

BAHRAIN

INTRODUCTION

by Saeed A. Mohamed

Area: 706.5 sq.km (Anon, 1992a).

Population: 519,000 (Anon, 1992a).

The State of Bahrain consists of more than 33 islands which vary considerably in size and structure. The largest island, known as Bahrain or Awal, is 48 km long from north to south and 16 km at its broadest. The islands lie in the southwestern waters of the Arabian Gulf, some 25 km to the east of the Saudi Arabian coast at 26°05'N and 50°33'E (Bahrain Island). The total area of all islands is around 700 sq.km. The most recent population census was in 1992, and indicated that the total population was 519,000. The seas around the islands are shallow and rarely exceed 20 metres in depth. Salinities range from 40 parts per thousand in the north to 60 parts per thousand in the southwest.

Bahrain is located in the core of an extensive zone of aridity, and forms part of Arabia. Geologists refer to the structure of the main Bahrain island as that of an eocene eroded limestone dome (Doornkainp *et al.*, 1980). The highest point of the island, located in the middle of the island, is known as Jabal Ad-Dukhan, and reaches a height of 122.4 metres above sea level. Most of the other islands are lowland. These include Muharraq (32 sq.km), Sitra (29 sq.km), Umm Nassan (20 sq.km) and Sawad (8 sq.km). Hawar Island (41 sq.km) and other small islets such as Hajiat and Jidda are limestone cliff islands which may exceed 20 m above sea level (Anon, 1972 & 1992a).

The main island of Bahrain is composed of five distinctive physiographic regions:

1. Central Plateau and Jabals

An elevated central plateau with scattered hills. The general surface of the plateau is at 40-60 metres above sea level, with the highest point on Jabal Ad-Dukhan (Mountain of Smoke) at 122.4 m.

2. Interior Basin

An asymmetrical ring of lowland surrounding the central plateau. The surface elevation ranges from less than 20 metres around the basin margin up to 70 m.

3. Multiple Escarpment

A multiple escarpment rising up from the outer perimeter of the interior basin.

4. Main Backslope

The gently sloping land from the crest of the escarpment to the edge of the coastal lowlands.

5. Coastal Lowlands

This zone starts from the base of the backslope, and has an elevation of less than 10 m down to sea level. Soil studies have shown that four soil types are present: solonchaks, regosols, vermosols and fluvisols.

Bahrain has a remarkable variety of gypsum accumulation which could be explained as a result of continuous upwelling of sulphate-rich groundwater since the last pluvial period (Vine, 1986). Despite the high gypsum content of the soil, the inhabitants of Bahrain have succeeded in cultivating various trees and vegetables where suitable irrigation water is available. On the northern part of the main island, as well as on Muharraq, Sitra and Nabih Saleh, date palms have been cultivated for thousands of years. The availability of an abundant supply of fresh water from natural springs has been the essential factor in the flourishing agriculture. Apart from oil production, which accounts for over 60% of the national income, banking, light industry, fishing and agriculture form the backbone of Bahrain's economy.

The country has a hot desert climate. Rainfall is rare, and almost non-existent from June to September. The average annual rainfall is approximately 77 mm, with March being the wettest month. There has been considerable annual variation in rainfall over the years with, for instance, a total of 232.9 mm falling in 1976. The temperature pattern shows less variation from year to year. The average daily temperature in winter is 14.7°C, and in summer 37.7°C. However, daily temperatures in summer are greatly influenced by wind direction, with the prevailing northerly winds creating the coolest conditions. Humidity is high and may reach 100% at certain times of the year.

Summary of Wetland Situation

The principal wetlands in Bahrain are coastal mudflats. These occur around many of the islands, and cover a large area in relation to the size of the country. The tidal regime is semi-diurnal, with a maximum annual tidal range of about 2.5 metres. The lowest spring tides occur during the night in the hot summer and during the day in winter. This regime has a beneficial effect on the inter-tidal flora and fauna, which would otherwise experience greater thermal stress (Vousden, 1986).

Most of the larger areas of mudflat are to be found on the eastern side of the main island. Tubli Bay, located near the northeast corner of the island, is much the most important of these. This bay contains the last remaining stand of mangroves (*Avicennia marina*) in Bahrain, and is an important nursery ground for commercially important shrimps, mainly *Penaeus semisulcatus*, but also *Metapenaeus stebbingi* (Abduiqader, 1994). Thousands of waterbirds utilize the abundant food resources available in the bay. Over 45 species of birds, mainly herons, shorebirds, gulls and terns, regularly visit the area during the migration periods and in winter (Mohamed, 1994). Algae, which represent the main food for the commercially important Rabbit Fish *Siganus canaliculatus*, are collected in the bay by fishermen to be used as bait in fishing (Basson, 1989).

