Seasonal Wetlands of Porbandar District, Gujarat

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ABSTRACT

Porbandar district is a coastal district in southern part of Saurashtra peninsula that is diverse in several natural wetlands. Estuaries, lagoons, creeks and depressed lands are some of the varied natural wetlands that exist in this region. This paper briefly highlights hydrological, soil and floral features of some of the seasonal wetlands present in the north-western and central parts of Porbandar district. Also being a developing area, the region is subject to various stresses from anthropogenic activities. For sustenance of these wetlands, it becomes imperative to know the existing conditions of these wetlands and their important role in the environment. A total of 32 plant species related to 21 families were identified from three distinct wetlands of the area. Characterised by poorly drained soils, the wetlands exhibit transient conditions between freshwater and saline water environment.

Keywords: seasonal wetlands, coast, Porbandar, freshwater, saline water

INTRODUCTION

Coastal areas, where land meets sea, constitute an important ecosystem that is rich, diverse and dynamic in nature. These areas are often characterized by presence of various geomorphological features such as soft or rocky shores, cliffs, hilly or flat coastal plains, and a wide variety of wetlands [1]. Wetlands as defined by the Ramsar Convention are 'areas of marsh, fen, peat-land or water, whether natural or artificial, fresh, brackish or salty, including area of marine water, the depth of which at low tides does not exceed six meters' [2]. Two general categories of wetlands are recognised: coastal and inland. Both inland and coastal wetlands serve as an important link in hydrological cycle providing number of goods, such as timber for local people, and a mixture of services; e.g. inland wetlands are good water replenishing structures for groundwater, coastal wetlands help in purification and regulation of flows, trapping of inorganic contents, protection from storm surges, fisheries, provide habitat for plants, animals and several micro-organisms. They also add to the recreational and tourism activities.

Wetlands vary widely because of regional and local differences in soils, topography, climate, hydrology, water chemistry, vegetation and other factors. Both, soil and hydrological conditions are interlinked. Water saturation to a large degree determines how the soil develops and the species of local flora and fauna that can thrive in this environment. Wetlands can be seasonal also i.e. they can be wet or dry for one or more seasons in a year. Seasonal wetlands in arid and semi arid regions may be wet, only periodically. Functions of such seasonal wetlands and their role in environment, in part, are determined by the timing of wet and dry periods and water quantity.

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In India, contribution of Gujarat is about 22.77% of total wetland area of country, which is the highest among all states of the country [3]. Total wetland area estimated in Gujarat is 34,74,950 ha which accounts for about 17.56% of geographical area of the state [4]. The Gujarat coast, due to its varied physiographic features, geomorphology, coastal processes and river discharge into the sea, provides a wide variety of coastal features. Coastal wetlands such as coral reefs, mangroves, tidal flats, mudflats, marshes, creeks, estuaries and beaches are exclusively found.

Porbandar is a coastal district in southern part of Saurashtra Peninsula on the west coast of Gujarat between latitudes $21^0$15' to $21^0$58' North and longitudes $69^0$23' to $70^0$00' East. Porbandar district falls under semi-arid climate zone with annual rainfall of 634 mm. About 93% of the rainfall occurs during June to September from south-west monsoon. The annual mean temperature in Porbandar district ranges from 21.6^0 C to 30.4^0 C with maximum temperatures occurring during May to June and minimum during January to February (IMD data records 1969-2001). Porbandar district covers 22,199 ha of wetland area which is 0.64% of the total wetland area of the state. Inland wetlands contribute 27.3% of the total wetland area and coastal wetlands contribute 72.7% of the total wetland area. Major wetland categories of the district are lagoons, rivers/ streams, reservoirs and sand/beaches [4]. Besides natural, man-made coastal wetland like salt pans are also present in the district. Many of the seasonal wetlands in Porbandar district are prioritized wetlands for conservation of biodiversity. Barda sagar in Porbandar district is a prioritized wetland that holds top biodiversity rank [5]. Kerly reservoir falls under important wetlands of Gujarat [4]. This paper attempts to describe floral, soil and hydrological characteristics of some of the important seasonal wetlands of the area.

STUDY AREA

Three sites representing different environmental conditions in Porbandar district were investigated viz. (A) Kerly creek, (B) Kerly reservoir and (C) Barda sagar. Figure 1 shows the location of the three sites. Kerly creek (Porbandar creek) is a coastal wetland represented by a narrow channel in the heart of Porbandar city that carries tidal sea water for nearly 4.5 km away from the coast up to the tidal regulator (Figure 1) that separates it from Kerly Reservoir.

