Pak.J.Bot., 32(1): 227-234, 2000.

# MANGROVES OF PAKISTAN-IRAN BORDER NEAR GULF OF OMAN

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**Abstract**

Gawatar Bay located at Pakistan-Iranian border facing Gulf of Oman serves as a connection between mangroves of the Gulf area and N.E. Arabian Sea of Pakistan. It forms the westernmost part of the coastal belt of Pakistan, the climate of which is maritime desert type. Only one species *Avicennia marina* (Forssk.) Vierh. prevails in the Bay as in the Arabian Gulf and the adjacent Kalmat Khor. Their vertical zonation pattern of different size groups is not regular but disturbed. The major problem facing the mangroves is excessive harvesting, which stems from the socio-economic set up of the local people residing in the area.

## Introduction

Gawatar Bay is located at Pakistan-Iranian border facing entrance of Gulf of Oman (Fig. 1). It forms a link between mangroves of Gulf of Oman on the eastern side and those of the North Arabian Sea coast of Pakistan on the western side. While the mangroves of either sides have been studied, those of the bay still remain neglected. Kogo *et al.*, (1980, 1982) described mangroves of Qeshm Island (Iran) and U.A.E. and Spalding *et al.*, (1997) reported their occurrence on the northeast coast of Oman. The adjacent lagoons of Miani Hor and Kalmat Khor of Pakistan (Fig. 1) have also been studied by Kogo *et al.*, (1982) and Rasool & Saifullah (1996), respectively. The present study therefore fills an important gap in the distribution of mangroves along the shores of the Gulf area and Pakistan.

## Materials and Methods

Area of Study: Gawatar Bay lies at the extreme corner of Makran coast of province Balochistan touching the boundary line between Iran and Pakistan, and facing entrance of Gulf of Oman (Fig. 1). It is an embayment with a 28 km wide mouth, opening into a very narrow productive shelf. Saifullah (1994) reported very high chlorophyll `a' values in the area. It penetrates as far as 30 km inside land and occupies an area of 621.2 $km^2$. A large ephemeral river, the Dasht river, with a catchment area of 27130 $km^2$ (Gillani & Azam, 1992), discharges into the northern part and forms a wide flood plain and a small delta inside it. As a result a number of landforms like mud flats, tidal flats, accretion edges, wetlands etc., are present which indicate an overall depositional environment (Mirza & Ali, 1992).

Four sites namely Noghazi, Kutani Khor, the Island and Marine Base (Fig. 1) inside Gawatar Bay were studied during January, April and December, 1994. Phytoso-