Other significant coastal wetlands on the main island include a sheltered stretch of coast in the southwest, which provides a good breeding site for White-cheeked Terns *Sterna repressa* and is also visited regularly by overwintering shorebirds and Greater Flamingos *Phoenicopterus ruber* (Mohamed, 1991), and a large area of inter-tidal mudflats at Ras Hayan on the southeast coast. The latter area supports a wide variety of fish species at high tide and many migratory shorebirds at low tide. It is the second most important wintering area for Greater Flamingos in Bahrain, after the Hawar Islands. The northern parts of the main island and Muharraq have moderately exposed shores, a large proportion of which has been reclaimed from the sea in the last 20 years.

Bahrain's coral reefs have recently been described by UNEP/IUCN (1988), and are therefore not included in this inventory. Coral fringes occur around the north and east coast of the main island of Bahrain and off Muharraq and Sitra. Further offshore to the north and east there are several large platform reefs and various small patch reefs which may have reef slopes extending to 10 m depth but rarely more. Reefs are also found off Askar. The largest reefs are Fasht Adhm off the northeast coast of Bahrain Island and Fasht al Jarim in the north. Thirty-one coral species in 19 genera have been reported.

Many of Bahrain's smaller offshore islands support breeding colonies of seabirds and other wildlife. The Hawar Islands, comprising an archipelago of large and small islands scattered in shallow water, are especially important. The breeding birds include Socotra Cormorant *Phalacrocorax nigrogularis*, Osprey *Pandion haliaetus*, Sooty Falcon *Falco concolor*, Caspian Tern *Sterna caspia*, White-cheeked Tern *S. repressa* and Bridled Tern *S. anaethetus*.

Bahrain has been known for a long time for its many natural freshwater springs which are scattered around Nabih Saleh and Sitra islands, and are particularly numerous around the northern and eastern side of the main island of Bahrain. Plantations of trees and agriculture have flourished because of the occurrence of these springs, and provide habitat which attracts many animals and migratory birds in particular. Starting in the early 1970s, the flow of fresh water from subterranean springs has dwindled or become progressively more saline because of a lowering of the water table as a result of depletion and over-use of the aquifer (Louri, 1990). This has led to the dereliction of many hectares of date garden and other cultivation.

The largest inland wetland in Bahrain is the artificial lake known as Dumistan or Lawzi Lake. The salinity varies from almost fresh in the northern part of the lake to hypersaline at the southern end. Some waterbirds, such as Moorhen *Gallinula chioropus* and Blackwinged Stilt *Hiinantopus himantopus*, have colonized the area and now breed there (Mohamed, 1993). Various studies have been carried out on the water chemistry of the lake and its microbiology (Al-Sayed *et al.*, 1992).

Wetlands are under threat from various human activities, and are also affected directly by oil spills. Large areas of coastal wetland around Bahrain were affected by a major oil spill in 1980 (Al-Alawi, 1981), but fortunately the country was not affected by any major oil slicks during the Gulf War of 1991, although overhead concentrations of smoke were reported at that time. Situated in the most densely populated part of the island, Tubli Bay is under heavy pressure from various human activities, such as land-fill, uncontrolled fishing and sewage disposal. Treated sewage effluent is discharged continuously into the bay from two treatment plants. Most serious, however, has been the reclamation of land for development, which has resulted in the destruction of biologically rich areas such as muddy shores and mangroves.

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified four sites of special importance for bird conservation in Bahrain (Evans, 1994). Three of these are coastal wetlands of considerable importance for waterfowl and seabirds, namely Tubli Bay, the southwest coast of Bahrain Island, and the Hawar Islands. All three are included in the present inventory, along with one other coastal wetland (Ras Hayan) and the artificial Lawzi Lake.

Wetland Research

Various ecological and biological studies have been conducted on the wetlands of Bahrain. Bodies involved in the study of wetlands have included the University of Bahrain, the Technical Secretariat of the Environmental Protection Committee, Bahrain Centre for Studies and Research, and the Directorate of Fisheries. Major research programmes have included studies of the following:

- mangrove ecology and biology in Tubli Bay;
- sewage effluents and their effect on marine organisms;
- birds in wetlands, and shorebird migration;
- the microbiology of Tubli Bay and Lawzi Lake;
- coastal halophytes;
- the importance of wetlands, particularly Tubli Bay, for fisheries.

