The Fish Fauna of Abu Dhabi Emirate

Mark Beech

Abu Dhabi Islands Archaeological Survey (ADIAS), Abu Dhabi
Introduction

The Emirate of Abu Dhabi has a long and variable coastline. Fisheries in this region are largely small scale and concentrate on fishing for demersal finfish species in shallow waters less than 30m deep. In order to understand the formation and characterisation of this resource, one must first consider from where the fish originate, what previous research has been carried out in the region, what information is available for Abu Dhabi, and what traditional/modern fishing methods are utilised in the region. The development of aquaculture and protected marine areas will be briefly discussed. Finally, there is a brief summary and checklist of some of the major species occurring in Abu Dhabi’s waters.

Origins of the Fish Fauna of the Gulf

The Gulf is a comparatively young sea which originated about 16,000 years BP (Sheppard et al. 1992). Sea level in the Gulf is generally believed to have not reached its present level until around 6000 years BP during the Holocene. This means that pre-Pleistocene historical factors do not account for the formation of the species of fish now living in the Gulf (Greenwood et al. 1966). The present day fish fauna was thus established by the penetration of species from the Indian Ocean through the Gulf of Oman and Straits of Hormuz. Although high levels of endemism have been supposedly reported for Gulf fish, in fact a very low number of species exist solely within the Gulf. Kuronuma and Abe (1986) reported that only seven (1.5%) out of a total of 465 species which they recorded as being present within the region are endemic species. This is because most of the species present (89%) are derived from both the Indian and Pacific Oceans, a smaller number (11%) being restricted to the Indian Ocean.
Fisheries Research

Table 8-1 presents a summary of major research which has been carried out concerning fisheries in the Gulf and the Gulf of Oman. One of the major problems faced in reading through the literature is the plethora of names and synonyms which exist for Arabian Gulf fish taxa. This is further complicated by the fact that a great number of misidentifications are present within the existing literature. The recent publication of Randall’s “Coastal Fishes of Oman” (Randall 1995) along with the FAO Field Identification Guide by Carpenter et al. (1997) have fortunately summarised many of these and represent the most recent attempts to update the taxonomy and description of fishes in the region. These are the two key bibliographic resources referred to in the present study. Various opinions exist concerning the precise number of fish species present within the Arabian Gulf and it is clear that many earlier records are questionable (Randall 1995).

A further problem is that many published accounts do not provide detailed distribution data and it is not always possible to determine if a particular species occurs in the Gulf or in the Gulf of Oman or in both (e.g., Relyea 1981, White and Barwani 1971). What is clear, however, is that there appears to be some variation in species richness throughout the Gulf. The deeper waters of the northern part of the Gulf and along the Iranian coastline are noted as being richer in species than the southern region. Studies have shown that habitat area (MacArthur and Wilson 1967) and its differentiation into zones can affect species richness (Goldman and Talbot 1976, Roberts 1986). It has also been demonstrated that trends in butterflyfish species richness and abundance in the Red Sea correlate closely with reef development patterns (Roberts et al. 1988). The harshness of the environmental conditions in the Gulf (e.g., extreme temperatures and high salinity) certainly appear to inhibit reef growth (Downing 1985, Sheppard 1988), and it is likely that this has reduced species richness within the region. Despite the fact that marine ecological research in the region dates back as far as the Danish expedition in 1775, which involved Forsskål, comparatively little is still known about the Arabian Gulf marine fauna. Although there have been a number of publications specifically concerning Gulf fishes (e.g., Al-Baharna 1986, Al-Sedfy 1982, Kuronuma and Abe 1972, 1986, Relyea 1981, Sivasubramaniam and Ibrahim 1982, White and Barwani 1971) these have been criticised in recent years for including many records based on old literature rather than on actual
specimens (Randall 1995). The few systematic fisheries surveys carried out in the Gulf using scuba-equipped observers have largely concentrated on reef fish assemblages. These appear to be far less diverse than elsewhere in the Indian Ocean, or even in the Red Sea at a similar latitude. Downing (1987) counted only 85 species on Kuwaiti reefs. Basson et al. (1977), McCain et al. (1984) and Coles and Tarr (1990) counted only 90, 106 and 101 species respectively along the east coast of Saudi Arabia and Smith et al. (1987) only 71 species in reefs off the coast of Bahrain. Roberts (quoted in Sheppard et al. 1992) observed only 35 species during a 10-hour observation of inshore reefs in Qatar. Unfortunately comparatively little is known about the fish fauna of the UAE Gulf coastline. The few popular publications which exist

### Table 8.1
Summary of major research concerning fisheries in the Gulf and the Gulf of Oman.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Location</th>
<th>No. Species</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>White and Barwani 1971</td>
<td>Trucial States (UAE), SE Gulf and northern Gulf of Oman</td>
<td>199</td>
<td>Book on fishes of UAE and Gulf of Oman</td>
</tr>
<tr>
<td>Kuronuma and Abe 1972</td>
<td>Kuwait</td>
<td>130</td>
<td>Book on fishes of Kuwait</td>
</tr>
<tr>
<td>Nellen 1973</td>
<td>Northern and southern Gulf</td>
<td></td>
<td>Discusses larval fish and differences between northern and southern Gulf by family, but not by genus or species</td>
</tr>
<tr>
<td>Kuronuma 1974</td>
<td>Kuwait, Qatar-Trucial Coast</td>
<td>152</td>
<td>Fishery-Oceanography survey by Unitaku-Maru vessel, Tokyo University Fisheries in collaboration with KISR</td>
</tr>
<tr>
<td>Basson et al. 1977</td>
<td>Western Gulf</td>
<td>90</td>
<td>N.B. : made within limited range of habitats</td>
</tr>
<tr>
<td>Randall, Allen and Smith-Vaniz 1978</td>
<td>Gulf and Gulf of Oman</td>
<td>166</td>
<td>UN Development Programme and FAO publication</td>
</tr>
<tr>
<td>Ali and Thomas 1979</td>
<td>Khor Fakkan, UAE, Gulf of Oman</td>
<td></td>
<td>Survey of fisheries landing data at Khor Fakkan, UAE, November 1976-October 1977</td>
</tr>
<tr>
<td>Cubanov and Schlieb 1980</td>
<td>Gulf</td>
<td>19 (sharks)</td>
<td>19 species of sharks recorded (N.B.: 6 records are doubtful according to Randall 1995)</td>
</tr>
<tr>
<td>Relyea 1981</td>
<td>Gulf</td>
<td>238</td>
<td>At least 4 species require confirmation as being actually present in the Arabian Gulf, according to Randall et al. (1994)</td>
</tr>
<tr>
<td>Al-Seffy 1982</td>
<td>Qatar</td>
<td>136</td>
<td>Book on fishes of Qatar</td>
</tr>
<tr>
<td>Sivasubramaniam and Ibrahim 1982</td>
<td>Qatar</td>
<td></td>
<td>Book on fishes of Qatar</td>
</tr>
<tr>
<td>Ali and Cherian 1983</td>
<td>Ra' al-Khaimah, UAE</td>
<td></td>
<td>Survey of fisheries landing data at Ra' al-Khaimah, UAE</td>
</tr>
<tr>
<td>Ali, Thomas and Marji 1984</td>
<td>United Arab Emirates</td>
<td></td>
<td>Report on the biology of some common UAE fishes</td>
</tr>
<tr>
<td>Department of Fisheries 1984</td>
<td>Umm al-Qaiwain, UAE</td>
<td></td>
<td>Report on the mariculture environment of Umm al-Qaiwain lagoon and the experimental rearing of shrimp, rabbitfish and mullet. It includes a species list for the lagoon there</td>
</tr>
<tr>
<td>Fischer and Bianchi 1984</td>
<td>Western Indian Ocean</td>
<td></td>
<td>Fish identification sheets for commercially important fishes</td>
</tr>
<tr>
<td>McCain et al. 1984</td>
<td>Manifa-Ras Tanajib area, Saudi Arabia, Gulf coast</td>
<td>106</td>
<td>Article on survey of coral reefs and reef fishes</td>
</tr>
<tr>
<td>Morgan 1985</td>
<td>Gulf</td>
<td></td>
<td>Review of status of shrimp and fish resources in the Gulf</td>
</tr>
<tr>
<td>Al-Baharna 1986</td>
<td>Bahrain</td>
<td>238</td>
<td>Book on fishes of Bahrain</td>
</tr>
<tr>
<td>Kuronuma and Abe 1986</td>
<td>Gulf</td>
<td>465</td>
<td>“Fishes of the Arabian Gulf” book. Only 244 are actual specimens, remainder of species identifications are from literature (many are questionable acc. Randall et al. 1994). Kuronuma and Abe (1986: 3) state that there are over 400 fish species in the Arabian Gulf</td>
</tr>
<tr>
<td>Randall 1986</td>
<td>Arabian Peninsula</td>
<td>43 (sharks)</td>
<td>43 shark species in Arabian waters</td>
</tr>
<tr>
<td>Williams 1986</td>
<td>Kuwait</td>
<td></td>
<td>Ageing Manual for Kuwaiti Fish-Otoliths research</td>
</tr>
<tr>
<td>Downing 1987</td>
<td>Kuwait</td>
<td>85</td>
<td>Fish census carried out over 2-year period on Kuwaiti reefs</td>
</tr>
</tbody>
</table>
suggest, however, that the number of species present is also low in number (Dipper and Woodward 1989). A number of fish landing surveys were carried out some twenty years ago by the Ministry of Agriculture and Fisheries in the UAE (Ali and Thomas 1979, Ali et al. 1980, Ali and Cherian 1983). These consist of landing data from Khor Fukkan and Kalha on the Gulf of Oman coast of the Emirates. A problem with the interpretation of such data is that many non-economic fish species may not be included, and there is also the problem of discarded by-catch. Furthermore, such landings data do not provide adequate samples from all coastal habitats and of all species for statistical analysis. Randall's detailed study of fishes in Oman identified 930 fish species within the entire region, with at least 95 families and 361 species being recorded.

