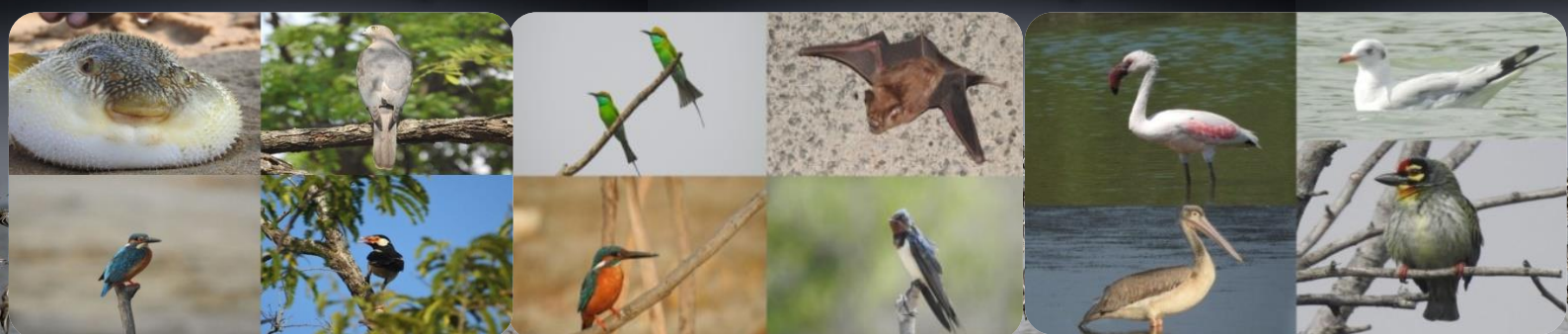


Impact of dredging and opening of the sea mouth into the Pulicat lake at Rayadoruvu village of Vakadu Mandal, on the habitat of Pulicat Bird Sanctuary, Andhra Pradesh
Final Report



Sálim Ali Centre for Ornithology and Natural History
(A Centre of Excellence under the Ministry of Environment, Forest and
Climate Change, Government of India)
P.O. Anaikatty, Coimbatore – 641108, Tamil Nadu

Citation:

Riddhika R, Quadros G, Ramesh T, Arun PR, Sharpana NB, George A, Anoop V, Prakash L, Pradeep S, and Velkumar R (2019). *Impact of dredging and opening of the sea mouth into the Pulicat lake at Rayadoruvu village of Vakadu Mandal, on the habitat of Pulicat Bird Sanctuary, Andhra Pradesh*. Project Report # PR-202, SACON, Coimbatore, 232 pp.

Impact of dredging and opening of the sea mouth into the Pulicat lake at Rayadoruvu village of Vakadu Mandal, on the habitat of Pulicat Bird Sanctuary, Andhra Pradesh

Final Report

Principal Investigators

Dr. Riddhika Ramesh

Dr. Goldin Quadros

Dr. T. Ramesh

Dr. P. R. Arun



Research personnel

Mrs. N. Sharpana Bharathi

Mr. Arun George

Mr. V. Anoop

Mr. L Prakash

Mr. S. Pradeep

Mr. R. Velkumar



Salim Ali Centre for Ornithology and Natural History
(A Centre of Excellence under the Ministry of Environment, Forest and Climate Change, Government of India)
P.O. Anaikatty, Coimbatore – 641108, Tamil Nadu