In 1985, the Environmental Protection Committee conducted detailed surveys of all critical habitats in the inter-tidal and sub-littoral zones around the major islands of the Bahrain and Hawar archipelagos. The habitat maps resulting from this study show the distribution of coastal and marine habitat types around Bahrain including areas of scientific and commercial importance and areas recommended for protection, conservation and management (Vousden, 1986). The most intensively studied wetland to date has been Tubli Bay, which was the focus of a special symposium organized in January 1994 to discuss problems and solutions regarding this important wetland. Much of the information on the importance of Bahrain's wetlands for waterfowl has been derived from mid-winter waterfowl counts, which have been undertaken in most winters since 1987/88 as part of the IWRB/AWB Asian Waterfowl Census.

Wetland Area Legislation

The National Committee for Wildlife Protection (NCWP) was established in October 1993 with the aim of protecting important ecosystems, including wetlands, other critical habitats, and vulnerable and endangered animal and plant species. A Law by Decree for the protection of wildlife in Bahrain was issued by His Highness the Amir in January 1995. This Law by Decree gives the NCWP the mechanism for the protection of wildlife in general and wetlands in particular.

At international level, Bahrain has ratified the World Heritage Convention and has signed the Biodiversity Convention and the Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, including the Kuwait Action Plan (Evans, 1994). The Government is currently giving serious consideration to ratification of the Convention on the Conservation of Wetlands of International Importance especially as Waterfowl Habitat (the Ramsar Convention). Two sites, Hawar Islands and Tubli Bay, have been proposed for designation as Ramsar Sites under this Convention.

Wetland Area Administration

Prior to 1995, the Environmental Protection Committee (EPC) was the main body concerned with the administration and management of protected areas in Bahrain. However, in January 1995 the recently established National Committee for Wildlife Protection (NCWP) assumed

responsibility for protected areas, legislation concerning wildlife matters, and international conventions relating to wildlife. The first step taken by Bahrain to protect its wildlife was the establishment of the Alareen Wildlife Park in 1976. Although concerned primarily with the conservation of endangered species of Arabian wildlife and increasing public awareness, Alareen Wildlife Park is also taking an active part in protecting and managing selected areas, in particular on Hawar Island. In 1988, the mangrove swamp at Ras Sanad in Tubli Bay was declared as a protected area under the supervision of the Environmental Protection Committee (EPC), established in 1982. The EPC retains responsibility for the management of the Ras Sanad mangroves, and has been involved in conducting various studies in Tubli Bay. It has alerted public awareness to the values of wetlands in general and to the importance of Tubli Bay in particular. In recent years, the NCWP has been making efforts to have the whole of the bay designated as a protected area.

The Government, through the NCWP, is taking various steps with the help of the Ministry of the Interior and Ministry of Defence to protect important sites in the Hawar Islands, and to minimize human disturbance to the wildlife. In addition, a considerable degree of protection is given to the southern part of Bahrain Island and the smaller archipelagos.

Organizations involved with Wetlands

National Committee for Wildlife Protection

The main body concerned with the administration and management of protected areas. The NCWP drafts legislation and makes recommendations for the protection of critical ecosystems and habitats, and protection of rare and endangered species of animals and plants; it also designates new sites as protected areas.

Environmental Protection Committee

Concerned with aspects relating to pollution and monitoring of effluents and other discharges. The EPC is the official body in charge of the Wildlife Reserve at Ras Sanad in Tubli Bay.

Directorate of Fisheries

Monitors and controls fishing in wetland areas.

Central Municipal Council

Involved in the cleaning of shores in wetland areas.

Alareen Wildlife Park

Involved in the monitoring of some birds, such as Osprey and Sooty Falcon, and mammals, such as the Arabian Rheem Gazelle, Arabian Oryx and Cape Hare, on the Hawar Islands.

Non-governmental bodies such as the Bahrain Natural History Society (BNHS) are involved in public awareness campaigns and the cleaning of coastal areas, including some wetlands. The BNHS also conducts faunal and floral surveys and publishes biennial reports entitled "Wildlife in Bahrain".

WETLANDS

Site descriptions compiled by Saeed A. Mohamed of the Department of Biology, University of Bahrain.

