

Assessment of existing mangrove plantation along Kuwait coastline

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ABSTRACT

A survey was conducted to study the quantitative and qualitative assessment of the existing mangrove plantations of Kuwait and their chances of settlement and development in this area. The study suggests that the Kuwait coastline has many good potential sites for mangroves, however the fast developmental activities and human interference pose a threat to their existence. These sites should be properly protected and designed to better assess the growth and development of mangrove plantations.

KEY WORDS

Avicennia marina; anaerobic condition; marine ecosystems; marine fauna; pneumatophores.

Received 22.8.2012; accepted 2.12.2012; printed 30.03.2013

INTRODUCTION

Avicennia marina (Forsk.) Vierh are salt-tolerant halophytic mangrove trees that grow in intertidal zones and form habitats for many marine species. Mangrove communities have always been regarded as an important component of renewable natural resources in coastal regions. As coastal and marine resources are of significant importance to Kuwait, any improvement in the coastal vegetation would significantly enhance the ecological and economic sustainability of such resources.

The fact that mangroves previously existed in Kuwait, and the fact that the prevailing climatic and soil conditions in the northern part of Kuwait are comparable with those of mangrove-growing areas in Bahrain and Saudi Arabia (Subandar et al., 2001), support the expectation that Kuwait could establish mangrove plantations to rehabilitate its coastal environment. Previous research efforts at the Kuwait Institute for Scientific Research (KISR) clearly established technical and environmental feasibility of growing mangroves successfully in Kuwait (Abu

El-Nil, 1994; Abu El-Nil et al., 2001; Bhat et al., 2002, 2003, 2004, 2007).

It has been reported that extensive intertidal planting of mangroves could produce fertile nursery grounds, and increase yields of fish species and marine fauna (Bhat et al., 2007; Al-Nafisi et al., 2009). The Kuwait bay experienced a massive fish kill during August and September 2001, due to bacteria *Streptococcus agalactiae* (Gilbert et al., 2002), resulted in poor water quality and hypoxic condition due to high rate of fish decomposition affecting the mangrove plantations in the coastal area.

Mangrove plantations along coastal areas are beneficial to scale down the impact of the natural disasters like tsunamis, storm and erosion. The root systems of mangroves slow down wave energy of tidal water and the sediments carried by the tides are deposited here enriching environment for marine species. Hence, mangrove communities play a great role in maintaining biodiversity. They constitute an important component of the renewable natural vegetative resources of the coastal zones in many tropical and subtropical parts of the world.



1



2



3



4



5



6

Figure 1. Young healthy mangrove plant. Figure 2. Full-grown mangrove plant flowering profusely. Figure 3. Progressive drying in an established mangrove plantation. Figure 4. Measuring the height and canopy spread of an existing mangrove plant. Figure 5. Counting the leaves of an existing mangrove plant. Figure 6. Established mangrove plantation with profuse pneumatophores.



Figure 7. Close up view of healthy pneumatophores.

They are the most prominent salt-tolerant forest trees of intertidal regions; they grow in saline, anoxic soils under conditions characterized by a combination of high temperature and irradiance (Stewart & Popp, 1987; Medina, 1999). The mangroves have become the center of discussions in many coastal, environmental and pollution issues. As part of a greenery program, mangrove plantations being highly salt-tolerant, offer best chance for enhancing greenery along Kuwait's coastline depending on the natural high-low tide of seawater (Bhat et al., 2002).

KISR has been involved in research on mangroves since 1992. Over the past several years, KISR has perfected techniques of mass propagation, hardening and growing mangrove plants (*Avicennia marina*) under Kuwait's environmental conditions. It has successfully established experimental plantations along Kuwait's coastline, and demonstrated the positive impacts of mangrove plantations in coastal and marine ecosystems (Bhat et al., 2002, 2007; Bhat & Suleiman, 2004; Al-Nafisi et al., 2009).

The study as a part of the Biodiversity of Terrestrial Ecosystems Program, was implemented by the Aridland Agriculture and Greenery Department (AAD) of Kuwait Institute for scientific research (KISR) to evaluate the status of existing mangrove plantations at different locations along the coastal bay.

MATERIALS AND METHODS

A survey was conducted by the project team along the coastline of Kuwait in November 2011, to locate and enumerate the existing mangrove plantations. Seven mangrove plantations were identified during that survey and the field evaluation of the existing mangrove plantations along Kuwait Bay was assessed (Fig.1). The main objective was to study the growth of the nearly 15-y-old mangrove plants amidst the man-made adversities and vagaries of nature present in Kuwait.

Those seven plantations were identified, and then assessed qualitatively and quantitatively to evaluate their physical and physiological status (Fig. 2). Each plantation was provided with an identification code, and the GPS coordinates were recorded for future reference. Each mangrove plantation was subdivided into smaller groups to facilitate access and to ensure accurate observations.

