

THE SULTANATE OF OMAN

INTRODUCTION

by Dr Sadiq Al Muscati *et al.*

Area: 309,500 sq.km.

Population: 2,017,591 (1993).

Oman is situated at the eastern extremity of the Arabian Peninsula, the Tropic of Cancer passing just south of the capital, Muscat. The northern mountains, of sedimentary and igneous formations, stretch in an almost unbroken chain from the Governorate of Musandam overlooking the Strait of Hormuz (separated from the rest of Oman by part of the United Arab Emirates) nearly to Ra's Al Hadd. They rise to a height of over 3,000 m in the centre, and enclose the fertile coastal crescent of the Batinah to the east.

The central plains, mainly arid flat gravel desert but with two extensive areas of sand dunes (the Wahiba Sands and the Rub' Al Khali), form some eighty per cent of the surface area. The Southern Governorate of Dhofar is characterised by a fertile coastal plain around the city of Salalah, overlooked by sedimentary flattish-topped mountains rising to 2,000 m and extending westwards beyond the Yemen border.

The coastline extends for some 1,800 km, with a number of islands offshore, the largest being Masirah to the east of central Oman. Its physical features vary considerably, from precipitous cliffs falling to depths of over 40 m close to the shore in Musandam, to shallow sandy beaches with scattered inlets and lagoons, some of which support mangroves, along the Batinah coast, to extensive sandy beaches along the coast of Central Oman, with areas of salt flats, especially the Barr Al Hikman which joins the Wahiba Sands opposite Masirah, and extensive high cliffs with some sandy beaches and tidal inlets along the coast of Dhofar.

The climate has two distinct periods: the cooler winter months when most rain falls in Northern Oman, especially in the mountains, and the hot summer when a southwest monsoonal airflow affects most of the country, with a significant deposition of fog moisture occurring in parts of the Dhofar highlands.

The southwest trade winds begin to blow across the Indian Ocean in May, reaching the Dhofar coast as the warm moist monsoon. By July and August, these winds reach a peak of 20-30 knots parallel to the coast, setting up a strong current from Somalia to western India. Deep, cold water wells up, particularly off Dhofar, and, being several degrees colder than the air passing over it, cools the air to dew-point. A bank of fog and ragged cloud then forms over the sea and a temperature inversion tends to prevent its dispersal, though daily changes occur. Where the Dhofar highlands face the wind, the fog and cloud press against them, riding to the top of Jebel Al Qara', but rarely over Jebel Qamar. The moisture condenses on objects (especially plants) and sometimes falls as drizzle. The

upwelling of nutrient-rich cold water during the monsoon is also responsible for a rise in marine productivity, which attracts large numbers of seabirds, fish and cetaceans. The fertile mountain region of Dhofar carries a high proportion of Oman's endemic plant species.

The economy of the Sultanate is substantially dependent on a modest income from the export of oil, natural gas and mineral products, but much of this revenue is being spent on the infrastructure for diversification of the economy, now that the most pressing needs for social development since 1970 have been substantially met. Apart from new manufacturing industries, agriculture and fishing provide important sources of income to the people. A significant proportion of the land surface area has been proposed for management as nature conservation areas in some 83 sites identified by an IUCN survey in 1986, accompanied by new laws governing the conservation of wildlife.

Summary of Wetland Situation

Apart from coastal cliffs such as those in the Musandam Region, the coastline is emergent, often with a shelf reef exposed at low water, backed by small dunes of calcareous sand bound by grasses and other halophytes. Inter-tidal flats are very extensive between the Barr Al Hikman and Masirah Island, south of the Wahiba Sands, and also occur in the Duqm area and to a lesser extent in the creeks (khawrs, the mouths of wadis which flood occasionally) of which there are many. Khawrs include those that are wide, shallow and surrounded by sabkha and halophytes, and those with deep narrow channels lined with the mangrove tree *Avicennia marina* or with reeds *Phragmites*, reed-mace *Typha* and other aquatic vegetation. Some are saline and strongly tidal, but others become lagoons when sealed temporarily from the sea by a sand bar until wadi flood or tide bursts through. Their waters are partly fresh at the inland end when this is fed by subsurface or very occasional surface flow. Examples are found along most of Oman's coastline.

Mangrove research workers have located mangroves at 15 sites on the coast of Oman, but at most of these sites, the stands are very small. Only one species, the Black Mangrove *Avicennia marina*, is present today, but there is evidence that a species of *Rhizophora* formerly occurred at some sites. Attempts have been made in recent years to replant some areas with *Avicennia* mangroves, and *Rhizophora stylosa* seedlings have been planted on experimental plots in Qurm creek and near Salalah (D'Souza, 1986).

Oman's coastal zone supports huge numbers of passage and wintering waterbirds and breeding and non-breeding seabirds. Mid-winter counts by a modest number of people covering the Sultanate's coastline give a total mid-winter population of 300,000-500,000 waterbirds of 90-110 species, with the majority of individuals being shorebirds and at a single site, the Barr Al Hikman. One recent record suggests that the globally endangered Slender-billed Curlew *Numenius tenuirostris* may winter in this area (three were present in January 1990, Uttley *et al.*, 1990). The distribution and conservation of seabirds breeding on the coasts and islands of Oman have been summarized by Gallagher *et al.* (1984).

A recent inventory of Important Bird Areas in the Middle East, sponsored by BirdLife International, identified 33 sites of special importance for bird conservation in the Sultanate of Oman (Evans, 1994). Eight of these are terrestrial sites with no significant wetlands, and nine are offshore islands and/or coastal headlands and cliffs of primary importance for their seabirds and Sooty Falcon *Falco concolor*. The remaining 16 sites are coastal wetlands. Fourteen of these are of considerable importance for waterfowl and are included in the present inventory, either individually or as a part of a larger site.

Wetland Research

A number of studies have been made which include Oman's wetlands. In 1985/86, a study of the overall flora and fauna situation was made by an IUCN team for the Diwan of Royal Court. The final report of this study, entitled *Proposals for a System of Nature Conservation Areas in the Sultanate of Oman* (IUCN, 1986), identified a number of wetland areas of conservation importance. Coastal zone management survey reports contain information on the coastal wetlands and coastal fauna of Oman (IUCN, 1986-89). Recent studies have included a study of the heron colonies in the Sultanate in 1992 (Jensen & Salm, 1992a), and a survey of the khawrs and springs of the Dhofar Governorate in 1993 (Fry & Eriksen, 1993). Mid-winter waterfowl counts have been undertaken annually since the winter of 1987/88 as part of the IWRB/AWB Asian Waterfowl Census, and by 1994, 14 sites had been counted at least once (Rose & Taylor, 1993).

The Oman Bird Group, through its volunteer membership, carries out continuous study throughout wide areas of the Sultanate. The Oman Bird Records Committee maintains the Oman Central Record on a computer database which holds some 100,000 records.

Wetland Area Legislation

Various Royal Decrees and Ministerial Decisions have been promulgated since 1970 to protect Oman's wildlife and habitats, as well as to prevent marine and terrestrial pollution. In July 1973, a Ministerial Decision was issued banning the hunting, capture and opening fire on all birds and other animals, extending protection still further.

By Royal Decree, all new development projects have to be referred to the Ministry of Regional Municipalities and Environment for the issue of environmental permits. As part of this procedure, these projects are studied by the Ministry, who may call for an independent consultant. Environmental Impact Assessment. This applies to any project anywhere in the Sultanate, but special scrutiny is made of those planned to occur within protected areas.