Wetland Name: Tubli Bay

Country: Bahrain

Coordinates: 26°11'N, 50°34'E

Location: At the northeast corner of the main island of Bahrain, almost surrounded by the capital city Manama.

Area: Approximately 2,500 ha.

Altitude: Sea level.

Overview: A sheltered bay with large areas of inter-tidal mudflats and the last remaining stand of mangroves in Bahrain; an important nursery area for fishes and prawns, and a staging and wintering area for thousands of migratory waterfowl, but under considerable pressure from urban and industrial development.

Physical features: A natural, shallow, sheltered bay in an urban area near the northeast corner of Bahrain Island. The bay contains extensive inter-tidal mudflats, mainly on the east side, and a large area of mangrove at Ras Sanad in the southwest. It receives freshwater run-off from nearby irrigated plantations and treated sewage effluent from two treatment plants. There are many freshwater springs offshore and onshore, the latter supporting reed-beds and date palm gardens. The tidal regime is semi-diurnal, with a maximum tidal range of about two metres; the salinity is about 40 parts per thousand.

Ecological features: The inter-tidal zone supports a stand of the Black Mangrove *Avicennia marina* and an abundance of green algae. Adjacent sandy areas support halophytic plants including species of *Salicornia*, *Suaeda* and *Haminada*. Reeds *Phragmites australis* and rushes *Juncus* sp. occur along drains and ditches, and at the mouths of sewage outfalls.

Land tenure: State owned; adjacent areas are privately owned.

Conservation measures taken: In 1988, the entire mangrove swamp at Ras Sanad was declared a Wildlife Reserve, with supervision entrusted to the Environmental Protection Committee (EPC). The reserve covers about 250 ha. A mangrove re-planting programme is under way to restore former areas of mangrove. Since its establishment in 1982, the EPC has been involved in conducting various studies in Tubli Bay, and has alerted public awareness to the importance of the bay for fisheries and wildlife. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: The National Committee for Wildlife Protection (NCWP) has been making efforts to have the whole of the bay designated as a protected area. Tubli Bay has been identified as one of two sites in Bahrain suitable for designation as a Ramsar Site if and when the Government of Bahrain ratifies the Ramsar Convention. An Action Plan for the Conservation of Wetlands in South and West Asia, drawn up at an international conference held in Karachi, Pakistan, in 1991, recommended to the Government of Bahrain that a ban be placed on all in-filling of mangrove and mudflat areas along the eastern shore of the main island of Bahrain (Anon, 1992b).

Land use: Fishing and recreation. Green algae, the main food plant of the commercially important Rabbit Fish, are collected by fishermen to be used as bait in fishing (Basson, 1989). The city of Manama surrounds much of the bay, although there are still some date gardens and other cultivated areas close by.

Possible changes in land use: Further filling in of the bay and reclamation of land for urban development is likely.

Disturbances and threats: Situated in the most densely populated part of the island, Tubli Bay is under heavy pressure from various human activities, such as land-fill, uncontrolled

fishing, the dumping of rubbish, sewage disposal and oil pollution. Since 1975, most of the original mangrove and large areas of inter-tidal mudflat have been lost to housing and other urban and industrial development, especially along the north shore of the bay, and reclamation of land for development is continuing. Fine silt is accumulating as a result of these reclamation activities. Treated sewage effluent is discharged continuously into the bay from two treatment plants. Recreational activities cause some disturbance to wildlife, but hunting is no longer a problem, as hunting with any type of weapon is now illegal throughout the country.

Hydrological and biophysical values: The only mangrove area in Bahrain, and an important nursery ground for commercially important shrimps, such as *Penaeus semisulcatus* and *Metapenaeus stebbingi*, as well as marine fishes.

Social and cultural values: The site represents a good example of the natural heritage for the people of Bahrain. It is an ideal place for outdoor recreation, especially birdwatching.

Noteworthy fauna: The most important site in Bahrain for migratory waterfowl. Over 45 species of waterfowl, mainly herons, shorebirds, gulls and terns, have been recorded during the migration seasons and in winter (Mohamed, 1994). Peak counts have included 100 *Egretta garzetta*, 250 *Ardea cinerea*, 300 *Charadrius hiaticula*, 500 *C. alexandrinus*, 2,000 *C. mongolus*, 500 *Pluvialis squatarola*, 250 *Arenaria interpres*, 1,000 *Calidris minuta*, 800 *Limicola falcinellus*, 150 *Larus ichthyaetus*, 2,000 *L. ridibundus* and 3,000 *L. genei*. Moorhen *Gallinula chloropus* and Black-winged Stilt *Himantopus himantopus* breed in the mangroves. Various species of fishes visit the bay at high tide, including the commercially valuable Rabbit Fish *Siganus canaliculatus*.