**REFERENCE**

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>NO. SPECIES</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>71</td>
<td>Article on Bahrain coral reef fish fauna</td>
</tr>
<tr>
<td>Manifa - Tarut, Saudi Arabia, Gulf Coast</td>
<td>101</td>
<td>Article on reef fish assemblages in western Arabian Gulf. Discussion of extreme environment</td>
</tr>
<tr>
<td>Arabian Sea</td>
<td>116</td>
<td>Tropical fish guide to Indian Ocean species</td>
</tr>
<tr>
<td>Gulf of Oman</td>
<td>312</td>
<td>Report on trawling in Oman</td>
</tr>
<tr>
<td>Arabia region</td>
<td>200</td>
<td>“Marine Ecology of the Arabian region” book. Reports that about 200 species are recorded in the Gulf, of which 125 are found on reefs</td>
</tr>
<tr>
<td>UAE</td>
<td>539</td>
<td>First record of <em>Mola monacantha</em> in UAE</td>
</tr>
<tr>
<td>UAE</td>
<td>(+51)</td>
<td>Article on some aspects of the biology of <em>Siganus canaliculatus</em> in the southern Arabian Gulf</td>
</tr>
<tr>
<td>Gulf</td>
<td>51</td>
<td>51 new species recorded within the Arabian Gulf</td>
</tr>
<tr>
<td>UAE</td>
<td>618</td>
<td>Article on heavy metal concentrations in the tissue of <em>Rhabdosargus sarba</em>, and on the biology of <em>Pomadasys stridens</em> from the UAE</td>
</tr>
<tr>
<td>Gulf</td>
<td>1,137</td>
<td>Article about xenobiotic metabolism by <em>Glutathione S-transferase</em> in Gills of fish from the Arabian Gulf</td>
</tr>
<tr>
<td>Oman</td>
<td>51</td>
<td>Article on some aspects of the biology of <em>Siganus canaliculatus</em> in the southern Arabian Gulf</td>
</tr>
<tr>
<td>Gulf of Oman, Gulf</td>
<td>930</td>
<td>“Marine species of the Sultanate of Oman” book, published by the Ministry of Agriculture and Fisheries, Sultanate of Oman</td>
</tr>
<tr>
<td>Gulf</td>
<td>539</td>
<td>“Coastal Fishes of Oman” book. N.B.: at least 95+ families and 361+ species specifically recorded as present within Arabian Gulf</td>
</tr>
<tr>
<td>Arabian peninsula</td>
<td>1,137</td>
<td>FAO Identification Field Guide, which includes 17 families + 46 species (Chondrichthyes), and 101 families + 493 species (bony fishes)</td>
</tr>
<tr>
<td>UAE</td>
<td>+1</td>
<td>N.B.: n total number of marine and freshwater species in all Arabia</td>
</tr>
<tr>
<td>Al Ain, UAE</td>
<td>350+</td>
<td>New record for UAE of the triggerfish, <em>Canthidermis maculatus</em></td>
</tr>
<tr>
<td>Arabian Sea, Gulf of Oman, Gulf</td>
<td>350+</td>
<td>Brief survey of fish sold in Al Ain fish suq</td>
</tr>
<tr>
<td>Abu Dhabi, UAE</td>
<td>350+</td>
<td>Review concerning demersal fisheries</td>
</tr>
<tr>
<td>Abu Dhabi</td>
<td>350+</td>
<td>Length-frequency data study of five species (<em>Epinephelus coioides, Carangoides bajad, Lethrinus nebulosus, Argyrops lineatus</em>, and <em>Acanthopagrus bifasciatus</em>), collected from Abu Dhabi Free Port Fish Landing site during June 2000-June 2001</td>
</tr>
<tr>
<td>Abu Dhabi, UAE</td>
<td>350+</td>
<td>Publication of Marine Atlas for Abu Dhabi</td>
</tr>
<tr>
<td>Abu Dhabi, UAE</td>
<td>350+</td>
<td>Ongoing research projects include: Abu Dhabi landing site survey, Fisheries stock assessment, mapping and baseline study, Fish length-frequency study, Kingfish DNA project, Sailfish tagging</td>
</tr>
</tbody>
</table>

**FIGURE PAGES 164-165.**

A school of striped eel catfishes (Plotosidae).
One of the most comprehensive recent attempts to systematically update the taxonomy and list of fishes occurring in the Gulf is the “FAO Species Identification Field Guide for Fishery Purposes for Kuwait, Eastern Saudi Arabia, Bahrain, Qatar, and the United Arab Emirates” (Carpenter et al. 1997). This publication includes 17 families including 46 species of Chondrichthyes, and 101 families with 493 species of bony fishes. A recent review of the demersal fisheries of the Arabian Sea, the Gulf of Oman and the Gulf has noted the presence of over 350 commercial fish species in this entire area (Siddeek et al. 1999). Primary families represented were emperors (Lethrinidae), seabreams (Sparidae), groupers (Serranidae), rabbitfishes (Siganidae), croakers (Sciaenidae), butterfishes/pomfrets (Stromateidae), snappers (Lutjanidae), cutlassfishes (Trichiuridae) and breams (Nemipteridae). Fishing effort in the Arabian Gulf was observed to be above the optimum level, and they suggest that reduced fishing effort, strictly enforced closed seasons and closed areas are urgently required. More recently a major study has been carried out of five of the major economic fish species in Abu Dhabi. This was initiated by the Marine Environmental Research Centre (MERC), part of the Environmental Research and Wildlife Development Agency (ERWDA) in Abu Dhabi. This study compiled length-frequency data study for five species (Epinephelus coioides, Carangoides bajad, Lethrinus nebulosus, Argyrops spinifer and Acanthopagrus bifasciatus), collected from Abu Dhabi Free Port Fish Landing site between June 2000–June 2001 (Al Abdessalaam 2002). Rather worryingly, it demonstrated that a large proportion of the fishery in Abu Dhabi constitute
immature fish. This is an effect of overfishing of large individuals. In 2002 a comprehensive year-long investigation of the fisheries in Abu Dhabi waters, in particular, and in UAE waters in general, was begun by Bruce Shallard Ltd., commissioned by MERC/ERWDA, in conjunction with the UAE Ministry of Agriculture and Fisheries. A research vessel from Australia has been traversing the coastal waters undertaking habitat mapping and sampling. The results of this recent initiative are awaited with great interest. They will undoubtedly go a long way towards enhancing our knowledge of the Abu Dhabi fisheries. Unfortunately there is little existing already published detailed data concerning fisheries in Abu Dhabi. Although there are various ‘grey literature’ reports issued by the Ministry of Agriculture and Fisheries, these simply refer to the general combined total weight of all fishes caught for the UAE as a whole. The numbers of fishermen and fishing boats operating in the UAE has steadily increased during the past two decades (Figures 8-1 and 8-2), and this has undoubtedly increased the pressure on marine resources in the region. The main fishing port in the westernmost part of Abu Dhabi is Dalma Island (Figure 8-3). The Dalma Co-operative Society retains records of the combined monthly total weight of catch at the two market landing points on the island. The information provided by Dalma Co-operative for January to December 1998, indicated that groupers (Serranidae) form the greatest percentage of the annual catch landed at Dalma Island (27%), followed by trout thicklips (Plectorhinchus pictus, 23%), emperors (Lethrinidae, 16%), spanish mackerel (Scomberomorus spp., 16%), anchovies (Engraulidae, 4%), and frigate tuna (Auxis thazard, 2%). Other fish, like sharks (mostly requiem sharks, Carcharhinidae), and golden trevally (Gnathanodon speciosus), all formed only 1% each of the annual catch. The best fishing seasons at Dalma are during the months of May–June and November, highest