September 2019



SL NO.	TABLE OF CONTENTS	PAGE NO.
	ACKNOWLEDGEMENTS	10
	EXECUTIVE SUMMARY	11-14
1.	BACKGROUND OF THE PROJECT	16-17
2.	LITERATURE REVIEW	18-31
2.1	ECOSYSTEM STABILITY IN LAGOONS	18-19
2.2	IMPACT OF DREDGING ON BIOLOGICAL COMMUNITIES	19-21
2.3	FAUNAL AND FLORAL DIVERSITY IN PULICAT BIRD SANCTUARY	21-24
2.4	HYDROLOGICAL AND NUTRIENT CHARACTERISTICS OF PULICAT LAKE	24-26
2.5	SEDIMENT CHARACTERISTICS AND BENTHIC ORGANISMS IN PULICAT LAKE	26-28
2.6	SOCIO-ECONOMIC & LIVELIHOOD CHARACTERISTICS OF PEOPLE IN PULICAT BIRD SANCTUARY	28-29
3.	INTENSIVE STUDY AREA	30-31
4.	OBJECTIVES	32
5.	ASSESS THE IMPACT OF DREDGING ON MAJOR FLORAL AND FAUNAL COMPONENTS AND ASSESSING THE BIRD HABITATS, BIRD DIVERSITY AND BIRD POPULATION TRENDS IN PULICAT SANCTUARY	33-65
5.1	MATERIALS & METHODS	33-38
5.2	RESULTS	39-60
5.3	DISCUSSION	60-65
6.	STUDY THE SOCIO-ECONOMIC IMPACTS OF SEA MOUTH OPENING ON PULICAT SANCTUARY AT RAYADORUVU	66-79
6.1	MATERIALS & METHODS	66
6.2	RESULTS & DISCUSSION	67-79
7.	DOCUMENTATION OF ENVIRONMENTAL PARAMETERS OF THE LAKE	80-129
7.1	MATERIALS & METHODS	80-85
7.2	RESULTS	86-123



7.3	DISCUSSION	124-128
8.	STUDY THE EFFECTS OF OPENING OF SEA MOUTH ON THE ECOSYSTEM OF PULICAT LAKE AND RECOMMEND MEASURES TO IMPROVE THE LAKE	130-138
8.1	MATERIALS & METHODS	130
8.2	RESULTS	130-135
8.3	DISCUSSION & RECOMMENDATIONS	135-138
9.	ASSESSING THE IMPACT OF SEA MOUTH OPENING ON FLAMINGO, OTHER BIRD POPULATIONS AND THE OVERALL ECOSYSTEM WITH REGARDS TO THE CHANGE IN WATER LEVELS AND SALINITY AND SUGGEST MANAGEMENT RECOMMENDATIONS	139-150
9.1	MATERIALS & METHODS	139
9.2	RESULTS & DISCUSSION	139-150
9.3	MANAGEMENT RECOMMENDATIONS	150
10.	STUDY ON THE IMMEDIATE CATCHMENT AREAS OF THE PULICAT LAKE AND RECOMMEND IMPROVEMENTS TO THE CATCHMENT AREAS TO MANAGE THE FRESHWATER INFLOW INTO THE PULICAT LAKE	151-163
10.1	OVERVIEW OF IMMEDIATE CATCHMENTS OF PULICAT LAKE	151-152
10.2	MATERIALS & METHODS	152-157
10.3	RESULTS	158-161
10.4	DISCUSSION AND MANAGEMENT RECOMMENDATIONS	162-163
11	REFERENCES	164-183



ACKNOWLEDGEMENTS

We sincerely thank all the officials from the Forest Department, Principal Chief Conservator of Forest (Wildlife), Chief Conservator of Forest (Tirupathi), Divisional Forest Officer, Rangers (Mr. Venu) and Research Biologist (Ms. Masthanamma) from Pulicat Wildlife Sanctuary for their constant help in arranging our logistics, and travel during field data collection. We are sincerely thankful to Dr. K. Sankar, Director, SACON for his enthusiastic support and critical comments at all stages of the project. We thank members of State Fisheries Department (Nellore), Andhra Pradesh, particularly, Joint Director Fisheries Department and Mr. Suresh for their initial orientation to the study site. We thank the District Collector (Nellore), Mr. Sridhar, and Mr. Ekambaram for their constant support during the study. Arrangements for our logistics and travel from Sriharikota island to Rayadoruvu would not have been possible without the support of many officials of Satish Dhawan Space Centre (SHAR), Indian Space Research Organisation (ISRO), mainly the Controller, Public Relations Officer, and Central Industrial Security Force. We thank the local fisherfolk community from Rayadoruvu; Mr. Subramaniam for providing boat facility, Mr. Arun for providing vehicle to conduct field work, Mrs. Kishtamma for arranging delicious sea food cuisine during field surveys especially after a tiring day. Special thanks to Mr. Ramesh, Mr. Dhandapani, Mr. Sathaam Hussain, Mr. Udaya for bearing with arduous hours of travel in Pulicat. Our Administrative Officer, Mr. Jayakumar and Finance Officer, Mr. Aneesh Abraham are thanked for handling all major administrative and financial duties for the smooth running of the project. From SACON's Ecotoxicology lab, we thank our Research Scholars; Mr. Khaja Maideen for making provisions for distilled water during water quality analysis and Mr. Karthi for sharing his skills in operating the spectrophotometer in the Wetland laboratory. We are grateful to Dr. B. Hemambika from SACON's Environmental Information System (ENVIS) centre for sharing her expertise in the laboratory analysis of water and sediment samples. We thank Mr. A. Srinivasan, SACON for his assistance in formatting the report at all stages.