Noteworthy flora: The site contains the only stand of mangrove in Bahrain, as well as an interesting saltmarsh community.

Scientific research and facilities: Various surveys and research projects have been carried out on different aspects of the bay. A special symposium was organized in January 1994 to discuss the problems affecting the bay, and to seek possible solutions for its conservation.

Conservation education: The Public Awareness Committee of the EPC has an educational programme which focuses on the site. The Mangrove Technical Committee has arranged several visits to the Wildlife Reserve for the general public. The NCWP has recently produced a documentary film on the bay.

Recreation and tourism: The site has considerable potential for outdoor recreation and tourism. Promising discussions have been held with the Directorate of Tourism concerning the promotion of the bay for tourism.

Management authority and jurisdiction: The Environmental Protection Committee is the official body in charge of the Wildlife Reserve in the mangrove area.

References: Abdulqader (1994); Anon (1992b); Basson (1989); Evans (1994); Gallagher & Rogers (1978); Mohamed (1994); Vousden (1986).

Reasons for inclusion: 1a, 1c & 3b. The largest area of inter-tidal mudflats in the country, with the only surviving stand of mangroves; a major staging and wintering area for migratory waterfowl, and an important nursery area for fish and shrimps.

Source: Saeed A. Mohamed.

Wetland Name: Lawzi (Dumistan) Lake

Country: Bahrain

Coordinates: 26°08'N, 50°30'E

Location: In the north-central part of the main island of Bahrain.

Area: 240 ha.

Altitude: Less than 15 m.

Overview: A small, artificial lake with a wide range of salinities and stands of *Phragmites* reeds; the largest inland wetland in Bahrain. A wide variety of waterbirds has been recorded on passage and in winter, and at least two species breed.

Physical features: Lawzi (or Dumistan) Lake is a man-made body of water near the centre of the main island of Bahrain. It was created by the excavation of sand from a large pit, and is fed by seepage from underground sources and by run-off from adjacent irrigated land. The water is generally rather shallow, and has a maximum depth of about 2.5 metres in the middle. The salinity shows a steep gradient from almost fresh (2 parts per thousand) at the northern end to hypersaline (60 parts per thousand) at the southern end. The lake is surrounded by housing and industrial estates and areas of irrigated agriculture.

Ecological features: Dense stands of reeds *Phragmites australis* grow along the northern edge of the lake where the salinity is low.

Land tenure: The lake is state owned; surrounding areas are privately owned.

Conservation measures taken: None.

Conservation measures proposed: The National Committee for Wildlife Protection has proposed that at least the northern part of the lake be protected as a nature reserve.

Land use: The lake is used as a reservoir to take excess irrigation water from adjacent agricultural land.

Possible changes in land use: Development projects might be approved in the area. Part of the site might be developed as a public park for outdoor recreation.

Disturbances and threats: None at present.

Hydrological and biophysical values: None known.

Social and cultural values: None known.

Noteworthy fauna: Some waterbirds, such as Moorhen *Gallinula chloropus* and Blackwinged Stilt *Himantopus himantopus*, have colonized the area and now breed there. Many species of waterfowl occur in small numbers on migration, including *Ardea cinerea*, *Anas crecca*, *A. platyrhynchos*, *Recurvirostra avosetta*, many other shorebirds, gulls and terns. The Arabian Killifish is present in the lake.

Noteworthy flora: The site contains some of the best stands of *Phragmites australis* in Bahrain.

Scientific research and facilities: Studies have been carried out on the water chemistry and microbiology of the lake (Al-Sayed *et al.*, 1992).

Conservation education: None at present.

Recreation and tourism: There is a proposal to develop part of the area as a public park for outdoor recreation and tourism.

Management authority and jurisdiction: Ministry of Housing and Bahrain Central Municipality.

References: Al-Sayed *et al.* (1992); Mohamed (1993).

Reasons for inclusion: 1d & 2b. The largest inland water body in Bahrain, supporting a diverse avifauna.

Source: Saeed A. Mohamed.

Wetland Name: Southwest Coast of Bahrain (Mumtalah)

Country: Bahrain

Coordinates: 25°54'N, 50°31'E

Location: On the southwest coast of the main island of Bahrain.

