

**The Qurm Environmental Information Center Project**

**Technical Document 4  
Mangrove Protection Guideline**

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## **1 Introduction**

### **1.1 Objective of the Guideline**

The Mangrove Protection Guideline (hereinafter abbreviated as “Guideline”) was prepared mainly to assist the staffs of QEIC/MECA responsible for managing and protecting the mangrove ecosystem in Oman. The Guideline explains potential threats to mangrove ecosystems in Oman and recommended measures to counter against these threats, which includes practical as well as regulatory measures. Note that the Guideline focuses on protecting not only the mangrove forest but also the various fauna that constitute the mangrove ecosystem.

### **1.2 Legal framework related to mangrove ecosystem protection**

Existing laws and regulations related to mangrove protection are as follows:

- The Law on Conservation of the Environment and Prevention of Pollution (Royal Decree No. 114/2001)
- The Law on Nature Reserves and Wildlife Conservation (Royal Decree No. 6/2003)
- Decision No 20/90 regarding the rules regulating and specifying coastal setbacks

Although there are no direct descriptions about mangroves in these laws and regulations, relevant articles are as follows.

#### Royal Decree No. 114/2001

This law is the basic environmental law of Oman. Article 21 prohibits cutting down, uprooting or damage of any tree, shrub or grass in public forests, without obtaining a permit from the Ministry. Article 33 penalizes anyone who cuts down tree in conservation area by either imprisonment for a term not exceeding one month or with fine not less than RO 10 and not more than RO 500. Since mangroves are basically public forests, these articles are applied.

#### Royal Decree No. 6/2003

This law is the basic law regarding nature reserves and wildlife conservation. Nature reserves are designated by Royal Decree as stipulated in Article 10. QNR and khwars of the Dhofar region are nature reserves with mangrove distribution. QNR and khwars of the Dhofar region are designated as nature reserve through Royal Decree 38/75 and Royal Decree 49/97, respectively.

Article 13 stipulates the development of management plan. The management plan is required to designate the nature reserve into public zone, specially protected zone and zone for research/education purposes.

#### Decision No 20/90

The Decision specifies setbacks for coastal areas including sandy beaches and khwars, which is where mangroves are commonly distributed. Setbacks of sandy beaches and khwars are specified as 150 m from the maximum end of tidemark. However, setbacks may be specified as 50 m for beaches where the construction developments have limited impact on the environment.

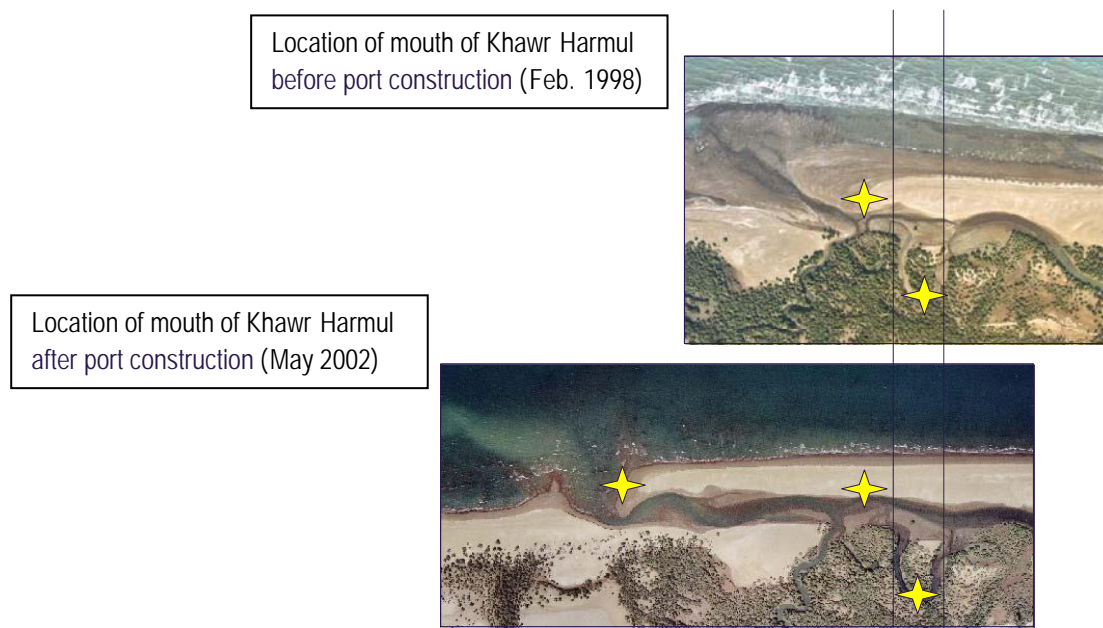
## 2 Potential threats to mangrove ecosystem and recommended protective measures

### 2.1 Coastal development

#### 1) Threats

Coastal development may adversely affect mangrove ecosystem in various ways. While development in mangrove area is basically prohibited in Oman, it is important to be aware that development activities outside of mangrove areas can also affect mangrove ecosystem, which may somewhat be a more gradual and long-term process.