\[ \text{Lethrinidae 34\%} \]
\[ \text{Serranidae 21\%} \]
\[ \text{Crustacean 3\%} \]
\[ \text{Siganidae 4\%} \]
\[ \text{Gerreidae 4\%} \]
\[ \text{Other fish 9\%} \]
\[ \text{Scombridae 9\%} \]
\[ \text{Haemulidae 9\%} \]
catches being made in the latter month. Catches made in May–June were largely comprised of groupers, trout thickest and emperors. In contrast, most of the November catch was formed by catches of Spanish mackerel (Scomberomorus spp.). By 2000 there were 578 licensed fishing boats working in Abu Dhabi's waters. These boats were owned by 486 UAE citizens and were operated by 4397 fishermen. Around 30,273 tons of fish was landed during 2000. The relative percentages of the main fish families landed at Abu Dhabi fishing port in 2000 are depicted in Figure 8-4. Emperors (Lethrinidae) were the most commonly exploited fish (34%), followed by groupers (Serranidae, 21%), grunts (Haemulidae, 9%) and tuna/mackerel (Scombridae, 9%).

**TABLE 8.2.**


<table>
<thead>
<tr>
<th>ARABIC NAME</th>
<th>METHOD</th>
<th>MAIN TYPES OF FISH CAUGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>al-Gargour (al-Doubaya)</td>
<td>Basket traps</td>
<td>Grouper (Epinephelus spp.)&lt;br&gt;Blackbanded trevally (Seriola littoralis)&lt;br&gt;Emperors (Lethrinus spp.)&lt;br&gt;Rabbitfish (Siganus spp.)&lt;br&gt;Other fish sometimes caught include: Cephalopholis hemistiktos, Latjurus fuloijlamma, Pinjalo pinjalo, Plectorhinchus pectus, Plectorhinchus schoof, Pomadasys argenteus, Acanthopagrus laticeps, Abudelahfaj naigenizis, Scomberoides commerson</td>
</tr>
<tr>
<td>al-Hadira</td>
<td>Circular, pentagonal or square shaped enclosure traditionally made of palm fronds (often used in the summer)</td>
<td>Blackspot snapper (Latjurus fuloijlamma)&lt;br&gt;Other fish sometimes caught include: Chirocentrus dorab, Arios spp., Belonidae, Gerres spp., Acanthopagrus spp., Rhabdosargus spp., Liza macrolepis, Talanigul sebeli, Siganus spp., Sphyraena spp.</td>
</tr>
<tr>
<td>al-Sakkar</td>
<td>Fathom wide fence of nets linked by wooden poles</td>
<td>Mojarra (Gerres spp.)&lt;br&gt;Goldlined seabream (Rhabdosargus spp.)</td>
</tr>
<tr>
<td>al-Dafaf</td>
<td>Second fence fitted behind 'al Sakkar'</td>
<td>Silvery black porgy (Acanthopagrus spp.)&lt;br&gt;Flathead mullet (Magil cephalus)</td>
</tr>
<tr>
<td>al-Liekh</td>
<td>Gillnet</td>
<td>Cobia (Rachycentron canadum)&lt;br&gt;Barracuda (Sphyraena spp.)&lt;br&gt;Tuna (Euthynnus affinis/Thunnus spp.)&lt;br&gt;Other fish sometimes caught include: Carcharhinus spp., Rhinobatidae, Nemotolosa nasus, Chirocentrus dorab, Chanas chaus, Ablennes johni, Rachycentron canadum, Echeneis naucrates, Atele maiz, Carangoides bajada, Decapterus russellii, Gnathanodon speciosus, Megalaspis cordyla, Scomberoides commersonius, Scomberoides toli, Latjurus russelli, Pinjalo pinjalo, Lethrinus spp., Acanthopagrus spp., Rhabdosargus spp., Liza macrolepis, Mugil cephalus, Scomberoides commersonius, Rastrelliger kanagurta, Scomberomorus commerson, Siganus spp., Triacanthus boscatus, Ablennes johni, Lagocephalus lunaris</td>
</tr>
<tr>
<td>al-Lafaf</td>
<td>Troll lines</td>
<td>Giant trevally (Caranx ignobilis)&lt;br&gt;Barracuda (Sphyraena spp.), barred Spanish mackerel (Scomberomorus commerson)&lt;br&gt;Tuna (Euthynnus affinis/Thunnus spp.)&lt;br&gt;Sailfish (Istiophorus platypterus)</td>
</tr>
<tr>
<td>al-Salieya</td>
<td>Casting net</td>
<td>Indian oil sardinelle (Sardinella longiceps), flathead mullet (Magil cephalus)</td>
</tr>
</tbody>
</table>
traps, known locally as haddrah (or al-hadhra). Such traps were made traditionally by driving a row of palm fronds and wooden stakes into the mud-sand bottom supported by stones at their base. A frond fence was then placed between these stakes out towards the outer circular/pentagonal enclosure, which in turn surrounded an inner chamber. With the receding of the tide, fish were thus channelled by the wings of the trap into first an outer, then an inner chamber. The modern versions of the haddrah are usually made with steel or iron poles and wire mesh or nylon netting. An example of one of these can be seen in Figure 8-7. In the UAE these traps are traditionally used especially during the summer months to catch the blackspot snapper (Lutjanus fulviflamma). Other typical kinds of fish caught using haddrah include needlefish (Belonidae), jacks (Carangidae), seabream (Sparidae), mullets (Mugilidae), barracuda (Sphyraenidae) and rabbitfish (Siganidae). Other bottom species may also be occasionally caught in these traps. Other variants of tidal barrier traps also exist in the UAE. One is a wide fence of nets linked by wooden posts called sakkar. This may be stretched across narrow estuaries or gaps in lagoons. This is particularly used in the capture of mojarras (Gerreidae) and goldstriped seabream (Rhabdosargus sarba). Sometimes a second fence called dafafis added behind the sakkar, and this may catch fish like seabream (Acanthopagrus spp.) and flathead mullets (Mugil cephalus).

**ARABIC NAME** | **METHOD** | **MAIN TYPES OF FISH CAUGHT**
--- | --- | ---
al-Oumla | Large wooden spear called 'Al Katra' with sharp metal unit 'Al Jalala' inserted into another metal unit called 'Al Kaber'. The Kaber has a float attached to it. | Tuna (Euthynus alifinis/Thunnus spp.)
Barred Spanish mackerel (Scomberomorus commersonii)
Other fish sometimes caught include large Carangidae.
Grouper (Epinephelus spp.)
Emperor (Lethrinus spp.)
al-Hadaq | Handline | Shark (Carcharhinus spp.)
Grouper (Epinephelus spp.)
al-Maushalla | Long line with 10–20 smaller lines + books | 40m long beach seine net
Nylon line with 4–8 shorter lines + books with lures (feathers/small pieces of coloured cloth) | Blacktip trevally (Caranx isomus)
Golden trevally (Caranx latus)
Queenfish (Scomberoides spp.)
Mojarras (Gerres spp.)
Flathead mullet (Mugil cephalus)
Rabbitfish (Siganus spp.)
Gillnets, known locally as liekh, are often set on the bottom. These catch a variety of fish, including grunts (Haemulidae), seabream (Sparidae), emperors (Lethrinidae), goatfish (Mullidae), rabbitfish (Siganidae), pomfrets (Stromateidae), and others. A further type of gillnet is known as hayal. These are special drifting gill nets, normally used during the winter, to capture, in particular, the narrow-barred Spanish mackerel (Scomberomorus commerson), abundant at that time. Two nets are used, one being movable whilst the other is fixed with weights. Such a method is also used to capture cobias (Rachycentridae), jacks (Carangidae), barracuda (Sphyraenidae) and tuna (Scombridae). Two other types of fishing nets are used. Beach seines, known locally as yaroof, can be up to 40 m or more in length. One end of the seine is moved rapidly from the shore in a wide arc in an effort to surround fishes; both ends of the seine are then pulled to shore. Speedboats with outboard motors and even four-wheel drive vehicles are used at the present day to pull these seine nets to the shore, but traditionally this was done by a large group of men. Fishing using this method is especially good at catching mojarra (Gerreidae), flathead mullets (Mugil cephalus) and rabbitfish (Siganidae). Many other fishes can also be caught including small needlefish (Belonidae) and jacks (Carangidae). The other type of fishing net which is sometimes used is the casting net, known locally as salieya. This is only used at particular times of year when fish like the Indian oil sardinella (Sardinella longiceps) and flathead mullets (Mugil cephalus) may be abundant in shallow inshore waters. The fishermen wade into shallow waters and throw a bell-shaped fine net onto the surface of the water which has small weights around its base to make the net sink and surround the fish. A device which resembles a sort of harpoon, known locally as oumla, is sometimes used. A large wooden spear referred to as al-katra with a sharp metal unit called al-jalala is inserted into another metal unit called al-kaber. This latter section has a float attached to it. The oumla is particularly used for the spearing of large pelagic fish like tuna, narrow-barred Spanish mackerel and was even occasionally used on cetaceans in the past.