Area: 200 ha.

Altitude: Sea level.

Overview: A long sandy beach with adjacent sand dunes and a small area of inter-tidal mudflats, important as a breeding area for White-cheeked Terns *Sterna repressa*, and as a wintering area for Greater Flamingos *Phoenicopterus ruber* and shorebirds. Access is restricted, and the area is relatively undisturbed.

Physical features: The site comprises a long stretch of sheltered sandy beach backed by low sand dunes and an adjacent small area of inter-tidal mudflats and sand flats on the southwest coast of Bahrain Island. The tidal regime is semi-diurnal with a maximum tidal range of about two metres. The inshore waters are shallow, with a maximum depth of 5 m and a relatively high salinity of over 50 parts per thousand.

Ecological features: Marine algae are represented by brown algae such as *Sargassum* sp. and *Hormophysa* sp. The sand dunes behind the beach support scattered halophytic plants such as *Halopeplis* sp., *Hammada* sp. and *Suaeda* sp.

Land tenure: The site is state owned; inland areas to the north are privately owned.

Conservation measures taken: The National Committee for Wildlife Protection has recently designated the southern region of Bahrain Island, including the coastal wetlands, as a protected area. No public disturbance or hunting is allowed in the whole region. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: Additional measures have been proposed to minimize human disturbance in the area.

Land use: None at the site. Some camels graze in the adjacent sand dunes.

Possible changes in land use: None known.

Disturbances and threats: There is some overgrazing of dune vegetation by camels, and the tern colonies are vulnerable to oil pollution on the beaches, but otherwise the area is little disturbed.

Hydrological and biophysical values: None known.

Social and cultural values: None known.

Noteworthy fauna: The area supports a native population of Arabian Rheem Gazelles *Gazella subgutturosa marica* (50-70 individuals) and the largest breeding colony of Whitecheeked Terns *Sterna repressa* in Bahrain. Between 1978 and 1983, the breeding population of *S. repressa* fluctuated between 1,500 and 2,030 pairs (Gallagher *et al.*, 1984), but in recent years there have been only about 500 pairs. Other breeding birds include Kentish Plover *Charadrius alexandrinus* and Hoopoe Lark *Alaemon alaudipes*. Between 50 and 100 Greater Flamingos *Phoenicopterus ruber* normally winter along this sheltered stretch of coast (Mohamed, 1991). The commercially important Rabbit Fish *Siganus canaliculatus* occurs in inshore waters.

Noteworthy flora: None known.

Scientific research and facilities: The gazelle and breeding bird populations are monitored on a regular basis, but otherwise there have been no specific research projects in the area.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: The area is managed by Alareen Wildlife Park, and is under the jurisdiction of the State.

References: Evans (1994); Gallagher *et al.* (1984); Mohamed (1991).

Reasons for inclusion: 1a, 1c & 3b. A relatively undisturbed coastal site, important for Arabian Rheem Gazelles, breeding White-cheeked Terns and wintering Greater Flamingos and shorebirds.

Source: Saeed A. Mohamed.

Wetland Name: Ras Hayan

Country: Bahrain

Coordinates: 26°02'N, 50°37'E

Location: On the southeast coast of the main island of Bahrain.

Area: 500 ha.

Altitude: Sea level.

Overview: A large area of relatively undisturbed inter-tidal mudflats with extensive seagrass beds close inshore; an important staging and wintering area for Greater Flamingos *Phoenicopterus ruber*, shorebirds and gulls.

Physical features: A large area of inter-tidal mudflats on the sheltered southeast coast of Bahrain Island; the largest area of relatively undisturbed mudflats in the country. The shoreline is very gently shelving and most areas are covered in very fine sediments, although there are also areas with scattered boulders. The tidal regime is semi-diurnal with a maximum tidal range of about two metres; salinities range from 38-40 parts per thousand.

Ecological features: Sub-tidal areas support extensive beds of the seagrasses *Halodule* sp. and *Halophila* sp. Sandy areas above the high-water mark support halophytes such as *Haloplepis amplexicaulis*, *Halocnemum strobilaceum* and *Suaeda veriniculata*.

Scattered boulders form a good substrate for many sessile animals including tube worms and sponges. The very rich mudflats support a rich invertebrate fauna of polychaetes, crabs, bivalves *etc.* which provide important food items for thousands of wading birds at low tide and fishes at high tide. Crabs, including the mud crab *Macrophthalmus* sp., occur at very high densities.

