SULTANATE OF OMAN

MINISTRY OF REGIONAL MUNICIPALITIES

AND ENVIRONMENT

CONVENTION ON BIOLOGICAL DIVERSITY

FIRST NATIONAL REPORT

Prepared by the Directorate-General of Nature Reserves

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EXECUTIVE SUMMARY

The Sultanate of Oman has undergone a period of rapid change since the accession of His Majesty Sultan Qaboos bin Said in 1970. Rapid development to meet the needs and aspirations of a rapidly increasing population has made severe demands on habitat. Much field study has been carried out in many taxonomic areas and knowledge is good. Policies made early in this process have halted severe loss of biodiversity, but threats still remain. Over-exploitation of the sea and rangelands are serious threats, but measures are being taken to address them. The institutional structure and capacity to meet these threats is under continual review and has been strengthened since the Sultanate became a signatory to the CBD in 1992.

Since then a National Conservation Strategy has been drawn up and ratified. Environmental scrutiny of development projects has been improved. Protected areas have been designated and management planning and implementation is progressing. Lack of available financial resources has constrained progress on all fronts, but much progress is being made. Monitoring and field management have been expanded and field studies and research continue. Specialist taxonomic working groups have been formed and others are planned. A National Biodiversity Strategy and Action Plan has been drafted and undergone technical scrutiny. Further integration of the environment into national development programme and the establishment of a computerised Biodiversity Conservation Information System are the two principal outputs of a GEF Enabling Project commencing in early 1998. Diversification of the economy away from dependence on oil revenues has further increased pressure on habitat as more land is needed for new types of development activity.

PARTICIPATION IN PLANNING AND REPORTING PROCESSES

Prior to 1992

The Sultanate of Oman has undergone a period of rapid change since the accession of His Majesty Sultan Qaboos bin Said in 1970. There was little infrastructure of government or expertise within the country and the modest oil revenue was used to carry out basic development: roads, schools and medical facilities for the people.

Very early on His Majesty the Sultan realised the importance of conserving Oman's natural heritage and, in 1974, established the Office of the Adviser for Conservation of the Environment in the then Ministry of Diwan Affairs. This enabled much early action to be taken to bring awareness of environmental matters to the new and expanding ministries. Legislation was passed by various ministries, such as a law to ban the hunting of certain wildlife species. In 1982 the Oman Natural History Museum was established in the Ministry of National Heritage and Culture (MNHC), bringing yet another ministry into the broadening field of consultation.

In 1982 Royal Decree No 10/82, the Law on Conservation of the Environment and the Prevention of Pollution was issued, addressing a wide range of environmental protection measures. They include the requirement that all development projects should undergo environmental scrutiny prior to the issue of a mandatory environmental permit. Permits may be refused, or have specific conditions attached to them requiring mitigation measures to be incorporated, and/or restoration after the project ends, to be carried out. A full EIA study is required to be carried out for larger projects or those in environmentally sensitive areas.

The implementation of this Decree (and its later amendments) has been strengthened considerably since 1992, providing better protection of ecosystems and wildlife habitat, as well as preventing water, soil and air pollution.

The Ministry of Environment was created in 1984. Responsibility for water resources was then added in 1985, until a separate ministry was established for that purpose. In 1991, the Ministry of Regional Municipalities was amalgamated to form the Ministry of Regional Municipalities and Environment (MRME) a single large ministry with a presence throughout all regions of the Sultanate of Oman.

In 1992 a national conservation strategy for sustainable development was drafted, with extensive consultation among the ministries and organisations with responsibility for biodiversity conservation, or whose development projects could present a threat to the habitat of flora and fauna. The exercise was concluded with a major seminar to extend this consultation. The document was finally ratified by the Cabinet as a guideline document in 1996.

Since 1992

Government Agencies. The NBSAP was developed at technical level with the participation of members of the specialist groups recently established by MRME. They are drawn from the Diwan of Royal Court, Ministry of Agriculture and Fisheries Resources (MAFR), MNHC and Sultan Qaboos University (SQU). The groups are chaired by staff of the Directorate-General of Nature Reserves and meet at intervals, bringing together the best expertise available within Oman.

In addition specialists in other relevant fields, for which specialist groups have not yet been formed, were involved in the development of the NBSAP.

The NBSAP is at the third draft stage, the implementation projects still being gathered from other ministries. Thus the degree of detail currently available varies according to the degree of participation by other ministries. The process of formulating the NBSAP has promoted awareness and understanding of the fields of responsibility, establishing much growing and beneficial dialogue between the various ministries and agencies involved in biodiversity conservation.

Once the third edition has been finalised, it will then be translated into Arabic and circulated at policy-maker level for ratification by the ministries concerned.

The NBSAP builds on the work already done in drawing up the National Conservation Strategy. Within the document is provision for the establishment of further interministerial specialist groups as capacity is built to make this possible. Care has been taken at this stage to avoid overambitious or rigid time scales for project implementation or commitments to funding, as these must depend on further integration of environmental matters within the development and financial planning process. None-the-less it is an important vehicle for organising conservation priorities and for an overview of the institutional requirements to meet the tasks.

The Biodiversity Enabling Project, due to start in early 1998, will further develop the NBSAP, within its present concise and translatable format.

NGOs and Volunteer Participation. The establishment of NGOs in Oman is still at an early stage. None-the-less many private individuals give their time to carrying out data and specimen collection under the guidance of the relevant ministry responsible for their field of interest. Ornithological work has hitherto been almost entirely carried out in this way. Those with specific skills are able to be co-opted to the specialist groups. Much good work is also done by such volunteers in the marine mammal field and by diving club members in the coral reef clean-up campaign. Private citizens in the Interior of Oman give much valuable support to studies of wildlife, traditional conservation systems and the monitoring of illegal hunting or damage to trees. The private sector of commerce and industry gives generously to environmental awareness projects as well as contributing to the data collection process through environmental impact assessment studies. Thus the current lack of official environmental NGOs does not inhibit activity by volunteers.

STATUS AND TRENDS - A SUMMARY

Monitoring
With certain notable exceptions monitoring systems on a wide scale are at an early stage of development. The MRME ranger units are still in the early stages of recruitment, expansion and training. None-the-less most of these units are now issued with wildlife observation cards on which sightings and incidents are recorded. The database to accommodate and process this data will be established under the Biodiversity Enabling Project.

Biogeographic Zones and Ecosystems

Northern mountains (including Musandam) and Dhofar mountains
Overgrazing is evident in those areas where roads have been constructed, water can be transported by vehicle for both people and livestock, supplementary feed can be delivered and transhumance has reduced or ceased altogether. (The latter has also reduced over a much wider area, including the foothills and surrounding plains for social reasons as well as those described above, putting greater pressure on rangelands close to the new permanent settlements during dry periods.)

In the Dhofar mountains the increased pressures are from camels and cattle, as well as from goats.

Measures to address these trends are included in the NBSAP. On the other hand, there are mountain areas which for social and economic reasons are almost unutilised by livestock, mainly those in north-western border regions.

Central Limestone Plateau of the Jiddat al Harasis
Although there has been some increase in livestock numbers, damage is being caused to pastures through an increase in off-road driving by vehicles, mainly those of pastoralists. Activity by companies prospecting for minerals, gas and oil, especially seismic and associated earthmoving equipment, has also damaged the surface.

Strict guidelines are applied and conditions are applied in environmental permits to minimise these impacts. Monitoring has been increased.

Sand Deserts
An increase in camel populations along the western border regions is reported.

In the Sharqiyah (Wahibah) Sands a considerable increase in livestock numbers is reported, together with vehicle use. In the past two years recreational use for tourism has also increased. The Arabian Gazelle (*Gazella gazella cora*) population of the Sharqiyah Sands has shown a sharp decline in the past ten years, exacerbated by illegal taking. (Further details of trends in this and other mammal species are given below).

Ranger protection has been increased and tourism guidelines have been drafted.

Batinah Coastal Plain
Since 1970 large areas of land have been turned to agricultural and housing development, resulting in a reduction of native tree cover and rangeland. Measures to minimise the loss of native trees on some of this enclosed land have been taken.

Batinah Coastal Lagoons, Barr al Hikman and Dhofar Coast
There has been some loss of habitat to development, although only after detailed environmental scrutiny. Earlier extensive use of the lagoons for waste dumping has now been halted and clean-up work carried out, although illegal fly-tipping still occurs occasionally.

The mangrove (*Avicennia marina)* coverage is stable, with a planting scheme projected for 1998. The decline in mangrove stands at Sur in the Sharqiyah Region, at Filam in the Barr al Hikman area of the Central Region and in some of the lagoons of the Governorate of Dhofar coast has been halted by measures taken in the past three years.

Falaj Ecosystems of the Northern Mountains
Since 1970 much work has been done to repair the traditional irrigation systems which tap aquifers to irrigate farms and date gardens. Open channel sections have been deepened and or covered to increase water flow and give protection from blockage by stones during floods, denying access to wild mammals. Open pools at sources have also been drained to reduce evaporation and increase flow. Waterfalls have been bypassed by open channels to increase efficiency and uncemented sections have been hardened to prevent leakage. The leaking sections and some open pools provided habitat for many insects, reptiles as well as food for birds.

Piping of the open channels has fortunately not been extensive, due to maintenance costs and hydraulic problems.

The process has been slow and its effect on biodiversity not yet assessed. A study proposed in the NBSAP addresses this issue.

Marine Ecosystems
Degradation and overutilisation have occurred in a number of areas, the trends and remedies described in more detail below under species sections.

Species

Much field study has been carried out in the period from 1973 to the present time, collecting data by observation and specimens which include the discovery of many new species. It has been possible to apply IUCN criteria to the status of threatened plants and mammals, some of which are considered to be critically endangered. If loss of biodiversity includes trends towards endangerment or extinction, then a distinction must also be made between national trends and those which are local to certain biogeographic regions.

Mammals - Ungulates

Arabian Gazelle (*Gazella gazella cm-a).* Thus, whilst the species is rare in the north-western regions of Oman, they are plentiful in the Central Region. Overall numbers suggest little threat to the species's survival in Oman. Good rains in the past three years have followed a serious period of drought. Browse is plentiful for this hardy species which has been observed to make a rapid population recovery once conditions are favourable.

Although some illegal taking, including live capture, has taken place in recent years, the rangers of both the Diwan of Royal Court and MRME are reporting that populations are apparently increasing. New populations are also being discovered in areas which have not previously been monitored.

Firm action has been taken against convicted offenders, especially since penalties for poaching in protected areas were sharply increased by Royal Decree on 31 December 1997. The population trend is therefore positive, as far as can be judged from recent reports.

Sand Gazelle, Reem (*Gazella subgutturosa***)**. The indications are that the species is nationally endangered, although an adequate monitoring capability has yet to be established. Therefore the species is data deficient. Living in the remotest desert regions and more shy than Arabian Gazelle, they are apparently more threatened by illegal hunting by those who travel in four wheel drive vehicles. Little data exists apart from that collected within the Arabian Oryx Sanctuary, but a small population of seven animals three years ago in the Wahibah Sands has not been seen since that time. Only one sighting has been made by rangers operating in northern Governorate of Dhofar. An action plan will be developed by the Terrestrial Mammal Specialist Group.

Arabian Oryx (Oryx *leucoryx*). Well protected and monitored by the rangers of the White Oryx Project, their population has expanded rapidly. However recent poaching incidents, mainly live capture, have had a temporary but serious impact on numbers. The population trend none-the-less is positive.

Nubian Ibex (*Capra nubiana*). The population is widespread, but no data yet exists to show the overall population trend. The species is considered to be nationally vulnerable and is threatened by illegal hunting in areas where a substantial ranger presence has yet to be established.

Arabian Tahr (*Hemitragus jayakari*). The population trend of this, Oman's only endemic large mammal, is cautiously estimated as positive. It was calculated in 1987 that in areas where illegal hunting had ceased, there was an annual 6% population increase. Substantial population increases are thought to have occurred in areas where there is active ranger protection, mainly south of Muscat in the Wadi Sareen Wildlife Reserve and in Jebel Qahwan, near Sur. Both are in the Eastern Hajar range. Reports of small and possibly fragmented populations have been received from many other areas, some of which have not previously been recorded.

Further north the situation is less clear, but no substantial populations are thought to exist. Early indications from field survey suggest a strong correlation between increased and unmanaged goat populations, particularly those which are now unshepherded, and reported local reductions in tahr numbers. Feral goat groups are reported to be increasing in some areas. This is exacerbated by a shortage of predators in these northern areas (see below). Illegal hunting is constrained by the inaccessibility of tahr habitat, but incidents have occurred recently in places where there is a substantial tahr population.

As it has to drink regularly, especially in hot weather, the protection of springs and water holes is a key element of tahr conservation action, this being addressed in environmental permit applications for projects which may affect surface water sources, **e.** g . mineral mining and quarrying.

With an animal which is apparently territorial and is never seen in groups of more than four or five animals, one has to be cautious in describing "fragmented" populations. Latest studies show that it moves long distances in search of food or during the rutting season.

Recent wet periods in both summer and winter in the northern mountains should ensure optimum conditions for populations to recover, provided diseases which are reported to afflict domestic goats during periods after rain do also affect the tahr. Some local reports suggest tahrs are susceptible to these diseases, as would be expected, but others refute this. Its territorial instinct provides a natural defence against the spread of disease within its populations.

Mammals - Carnivores

Arabian Leopard (*Panthera pardus nimr*). The small population of the Musandam region and the UAE mountains has suffered from past persecution by shepherds who suffer losses to their livestock. Hunting of its prey species and loss of food for these to large numbers of goats has probably caused it to turn more towards domestic livestock. Protected by law since 1993, much work has been done to persuade local people of its biological importance. However it is likely that its fragmented population by that time had already reached a level which is no longer sustainable. Occasional sighting reports are still received and it is hoped that the highly broken terrain of its habitat may still conceal a larger population than can be confirmed at present.

further halt any decline. The matter is addressed in the NBSAP and included in the Critical Mammal List being developed by the Terrestrial Mammal Group.

Other Mammals. Other species are either widespread, unthreatened or data-deficient. The precautionary principle is being applied to those taxa which are data-deficient and uncommon.

Birds

The number of birds and bird species recorded in Oman has increased substantially since 1970, due to better roads and an increased number of birdwatchers. Recorded bird numbers reached almost 400,000 in 1989, with species recorded reaching 329 in the same year. (441 species are recorded in the Oman Bird List. 109 of these have been reported less than 10 times and 49 have been reported only once.) Since then records have remained reasonably constant, at between 400,000 and 486,000, with an exceptional peak of 732,000 in 1991.

Nothing within these figures suggests that there has been an overall loss, although threats to a few individual species have been identified mainly caused by habitat loss and illegal hunting. The level of annual birdwatching activity to produce these records has not been quantified. 14 recorded species are known to be globally or nationally threatened.

The Sultanate of Oman is in the process of becoming a signatory to the Ramsar Convention, which carries with it the obligation to designate a specific wetland site. A proposal is under consideration. Public awareness and ranger activities have been focused on preventing illegal hunting.

Turtles

Studies on the Green Turtle (*Chelonia mydas*) up to 1991 have indicated that the population loss caused by hunting for meat, egg collection and accidental deaths in fishing nets were considerably higher than that which would allow the present population to be sustained.

Measures introduced to reverse this trend include legal protection of all turtle species, law enforcement by an expanding ranger organisation, an ongoing and expanding public awareness programme and a publicised award made for a turtle rescued when it was found entangled in a fishing net. However further measures are needed and are being studied. Programmes of monitoring and tag-and-release are ongoing at the Ra's Al Hadd Turtle Reserve, designated by Royal Decree and under management planning.

Fish

A total of 1,142 species have been identified in Oman's territorial waters, of which more than 400 are demersal (511 of which are from coral reefs and coastal lagoons), 2 mesopelagic, 157 pelagic, 30 bathypelagic and 7 are bathydemersals. Current fishing levels are either close to the maximum sustainable or have exceeded it. 4 freshwater species occur in Oman.