Each plantation was assessed visually for the parameters like plant mortality, dieback, leaf scorching, branching, pneumatophores presence, establishment, and rated on a scale from zero to five. The total score was computed to assess the overall performance of the plantation. Quantitative evaluation included number of trees, average number of leaves of apical shoot one-foot length, maximum plant height, plantation height, canopy spread and number of pneumatophores per square foot (Figs. 3-7).

RESULTS AND DISCUSSION

Mangrove plantations were found to thrive best in fine-textured soils composed of muddy clay loam. To a great extent, the height and frequency of tides determine the texture and composition of soils in coastal sites. Only those sites where tides regularly cover the entire area were found ideal for mangrove plantation. Mangrove plantations cannot be established in every available site or vacant mud-flat, as site and environmental conditions largely determine the successful establishment, productivity and sustainability of mangrove ecosystems.

The quantitative observations recorded to assess the existing mangrove plantations are presented in

Site Code	GPS Coordinates	No. of Tree Group	No. of Trees	Average No. of Leaves/Shoot
MP-1	29° 20' 11.6" N 47° 54' 17.0" E	8	96	80.0
MP-2	29° 20' 00.2" N 47° 54' 09.1" E	5	21	61.0
MP-3	29° 20' 03.1" N 47° 54' 07.0" E	14	29	50.0
MP-4	29° 19' 02.0" N 47° 51' 40.7" E	7	100	39.9
MP-5	29° 19' 02.1" N 47° 51' 03.0" E	1	4	48.0
MP-6	29° 19' 09.9" N 47° 50' 14.0" E	2	225	39.5
MP-7	29° 35' 58.3" N 48° 09' 21.9" E	1	13	32.0

Table 1. Quantitative assessment of mangrove (*Avicennia marina*) plantations in Kuwait-January 2012.

Site Code	Max. Plant Height (m)	Average Plantation Height (m)	Canopy Spread (m ²)	Pneumatophore (No./ Ft ²)
MP-1	3.8	1.88	600.0	30.0
MP-2	7.4	3.50	489.0	30.4
MP-3	4.5	2.35	647.0	16.4
MP-4	4.0	1.80	571.2	15.1
MP-5	4.0	2.00	68.8	52.0
MP-6	4.0	2.50	577.8	63.5
MP-7	3.5	1.70	90.0	32.0

Table 2. Vegetative assessment of mangrove (*Avicennia marina*) plantations in Kuwait-January 2012.

Site code	Physiological Expression			
	Mortality	Dieback	Leaf Scorching	Branches
MP-1	High	High	Moderate	High
MP-2	Moderate	Moderate	Low	Moderate
MP-3	Nil	Moderate	Moderate	Moderate
MP-4	Low	Low	Low	Moderate
MP-5	Low	Moderate	Moderate	Moderate
MP-6	High	High	High	Moderate
MP-7	High	High	Moderate	Moderate

Table 3. Qualitative assessment of physiological expression of existing mangrove plantations in Kuwait-January 2012.

Site code	Establishment	Pneumatophores		Total Score (Max 50)
		Presence	Health	
MP-1	Excellent	Moderate	Good	34
MP-2	Very Good	Moderate	Fair	33
MP-3	Good	High	Good	37
MP-4	Excellent	Moderate	Fair	37
MP-5	Poor	High	Fair	29
MP-6	Good	Profuse	Very Good	31
MP-7	Fair	Moderate	Good	26

Table 4. Qualitative assessment of existing mangrove plantations in Kuwait-January 2012.

tables 1 and 2, respectively. Based on the quantitative data on Tables 3 and 4 among the seven plantations identified, two plantations had above average establishment, scoring 37 points out of 50; whereas three plantations had average performance and establishment despite no active management or protection. Two plantations exhibited below average establishment, scoring below 30.

The study revealed that few sites along Kuwait Bay appear to have excellent establishment of mangrove plantation. These areas were found to have periodical flushing of tidal water and not contaminated by any human activities. The major reasons for poor performance of established mangrove plantations were due to lack of proper management and the lack of favourable atmosphere for the healthy growth of pneumatophores. Fast developmental activities along the coastal area pose severe threat to mangrove plantations in the existing areas. The textural composition, salinity of the surface layer and occurrence of anaerobic condition play a major role in the establishment and growth of mangrove seedlings (Bhat & Suleiman, 2004). Many researchers have reported that rapid and poorly planned coastal development programs have contributed to the destruction of suitable habitats for mangrove and its disappearance from Kuwait (Abu El-Nil et al., 2001). Salinity has been recognized as a critical factor in regulating survival growth, regeneration and zonation in mangrove species (Semeniuk, 1983).

The satisfactory establishment in most of the existing mangrove plantations, despite the harsh climatic conditions supports the idea for further large-scale establishment of mangrove plantations in Kuwait. This finding needs to be confirmed through evaluation of the physical and chemical properties of the soils. Providing good habitat and proper management can provide good mangrove plantations along Kuwait coastline.

ACKNOWLEDGEMENTS

The authors would like to thank the Kuwait Institute for Scientific Research (KISR) for continued interest in and encouragement of the scientific research.

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