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ALGAL EPIPHYTES ON MANGROVES OF BALOCHISTAN, PAKISTAN

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Abstract

Twenty one species of algae were found growing as epiphytes on the pneumatophores of mangrove *Avicennia marina* (Forssk.) Vierh. They appear to be new reports as epiphytes on mangroves of Pakistan except for *Chaetomorpha gracilis* Kützing, *Enteromorpha torta* (Mert.) Reinbold, *Lyngbya majuscula* Gomont, *Polysiphonia abscissa* J. Hooker et Harvey. Most species occupied middle position on the pneumatophores indicating avoidance from both long-term exposure and submergence.

Introduction

Mangroves which grow abundantly in Pakistan are located mostly in the Indus Delta region occupying an area of 600,000 acres. Whereas 4 different species are presently known to occur, only *Avicennia marina* (Forssk.) Vierh., is the most common and abundant (Saifullah *et al.*, 1994). Pneumatophores of this species provide a favourite habitat for a number of epiphytic algae (Humm & Wicks, 1980; Mandura *et al.*, 1987; Rodriguez & Stoner, 1990). Tanaka & Shameel (1992) and Saifullah & Taj (1995) described the occurrence of algae from mangroves of Karachi, which constitutes the western most part of the Indus Delta region. The present report describes the occurrence of algal epiphytes in mangroves of the Balochistan coast, which forms the largest part of the coastline of Pakistan.

Material and Methods

The coast of Balochistan which extends from Karachi in the east to the Iranian border in the west is 700 km long and covers almost two-third of Pakistan's coastline. Despite its large area it harbours a much smaller mangrove cover than that of Indus Delta mainly because of its exposed nature. The mangroves here are localized in three small embayments viz., Miani Hor, Kalmat Khor and Gawatar Bay (Fig. 1), with *Avicennia marina* present in all the three locations.

Algal epiphytes (growing on pneumatophores) were collected from Kalmat Khor (11.01.94) and Gawatar Bay (Jiwani) (15.01-94 and 08.04.94) and stored in 5% formalin. The specimens are preserved in the Mangrove Ecosystem Laboratory of Department of Botany, University of Karachi. The relative positions of different species on the pneumatophores were noted as they indicate different periods of submergence

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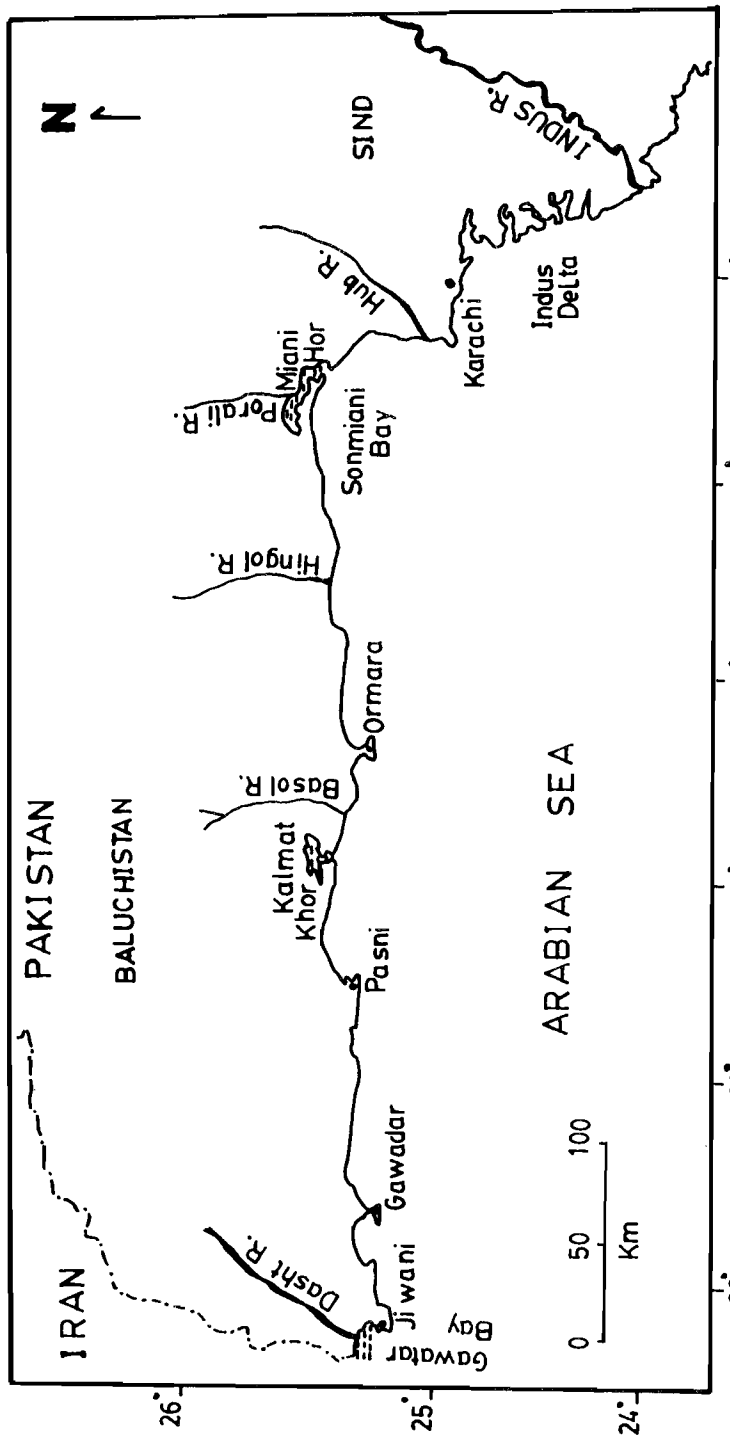