All other traditional fishing methods utilised rely on hook and lines of one sort or another. In its most simple form, the hook and line method, known locally as hadaq, is particularly used for the capture of groupers (Serranidae), cobias (Rachycentridae), jacks/trevallies (Carangidae), grunts (Haemulidae), emperors (Lethrinidae), seabream (Sparidae), and Spanish mackerel (Scombridae: Scomberomorus spp.). Sometimes long lines, known locally as manshalla, are used which may have between 10 and 20 attached smaller lines and hooks. These are reputed to be good for catching requiem sharks (Carcharhinidae) and groupers (Epinephelus spp.). Another local variant is shab, which is a nylon line with 4–8 shorter
lines and hooks which have lures (small feathers or pieces of coloured material) fastened to them. This is apparently very good at catching blacktip trevally *Caranx heberi*, golden trevally (*Gnathanodon speciosus*) and queenfish (*Scomberoides* spp.). The final method which is used from moving boats is a trolling line, known locally as *lafah*. This is particularly used for the capture of larger fish like giant trevally *Caranx ignobilis*, barracuda (*Sphyraena* spp.), narrow-barred Spanish mackerel *Scomberomorus commerson*, tuna (mostly *Euthynnus affinis* and *Thunnus* spp.), and occasionally sailfish *Istiophorus platypterus*.

Modern Fishing
The methods used to capture particular fish are listed in Table 8-2. The majority of the catch (over 80%) at the present time is caught using basket traps (*gargoor*, see Figures 8-5, 8-6). These are made with steel wire, usually imported from Japan or the Far East. The modern fisheries can broadly be divided into modern commercial fisheries, dhow-based fisheries, speed-boat based fisheries and recreational fishing. Commercial or industrial fisheries take place using modern trawlers. These, in particular, target shrimp during the open season and finfish during the closed season. A variety of fish are caught including sharks and rays, sea catfish (*Ariidae*), lizardfish (*Synodontidae*), flatheads (*Platycephalidae*), groupers (*Serranidae*), jacks (*Carangidae*), ponyfish (*Leiognathidae*), snappers (*Lutjanidae*), threadfin bream (*Nemipteridae*), emperors (*Lethrinidae*), seahream (*Sparidae*), goatfish (*Mullidae*), turbot (*Psettodidae*), flounders (*Bothidae* and *Paralichthidae*) and tonguesoles (*Cynoglossidae*). Within the Gulf the amount of trawling has been severely reduced in recent years by limiting the size of fleets and the length of the open season. The combination of over-exploitation resulting from inadequate fisheries management and degradation of the environment is a major cause of the overall decline in fish and shrimp catches. This degradation includes the elimination of important nursery areas (especially for shrimp) by land reclamation and dredging in the coastal areas, destruction of feeding and breeding habitats by bottom trawling, and increased marine pollution by discharge of liquid and solid wastes into the marine environment (Chifffings 2000).

Dhow-based fisheries are usually either artisanal or small commercial operations. Traditional wooden dhows usually about 10–20 m in length are powered by 150–300 horsepower inboard diesel engines (Figure 8-9). Dhows typically fish with baited basket traps (*gargoor*), trawls, drift nets, hook and line and trolling lines. The fishing traps are usually
manufactured from galvanised steel wire of 1–1.5mm thickness, which is imported from the Far East and are usually made as dome-shaped traps with a base diameter of between 1–3 m supported by reinforced steel bars and a funnel like entrance. Two types of gargoor (plural: garagir) are operated — smaller traps (180 cm in diameter and 90 cm in height) are used in shallower waters between 4 and 40m depth by fishermen using fibreglass boats; the larger traps (250 to 300 cm in diameter and 150 to 180 cm in height) are used by big dhows in offshore deeper waters at depths ranging from 60 to 200 m. Polystyrene or plastic marker buoys are used to mark their location. These traps are usually set in the afternoon and the retrieval of fish is carried out the following morning.

A variety of baits are used inside the traps including green algae (Enteromorpha sp.), ground dry fish, dead fish, bread and shrimp. Large garagir target species like groupers (Epinephelus spp.), emperors (Lethrinus spp.) and grunts (Haemulidae). Other important varieties of fish caught in such traps include various jacks (Carangidae) including the blackbanded trevally (Seriolina nigrofasciata), snappers (Lutjanidae), seabream (Sparidae), parrotfish (Scaridae) and rabbitfish (Siganidae).

Small shore-based fisheries usually use fibreglass speedboats with one or two 30–60 horsepower outboard motors (Figure 8-8). Fibreglass boats and outboard motors have been introduced since the early 1970s. Shore-based fishing is mostly carried out with traps and hook and line along rocky shores and jetties, or more often along beaches or intertidal areas using beach seines, gillnets and barrier traps (haddrah, see Figure 8-7). One serious problem affecting fisheries in the region is the loss of fishing traps and nets. Their accidental loss leads to ‘ghost fishing’, i.e. the traps/nets continue to trap fish, killing many in a continuous over-fishing process. According to information provided from the fishermen’s cooperatives, inshore fishermen may lose between 7 to 12 traps per month, whilst big dhows generally operate between 150 to 200 traps with a loss of 20 to 25 traps per month (Tawfik 2000a).

The small traps may take anything between five to seven months to corrode and deteriorate at depths of 4 to 40 m, so they may continue trapping fish for some time after they are lost. One method which has been utilised in other parts of the world is to develop fastenings for the doors to fish traps which naturally decompose after a certain period of time, thus allowing any trapped fish to escape. The possible introduction of such techniques should be investigated. One method which has been attempted to rectify the depletion of the fisheries resource is the creation of artificial reefs. A number of these have been created on the eastern coast of the Emirates as part of the management programme for maintaining and improving the marine resources. The first of these was sunk in Al Faqeet, near Dibba, in February 1998 in approximately 8 m of water. The second artificial reef was sunk at the Aqqa Marine Reserve to protect coral from fishing nets lost in 4 m of water. The third reef was created at the end of 2000 by sinking one hundred ‘caves’ at the edge of the Aqqa Reserve (Tawfik 2000b). There are now more than 600 conical cement structures underwater at Al Faqait, Ra’s Dibba and Al Aqqa. In February 2001 experiments were carried out using a new cheaper type of triangular-shaped cave made of palm leaves woven together and held in place by iron grids and rope (Shaghouri 2001). Whilst the creation of artificial reefs may appear to encourage the development of marine resources in the short term, unless they are established within protected areas which are regularly patrolled by enforcement officers they can actually have a negative effect. This is because artificial reefs can serve as an aggregatory device, which tend to concentrate fish stocks allowing fishermen to more rapidly exhaust stocks by targeting such areas. Establishment of such artificial reefs should, in any case, only take place once the appropriate scientific advice has been obtained.
**FIGURE 8-11**: Sharks and rays
8-11a *Carcharhinus melanopterus*
8-11b *Spilomyra louna*
8-11c *Rhinobatos sp.*

**FIGURE 8-12**: Wolf herring, miltfish, sea catfish, halfbeak and needlefish
8-12a *Chironectes mordax*
8-12b *Hemiramphus marginatus*
8-12c *Ablesistes hants*

**FIGURE 8-13**: Grouper and bigeye
8-13a *Cephalopholis hemistiktos*
8-13b *Epinephelus coroides*
8-13c *Prionodon tayensis*
In April 2000 a new Federal law on the protection of the marine environment (No. 23 for 1999) was introduced in the United Arab Emirates. This law implemented various changes. Fishing boats will only be allowed to sail if their owner, who must be a UAE citizen, is aboard, or unless another citizen deputises for them. The Frontier and Coast Guard patrols will stop and confiscate any boat that violates this rule. Article 26 of the law banned the use of fixed or drifting hayali fishing nets in Abu Dhabi waters. Each fishing boat formerly used to often carry 20 to 50 drift nets, measuring between 200 m and a kilometre in length. These nets often caught and drowned endangered species like dugong, dolphins, porpoise and turtles.