In 1994, a large area encompassing the highly successful Arabian Oryx Re-introduction Project was established by Royal Decree, to protect the area, which includes the Sahil Al Jazr coastline of Central Oman, to become what is now called the Arabian Oryx Sanctuary.

Wetland Area Administration

The Directorate General of Nature Protectorates in the Ministry of Regional Municipalities and Environment is responsible for the protected areas, as well as the protection of wildlife in non-designated areas. Coastal zone management plans have been drawn up for sections of the coastline of Oman. Action is being taken now to prevent flytipping and unauthorized developments from taking place in the proposed protected areas. The Wildlife Ranger Force of Oman is currently being formed and trained to provide comprehensive mobile protection and surveillance of wildlife in the Sultanate. Units will be assigned to monitor activities in the wetlands. With the emphasis on good training and efficiency, together with limited available funding, it will take some time to expand this organisation to its full strength across the country.

Management organisations tailored to suit each type of wetland site will be established according to priorities and available finance.

Organizations involved with Wetlands

Ministry of Regional Municipalities and Environment

This Ministry is the main environmental protection agency in the country. It is in the process of expanding its organisation and activities, through the Directorate General of Nature Protectorates, to take full management responsibility for all protected areas and for wildlife throughout Oman.

Ministry of National Heritage and Culture

The Oman Natural History Museum, formed by this Ministry in 1985 and expanded in 1992, exhibits the natural environment of Oman in several large galleries and a small botanical garden. Firmly based on the results of scientific studies over many years, and exhibiting only Omani animals which died from natural causes, it provides the Sultan Qaboos University, schools, the general public and tourists with an authentic view of the country's natural environment and of "Conservation in Action" by the Government. The Museum manages the National Herbarium of Oman (ON), the National Shell and Coral Collections, an important study collection of insects, arachnids and other invertebrates, and an extensive collection of fossils and skeletal material. It also hosts visiting biologists.

Ministry of Agriculture and Fisheries Resources

This Ministry undertakes a number of marine research projects, mainly for the sustainable development of fishery resources, through its Marine Science and Fisheries Centre.

Sultan Qaboos University

The University's Colleges of Science and Agriculture have carried out a number of floral and faunal studies and maintain a botanical garden. The College has participated in a number of marine projects by visiting research ships. An M.Sc. course in environmental

studies is expected to commence in 1995, in addition to present B.Sc. courses in Biology, Agronomy and Fisheries.

Office of the Adviser for the Conservation of the Environment, Diwan of Royal Court
This Office manages the Arabian Oryx Re-introduction Project, the Arabian Tahr Reserve and two coastal bird sanctuaries. The Office has coordinated and hosted a number of important wildlife surveys throughout the Sultanate, with the support of IUCN and WWF, and has published the results. It provides an advisory service to the Diwan of Royal Court, Ministries and other Government departments.

The Oman Bird Group

An NGO of ornithologists, represented by the Oman Bird Records Committee, which encourages this hobby, maintains a database, publishes a list of all accepted bird records, and assists and advises the Government in ornithological matters.

The Historical Association of Oman

An NGO with some 900 members, formed in 1971 to promote interest in Oman's history. Its activities were formally expanded to include Natural History in 1981. They include field trips and lectures throughout the year.

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WETLANDS

Site descriptions compiled by M.D. Gallagher (Natural History Museum), Jens Eriksen (Sultan Qaboos University), C. H. Fry (Sultan Qaboos University) and M.A.L. Cummins (National Survey Authority).

Wetland Name: Al Batinah Coast and Khawrs

Country: Oman

Coordinates: 24°59'N, 56°22'E to 23°40'N, 58°12'E; Khawr Kalba 24°59'N, 56°22'50"E; Khawr Shinas 24°43'N, 56°28'E; Khawr Nabr (previously also referred to as Khawr Al Liwa) 24°32'N, 56°36'E.

Location: On the north coast of Oman from Khawr Kalba on the border with the United Arab Emirates in the northwest to the region of As Seeb in the east, Al Batinah Region.

Area: Approximately 9,000 ha of wetlands along 300 km of coast, including Khawr Kalba 100 ha, Khawr Shinas 1,200 ha and Khawr Nabr 300 ha.

Altitude: Sea level.

Overview: A long stretch of sandy beach on the coast of the Gulf of Oman, with three major mangrove-lined tidal creeks (Khawr Kalba, Khawr Shinas and Khawr Nabr) and a number of smaller creeks; important for passage and wintering waterbirds, notably shorebirds, gulls and terns, and also resident and migratory breeding species. The creeks support a resident fauna of molluscs and crustacea, and are probably nurseries for marine fish.

Physical features: About 300 km of exposed sand beach facing the Gulf of Oman, extending from As Seeb in the east to the UAE border in the northwest. Khawrs (creeks) occur at the mouths of drainage lines; most are transitory, appearing and disappearing according to the occurrence of strong tides and wadi floods.

Khawr Kalba is a large creeks system with extensive stands of old mangroves, straddling the border between Oman and the United Arab Emirates. Most of the creek system lies within the UAE (see Site 20 in UAE chapter), but about 100 ha at the southern end are in Omani territory near Khatmat Milalah. Here there is a single tidal pool (between the customs posts) and a tidal creek of alluvial mud extensively lined with mangrove and surrounded by sabkha (saline flats) and unconsolidated sand with many chenopods.

Khawr Shinas, about 30 km south-southeast along the coast, is a 6 km long tidal creek divided by deep channels. The southern part is lined with dense stands of mangroves; the northern arm of the creek is blocked by a causeway. The creek system is surrounded by a wide area liable to flooding, with many chenopods and some patches of grasses and *Cyperus* sp.

Khawr Nabr, which lies a further 25 km to the south-southeast, is a 3 km long tidal creek, divided by channels lined with mangroves. There is a single exit to the sea near the village of Sahi Harmul.

Ecological features: The three main creeks support stands of the Dwarf or Black Mangrove *Avicennia marina*. Adjacent tracts of saline coastal sands and sabkha are very sparsely vegetated, the dominant species being chenopods. There is one patch of grass and some *Cyperus* sp. at Khawr Shinas.

Land tenure: The creeks are state owned. Adjacent land is partly state owned and partly in private hands (residential housing, gardens *etc.*).

Conservation measures taken: No formal protection. A ranger force is currently being set up to increase monitoring. Action is now in hand to implement management plans and tighten control. The Batinah coast and the three main khawrs (Kalba, Shinas and Nabr) have been identified as Important Bird Areas by BirdLife International (Evans, 1994).

Conservation measures proposed: Two protected areas have been proposed for Khawr Shinas, a National Scenic Reserve and a National Nature Reserve (IUCN, 1986).

Land use: Dumping of rubbish and movement of people associated with boats and leisure. There is some browsing by camels in the mangrove areas. A graded track at Khawr Shinas facilitates driver training close to the mangroves. Action is now being taken to prevent tipping at the creeks.

Possible changes in land use: None known.

Disturbances and threats: Khawr Shinas and Khawr Nabr have been adversely affected by the cutting of mangroves (for browse and formerly for poles), the tipping of builders' rubbish, disturbance from vehicular traffic, the parking of fishing boats, nets and vehicles, extension of built-up areas to the edge of the sabkha, and the creation of tracks to beach shelters to encourage tourism. Khawr Nabr has also become a refuge for feral dogs. Khawr Kalba remains relatively undisturbed.

Hydrological and biophysical values: The creeks are an integral part of the wadi systems draining the surrounding low-lying land during periods of heavy rainfall.

Social and cultural values: The mangroves were previously used as a source of timber for construction and boat building.