Land tenure: State owned; adjacent areas inland are privately owned.

Conservation measures taken: None.

Conservation measures proposed: The National Committee for Wildlife Protection has proposed that at least a part of the area be protected as a nature reserve.

Land use: Fishing, using traditional fish traps; housing and other development inland. State fish farms and a mariculture centre are located in this area.

Possible changes in land use: There is a proposal to establish a new city near the site. This would change the entire area, and could result in the complete destruction of the site.

Disturbances and threats: Further development of housing along the shore is likely, and there is also a possibility that some of the mudflats will be reclaimed for development.

Hydrological and biophysical values: An important area for fisheries.

Social and cultural values: There are many traditional fish traps scattered throughout the area.

Noteworthy fauna: Over 30 species of waterfowl have been recorded. Thousands of waterfowl occur on the mudflats during the migration seasons and in winter, especially shorebirds which are present at most times of the year except mid-summer. The mudflats are the second most important wintering area for Greater Flamingos *Phoenicopterus ruber* in Bahrain (after the Hawar Islands); birds are present for most of the year, and numbers may exceed 300 in December. Over 50,000 Black-headed Gulls *Larus ridibundus* were recorded in November 1990. The rich inshore waters support a wide variety of fishes.

Noteworthy flora: Extensive seagrass beds.

Scientific research and facilities: Some studies have been carried out on coastal birds, and marine ecology. The Directorate of Fisheries has conducted trials with mangrove replanting in the area.

Conservation education: The mudflats are an important research and educational site for the University of Bahrain. Field work for ecology courses takes place here.

Recreation and tourism: The site contains a good beach for use by the public, and has considerable potential for bird-watching.

Management authority and jurisdiction: The State.

References: Saleh & Mohamed (1990, 1993).

Reasons for inclusion: 1a & 2a. A large and relatively undisturbed area of inter-tidal mudflats, attracting large numbers of waterfowl on migration and in winter; one of the few intact mudflats in Bahrain.

Source: Saeed A. Mohamed.

Wetland Name: Hawar Islands

Country: Bahrain

Coordinates: 25°40'N, 50°50'E

Location: In the Gulf of Bahrain, 25 km southeast of the main island of Bahrain.

Area: Approximately 5,300 ha of islands.

Altitude: Sea level to 20 m above sea level.

Overview: An archipelago of small desert islands and islets surrounded by shallow seas with extensive seagrass beds; still in a relatively pristine condition, and especially important for breeding seabirds (notably the world's largest concentration of Socotra Cormorants *Phalacrocorax nigrogularis*), Dugongs *Dugong dugon* and sea turtles. Six islands have been designated as protected areas, and access to all except the main island is severely restricted by the coast guard and the military.

Physical features: The Hawar Islands are an archipelago of 16 small, limestone, desert islands and islets in the Gulf of Bahrain. Some of the islands are hilly with cliffs up to 20-30 m high; others are flat and sandy with gently sloping shores. The largest island, Hawar, covers more than 4,100 ha. The surrounding seas are shallow, with depths of less than five metres in most areas. The sheltered shores feature scattered boulders, pebbles or sand. The tidal regime is semi-diurnal, with the maximum spring tide not exceeding 2.5 metres.

Ecological features: Some of the islands support a relatively dense cover of halophytes, the dominant plants being species of *Halopeplis*, *Limonium*, *Halocnemum*, *Phragmites*, *Hammada*, *Salicornia*, *Zygophyllum* and *Suaeda*. There are very extensive beds of seagrasses and algae in the surrounding shallow seas.

Land tenure: The islands and surrounding waters are state owned.

Conservation measures taken: Six small islands have been designated as protected areas by the National Committee for Wildlife Protection (NCWP) because of their importance for breeding seabirds. Access to the area is controlled by the coast guard and Ministry of Defence because of a military presence on the islands. The islands thus receive some protection from non-military disturbance. The NCWP is taking various measures to protect the most important sites and minimize human disturbance to the wildlife, with the help of the Ministry of the Interior and the Ministry of Defence. The islands have been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: An Action Plan for the Conservation of Wetlands in South and West Asia, drawn up at an international conference held in Karachi, Pakistan, in 1991, makes the following recommendation: "Adequate protection should be given to the small offshore islands, such as the Hawar Group, which support huge colonies of breeding waterbirds (including the largest colony of Socotra Cormorants in the world) as well as breeding Ospreys and Sooty Falcons" (Anon, 1992b). The Hawar Islands have been identified as one of two sites in Bahrain suitable for designation as a Ramsar Site if and when the Government of Bahrain ratifies the Ramsar Convention.