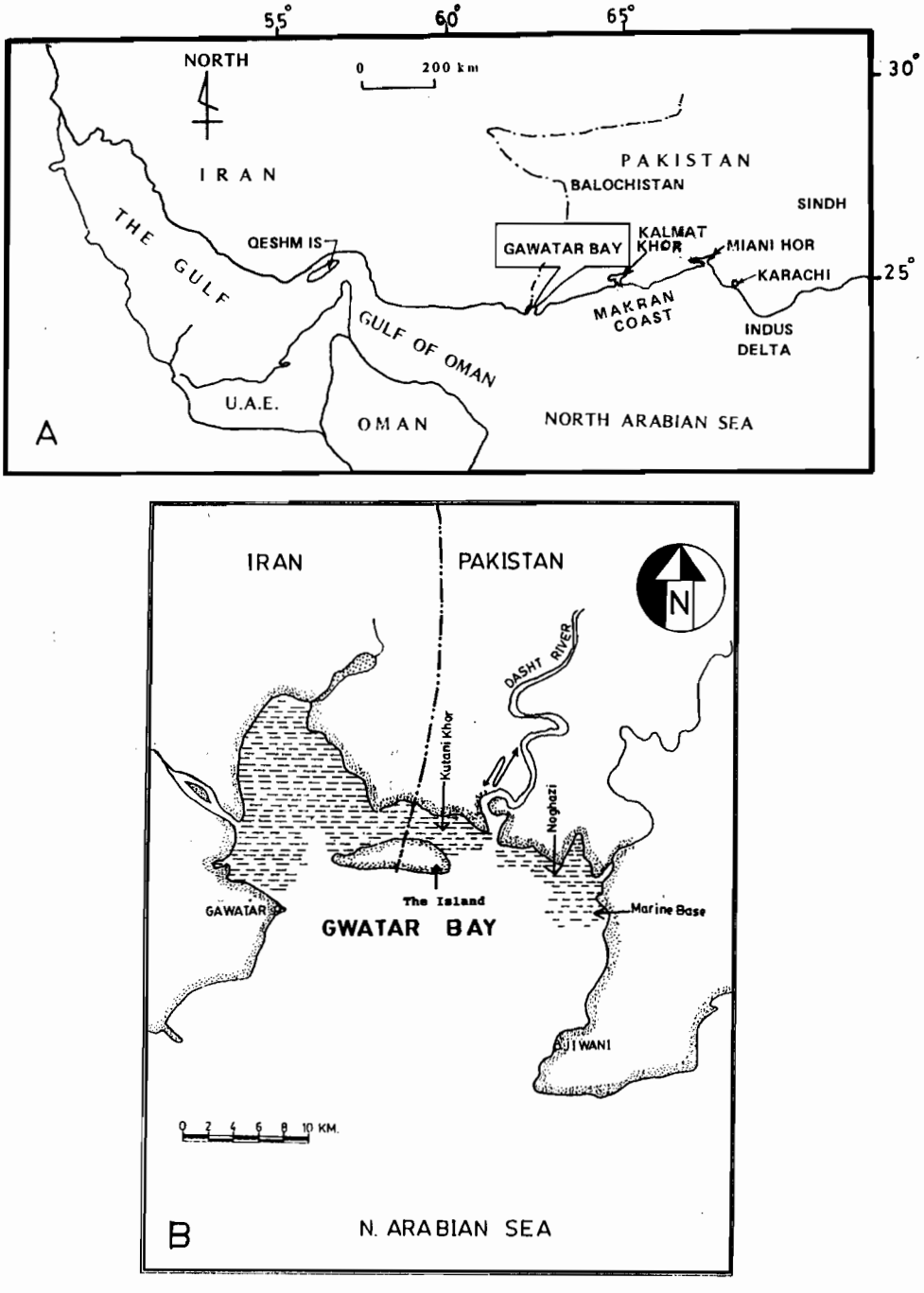


Fig. 1. (A) Location of Gawatar Bay in the region.
(B) Gawatar Bay enlarged.