Noteworthy fauna: The open shore supports large numbers of wintering shorebirds, especially Sanderling *Calidris alba*, and roosting gulls and terns; the two latter often concentrate at the entrance to the small khawrs. Mid-winter counts along the entire Batinah coast in recent years have included up to 86 Western Reef Egret *Egretta gularis*, 67 Grey Heron *Ardea cinerea*, 325 Lesser Sand Plover *Charadrius mongolus*, 2,500 Sanderling *Calidris alba*, 800 Sooty Gull *Larus hemprichii*, 3,800 Great Black-headed Gull *L. ichthyaetus*, 35,000 Black-headed Gull *L. ridibundus*, 1,700 Slender-billed Gull *L. genei*, 7,400 Yellow-legged Gull *L. cachinnans*, 850 Lesser Crested Tern *Sterna bengalensis* and 1,080 Sandwich Tern *S. sandvicensis*. Wintering birds of prey have included Osprey *Pandion haliaetus* (maximum 9), all four species of harrier *Circus* spp., Greater Spotted Eagle *Aquila clanga* and Peregrine Falcon *Falco peregrinus*. Khawr Kalba has an endemic subspecies (*kalbaensis*) of the White-collared Kingfisher *Halcyon (Todirhamphus) chloris*, the total population of which may not exceed fifty birds. Individuals occasionally wander to Khawr Shinas and Khawr Nabr, but the species is not known to have bred there. Other breeding birds in the mangroves include Little Green Heron *Butorides striatus*, Clamorous Reed Warbler *Acrocephalus stentoreus*, Booted Warbler *Hippolais caligata rama* and possibly also Olivaceous Warbler *H. pallida*. The Batinah khawrs are one of the few breeding localities for *H. caligata* in Arabia, and are at the southern edge of the breeding ranges of *A. stentoreus*, *H. caligata* and *H. pallida*. Old nests of *Egretta garzetta* have been found at Khawr Nabr, and it is thought that the species would breed again in this area if secure from disturbance.

Noteworthy flora: The creeks contain some of the finest remaining stands of the Dwarf or Black Mangrove *Avicennia marina* in Oman.

Scientific research and facilities: Annual mid-winter waterfowl counts have been undertaken since January 1988.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.

References: Cowles (1980); Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1988-94 (*e.g.* Rose & Taylor, 1993).

Reasons for inclusion: 1a, 2a, 2b & 3c. A relatively undisturbed area containing noteworthy stands of mangroves with an endemic subspecies of kingfisher and at least two species of warbler not breeding elsewhere in Oman. The region as a whole is extremely important for passage and wintering shorebirds, gulls and terns.

Source: M.D. Gallagher, Natural History Museum.

Wetland Name: Barr Al Hikman and Masirah Island

Country: Oman

Coordinates: Approximate central coordinates 20°30'N, 58°30'E

Location: About 350 km south of Muscat in the Wilayats of Mahawt and Masirah, Al Wustta and Ash Sharqiyah Regions.

Area: Barr Al Hikman 290,000 ha (coastline 160 km, greatest area of exposed mudflats at least 22,000 ha). Masirah Island 109,500 ha (coastline 170 km, greatest area of exposed mudflats 2,000 ha).

Altitude: Wetlands at or near sea level. The hills on Masirah Island reach a peak at about 280 m.

Overview: An extensive area of inter-tidal mudflats, shallow lagoons, sea bays and straits, together with a number of offshore islets, a small area of mangrove (Mahawt) and sandy beaches; of outstanding importance for passage and wintering waterbirds, especially shorebirds, for breeding seabirds, and for nesting sea turtles. Much of the site remains relatively undisturbed and has been proposed for protection in several National Nature Reserves.

Physical features: The site comprises the raised rocky limestone peninsula of Barr Al Hikman, with about 160 km of coastline fringed by extensive inland sabkha and at least 22,000 ha of inter-tidal mudflats, the large island of Masirah and associated islets some 20 km to the east, and the intervening shallow channel, the Masirah Straits. There are five tidal inlets along the mainland coast, one of which (Khawr Barr Al Hikman) at 4,000 ha is the largest khawr in Oman. In the west, the Barr Al Hikman peninsula borders on a large shallow sea bay (Ghubbat Hashish) which contains a mangrove-fringed island (Mahawt) and the richest and most extensive seagrass beds in Oman. Masirah Island is gently undulating with a central spine of hills and peripheral coastal plain. There are extensive inter-tidal mudflats along the central and northern parts of the west coast, while the east coast is exposed ocean beach. Small offshore islands include Jazirat Shaghaf, Jazirat ash Shi'inzi, Jazirat Kalban and associated islets. Jazirat Shaghaf, with an area of 753 ha, is the largest island in the whole Barr Al Hikman/Masirah area apart from Masirah Island itself. It has areas of shallow dunes and a mangrove stand at the northeastern extremity, the only one in Masirah.

An ophiolite suite of uncertain age, but which may have been introduced into the margin of Arabia during the late Cretaceous, covers most of Masirah Island, presumably forms the bedrock of the Masirah Straits and appears as an isolated outcrop in the southeast corner of Barr Al Hikman. The shallow marine limestone and marl that cover the remainder of Barr Al Hikman date from the Palaeocene or the Eocene. Soils, where present, are generally shallow and sandy and, except in one area at the south end of Masirah Island, have little agricultural potential.

The mean annual rainfall is 110 mm, but it is erratic and, since 1956, has varied from 0 mm to over four times the mean figure. The July mean temperature is 33°C; the January mean 20°C. Annual and diurnal variation is moderated by the maritime setting. Between April and September, the wind direction is predominantly southwest influenced by the southwest monsoon in the Indian Ocean. The mean July wind speed, when the influence of the monsoon is usually at its peak, is in excess of 30 km.p.h. Outside the monsoon period, winds are lighter and more variable, often with an easterly component. The mean tidal variation (MHHW to MLLW) at Rounders Bay (20°13'N, 58°38'E) is given as 1.5 metres. Tidal streams for various points in the Masirah Straits are shown on the hydrographic charts, but are nowhere greater than one knot. Monsoonal currents are said to be less than half a knot.

Ecological features: Extensive inter-tidal and sub-littoral mudflats occur along the eastern side of Barr Al Hikman, bordering the Masirah Straits. In the Bayad Dimnah area, opposite Masirah Island, an extensive rock platform underlies the mud and sand. Here the mudflats are up to 7 km wide at low tide. Low coastal cliffs with inter-tidal and sub-littoral sand occur around the outer portions of the Barr Al Hikman peninsula. The seagrasses *Halophila ovalis*, *Thalassia hemprichii* and *Halodule uninervis* dominate the substrate in the Ghubbat Hashish and Masirah Straits, and there are also some isolated and fringing coral reefs in the straits. The east coast of Masirah Island has low cliffs with mostly sandy inter-tidal and sub-littoral zones. The west coast has inter-tidal and sub-tidal sand and mud, some of the fine sub-littoral substrates being dominated by seagrasses. The small island of Mahawt in Ghubbat Hashish is fringed by well developed stands of the Dwarf or Black Mangrove *Avicennia marina*, as is the northeastern extremity of the larger island of Jazirat Shaghaf, off Masirah, and there are also some small specimens of mangroves in some of the creeks on the east coast of Barr Al Hikman. Inland near the coast there are areas of sand and gravel plains with some sand dunes. The terrestrial vegetation on Masirah Island is dominated by dwarf shrubs such as *Limonium*, *Suaeda* and *Arthrocnemum*.