Port construction, including marinas, is one of the major threats to mangroves in Oman. An example can be seen at Khawr Harmul at Liwa. Following the construction of Port of Sohar at a location approximately 2.5 km southeast from Khawr Harmul, severe beach erosion and accretion occurred along the coastline, and as a result, the mouth of Khawr Harmul had moved 200-300 m from the original location. Figure 1 shows how the location of the mouth of Khawr Harmul has changed before and after port construction. Such movement of the mouth will have changed significantly the hydrology of the mangrove forest, and as a result threaten the long-term survival of the mangroves. In extreme case, the mouth of Khawr Harmul could eventually close through sediment accretion, which will have devastating impacts on the mangrove ecosystem as there will be no more seawater inflow from the mouth.



**Figure 1 Location of mouth of Khawr Harmul before and after port construction**

Road construction in the vicinity of the mangrove forest may also have adverse impacts. For example, when roads are built, the underlying soil is compressed and this results in soil compaction. This as a consequence, may alter the hydrology of the mangrove area (e.g. hindrance of water drainage), and as a result affect mangrove health.

Construction activities may also impact mangrove ecosystems. Following are some examples:

- Pollution of lagoon water by discharge of construction wastewater (see Figure 2)
- Disturbance to fauna (e.g. birds) by emission of loud noise (e.g. pile-driving works)
- Accumulation of dust on mangrove leaves by dust dispersion



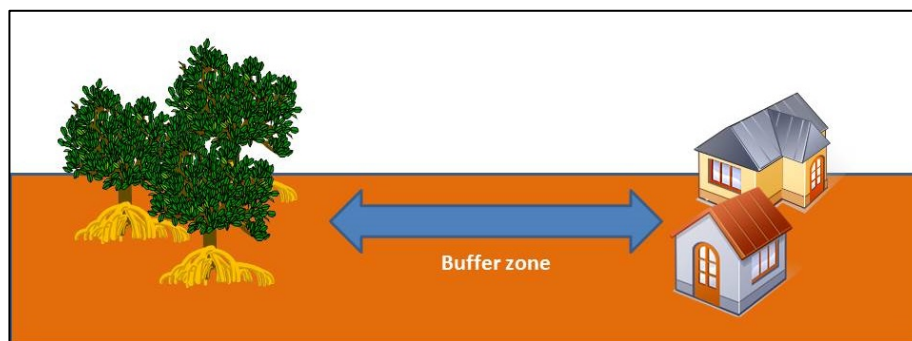
**Figure 2 Wastewater discharge into QNR**

## 2) Protective measures

### Establishment of buffer zone

To protect mangrove ecosystem from encroaching development activities, a “buffer zone” may be established outside the periphery of mangrove forest (see Figure 3). While people will be free to enter the buffer zone, no industrial, commercial or housing structures will be allowed to be built inside the buffer zone, including temporary structures (e.g. access road). However, small-scale structures that are used for recreational purposes (e.g. boardwalk, huts) may be exempted. The width of the buffer zone may be determined on a site-by-site basis, by taking into account the characteristics of each site.

A buffer zone may also help to remove pollutants contained in wastewater (e.g. from septic tanks) through its soil purification function, and consequently prevent or minimize pollutants reaching the mangrove area.



**Figure 3 Concept of buffer zone**

### Implementation of EIA

Any development projects with potential impacts on mangrove ecosystem should be required to undertake an Environmental Impact Assessment (EIA) study. The EIA study should include among others a detailed baseline study, analysis of alternatives, impact assessment and environmental management plan. Following are some important points to be covered by the EIA:

- The EIA should have a detailed and rational description on the site selection process, including an analysis of alternative development sites.

- The baseline study should be based on a comprehensive field survey, including both physical (e.g. water quality) and biological environment. Seasonal variations in the environment (e.g. migratory patterns of birds) should be taken into account when planning the timing of field surveys.
- Impacts on hydrology (both groundwater and surface water) and topography of the mangrove forest are one of the major concerns, and hence should be assessed in detail by for example employing a numerical simulation model. If significant changes are predicted, impacts of such changes to the mangrove ecosystem should be assessed in detail including long-term impacts.
- A detailed environmental management plan should be provided if any impacts on mangrove ecosystem are predicted. The environmental management plan should include cost, schedule and the organization responsible for implementing the mitigation measures and monitoring activity.