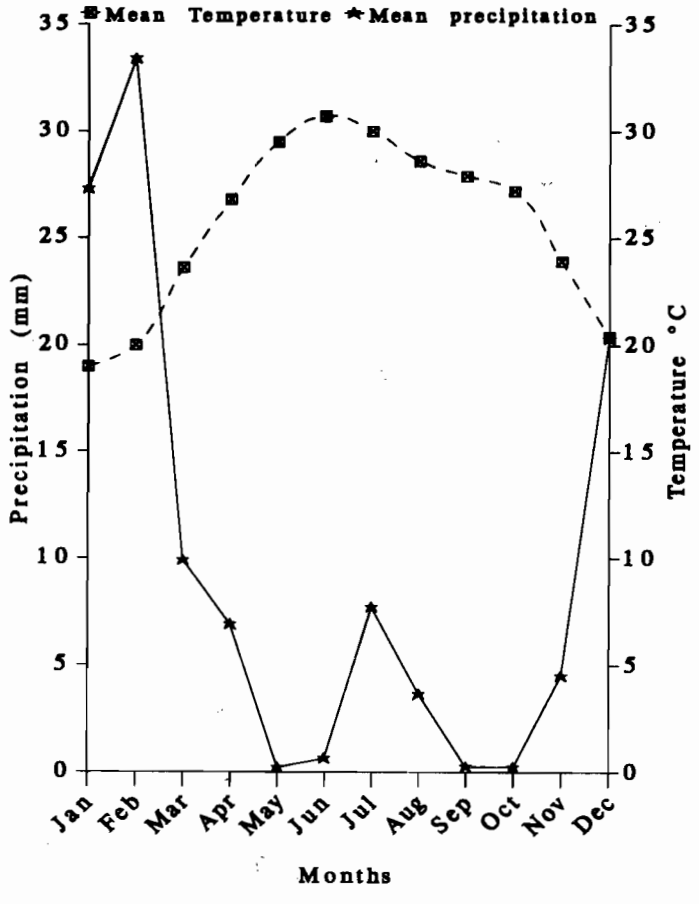


Fig. 2. Variation in mean monthly air temperature and precipitation values at Gawatar Bay, Jiwani (thirty years average 1961-1990).

ciological and vegetational analysis of mangrove stands of only the first two mentioned localities were carried out following the methods of Curtis & McIntosh (1951), Curtis (1959) and Cintron & Novelli (1984). Three quadrats (10x10 m) were taken along a vertical transect across the tidal belt. All trees within the quadrat with dbh more than 3 cm, approximately 50 cm above ground, were taken into account (Saifullah *et al.*, 1994). Importance value (I.V.) was calculated following the method of Pool *et al.*, (1977). Methods for estimating salinity, temperature, dissolved oxygen concentration, pH of seawater and pore water, grain size analysis and organic content of mangrove soil have already been described elsewhere (Saifullah *et al.*, 1994; Rasool & Saifullah, 1996).

## Results and Discussion

The climate of the area is referred to as a subtropical maritime desert type (Chaudhry, 1961) or as a hot desert type (Koppen, 1936). Air temperatures are high

**Table 1. Environmental parameters at different sites of Gawatar Bay.**

| Sites | Date | Salinity (ppt) | | Temp. °C | | pH | | $O_2$ | Silt+Clay | Sand | Organic matter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | SW | PW | SW | PW | SW | PW | mg/l | % | % | % |
| Kutani Khor | 15.01.94 | 40 | 40-42 | 20 | 18-20 | 8.0-8.3 | 7.9-8.1 | 4.9 | 85.0-94.1 | 5.9-13.5 | 6.2-7.7 |
| | 04.12.94 | 40-41 | 39-40 | 25-26 | 20-22 | 8.0 | 7.9 | - | - | - | - |
| Noghazi | 08.04.94 | 41 | 40-42 | 27 | 24 | 8.1 | 8.0 | 5.1 | 89.6-90.8 | 9.2-10.4 | 7.0-8.2 |
| The Island | 04.12.94 | 40 | 39 | 25 | 24 | 8.0 | 7.9 | - | - | - | - |
| Marine Base | 05.12.94 | 42 | 39 | 24 | 20 | 8.0 | 7.9 | - | - | - | - |

ppt = Parts per thousand; SW = Seawater; PW = Pore water.

with a mean value ranging between 18°C - 31°C and rainfall very scanty with a mean monthly range of 0-34 mm (Fig. 2) when the annual figure rainfall never exceeds 200 mm $yr^{-1}$. The area is not affected by monsoons and the annual distribution shows a peak value in winter.

Seawater temperature and salinity values are also high (Table 1) indicating extreme climatic conditions (Rasool & Saifullah, 1996). Dissolved oxygen and pH values are normal (Table 1). Soil texture is mainly muddy with silt and clay fraction greater than sand, so characteristic of mangrove soils. Environmental conditions observed at different study sites show very little variation (Table 1) indicating significant tidal mixing. Tides are semi-diurnal with an amplitude as high as 10 feet.