Land tenure: The entire area is state owned.

Conservation measures taken: The site has no formal protection. A ranger force is currently being set up to increase monitoring. Barr Al Hikman and Masirah have been identified as Important Bird Areas by BirdLife International (Evans, 1994).

Conservation measures proposed: The whole of the Barr Al Hikman area has been proposed as a National Nature Reserve (288,000 ha), apart from 2,000 ha on the west coast of Ghubbat Hashish. The main areas for wildlife on Masirah Island and part of Masirah Straits are covered by three proposed National Nature Reserves: East Masirah (4,500 ha), South Masirah (19,000 ha) and Masirah Straits (86,000 ha). The latter encompasses the west coast of the island, the eastern half of the straits and Jazirat Shaghaf.

Land use: Seasonal commercial fishing of various kinds takes place all along the coast, with prawn fishing being especially important in Ghubbat Hashish. Seabirds' eggs are taken from many of the small islands. About 5,000 people live on Masirah Island; some small areas of irrigated land are farmed, and goats are grazed over most of the island. The dry areas of Barr Al Hikman are unused.

Possible changes in land use: Development of the commercial fishery continues to take place, but appears to be under reasonably tight control. It appears there is a possibility of a fishing port being constructed within the area.

Disturbances and threats: The large areas of soft inter-tidal mud and sabkha, which make access difficult, are likely in the short term to prevent disturbance of the main shorebird wintering grounds around Barr Al Hikman. However, modern four-wheel drive vehicles provide easy access to the sandy bays on the southern shore, and mopeds with an "all terrain" capability could provide a threat if control measures are not taken in time. Development of commercial fisheries could pose a threat to the seagrass beds and corals in the Masirah Straits. Egg collection and disturbance are major threats to breeding seabirds on the small islets off Masirah, some of which are accessible by vehicle at low tide. Large numbers of gull and tern eggs and gull chicks are collected for food by local people, especially from the islets of Shagaf and Shi'inzi, and over-exploitation is now thought to be occurring, as the nesting populations of most seabirds breeding on and around Masirah appear to be declining. Human disturbance is already excessive at some of the colonies, and will increase if local tourism is allowed to develop without very strict controls.

Hydrological and biophysical values: No information.

Social and cultural values: At present, the whole seacoast and the straits are used by the local population in fishing and food gathering activities. Weekend and holiday tourism is developing with the increasing availability of reliable four-wheel drive vehicles.

Noteworthy fauna: **Barr Al Hikman** is of outstanding importance as a major staging and wintering area for migratory shorebirds and other waterfowl. The globally threatened Slender-billed Curlew *Numenius tenuirostris* has been identified, and is presumed to occur regularly in very small numbers. Concentrations of 28,500 Sooty Gull *Larus hemprichii* (70 % of the estimated world population) and 3,000 Crab Plover *Dromas ardeola* (8 % of the world population) have been recorded in mid-winter. Other species which occur in numbers exceeding 1 % of the regional population include the following (peak counts in brackets): Great Cormorant *Phalacrocorax carbo* (8,200), Socotra Cormorant *P. nigrogularis* (15,000), Western Reef Egret *Egretta gularis* (1,800), Greater Flamingo *Phoenicopterus ruber* (9,300), Oystercatcher *Haematopus ostralegus* (10,700; 40% of Southwest Asian wintering population), Lesser Sand Plover *Charadrius mongolus* (5,000), Greater Sand Plover *C. leschenaultii* (800), Grey Plover *Pluvialis squatarola* (2,600), Great Knot *Calidris tenuirostris* (1,200), Sanderling *C. alba* (11,000), Little Stint *C. minuta* (16,000), Curlew Sandpiper *C. ferruginea* (17,000), Dunlin *C. alpina* (60,000), Broad-billed Sandpiper *Limicola falcinellus* (5,000; 20% of Southwest Asian wintering population), Bar-tailed Godwit *Limosa lapponica* (50,000), Slender-billed Curlew *Numenius tenuirostris* (3), Eurasian Curlew *N. arquata* (1,750), Terek Sandpiper *Xenus cinereus* (600), Ruddy Turnstone *Arenaria interpres* (1,700), Great Black-headed Gull *Larus ichthyaetus* (1,500), Slender-billed Gull *L. genei* (50,000), Yellow-legged Gull *L. cachinnans* (22,000), Caspian Tern *Sterna caspia*

(1,400), Great Crested Tern *S. bergii* (4, 100), Lesser Crested Tern *S. bengalensis* (3,000) and Sandwich Tern *S. sandvicensis* (45,000). Other species occurring in significant numbers in winter include Great Egret *Casmerodius albus* (340), Grey Heron *Ardea cinerea* (600), Spoonbill *Platalea leucorodia* (180), Kentish Plover *Charadrius alexandrinus* (3,500), Whimbrel *Numenius phaeopus* (950), Redshank *Tringa totanus* (13,200), Greenshank *T. nebularia* (3,200), Common Tern *Sterna hirundo* (3,000) and Saunders's Little Tern *S. saundersi* (320). An incomplete survey conducted in January 1991 recorded over 336,000 waterfowl of at least 39 species. Even larger numbers of waterfowl might be expected to occur in autumn, and numbers in spring are also likely to be very important. Birds of prey occurring in the area in winter include Osprey *Pandion haliaetus* (maximum 44), Marsh Harrier *Circus aeruginosus* (maximum 28) and Peregrine Falcon *Falco peregrinus* (maximum 8). Breeding birds in the Barr Al Hikman area include about 90 pairs of *Egretta gularis*, 75-100 pairs of *Larus hemprichii*, 10 pairs of Roseate Tern *Sterna dougallii*, 1,500-2,500 pairs of Bridled Tern *S. anaethetus* and 20 pairs of *S. saundersi*.

Masirah Island also supports very large wintering populations of herons, shorebirds, gulls and terns. Species occurring in internationally important numbers include the following (peak counts in brackets): *Egretta gularis* (420), *Haematopus ostralegus* (3,000), *Dromas ardeola* (2,000), *Charadrius mongolus* (6,400), *Pluvialis squatarola* (550), *Numenius arquata* (1,000), *Larus hemprichii* (10,400), *L. ichthyaetus* (1,000), *L. genei* (1,700), *L. cachinnans* (13,000), *Sterna caspia* (170), *S. bergii* (8,700) and *S. sandvicensis* (7,200). Other species occurring in substantial numbers include *Ardea cinerea* (220), *Calidris alba* (700), *Limosa lapponica* (2,800), *Numenius phaeopus* (330) and *Arenaria interpres* (630). In addition, there is a very significant autumn passage of *Charadrius leschenaultii* (maximum 5,250), *Pluvialis squatarola* (1,600), *Numenius phaeopus* (2,000), *Tringa totanus* (2,000), Red-necked Phalarope *Phalaropus lobatus* (2,000) and White-cheeked Tern *Sterna repressa* (70,000 on one occasion in October). Wintering birds of prey include up to 60 *Pandion haliaetus* and 21 *Circus aeruginosus*. The small islets off Masirah Island, especially Jazirat Shaghaf, have breeding colonies of *Larus hemprichii* (5,200 pairs), *Sterna bergii* (300 pairs), *S. dougallii* (160 pairs), *S. repressa* (1,200 pairs) and *S. anaethetus* (15,500 pairs). Other breeding species on Jazirat Shaghaf include *Egretta gularis* (20-30 pairs) and *Dromas ardeola* (85 pairs). Concentrations of seabirds off the east coast of Masirah during July-August, when there is a cold current, include Jouanin's Petrel *Bulweria fallax*, Flesh-footed Shearwater *Puffinus carneipes*, Persian Shearwater *P. (lherminieri) persicus*, Wilson's Petrel *Oceanites oceanicus*, Pomarine Skua *Stercorarius pomarinus*, Arctic Skua *S. parasiticus*, *Sterna caspia*, Lesser Noddy *Anous tenuirostris* and Brown Noddy *A. stolidus*. The Corncrake *Crex crex* has been reported on at least ten occasions on passage on Masirah Island, and the Houbara Bustard *Chiamydotis undulata* is said by local people to be a regular passage migrant in small numbers. There is an isolated breeding population of the White-breasted (Abyssinian) White-eye *Zosterops abyssinica*, possibly of an undescribed subspecies, on Mahawt Island.