Executive summary

Our study assessed the impact of dredging on flora, fauna, environmental parameters, socio-economics in and around Rayadoruvu inlet, and the immediate catchments surrounding Pulicat Sanctuary, Andhra Pradesh from January to March 2019. We recorded 141 bird species from 52 families and 18 orders which included a total count of 7358 wetland birds comprising of 79 species. Eight raptors and a wader listed under “Schedule I” as per the Indian Wildlife Protection Act (IWPA) 1972 were recorded. Four “Near Threatened” waders and a “Vulnerable” raptor as per the IUCN Red list were also recorded. Of the 12 mammalian species recorded, five belonged to “Schedule II” category of IWPA. We recorded seven dead Olive Ridley Sea Turtles *Lepidochelys olivacea* near the mouth of Rayadoruvu inlet. The species is listed under “Schedule I” of IWPA 1972 and “Vulnerable” as per the IUCN Red List. Of the 107 plant species recorded from 46 families, we recorded 16 invasive plant species. Salinity (70 PSU), conductivity (183.7 $\mu\text{S}/\text{cm}$) and total dissolved solids (91.86 ppm) were three to four times higher in the lake than sea water (salinity 31 PSU, conductivity 47.94 $\mu\text{S}/\text{cm}$ and total dissolved solids 23 ppm), attributed to low water depth and high evaporation rate. Eighteen orders of phytoplankton, ten orders of zooplankton, seven orders of macrobenthos and nine classes of meiobenthos were recorded in the lake. Overall phytoplankton abundance was significantly lower in the lake than sea water while macrobenthos abundance was higher in the lake than sea.

Based on our findings we conclude that dredging of Rayadoruvu inlet will be beneficial for the Pulicat lake ecosystem. The exchange of water between sea and lake will stabilize the salinity levels, thereby increasing the diversity and abundance of planktons and fish availability in the lake. This in turn can help in sustaining larger wetland bird population in Pulicat Bird Sanctuary which lies in the Central Asian Flyway Region supporting several important migratory species including high altitude migrants such as the Bar-headed Goose *Anser indicus*. The proposed dredging area and its immediate environs does not include core flamingo habitats. Larger flocks of Greater flamingos *Phoenicopterus roseus* were recorded nearly 10 km away from the inlet, and minimal changes are only expected in the water level and salinity in this area after opening the sea mouth. Hence, no impact on flamingo population is expected from the proposed sea mouth opening. We conducted open-ended questionnaires for



252 respondents from 8 village clusters of which, Madhavapuram, a small island and Nawabpet had negative opinion on dredging as the former envisaged rise in water level surrounding their village and the latter perceived a lower harvest rate of prawns. Yet, nearly 93% of the respondents had a positive opinion on dredging. As per National Institute of Ocean Technology's predictive model, the variation in water depth after the opening of sea mouth during low (-0.1 m) and high tides (0.3 m) will not have any impact on flamingoes, nor will the rise in water level is likely to affect Madhavapuram village. The immediate catchment areas of Swarnamukhi and Kalangi river channels bringing freshwater inflow to the Rayadoruvu inlet needs improvement through effective catchment area treatment plans simultaneously along with the dredging of sea mouth for atleast 5 to 10 years. Afforestation measures along these catchments by planting native trees and shrubs will improve the green cover and thereby restore water availability in the catchments. No dredged material should be deposited in Pulicat Sanctuary and its catchment areas.