The nets also damaged commercial fish stocks, catching fish that were not brought to market or fish of no commercial use. Enforcement of the law is undertaken by the Border and Coast Guard, UAE navy, police, the relevant Municipalities and other agencies. Any fishermen violating the new law now face heavy penalties. Recreational fishing is a rapidly growing phenomenon in the region. This is largely carried out by small motor boats based from the shore. On May 4, 2002, a Federal Law on the management of marine resources came into effect in Abu Dhabi to ban recreational fishing without a licence. Under the regulation, only two methods of recreational fishing are allowed with a licence: hand line and rod reel. The lower age limit for acquiring a licence is 18. However, children can continue to fish in the company of a licence holder. The regulation is part of Federal Law No. 23 for 1999 on Appropriate Exploitation, Protection and Development of Marine Bio-Resources in the UAE, and awaits implementation.

Two types of licence are available for recreational fishing. For an annual licence, the applicant has to visit the office of the implementing body, the Environmental Research and Wildlife Development Agency, ERWDA, in person with a passport copy or residency visa and two passport size photos. The licence will be issued on the spot against an annual fee of 120 UAE Dirhams, after filling out a single form. Weekly temporary licences, targeted for short-time visitors to the country, are printed vouchers costing 30 UAE Dirhams. These can be obtained by identification proof, without any document or photos. An applicant simply needs to fill out the voucher with the information required. Weekly licences are available at marine sports clubs, hotels and shops selling fishing gear.

Aquaculture

The Marine Resources Research Centre (MRRC) of the Ministry of Agriculture and Fisheries, based in Umm al-Qaiwain Emirate, has been the leading player in the field of aquaculture in the Emirates. This Centre was initiated in 1978 with the help of a technical cooperation programme between the UAE Government, represented by the Ministry of Agriculture and Fisheries, and the Japanese government, represented by the Japan International Cooperation Agency (JICA). The MRRC began its activities in April 1984. It has succeeded in developing a suitable technology for growing rabbitfish (Siganus canaliculatus and Siganus javus) from induced spawned eggs to marketable size fish. Work has also been carried out on shrimp culturing, both at Umm al-Qaiwain and on Abu al-Abyadh Island in Abu Dhabi.

In 1999 the International Fish Farming Company, ASMAK, was set up with a total capital of 300 million UAE Dirhams. The company specialises in fish and shrimp farming, has 31,000 investors and shareholders from different Emirates. One of the projects supported by them is the new 10 million UAE Dirham fish farm near Dibba in Fujairah. Several floating cages have been placed over an area of 25 hectares where two main species of fish are farmed. A factory is being developed on 5000 m² of land where warehouses will allow the storage of the finished product and fish fodder. Fish farming
may be developed further in the future to increase the stock of commercially viable fish in UAE waters. The Marine Resources Research Centre is trying to stimulate the development of fish farming to help meet local market demand, encouraging UAE citizens to undertake training in how to establish suitable coastal areas. The Centre supplies cage nets, frames for cage nets, buoys and other equipment free of charge to aquaculture enthusiasts as an incentive.

**Marine Protected Areas: The Future?**

As a complete biogeographic province, the Gulf is an area of global importance. It has global status as a major conservation area for the dugong and other rare and endangered species. The only truly successful means of protecting the fisheries resources of the region is to establish regional Marine Protected Areas (MPA). Protection should also be afforded to mangroves, lagoons, seagrass beds, reefs and islands along the Emirates coastline, such habitats representing important breeding grounds for fisheries. Without a network of such protected areas, there is little hope of protecting fisheries resources for future generations.

In the Emirates four marine reserves have been established on the East (Gulf of Oman) Coast to enhance coral reef formation. Three were established in 1997, the fourth being established in 2000. Management of the reserves is undertaken by Dibba Municipality, which has marked the reserves with large buoys in co-ordination with the Ministry of Agriculture and Fisheries. A Marine Protected Area. MPA, has also been established in the waters of Abu Dhabi Emirate, covering an area of several thousand square kilometres, including islands, from Abu al-Abyadh westwards to the island of Bazm al-Gharbi, and northwards to the Bu Tinah shoals. Named the Marawah MPA, after one of the islands included, it is managed by ERWDA in association with other stakeholders, including the navy, the Municipality and other bodies. Without patrolling and enforcement of MPAs, however, they cannot be effective.

There has been much discussion recently about the value of 'no-take zones', where fishing is completely prohibited (Pezzey et al. 2000, Roberts 1998a, b, c, 1999, Roberts and Hawkins 1997). It is clear from a number of studies that, even after just a few years of no fishing in these areas, stocks can successfully replenish. The difficult challenge for the future, however, will be the formation of integrated MPA networks for the Gulf region. Fish do not respect national boundaries, so future management strategies have to take into account a Gulf-wide and international perspective.

**Fishes of Abu Dhabi**

There is much still to learn about the current fish fauna of the Gulf. Many UAE fish species have spawning seasons between April–June, and the timing of this may be linked to sea water temperature. Further studies are urgently required, however, concerning the physiology of the fishes, age determination of the fishes by study of their otoliths and scales, as well as hydrographical and ecological studies of local conditions before firmer conclusions can be drawn (Ali et al. 1984).

Certainly there appears to be considerable regional variation in the numbers, diversity and composition of fish taxa observed in different areas within the Gulf. Fewer species, in particular, seem to be identified in some of the western and southern areas of the Gulf (Coles and Tarr 1990, Smith et al. 1987, Dipper and Woodward 1989). This may be related to factors such as bottom topography and sediment type.