Only one species *Avicennia marina* (Forssk.) Vierh. occurs in the Bay like Kalmat Khor (Rasool & Saifullah, 1996), Qeshm Island (Iran) and U.A.E. (Kogo *et al.*, 1980). In Miani Hor, *Ceriops tagal* and *Rhizophora mucronata* are present in addition to *A. marina* (Saifullah & Rasool, 1995) and in Cyrith estuary (Iran) only *R. mucronata* (Spalding *et al.*, 1997). The absence of these two species in Gawatar Bay may be due to its exposed nature with a relatively wide mouth opening into the shelf. Both species are known to occur in very sheltered areas (MacNae, 1968; Tomlinson, 1986), while *A. marina* is resistant to severe environmental conditions (MacNae, 1968) and in fact the only prevalent species in the highly saline and warm waters of Red Sea (Saifullah, 1996) and the Gulf (Spalding *et al.*, 1997).

Fig. 3. Large trees of *A. marina*.

**Table 2. Structural components of mangrove stand at Kutani Khor and Noghazi.**

| dbh size group (cm) | Q.No. | D Trees/ 0.1 ha | C $m^2$/0.1 ha | B $m^2$/0.1 ha | RD | RF | I.V. |
|---|---|---|---|---|---|---|---|
| **Kutani Khor:** | | | | | | | |
| 0-10 | 1 | 13.33 | 12.21 | 0.05 | 21.04 | 11.11 | 11.20 |
| 10-20 | 1,3 | 6.66 | 12.11 | 0.20 | 10.52 | 22.22 | 12.82 |
| 20-30 | 1,2,3 | 30.00 | 155.89 | 1.35 | 47.34 | 33.33 | 39.88 |
| 30-40 | 2 | 3.33 | 39.37 | 0.29 | 5.26 | 11.11 | 8.24 |
| 40-50 | 2,3 | 10.00 | 86.86 | 1.58 | 15.78 | 22.22 | 27.85 |
| Total | | 63.32 | 306.44 | 3.47 | | | |
| **Noghazi:** | | | | | | | |
| 0-10 | 1 | 6.66 | 4.50 | 0.03 | 4.25 | 12.49 | 5.70 |
| 10-20 | 1,2,3 | 40.00 | 73.97 | 0.84 | 25.53 | 37.50 | 24.85 |
| 20-30 | 1,2,3 | 83.33 | 269.53 | 4.32 | 53.19 | 37.50 | 49.99 |
| 30-40 | 1 | 26.66 | 91.78 | 2.10 | 17.02 | 12.49 | 19.43 |
| Total | 3 | 156.65 | 439.78 | 7.29 | | | |

Q = Quadrat, D = Density, C = Plant cover, B = Basal area, RD = Relative density, RF = Relative frequency, I.V. = Importance value.

Mangrove cover is poor with an area of 21.1 $km^{-2}$ (Mirza *et al.*, 1988), which forms only a fraction of the total area of the bay. This may be due to the exposed nature of the bay which does not favour large scale mangrove settlement. Another major factor responsible is the excessive harvesting of mangrove parts for fuel and fodder by the local people who are extremely poor and cannot afford to purchase those available in the market. There is no electricity and only dirt roads are present in the area. Tree density is also not high, nevertheless, tree development is probably the best in the area. They are usually as tall as 6 m with a common dbh size of 20-30 cm, although a significant proportion may be as thick as 40-50 cm (Table 2 & 3; Fig. 3). The basal area measured is as high as 7.29 $m^{-2}$/0.1 ha as compared to less than 2.7 $m^{-2}$/0.1 ha measured in Qeshm Island (Kogo *et al.*, 1980), Kalmat Khor (Rasool & Saifullah, 1996) and Miani Hor (Saifullah & Rasool, 1995). This may be attributed to the discharge of alluvium and freshwater by the Dasht river which is so important for favourable growth of mangroves (Walsh, 1974).

