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Remote Sensing and Field Studies on Narrowing of Three Sea Mouths of Pulicat Lake Sanctuary and Ecological Impact

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Abstract: The sea mouths at Tupilipalem, Rayadoruvu and Pulicat Village of Pulicat Lake, the second largest brackish water lagoon in India, next to Chilka Lake is gradually closing with sand bar formation due to blow of north bound wind recorded from both Satellite remote sensing imagery data and direct observational data from 2000-2009. Pulicat Lake requires immediate action for dredging, as done for Chilka Lake, for ecoresiliency. Construction of a groyne is recommended to prevent sea mouth closure by sand deposition. The sea mouths of Pulicat Lake are not simply a passage but also a biocorridor for migration of fishes, crustaceans after spawning in sea and migration after breeding in brackish water lake and vice versa. This important chronoecological process is basic requirement for making available food for long distant migratory birds, local migrants but also 50,000 fishermen who are dependent on this lake spread in 600 sq. km.

Key words: Pulicat Lake % Sea mouth narrowing % Ecology % Flamingo feeding % Fish catch

INTRODUCTION

The Pulicat lake brackish water lagoon declared as bird sanctuary extending between 13° 20'-13° 40' N lat. and 80° 14'-80° 15' E log. and formed out of backwaters of the Bay of Bengal [1, 2], is the second largest brackish water lagoon having an area of approximately 600 km^2 and has three sea mouths namely one at Tupilipalem [2], another at Rayadoruvu at northern end of Sriharikota Island and the third one at south end of Sriharikota near Pulicat Village. The northern part of lake appears more or less like a mudflat with a thin water column or shallow water and is desiccated apparently due to tectonic upliftment [1] causing displacement of surface sediment and for this reason the lake is shallow in this area. During high tide the sea water flows from the Rayadoruvu sea mouth located north end of Sriharikota Island from east to south-west direction responsible for existence of shallow water west of Sriharikota Island known in local vernacular as Attakanithippa, Venad and a part near Irakkam Island of Pulicat Lake [3]. During low tide, lake water flows in reverse direction into sea from lake in all sea mouths. Heavy inflow occurs in lake during north east monsoon rains which flood Swarnamucki, Kalangi, Ponneri, Uppativagu rivers and other small rivulets [2]. Thus a brackish water regime exists. The sea mouths exhibit dynamic changes viz. opening and closure at their mouths by sand deposition due to blow of powerful northern wind and also erosion of sand and shift in their location during heavy rainfall, cyclonic storms or tsunami causing breaking of sandbar and widening of sea mouth [2]. However a gradual accumulation of sand is piled up cumulatively resulting in gradual closure and silting at sea mouth. The sand bank became so thick that it is not breached naturally even in the monsoon season during the past four years [2] in case of Tupilipalem sea mouth. Scientific reports on combined study of satellite remote sensing data and field work are essential for retrospective and real time data for any ecosystem [4]. Such work on impact of sea mouth closure on plankton density, shift in long distant migratory bird's feeding grounds, fishing activity and remedial measures are meagure on Pulciat Lake. The research paper emphasizes these aspects for ecoresiliency measures.

MATERIALS AND METHODS

Study was under taken on three sea mouths status i.e., Tupilipalem, Rayadoruvu and Pulicat Village from the year 2000 to 2009. IRS P6 LISS III satellite data pertaining to three sea mouths width of Pulicat Lake was studied for retrospective data for the period 2000 to 2006 through