Traditional fisheries form about 85 % of the total fish production the remaining 15 % by industrial fisheries. In the ten year period from 1985 to 1995 fish exports rose from less than 20,000T to about 60,000T. In almost the same period the number of fishermen increased from 12,000 in 1985 to 25,575 in 1996, an annual average

increase of 8%. The result has been that the annual catch per fisherman has decreased by about 50%, from 6.64 to 9.37T in 19851990 to 3.4 to 4.72T in 1994-1995. Many high value fish have shown considerable declines. Kingfish (*Scomberomorus commerson*), for example, contributed only 14.4% of the large pelagic catch in 1995, compared with 38.4% in 1988.

Studies are continuing and a management plan for the Kingfish is being developed. Strict regulations are applied to industrial trawler fishing and others are being further developed for artisanal fishing. A pilot aquaculture project started in 1996, with tanks at the Marine Science and Fisheries Research Centre and cages in a coastal lagoon near Muscat. The first harvesting took place in late 1997.

Corals

A steady decline in the quality of coral reefs due to degradation by fishing nets, litter and indiscriminate anchoring has led to action which should now reverse the trend. Some predation by Crown of Thorns Starfish has been detected. Conservation measures now being implemented are described below.

Plants

Whilst the overall population of native plants has inevitably decreased due to land-take for development during the period from 1970, the diversity of species is not so far thought to have decreased significantly. A sharp decline in most of the grass species was noted in the hills of Dhofar in the period 1989-1995 and no change in conditions has occurred since then which would have halted this decline. One plant, *Caralluma tuberculata*, subject to further checks has disappeared from its only known habitat and a second plant can no longer be found in the wild, although it is known to be thriving abroad following collection and export for scientific purposes. A third, Delphinium *pencillatum*, collected in 1838, is identified as extinct. Several attempts have been made to locate it but it has not been collected since. A fourth plant, *Caralluma edulis*, has been removed from its only known Northern Oman habitat, probably due to a minor unpermitted development project improving access to the site. Its single Dhofar population is thriving within a newly designated protected area.

Some 11 species are currently considered to be endangered or critically endangered, out of 1204 occurring in Oman. Of this total, 58 species are endemic and 38 regionally endemic, with a further 10 as yet undescribed.

Damage to native woodlands by illegal felling for fuel and illegal cutting of branches to extract fodder for domestic livestock has been brought under control in the past three years, by increased monitoring and enforcement. A break in the drought conditions during the seven year period to 1995 has also improved browse and grazing, reducing the pressure on trees.

An unquantified increase in indigenous invasive and unpalatable plant species, such as *Tephrosia apollinea* and *Dodonea viscosa*, has been observed in areas grazed by domestic livestock and is regarded as an important indicator of overgrazing.

Invasion by imported *Prosopis juliflora* has reached serious proportions.

Action taken to conserve Oman's flora has included the drafting of a critical list of 137 taxa, using IUCN Red List categories. This constitutes 11.5 % of the total flora, of which 66% occurs in the southern Governorate of Dhofar. This is now under

development by the Plant Specialist Group, as part of an action plan for plant conservation, within the NBSAP.

The designation and implementation of protected areas, including Khawr Mughsayl, gives increased protection to these species. Project scrutiny under the environmental permit procedure also takes these threatened populations into account.

MAJOR CAUSES OF IN-SITU BIODIVERSITY LOSS

Direct Causes of Biodiversity Loss

Overgrazing

Plant numbers and local diversity are being reduced, though overgrazing by increased domestic livestock numbers including feral donkeys. Improved animal health, through extensive MAFR programmes of regional husbandry training by field staff, vaccination and active veterinary care, has reduced livestock losses. This has impacted on the food supply for wild ungulates and, consequentially, on the wild food of carnivores. It is causing serious loss of habitat for many wild mammals, reducing birth rates and successful rearing because of a loss of milk supply under conditions which may already be marginal.

Changed livestock management practices, already described, coupled with the virtual extinction of the wolf in northern areas, increase the likelihood that a proportion of goats will stray to inaccessible areas, meet others and breed in the wild. Already small groups have been reported in several areas and connected by local people to the loss of the tahr.

Measures Taken
A detailed land use study of the Dhofar mountain rangelands, specifically targeting the overgrazing problem, has recently been completed and is awaiting funding and implementation.

A full agricultural census was carried out in 1993, a more comprehensive study than that carried out in 1982, which gave important guidance as to the carrying capacity of various types of rangelands.

A development plan for the Jebel Al Akhdhar was approved for implementation in the Fourth and Fifth National Development Plans, which includes rehabilitation of degraded pastures.

Protected areas have been designated by Royal Decree, since 1992, covering over 30,000 sq km of mountain and desert rangeland. Management planning is nearing completion and implementation is awaited. Management planning will-specifically address overgrazing where it is occurring.

Oman has ratified the Convention on Desertification and a steering committee has been formed.

Measures Proposed
The NBSAP specifically addresses this issue in the action plan. including an agreed project under the National Conservation Strategy (Strengthening Services of Range Management, Reforestation and Halting of Desertification).

Loss of Habitat through Land Taken for Development

Inevitably an increasing human population, with expectations of a continued improvement in their standard of living, has required the establishment of an infrastructure of roads. Housing, schools hospitals and clinics, and more recently industry has required land for development.

Intensive agriculture has expanded, with the establishment of large farms, especially on the plains of the Batinah Region, the Salalah Plain, the Negd of northern Governorate of Dhofar and the Interior Region. This has also involved the felling of mature trees, mainly Acacia spp. but also *Prosopis cineraria,* replaced by economic crop monoculture but also including diverse native and exotic fruit tree taxa.

The overall annual increase in land under cultivation in the Sultanate of Oman was 2.276% between 1993 and 1996, but local increases are constrained by availability of irrigation water. The issue of new well permits in all regions is now strictly controlled by the Ministry of Water Resources (MWR). The use of pesticides on fruits and crops fell between 1994 and 1996 (59%: fruit trees, per tree, and 38%: field crops and vegetables, per hectare); the tonnage of chemical fertilisers distributed to farmers has also fallen between 1994 and 1996 (49.5 %); both tending to reduce potential pollution, especially of underground aquifers.

Diversification of the economy away from dependence on oil revenues has further increased the pressure on land use, for industrial expansion and tourism, the latter providing economic rationale for nature conservation. The exceptional and diverse landscape forms a foundation for almost all types of tourism, whilst opportunities for the sustainable use of wildlife for tourism are under development.

This loss of habitat has mainly affected the population of common species, as sensitive areas have been protected by environmental permit procedures.

Measures Taken
The increased application of Royal Decree No 10/82, together with improved monitoring of compliance with permit conditions, has had given essential protection to habitat, site sensitivity being taken into account.

Measures Proposed
Additional guidelines for EIA procedures and for the projects themselves, together with early consultation procedures, are currently in the final stages of consultation. Further guidelines are contained in management plans for specific designated protected areas.

Overuse of and Damage to Coastal and Marine Ecosystems

More intensive fishing, using new methods and equipment, also leading to more activity around coral reefs, has led a drop in catches by coastal fishing communities and a degradation of reefs from discarded nets and fish traps, anchor damage and litter. Expanding recreational use of some coral reef areas by divers and sporting fishermen has also added to this problem in some areas, mainly near Muscat.

Turtle losses through net catches, direct impact by boats and illegal hunting (Green Turtles only), described above, have also caused a reduction in the population of at least four of the five species which occur in Oman.

Over-exploitation of inland water resources in the early 1980s caused serious saline intrusion in the Batinah Region. This appeared to be more detrimental to agricultural production than to native plant or other wildlife biodiversity . A number of major recharge dams were constructed across principal watersheds, to slow down fresh water flow after rain and stem the saline intrusion. This has denied some coastal lagoons from being flushed by flood water and has reduced the flow of fresh water within the lagoons. The ecosystems which they supported cannot now be sustained. Plans to restore some of the lagoons, including planting mangroves to lagoons from which they have disappeared, have been abandoned.

Measures Taken

The Coastal Zone Management Plan has drawn attention to these problems. A coral reef survey in 199611997 produced a more detailed picture and it was quickly followed by a Coral Management Plan and the implementation of the first phase of a clean-up campaign, involving local fishermen and diving clubs.

Several studies of turtles have been carried out, giving warning of the potential for population losses, the last being a re-evaluation of data collected in 1991.

Ranger monitoring has been increased, ongoing public awareness measures implemented and an exemplary and much-publicised reward paid for a citizen who rescued a turtle entrapped in a fishing net.

Designation of the Ra's Al Hadd Turtle Reserve and the Dimaaniyat Island Nature Reserve, with management planning now complete and implementation already under way, gives further important protection to the biodiversity of these key ecosystems.

A plan to restore some coastal lagoons on the Batinah Coast has financial approval and is close to implementation.

Measures Proposed

The further development and training of the ranger units, increased public awareness measures targeted at local communities, further studies to update the 1991 turtle data and co-operation with MAFR to implement modifications to the permissible range of fishing equipment, are planned.

Continuation of research by the Marine Science and Fisheries Centre (MAFR) and the Department of Fisheries Science and Technology Centre, SQU is planned.

Further implementation of the Coastal Zone Management Plan, the Coral Reef Management Plan and of management plans for the recently designated coastal and marine protected areas are also planned.

Invasive Species

Invasion of habitat by fast growing exotic plants has already caused serious concern, because of their effect on habitat of native plants and the consequential loss from the food chain of wild fauna.

Invasive native plant species, mostly unpalatable to herbivores, are spreading in areas heavily used by domestic livestock, inhibiting the growth of palatable species and further reducing habitat.

Potentially invasive exotic birds have recently been recorded, especially the Common Mynah (*Acridotheres tristis*).

The donkey has largely been replaced by mechanical transport and its use now reduced to a few mountain regions and some areas of the Batinah Coast. Redundant animals have been turned loose, with the result that large groups of up to 15 feral animals are now roaming wide areas of northern and central Oman. Mountain herds formerly owned by pastoralists as breeding stock, are also thriving, with little offtake for domestic use. The number of young animals amongst the groups suggests that they are breeding rapidly. They are removing habitat from wildlife, as well as that of domestic animals of economic value, by contributing to the overgrazing problem.

Feral dogs are present in visible numbers in some areas, including coastal lagoons where they are a threat to birds, mainly through disturbance. Hybridisation with wolves, although no case has been proven, may occur and at least one captive "wolf" in 1976 was considered by some to be a dog hybrid. Feral and domestic cats are present in large numbers in some urban areas. They present a serious threat to the genetic purity of the Gordon's Wild Cat and one such hybrid is currently in captivity. Feral and uncontrolled domestic dogs, as well as feral and domestic cats also threaten wild fauna directly by predation of birds, reptiles, hares and ungulates, especially young animals.

Overall, unchecked invasive species represent a serious threat to biodiversity through loss of habitat to those species which are wanted. The actual loss of biodiversity caused by invasive species has not been quantified. Feral cats and dogs both prey on wild fauna and directly threaten the genetic purity of the Gordon's Wild Cat and the Arabian Wolf, as well as predating wild fauna. They can also act as carriers of rabies and parasites such as *Taenia hydatigena.*

Measures Taken

Attention has been drawn to the threat of invasive exotic plant species, through public awareness measures, with a view to drafting new legislation to control the import of exotic plants.

Control of feral dogs is carried out periodically by the Royal Oman Police and the regional municipalities. he control of feral cats is carried out by the regional municipalities, by live trapping and humane destruction.

Measures to overcome overgrazing, the main cause of invasion by native plant species, have already described earlier,

Measures have been taken periodically to control feral donkeys in some areas.

Measures Proposed

A fuller evaluation of all problems caused by invasive species is planned and a multidisciplinary Invasive Species Specialist Group is proposed in the NBSAP. An effective monitoring programme is proposed.

Careful account will be taken of the potential future sustainable use of donkeys for tourism, as well as other possible uses. Their presence in view of main roads, although presenting a traffic hazard, has strong aesthetic appeal which will not be overlooked as a benefit to tourism. Ideally, methods of ensuring that they are managed and that their numbers remain sustainable will be developed. It is a

priority to ensure that the Oman races are preserved for future use by man if other types of transport become uneconomic.

Anthropogenic Disturbance to Wildlife

The rapidly expanding human population, wide vehicle ownership and use, traffic on an expanded road network, including minor roads to permanent settlements which were previously inaccessible, aircraft movement, motorised marine traffic and expanding tourism from abroad, all cause increased disturbance to sensitive wildlife species.

Although many species adapt to such disturbance when they find it is not hostile, others may not. There is evidence that the Arabian Tahr, for example, can be completely driven out of an area because of a period of new mechanical disturbance, although in the case in question the population returned some four months after the two week period of disturbance had ceased. Those species which cannot tolerate disturbance may be unable to find suitable alternative habitat with a source of food and water. Disturbance of pregnant ungulates may affect birth rates and rearing of very young animals. Continuous and sporadic disturbance by people on foot in newly settled areas may have a serious cumulative effect when added to other causes of disturbance, effectively denying habitat to wild mammals.

The effects of this major increase in disturbance have not been quantified in Oman, but by the Precautionary Principle it is assumed to have a significant long term impact on biodiversity conservation.

Measures Taken
Potential disturbance to wild fauna is scrutinised carefully during environmental permit assessments.

The programme of implementing and managing proposed protected areas will ensure that adequate habitat remains available for the survival of all native species, even though there will be an inevitable decline in animal numbers in inhabited or disturbed areas.

Measures Proposed
The only further action possible is to develop application of the environmental permit system as knowledge of the effects of various types of disturbance on wild fauna increases.

INDIRECT CAUSES OF BIODIVERSITY LOSS

Population Growth

The population of the Sultanate of Oman in 1996 was 2,214,720, of whom 1,601,884 were Omanis and 612,836 were non-Omanis. The total in 1993 was 2,018,074, of whom 1,483,226 were Omanis and 534,848. This shows an annual increase in the Omani population of about 2.7%. At the same time the number of non-Omanis has risen by some 6 % , giving an overall annual population increase of 5%. This compares sharply with the situation in 1970 when the Omani population was estimated at around 500,000, with an insignificant number of non-Omani.

The demand for land, water and marine resources to feed, house and administer this rapidly increasing population is an underlying cause of the major biodiversity losses already described.

Measures Taken

Soon after his accession in 1970 His Majesty the Sultan implemented a policy of Omanisation which has resulted in intensive programmes of education and training to enable Omanis to replace expatriates as fast as they became qualified. The rapid expansion of infrastructure in both the Government and the private sector has to some extent changed the role of expatriates in this process. Whilst Omanisation of government ministries has reached a high level, the private sector is now undergoing rapid expansion and requires numbers of skilled staff who are not yet available amongst Omanis.

The need for applicable skills rather than pure education was recognised in the 1970s. In 1997 the Vocational Training Authority was integrated with the Ministry of Social Affairs and Labour to improve programming of training in the various public and private technical training institutes. Omanisation targets have been set for all sectors and are constantly under review.

Thus Omanisation has progressed in parallel with expansion and will substantially mitigate the overall population expansion in the coming years.

A programme of public awareness of the problems of the high birth rate has been implemented, concentrating initially on the medical problems associated with low birth spacing.

Measures Proposed

The above strategies and programmes will be continuously reviewed and developed until a more sustainable population growth is achieved.

New Technology and Diversification of the Economy

The NCS recognises that modern technology has contributed to a reduction in the quantity and quality of renewable natural resources.

Fossil energy reserves are limited. Natural gas reserves are now being further exploited to provide a follow-on to the income from oil production, but they too are finite. Thus the Government is actively promoting the development by the private sector of value-adding means of using the present reserves of fossil fuel to provide more employment for Omanis and reduce the cost of government. Apart from manufacturing industries, which use raw materials available in Oman, service

industries and regional infrastructure projects such as a major international container terminal to be built in the Governorate of Dhofar, are being planned and implemented. Tourism is now being actively promoted as a potentially large contributor to the GDP.