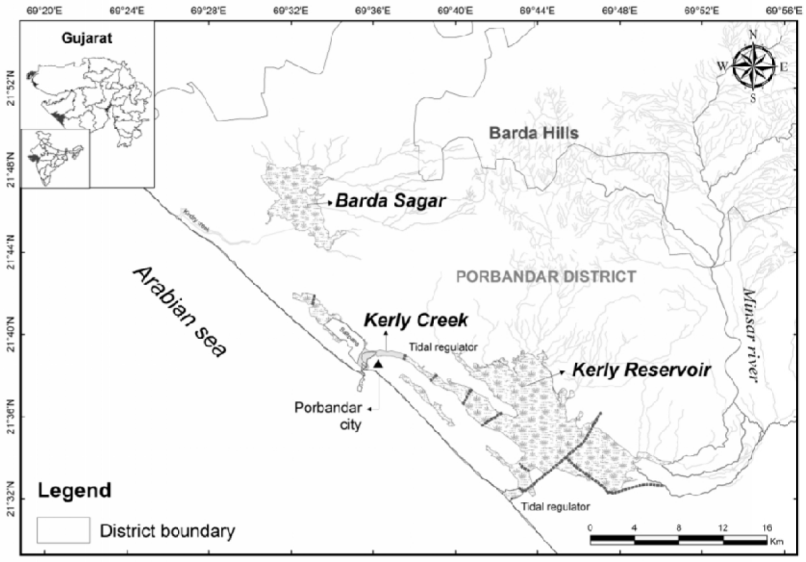

Figure 1. Map showing location of study sites investigated in Porbandar district (A) Kerly creek (B) Kerly Reservoir and (C) Barda Sagar. Inset shows location of Pobandar district in Gujarat state.

On the east of Porbandar city, the Kerly reservoir is located, which is a seasonal wetland characterised by its low-lying topography. Both creek and reservoir are separated by a tidal regulator that marks their ends. At its other end near Tukda-Gosa village (about 30 km from city), the reservoir is separated from the Arabian Sea by another tidal regulator. The maximum water spread area of Kerly reservoir is about 82 km^2. Many seasonal streams and distributaries of Minsar river drain into this reservoir. Barda Sagar, located north-west of Porbandar city, is also a low lying region and a seasonal wetland. It receives water from seasonal streams that originate in Barda Hills. Maximum water spread area of Barda Sagar is approx. 21 km^2.

MATERIALS AND METHODS

Each site was investigated for soil, floral and hydrological conditions. Floral characteristics of these sites were studied by conducting survey at selected sampling points in the region in different seasons of the year. Plants were identified on the basis of morphological characteristics like structure of stems, roots, leaves and flowers. Soil conditions were studied by collecting soil samples taken field from different depths followed by analysis in laboratory for texture, pH and salinity. Soil salinity and pH were determined by using digital EC (electrical conductivity) meter and pH meter to measure the EC and pH of soil water suspension (1:5 ratio) prepared in the lab, while the soil texture was determined by sieve analysis and laser particle size analyser. Hydrological conditions were studied by on-site measurements for salinity and water level depth by TLC meter (used for measurement of EC, depth and temperature) in different seasons. Aerial extent of mangroves found in Kerly creek site, water spread area of Kerly reservoir and Barda sagar, were interpreted through Landsat-8 satellite data of 30 m resolution pertaining to different months in monsoon and non-monsoon seasons. For measurement of tidal fluctuations in Kerly creek, a graduated (linear scale) staff gauge was utilized.

RESULTS AND DISCUSSION

Kerly creek is under tidal influence and is characterised by daily flushing in and out of the sea water. Tidal amplitude varies seasonally in a year. With an average intertidal amplitude of 0.60 m per month, the creek has measured average high tide of amplitude 0.90 m to average low tide of 0.22 m in Feb-March months. During monsoon (June-Oct) months, measured average salinity is 30 mS/cm that reaches a peak value of upto 75.5 mS/cm in summer (April-May) months. Soil conditions of this region are characterised by loamy texture with poorly drained properties. Soil is saline in nature with an average pH of 8.

Floral characteristics of this region are predominantly halophytic in nature. Scrubby patch of mangrove *Avicennia sp.* belonging to Verbenaceae family occupies about 1.41 km^2 of the area. Presence of onshore mangroves in this region along the creek banks checks erosion and aids in preventing flooding during storm surges from sea by reducing the flow. Vegetation in the study site was investigated at approachable sites in the creek. Identified plants were from families Convolvulaceae, Salvadoraceae, Amaranthaceae, Aizoaceae, Boraginaceae and Amaranthaceae. Identified plants were *Cressa critica, Salvodara persica, Suaeda sp., Sesuvium portulacastrum, Heliotropiumsp. and Salicornia sp*. All the above plants are halophytic in nature. Kerly creek is also visited by number of migratory and other birds. Flamingos, Pelicans, Spoonbills, Ibis and teals are some of the birds that were seen in the area.