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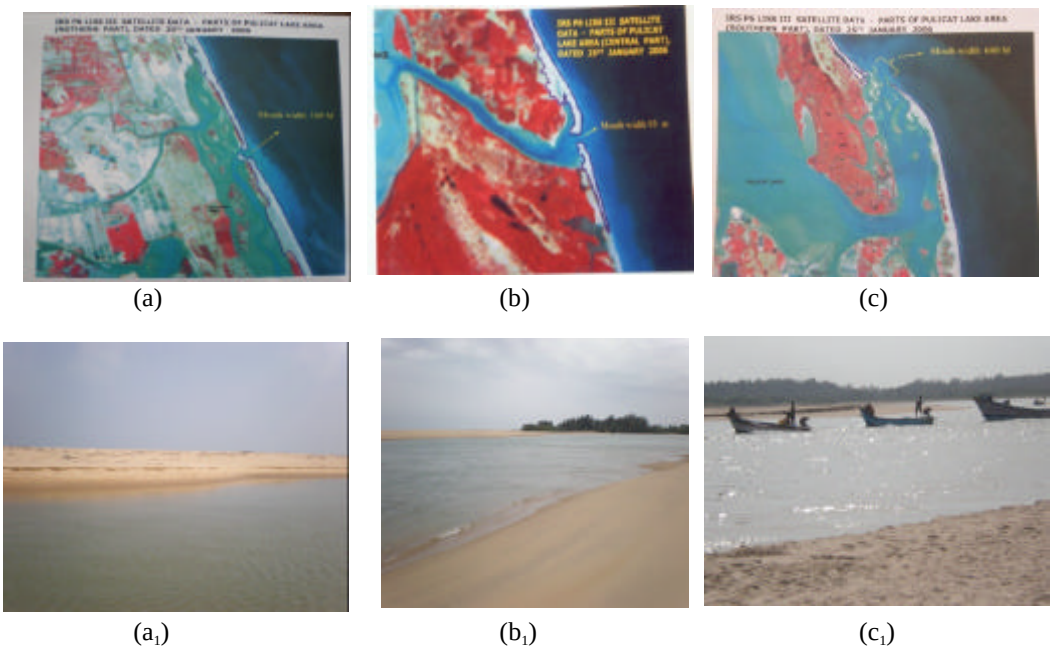

(a) (b) (c)

(a_1) (b_1) (c_1)

Fig. 1: Satellite imageries of sea mouths of Tupilipalem (a), Rayadoruvu (b) and Pulicat Village (c) for the year 2006 January respectively and direct observational photographs of sea mouths of Tupilipalem (a_1), Rayadoruvu (b_1) and Pulicat Village (c_1) for the year 2009 August respectively.

(a) (b) (c) (d)

Fig. 2: Showing fisheries catch (a) and Flamingo feeding grounds in December 2007 (b). Partly dried up lake and absence of fisheries catch in December 2008 (c) and thermal death of fishes in March 2009 (d).

Table 1: Sea mouths widths of Tupilipalem, Rayadoruvu and Pulicat Village by Satellite remote sensing and direct field observation from 2000-2009

	Sea mouth width (Meters)		
Year	Tupilipalem	Rayadoruvu	Pulicat Village
2000 (November)	26.98 (SD)	23.67 (SD)	NA
2005 (January)	59.60 (SD)	55.48 (SD)	NA
2006 (January)	168.08 (SD)	93.00 (SD)	680.00 (SD)
2006 (April)	118.00 (DO)	30.00 (SD)	448.00 (SD)
2007 (January)	71.00(DO)	81.00 (DO)	NA
2008 (January)	37.00 (DO)	65.00 (DO)	244.71 (DO)
2008 (March)	0.00 (DO)	61.00 (DO)	
2009 (March)	0.00 (DO)	60.00 (DO)	250.00 (DO)
20009 (August)	0.00 (DO)	58.00 (DO)	233.00 (DO)

SD-Satellite data; DO-Direct observation; NA-Not available

Table 2: Comparative table showing decrease in Plankton density in Pulicat Lake fifth km. from west of Sriharikota Island in Attakanithippa shallow water location from 2007-2009

	December 2007	December 2008	December 2009
Location in Lake	Plankton density/ 100 CFT	Plankton density/ 100 CFT	Plankton density/ 100 CFT
5 km	8,59,100	28,330	20,000

Values mean of 8 observations

Satellite imageries obtained from Andhra Pradesh State Remote Sensing Applications Centre, Government of Andhra Pradesh, Hyderabad (Fig. 1) whereas direct field work at the ground level was conducted for the period 2007-2009. This was done by proceeding to the sea mouth directly to all sea mouths on boat and sea-mouth widths were measured (Fig. 2; Table 1) for the period from 2007-2009 (Table 1). Water samples were collected and plankton density was estimated [5]. Flamingoes (*Phoenicopterus ruber*) numbers and feeding grounds were recorded by direct observation.