All these projects require land, some more than others. Open-cast mineral mining, for example, consumes considerably more land for the same return to the national economy than oil or gas. Some mitigation is possible, once the deposits are exhausted, but this is considerably less effective in a desert country than in temperate climates where the land can be restored and natural vegetation restored. The landscape is an important element of economic value to most types of tourism.

Thus the expansion of these economically important projects is also a major underlying cause of the biodiversity losses already described, although they may largely affect populations of common rather than rare species of flora and fauna.

Measures Taken
The environmental permit procedures already described are being applied to all development projects to ensure the minimum effect on biodiversity.

The continued programme of protected area establishment has given further strength to the process. For these purposes, proposed protected areas with known sensitive resources are treated as if they have already been designated.

Measures Proposed
Further field study of Oman's biological resources and research into the sensitivity of taxa will help to ensure that environmental impact assessment studies for major development projects produce valid results.

Evaluation of the economic benefits of biodiversity and landscape conservation will enable environmental issues to be integrated further into the national development process, ensuring that worthwhile investment is made in projects which are biodiversity-related.

ACTIONS TO ACHIEVE THE THREE OBJECTIVES OF THE CONVENTION ON BIOLOGICAL DIVERSITY

General Approaches

Introduction
The articles of the CBD form the basis of the National Biodiversity Strategy contained within the NBSAP. Throughout the period since the early 1970s action has taken which meets these articles, much within the framework of rapid development of the country. The NBSAP includes in its Introduction the conclusions and recommendations of the National Conservation Strategy (NCS). Thus, for example, it is possible to exclude pollution from the major causes of biodiversity loss. One project at Annex A carried out by SQU concerns an isolated case, when an old diesel tank leaked and polluted an aquifer affecting the irrigation supply of a village. The incident served as a sharp reminder of the potential dangers of pollution of groundwater in a desert country. Many of the projects proposed under the NCS are biodiversity related and have therefore been incorporated within the Action Plan of the NBSAP.

Ecosystem Approach

The NBSAP projects include capacity building to establish specialist groups to advise on ecosystem management, designation of further protected areas to conserve ecosystems, field study and research of ecosystems outside protected areas, and development of ecosystem monitoring procedures. There are specific projects to carry out ecosystem studies in various habitats, including rangelands, coastal lagoons , desert seepages, irrigation channel ecosystems, the impact of permitted pesticides for insect control at open water.

Achievement since 1992

Over 30,000 sq km of land and coast has been formally designated by Royal Decree since 1992, for most of which management plans have now been drawn up and await full implementation. These include desert, marine and coastal ecosystems and many threatened species. The process is continuing. Future targets include most of those proposed by the IUCN studies in the 1980s and others which have since been identified.

Precautionary Approach

The Precautionary Principle (in its widest environmental sense) lay at the heart of the rationale behind Royal Decree 10/82, even though this law was ratified long before the CBD was drafted. All decisions to designate the protected areas already mentioned were made without full scientific knowledge. Designation was made on the basis of a reasonable amount of data of the ecosystems and species contained and the threats they faced. Further scientific studies form an integral part of the management planning process and the plans themselves.

For example, populations of the Arabian Leopard and its prey species (which include the Nubian Ibex) had been confirmed to exist in Jebel Samhan, without any knowledge of the size of these populations. The area was designated in 1997 as a national park and management planning is in progress. During this period a scientific study of the leopard commenced which is expected to provide information relevant to its conservation and management. During this study the presence of the Striped Hyaena has recently been confirmed, adding to current knowledge of ecosystems of the area.

Lack of full scientific certainty has played no part in preventing measures being taken to address known threats to biodiversity. Only capacity and financial resources have acted as temporary constraints.

Adaptive and Cyclical Planning Approach

Within the Directorate-General of Nature Reserve a simple cyclical and adaptive planning has recently been established, although it is too early for the cycle to have been completed. Three examples from case history are as follow:

a. **Species. (e.g.** Arabian Leopard (*Panthera pardus nimr*). Baseline data> production of species action plan (multi-disciplinary specialist group) > implementation > new data collection/monitoring > review and update of species action plan by specialist group > implementation of changes

b. **Protected Areas. (e.g.** Jebel Samhan National Park). Baseline data> update studies > selection of priority area for designation> collection of new field data > interministerial consultation > legal designation > collection of further field

data/local consultation > production of protected area management plan > implementation > feedback of data > review of management plan

c. Ecosystems. (e.g. Coral Reefs). Baseline data> Comprehensive study> production of management plan> pilot implementation (coral reef clean-up campaign- phase I) > full implementation> monitoring > review of management plan

Protected area designation includes full consultation with stakeholders (relevant government ministries, private sector companies (where applicable) and local residents).

Information Management Approach

Although much study has been carried out, data is held in various forms by various organisations and private individuals. There is no single point of access to this data. This is a constraint on the environmental permit vetting process and commercial consultants who need access to data for obligatory environmental impact studies. Whilst it does not lower the quality of EIAs, it wastes professional working time.

The National Herbarium Database of the Oman Natural History Museum is in the process of being placed on computer. A national fish database has recently been established by the Department of Fisheries Science and Technology at SQU, including species occurring in neighbouring countries.

One of the main components of the forthcoming Biodiversity Enabling Project is to advise, set up and train staff to run a Biodiversity Conservation Information System (BCIS) within the Directorate-General of Nature Reserves, to link and access all the master biodiversity databases in Oman.

Participatory Approach

The following ministries are directly responsible for implementing projects contained in the NBSAP:

a. Ministry of Regional Municipalities and Environment (MRME)

b. Ministry of Agriculture and Fisheries Resources (MAFR)

c. Diwan of Royal Court (DRC)(Office of the Adviser for Conservation of the Environment (ACE), Directorate-General of Agriculture and Veterinary Services)

d. Ministry of National Heritage and Culture (MNHC)(Oman Natural History Museum)

e. Sultan Qaboos University (SQU)(College of Science, College of Agriculture)

Others are closely involved in projects relevant to biodiversity conservation, e.g. Ministry of Water Resources (MWR), Ministry of Health, Sultan Qaboos University (College of Medicine)

The projects listed at Annex A under each organisation, whilst not complete, show clearly the extent to which other ministries are involved in the process of

implementing the articles of the CBD. Those listed are the ones have been completed or have been started during the period since 1992, following Oman's accession to the CBD and form part of the NBSAP Action Plan. They give some indication of recent or current activity and the commitment of Oman towards implementing the NBSAP.

Annex A also lists the projects being implemented by MRME, or completed since 1992.

General Protective Measures

Many measures are already incorporated in legislation, within or developed from Royal Decree 10182. Capacity to enforce this legislation has steadily been expanded under the Directorate-General of Environmental Affairs (DGEA), MRME, which has specialist sections dealing with, inter *alia*, air and noise pollution, solid waste management, chemical substances, water pollution and marine pollution, as well as the Environmental Planning and Permits Section which is the focal point for all environmental permit applications. Monitoring of pollution and compliance with environmental permit conditions is carried out by these sections directly or by their regional staff. The latter co-operates closely with the Directorate-General of Nature Reserves, especially on development projects which may impact on biodiversity. Both Directorates-General co-operate closely and also provide technical support to the Directorate-General of Environmental Affairs, Governorate of Dhofar, which is responsible for implementing biodiversity conservation and for pollution monitoring and control within the Governorate. DG of Environmental Affairs, Governorate of Dhofar also maintains close liaison with stakeholders of other ministries and organisations in that region. All three directors-general report to the Undersecretary for the Environment.

PRIORITIES FOR ACTION

The NBSAP is still in its early stages of development. Major issues are addressed within it without orders of priority yet assigned to them. The list of terrestrial mammals has however been placed in a provisional order of priority for action planning. A list of Oman's critical mammals is under preparation and one has been drafted for flora. Priorities for designation of protected areas have not been fully re-examined following the recommendations of IUCN studies from 1985 onwards. Progress in this field is constrained by lack of capacity. However some progress is being made in increasing human resources and more Omani graduates have recently joined the MRME. An environmental planner has recently been appointed to the DGEA

Priorities for implementation of biodiversity projects which are the responsibility of other ministries will of course be decided by them, with increasing co-operation with MRME as the specialist groups and the BCIS are further developed.

Current priorities for major environmental studies and expansion of institutional capacity have generally been guided by the NCS.

TARGETS

The NBSAP does not yet list targets or timetables for project implementation. Tight control of government expenditure, even within the targets of the current 5-year development, makes it unrealistic to plan a lavish programme of projects which may not be funded in the planned time scale. The current fall in oil prices has further chastened the situation. However there are financial provisions for biodiversity capacity building and protected area implementation in the present 5-year development plan. Progress is being made and will continue. Only the timing is still to be resolved. The Biodiversity Enabling Project should improve the mechanisms for integrating the environment into the national development planning process.

REVIEW OF SECTORAL AND CROSS-SECTORAL AREAS

There is continuous review of sectoral plans and programmes, circulated to MRME as part of an ongoing environmental consultation process between ministries. They cover a wide spectrum of activities, not limited solely to development projects. Recent illustrative examples include:

a. National Tourism Strategy
b. Tourism Implementation Plan
c. Proposed new mining law
d. Regional and subregional development plans
e. Key town structure plans
f. Village infrastructure development plans
g. Cave survey for tourism development
h. Geothermal spring survey for tourism development
i. Economic development of the Batinah Region (a strategic consultation exercise)
j . A proposed international motorcycle trial

In return, MRME has developed environmental guidelines for consultation with and guidance of other ministries, as well as for guidance of prospective developers.

The consultation process has recently become highly effective in modifying potential impacts and regulation of resultant activity on the ground, as well as promoting understanding of environmental issues amongst officials of other ministries. Never has co-operation between ministries been closer and more effective. Likewise, dialogue with the expanding private sector has increased during the past year. Permit procedures and EIA guidelines have been further developed, with emphasis placed on early consultation at project concept stage.

As all development projects require an environmental permit before they can proceed, it would be impracticable to list them in this document. Each plan is scrutinised in detail and all those which could possibly impact on biodiversity conservation are referred for further scrutiny to the Directorate-General of Nature Reserves. Where an EIA study is required, this too is referred to DGNR for scrutiny. Therefore no plan or project can be implemented without the knowledge and advice of DGNR, who will ensure that mitigation measures are defined for inclusion in the permit conditions where necessary to protect biodiversity.

INTEGRATION OF BIODIVERSITY CONSERVATION AND SUSTAINABLE USE INTO SECTORAL AND CROSS-SECTORAL AREAS

The National Conservation Strategy was drawn up and finally approved in 1996. Its main recommendations included the following (summarised from the unofficial English version):

a. That there should be increased and sustained investment in the conservation of natural resources and protection of the environment.

b. That subsidies need to be restructured to reduce overuse of natural resources and be linked to conditions which promote conservation and environmental protection.

c. That there should be moves to integrate development planning and administration with environmental planning and management.

d. That resource-based development and environmental protection should be the business of Omanis at all levels and in all sectors.

Specific projects contained within the NCS address the integration of environmental considerations into socio-economic planning, integrated land use plans, increasing public awareness of environmental issues and the establishment of environmental staff in other ministries.

Thus this issue is enshrined in Government policy and contained within the NBSAP. Implementation has been to some extent constrained by lack of finance, although a strong public awareness programme is continuing to broaden its impact throughout the regions of the country.

SUSTAINABLE USE

The aim of the NCS is the realisation of sustainable and environmentally sound development throughout the Sultanate of Oman. Thus sustainable use is enshrined in Government policy. The CBD definition of sustainable use is incorporated in the introduction to the NBSAP.

The term is continually incorporated in material used in public awareness programmes.

Specific measures contained in the NBSAP include:

a. Promotion of projects to provide evidence of the economic benefits of sustainable use for financial decision-makers.

b. Address sustainable use of coastal regions (through the Coastal Zone Management Plan).

c. Inclusion of sustainable use in the terms of reference of each of the taxonomic and disciplinary specialist groups (in co-operation with the IUCN SSC Sustainable Use of Wild Species Specialist Group).

d. Specific programme to include sustainable use of coral reefs for tourism and recreation, as well as conserving them for sustainable fishing, contained within the Coral Reef Management Plan.

e. Projects to address overgrazing and overfishing, establishing sustainable use of these resources.

f. Specific programmes to encourage sustainable use of wildlife for tourism, e.g. Ra's al Hadd Turtle Reserve and the Arabian Oryx Sanctuary.

g. Basic research into the utilisation of natural resources, contained in the NCS.

h. Study of traditional Omani practices for the sustainable use of natural resource.

Progress has been made on a number of fronts, including expansion of visitor facilities at Ra's al Hadd, a pilot scheme for tourism in the Arabian Oryx Sanctuary under discussion with tour operators and a new GCC-sponsored environmental film project, which includes footage highlighting the Omani traditional *Hamiyah* system of protected areas for sustainable use of plant resources.

A law is in force which prevents the cutting of live trees, enabling them to remain available for browsing animals. Enforcement is now widespread and effective. The sale of firewood is markets has been forbidden in at least one region. A number of legislative measures are in force to regulate fishing, including a system of permits for commercial and recreational fishing. These are well monitored, often by local fishing communities.

EQUITABLE BENEFIT SHARING

The current benefits of biodiversity are shared equitably through the following policies and mechanisms:

a. Employment of field staff, especially wildlife rangers is directed towards local communities. Rangers are recruited from the areas in which they work, sufficiently close to their homes to enable them to live at home in between their periods of official duty. This is both for good social and management reasons, as well as to strengthen co-operation with local communities.

b. Guidelines for tour operators setting up projects within protected areas, such as the Arabian Oryx Sanctuary, require that maximum financial benefit be given to local communities through the purchase of local food, employment of and training of local people as tour guides, and the provision of services such as hired transport and camel rides by local communities.

c. Local investment and management is fostered by encouraging local people to build tourism infrastructure facilities, such as hotels, resthouses, shops, restaurants and cafes.

d. Although this is at an early stage, local contractors are sought where possible for the construction of government infrastructure projects for wildlife conservation.

PUBLIC OUTREACH AND AWARENESS

The NCS recognises that economic and social development has hitherto led to an illusory public perception of virtually unlimited resources. Thus specific projects address the need to increase public awareness of the importance of environmental protection.

The NBSAP reaffirms and strengthens this, including planning action to continue to strengthen programmes of environmental awareness, through the media, books, leaflets and posters, exhibitions, regional seminars and ranger contact with local communities in areas of high biodiversity, especially in the range areas of threatened species. Incorporation of nature conservation and related environmental issues, as well as promotion of the use of native trees for landscaping, are also contained in the NBSAP Action Plan.

Much activity has taken place to implement this action in recent years and the process is increasing steadily. Support is given by the private sector to fund much of the written material. In a situation where capacity is limited within MRME it remains an area of high priority for expenditure. Because of the high priority to protect certain predators, much effort in the field is being focused on tackling this difficult issue.

Much focus is directed on the Islamic principles which govern the conservation of natural resources, in conjunction with promoting scientific and economic justification for biodiversity conservation.

ON-THE-GROUND IMPLEMENTATION

The main thrust of the NBSAP is directed towards action on the ground, so resources are not squandered on esoteric policy issues. The participatory process of establishing protected areas has already been described in detail. The Directorates-General of Regional Municipalities and Environment play an integral role in the day-to-day management of the wildlife rangers, their work inside and outside designated protected areas. Their presence in all regions for the management of municipality affairs considerably strengthens the MRME's overall interface with local communities. Whilst project planning is done centrally, much of the consultation work is carried out by regional staff. In addition they have identified small areas of natural beauty and established picnic facilities, providing an added bonus to the main programme for protected areas. They also have environmental staff whose role includes the issue of minor environmental permits, checking that environmental permit conditions for major projects are complied with by contractors and monitoring pollution.

CO-ORDINATION AND FOLLOW-UP PROCESS

The NBSAP includes review mechanisms for species action plans, assisted by the specialist groups, and management plans by DGNR staff. However it is generally too early in the process to give specific examples of the review process. There have been several follow-up surveys and reviews carried out in Oman prior to 1992. For example turtle data contained in an earlier study was re-examined using new techniques in 1991 by staff at SQU. The 1976-78 Arabian Tahr study was followed by a follow-up field study and analysis of data collected by rangers since the first study ended, enabling an annual population increase to be estimated.