Fig.1. Map of Pakistan showing the mangrove sites of Gawatar Bay, Kalmat Khor, Miani Hor and Indus Delta.

Table 1. Environmental observations recorded at sampling sites in Kalmat Khor and Gawatar Bay (Jiwani) (SW = seawater; ppt = parts per thousand)

Locality	Sea water salinity ppt	Temp.°C	pH	Soil texture Silt+Clay (%)	Sand (%)
Kalmat Khor 11.01.94	44	22	8.1	81.30	18.70
Gawatar Bay (Jiwani) 15.01.94	40	20	8.1	94.10	5.90
Gawatar Bay (Jiwani) 08.04.94	41	27	8.1	90.75	9.25

and exposure with changing tidal levels. Simultaneous observations on water temperature were taken using a thermometer and salinity by a salinometer. Soil samples were also collected with a corer from a depth of 20 cm and were studied for soil texture by sieving method (Saifullah *et al.*, 1994).

Results and Discussion

Soil texture analysis showed preponderance of silt and clay fractions (Table 1) which is typical of muddy habitats of mangrove swamps. Water temperature and salinity values indicate the tropical arid nature of the climate (Ahmed, 1951).

A list of 21 species of algal epiphytes belonging to Chlorophyta, Rhodophyta and Cyanophyta (Cyanobacteria) found growing on the pneumatophores of *A. marina* is given below:

A. CHLOROPHYTA

I. ULVALES

1. *Enteromorpha compressa* (L.) Nees.
   Natour *et al.*, 1979, p. 42, Fig. 3.
   Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore).
2. *Enteromorpha lingulata* J. Agardh
   Joshi & Krishnamurthy, 1972, p.120, Fig. 1,D, Fig.2, H, S.
   Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore).
3. *Enteromorpha torta* Vickers (Mert.) Reinbold
   Hamel, 1930, p. 154, Fig. 2.6, 2.8.
   Saifullah & Taj, 1995, p. 411, Fig. 2.6.
   Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore).

II. CLADOPHORALES

4. *Chaetomorpha gracilis* Kützing
   Bφrgesen, 1913, p. 19, Fig. 2.5.
   Locality; Gawatar Bay, 15.01.94 (middle of pneumatophore).
5. *Cladophora magdalenae* Harvey
   Nizamuddin & Begum, 1973, p. 8, Figs. 35-37.
   Locality; Kalmat Khor, 11.01.94.
6. *Cladophora vaughanii* Boergesen
   Nizamuddin & Begum, 1973, p. 10, Figs. 54-57.
   Locality; Gawatar Bay, 15.01.94 (tip of pneumatophore).

B. RHODOPHYTA

I. ERYTHROPELTIDALES

7. *Erythrotrichia carnea* (Dillwyn) J. Agardh
   Basson, 1979, p. 67, pl. X, Fig. 54.
   Shameel & Tanaka, 1992, p. 43.
   Locality; Kalmat Khor, 11.01.94 (entire length of pneumatophore);
   Gawatar Bay, 15.01.94 (tip of pneumatophore).

