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# Bacterial community and some physico-chemical characteristics in a subtropical mangrove environment in Bahrain

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**Abstract**

A study of bacterial communities and some physico-chemical parameters of a subtropical mangrove habitat in the Arabian Gulf (Bahrain) was carried out in 1993–1994. Six stations at different parts of the tidal channel were selected for sampling. The mangrove habitat was found to harbor diverse bacterial communities, included among them anoxygenic phototrophs (AP), oxygenic phototrophs (OP), organotrophs (OT), total coliforms (TC), faecal coliforms (FC) and haloalkaliphiles (HA). Spatial and temporal variations in bacterial communities and environmental parameters were found. Each of the OT, AP, TC, and FC were dominant in the innermost stations (S1&S2) and gradually decreased seaward. The HA community on the other hand, was dominant at the seaward stations (S5&S6) and was most likely to have originated from the sea through the tidal flows. Both AP and OT were considered as part of the mangrove native flora, whereas TC and FC were alien and believed to have been introduced through partially treated sewage released at the upstream of the tidal channel. Closely monitoring of the mangrove water revealed succession pattern in bacterial communities. The AP community was predominant from November 1993 to March 1994, succeeded by dominance of OP from June 1994 to October 1994. Both bacterial blooms gave water a pinkish, purple, or green color, respectively. Although OT prevailed during Transitional period between AP and OP eutrophication, it remained comparatively constant (not less than $2 \times 10^5$ cfu/ml) through other periods. Frequent eutrophication phenomena of OP, which took place in summer and autumn, coincided with increases in water temperature, chlorophyll *a*, and nutrients ($NO_3^-$ and $PO_4^-$). On the other hand, OT and AP were negatively correlated with temperature, salinity and chlorophyll *a*, but no specific pattern was observed in relation to $NO_3^-$ and $PO_4^-$.

In comparison with seawater, nutrients such as $NO_3^-$ and $PO_4^-$ were consistently higher in the mangrove habitat. Partially treated sewage and farm drainage canals are proposed to form additional sources of nutrients. Although, the mangrove habitat has been demonstrated to possess self-cleaning properties, data obtained suggest that anthropogenic pollution has a deleterious effect.


*Keywords:* Mangrove; Bacteria; Community; Structure; Physico-chemical factors; Bahrain

## 1. Introduction

Great awareness of the importance of mangrove in productivity of coastal ecosystems and danger of degradation and loss of these habitats has recently been developed among government departments and research centers in Bahrain. Furthermore, considerable interest in re-establishing the mangrove has led to several successful attempts for replanting the mangrove from seedling and seeds at several coastal areas around the country.

Vousden (1988) has clearly identified mangrove among the critical marine habitats that need urgent attention and conservation. Mangrove was well established around Bahrain before the seventies, but at present is restricted to scattered patches along some shores. The last of the naturally occurring mangrove is located at the southern part of Tubli Bay, bordering a tidal channel (1–2 km long) which receives semi-treated sewage at one end and drainage water from surrounding

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farms at various points. Frequent land infilling practices seriously threaten the remaining mangrove habitat in Bahrain by obstructing or restricting seawater flow inside the tidal channel, causing stagnation conditions in the innermost part of the channel. Such practices probably modify the native microbial structure and distribution of the mangrove habitat, which may in turn affect the mangrove vegetation. Mangrove is of value as a habitat and provides detritus food sources for marine organisms, as well as being of direct commercial value as a source of lumber, firewood and tanning agents (Odum and Heald, 1972).

The role of microorganisms in aquatic habitats is well documented (Wheeler and Kirchman, 1986; Longhurst and Harrison, 1989; Pett, 1989;Tupas and Koike, 1990; Kirchman et al., 1991). Microorganisms are considered the main primary producers as well as being secondary producers and consumers. Activities of photosynthetic, lithotrophic, and organotrophic microorganisms collectively bring the habitat into an equilibrium state, important for the conservation of other life forms. Therefore, community diversity and persistence are important characteristics of the natural habitats. Unfortunately, the microbial communities in the Bahrain mangrove habitat had been neglected before the onset of the present work. Therefore, the objective of the present study was to assess characteristics of the mangrove habitat in terms of microbial community structure, species diversity and related physico-chemical properties of mangrove water in comparison with the seawater.