Whereas the northern and eastern parts of the Gulf, as well as the entrance Hormuz area, are relatively rich in certain species, much less variety of fish are present in the south-west and southern shores of the Gulf. For example, certain...
<table>
<thead>
<tr>
<th>FAMILY</th>
<th>TAXON</th>
<th>COMMON NAME</th>
<th>LOCAL NAME</th>
<th>SB</th>
<th>TL</th>
<th>SR</th>
<th>SS</th>
<th>SM</th>
<th>GB</th>
<th>COR</th>
<th>OW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemiscyllidae</td>
<td>Chiloscyllium arabicum</td>
<td>Bamboo shark</td>
<td>Herify</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carcharhinus leucas</td>
<td>Bull shark</td>
<td>Jarjur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carcharhinus melanopterus</td>
<td>Blacktip reef shark</td>
<td>Jarjur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carcharhinus sorrah</td>
<td>Spot-tail shark</td>
<td>Jarjur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Catostomus catenatus</td>
<td>Tiger shark</td>
<td>Jarjur</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphyridae</td>
<td>Sphyra lewisi</td>
<td>Scalloped hammerhead</td>
<td>Apran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristidae</td>
<td>Anoxypristis cuspidata</td>
<td>Knifetooth sawfish</td>
<td>Apran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristidae</td>
<td>Pristis ziyus</td>
<td>Green sawfish</td>
<td>Apran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhinobatidae</td>
<td>Rhinobatos gunnatinius</td>
<td>Sharpnose guitarfish</td>
<td>Hariri</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhinobatidae</td>
<td>Rhynchobatus djiddensis</td>
<td>Giant guitarfish</td>
<td>Hariri</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dasyatidae</td>
<td>Himantura gerrardi</td>
<td>White-spotted whipray</td>
<td>Lokhnah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dasyatidae</td>
<td>Himantura uranak</td>
<td>Reticulated whipray</td>
<td>Hayyasah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myliobatidae</td>
<td>Aetobatus narinari</td>
<td>Spotted eagle ray</td>
<td>Thuwar ‘amir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myliobatidae</td>
<td>Aetomyctes nicholii</td>
<td>Banded eagle ray</td>
<td>Thuwar ‘amir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clupeidae</td>
<td>Nematalosa nasus</td>
<td>Bloch’s gizzard shad</td>
<td>Yuwaif/ Awaf</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clupeidae</td>
<td>Sardenella longiceps</td>
<td>Indian oil sardine</td>
<td>Oooma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engraulidae</td>
<td>Stolephorus indicus</td>
<td>Indian anchovy</td>
<td>Gasir</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chirocentridae</td>
<td>Chirocentrus dorab</td>
<td>Dorab wolf-herring</td>
<td>Huff</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chanidae</td>
<td>Chanos chanos</td>
<td>Milkfish</td>
<td>Neuer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ariidae</td>
<td>Arius thalassinus</td>
<td>Giant sea carpfish</td>
<td>Chim. Khinn</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belonidae</td>
<td>Ablennes hispin</td>
<td>Needlefish</td>
<td>Hagool</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemiramphidae</td>
<td>Hemiramphus marginatus</td>
<td>Yellowtip halfbeak</td>
<td>Silh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exocoetidae</td>
<td>Cypselurus elongatus</td>
<td>Large-scale flyingfish</td>
<td>Garadah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scorpaenidae</td>
<td>Pterois miles</td>
<td>Military turkeyfish</td>
<td>Deshe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platycephalidae</td>
<td>Platysphalas indicus</td>
<td>Indian flathead</td>
<td>Wahar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serranidae</td>
<td>Cephalopholis hemistiktis</td>
<td>Halfspotted hind</td>
<td>Bertamah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serranidae</td>
<td>Epinephelus areolatus</td>
<td>Areolate grouper</td>
<td>Sonman</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAMILY</td>
<td>TAXON</td>
<td>COMMON NAME</td>
<td>LOCAL NAME</td>
<td>SB</td>
<td>TL</td>
<td>SR</td>
<td>SS</td>
<td>SM</td>
<td>GB</td>
<td>COR</td>
<td>OW</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------</td>
<td>--------------------</td>
<td>------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Serranidae</td>
<td>Epinephelus bleekeri (Vaillant 1877)</td>
<td>Duskytail grouper</td>
<td>Hamoor</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serranidae</td>
<td>Epinephelus coeruleopunctatus (Bloch 1790)</td>
<td>Whitespotted grouper</td>
<td>Hamoor</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serranidae</td>
<td>Epinephelus coieolides (Hamilton 1822)</td>
<td>Orange-spotted grouper</td>
<td>Hamoor</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pristidae</td>
<td>Priacanthus tenerus (Richardson 1846)</td>
<td>Purple spotted bigeye</td>
<td>Yimyam,</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teraponidae</td>
<td>Terapon jarbua (Forskal 1775)</td>
<td>Jarbua terapon</td>
<td>Yimyam,</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teraponidae</td>
<td>Terapon puta (Cuvier and Valenciennes 1829)</td>
<td>Small-scaled terapon</td>
<td>Zimmoor</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rachycentridae</td>
<td>Rachycentron canadum Linnaeus 1766</td>
<td>Cobia</td>
<td>Sichil</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Echeneidae</td>
<td>Echeneis naucrates Linnaeus 1758</td>
<td>Shark sucker</td>
<td>Lazzag</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coryphaenidae</td>
<td>Coryphaena hippurus Linnaeus 1758</td>
<td>Dolphinfish</td>
<td>Anfalous</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Alectis indica (Rüppell 1837)</td>
<td>Indian threadfish</td>
<td>Khait</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Alepes djedaba (Forskal 1775)</td>
<td>Shrimp scad</td>
<td>Yami-sah</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Atule mate (Cuvier 1833)</td>
<td>Yellowtail scad</td>
<td>Dordoman</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Carangoides chrysophrys (Cuvier 1833)</td>
<td>Orange-spotted jack</td>
<td>Jash teetee</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Caranx heben (Bennett 1830)</td>
<td>Blacktip trevally</td>
<td>Jash faro</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Caranx ignobilis (Forskal 1775)</td>
<td>Giant trevally</td>
<td>Jash yep</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Caranx seafasciatus Quoy and Gaimard 1825</td>
<td>Bigeye trevally</td>
<td>Kefdar</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Decapterus russelli (Rüppell 1830)</td>
<td>Indian scad</td>
<td>Sinah</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Elagatis bipinnulata Quoy and Gaimard 1824</td>
<td>Rainbow runner</td>
<td>Charibah</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Gnathanodon speciosus (Forskal 1775)</td>
<td>Golden trevally</td>
<td>Zeraidy</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Megalaspis cornylia (Linnaeus 1758)</td>
<td>Torpedo scad</td>
<td>Titi</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Scomberoides commersonnianus Lacépède 1802</td>
<td>Talang queenfish</td>
<td>Bisar, Dalaa</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Scomberoides dolimontis (Cuvier 1832)</td>
<td>Queenfish</td>
<td>Seen</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Selar crumenophthalmus (Bloch 1796)</td>
<td>Bigeye scad</td>
<td>Sinah</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Seriola nigrofasciata (Rüppell 1829)</td>
<td>Blackbanded trevally</td>
<td>Halwayoc</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Trachinotus blochii (Lacépède 1801)</td>
<td>Snubnose pennanbo</td>
<td>Seben</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carangidae</td>
<td>Ulua mentals (Cuvier 1833)</td>
<td>Longrakered jack</td>
<td>Jash</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAMILY</td>
<td>TAXON</td>
<td>COMMON NAME</td>
<td>LOCAL NAME</td>
<td>SB</td>
<td>TL</td>
<td>SR</td>
<td>SS</td>
<td>SM</td>
<td>GB</td>
<td>COR</td>
<td>OW</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------</td>
<td>----------------------</td>
<td>---------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Leiognathidae</td>
<td>Leiognathus equulus</td>
<td>Common ponyfish</td>
<td>Farshgooh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gerres oyena</td>
<td>Mojarra</td>
<td>Baddia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lutjanidae</td>
<td>Lutjanus juleffimmama</td>
<td>Snapper</td>
<td>Naizer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lutjanus johnii</td>
<td>John's snapper</td>
<td>Naasar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Lutjanus quinquelineatus</td>
<td>Five-lined snapper</td>
<td>Aqlaa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Lutjanus russelli</td>
<td>Snapper</td>
<td>Um drais</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lutjanus sanguineus</td>
<td>Humphead snapper</td>
<td>Hamrah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pinjalo pinjalo</td>
<td>Pinjalo</td>
<td>Na'imee</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Haemulidae</td>
<td>Diagramma pictum</td>
<td>Painted thicklip</td>
<td>Farsh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plectorhinchus pictus</td>
<td>Trout thicklip</td>
<td>Farsh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pomadasys argentatus</td>
<td>Silver grunt</td>
<td>Nagaor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pomadasys commersonii</td>
<td>Spotted grunt</td>
<td>Nagaor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Haemulidae</td>
<td>Pomadasys serratus</td>
<td>Striped piggy</td>
<td>Nagaor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Nemipteridae</td>
<td>Nemipterus peroni</td>
<td>Nuchfin threadfin</td>
<td>Sultan Ibrahim</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nemipteridae</td>
<td>Scolopsis ghanam</td>
<td>Arabian monoche</td>
<td>Ebzaimy</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Nemipteridae</td>
<td>Scolopsis tumnus</td>
<td>Blackstreak bream</td>
<td>Ebzaimy</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Lethrinidae</td>
<td>Lethrinus tenot</td>
<td>Pinkear emperor</td>
<td>Shaeri, Shekhsai</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Lethrinidae</td>
<td>Lethrinus microdon</td>
<td>Smalltooth emperor</td>
<td>Shaeri, Suli</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Lethrinidae</td>
<td>Lethrinus nebulosus</td>
<td>Spangled emperor</td>
<td>Shaeri kabir</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Acanthopagrus berda</td>
<td>Picnic seabream</td>
<td>Sheam</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sparidae</td>
<td>Acanthopagrus bifasciatus</td>
<td>Doublebar seabream</td>
<td>Faskar</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Acanthopagrus latus</td>
<td>Yellowfin seabream</td>
<td>Sheam</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Argrops spinifer</td>
<td>King soldierbream</td>
<td>Kofar</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sparidae</td>
<td>Crenidens cremidens</td>
<td>Karanteen seabream</td>
<td>Ebzaimy</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Hbabasargus haffara</td>
<td>Haffara</td>
<td>Kabet</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Sparidae</td>
<td>Hbabasargus sarba</td>
<td>Goldstriped seabream</td>
<td>Kabet</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Mugilidae</td>
<td>Chelon macrolepis</td>
<td>Large-scaled mullet</td>
<td>Byiah Sfairy</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>FAMILY</td>
<td>TAXON</td>
<td>COMMON NAME</td>
<td>LOCAL NAME</td>
<td>SB</td>
<td>TL</td>
<td>SR</td>
<td>SS</td>
<td>SM</td>
<td>GB</td>
<td>COR</td>
<td>OW</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Mugilidae</td>
<td>Mugil cephalus</td>
<td>Flathead mullet</td>
<td>Biyah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Valamugil sebili</td>
<td>Blue spot mullet</td>
<td>Biyah Arabi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mullidae</td>
<td>Parapeneus heptacanthus</td>
<td>Cinnabar goatfish</td>
<td>Heddi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mullidae</td>
<td>Parapeneus margaritius</td>
<td>Pearly goatfish</td>
<td>Heddi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mullidae</td>
<td>Upenaeus troglus</td>
<td>Frocked goatfish</td>
<td>Heddi</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaetodontidae</td>
<td>Chaetodon melapterus</td>
<td>Arabian butterflyfish</td>
<td>Asroo al-agam</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaetodontidae</td>
<td>Chaetodon nigropunctatus</td>
<td>Dark butterflyfish</td>
<td>Quafeth</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaetodontidae</td>
<td>Heniochus acuminatus</td>
<td>Pennant coral fish</td>
<td>Mosht al-arwa</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomacanthidae</td>
<td>Pomacentrus maculosus</td>
<td>Yellow bar angelfish</td>
<td>Anfooz</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomacanthidae</td>
<td>Abulidephio saxigeanus</td>
<td>Indo-Pacific sergeant</td>
<td>Shnino</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pomacentridae</td>
<td>Dascyllus trimaculatus</td>
<td>Three spot dascyllus</td>
<td>Shnino</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labridae</td>
<td>Cheilinus lunulatus</td>
<td>Broomtail Wrasse</td>
<td>Makr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaridae</td>
<td>Scarus ghobban</td>
<td>Yellow Scale Parrotfish</td>
<td>Gain, Gen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scaridae</td>
<td>Scarus percarus</td>
<td>Gulf Parrotfish</td>
<td>Gain, Gen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soleidae</td>
<td>Karyglossus orientalis</td>
<td>Oriental Sole</td>
<td>Shwas, Lisan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soleidae</td>
<td>Pardachirus marmoratus</td>
<td>Fine-Scale Sole</td>
<td>Muskat, Mouss</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphyraenidae</td>
<td>Sphyraena barracuda</td>
<td>Great Barracuda</td>
<td>Gidd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphyraenidae</td>
<td>Sphyraena jello</td>
<td>Pickhandle Barracuda</td>
<td>Gidd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sphyraenidae</td>
<td>Sphyraena putnamiae</td>
<td>Sawtooth Barracuda</td>
<td>Gidd</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Auxis thazard</td>
<td>Fregate Tuna</td>
<td>Tebban</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Kathymus affinis</td>
<td>Kawakawa</td>
<td>Sdah</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Rastrelliger kanagurta</td>
<td>Indian Mackerel</td>
<td>Karfsh</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Scomberomorus commerson</td>
<td>Kingfish</td>
<td>Kan‘ad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Scomberomorus guttatus</td>
<td>Indo-Pacific Mackerel</td>
<td>Kan‘ad, Farshy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scombridae</td>
<td>Thunnus tonggol</td>
<td>Longtail Tuna</td>
<td>Gebab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Istiophoridae</td>
<td>Istiophorus platypterus</td>
<td>Indo-Pacific Sailfish</td>
<td>Kheil al-bahar</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ephippidae</td>
<td>Platx orbicularis</td>
<td>Orbicularis Barfish</td>
<td>Emad</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
FIGURE PAGE 183.
A coral reef area along the coast of Abu Dhabi, with yellowbar angelfishes and a great grouper in ambush.