Land use: The islands are uninhabited except for a police and military garrison. Local fishermen are allowed to fish in adjacent waters, and there is some recreational fishing and other tourism, e.g. diving. There is, however, very little human activity on most of the islands.

Possible changes in land use: No major changes are proposed or expected.

Disturbances and threats: In general, there is very little human disturbance to the islands and surrounding marine ecosystems, and the sea remains very clean and unpolluted compared to the situation elsewhere in Bahrain. Fishermen cause some disturbance to breeding seabirds, and the collection of eggs and capturing of birds (especially Socotra Cormorant chicks) is reported to have been a problem (Evans, 1994). The islands have been affected by major oil spills in the past (*e.g.* during the Iran-Iraq war in 1980-88), and this remains a serious potential threat, especially during the breeding season.

Hydrological and biophysical values: The shallow seas around the islands support a rich fishery.

Social and cultural values: The islands remain in almost pristine condition and afford excellent opportunities for eco-tourism because of their scenic beauty, large breeding colonies of sea-birds, and populations of Arabian Oryx and Rheem Gazelle.

Noteworthy fauna: The Hawar Islands hold the world's largest breeding concentration of Socotra Cormorants *Phalacrocorax nigrogularis*. The main breeding site is on Suwad al Janubiyah island, where there were estimated to be between 200,000 and 300,000 adults (100,000-150,000 breeding pairs) in November 1992. In January 1995, this island held an estimated 155,000 pairs of Socotra Cormorants along with about 110,000 chicks. Other breeding birds include Western Reef Egret *Egretta gularis* (100 pairs), Osprey *Pandion haliaetus* (11 pairs), Sooty Falcon *Falco concolor* (15 pairs), Caspian Tern *Sterna caspia* (10 pairs), White-cheeked Tern *S. repressa* (100 pairs), Bridled Tern *S. anaethetus* (100 pairs) and Saunders's Little Tern *S. saundersi* (100 pairs). Up to 750 Greater Flamingos *Phoenicopterus ruber* winter amongst the islands, and it is suspected that some of these birds may occasionally breed.

A free-ranging herd of Arabian Oryx *Oryx leucoryx* has been established on the main Hawar Island by Alareen Wildlife Park. Native mammals on the main island include Arabian Rheem Gazelle *Gazella subgutturosa marica*, Cape Hare *Lepus capensis* and jerboas *Jaculus* sp. The shallow seas around the Hawar Islands support a very large population of Dugong *Dugong dugon*, which is thought to exceed 700 individuals in winter. The Green Turtle *Chelonia mydas*, Hawksbill *Eretmochelys imbricata*, Leatherback *Dermochelys coriacea* and Loggerhead *Caretta caretta* occur amongst the islands, and *C. mydas* may breed. Other reptiles include the Spiny-tailed Lizard or Dhab *Uromastix* sp. and several species of geckos such as *Stenodactylus* sp. The extensive beds of seagrasses and algae support a rich fish fauna including commercially important species such as the Rabbit Fish *Siganus canaliculatus*. The pearl oyster *Pinctada* sp. occurs in the area.

Noteworthy flora: Extensive beds of seagrasses.

Scientific research and facilities: Several surveys of the breeding birds have been undertaken, and Sooty Falcons have been the subject of a ringing programme.

Conservation education: Various educational films about the islands have been shown on local television, and a series of documentary films on the breeding birds of the Hawar Islands has almost been completed.

Recreation and tourism: The islands have considerable potential for eco-tourism. The Municipality has already built some chalets for visitors, and organizes daily trips to the main island by boat.

Management authority and jurisdiction: National Committee for Wildlife Protection, Bahrain Municipality and Alareen Wildlife Park.

References: Anon (1992b); Evans (1994); Gallagher & Rogers (1978); Gallagher *et al.* (1984); Hill & Webb (1986); UNEP/IUCN 1988.

Reasons for inclusion: 1a, 1c, 2a, 2c, 3a & 3c. A beautiful and virtually pristine group of islands with the world's largest breeding concentration of Socotra Cormorants and an internationally important population of Dugongs. The islands have a fauna and flora which is

perhaps typical and representative of the few remaining unspoilt islands in the whole Arabian Gulf.

Source: Saeed A. Mohamed.

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