Thus whilst the review process is well understood and established, further implementation and capacity building is required.

LONG-TERM CAPACITY

The NBSAP attempts to give a realistic programme suited to Oman's short and medium term needs. It aims for action and seeks a clear and simple way forward, whilst recognising the complexity of the issues involved in the long term.

Therefore it nominally addresses a period of approximately seven years, based on the rationale that purposeful discussion on each 5-year development plan's needs takes place within the two years before each 5-year plan starts.

Long term strategy is continually examined by the Government in a number of fields, such as the Economic Strategy Vision 2020 presented in 1995 at seminar which looked at future economic possibilities. The NCS examines long term issues and proposes long term strategy. However the introduction of detailed long term strategic issues into NBSAP at this early stage would do no more than cloud the pressing short term issues to be addressed. The performance of an effective and easily understood NBSAP will enhance future discussion on long term needs.

FINANCIAL CAPACITY

The NBSAP at its present stage of development avoids proposing detailed financial capacity needs. Once technical and administrative scrutiny and consultation processes have been completed, including an order of priorities for implementation, then the plan can be costed.

A budget already exists within the present 5-year development plan, which covers issues addressed in the NBSAP including implementation of management plans for protected areas. The NCS also has a financial annex, but the programme for funding has not yet been determined.

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Plus numerous internal MRME reports in the period 1994-1997.

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Ministry of National Heritage and Culture (Oman Natural History Museum)
Ministry of Agriculture and Fisheries Resources
Sultan Qaboos University (College of Agriculture, College of Science)

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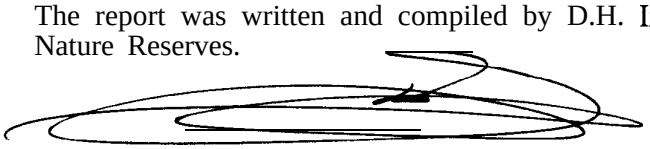
The report was written and compiled by D.H. Insall, of the Directorate-General of Nature Reserves.



Dr Mehdi bin Ahmed bin Jaaffar

Director-General of Nature Reserves **31 December 1997**

ANNEX A

SOME OF THE BIODIVERSITY-RELATED PROJECTS CARRIED OUT OR STARTED SINCE 1992

PROJECTS UNDER THE AUSPICES OF MRME

Directorate-General of Public Awareness and Guidance
In addition to regular media activity, including weekly TV and radio programmes, an environmental magazine, posters, booklets, leaflets, children's painting competitions, seminars, lectures, press releases and articles (both regionally and nationally):

a. Completion in 1996 of NCS Project ENR (18): A Study of Attitudes and Behavioural Patterns of Omanis in Relation to their Environment.

b. Production of a series of books aimed at introducing young people up to university entrance level to biodiversity topics, including the environment in general, native trees, turtles, birds, mammals etc.

c. Production of a general book for children: "Fifty Things you can do to Help the Environment".

d. Production of colouring books for children, describing Oman's wild fauna.

e. Production of a reference book on the environment in Oman.

e. Support for four environmental films on Oman, including "Oman, Jewel of Arabia" due to be released in February 1998 by the BBC, focusing on wildlife and conservation issues.

Directorate-General of Environmental Affairs

Marine
Oman National Coral Reef Management Plan. This began in 1996 with a comprehensive study of the current status of coral reefs and is ongoing. The aim of the plan is to ensure that the coral reefs are used sustainably and that their various uses (fisheries, tourism, recreation, coastal protection, scientific study, marine biodiversity and marine ecology) are compatible. Management is to be achieved by active participation of all stakeholders in the use of corals, from recreational divers to local fishermen.

A pilot scheme has been set up at the Juzur ad Dimaaniyat Nature Reserve and the Coral Reef Clean-up Campaign Phase I was completed there and in the Muscat area in 1997. Similar schemes will be set up elsewhere, at sites listed in order of priority. Further detailed plans will be drawn up for specific areas.

A trial scheme to create artificial coral reefs is also in progress as part of the plan.

A study of Hydrodynamics and Sediment Dynamics of the Ghubbat al Hashish is continuing as an M. Phil. thesis.

A further phase of the Coastal Zone Management Plan was completed in 1994.

Waste Management
A major study, including an inventory of all solid waste disposal sites, followed by a management plan, has been commissioned, as further protection against pollution threats.

Further biodiversity-related field studies have been carried out by consultants as part of EIA procedures during the period.

Air and Noise Pollution
A study of the effects of climate change on the environment of Oman is at the tender stage and incorporates an M.Sc. dissertation by an Omani graduate.

Desert Rangeland Ecology: Off-road Vehicle Driving Impacts
A study entitled "Ecological Impacts of Off-road Driving in Oman" was carried out in 199611997 by an Omani graduate for an M.Sc. dissertation. It comprised a study of biota (annual plants) and their relationship with their environment (abiota - the soil). This addressed concerns over increased off-road driving in desert rangelands, both for recreational purposes and by pastoralists. The project covered four main aspects:

a. Rainfall infiltration through tracks at various degrees of vehicle impact.

b. Seed density.

c. Soil organic matter.

d. Growth of annual plants.

The results point to the further studies which are now required to extend understanding of the impacts, as well as to measures necessary to prevent damage to sensitive areas.

Directorate-General of Nature Reserves

14 protected areas have been proposed for designation and have been promulgated by Royal Decree. Further field studies have been carried out. Management planning has been completed for some (The Arabian Oryx Sanctuary, Ra's al Hadd Turtle Reserve, Juzur ad Dimaaniyat, 9 coastal lagoons in the Governorate of Dhofar) and is in progress for Jebel Samhan. Meanwhile implementation is already in progress for some of the areas.

Field studies for other proposed protected areas have been carried out and are ongoing.

Ranger units were expanded in 1995. They were equipped and received preliminary training. The expansion and training process has continued each year since then, with the result that much useful wildlife data is now being gathered in key habitats. The process is ongoing.

An ongoing project to tag, record and release turtles is being carried out in the Ra's al Hadd Turtle Reserve, as part of an ongoing monitoring programme, including exchange of data with other Indian Ocean Rim states.

On the other hand, in the Governorate of Dhofar there is evidence of a scattered population throughout the mountain region. Much work is being done to increase public awareness of the importance of the species there and some of those who feel their livestock is threatened have reported their fears to the Government rather than break the law. Illegal killing is therefore thought to have declined. It is too early to say whether or not overall numbers have increased, but recent measures have probably stabilised the population. The designation of Jebel Samhan as a National Park is the most important recent step taken for Arabian Leopard conservation.

Caracal (*Caracal caracal schmitzi).* This species appears to be more successful than other predators, despite persecution. Even taking into account the fact there is now wider reporting than before 1992, at least three recent sightings have been reported in areas from which it has not been seen for many years. There is a popular belief in Musandam that numbers have increased in the past three years. The population trend may therefore be positive, its current distribution being widespread.

Gordon's Wild Cat (*Felis silvestris gordoniensis***).** This subspecies is now apparently much more widespread than previously thought, although threatened by hybridising with domestic cats, with some persecution reported in areas not yet covered by ranger activity. One such hybrid is in captivity at the Breeding Centre for Omani Mammals. There is no evidence of a decline in numbers.

Striped Hyaena *(Hyaena hyaena sultana).* This species appears to have suffered decline since 1970 throughout its former range in northern and central Oman, although its widespread occurrence in the Governorate of Dhofar has recently been confirmed. The matter is addressed in the NBSAP and included in the Critical Mammal List being developed by the Terrestrial Mammal Group.

Arabian Wolf (*Canis lupus arabs***).** From ranger monitoring and other sources, the indications are that since 1970 the Wolf has become extinct in areas northwards from the Jebel Al Akhdhar to the Musandam. Flock predation by wolves has recently been reported in two areas of the Jebel Al Akhdhar and has been sporadically reported throughout the remaining areas of the northern mountains, throughout most regions along the east coast and in eastern areas of the Governorate of Dhofar, where incidents are reported frequently. Several ranger sightings have been made in the latter areas.

However there have been predations blamed on wolves which were almost certainly caused by feral dogs, which have increased their numbers in some areas despite some measures being taken to control them. To add further to the uncertain status of the wolf, at least one captured live in 1976 appeared to be a wolf-dog hybrid and others now in captivity show variations which may or may not be the result of hybridisation. Genetic sampling may resolve the uncertainty.

Where there is a wolf presence, such as in the Wadi Sareen Tahr Reserve, many flock owners bring their animals into secure enclosures at night for protection. Thus its presence often has a beneficial effect on the control and management of livestock.

Overall there is likely to have been a net decline in the population nationally during the period, caused mainly by persecution by livestock owners. Now that killing or capture are illegal public awareness measures are being implemented to highlight the importance of wolf protection. Some compensation has been paid where livestock losses have caused hardship. Measures to conserve prey species will

A detailed study entitled “An Assessment of Options for Designating a Reserve to Conserve the Wa’al Al 'Arabi (Arabian Tahr - *Hemitragus jayakari)* in the Sultanate of Oman” was completed in 1997.

A study of the status and distribution of the Arabian Tahr was started in 1994 and is ongoing.

A study of the ecology of the Arabian Tahr through Omani Tahr experts (former hunters and pastoralists) was started in 1997 and has reached mid-point. The preliminary results are being studied to determine the extent of further interviews necessary to draw firm conclusions. As happened during the original 1976-1977 study of the tahr, it will provide an important basis for the focus of future scientific studies and the implementation of conservation measures for the survival of the species in the wild.

A study of the status and distribution of the Arabian Wolf, the Striped Hyaena, the Caracal and the Gordon’s Wild Cat is being made during the course of the same field work.

A database of Omani vernacular names for mammals was established in 1994 and its development is ongoing.

A study, started in 1976, of traditional uses of wild fauna products, including those of the Brandt’s Hedgehog is ongoing.

A study of the *Hamiyah* system of traditional Omani conservation areas, its potential application to the future sustainable use of rangelands and to wildlife conservation, started in 1994, is in progress. Field studies for the same project also record other traditional practices which promote the sustainable use of biological resources. Assistance was given to a GCC sponsored film project highlighting the *Hamiyah* system in 1997.

Various plant collections have been made during the period from 1994, establishing a number of new location records. Distribution of the orchid (*Epipactis veratrifolia)* and the *Mays* tree (*Dalbergia sissoo)* is being recorded, during field work. This work has been in co-operation with the Oman Natural History Museum, Sultan Qaboos University and overseas researchers. A significant contribution has been made to the database of Omani vernacular plant names.

A study was started in 1996 to investigate a specific method of using sea water by domestic and semi-feral goats in the Governorate of Musandam. Arabian Gazelle and Nubian Ibex have already been reported to drink sea water, but so far not the Arabian Tahr .

PROJECTS UNDER THE AUSPICES OF THE OFFICE OF THE ADVISER FOR CONSERVATION, DIWAN OF ROYAL COURT

Arabian Leopard Survey. No published research has been carried out into the ecology of the Arabian Leopard in the wild. Current knowledge is based on known kills, photographs or anecdotal evidence of varying reliability. A project was started in September 1997, based on survey and photo-trapping, to increase knowledge of the ecology of the leopard, so that its viability can be assessed and

management action taken for its conservation. Under the project data is being collected on different aspects of its ecology in the Jebel Samhan National Park.

Arabian Gazelle Census. A first systematic census of Oman's largest Arabian Gazelle population, in the Jiddat al Harasis, within the Arabian Oryx Sanctuary, was commenced in 1997 by staff of the White Oryx Project. In Phase I line transects were driven over an area of approximately 16,000 km^2 over a seven-day period in July 1997. Phase II, a winter count, will be completed in January 1998. The result of the two surveys will be analysed and published in 1998.

Arabian Tahr Feeding Study (joint DRC/SQU). The project aims to increase existing ecological data, to support designation, management planning and management of areas to conserve the tahr. It is being carried out in the Wadi as Sareen Reserve, commenced in 1973 but not yet legally designated, where a known tahr population exists. A feeding study, based on faecal analysis, is being carried out to investigate seasonal variation in food habits, food selection and food availability. Fresh pellets are being collected from the same areas each week over a twelve-month period, which started in June 1997. A reference collection of plant tissues will be developed for comparison with the faecal material using standard methods. The work is being carried out as a M.Sc. Project by an Omani student from Sultan Qaboos University. under the supervision of University staff and staff of the Diwan of Royal Court.

PROJECTS UNDER THE AUSPICES OF THE MINISTRY OF NATIONAL HERITAGE AND CULTURE (OMAN NATURAL HISTORY MUSEUM), MINISTRY OF AGRICULTURE AND FISHERIES RESOURCES AND SULTAN QABOOS UNIVERSITY ARE ENCLOSED ON THE FOLLOWING PAGES.

OMAN NATURAL HISTORY MUSEUM
ref: ES.
10 January 1998

To: Ministry of Regional Municipalities & Environment

BIOLOGICAL DIVERSITY - FIRST NATIONAL REPORT

The following projects during the four years 1994-1997 are notified for inclusion in this Report. All involve the Oman Natural History Museum (ONHM), which has been very active in assessing Oman's biodiversity, in some cases since formation in 1982. The aims of all projects are:

(1) to identify species of plants and animals in the wild in Oman; and

(2) to build up and maintain well-researched reference and study Collections of preserved specimens for use by scientists and senior students in Oman; and

(3) to prepare *Oman Natural History Museum Checklists* of Oman's fauna; and

(4) to use this information and some specimens in Museum exhibits of Oman's biodiversity to heighten public awareness; and

(5) to enter this information in Oman's Biological Diversity Database (Biological Conservation Information System).

POLLUTION

1. Marine Pollution. Assistance, particularly with bibliographical references in the Museum library, to Lt.Cdr. L I Howard, RNO, in his research for his M.Sc. thesis on marine pollution, Sep 1997. (Contact tel 6 18854).

VERTEBRATA

2. Freshwater fishes. With Dr K E Banister, BMNH, to 1990; paper in *Journal of Oman Studies Special Reporr No. 1 (1977);* then with Dr F Krupp (Forschungsinstitut und Naturmuseum Senckenberg (Biodiversitatsforschung), Germany). Reference collection, papers in *Fauna of Saudi Arabia, ONHM Checklist* No.6.1990-ongoing.

3. Cetacea

Continued research (from 1982) into (a) the occurrence and behaviour of cetaceans in Oman's waters; and (b) subspecific variation amongst dolphin species in Omani waters (Odontoceti: Delphinidae), both using the Osteological Collection in ONHM. *ONHM Checklist* No.2.

Example: by Dr K Van Waerebeek (Peruvian Center for Cetacean Studies) and V Papastavrou (Bristol University, UK) (12-22 May 1996 and ongoing). In this visit a thorough re-examination of the Collection disclosed single examples of two species not previously reported in Omani waters: Rough-toothed Dolphin *Steno bredunensis,* and Melon-headed Whale *Peponocephala electra.* A publication is in press; another is in preparation involving current observations by field workers in Oman.

(NOTE. A copy of the database of cetacean records for the seven years 1984-1992, on Database III+ by Dr R V Salm, IUCN, is held in ONHM and awaits staff and funds to transfer it to another programme and to update it from written reports collected and held by the Museum).

4. Terrestrial mammals

4.1 Assistance to the Ministry of Regional Municipalities & Environment (MRME) in the study of the distribution of Leopard *Panthera pardus nimr* in Oman, using the skulls and associated data in the Collection and database of accessions in ONHM. 1996-ongoing.

4.2 Continued assistance to Dr David L Harrison (senior mammalogist of Arabia) and MRME in helping determine the taxonomy of species extant in Oman by preserving specimens found dead, either as whole specimens or as skeletons, for critical examination. *ONHM Checklist* No.2.1982-ongoing.

4.3 Assistance to National Wildlife Research Center, Taif, Saudi Arabia (Ahmed Al Boug on 20 July 1997), in studies of the DNA of the leopard. Hairs were taken from two specimens, 0NHM1288 and 1523. (This is a repeat of examples given some years ago).