## **2.2 Tourism**

### **1) Threats**

Mangrove forests have high potential for tourism as it can readily provide opportunities for people to enjoy greenery and its rich biodiversity. While tourism in mangrove forests should be encouraged, it could have adverse impacts on mangrove ecosystem, if conducted in an uncontrolled manner. Possible impacts of tourism include:

- Disturbance of benthic organisms by tourists trampling over their habitats (e.g. burial of crab burrows)
- Disturbance of sensitive wildlife by inconsiderate behaviour of tourists (e.g. chasing or scaring off birds)
- Collecting of animals by tourists
- Littering and defecation by tourists

### **2) Protective measures**

In order to promote sustainable tourism, certain facilities and rules should be set to avoid or minimize adverse impacts. Following are some recommended measures:

- To minimize disturbance to benthic habitat, tourist should be allowed to walk only along designated pathways. Boardwalks may be constructed for this purpose (see Figure 4).
- Number of tourists entering the mangrove forest should be limited to prevent unnecessary disturbance to wildlife. A no-entry period may be established to allow recovery of animals.
- Shouting or generating loud noise should be prohibited.
- Collection of wildlife should be prohibited.
- Littering should be strictly prohibited and should be taken back by the tourist.
- Toilets should be installed at appropriate locations.
- Signboards should be installed that shows the prohibition rules.





**Figure 4 Boardwalk in QNR**

## **2.3 Waste dumping**

### **1) Threats**

Mangrove forests could end-up as a convenient place for dumping wastes, as the dumped waste will be hid by the trees and not be as visible as dumping in open space. Waste dumped in the upstream area or sea may also end-up in the mangrove forest by flood, current and tidal movement. Following are some potential adverse impacts of waste dumping:

- Wastes can bury habitats of benthic organisms (e.g. crabs).
- Animals could consume wastes by mistaking them as food.
- Wastes (e.g. plastic bag) can entangle on young mangrove trees and consequently bend or uproot the stem by acting like a sail in windy condition (see Figure 5).
- Wastes (e.g. plastic bag) can entangle or bury aerial roots and consequently hinder respiration of mangrove trees (see Figure 5).
- Toxic pollutants such as PCBs can leak out from wastes (e.g. electrical products) and pollute the forest and kill animals.
- Food waste could attract unwanted animals such as rats.



**Figure 5 Impacts of waste on mangrove forest**

## 2) Protective measures

Illegal waste dumping is a common occurrence among localities where their waste collection system is inadequate or enforcement of proper waste disposal is weak. Strengthening of the local waste management is hence the first priority. Following are some additional measures that could be implemented:

- Implementation of education and awareness campaigns (e.g. beach clean) to reduce illegal dumping.
- Signboards may be installed at mangrove areas that are prone to waste dumping (e.g. mangrove areas located adjacent to roads). Fences and surveillance cameras may also be installed if signboards are ineffective.

### 2.4 Mangrove utilization

#### 1) Threats

Mangrove trees have been utilized by local people as building materials (see Figure 6), animal fodder, firewood and so on. While these activities are now prohibited in Oman, they are still an ongoing practice in some rural areas. If these activities continue on an unsustainable manner, it may threaten the existence of mangrove forest.



**Figure 6 Hut made from mangrove**

#### 2) Protective measures

Although cutting or damaging of mangrove tree is prohibited, it may be difficult to enforce such rules in rural areas due to their remote locations. The local people may also feel that they have the right to use mangroves, as such practices may have been conducted traditionally for many years. In such case, as a comprise solution, MECA may as an exception allow the use of mangrove, providing that it will be conducted in a sustainable manner. Following are some suggestions of sustainable use of mangrove:

- Leaf grazing may be allowed with mature trees that grow along fringes of dense mangrove forest. On the other hand, leaf grazing should not be allowed with young trees or where mangrove density is low. Also a “no-grazing period” may be established to allow mangrove leaf regeneration.
- Use of mangrove for building material and firewood may be allowed providing that only dead or near-dead branches (e.g. branches with no or very few leaves) are selected. This may in fact

improve the condition of the forest, as it will enhance aeration within the forest and hence reduce risk of fungi growth.