Arabian Gazelle *Gazella gazella* and perhaps Goitred Gazelle *G. subgutturosa* occur in the Barr Al Hikman area, and *Vulpes rueppellii* has been reported. The Arabian Gazelle and an endemic subspecies of Cape Hare *Lepus capensis jefferyi* occur on Masirah Island. Four species of sea turtles, Loggerhead *Caretta caretta*, Green Turtle *Chelonia mydas*,

Hawksbill *Eretmochelys imbricata* and Olive Ridley *Lepidochelys olivacea*, are present in the area at various times of the year when they come ashore to nest, and a fifth species, the Leatherback Turtle *Dermochelys coriacea*, visits the area very occasionally. Surf Beach, on the eastern shore of Masirah Island, is a nesting site of world importance for *C. caretta*, with an estimated 30,000 females coming ashore each May-September. The east coast of Masirah also provides an important nesting site for *C. mydas*, while *E. imbricata* and *L. olivacea* nest on beaches at the southern end of the island. The Straits of Masirah contain populations of the scarce endemic mollusks *Acteon eloiseae* and *Conus boschi*. Various corals occur as fringing reefs and as isolated patches offshore, and there is a vast monospecific reef of cabbage coral *Montipora foliosa* offshore.

Noteworthy flora: The three species of seagrass *Halophila ovalis*, *Thalassia hemprichii* and *Halodule uninervis* have a restricted range in Oman, and are important as a food source for turtles. There is a particularly rich growth of these seagrasses in the Ghubbat Hashish, with further beds in the Masirah Straits. Well developed stands of the Black Mangrove *Avicennia marina* fringe Mahawt Island.

Scientific research and facilities: A number of research projects are under way in connection with the development of the fisheries, and there is a geological survey of Masirah Island being carried out for the Ministry of Petroleum and Minerals. An intensive study of the hydrodynamics of the Masirah Straits area and the effect of these on the erosion and deposition of sediments around Barr Al Hikman is presently being undertaken under the auspices of the Ministry of Regional Municipalities and Environment. The birds of Masirah Island have been well studied and documented (e.g. Rogers, 1988), but it is only in recent years that the full importance of the Barr Al Hikman area for wintering shorebirds has been proved (e.g. Green *et al.*, 1992). Annual mid-winter waterfowl counts have been undertaken at Masirah Island since January 1988 and at Barr Al Hikman since January 1989. There are no special facilities for research in the area.

Conservation education: The Ministry of Regional Municipalities and Environment has an extensive national programme of conservation education which in recent years has highlighted the importance of this area for wildlife. The west shore of Masirah Island would make an excellent site for a local field study.

Recreation and tourism: At present the area is little used for tourism, although it has considerable potential (Munton, 1986).

Management authority and jurisdiction: The management authority is the Ministry of Regional Municipalities and Environment.

References: Anon (1992); Dutton (1986); Evans (1994); Gallagher & Woodcock (1980); Green *et al.* (1992); IUCN (1986); Jensen & Salm (1992b); Moseley & Abbotts (1979); Munton (1986); Rogers (1988); Rose & Scott (1994); Sultanate of Oman (1990); UNEP/IUCN (1988); Uttley *et al.* (1990). Also: Asian Waterfowl Census data 1988-94 (e.g. Rose & Taylor, 1993).

Reasons for inclusion: 1a, 1c, 2a, 2b, 2c, 2d, 3a & 3c. An area of outstanding importance for passage and wintering waterbirds, holding internationally important numbers of at least 28 species; also of international importance for breeding seabirds and sea turtles, with one of the world's most important nesting sites for the Loggerhead *Caretta caretta*.

Source: M.A.L. Cummins, National Survey Authority.

Wetland Name: Ghubbat Quwayrat (Ad Duqm)

Country: Oman

Coordinates: 19°42'N, 57°41' E

Location: Near the village of Ad Duqm on the south-central coast of Oman, 120 km southwest of Masirah Island, Al Wushta Region.

Area: Approximately 1,000 ha.

Altitude: Sea level.

Overview: A shallow sea bay with coastal lagoons and mudflats, important for passage and wintering waterfowl, especially shorebirds, gulls and terns.

Physical features: A shallow, sandy bay with saline coastal lagoons, extensive inter-tidal mudflats and some rocky outcrops, bordering on sand and gravel terrain of low hills, ridges and escarpments. The maximum tidal range is about one metre. There are relatively few settlements in this region, apart from the town of Ad Duqm to the south.

Ecological features: No information.

Land tenure: State owned.

Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: None.

Land use: Fishing and livestock grazing (mainly goats). The human population density is low.

Possible changes in land use: No information.

Disturbances and threats: The town of Ad Duqm is developing and expanding.

Hydrological and biophysical values: No information.

Social and cultural values: No information.

Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably herons, flamingos, shorebirds, gulls and terns. Over 31,400 waterfowl of 32 species were present in January 1993. Recent mid-winter counts have included up to 250 Western Reef Egret *Egretta gularis*, 30 Great Egret *Casmerodius albus*, 250 Grey Heron *Ardea cinerea*, 210 Spoonbill *Platalea leucorodia*, 3,000 Greater Flamingo *Phoenicopterus ruber*, 370 Oystercatcher *Haematopus ostralegus*, 175 Avocet *Recurvirostra avosetta*, 510 Lesser Sand Plover *Charadrius mongolus*, 500 Greater Sand Plover *C. leschenaultii*, 200 Grey Plover *Pluvialis squatarola*, 500 Bar-tailed Godwit *Limosa lapponica*, 520 Eurasian Curlew *Numenius arquata*, 1,000 Little Stint *Calidris minuta*, 1,000 Dunlin *C. alpina*, 4,700 Sooty Gull *Larus hemprichii*, 1,300 Great Blackheaded Gull *L. ichthyaetus*, 5,300 Slender-billed Gull *L. genei*, 6,800 Yellow-legged Gull *L. cachinnans*, 200 Caspian Tern *Sterna caspia*, 2,300 Sandwich Tern *S. sandvicensis* and 620 Great Crested Tern *S. bergii*. Up to 15,000 Socotra Cormorants *Phalacrocorax nigrogularis* have been recorded along the coast in winter. The Osprey *Pandion haliaetus* is a common winter visitor (maximum 49).

Noteworthy flora: No information.

Scientific research and facilities: Annual mid-winter waterfowl counts have been undertaken since January 1989. Otherwise the area remains relatively poorly known.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.

References: Evans (1994). Also: Asian Waterfowl Census data 1989-94.

Reasons for inclusion: 1a, 3a & 3c. An extremely important wintering area for a wide variety of waterfowl.

Source: See references.

Wetland Name: Khawr Dhirif

Country: Oman

Coordinates: 18°56'N, 57°21' E

Location: On the Sahil al Jazir coastal plain of south-central Oman, about 50 km west of Ra's al Madrasah, Al Wushta Region.