Vertical zonation pattern of *A. marina* along the shore is disturbed at Kutani Khor and Noghazi sites mainly due to indiscriminate harvesting of mangrove parts for fodder and fuel (Fig. 4). However, the trees are normally distributed at the sites of Marine Base, decreasing progressively in size with distance from shore most probably due to increase in soil salinity (Pool *et al.*, 1977). On elevated banks halophytes like *Arthocnemum* sp., and *Suaeda monoica* preceded the mangrove belt.

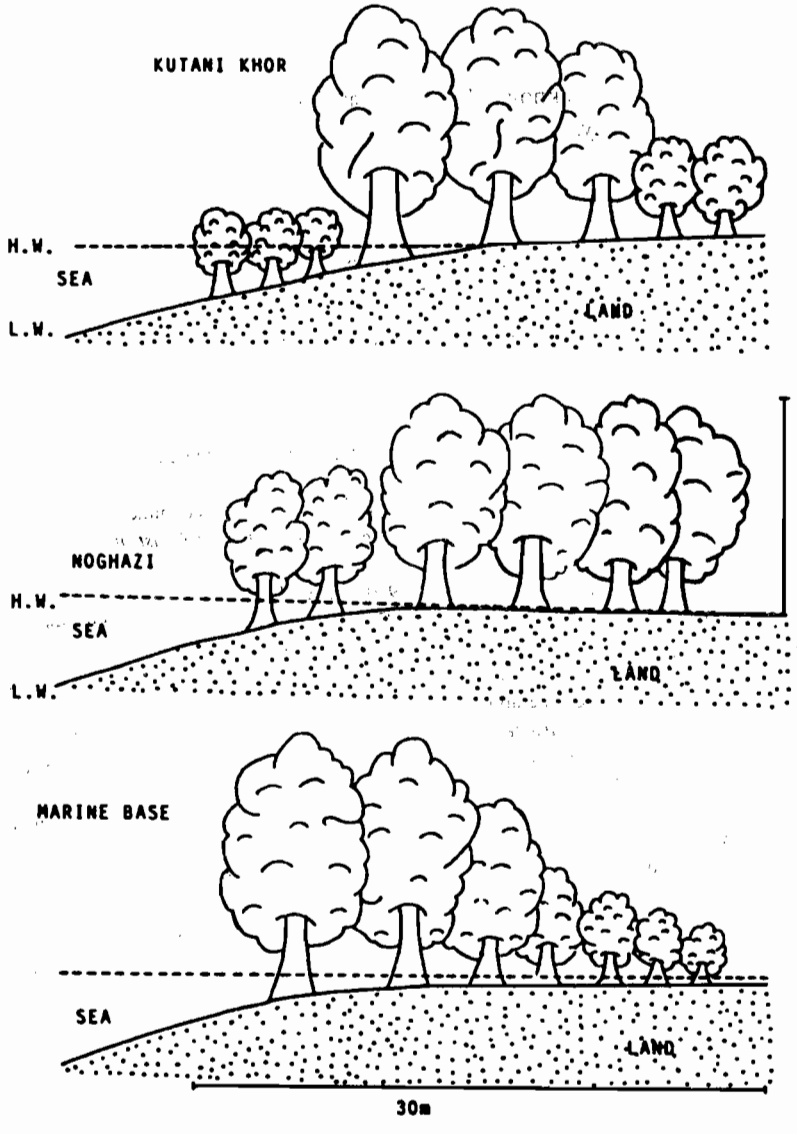


Fig. 4. Vertical zonation of different size groups of *A. marina* at three different sites.

In general mangrove growth in Gulf of Oman area seems to be better than inside the Gulf (Kogo *et al.*, 1980; Spalding *et al.*, 1997); due to favourable oceanographic conditions prevailing there. The North Arabian seawater which enters into the former area is richer in nutrients and less saline and warmer than inside the latter area (Anon., 1960). Moreover, the upwelling in the adjacent Arabian coast and Pakistan's shelf also enriches the area (Quraishi, 1988).

## Acknowledgement

The authors wish to acknowledge the financial support provided by WWF - Pakistan to carry out this study.

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(Received for publication 3 May 2000)