5. Birds

ONHM contributes to the current study of the birds of Oman by the Oman Bird Group by preserving specimens of birds found dead, for study and exhibition or donation of surplus specimens to other institutions eg to Paris and BMNH (eg May 1996), and for listing on the Oman Bird Record database. Suitable specimens are loaned to schools. Assists with publications eg *Oman Bird List (1994)* and *Atlas of Breeding Birds of Oman (1998);* 1982-ongoing.

Reptil ia

6.1 Snakes Preserving snakes found dead, for identification and inclusion in the Museum accession database and in the booklet *Snakes of the Arabian Gulf & Oman. The* Collection is also used by doctors and for lectures.

6.2 Vipers Assistance to Dr A S Gardner, Sultan Qaboos University (SQU) and BMNH, in the studies of the morphological differences in the Carpet Vipers genus *Echis* in Oman, using additions to the ONHM Collection. 1994-ongoing.

6.3 Reptiles Assistance to the National Museums of Scotland (Edinburgh) in studies of a wide range of vipers; donation of surplus preserved specimens of snakes found dead in northern Oman. 1996-ongoing.

6.4 Chameleons Co-operating with the BMNH, London, for the specific identification of a collection of Chameleons *Chamaelio arabicus* found dead on Masirah island and now in ONHM; and with J L Jarchow, Sonora Animal Hospital, Tucson, Arizona, USA, for their necropsy to determine the cause(s) of death. 1997-ongoing.

PLANTS

7. The following projects were in progress during the last four years, making use of the 11,500 plant specimens in the National Herbarium of Oman (ON), and its facilities (library, partly-computerised database, benches, microscope etc).

7.1 *Ziziphus* Assistance to Darrin W Duling, USA and University of Reading, UK, in his M.Sc. plant taxonomy studies in Oman on a new species of *Ziziphus* ("Qassum"), commencing with his visit to Oman and the National Herbarium from March to April 1996.

7.2 *Orobanche* Loans of plant specimens to Michael Foley, Department of Biological Sciences, University of Lancaster, UK, for his MSc thesis on the genus. October 1994-1998.

7.3 *Flora of Oman* Co-operation with Dr S A Ghazanfar, SQU, in her work on the compilation of this special volume, including the loan of specimens and use of facilities. 1992-ongoing.

7.4 Lichens Co-operation with Dr S A Ghazanfar, SQU; and Dr J David, International Mycological Institute, UK, in compiling a list for publication. This requires much collecting in the field and checking of Museum holdings and references. 1993-ongoing.

7.5 Biblical plants Co-operation with Dr Zoltan Kereszty, Institute of Ecology & Botany of the Hungarian Academy of Sciences, Vacratot, Hungary, in a book and exhibition, by provision of photos, specimens and advice. 1996-8.

7.6 *Flora of the Arabian Peninsula & Socotra* Co-operation in this ongoing project with Royal Botanic Garden, Edinburgh, and with Royal Botanic Gardens, Kew, by collecting plants in Oman and donating the top copies of each specimen for examination and determination. The entire holding of the Chenopodiaceae was loaned to K Boulos (associate editor), Kuwait, 1991-1992, for listing in this publication.

7.7 Marine algae

7.7.1 Assistance to Prof Michael J Wynne, Herbarium, University of Michigan, Ann Arbor, USA, in his research into this group in Oman's waters. 1997-ongoing.

7.7.2 Co-operation with the Marine Science and Fisheries Centre, Ministry of Agriculture & Fisheries and their contractor Berardi & Associati, Italy, in the study of Oman's marine algae of possible economic value, referring to and adding to contributions to the National Herbarium collection. 1997-ongoing.

7.7.3 Co-operation on preliminary work for the UK Darwin Initiative with Huntings Aquatics Services, York University, UK, (November 1997 for 1998?), and Plymouth Marine Laboratory, Plymouth University, UK, (December 1997 for 1999?): studies of marine algae and associated organisms (crabs, molluscs etc).

7.8 Loans Loans of plant specimens to other institutions eg six specimens of *Urospermumpicroides* to Museum of Berlin, Germany; and seven specimens of *Commiphora* spp. to Inst.Syst.Bot.Berlin.

INVERTEBRATA

8. The Museum is contributing to many studies, several of medical or economic importance. The Museum staff make field collections of certain groups, send them to specialists round the world for study, identification and publication in the scientific literature (eg *Fauna of Saudi Arabia),* and return for incorporation in the national study and reference Collection in the Museum, and listing in the *Oman Natural History Museum Checklists. The* following are examples:

Insecta

9.1 Thysanura (bristle-tails). With Dr J Irish, Head of Entomology, National Museum, Bloemfontein,

South Africa, for identification and publishing. Identified examples are returned to ONHM. 1989-ongoing.

9.2 Enhemerontera (mayflies). Two contributions were made in 1995 and 1997 to Dr M Sartori, Lausanne museum, Switzerland, for his studies and publication.

9.3 Odonata (dragonflies). With Dr W Schneider, Hessisches Landesmuseum Darmstadt, Germany, in researching the Odonata fauna of Oman, leading to additions to the Collection and to publications eg in *Fauna of Saudi Arabia* Vol.16 (1997) and *ONHM Checklist No.9.* 1987-ongoing.

9.4 Orthontera (grasshoppers & locusts). With G B Popov, MBE, BMNH, London, to identify the species in Oman and so assess their economic importance. ONHM now has a database on *ONHM Checklist* No.3, and a growing Collection and exhibition. The Collection is consulted by representatives of the Ministry of Agriculture & Fisheries. 1982-ongoing.

9.5 Orthontera (crickets). Apart from some groups which are the responsibility of G B Popov, the crickets are being studied by Dr A V Gorachov, Russian Academy of Sciences, St Petersburg, Russia. *ONHM Checklist* No.3.1995-ongoing.

9.6 Dictyoptera/Mantodea (mantids). Studies with Prof A Kaltenbach, Natural History Museum, Vienna, Austria, commenced in 1982 and ended in 1989 with the return of a complete mounted collection to ONHM. *ONHM Checklist* No.16. We continue to collect and study this group for Prof Kaltenbach's return.

9.7 Isoptera (termites). Studies took place between 1979 and 1985, involving the Centre of Overseas Pest Research (COPR, London) and Dr 0 B Chhotani, Zoological Survey of India, Calcutta, and may be continued. *ONHM Checklist* No.7.

9.8 Hemiptera (bugs).

- Miscellaneous: National Museum of Wales, UK (1992-ongoing)
  Cicadidae: Dr W Schedl, Austria (1996-7).

9.9 Neuroptera (lacewings and antlions). With H Hölzel, Austria. *Checklist No.* 15. 1982-ongoing.

9.10 Lenidoptera (moths).

9.10.1 With E.P.Wiltshire, CBE, UK, sampling the moth fauna of Oman until 1995. The collection is in the British Museum, London, but items needed in ONHM are returned as required. Latest publication (of many) is *Fauna of Saudi Arabia* Vol. 16 (1997).

9.10.2 With B Skule, Denmark, and Ole Karsholt, Zoological Museum Copenhagen, Denmark, to increase the database and ONHM Collection, and to construct an illustrated guide to the moths of Oman. *ONHM Checklist No.* 11A.1992-ongoing.

9.10.3 The first study of the day-flying moths, family Zygaenidae, in Oman was commenced with Prof C M Naumann, Museum Koenig, Bonn, Germany, in October 1997. This study continues, and will lead to a scientific and a popular publication and a public exhibition in the Oman Natural History Museum. 1997-ongoing.

9.11 Lepidoptera (butterflies)

With Dr V H Hitchings (to 1997) and Dr G Hoetz (1994-ongoing). Building a reference and study collection and database (on Access).

9.12 Trichontera (caddisflies). With Dr H Malicky, Biologische Station Lunz, Austria. Further publications in press. *UNHM Checklist No. 18.* 1988-ongoing.

9.13 Diptera (true flies).

* Most flies go to J C Deeming, National Museum of Wales, UK, (1989-ongoing) who sends them to specialists for determination, return and publication. Specialists include:

* Beeflies: K M Guichard and Dr D J Greathead;

* Mosquitoes: Dr R P Lane; and Mrs R Roberts, Sultan Qaboos University;
* Tabanidae, Asilidae, Chrysomyidae, Chyromyidae: Dr M J Ebejer, Malta (1987-ongoing);
* shoot flies and others: J C Deeming;
* biting flies: Dr J Boorman, BMNH London.
ONHM Checklist No.1, and numerous published papers.

9.14 Siphonaptera (fleas). With Dr R E Lewis, Iowa State University, USA, for determination, publication and return. 1991-ongoing.

9.15 Hymenoptera (ants). With C A Collingwood, City Museum Leeds, UK, to identify Oman's fauna and publish a field guide. *ONHM Checklist* No.5B.1982-ongoing

9.16 Hymenoptera (bees and wasps).
* Parasitic bees: to Dr M Schwarz, Ansfelden, Austria (1997-ongoing).
* Stephanidae: one special specimen is on loan to Alexandre Pires Aguiar, Columbus, Ohio, for his MSc. (1996).
* Mutillidae: Dr D J Brothers, University of Natal (1996-ongoing);
* Chrysididae: Dr H.c. W Linsenmair, Ebikon, Switzerland (1995);
* Parasitic wasps: Dr J Huber, CEC, Ottawa, Canada. 1986-ongoing.
ONHM Checklist 5A.

9.17 Coleoptera (beetles).
We have a long list of specialists who are studying the beetle fauna of Oman with ONHM, including M W Balkenohl, who receives miscellaneous specimens and distributes them to these and other specialists, who publish eg in *Fauna of Saudi Arabia:*
* Anthicidae: Dr G Uhmann, Germany (1994-ongoing);
* Aphodidae: Dr G Dellacusa (1996-ongoing);
* Bostrychidae, Lyctidae: K-U Geis, Germany (1997-ongoing);
* Buprestidae: S Bily, Czech Republic (1997);
* Carabidae: Dr M W Balkenohl (1994-ongoing);
* Cerambycidae: C Holzschuh (from 1982); K Adlbauer, Graz, Austria (1995-ongoing);;
* Cicindelidae: Dr F Cassola, Rome, Italy (1995-ongoing);
* Chrysomelidae: Dr M Daccordi, Turin, Italy (1996-ongoing);
* Dermestidae: J Hava, Czech Republic (1997-ongoing);
* Elateridae: R Schimmel, Germany (1995-ongoing);
* Hydrophilidae (and other water beetles): Dr F Hebauer, Grafling, Germany (1997');
* Melolonthidae: Dr G Sabatinelli, Rome, Italy, (1997-ongoing);
* Scarabidae: E Barbero, Turin, Italy, (1996-ongoing);
* Tenebrionidae: M Lillig, Germany (since 1995); J Ferrer, Sweden (since 1995); Dr W Schawaller, Stuttgart, Germany;
* Most families: NHM Basel, Switzerland (1989-1993).

Crustacea

10.1 Freshwater Branchiopoda With Dr G A Boxhall, BMNH from 1982; then with Prof H J Dumont, Rijksuniversiteit, Gent, Belgium, from 1987; then with Dr A Thiery, University of Avignon, France, in a study of the large branchiopods of Oman; published in *Fauna of Saudi Arabia* Vol. 15 (1996); specimens in ONHM. 1982-ongoing.

10.2 Terrestrial Isopoda. With Drs F Farrara and S Taiti, Firenze, Italy and published in *Fauna of Saudi Arabia eg* in Vol.12 (1996); *ONHM Checklist* No.12B.1987-ongoing.

10.3 Decapoda : marine crabs. With Dr R W Ingle, BMNH, from 1982; then with Dr D A Clayton, SQU, in the study of the crabs of Oman's shores. Dry and spirit collections now in ONHM. *ONHM Checklist No. 12A.* 1994-ongoing.

Acari

11 Ticks : Argasidae & Ixodidae With BMNH from 1981, then with Dr H Hoogstraal and Mrs H Wassef, NAMRU 3, Cairo. Several publications, including *Fauna of Saudi Arabia Vol.16 (1997)* and

ONHM Checklist No.20.1982-ongoing.

Arachnida

12.1 Scorpions With Dr G Lowe, USA. The number of known species has increased from 16 to about 36 in four years. A monograph and an illustrated booklet are in preparation. A representative collection of specimens will come to ONHM and to leading world museums. 1994-ongoing.

12.2 Pseudoscornions With Dr V Mahnert, National Museum, Geneva, Switzerland. From 1985-ongoing. Has led to publications in *Fauna of Saudi Arabia, ONHM Checklist* No.17, and to the reference collection in ONHM.

Chilopoda

13 Centipedes With Dr J G E Lewis, UK. Published in *Fauna of Saudi Arabia eg Vol.13* (1993); *ONHM Checklist No.* 19. 1986-ongoing.

Mollusca

14.1 Terrestrial and Freshwater With Drs P Mordan and D S Brown, BMNH, from 1982. With Dr E Neubert, Forschungsinstitut und Naturmuseum Senckenberg (Biodiversitätsforschung), Germany. 1996-ongoing.

14.2 Marine With Dr D T Bosch, Oman; Dr P G Oliver, National Museum of Wales, UK; S P Dance, UK, and Dr R G Moolenbeek, Zoological Museum, Amsterdam, Netherlands. Co-operation with many publications, including the new volume *Seashells of Eastern Arabia,* and a large reference Collection (including 87 species added in 1997, some of them new to Oman). 1982-ongoing.

Coelenterata

15 Corals With Dr F Green & Dr R Keech, Oman, 1982-1986; Dr L Barratt, York University, UK, 1983-4; Dr S Head, SQU to 1986; Dr S Coles, SQU to 1995; Dr R V Salm, IUCN, 1984-1992; and others - ongoing. Lists, reports, publications eg in *Fauna of Saudi Arabia Vol.7* (1985), and a growing reference Collection.

prepared by M D Gallagher, Curator & Khabir

جدول الدراسات والمسوحات الحديثة منذ يناير ١٩٩٤م.

القطاع	إسم المشروع	مدة المشروع	وصف موجز للمشروع وأهدافه	الجهة المنفذة
الثروة السمكية: أ) تقدير حرو السمكي	١- ديناميكية مجموعات الأنواع ذات الأهمية التجارية في المياه الساحلية والمياه البعيدة لسلطنة عمان.	بدأ المشروع في عا ١٩٩٤م وما زال مستمراً حتى الآن.	توفير معلومات بيولوجية وسمكية ضرورية لضمان الإستغلال الأمثل للموارد السمكية ويشمل العمل جمع وتحليل وتفسير البيانات عن المخزون السمكي لتحديد تواريخ نمو ونفوق الأسماك وتشمل الدراسة الصفيلح والشارخة والربيان والكنعد وعدد من الأنواع القاعية.	مركز العلوم البحرية والسمكية التابعة لوزارة الزراعة والثروة السمكية.
	- تقدير أعمار الأسماك وعمل مفاتيح العلاقة بين العمر والطول للأنواع السمكية والبحرية لرئيسية في المياه لعمانية.	منذ ١٩٩٥م وما زال مستمراً.	التقدير السليم للمخزون السمكي وإدارته للحصول على مستويات الإنتاج المناسبة، ووضع النظم لحماية الأسماك غير الناضجة في مخزونات ومجموعات بالتركيز على أسماك الكنعد والكوفرة والساردين.	مركز العلوم البحرية والسمكية.