Area: 100 ha.

Altitude: Sea level.

Overview: A small, coastal, freshwater lagoon with submerged aquatic vegetation, important for passage and wintering waterfowl, especially ducks (Anatidae).

Physical features: A small lagoon, 900 metres long by 600 metres wide, on the Sahil al Jazir coastal plain, land-locked and predominantly freshwater, and surrounded by flat, sandy terrain including dunes.

Ecological features: The aquatic vegetation includes *Potamogeton* sp. and *Ruppia* sp. Salt-tolerant dwarf shrubs and woody-based herbs are abundant around the site, becoming sparse away from the water.

Land tenure: State owned.

Conservation measures taken: None. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: The lagoon is part of the proposed North Jazir National Nature Reserve (15,000 ha), which is part of a proposed natural World Heritage Site (IUCN, 1986).

Land use: Fishing and livestock grazing. The human population density is low.

Possible changes in land use: No information.

Disturbances and threats: None known.

Hydrological and biophysical values: No information.

Social and cultural values: Fishing is important in the coastal people's economy.

Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably ducks, gulls and terns. Recent mid-winter counts have included up to 660 ducks of 11 species (mainly Wigeon *Anas penelope*, Common Teal *A. crecca*, Pintail *A. acuta* and Shoveler *A. clypeata*), 300 Sooty Gull *Larus hemprichii*, 140 Yellow-legged Gull *L. cachinnans*, 50 Gull-billed Tern *Gelbchelidon nilotica*, 80 Caspian Tern *Sterna caspia* and 350 Sandwich Tern *S. sandvicensis*. Saunders's Little Tern *Sterna saundersi* breeds in the area (maximum 60 birds), and up to 15 Ferruginous Duck *Aythya nyroca* and 300 Great Crested Tern *Sterna bergii* have been recorded on migration. Greater Flamingo *Phoenicopterus ruber* (22) and Eurasian Coot *Fulica atra* (50) were recorded in December 1986 (M.D. Gallagher). The Houbara Bustard *Chiamydotis undulata* is a scarce winter visitor to the surrounding desert, and the Arabian Gazelle *Gazella gazella* occurs in the area.

Noteworthy flora: The terrestrial vegetation shows a high degree of endemism.

Scientific research and facilities: The site has been visited occasionally by ornithologists since 1981. Annual mid-winter waterfowl counts have been undertaken since January 1989. Otherwise the area remains relatively poorly known because of its remoteness.

Conservation education: None.

Recreation and tourism: None.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.

References: Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1989-94 (e.g. Rose & Taylor, 1993).

Reasons for inclusion: 1d, 2b & 3b. A good example of a predominantly freshwater lagoon, and the most important site for passage and wintering ducks in central Oman.

Source: See references.

Wetland Name: Khawr Shumayr (Ghawi)

Country: Oman

Coordinates: 18°34'N, 56°38'E

Location: On the southeast coast of Oman, about 45 km north of Sawqirah, Al Wushta Region.

Area: Approximately 1,000 ha.

Altitude: Sea level.

Overview: A large tidal inlet with extensive mudflats, important during the migration seasons and in winter for herons, flamingos, shorebirds, gulls and terns.

Physical features: A six km long tidal inlet parallel to the coast, open to the sea at the northern end and separated from the sea by a long, sandy barrier beach. Extensive intertidal mudflats are mostly dry at low tide and flooded to a maximum depth of one metre at high tide. The inflow of fresh water is minimal. The wetland is sheltered by dunes with much shrubby halophytic vegetation; otherwise the surroundings are very flat and sandy. Human density is generally low in the region, although there is a small, new township (Al Kahil) nearby. The climate is generally dry and hot to very hot.

Ecological features: Extensive inter-tidal mudflats; surrounding dunes with shrubby halophytic vegetation.

Land tenure: The wetland and surrounding areas are state owned.

Conservation measures taken: The area was protected by Royal Decree in 1994, as part of the Arabian Oryx Sanctuary. The site has been identified as an Important Bird Area by BirdLife International (Evans, 1994).

Conservation measures proposed: The area is part of the proposed South Jazir National Nature Reserve (18,000 ha), which is part of a proposed natural World Heritage Site (IUCN, 1986).

Land use: Fishing in the khawr and in the adjacent sea. Some camels roam the area in a semi-wild state. There may be some recreational use by expatriates from southern oilfields.

Possible changes in land use: None known.

Disturbances and threats: None known. The area is relatively undisturbed, partly because of its remoteness and the low human population density.

Hydrological and biophysical values: An important fishing ground for the local population.

Social and cultural values: None known.

Noteworthy fauna: An important staging and wintering area for migratory waterfowl, notably herons, flamingos, shorebirds, gulls and terns. Recent counts have included up to 100 Western Reef Egret *Egretta gularis*, 120 Grey Heron *Ardea cinerea*, 110 Spoonbill *Platalea leucorodia*, 1,000 Greater Flamingo *Phoenicopterus ruber*, 100 Avocet *Recurvirostra avosetta*, 5,000 Lesser Sand Plover *Charadrius mongolus* and Greater Sand Plover *C. leschenaultii*, 500 Grey Plover *Pluvialis squatarola*, 1,500 Sanderling *Calidris alba*, 2,000 Little Stint *C. minuta*, 4,000 Dunlin *C. alpina*, 1,000 Curlew Sandpiper *C. ferruginea*, 230 Ruddy Turnstone *Arenaria interpres*, 700 Broad-billed Sandpiper *Limicola falcinellus*, 2,000 Slender-billed Gull *Larus genei*, 500 Yellow-legged Gull *L. cachinnans*, 500 Caspian Tern *Sterna caspia* and 775 Saunders's Little Tern *S. saundersi*.

Noteworthy flora: No information.

Scientific research and facilities: Mid-winter waterfowl counts have been undertaken every years since 1989 as part of the Asian Waterfowl Census. Otherwise the area remains relatively poorly known because of its remoteness.

Conservation education: None.

Recreation and tourism: The area has great scenic attraction, and could have some potential for eco-tourism, but is currently far away from major towns and paved roads. The Greater Flamingos tend to be pinker here than anywhere else in the Sultanate.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment.

References: Evans (1994); IUCN (1986). Also: Asian Waterfowl Census data 1989-94 (e.g. Rose & Taylor, 1993).

Reasons for inclusion: 1a & 3c. One of the most important coastal wetlands for passage and wintering waterbirds in southern Oman. Concentrations of *Limicola falcinellus* (up to 700) and *Sterna saundersi* (up to 775) are internationally important.

Source: Jens Eriksen, Sultan Qaboos University.

Wetland Name: The Dhofar Khawrs and Wadi Darbaat

Country: Oman

Coordinates: 17°02'N, 54°26'E to 16°59'N, 54°02'E; The principal khawrs are Khawr Rawri 17°02'N, 54°26'E, Kliawr Hassan 17°02'N, 54°23 'E, Khawr ad Dahariz 17°01 'N, 54°1 1 'E and Khawr Salalah 17°00'N, 54°04'E

Location: Along a 45 km stretch of coastline in the extreme south of Oman, from 10 km west of Salalah to 35 km east, Dhofar Governorate.

Area: Total area unknown. Khawr Rawri 1, 100 ha; Khawr Hassan 300 ha; Khawr ad Dahariz 150 ha; Khawr Salalah 200 ha.

Altitude: Sea level to 200 m (in Wadi Darbaat).