RESULTS AND DISCUSSION

The sea mouths at Tupilipalem, Rayadoruvu and Pulicat Village are not simply a passage of water into lake but a biocorridor for survival of both aquatic fauna and also 150 species of long distant and local migrant avifauna which feed on aquatic fauna of lake. The lake also lively hood for 50,000 fishermen. Satellite remote sensing and direct field observation of Pulicat Lake sea mouths showed gradual shrinkage (Fig. 1; Table 1). During monsoon and cyclonic storms of north east monsoon with heavy inflows into lake from river, the sand bar opens at weak points, widens and again closes down during of dry periods i.e., from May to September. The width of sea mouth shows occasionally opening much wider than preceding years but the overall sea mouth widths from 2000 to 2009 is gradually decreasing at Rayadoruvu (Fig. 1 b_1) and Pulicat Village (Fig. 1 c_1) and whereas completely closed at Tupilipalem (Fig.1 a_1; Table 1). The depth at sea mouth is also lesser due to siltation in 2009 than in previous years. With gradual narrowing of sea mouths, less sea water flows over tectonically uplifted shallow water lake portion, i.e., from Rayadoruvu to Attakanithippa and Venad during high tide and the quantity would not be sufficient to reach the other west side coast ridge of Pulicat Lake near Attakanithippa and Venad and the lake gets dried up in March/April itself (Fig. 2). The thrust of sea wave is resisted by growing sand bank (Fig. 1) resulting in less flow of water and quick drying up of a part of lake in January 2009 itself (Fig. 2b) and fishes showed thermal deaths in March 2009 (Fig. 2). In this context it is a significant observation that the tectonically uplifted segment of northern portion (Attakanithippa and Venad) is a natural shallow water niche body where Flamingos feed on enriched plankton (Fig. 2b), Pelicans feed on fishes and other migrant waders feed on zoo and phytoplankton and fishermen catch both fishes and shrimps with fixed nets (Fig. 2). In the year 2009 January the Flamingos and Pelicans were not seen in Attakanithiappa area due to drying up of a part of lake in January itself (Fig. 2c). The obvious reason being narrowing of sea mouth and late monsoon rains. As an ecoremedial measure, it is recommended to dredge sand bar and construct groyne near all sea mouths while maintaining water equilibrium between lake and sea and to allow shallow water stagnation until long distant migratory bird season lasts i.e., from September to April. This helps in conservation of aquatic fauna and 150 species of avifauna [6] and a variety of planktonic forms and pelagic fishes and shrimps which act as trophic level II organisms for migratory birds which occupy trophic III level. This would also help 50000 fishermen who depend on Pulicat Lake for shrimp and fish catch. Thus three sea mouths are not simply a passage but also a biocorridor for migration of fish, crustaceans, after spawning and breeding from lae to sea and vice versa acting as food for long distant migratory birds Flamingoes, Pelicans and innumerable waders. The shallow water regimen of Attakanithippa and Venad is also an ideal niche during monsoon and also during post monsoon period upto March for rich plankton density which showed a correlation to sea mouth decrease and decrease in plankton density (Table 1 and 2).

A different situation exists in sea mouth at Pulicat Village area. The third Pulicat Lake mouth at south end of Sriharikota Island and the lake depth at south end of lake ranges from 1 to 3 m (Fig. 1). Hence the fishing activity is high in this area compared to adjacent areas of other two sea mouths namely Tupilipalem and Rayadoruvu. A significant observation in south end near “Pulicat Village” deeper areas exist where migratory birds like Pelicans and Flamingoes are not observed unlike at shallow region of the lake adjacent to Rayadoruvu, Venad and Attakanithippa area (Fig. 2a, 2b)

It is concluded that the two northern area sea mouths namely Tupilipalem and Rayadoruvu needs dredging followed by construction of groyne [2] for free flow of sea water into lake during high tide and in reverse direction during low tide from lake to sea otherwise it is visualised that over a period of time, the cumulative sand siltation would gradually decrease water flow into lake.

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