القطاع	إسم المشروع	مدة المشروع	وصف موجز للمشروع وأهدافه	الجهة المنفذة
ب) الإستزراع السمكي	١- المسح لإختيار مواقع الإستزراع البحري.	من ١٩٩٥م إلى ١٩٩٨م	التعرف وتقييم مدى ملائمة المواقع المختلفة للإستزراع البحري على طول الساحل العماني وذلك لتوفير دليل للتنمية والمراقبة والإدارة على النحو الصحيح. وقد تم جمع بيانات عن البيئة وتركيبة الأنواع وهيدروغرافية وتضاريس المنطقة.	مركز العلوم البحرية والسمكية.
	٢- دراسة جدوى تعزيز مخزون الصفيلح العماني وإستزراعه.	حد منذ ١٩٩٤م وما زال مستمراً حتى الآن.	تحديد جدوى تعزيز مخزونات ومجموعات الصفيلح في البحر وإستزراعها كوسيلة لتقليل ضغط الصيد الواقع عليه والحفاظ على أنواعه. ومن أنشطة هذا المشروع تجارب تحفيز التكاثر وتربية الصفيلح في الأسر.	مركز العلوم بحرية والسمكية.
ج) الدراسات البيئية	١-وفرة العوالق الحيوانية والمظاهر البيئية المؤثرة عليها.	من ١٩٩٢م وما زال مستمراً	دراسة وفرة وتوزيع العوالق الحيوانية في المياه العمانية وتحديد تأثيرها على الأنماط المحلية.	مركز العلوم البحرية والسمكية.
	٢- الدراسات عن امواج المد الحمراء في المياه قبالة سلطنة عمان.	ليس له فترة محددة	مراقبة وتسجيل حوادث إزدهار الطحالب مما ينتج عن ذلك موت جماع للأسماك والكائنات البحرية الأخرى.	مركز العلوم البحرية والسمكية.

القطاع	إسم المشروع	مدة المشروع	وصف موجز للمشروع وأهدافه	الجهة المنفذة
د) دراسة أشنوغرافية	الدراسة العالمية المشتركة للتدفق المحيطي في بحر العرب.	من ١٩٩٤م إلى ١٩٩٧م	تحديد مصير الكربون العضوي خلال دورته في المحيط. وسوف يكون ممكناً فهم معدلات التحلل الناتج بفعل الكائنات الحية من خلال تفسير المعدل التاريخي للتمثيل الضوئي ومن سجلات الرواسب.	مركز العلوم البحرية والسمكية، برامج الدراسة العالمية المشتركة للتدفق المحيطي الوطنية للمملكة المتحدة، الولايات المتحدة الأمريكية، هولندا، ألمانيا، الهند وباكستان.
هـ) تطوير المنتجات السمكية وتجهيزها.	إنتاج السوريمي على مستوى المختبر لتقييم مدى ملائمة ووفرة المادة الخام.	منذ ١٩٩٥م وحتى الآن	محاولة لدراسة إمكانية إستغلال الأنواع غير المرغوبة وزيادة المورد من بروتين السمك الصالح للأكل. وهدفه إختبار مدى قبول الأسماك المجمدة كمواد خام لتصنيع السوريمي.	مركز العلوم البحرية والسمكية.

القطاع	إسم المشروع	مدة المشروع	وصف موجز للمشروع وأهدافه	الجهة المنفذة
و) التصنيف العلمي.	تصنيف الأسماك	من ١٩٩٤م إلى ١٩٩٥م	نشر دليل عن الكائنات البحرية في المياه العمانية وتجميع الأنواع حسب العائلات التصنيفية.	مركز العلوم البحرية والسمكية.
الثروة الزراعية:	١- جمع وحفظ وإستغلال المصادر الوراثية النباتية المتنوعة وتحديد حيوية بذور المصادر المخزنة.	مشروع قومي مستمر.	مسح وجمع المصادر الوراثية النباتية للمحاصيل المختلفة وكذلك الأقارب البرية والسلالات المختلفة للمحاصيل الحقلية وحفظها وإستغلالها في أستنباط أصناف ملائمة لظروف البيئة العمانية.	المديرية العامة للبحوث الزراعية بالتعاون مع منظمة إيكاردا.
	٢- إستغلال الشجيرات المقاومة للملوحة في زراعة الأراضي الهامشية والمتحملة والإستفادة منها في غذاء الحيوان.	منذ ١٩٩٤م ولازال مستمرا	جمع شجيرات مقاومة للملوحة وزراعتها في أراضي هامشية للإستفادة منها كغذاء للحيوان مما يقلل من تكلفة التغذية للحيوان.	المديرية العامة للبحوث الزراعية.

القطاع	إسم المشروع	مدة المشروع	وصف موجز للمشروع وأهدافه	الجهة المنفذة
	٣- مشروع تنمية وتطوير الغابات والمراعي.	الكامل والوافي عام ١٩٩٤م وبركاء عام ١٩٩٥م.	زراعة الاشجار لتثبيت التربة من الإنجراف وزيادة خصوبتها والمحافظة على التوازن البيئي وتوفير النواحي الجمالية الطبيعية والظلال في المنطقة الشرقية (الكامل والوافي) ومنطقة الباطنة (بركاء) وأجزاء أخرى من السلطنة.	وزارة الزراعة والثروة السمكية

لمرفقات:

١. رسالة ماجستير عن توزيع ومكونات الأسماك القاعية في عمان.

٢. دراسة جدوى تعزيز مخزون الصفيلح العماني وإستزارعة.

٣. خطة إدارة المصايد السمكية بالنسبة لمصايد الكنعد التقليدية في عمان.

٤. تقرير عن هايدروبيولوجية عمان.

٥. الكائنات البحرية في سلطنة عمان (دليل تصنيف) باللغتين (عربي/إنجليزي).

National Report on Biodiversity

Projects at the MSFC that play a part and advance biodiversity since 1994.

1. FISH STOCK ASSESSMENT

1.1. Project Title: Population dynamics of commercially important species in coastal and offshore waters of Oman.

Brief Description: Conducted by the Center's Biology Section, this project is part of the ongoing work of the section and constitutes part of the section's responsibility to provide biological and fisheries information required for rational utilization of Oman's marine and fisheries resources. The work includes collection, analysis and interpretation of data on major fish and marine stocks in Omani waters in terms of their life history parameters such as growth, mortality, recruitment ..etc. Among the species involved includes Abalone, Lobster, Shrimps, Kingfish and a number of demersal species.

Project Schedule : This is an ongoing project to estimate the various biological and fishery parameters needed for stock assessment and constitute attempts to manage fish populations for optimum yields.

Executors of the project : Biology Section of the Marine Science and Fisheries Center.

1.2. Project Title: Ageing and establishing Age-Length keys of major marine and fish species in Omani waters.

Brief Description: Information on age and growth of fishes constitutes a key element in conducting proper stock assessment and hence their management to obtain optimum yield levels and set regulations for the protection of immature fishes within specific stocks and populations. Current work is concentrated in ageing of and establishing Age-Length keys for three species (*Scomberomorus commerson),* Seabream (*Argyrops spinifer*) and the Indian oil sardine.

Project Schedule: The project was commenced in 1995 and is being continued until the year 2000 by which time we should have at least 20 species with age-length keys.

Executors: Biology section of the Marine Science and Fisheries Center.

2.0. AQUACULTURE

2.1. Project Title: Aquaculture Site Selection Survey.

Brief Description: The objective of this survey is to identify and evaluate different sites along the Omani coast as potential sites for mariculture. This stems from the

need to provide guidelines for the appropriate development, control and management of aquaculture consistent with the needs of other users and the marine environment. As part of this project, field visits were conducted to document sites suitable for different aquaculture practices. At each of these sites data on ecology, species composition, hydrography and topography were collected and compiled.
The ultimate aim is to make this information available in a form of a booklet. This information will constitute an important component towards formulating future policies and development plans in the field of aquaculture.

Project Schedule: 1995- **1998**

Executors: Aquaculture Section, MSFC.

2.2. Feasibility Study on Stock Enhancement and Culture of the Omani Abalone

Brief Description: A pilot scale project was established in Sadh and Mirbat in the Governate of Dhofar to determine the feasibility of enhancing stocks of abalone populations in the wild and their outright culture as a means of reducing harvesting pressure and conserving the species. The research activities involved work on spawning inducement and rearing of the abalone in captivity. The results to date, suggest that the stock enhancement and culture of abalone in Oman is technically possible and that the behavior of the species in this regard is no different from the Japanese abalone.

Project Schedule: 1994 till present

Executors: Aquaculture Section, MSFC.

3.0. **ECOLOGICAL STUDIES**

Project Title: Zooplankton abundance and ecological parameters affecting this abundance.

Brief Description: The aim of this project is to quantify the distribution and abundance of zooplankton in Omani waters and to determine the influence of local hydrodynamics on these patterns.
Zooplankton play an important role in, food chain and are a major consumer of the phytoplnkton.
Estimates of abundance and biomass of zooplankton were collected through out coast of Oman.

Project Schedule: Commenced in 1992 for a period of five years.

Executors: Ecology Section, MSFC

3.2. Studies on red tides off Oman

Brief Description: Occurrence of red tides and algal blooms and consequent mass mortality of fish and other marine organisms have been documented in Oman. Phytoplnkton or algal blooms are discrete events in space and time and come about due to elevated concentrations of unicellular phytoplankton organisms. The causative mechanism of concentration may either be physical or biological. Potential adverse effects of these blooms include discoloration of the water, toxicity, changes in ecosystem structure and diversity, and increased sedimentation load on benthic communities. Studies on the red tide phenomenon at the Center involves monitoring and documenting the incidences of the blooms, collecting information on the areas of occurrence, plankton species causing the blooms, and environmental conditions at the time of these blooms.

Project Schedule: The studies are ad hoc in nature and are done when and where the blooms occur and consequently are an ongoing feature.

Executors: Ecology Section, MSFC.

4.0. OCEANOGRAPHIC STUDIES

4.1. Project Title: Arabian Sea Joint Global Ocean Flux Study

Brief Description: The Joint Global Ocean Flux Study (JGOFS) was part of the program to determine the fate of organic carbon cycling through the ocean. Carbon dioxide is considered to be a major player in determining long term climatic changes and global warming. Through the interpretation of historic data of photosynthesis from sedimentary records, it may be possible to understand biogenic decomposition rates. The project took measurements of the rates of production for substances that result from decomposition through process studies and time series observations.

Project Schedule: Four years from 1994 to 1997.

Executors: MSFC, National JGOFS programs of UK, USA, Holland, Germany, India and Pakistan.

5.0. PRODUCT AND PROCESS DEVELOPMENT (Seafood technology)

5.1. Project Title: Laboratory scale production of surimi to assess suitability and availability of raw material.

Brief Description: Surimi is a refined form of mechanically deboned fish meat. It is an intermediate product manufactured from minced fish. The current research is an attempt to investigare the potential of minced fish to utilize currently underutilized species and increase the supply of edible fish protein from these species there by reducing pressure on targeted species.

Laboratory trials were used to test the feasibility of processing surimi from various species including liirdfish, threadfin bream, sharks and sweetlips and to test the acceptability of frozen fish as raw material surimi. Preliminary testing presents possibilities of utilizing several currently underutilized species for surimi.

Project Duration: 1995 - Present

Executors: Seafood Technology Section, MSFC.

6.0. **Taxonomic Classification**

6.1. Project Title: Fish Taxonomy

Brief Description: Species diversity is a key elements' of biodiversity and the Center has been undertaking taxonomic studies in support of fisheries biology work. Part of this effort was the publication of an identification guide to the marine species in Omani waters. Species of sharks, rays, bony fishes, crustaceans and cephalopods were described. Species were grouped into families with each family forming a chapter. Information on distinguished features, distribution and natural history of each species were described. A total of 280 species from 92 families were documented.

Project Schedule: 1994-1995

Executors: MSFC

Memo

Department of Fisheries Science & Technology
College of Agriculture.

To Prof. Christopher D. Lu
Dean

From : Dr. Moustafa M. Fouda M.M Fouda
Head, Department of Fisheries Science & Technology

Date *24* December 1997

Subject : ***National Report on Marine Biodiversity***

The Department of Fisheries Science & Technology has carried out numerous research activities dealing with marine biodiversity. These activities have dealt with biodiversity at communities and species level, biodiversity as a resource and human impacts on these resource and building capacity for conservation of marine biodiversity.

At community level, research activities covered many important coastal habitats such as mangroves, coral reefs, lagoons and sandy beaches. At species level, research activities dealt with fisheries of Oman at large and emphasis was given to commercial finfish and shellfish such as kingfish, sardines, shrimps, abalone and lobster. At conservation level, emphasis was given to marine protected areas and green turtle population. For details, see the list of publications of the Department of Fisheries Science & Technology. Status of fish biodiversity in the Sultanate of Oman is provided as an example to be included in the national report on biodiversity.

The following are brief description of research activities related to marine biodiversity:

A. Marine Biodiversity at Community Level

Project 1: ***Resource Management of Mangroves in the Sultanate of Oman***

Summary: More than 20 sites were studied along the coast of Northern Batinah, Capital Area, Sharquiah and Salalah. All sites have only one species, *Avicennia marina.* The areas of the sites vary from less than 2 ha (Qurm Al-Saghier at Salalah) to 162 ha at Mahout Island, Gulf of Masirah. The mangroves represent mosaic habitats containing both hard and soft substrates. Mangroves of Mahout island are the most developed, with three heights reaching 10 m. Significant differences in soil texture and chemical analyses are found within and between sites. Water salinity shows remarkable variation from fresh and brackish water to hypersaline water (>100°/∞). Mangrove communities include fauna1 assemblage of many species of birds, fish, crustaceans and molluscs. Biological notes on the main species are presented.

Prehistoric fishermen exploited the mangrove resources at Qurm (Muscat) more than 7000 years ago, and currently Mahout Island provides sustainable products, mostly shrimp (*Penaeus indicus*), for several hundreds fishermen. In addition, mangroves at Salalah have potential for small-scale fishery development (based on grey mullet, *Mugil cephalus* and milkfish, *Chanos chanos*) and different types of aquaculture.

Experimental planting of the mangrove *Rhizophora stylosa* started at Qurm and Salalah in 1983' and 1985, with little success, Mangrove afforestation with *Avicennia marina* started recently at Barka, north of Muscat. Human impacts on mangrove include: overgrazing, urbanization, and development, littering-and pollution. Management options, based on sustainable development are suggested.

Investigators: Moustafa Fouda, Dept. of Fisheries Science & Technology
Mohammed Al-Muharrami, Ministry of Regional Municipalities & Environment

Start/End Date: June 199 1 - ongoing project

Project 2: *Fish Resources of **Dhofar Khawrs***

Summary: A fish resource monitoring programme was undertaken 'during 1992-l 993 in nine Dhofar khawrs (coastal lagoons) of Oman. The khawrs contained a large number of fish comprising mostly milkfish, *Chanos chanos* (Forskal), and mullet *Mugil cephalus* L. A wide range of species were recorded (47) with Khawr Sawli supporting the highest number (26). Most fish use khawrs as nursery grounds and migrate to the sea for breeding. Mullets'matures in winter, milkfish in early spring and the other species in spring-summer except the sleeper, *Ophiocarn porocephala* (Valenciennes), which breeds all year round. Three species of invertebrates with commercial value were collected: Indian white shrimp, *Penaeus indicus* H. Milne Edwards, Mud crab, *Scylla serrata* (Forskal), and swimming crab, *Portunus pelagicus* (L.), Khawrs water temperature followed a seasonal cycle and surface temperatures were higher than the deeper waters. Heavy rains in early spring caused extensive flooding and opening of khawrs to the sea. This had little effect on water salinity in some khawrs (Rawri and Mughsayl), while others displayed marked elevation in salinity (Taqah, Sawli and Jnawf) or reduced salinity by 50% (Qurm al-Kabir). Sedimentation and organic decomposition added during flooding produced drastic reduction in dissolved oxygen. Khawrs were again connected to the sea during monsoon (June-September) as water levels increased. Intrusion of sea water increased salinity and continued for several months in shallow khawrs (Jnawf); however, freshwater seepage reduced salinity in most khawrs. Massive fish mortality following heavy rains was the most significant seasonal occurrence. Extensive fish losses also occurred when water levels dropped after opening khawrs to the sea, and left many fish stranded in shallow areas. Other environmental perturbations existed in most khawrs (e.g., pollution and overgrazing). However, these khawrs have potential for small-scale fisheries and different types of aquaculture. Management problems are identified and options for solutions suggested.