Families such as croakers (Sciaenidae) and soles (Soleidae) have more species in the NW Gulf than in the SE. Sheppard et al. (1992) have recognised that important ecological gradients or controls in species distribution and abundance have to be taken into consideration in understanding the biogeography of fishes in Arabia. One of the key problems is the lack of ecological data on fish habitat preferences. Preliminary work by Basson et al. (1977), McCain et al. (1984), Downing (1987), Smith et al. (1987) and Smith and Saleh (1987), all suggest that certain fish may be associated with particular habitats and that their occurrence may be highly seasonal.
An extensive and luxuriant forest of macroalgae where brown algae are the dominant species.

The following reference material was cited throughout the Atlas in accordance with the Harvard system and has been combined to provide a valuable reference source, providing detailed scientific information on marine and coastal habitats, marine wildlife and fisheries, and research and management issues from both an international and regional perspective.

Within each chapter of the Atlas, the reader is provided with references from previous works that either support the information presented by the author, or refers the reader to additional relevant information on that particular subject. All these references are then cited in full within this Atlas Bibliography, to allow the reader to obtain that information.

Alternatively, this Atlas Bibliography can be used as a direct source of information on various subjects concerned with marine and coastal environmental issues, and is currently the most up-to-date source of published scientific information on this subject in the United Arab Emirates.

This Atlas Bibliography will be essential for organisations undertaking research or planning in the marine and coastal environment, and will be an invaluable asset for students studying ecology, environmental science, natural resource management, and geography.

For a Reference list of the abbreviated names of the scientific journals see page 275.

REFERENCES CITED IN THE ATLAS


Baldwin, R., Cockcroft, V.G. 1995. Is the world’s second-largest...


Blegvad, H. 1914. Food and conditions of nourishment among the communities of invertebrate animals found on or in the sea bottom in Danish waters. Rep. Danske Biol. Stn. 22, 46–89.


Fenchel, T. 1969. The ecology of marine microbenthos. IV. Structure and function of the benthic ecosystem, its chemical and physical structure and the microfauna community with
special reference to the ciliated protozoa. Ophelia 6, 1–182.


Gasperetti, J., Stimson, A., Miller, J.D., Ross J.P., Gasperetti, P.,


Iddison, P. 1998. A Fish Suq in the UAE Desert. Privately published, Al Ain, UAE.


Development. The World Bank, Washington, DC, pp. 96-100.


IUCN Gland, Switzerland, and UNEP, Nairobi, 389 pp.


Orth, R.J., Moore, K.A. 1983. Chesapeake Bay:
an unprecedented decline in submerged aquatic vegetation.

Science 22, 51-52.

Tawfik, F. 2000a. ‘Ghost fishing’ blamed for death of coral,

Tawfik, F. 2000b. Third reef to boost fish stocks. Gulf News,

Thayer, G.W., Wolfe, D.A., Williams, R.B. 1975. The impact of

Thayer, G.W., Stuart, H.H., Kenworthy, W.J., Ustach, J.F.,
Hall, A.B. 1979. Habitat values of saltmarshes, mangroves,
and seagrasses for aquatic organisms. In: Greeson, P.E.,
Clark, J.R., Clark, J.E. (Eds.), Wetland Functions and Values: The
State of Our Understanding. In: Proceedings of the National
Symposium on Wetlands, American Water Resources
Association, Minneapolis, Minnesota, pp. 235-247.

347 pp.

University Press, Cambridge, UK.

UNEP 1994. Assessment and Monitoring of Climatic Change
Impacts on Mangrove Ecosystems. UNEP Regional Seas
Reports and Studies No. 154, 62 pp.

Virtanen, R.W., Mikkelsen, P.S., Cairns, K.D., Capone, M.A.
1983. Seagrass beds versus sand bottoms: the trophic
importance of their associated benthic invertebrates. Fla. Sci.
46 (3-4), 363-381.

The coastal survey in the Western province of Abu Dhabi, 1983.

Waerebeek, K.V., Bresssem, M.V., Felix, F., Alfaro-Shigueto, J.,
García-Godos, A., Chavez-Lisambart, L., Onton, K., Montes, D.,
fisheries off Peru and southern Ecuador in 1994. Biological
Conservation 81, 48-49.


of the Genus Acropora. CSIRO, Melbourne, Australia, 422 pp.

Survey of Sea Turtles, Marine Mammals and Fishing Activities
within the Kenyan Marine Environment. Report by the Kenya

of the toxicity of two oils and a dispersant to the mangrove

Ocean, Red Sea and Gulf. UNEP/IUCN, Cambridge, UK,
389 pp.