Kerly reservoir is a low lying region which is seasonally flooded during monsoon with fresh water from upstream areas. Before 1970's, this region was an intertidal mudflat where sea water from Arabian sea near village Gosa could enter inland and mix with upstream runoff collected in the depressed land during monsoon season. This mixing of freshwater and sea water adversely affected

the groundwater quality and agriculture locally. In order to prevent this mixing and store upstream freshwater runoff for longer period of time, Salinity Ingress Prevention Cell (SIPC), Gujarat, built structures across the creek such as tidal regulators (masonry wall) and bunds at different locations. These structures prevented the mixing of freshwater and seawater, thus, increasing the availability of water of improved quality in the region and enabled farmers in nearby villages to use this water for irrigation purposes, thereby improving the crop yields. Figure 2 shows the Kerly reservoir along with all the structures that aid in proper utilisation of water.

During monsoon period (June - Oct) available water in the reservoir is fresh (runoff from upstream areas) having EC value ranging between 800-1000 µS/cm. Due to utilization of reservoir water for irrigation as well as evaporative losses, water levels in the reservoir gradually reduce after monsoon accompanied by increasing water salinity. The reservoir almost gets dry in the month of May with salinity reaching a maximum value of about 4000 µS/cm. The general variation in reservoir salinity (expressed in µS/cm) with water spread area is shown in Figure 3.

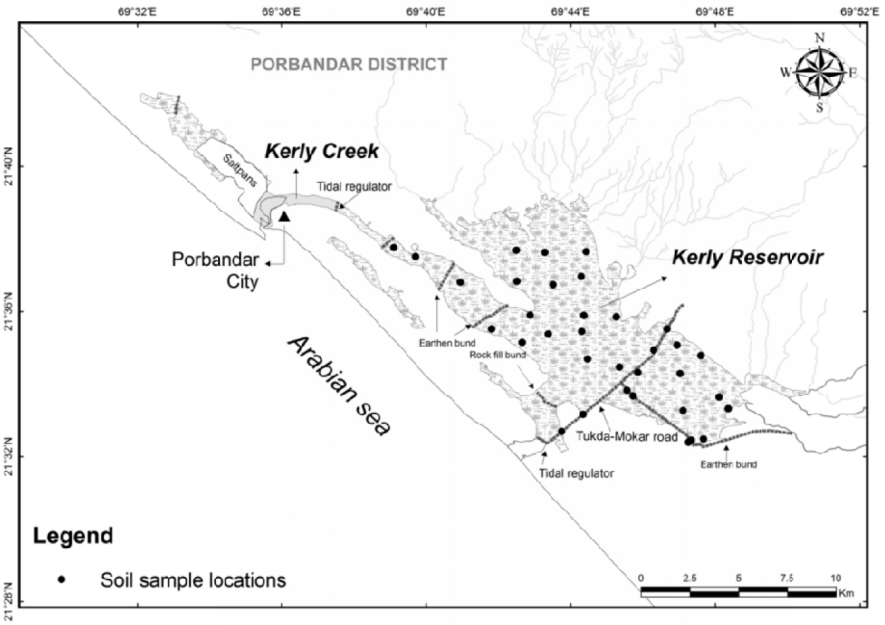

Figure 2. Map showing locations of soil sampling points in Kerly reservoir.

Figure 2 shows the location of sampling points where the soil sampling was carried out. Analysis of the 39 collected soil samples reveals that the soil pH ranges from 7.56 to 8.25 with average pH of 7.98 and electrical conductivity of soil saturation extract (EC_e) ranges from 1.1 to 11.8 dS/m with average EC_e of 5.68 dS/m. USDA Saline laboratory defines a saline soil as having an EC of 4 dS/m or more [6]. Thus, it can be inferred that the average soil conditions in the region are of saline nature except for a few locations where salinity is less than 4 dS/cm. Almost all the samples analysed for texture analysis are of silty loam soil texture except a few locations where texture was silty clay loam. The transient conditions of both freshwater and moderate saline water environment in Kerly reservoir, makes floral composition of the region to be rich in both freshwater to moderate saline tolerant species.

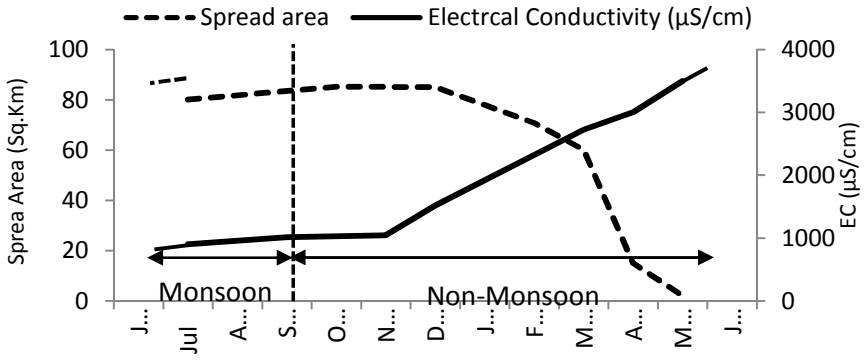

Figure 3. Variation of electrical conductivity and water spread area of Kerly reservoir in different months of a year.