Investigators: Moustafa Fouda, *Dept. of Fisheries Science & Technology*
Donald Johnson, *Dept. of Fisheries Science & Technology*

Start/End Date: January *1992* - January 1994

Project 3: ***Baseline Studies for Evaluating Long-Term Changes in Cord Reefs and Reef Fish Communities in the Vicinity of Muscat***

Summary: An inventory of corals and coral reef associated fish and invertebrate fauna was made. More than 200 fish species and 100 invertebrates have been recorded and photographed, Coral reef fish visual census (fish species, size and abundance) indicated that fish recruitment to adult population was successful during 1996, hence coral reefs act as nursery ground for juvenile fish (- 10 cm) of commercial importance. The most dominant fish were yellow lined snapper, yellow striped goatfish, sergent major, yellowfin chromis, domino, yellowstriped fusilier, cardinal fish and dotted bream, These dominant fish varied in abundance between 65 and 1024 per dive (30 minutes). Fishes were collected for biological studies. Food analysis of selected fish (e.g., grouper, threadfin bream, scod, butterfly fish, damselfish, goatfish, cardinal fish, snappers, sweeper, lube fish) indicated that fish feed on a high diverse food (e.g., cyanobacteria, chlorophyta, copepods, amphipods, cirripeds, nematodes, polychaetes, crabs, Shrimps, fish eggs and many others) available in the coral reef areas. The trophic level of major fish species is being established.

Field studies indicated that apart from some sedimentary fringing reefs, no true structural reefs have developed in the region. Although coral communities are very small (about 5% of the total benthos), they are of invaluable importance for the coastal ecosystems, culturally and economically (e.g., fisheries, tourism). However, coral communities are threatened by natural and human impacts. The impact of episodic rain, is the most decisive natural factor hindering the full development of coral reefs, resulted in instant killing of corals and associated sessile fauna. Other environmental impacts are siltation, steadily high-phytoplankton production and temperature oscillation (18-3 6 °C). Human impacts include boating, diving, harmful fishing practice and other coastal activities and construction. These resulted in coral pathology (bleaching, black-band disease and coral cancer). Management measures for coral reef protection are being prepared.

Investigators: Moustafa Fouda, Dept. of Fisheries Science & Technology
Joze Stirn, Dept. of Fisheries Science & Technology
Michel Claereboudt, Dept. of Fisheries Science & Technology

Start/End Date: January 1995 - ongoing project

Project 4: ***Biodiversity of Sandy Bench Macrofauna in Oman***

Summary: The benthic macrofauna and physical features of 10 sandy beaches along the coast of Oman were surveyed quantitatively. This is a mesotidal regime mostly subject to low to moderate wave energy but more exposed in the south. Five northern beaches were tide dominated, with low wave energy, and their profiles consisted of a berm, a steep, swash-dominated upper shore and a broad tide-dominated terrace from mid shore downwards. They were composed of moderately sorted fine to medium' sands. Southern beaches experience greater wave energy, particularly during the summer southwest monsoon, and exhibit smoother, concave profiles with fine, fairly well sorted carbonate sand. A total of 59 species. and species' groups were recorded, with crustaceans, polychaetes and molluscs dominant. In general species richness was high, at least 20-26 species per beach, but dry biomass moderate to low at 26-90 g m^{-1} shoreline, with one high value of 450 g.m^{-1}. Total abundance was moderate at 3-73 x 10^{3} organisms m^{-1} of beach. Some zonation was evident with ocypodids and Tylos in the supralittoral, cirolanids on the upper shore and a variety of species on the lower shore. The coast of Oman appears to constitute a single zoogeographic region, but with some regional differentiation between north and south due to varying physical condition. These results show that Oman's beaches are characterized by tide-dominated morphodynamics and exceptionally high species richness.

-Investigators: Anton McLachlan, Department of Fisheries Science & Technology

Start/End Date: October 1995 - October 1997

B. 'Marine Biodiversity at Species Level

Project 1: ***Cords of Oman***

Summary: 'More than 50 species of corals in the Sultanate of Oman are described. Their occurrence and abundance are provided. The unique environmental stress affecting corals are discussed. Threats to Oman's corals and coral reefs from man-made related and natural stresses are reviewed.

Investigators: Steve Coles, Department of Fisheries Science & Technology

Start/End Date: September 1992 - June 1995

Project 2: ***Status of Fish Biodiversity in the Sultanate of Omnn***

Summary: The rich and diverse fish resources of Oman constitute its main natural resource after oil and natural gas. A total of 1,142 species were identified, distributed among 520 genera and 164 families. Most of these are marine with broad geographical distribution; only four are freshwater species (*Cyprinion, micropthalmum, Garra barreirnie, G. longispinnis,* and *Oreochromis aureus*). The ichthyofauna of Oman is characterized by large number of species in 21

families, comprising 92.6% of the estimated total number of marine families of the whole Indo-Pacific region, and 49.9% of the world's marine families. The Arabian Sea and Gulf of Oman are more diverse in fish species (- 1,000 fish species) than the Arabian Gulf (>500 fish species). More than 400 species are demersal, 5 11 species inhabit coral reefs and coastal lagoons, 2 are mesopelagic species and the remainder are pelagic (157), bathypelagic (30) and bathydemersal (7 species). Current fishing effort levels on some target species are either close to maximum sustainable yield or exceed it. Shift in species composition resulted in declining landings of some high value fishes. A pilot aquaculture programme has just started with the introduction of sea bream, *Sparus aurata* and tilapia *Oreochromis aureus*. Fisheries management is hampered by lack of appropriate management regulations, enforcement and data on most stocks. Coastal habitats are being threatened by both natural and man-made impacts. Fisheries research programmes are directed to fish taxonomy, ecology, biology and stock assessment of some commercially important species. An extensive fish database and reference collection are currently being established at Fisheries Science and Technology Department, Sultan Qaboos University. Local human resources are needed to support the rational development and management of fishery resources.

Investigators: Moustafa Fouda, Dept. of Fisheries Science & Technology
Gregorio Hermosa, Jr., Dept. of Fisheries Science & Technology
Said Al-Harthi, Dept. of Fisheries Science & Technology

Start/End Date: November 199 1 - ongoing project

Project 3: ***Biology & Fisheries of Kingfish***

Summary: Analysis of historical data on catch, effort and length frequencies indicated Omani *Scomberomorous commerson* is overexploited and based on the biological reference points F_{rep}, and F_{50}, estimates it was suggested to reduce fishing effort by 14-40%. There is an ongoing kingfish management program which involves biology, stock assessment and economic investigations formulate a management plan for kingfish.

Investigators: Shareef Siddeek, Dept. of Fisheries Science & Technology
Moustafa Fouda, Dept. of Fisheries Science & Technology
Thabit Zahran Al-Abdessalaam, Marine Science & Fisheries Centre
Ahmed Al-Hosni, Ministry of Agriculture and Fisheries

Start/End Date: October 1997 - ongoing project

Project 4: *Biology and Culture of Omani Abalone*

Summary: The Arabian abalone occurs in the Arabian Sea's rocky coastal zone in association with conspicuous macroalgal communities in which it represents the dominant herbivorous component. Despite such ecological importance and although the commercial exploitation of abalone presents a considerable contribution to

Omani fisheries, almost nothing is known about the biology of this species. This report presents results of research carried out in the field and with laboratory cultures, and draws general conclusions related also to the fisheries management of these possibly overexploited abalone populations. Cohort observations in the field and measured increments of cultured specimens showed a growth rate significantly higher than in other abalone species, i.e., greater than 3 mm shell-increment per month. The very early sexual maturity demonstrated by captivity spawning of approximately one year old animals is also quite unusual. The ejected eggs formed mucous monolayer attached to the substratum whereas other abalone species produce pelagic eggs. Juvenile cohorts in nature and the periodic spawning of cultured animals indicate the major spawning in spring and postmonsoon one in autumn. The models previously applied in fisheries management of abalone in Oman assumed only one spawning per year - the first being at age 2+ - and a slower growth-rate. These models should be reconsidered using the new data, which may partially explain why abalone are less overexploited than one would expect looking at heavy harvesting. In view of a projected commercial abalone cultivation our laboratory rearing experiments showed that both natural and/or artificial food may be used, provided this contains -apart from standard ingredients - the seaweed-borne components (probably phycobillins) required for a normal parasite - resistant shell formation. With regard to artificial reproduction, our preliminary trials showed that spawning, fertilization, and initial larval rearing present no problems. The steps from the pediveliger to larval settlement, however, seem to be fatally exposed to ciliate attacks. Further research is needed in order to eliminate this critical problem.

Investigators: Joze Stirn, Dept. of Fisheries Science & Technology
Khalid Al-Hashmi, Dept. of Fisheries Science & Technology

Start/End Date: October 1992 - October 1993

Project 5: ***Stock Assessment and Management of Omani Abalone***

Summary: Settlement of the Omani abalone *Haliotis mariae* Wood on the Dhofari coast in 1992 occurred from January until April. Growth was measured by analysis of modal progressions of cohorts in length-frequency data, mark-recapture data and frequency of primary growth checks. The annual increase in shell length was about 43 mm in the first year and 20-25 mm in the second and third years. Primary and secondary growth checks in the shell were caused by spawning and seasonal factors. Parameters of fitted von Bertalanffy growth curves were K = 0.27 -0.43 per year and L = 139 to 149 mm according to site. Examination of the rate of deposition of rings in the spire indicated that four rings per year were laid down, but that one ring per year was lost through erosion of the shell.

The fecundity, size, ar sexual maturity, sex ratios and total mortality of *Haliotis mariae* on the Dhofar coast of the northern Arabian Sea were measured. These data, and estimates of the growth rate, were used for yield-per-recruit and egg-per-recruit analyses. Maximum yields occur at 3+ to 4+ years of age, depending on the natural mortality rate chosen. At the present age at first capture egg

production levels are 2-29% of the unfished stock, depending on estimates of the fishing mortality rate and the natural mortality rate, and are considered to be far too low to maintain recruitment. At 50% egg production of the maximum possible the age at first capture is 4 to 4-5 years, i.e., 105-l 15 mm shell length, depending on site.

Historical length-frequency data of Omani abalone *(Haliotis marine)* from two areas (Sadh and Hadbin) of the Dhofar coast of the Sultanate of Oman were used to estimate growth parameters by non-linear least square fitting. The results were verified using the ELEFAN 1 program and then combined to calculate total mortality (Z) and recruitment patterns. The growth parameters values with combined sexes were $L\infty$ = 137 mm shell length (SL), K = 0.75 $year^{-1}$ and t_0 = 0.73 year-'. The 1987/89 Z values were 1.7 $year^{-1}$ and 1.57 $year^{-1}$ on Sadh male and female, respectively. The female Z value in Hadbin was 1.55 year-' in 1989/90. The 1991 Z values for combined sexes were 2.37 year-' in Sadh and 1.66 $year^{-1}$ in Hadbin, showing much higher fishing pressure in recent years There were two recruitment pulses, a major one in January and a minor one in May.

Investigators: Donald Johnson, Dept. of Fisheries Science & Technology
Shareef Siddeek, Dept. of Fisheries Science & Technology
Scoresby Shepherd, Dept. of Fisheries Science & Technology
Adnan Al-Azri, Dept. of Fisheries Science & Technology

Start/End Date: June 1990 - September 1996

Project 6: ***Shrimp Biology, Ecology and Stock Assessment in the Gulf of Masirah***

Summary: Biological investigation on *Penaeus indicus* in the Gulf of Masirah was carried out from September 1990 to March 1992. The study area is a sheltered bay within the Gulf of Masirah which supports the major artisanal shrimp fishery in the Sultanate of Oman. Morphometric relationships, sex distribution, size at maturity and fecundity abundance were determined. Females grew to a larger size of 53.7 mm carapace length (CL) than the males (46.2 mm CL). Morphometric relationships between the sexes were highly significant ($P < 0.005$). A drastic fall in the proportion of females during January indicated the probable spawning movement offemales to deep waters. The 25, 50 and 75 percent maturity lengths were 38, 40 and 42 mm CL, respectively. The fecundity varied between 212,800 and 460,084 through the size range 41-51 mm CL. The main autumn (September) fishery recruitment arose from the major spawning peak in spring February and March).

An investigation of postlarvae, early juveniles and pre-adult Indian white shrimp, *Penaeus indicus* H. Milne Edwards, in Ghubat Hasish Bay around Mahawt Island in the Gulf of Masirah was carried out from January 1991 to December 1992. Peak abundance of postlarvae and juveniles was observed during March and April. The size of newly recruited postlarvae ranged from 9 to 11 mm total length. The highest concentration of postlarvae and early juveniles occurred in muddy

substratum covered by mangrove detritus. Postlarvae and juvenile densities varied significantly between years, seasons and habitats. The main fishery recruitment observed in late August and early September resulted from the major postlarval abundance peaks in March and April. Growth rates of postlarvae, juveniles and pre-adult shrimp of the main cohort recruited in March were calculated. During the peak fishing season (September to November), pre-adults were concentrated at depths of 3-5 m in muddy substrata south-west of Mahawt Island. An environmental impact study is recommended in this area prior to the proposed harbour development at Mahawt.

The von Bertalanffy growth parameters estimated based on the 1990/9 1 carapace length data of *Penaeus indicus* from the Gulf of Masirah, Oman were used to calculate total mortality, yield-per-recruit (i.e., average weight of a shrimp from a cohort under a given fishing pattern) and relative mean biomass (i.e., exploited cohort biomass over un-exploited cohort biomass) for the population sampled. The instantaneous total mortality coefficient value indicated under exploitation in 1990/91. When different fishing seasons scenarios were considered with the current total mortality level, but with a range of natural mortality values, high yield - per-recruit and relative mean biomass values were shown for October-April and November-April fishing seasons. The fishing season is currently late August to end of April. Thus, a one to two-month delay in the fishing season appears to be beneficial to this fishery.

Investigators: Shareef Siddeek, Dept. of Fisheries Science & Technology
Ramasamy Mohan, Dept. of Fisheries Science & Technology

Start/End Date: September.1990 - March 1992

Project 7: Biology & Fisheries of Sardine

Summary: Sardine biological investigations indicate two spawning peaks, pre- and post-monsoon, in the capital area. The stock size fluctuated with different environment conditions in different years. Because of low intensity of artisanal fishery (beach seine and gillnet), the stock is not threatened. However, the beach seine appears to be wasting the resource potential by harvesting small size fish as well as the products are wasted by unhygienic drying method for animal feed.

Investigators: Shareef Siddeek, Dept. of Fisheries Science & Technology
Mohammed Al-Amri, Dept. of Fisheries Science & Technology
Hussain Al-Masroori, Dept. of Fisheries Science & Technology

Start/End Date: 1992 - ongoing project

C. Conservation of Marine Biodiversity

Project 1: Marine Protected Areas in the Arab World

Summary: A total of 27 marine protected areas in the Arab world (e.g., Oman, Saudi Arabia, Egypt) have been described (geographical location, areas, physical and biological resources and level of management). They were assessed based on criteria of the Global System of Protected Areas. Emphasis was given to role of governmental institutions and NGO's for conservation of marine resources. A review was given on international, regional and national legislation and conventions. Suggestions are provided for selection of protected areas and priorities for marine conservation.

Inves *tiga tor:* Moustafa Fouda, Department of Fisheries Science & Technology

***Start/End** Date:* September **1995 -** September 1997

Project 2: Consenwtion of Oman Green Turtle

Summary: We applied the stage-class matrix model to published data to investigate the population growth rate of Oman female green turtles (*Chelonia mydas*) under different simulated biological and fishery conditions. Juveniles dominated the stable stage-class population vector. Juveniles and adults contributed most to the potential reproductive output. The present total fishing deaths consisted of approzimately 2280 hunted and 2000 accidentally drowned (in fishing nets) female turtles. The model suggested a maximum hunting quota of approximately143 females to maintain a stable population. In addition to protecting eggs and hatchlings, reduction in the juvenile mortality significantly increased the population growth rate. Simulated reduction in the current annual 4280 female fishing deaths to 268 produced a positive population growth rate within feasible stock parameter values. Previous studies have indicated a size at first maturity below 85 cm curved carapace (CCL). Thus, restricting the number of hunting and accidental drowning deaths to less than 268 females and enforcing a minimum size limit of 85 cm CCL in the traditional turtle fishery appeared necessary to reverse the population decline. More studies on stock abundance, sex composition, stage specific growth, survival and reproductive rates are needed to refine the model.