In any case, MECA should discuss thoroughly with the local stakeholders about how to sustainably use mangrove, and develop a “mangrove management plan”. The management plan should include information such as:

- Areas where mangrove utilization is allowed
- Areas where mangrove utilization is strictly prohibited
- Period when mangrove utilization is prohibited

Where mangrove utilization is strictly prohibited, fences and notice signboards may be installed around the area to prevent people entering.

## **2.5 Collection of fauna**

### **1) Threats**

Mangrove forests are known to provide habitat for various fauna including commercial fish and crab species. Collecting such fauna for food or selling, even at small quantity, may have significant adverse impacts on mangrove ecosystem, especially in Oman where most forests are relatively small and hence have limited carrying capacity of fauna. Reduction of fauna will also result in less food available for migratory birds. Mangrove forests also function as a nursery for young fishes and crabs, and collecting such fauna may result in reduction of local marine resource.

### **2) Protective measures**

In principal, fauna collection should be prohibited at all mangrove forests for reasons stated above. An exception may be applied to relatively large mangrove forest and where its local population is small enough that collection can be conducted on a sustainable basis. However, even in such case, rules such as the following should be applied:

- Catching of juvenile fish should be avoided by using nets with large mesh size.
- A no-fishing period should be applied to allow recovery of fish stock.
- Only mature crabs should be caught. A size limit should be established for each species.

In any case, MECA should discuss thoroughly with the local stakeholders about how to sustainably use the fauna resource, and develop a “fauna management plan”. The management plan should include information such as:

- Prohibited collection methods
- Permitted mesh size
- Size limit for all target species
- No collection period

## **2.6 Invasive species**

### **1) Threats**

Invasive species may have significant impacts on the mangrove ecosystem. For example, *Prosopis juliflora* is an invasive plant species that has colonized many areas of Oman, and some are seen

along fringes of mangrove forest (see Figure 7). Since, *Prosopis juliflora* is known to be relatively salt tolerant, they could possibly invade into existing mangrove areas if conditions become more favorable for their growth.



**Figure 7 Example of invasive plant species**

During a recent fish survey at QNR, a tilapia species was collected, which are generally considered as an invasive species (see Figure 8). They may be a possible threat to the native species of QNR through competition for food and nest space. One tilapia species (*Oreochromis mossambicus*) is nominated as IUCN's "100 of the World's Worst Invasive Alien Species".



**Figure 8 Tilapia species caught in QNR**

## **2) Protective measures**

It is very hard to completely remove invasive species once they become established in the area. Therefore, it is important to detect invasive species in advance through monitoring activities and implement proactive measures before they proliferate to irreversible levels. The cause of such intrusion of invasive species should also be investigated and measures taken to prevent any recurrences. MECA should also make a list of invasive species that have risk of intrusion into mangrove areas.

### **2.7 Overgrowth of algae**

#### **1) Threats**

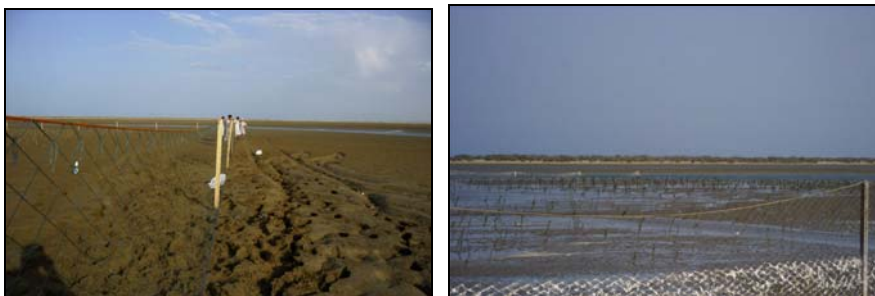
Some algae species increase explosively when conditions are suitable (e.g. excess of nutrients) and can accumulate to form visible filamentous algae mats (see Figure 9). These algae mats, when they entangle on mangrove trees, can have a wide range of adverse effects (e.g. hindrance to mangrove respiration by smothering the aerial roots). Young mangrove seedlings are also vulnerable to algae, as they can cover-up the entire seedling including the leaves (see Figure 9). This can hinder photosynthesis as well as stress the stem with its weight.



**Figure 9** Algae covering aerial root (left) and seedlings (right)

## **2) Protective measures**

In order to minimize entanglement of algae on young seedlings, nets may be installed in front of the seedlings. If done properly, algae should entangle onto the net and not reach the seedlings. However, once algae are entangled onto the seedlings, the only option will be to remove by hand. Such work could be conducted as a part of environmental education by inviting local schools and/or relevant organizations.



**Figure 10** Examples of net installation