Dredging operations should be completed before the monsoon ends and before the bird migratory season (December to January). It is suggested not to perform dredging directly perpendicular to the mouth of the inlet in order to prevent maximum sea water entering the lake under the influence of strong tidal forces which in turn may lead to sudden changes in the lake ecosystem. Instead, it is suggested that the opening of training jetties may be tilted towards the north-east direction (Fig. 1a), considering the historical gradual flow of sea water into the inlet. We suggest that dredging is undertaken in proportion to the width of the inlet (Fig. 1a). This is essential so that the inter-tidal zone as designated in the Andhra Pradesh Coastal Zone Management Plan which comprises of edge habitats of mangrove patches and feeding grounds of shallow water feeders (Heron, Plover, Sandpiper, Stint, Whimbrel and Curlew) are kept intact. Dredging should not disturb the Olive Ridley Sea Turtle nesting site which is hardly a kilometer northwards from the sea mouth and hatchery and it should not overlap with the nesting period (mid-January to mid-March). Additional dykes/walls/groynes jutting into the sea from Sriharikota island eastwards may aid in deflecting the waves and movement of sediments arising from the nearest port activity towards Rayadoruvu sea mouth. It is important to conduct post-dredging impact

assessments on the flora, fauna, people's livelihood and hydrological parameters in Pulicat lake for atleast one year.

Fig 1a. The proposed dredging plan by SACON at Rayadoruvu inlet



Suggested steps for dredging at Rayadoruvu inlet

- The north training wall can extend up to approximately 350 m away from the coastline while the south training wall can be longer than the north training wall i.e 420 m from the coastline (NIOT 2017)
- The opening of 120 m at the entrance mouth at the sea side of the training walls facing the coastline is suggested to be maintained to allow adequate flow of sea water during low and high tides (NIOT 2017). While the gap between the north and south training walls facing the Rayadoruvu inlet should be maintained at 300 m (NIOT 2017).
- The height of both training walls should be according to the maximum wave height as measured by NIOT (2017). Therefore, the height of north and south training walls may be fixed at 7 m from the ground.
- Over time, it is possible that the training walls may weaken and collapse from weathering due to the impact of strong sea waves and currents and corrosive



nature of salt water, hence it is suggested that gabions maybe placed covering the training walls to keep the walls packed tightly together.

- Dredging should be undertaken in proportion to the width of the inlet i.e if the total width of the channel at any given point is 100 m then 80 m maybe allowed for dredging in the middle sub-tidal part of the channel leaving the edges of the channel intact to avoid any damage to mangrove vegetation and shallow feeding areas for birds.

Suggested steps for post-dredging activity and maintenance

- No dredged material should be disposed in and around Pulicat Sanctuary
- Dredging operations should be completed before the monsoon ends and before the bird migratory season (December to January).
- It is suggested that the Forest Department shall periodically monitor (once in three months) the Rayadourvu inlet to prevent further siltation of the sand bar subsequent to the proposed post-dredging operation as part of regular maintenance. Since the closure of tidal inlet is expected to occur in the summer season when there is less exchange of water and based on the sediment movement from south to north from littoral drift it is suggested that the removal of sand from both openings of the training walls can minimize siltation.
- It is suggested that there should be regular monitoring of the physio-chemical parameters at different sections of the lake using portable multiparameter probes to record the fluctuations in salinity and water levels on seasonal basis and to maintain the hydrological parameters within the acceptable range.
- For at least one year, post-dredging assessment of vegetation, wetland birds, water and sediment quality analysis, and socio-economic surveys must be conducted on a seasonal basis to assess the success of dredging operations.
- Wetland bird counts as part of the annual census should also include sites along Rayadoruvu inlet.