Overview: A chain of 12-15 khawrs on the Salalah Plain and an associated wadi with permanent surface water, of considerable interest for their very rich and diverse aquatic

fauna and flora. The khawrs are mainly impermanent embouchures of springs and seepages arising in backing mountains; they are open or closed to the sea, of varying salinity, and mostly with reed and mangroves.

Physical features: The site comprises the lower portion of Wadi Darbaat and a chain of some 12 to 15 brackish inlets (khawrs) along a 45 km stretch of coastal plain around Salalah in the Dhofar region of southern Oman. The plain is backed by the Qara Mountains. Khawrs lie at the mouths of drainage systems where groundwater comes to the surface. They are separated from the sea by a sand bar. The salinity of the water varies according to season, periodic rainfall and the strength of freshwater seepage. Generally water levels in the khawrs are higher during the monsoon, when seawater flows over the sand bar at high tides. Levels drop by about 20 cm to a minimum in winter. During floods, however, there are rapid changes in water level.

From east to west, the principal khawrs are Rawri, Hassan, Sawli, Dahariz, Baud, sauauth, West and Thet. The largest khawr, Khawr Rawri (1,100 ha), is larger than all others combined. It is about 2.6 km long and receives substantial inflow from Wadi Darbaat. Its sandbar is occasionally breached, when the lagoon becomes temporarily tidal. Wadi Darbaat is 3.5 km long, and contains a series of permanent pools up to 20 m wide. Khawr Hassan (or Khawr Taqah, 300 ha) is a complex coastal lagoon system with a substantial but variable freshwater inflow, said to be at least partly from a freshwater spring at the north end, where the shore is rocky. Khawr ad Dahariz (150 ha) is a thin coastal lagoon near Salalah town, broadening inland and fed by substantial but variable freshwater inflow from Wadi Sahnut. A gravel road crosses the sand bar which separates the lagoon from the sea, but this is still sometimes breached. Khawr Salalah (200 ha) is a predominantly freshwater lagoon, about 1.1 km long, on the outskirts of Salalah and fed by seepage from a tributary wadi. The sand bar is occasionally breached by wadi floods.

Ecological features: The vegetation of Khawr Salalah, which has been well documented, follows a recognizable zonation. Towards the seaward side, *Ipomoea pes-caprae*, *Halopyrum mucronatum* and *Atriplex* spp. are present on the sand bar and sandy edges. In the central part of the "anchor" and along the length of the khawr, the dominant vegetation is composed of *Schoenoplectus litoralis*, *Phragmites australis*, *Arthrocnemum macrostachyum*, *Paspalum vaginatum*, *Sporobolus virginicus* and *Urochondra setulosa*. Toward the landward end, *S. virginicus* and *Cressa cretica* are dominant. A few *Acacia nilotica* trees are also present. The zonation of vegetation from the water edge outward is such that *S. litoralis* with *Paspalum vaginatum* form the first zone, behind which *S. virginicus* is present in association with *Suaeda imbricata*. In this zone, *A. macrostachyum* is present, and forms large clumps in restricted areas along the length of the khawr. This community is present on damp to wet soil. Behind the *Sporobolus-Suaeda-Arthrocnemum* community, *Suaeda* sp. and *A. macrostachyum* are replaced by *Urochondra setulosa* and *Limonium axillare*. Associated species with these are *Cyperus conglomeratus*, *Heliotropium fartakense*, *Aeluropus lagopoides* and *Cressa cretica*. *I. pes-caprae* is present in some areas where the substrate is sandy. *U. setulosa* forms the dominant vegetation, forming pure stands behind the third zone. It is normally present on mounds, and in some parts of the coast on the seaward side, clumps of *U. setulosa* form circles ranging from 1-1.5 metres in diameter.

At Khawr Rawri and Khawr Hassan, the water surface is partly open, with a dense fringe of *Juncus*, *Phragmites*, *Typha*, sedges and grasses, and there are beds of water-weed

Chara sp at Khawr Rawri. The margins of Khawr ad Dahariz are mostly rocky and lined with dense *Phragmites*, *Juncus* and sedges, but there are also some open, sandy, grassy banks.

Open shallow water with abundant submerged vegetation has much higher oxygen levels than deeper areas. The surface water is also much richer. Khawrs shaded by mangrove trees or reeds without much submerged vegetation have the lowest oxygen values. At times of flood, the silty floodwater stirs up low-oxygen water from the bottom of the khawr. This sudden reduction in oxygen at the surface may be responsible for the fish kills observed in many of the khawrs at this time.

Land tenure: The khawrs and most of the surrounding areas are state owned, with traditional grazing rights.

Conservation measures taken: Khawr Salalah is the property of the Diwan of Royal Court and is maintained as a bird sanctuary by the Office of the Adviser for Conservation of the Environment. It is fenced, except at the seaward barrier-beach end, and public access is restricted by permit. Guards patrol the site, two hides have been constructed, a visitor centre is planned, and a management plan has been drawn up. Khawr Rawri, Khawr Hassan, Khawr ad Dahariz and Khawr Salalah have been identified as Important Bird Areas by BirdLife International (Evans, 1994).

Conservation measures proposed: Khawr Salalah has been proposed for designation as a National Nature Reserve, having great scenic, historic and wildlife value (IUCN, 1986). Once designated, it would be managed by the Ministry of Regional Municipalities and Environment. Khawr Rawri, Khawr Hassan and Khawr ad Dahariz have also been proposed as National Nature Reserves.

Land use: Grazing by cattle, camels, sheep and goats occurs all year round at the khawrs, but pressure is greatest during the monsoon when additional animals are brought down from highland pastures in the Qara Mountains. Some cutting of reeds occurs at Khawr Hassan and possibly elsewhere. Boats are present on many of the khawrs, and there is some fishing for domestic use (with gill nets), but there is no commercial fishing. Some of the adjacent beaches (*e.g.* at Salalah Khawr) are popular picnicking areas, and there is a considerable amount of fishing along the coast. Much of the Salalah Plain has been taken over by residential housing and urban and light industrial development. Salalah is a fast developing town which has already engulfed several of the khawrs in its essentially linear growth along the coast.

Possible changes in land use: The continued expansion of Salalah town could engulf further khawrs.

Disturbances and threats: Grazing pressure is increasing as the number of pastoralists and the size of their herds increase. Increasing urban, suburban, recreational and agricultural encroachment threaten many of the khawrs. The freshwater inflow into Khawr Salalah has been controlled as part of measures to reduce flood damage in the town. Pollution from sewage has occurred at some khawrs (*e.g.* Khawr ad Dahariz), and illegal dumping of chemical and other waste still occurs, but this is under constant and increasingly effective surveillance to prevent it. There is also some seasonal bird-catching and shooting, but measures to control these illegal activities are now in hand. Local people claim that the grazing is poorer than formerly, and that water quality has deteriorated. They attribute this to intensive recreational use, expansion of urban development, construction of new paved roads, and increasing grazing pressure from

domestic camels. Khawr Sawli has been fenced off following a deterioration in water quality and reports of camel deaths. As Salalah develops as a popular holiday resort for tourists from Oman and the Gulf States (mainly during the monsoon season), there will inevitably be increasing human-use impact on the more popular khawrs.

Hydrological and biophysical values: No information.

Social and cultural values: Most of the khawrs are used by local people for drinking water, grazing and watering of their livestock, and fishing for domestic use, while several are popular for outdoor recreation. There is an important archaeological site (Samharan) on the southeast bank of Khawr Rawri; it is fenced off and visited regularly by tourists with guides. There is also an important archaeological site at Khawr Baud (NNR).