II. CERAMIALES

8. *Herposiphonia tenella* f. *secunda* (C. Agardh) Hollenberg
   Abbott and Hollenberg, 1976, p. 72, fig. 688.
   Locality; Gawatar Bay, 15.01.94.
9. *Polysiphonia abscissa* J. Hooker et Harvey
   Zahid *et al.*, 1981, p. 210, Figs. 34-38.
   Locality; Kalmat Khor, 11.01.94 (upper half of pneumatophore).
10. *Polysiphonia nizamuddinii* Farooqui et Begum
    Zahid *et al.*, 1981, p. 202, Figs. 12-28.
    Locality; Gawatar Bay, 15.01.94 (upper half of pneumatophore).
11. *Polysiphonia simplex* Hollenberg
    Abbott and Hollenberg 1976, p. 694, Fig. 641.
    Locality: Kalmat Khor, 11.01.94; Gawatar Bay 15.01.94
    (upper half of pneumatophore).

C. CYANOPHYTA (CYANOBACTERIA)

I. COCCOGONALES

12. *Aphanocapsa littoralis* Hansgirg
    Desikachary, 1959, p. 131, pl. 21, Fig. 1.
    Locality; Kalmat Khor, 11.01.94 (tip of pneumatophore).
13. *Aphanothece nidulans* P. Richter
    Desikachary, 1959, p. 138, p. 22, fig. 1.
    Locality; Kalmat Khor, 11.01.94 (tip of pneumatophore); Gawatar Bay, 15.01.94.

II. NOSTOCALES

14. *Calothrix crustacea* Thuret
    Humm and Wicks, 1980, p. 84-85, Fig. 29.
    This species was very abundant throughout the length of the pneumatophore.
    Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore);
    Gawatar Bay, 15.01.94 (middle of pneumatophore).

15. *Lyngbya birgei* **G.M. Smith**
Desikachary, 1959, 296, pl. 50, Figs. 7, 8.
Locality; Gawatar Bay, 15.01.94 (middle of pneumatophore).
16. *Lyngbya majuscula* **Gomont**
Desikachary, 1959, p. 313, pl. 48, Fig. 7.
Saifullah and Taj, 1995, p. 414, fig. 2.19.
Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore);
Gawatar Bay, 8.04.94 (middle of pneumatophore).
17. *Lyngbya semiplena* **(C. Agardh) J. Agardh**
Desikachary, 1959, p. 315, pl. 49, Fig. 8.
This was very abundant.
Locality; Kalmat Khor, 11.01.94 (upper half of pneumatophore).
18. *Microcoleus cthonoplastes* **(Mertens) Gomont**
Desikachary, 1959, p. 343-344, pl. 60, Figs. 7-9.
Shameel and Tanaka, 1992, p. 5.
Very abundant.
Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore).
19. *Oscillatoria corallinae* **Gomont**
Phormidium corallinae (Gomont) Anagnostidis *et* Komarek.
Chapman, 1961, p. 23, fig. 11.
Anagnostidis and Komarek, 1988, p. 405.
Humm & Wicks (1980) regard this species as a form of *Microcoleus lyngbaceus* (Kützing) Crouan.
Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore);
Gawatar Bay, 15.01.94 (middle of pneumatophore).
20. *Phormidium fragile* **(Meneghini) Gomont**
Humm and Wicks, 1980, p. 136; Desikachary, 1959, p. 253, pl. 44, Figs. 1-3.
Locality; Gawatar Bay, 8.01.94 (middle of pneumatophore).
21. *Spirulina subsalsa* **Oersted**
Humm and Wicks, 1980, p. 65, Fig. 15.
Locality; Kalmat Khor, 11.01.94 (middle of pneumatophore).

The epiphytes on mangroves provide an additional source of energy to the ecosystem (Rodriguez & Stoner, 1990). Balochistan shores are very poor in nutrients and marine life (Saifullah, 1992) and therefore abundance of epiphytes in the area is but an adaptation to overcome this stress. These algae not only fix solar energy but also are a source of nutrients to the ecosystem.

A preponderance of Cyanophyta (10 species) as compared to any other major group was observed. They are known to fix elemental nitrogen in mangrove habitats (Potts, 1979) and as such contribute significantly to the overall nitrogen input of the mangrove ecosystem which is otherwise poor. Mandura *et al.*, (1987) also recorded mass occurrence of blue-green algal forms in mangroves of the extremely oligotrophic Red Sea. Brown algal epiphytes were recorded in the Indus Delta (Saifullah & Taj, 1995) but not in Balochistan which may be due to limited sampling. Whereas *Chaetomorpha gracilis, Enteromorpha torta, Lyngbya majuscula* and *Polysiphonia abcissa* have been reported

from the Indus Delta region (Tanaka & Shameel, 1992; Saifullah and Taj, 1995), there does not appear to be any previous report on remaining mangrove epiphytes either from Balochistan or other parts of Pakistan.

Most epiphytes occupied the middle position of pneumatophores and not their tip or the base, which indicates that they avoid both submergence and exposure for long periods.

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