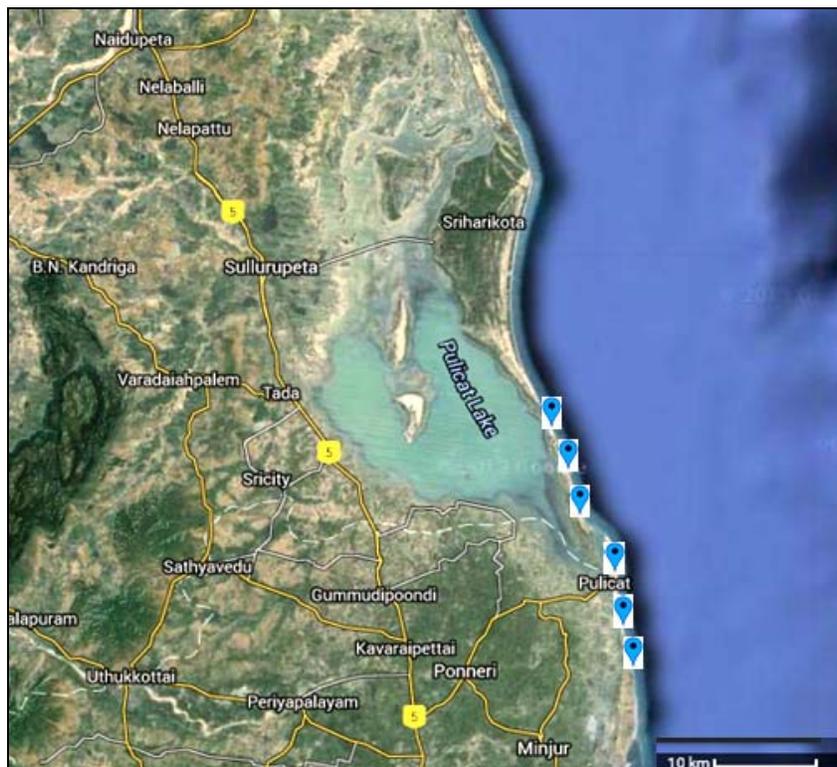


Fig 1: Map of Pulicat lagoon showing the six sampling sites

3. Results and Discussion

The lancelets are the modern representatives of the Subphylum Cephalochordata which comprises fish-like marine chordates belonging to the Class Leptocardii and Order Amphioxiformes. They are globally distributed in tropical and subtropical shallow seas where water depths range from 8 to 16 m and are usually found half-buried in sand^[10]. Amphioxus is regarded as a living fossil since it is the closest extant relative of the vertebrates and occupies an extremely important phylogenetic position in the evolution of vertebrates^[10]. Lancelets probably spend most or all of their larval life in the planktonic form and then settle to the bottom at the end of metamorphosis^[11]. They are an important object of study in zoology as they provide indications about the evolutionary origin of the vertebrates. Cephalochordates occupy at present the key phylogenetic position to get insights into the invertebrate-vertebrate transition and the evolutionary genesis of vertebrates. The prototypical body plan with respect to vertebrates facilitates the comparative analysis and linkage between invertebrates and vertebrates^[12].

Branchiostoma lanceolatum were absent in all the collections done, indicating the disappearance of this lancelet from the Pulicat lake mouth area. Large populations of *Branchiostoma lanceolatum* have been reported by researchers up to the late 1970's. Twenty specimens of *Branchiostoma lanceolatum* were collected from the Pulicat lake and described^[13] and thereafter, sightings were sporadic, anecdotal or hampered by infrequent sampling intervals^[14]. From the time of commencement of the present study in 2000, no specimen was collected, documented or reported. The bulletin issued by National Biodiversity Authority (NBA) of India (2006) authored by Raj^[15] also refers to collections made in 1967 in Pulicat lake and thereafter no sightings.

The possible causes for the disappearance of this interesting and important cephalochordate from the Pulicat area may be manifold. Gradual changes in the water quality due to

pollutants arriving through the fresh water inflows may be a probable cause. North Chennai Thermal Power Station (NCTPS) set up by the Tamil Nadu Electricity Board (TNEB) is located within CRZ-I; however clearance for this was granted prior to 1991 when CRZ came into existence. Till 2000, this plant drew 44 lakh litres of freshwater from Ennore creek and released hot coolant water into Buckingham canal and discharged about 3000 tonnes of toxic fly-ash in the form of slurry containing hazardous elements *viz.*, arsenic, cadmium, mercury, lead, manganese, fluorine and beryllium every day. The release of hot coolant water at temperatures of about 40 °C would have led to oxygen depletion and death of aquatic life. The combination of coolant water and fly-ash has had a serious impact by depleting fish populations. The NCTPS later devised a system of reusing the hot water it releases, and it was no longer necessary to discharge hot water into the lagoon^[16].

Ennore port is located north of Chennai port between Ennore and Pulicat. Right from the construction stage the port caused changes in the shoreline, with accretion and siltation on the southern side in front of the Ennore creek inlet and severe erosion of the sand barrier between Pulicat Lake and the sea on the northern side^[17]. Erosion of the coastal area by the construction of this port has caused the ingress of the sea 50 m into the mainland that separates the Pulicat lagoon system and the sea. Habitat destruction by such large scale erosion could have resulted in the disappearance of the lancelet. Construction of the port has also choked the mouth of the Ennore creek where the Kortalaiyar River joins the sea. This not only prevents the river from entering the sea, but also turns the water body into a cesspool of stagnant water^[6]. Another possible cause for the disappearance of the lancelet may be fluctuations in the inflow of freshwater due to inconsistent monsoon rains. Studies indicate large-scale sedimentation, which signifies a disaster in the making along the coast^[6]. Dhinamala *et al.*^[18] have recently reported an increase in the

values of BOD, COD, TDS and TH in Pulicat lake waters indicating that there has been an increase in pollutants reaching the estuary. Recent studies on the occurrence of heavy metals in Pulicat lake waters has revealed that copper, zinc, chromium and mercury were moderately above the permissible limits and cadmium concentration was found to be high [19]. Konsulova [20] has reported that in the 1960s *Branchiostoma lanceolatum* was quite common along the Bulgarian coast but disappeared from 1991. The main threat was the reduction in areas with coarse sand as a result of eutrophication and organic pollution. Amphioxus (*Branchiostoma belcheri tsingtauense*) present in the Luan river estuary, China was threatened following the rapid development of the inshore economy and environmental pressures on the inshore sea [21]. Amphioxus populations are threatened by discharge of land-sourced pollutants into the sea, sand mining, sediment transportation and illegal fishing [22], aquaculture expansion and increasing maritime traffic [23] which both kills Amphioxus and destroys their habitat [24]. Yuan *et al.* [25] also reported a decline in the population of *Branchiostoma belcheri* in Jiaozhou Bay and adjacent areas in China and recommended the creation of a reserve to protect this animal species.

The changing water quality parameters and rising metal levels above the normal limits in Pulicat Lake will prevent any re-establishment of Amphioxus population in the near future. The lesson learnt from the disappearance of the lancelet from the Pulicat area should serve as a warning to conserve such priceless living treasures by conservation of habitat at all cost. *Balanoglossus*, an ocean dwelling hemichordate acorn worm was once abundant in the Krusadai island of Gulf of Mannar in the late 1980's and 1990's and now has totally disappeared from the island's vicinity. Following this, disappearance of Amphioxus from the Pulicat Lake is primarily due to the degradation of the marine habitat. A thorough study on their distribution, abundance and diversity is an urgent need in order to understand the fate of this sensitive organism.

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