## 2. Materials and methods

Locations and sampling; six stations running across different parts of the tidal channel were selected (Fig. 1). Stations 1 and 2 lay at the outfall of a sewage treatment works (upstream); stations 3 and 4 were sited at the midstream; stations 5 was located at the end of the channel (downstream) and stations 6 was located outside the tidal channel and represent open seawater conditions. Initially seawater samples and environmental parameters were collected and measured from S4, S5 and S6 between November 1993 and March 1994, and stations 1, 2, and 3 were also sampled between March and October 1994.

Samples for bacteriological work were collected in duplicate in sterile glass stopper bottles. The samples for physico-chemical analyses were collected in clean brown bottles. All samples were collected at ebbing fide, kept in an icebox, transferred to the laboratory and processed within 2 h.

Field measurements and physico-chemical analyses: temperature, pH, dissolved oxygen, and salinity measurements were made in situ using a digital glass thermometer, a battery operated pH meter (Radiometer model pH 82), oxygen meter (Eil 7130) and refractometer (Atago F/mill 8901) respectively. Concentrations of nutrients (nitrate, phosphate) and chlorophyll *a* were measured according to Strickland and Parson (1972).

### 2.1. Isolation and counting culturable bacterial communities

Water samples were serially diluted as appropriate. Viable counts for organotrophic bacteria (OT) were achieved by inoculating 1 ml of the $10^{-5}$ and $10^{-6}$ dilutions into 15 ml liquefied count agar (Oxoid) and then pouring the agar into sterile petri dishes. Cultures were incubated for ca 48 h at 35 °C. Total coliforms (TC) and faecal coliforms (FC) bacteria were counted by

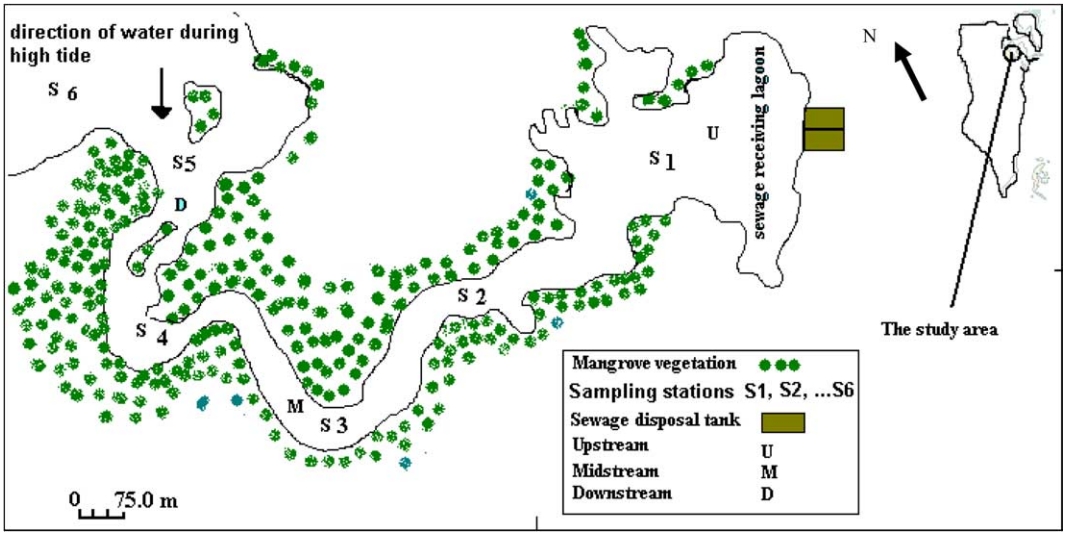


Fig. 1. Sampling stations from the mangrove intertidal channel at Tubli Bay in Bahrain.