Noteworthy fauna: The Salalah khawrs support a very diverse avifauna. At least 156 species of waterbirds and 133 landbirds have been recorded in the area. The coastal khawrs attract thousands of wintering waterbirds, many of which move backwards and forwards between these khawrs and Wadi Darbaat, about 6 km inland. Up to about 80 Little Grebe *Tachybaptus ruficollis* occur on Wadi Darbaat, where they breed in wet years. The Great Cormorant *Phalacrocorax carbo* is a regular winter visitor to the khawrs, and large numbers of Socotra Cormorant *P. nigrogularis* occur offshore in winter (e.g. up to 2,000 off Khawr ad Dahariz). Eleven species of herons and egrets (Ardeidae) occur on passage and in winter, and Little Bittern *Ixobrychus minutus* may breed at Khawr Hassan. Up to 35 Glossy Ibis *Plegadis falcinellus* and about 50 Spoonbill *Platalea leucorodia* occur in winter. The Greater Flamingo *Phoenicopterus ruber* is a common winter visitor, with peak numbers (150-300) occurring in December and January. At least 16 species of Anatidae, mainly surface-feeding ducks *Anas* spp., have occurred on the khawrs in winter, peaking at over 1,000 individuals in January, and regularly including about 30 Cotton Pygmy-geese *Nettapus coromandelianus* (especially at Khawr Salalah). Khawr Rawri is the most important khawr for wintering ducks. Up to 1,200 ducks have been recorded at this khawr in winter, including up to 30 Ferruginous Duck *Aythya nyroca*. Smaller numbers of *A. nyroca* have also been recorded on passage at Khawr ad Dahariz (maximum 16) and Khawr Salalah (maximum 8). The Moorhen *Gallinula chloropus* and Eurasian Coot *Fulica atra* breed on at least six of the khawrs, where the combined population is about 200 birds. Up to 50 Pheasant-tailed Jacana *Hydrophasianus chirurgus* occur in winter, especially at Khawr Rawri and Khawr Salalah. Large numbers of gulls and terns (Laridae) occur along the coast, and often roost on sand bars at the mouths of the khawrs, e.g. up to 1,330 Sooty Gull *Larus hemprichii*, 3,300 Black-headed Gull *L. ridibundus*, 920 Great Crested Tern *Sterna bergii*, 37 Roseate Tern *S. dougallii* and 500 Common Tern *S. hirundo* at Khawr Hassan, up to 1,300 *L. hemprichii*, 600 *S. bergii*, 30 *S. dougallii* and 300 *S. hirundo* at Khawr ad Dahariz, and up to 1,000 Yellow-legged Gulls *Larus cachinnans* at Khawr Salalah.

Peak counts of waterbirds in the Dhofar Khawrs in recent winters have included 100 *Tachybaptus ruficollis*, 115 *Phalacrocorax carbo*, 140 Cattle Egret *Bubulcus ibis*, 100 Western Reef Egret *Egretta gularis*, 92 Little Egret *E. garzetta*, 340 Grey Heron *Ardea cinerea*, 78 White Stork *Ciconia ciconia*, 35 *Plegadis falcinellus*, 53 *Platalea leucorodia*, 260 *Phoenicopterus ruber*, 22 *Nettapus coronandelianus*, 230 Wigeon *Anas penelope*, 190 Common Teal *A. crecca*, 290 Pintail *A. acuta*, 165 Garganey *A. querquedula*, 210 Shoveler *A. clypeata*, 380 *Gallinula chloropus*, 240 *Fulica atra*, 33 *Hydrophasianus chirurgus*, 1,700 *Larus hemprichii*, 3,200 *L. ridibundus*, 940 Slender-billed Gull *L. genei*,

2,100 *L. cachinnans*, 65 Whiskered Tern *Chlidonias hybridus* and 250 Lesser Crested Tern *Sterna bengalensis*. At least 35 species of shorebirds have been recorded in winter, mostly in rather small numbers; most notable have been up to 630 Kentish Plover *Charadrius alexandrinus*, 73 Pacific Golden Plover *Pluvialis fulva*, 130 Eurasian Curlew *Numenius arquata* and 200 Greenshank *Tringa nebularia*. Wintering birds of prey include up to 39 Osprey *Pandion haliaetus*, 17 Marsh Harrier *Circus aeruginosus*, 7 Greater Spotted Eagle *Aquila clanga*, 16 Imperial Eagle *A. heliaca* and 2 Peregrine Falcon *Falco peregrinus*. Notable counts of waterfowl during the migration seasons have included up to 63 Black-crowned Night-Heron *Nycticorax nycticorax* at Khawr Hassan, 150 *Ciconia ciconia* at Khawr Rawri, 300 Sanderling *Calidris alba* at Khawr ad Dahariz, and up to 106 *P. fulva*, 48 Marsh Sandpiper *Tringa stagnatilis* and 400 Ruff *Philomachus pugnax* at Khawr Salalah.

The fish fauna is rich and diverse. Most fish species use the khawrs as nursery grounds, and leave to breed in the sea when, and if, the sand bar is breached. Mullet mature in winter and milkfish in early spring; the other species mature in spring and summer.

The mammalian fauna of Dhofar is largely Afrotropical in its affinities, and includes Leopard *Panthera pardus*, Wolf *Canis lupus*, Honey Badger *Mellivora capensis*, Whitetailed Mongoose *Ichneumia albicauda*, Genet *Genetta genetta*, Striped Hyaena *Hyaena hyaena* and a porcupine *Hystrix* sp. The hyaena and porcupine have been recorded around the Salalah khawrs in recent years, and several of the other species may also occur there.

Noteworthy flora: The freshwater khawrs, such as Khawr Salalah, support a very diverse aquatic flora, unusual in this part of Arabia. At least three species of plants on the Salalah Plain are endemic or near-endemic to Oman, and some may be present around the khawrs.

Scientific research and facilities: Numerous surveys and monitoring studies have been carried out, mainly by students of Sultan Qaboos University in 1992. These have included studies of the physical parameters of the khawrs, water chemistry, fish populations, vegetation, aquatic macrophytes, littoral micro-invertebrates, marine crustaceans, microfauna, mosquitos, birds, socio-economic uses, freshwater snails and sand bars. Annual mid-winter waterfowl counts have been undertaken since January 1988 as part of the Asian Waterfowl Census.

Conservation education: The area has huge potential for conservation education. The results of studies made at the khawrs are already being taught in the Biological Conservation course at Sultan Qaboos University. A colour booklet "The Khawrs of Dhofar" was produced in Arabic and English in 1993 by the Technical Secretariat of the Planning Committee for Development and Environment in the Governorate of Dhofar.

Recreation and tourism: The khawrs are already used to some extent for outdoor recreation, and this is likely to increase as Salalah develops as a popular holiday resort for Arabs and others from the Gulf States.

Management authority and jurisdiction: Ministry of Regional Municipalities and Environment, and Office of the Adviser for Conservation of Environment at the Diwan of Royal Court.

References: Anon (1989, 1990, 1993); Evans (1994); IUCN (1986, 1989); Gallagher *et al.* (1980); Jensen (1991). Also: Asian Waterfowl Census data 1989-94.

Reasons for inclusion: 1a, id, 2b, 2c and 3c. The site contains excellent examples of various types of khawrs, including khawrs which are predominantly freshwater with rich and diverse aquatic vegetation; it also supports a very diverse bird fauna, especially in winter, with several species occurring in internationally significant numbers.

Source: C.H. Fry, Sultan Qaboos University.

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