Region 10: Central Indian Ocean. In: Kelleher, G., Bleakley C.,
Wells S. (Eds.), A Global Representative System of Marine
Protected Areas. Vol. 3: Central Indian Ocean, Arabian Seas,
East Africa, and East Asian Seas. Great Barrier Reef Marine
Park Authority, The World Bank and The World Conservation
Union (IUCN), Washington, pp. 13-37.

Western, A.R. 1989. The flora of the United Arab Emirates – an
introduction. UAE University, Al Ain, UAE.

Wetzel, R.C., Penhale, P.A. 1979. Transport of carbon and
excretion of dissolved organic carbon by leaves and roots/rhizomes
in seagrasses and their epiphytes. Aquat. Bot. 6, 149-158.

White, A.W., Barwani, M.A. 1971. Common Sea Fishes of the
Arabian Gulf and Gulf of Oman. Trucial States Council, Dubai,
UAE.

Williams, T.B. 1986. Ageing Manual for Kuwaiti Fish. KISR 1915: MB-44. Mariculture and Fisheries Department, Food Resources Division, Kuwait Institute for Scientific Research, Kuwait.


REFERENCE LIST OF THE ABBREVIATED NAMES OF THE SCIENTIFIC JOURNALS REPORTED IN BIBLIOGRAPHY

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Journal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am. Sci.</td>
<td>American Scientist</td>
</tr>
<tr>
<td>Aquat. Bot.</td>
<td>Aquatic Botany</td>
</tr>
<tr>
<td>Aust. Wildl. Res.</td>
<td>Australian Wildlife Research</td>
</tr>
<tr>
<td>Bull. Environ. Contam. Toxicol.</td>
<td>Bulletin of Environmental Contamination and Toxicology</td>
</tr>
<tr>
<td>Bull. Florida State Mus.</td>
<td>Bulletin of the Florida Museum of Natural History (Biological Sciences)</td>
</tr>
<tr>
<td>Caribbean Res. Inst. Water Pollution Rept.</td>
<td>Caribbean Research Institute, Water Pollution Report</td>
</tr>
<tr>
<td>Environ. Conserv.</td>
<td>Environmental Conservation</td>
</tr>
<tr>
<td>Environ. Poll.</td>
<td>Environmental Pollution</td>
</tr>
<tr>
<td>Fla. Dept. of Nat. Resources. Tech. Ser.</td>
<td>Florida Department of Natural Resources Technical Series</td>
</tr>
<tr>
<td>Fla. Sci.</td>
<td>Florida Scientist</td>
</tr>
<tr>
<td>J. Geol.</td>
<td>Journal of Geology</td>
</tr>
<tr>
<td>Limnol. Oceanogr.</td>
<td>Limnology and Oceanography</td>
</tr>
<tr>
<td>Mar. Freshwater Res.</td>
<td>Marine and Freshwater Research</td>
</tr>
<tr>
<td>New York Fish. Game J.</td>
<td>New York Fisheries Game Journal</td>
</tr>
<tr>
<td>Smithsonian Contr. Mar. Sci.</td>
<td>Smithsonian Contribution to the Marine Sciences</td>
</tr>
<tr>
<td>Theor. Appl. Genetics</td>
<td>Theoretical and Applied Genetics</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

We are grateful to the President of the United Arab Emirates, H.H. Sheikh Zayed bin Sultan Al Nahyan, for his commitment to protecting the environment of the United Arab Emirates and to H.H. Sheikh Khalifa bin Zayed Al Nahyan, the Crown Prince of Abu Dhabi and Deputy Supreme Commander of the Armed Forces, for his support of environmental programmes throughout Abu Dhabi Emirate.

We would like to thank H.H. Sheikh Sultan bin Zayed Al Nahyan, Deputy Prime Minister of the United Arab Emirates, and Chairman of the Emirates Heritage Club, for his great enthusiasm and constant support in undertaking the Marine Atlas Program. We also thank H.H. Sheikh Hamdan bin Zayed Al Nahyan, Minister of State for Foreign Affairs and Deputy Chairman of the Environmental Research and Wildlife Development Agency, ERWDA, for providing field assistance during the atlas surveys.

The editors thank the Emirates Heritage Club for their support and assistance, and especially the Marine Atlas Higher Committee, consisting of Ahmed Ali Al Rumaithy, Omar Al Muhairby, Abdulmonem Darwish, Adel Al Rashid, Adnan Al Hosani, Saeed Al Muhairi, Sanad Saif, and meetings’ coordinator Adnan Al Mawed. We also thank other members of the staff of the Commission of Environmental Research for their dedication and valuable contributions throughout the Atlas Program, including Abdulkareem Hassan Al Ali and Salem Adnan Wrdyani. Also, we thank the Zayed Center for History and Heritage for their assistance in reviewing and editing material.

We are pleased to extend our appreciation to the following names who have helped in editing the Marine Atlas:
Mr. Ronald A. Loughland
Dr. Fatima S. Al Muhairi
Mr. Sanad S. Fadel
Dr. Ahmed M. Almehdi
Mr. Peter Hellyer

And to extend our appreciation to the National Bank of Abu Dhabi and The Abu Dhabi Commercial Bank for their financial contribution.

Dr. Peter Bridgewater, Division of Ecological Sciences, UNESCO, Abdul Rahman al-Muftah, UNESCO consultant, Dr. Benno Boer, UNESCO Regional Office in the Arab States of the Gulf, and Mr. Peter Hellyer, Abu Dhabi Islands Archaeological Survey, are thanked for their valuable comments on the manuscript.

The successful completion of the Marine Atlas would not have been possible without the valuable assistance of many organisations and individuals, and we are especially grateful to the following:

UAE Ministry of Communications – Department of Meteorology
UAE Ministry of Interior
Sharjah Police Airwing
Abu Dhabi Police Airwing
GHQ, UAE Armed Forces
UAE Coast Guard

The Private Department of the President of the United Arab Emirates, H.H. Sheikh Zayed bin Sultan Al Nahyan.


Abu Dhabi Aviation
Abu Dhabi Company for Onshore Oil Operations (ADCO)
Abu Dhabi Marine Operating Company (ADMA-OPCO)
Abu Dhabi National Oil Company (ADNOC)
Environment and Protected Areas Authority, Sharjah
Environment and Protected Areas Authority, Sharjah
Environment and Protected Areas Authority, Sharjah
Environmental Research and Wildlife Development Agency (ERWDA)
Federal Environment Agency
Japanese Oil Development Company (JODCO)
Zakum Development Company (ZADCO)
And to the following individuals, institutions and private
companies in the United Arab Emirates and overseas:

Ahmed S. Massasati, Ph.D Associate Professor, Department
of Geography, UAE University
Martin Middle East Abu Dhabi
Simon Culshaw
Sirenia, Abu Dhabi
Sun Divers Abu Dhabi
R. Klaus, Warwick University
The Natural History Museum, London
The staff of LET, Laboratoire d’Ecologie Terrestre de Toulouse,
France, for allowing us to use their facilities, and, in particular,
Jean-Luc Cryon and Daniel Lacaze for creating the maps
and Maria France for facilitating and solving all the logistic
problems.

We would also like to thank the UAE students who participated
in the Marine Atlas Workshops.

PHOTOGRAPHIC CREDITS

Photographs, unless otherwise credited, copyright by The
Emirates Heritage Club, Abu Dhabi. Other photographs are
individually credited to the following authors
(Legend: t = top, b = bottom, r = right, l = left):

S. Aspinall: pp. 176; 210; 220; 221; 230; 236-237

M. Beech: pp. 174; 175; 177; Map 10

D. George: pp. 24 t, b; 26; 32-33; 40; 67; 94; 97; 102-103;
105; 106; 107; 108; 111; 112-113; 114-115; 116; 119;
120-121; 124; Map 5; 132-133; 138-139; 140; 143; 144; 145;
149; 150; 154; 155; 157; 170 (5, 7); 171; 185; 246-247;
251 t r; 251 b r; 252.

C. Harris: pp. 158; 162-163; 191; 197; 198-199; 232-233;
244; 245

P. Hellyer: pp. 44; 45; 46; 48-49; 50; Map 2

John Nowell/Zodiac Publishing: pp. 214-215, Map 12; Map 13;
Map 14; 278

Panda Photo/Bios/Greth: p. 250 b r

A. Preen: pp. 208; 209; 240hl

P. Saenger: pp. 61b; 68; Map 3

Ch. Sheppard: p. 39, Map 4

E. Trainito: pp. 184; 188-189; 202; 206-207; 211; Map 15