Floral characteristics of the reservoir include aquatic to marshy vegetation. Some of the plants that were observed in this reservoir are *Cyperus sp., Fimbristylis sp., Cynodon dactylon, Cressa critica, Salichornia sp.* (Salt tolerant) and *Nelumbo nucifera* (freshwater) belonging to Cyperaceae, Poaceae, Convolvulaceae, Amaranthaceae and Nelumbonaceae families. Like Kerly creek this region is also visited by a variety of migratory birds during the winter months.

Barda Sagar, similar to Kerly reservoir, gets flooded periodically during monsoon season. The reservoir gets filled up in the months of June-July depending upon the monsoon, with water remaining in the reservoir till December, after which the water levels slowly recede till it eventually gets dry in the months of Feb-March. Salinity in the reservoir, similar to Kerly reservoir, is low in the range 400-500 µS/cm during monsoon that increases with time to about 2500 µS/cm in Feb-March just before getting dry.

Barda sagar has been developed to serve as an effective source of fresh water supply to meet local irrigation demands. This is because, in the past, the region faced problems of groundwater salinity. To overcome this situation, SIPC in 1974-1975 took initiatives to develop it into regulated irrigation scheme by constructing bunds and weir to increase its storage capacity. Several radial canals were also constructed in subsequent years thereby providing canal water supply benefits to nearby villages. Thus, Barda sagar being a wetland, provide direct and indirect benefits in form of irrigation water supply, feeding ground for migratory birds, and recharge to groundwater.

Soil conditions in this region are more or less similar to conditions existing in Kerly reservoir. Characterised by poor drainage properties with silty clay texture in most parts, soils are saline with average pH of 7.8. Surveys carried out to investigate floral characteristics reveal that the area shows presence of freshwater, moderate to high saline tolerant plants and semi-arid plants with drought resistance characteristics. Major plant families were Fabaceae, Poeaceae, Acanthaceae, Capparaceae, Convovulvacea and Cyperaceae.

Salt tolerant plants identified in this region include plants of families – *Cyperaceae (Cyperus rotundus, Fimbristylis* sp.*), Poaceae (Cynodon dactylon, Desmostachya bipinnata, Dicanthium annulatum), Fabaceae (Acacia senegal, Prosopis cineraria, Acacia nilotica, Indigofera oblongifolia), Capparaceae (Capparis deciduas), Typhaceae (Typha angustifolia), Salvadoraceae (Salvadora persica), Malvaceae (Triumfetta rhomboidea), Acanthaceae (Acanthus illicifoius),* and *Caesalpiniaceae (Cassia auriculata).* Halophytes includes plants of families *Amaranthaceae (Salicornia* sp., *Suaeda* sp.) *Convolvulaceae (Cressa critica)* and *Celastraceae (Maytenus emarginata)*. Other plants that were identified included plants of families *Gentianaceae (Enicostemma hyssopifolium), Asclepiadaceae (Leptadenia reticulate), Lamiaceae (Ocimum*

sanctum), Cactaceae (Opuntia dillenii), Burseraceae (Commiphora wightii), Acanthaceae (Barleria prionitis), Convolvulaceae (Rivea hypocrateriformis) and *Capparaceae (Cadaba fruticosa).*

CONCLUSION

The paper describes the hydrological, soil and floral characteristics of three distinct wetlands of Porbandar district and their role in environment. Survey results suggest that the wetlands are represented by poorly drained soils, mostly salt tolerant plants and both fresh water and moderately saline transient hydrological conditions. Kerly reservoir and Barda sagar play an important role of freshwater source for irrigation water, recharge to groundwater thereby reducing groundwater salinity in the coastal region, and as a feeding ground for a variety of migratory birds. Kerly creek aids in stabilising the environment near coast and prevents flooding due to storm surges. Porbandar district in Saurashtra is a fast developing region experiencing a steady growth in agricultural and industrial sectors. In nearby future, developmental activities may have environmental implications on biodiversity of coastal wetlands. Capacity of the scientific community to tackle critical issues for sustainable development of a region, especially coastal zones, could be enhanced by segregation of details of an area about its environment and hydrology, such as presented in this study, and come up with answers for complexities posed by these sensitive systems.

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