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Robert Baldwin, Ministry of Regional Municipalities and Environment

Start/End Date: September 1994 - December 1996

Department of Fisheries **Science &** Technology
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Status' of Fish Biodiversity in the Sultanate of Oman

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INTRODUCTION

The Sultanate of Oman occupies the eastern comer of the Arabian Peninsula and is surrounded by three biogeographic seas (Arabian Sea, Gulf of Oman and Arabian Gulf). Fish resources of the Sultanate of Oman are immense and diverse, due to its coastal tropical habitats, wide exclusive economic zone (300,000 km^2), broad climatic spectrum and its unique geographic location in the upwelling region of the northwestern Indian Ocean (Fouda and Hermosa, 1993). The Sultanate has taken a number of sound initiatives to link the rapid socio-economic development with the planned protection of the environment and the natural resources.

The fish fauna of Oman are generally not well known. There are insufficient data on the distribution, abundance and biology of many species; a fact largely due to the incorrect identification of species in routine fishery work. In addition, publications regarding ichthyological or biological works specific to the Arabian Sea and the Gulf of Oman are scarce. White and Barwani (197 1) recorded 199 species from the waters off the Trucial coasts and the Gulf of Oman. In another study, Kuronuma and Abe (1986) recorded 465 fish species from the Arabian Gulf, and a few from the Gulf of Oman. In 1984, the FAO species identification sheets which covered the Western Indian Ocean (Fishing Area 51) including the Arabian Sea and the Gulf: of Oman, were extensively edited by Fischer and Bianchi for fishery purposes and included 2,354 species of marine fishes and sharks. Al-Abdessalaam (1995) illustrated 280 fish species from Oman and Randall (1995) increased the number into 930 fish species. ICLARM FishBase (1996) includes 280 fish species from Oman. Banister and Clarke (1977) recorded nine fresh water fish species from streams and drainage basins in the Arabian Peninsula. Related works on the fish fauna of the adjacent waters have been reported by Kuronuma and Abe (1972). Relyea (198 I), Randall *et.al.*, (1978), Randall (1983, 1986) and Debelius (1993) among others.

Since 1990, the Department of Fisheries Science and Technology, College of Agriculture, Sultan Qaboos University (SQU), has been conducting research work to document the diiersity of the fish fauna of the Sultanate. A tentative systematic listing of

905 fish species, together with common and Arabic names, was prepared (Fouda and Hermosa, 1993), based on extensive collection of fish and examining the existing records of Oman's fishes. This led to the establishment of a fish database in Oman. Since then, more fish species have been added and more information are now available on the distribution of fish.

The Sultanate of Oman .signed the Biodiversity Convention in 1992 and became a member after ratification of the convention in 1995. The present study on status of fish biodiversity in Oman is a contribution to the national report on the conservation of biodiversity which aims to provide an inventory on the conservation of fish biodiversii in terms of species, distribution, abundance, conservation efforts and the capacity building.

MATERIALS AND METHODS

Fish specimens were collected from various parts of the Sultanate during the period from November 1990 to June 1997. Samples were collected by members of the Department of Fisheries Science aud Technology, Sultan Qaboos University (SQU) during regular visits to the many fish markets, fishery ports, students' field trips, and research surveys on board the Department's training and research vessels.

This work was not limited to the fish collection of Department of Fisheries Science and Technology, SQU. In order' to develop a comprehensive checklist of fish species of the Arabian Sea, the Gulf of Oman and the Arabian Gulf, the existing records of Oman's fish species were consulted and verified.' These 'include: (a) FAO species identification sheets for Western Indian Ocean (Fishing Area 5 1) (Fischer & Bianchi, 1954); (b) species identified on board the Korean trawlers (Hare, 1989) which were restricted to fishing at waters deeper than 50 meters, between 17" N and 20" N latitude; (c) fish species collected during the acoustic and trawl survey in 1989-1990 by the RV Rastrelliger, (Al-Abdessalaam, 199 1); (d) fish species collected during the RV Dr. Fridtjof Nansen surveys iu 1983- 1954 (Stromme, 1986); (e) Coastal Fishes of Oman (Randall, 1995) aud Marine Species of the Sultanate of Oman (Al-Abdessalaam, 1995); (f) freshwater species collected from the "wadis" or oases; (g) cultured species introduced into the country; and (h) underwater observations of fish in coral reef areas.

Fish species identification was confirmed following the works of Myers (1991), Carpenter & Allen (1989), Carpenter (1987, 1988), Allen & Steen (1988), Smith & Heemstra (1986), Randall (1983, 1986 and 1995), ICLARM FishBase CD-ROM (1995; 1996) Kuronuma & Abe (1986), Nakamura (1985). Allen (1985), Fischer & Bianchi (1984), Debelius, 1993 and Carcasson (1977) among others (see references). The checklist of species is stored in the Fishery Science & Technology Department's computer fish database at Sultan Qaboos University.

Information on the state of traditioual and industrial fishery during the last 10 years were obtained from the Department of Fisheries Statistics, Directorate General of Fisheries Resources, Ministry of Agriculture and Fisheries. These included annual catch, catch by species and region, number of fishermen, fishing boats (by-type) and gear, etc. Trends of fish catch, fishing efforts and changes in species composition of some commercial fish were also studied.

Fishery protection measures and the current state of consewation of fish biodiversity and sustainable use in the Sultanate of Oman were assessed based on the following: (a) the Marine Fishing and Living Aquatic Resource Protection Law, Conservation of the Environment and Prevention of Pollution Law, other Royal Decrees and Executive Regulations; (b) current marine conservation efforts in the Sultanate; (c) consultation with reports and surveys on the marine environment; (d) interviews with officials at the Ministry of Regional Municipalities and Environment, Ministry of Agriculture and Fisheries; (e) overview on those land-based activities affecting the marine environment in the Sultanate of Oman (Fouda, 1996); and (f) existing human resources involved, and development needs for work in fisheries and marine conservation.

RESULTS

Fishes of Oman

A total of 1, 142 fish species belonging to 520 genera and 164 families were recorded; 9 1 cartilaginous species and 1,05 1 bony fishes (Table 1). All fish species are marine except for four freshwater species. Most species are widespread throughout the Indo-Pacific region with some occurring worldwide. A checklist of Fishes of Oman, arranged in

approximate phylogenetic order, together with distribution and abundance is presented in Appendix I. Genera and species are listed alphabetically within their respective families. Classification of sharks and rays into tasa (Order, Family and Genus) aud their order of arrangement followed mainly Compaguo (1984) and Smith and Heemstra (1986). Classification of bony fishes into tasa (Order and Family) and their order of arrangement followed mainly Nelson (1984), with some modifications based on the works of Greenwood *et.al.*, (1966), Smith and Heemstra (1986), Paulin, *et.al.*, (1989), Myers (199 1), and others.

The Arabian Sea, the Gulf of Oman aud the Arabian Gulf are parts of the Indian Ocean, one of the sub-regions of the Indo-Pacific tropical ocean. The Iudo-Pacific region contains the world's largest shorefish fauna, estimated at over 4,000 species in 179 families (Myers, 1991). The West Pacific sub-regiou is the richest in the Indo-Pacific, with 175 families followed by the Indian Ocean with 162 families. Both sub-regions probably contain half of the species found in the eutire Iudo-Pacific region (Myers, 199 1). In comparison, the marine fish fauna of Oman comprises 162 families (freshwater families Cichlidae and Cyprinidae not included) constituting all the total marine families in the Iudiau Ocean and 92.6% of the total marine families of the whole Indo-Pacific. Thus, the ichthyofauna of Oman is diverse, representing 49.9% of the world's 325 marine families (Smith and Heemstra, 1986). Oman's fish fauna is characterized by species with wide distributions. However, 50.9% of the total reported number of species (2,354 species) (Fischer & Bianchi, 1984) in the Western Indian Ocean Fishing Area 5 1, have been identified so far, constituting 29.9% of the total estimated number of species in the Indo-Pacific Ocean, aud 9.2% of the world's approximate 13,000 marine species (Myers, 1991). Many species probably remain to be discovered and reported, particularly coral reef associated species, mesopelagic and bathypelagic species from the Arabian Sea (southern part of Oman).

Oman's fish fauna may be described fiuther by the occurrence of large numbers of species in several families as shown in Table 2. Twenty one families (12.8% of the 164 families) have the most species, accounting for 55.4% of the total number of species. Most of these families typically comprise the bulk of the common ichthyofauna of the Indo-Pacific. The top 10 families contained 635 species, representing 55.6% of all species

recorded from Oman. Gobiidae and Labridae are the largest families with 69 and 59 species, respectively. This is followed by Carangidae (54 species) and Serranidae (52 species). It is of interest to mention that Carangidae, a family of highly commercial species, of Omani waters represent 83.1% of the 65 species of Carangidae in the Western Indian Ocean Fishing Area 5 1 (Fischer and Bianchi, 1984). This figure is higher than those found for Carangidae in other regions such as Micronesia (3 1 species) (Myers, 1991); the Arabian Gulf (38 species); Western coast of Australia (40 species); the Philippine Islands (53 species) (Kuronuma and Abe, 1986); and Southern Africa (54 species) (Smith and Heemstra, 1986). The family Carcharhinidae of the cartilaginous fishes, which is considered the most important shark family for fisheries in the tropics (Compagno, 1984), is included amongst the families having the most species.

Based on the FAO list of species of occurrence, and the recent work of Al-Abdessalaam (1995) and Randall (1995), there are in our list 42 new species, described by Randall and others, and an additioual 48 species which were not previously recorded in the Western Indian Ocean Fishing Area 5 1 and in Omani waters. It also indicates 15 rare species whilst the remainiug species are either common or abundant.

Although the Oman Butterfly fish *Chaetodon dialeucos* Mee and Salm, 1989 is considered an endemic species, it is believed that this species will be found in other coral reef areas of the region when more observations are made. In the present study there were 3 species (*Megalopos cyprinoides*, *Ophiocara porocephala* and *Anguilla* sp.) which were found only in the Khawrs (coastal lagobns).

The distribution of fish in the three bodies of Oman's marine waters indicates that the Gulf of Oman has the highest number of species (937 species) followed by the Arabian Sea (S95 species) and then the Arabian Gulf (5 14 species). The difference in number of species are due to several factors including the extreme environmental conditions of high water temperature and saliuity as well as the shallowness of the Arabian Gulf, and the upwelling phenomena of the Arabian Sea. In addition, all fishes recorded in the literature for the Arabian Gulf are not included in this list, only the ones which have been recorded in the Omani territorial waters of the Arabian Gulf (i.e., Musandam at the entrance of the Gulf).

Fishes are classified according to their general habitats. Coral reefs accommodate the largest number of species (5 1 l), followed by other demersals (420 species from mangroves, seagrass beds, soft-hard muddy bottom habitats), pelagics(157 species), bathypelagics (30 species), bathydemersals (7 species) and mesopelagics (2 species).

Fish eries

Oman's fisheries constitute its main natural resources after oil and are considered to be one of its important long-term renewable resources. Annual fish production has averaged about 120,000 metric tons (t) during the last decade. Traditional fisheries constituted about 85% of the total fish landings with the remaining 15% taken by the industrial fleet. Fish exports increased from less than 20,000 t in 1985 to almost 60,000 t in 1995. Fishing efforts and utilization of this resource has increased dramatically in recent years. The number of fishermen increased from 12,000 in 1985 to 25,575 in 1996 (average annual increase of 8%). The result was that catch per fishermen/year has decreased by about 50% from 6.64 to 9.37 t during 1985- 1990 down to 3.4 to 4.72 t in 1994-95. In addition, many high-value pelagic and demersal fish have shown considerable declines and shift in composition in the catches. For example kingfish contributed 38.4% (27,784 t) of the large pelagics in 1988 and only 14.4% (6,129 t) in 1995 (Anonymous, 1996). There was also a shift in recent years in the length-frequency distribution of the annual catch of kingfish from large to small (immature) fish. Targeted high-value demersal fish such a sea bream, groupers and emperors, which a decade ago, accounted for more than 65% of the demersal catch, and now account for about 40%. Meanwhile, the proportion of low-value fish in the catch, such as threadfin bream, lizardfish, bigeye and hairtail, has shown a marked and steady increase (Anonymous, 1996).

Aquaculture

Finfish aquaculture programme started with the introduction of the Mediterranean Sea Gilthead Bream, *Sparus aurata* and the freshwater Blue-mouthed Broader Tilapia *Oreochromis aureus* in the Sultanate. Sea bream were imported as fiy from Cyprus in late 1996 and are maintained in tanks at the Marine Science and Fisheries Ceutre and in cages at Bandar Khayran lagoon, close to Muscat. So far, they have adapted to the local environmental conditions and are expected to be harvested in late 1997. Tilapia, brought

as fry from U.A.E. in 199 1, are kept in holding tank and an earthen pond at the Agriculture Experimental Station, College of Agriculture (SQU) and where they are used for teaching and research purposes.

Fisheries Management

The Marine Fishing and Living-Aquatic Resource Protection was issued in 198 1. Some essential amendments have been made in 1994 to organize activities and to define responsibilities and duties of workers in the artisanal and industrial sectors. So far, fishing regulations exist for shellfish (e.g.. abalone and lobster) but not for finfish. The only fishing restriction on traditional fishery is the prohibition of the use of monofilament gill nets. On the other hand, industrial trawl fishery is subjected to strict regulations, designed to protect the stocks available to the artisanal fishermen and avoid conflict between the two sectors. Fishing regulations on industrial trawl fishery include restricted fishing grounds, fishing gear, mesh size, catch report, limit on number of vessels and restriction on target species.

The existing fishing regulations for artisanal fishery are of general nature and there is no specific management plan for either pelagic or demersal fishery. Further studies are needed to determine the standing stocks of important commercial species and to develop management plans. A management plan is presently being developed for kingfish (*Scombermorus commerson*). Enforcement of fishing regulations is difficult because the artisanal fishery has numerous landing sites. At present, fishing harbours and jetties are in operation at Muttrah, Sidab, Seeb, Masirah Island, Mirbat, Al-Halaniyat Island, Khasab, Diba, Bukha, Quriyat, Sur and Salalah. The Govemment constructed 1 1 small marketing support facilities along the coast. These facilities generally consisted of ice plants, small cold storage rooms and machinery for power generation

Threats to Fish Habitats

Coastal habitats are threatened by both natural and man-made impacts. Natural impacts include coastal erosion, episodic rain which instantly kill corals and associated fauna, siltation, steadily high phytoplankton production and water temperature fluctuation (1 ***S-36 "C).*** Human impacts are due to many activities including coastal urban and residential development, fishing, recreation and tourism, oil and gas industry, desalination plants. and others. Coastal structures matching these activities include harbours, dams,

jetties, comiches, roads, etc. Coral reefs have been affected by lost and abandoned nets, fishing traps, anchor damage, littering, predation by the Crown of Thorn Starfish, coastal construction, oil pollution and eutrophication (Salm, 1993). These resulted in coral diseases such as tumors, band diseases and bleaching (Stim, pers. comm). Similarly, mangroves have been affected by overgrazing,urbanization, coastal development, littering and pollution (Fouda, 1995b). Human activities are expected to increase in the future as more large projects (liquid natural gas (LNG), fertilizer plant, petrochemical plants) are either underway or planned around the major coastal cities (e.g., Sur, Sohar and Salalah).

Conservation of Biodiversity

A series of Royal Decrees (e.g., Law on Conservation of the Environment and Prevention of Pollution, Law on National Parks and Natural Protected Areas) and legal provisions have created an initial framework for protection, pollution prevention and conservation (including the requiremeut for "Environmental Permit" for all major development projects in Oman). Policy framework and strategies have been prepared, some programmes are being implemented covering a system of national conservation areas, programme for the entire coastal zone of Oman, national conservation strategy, establishment of marine protected areas in Muscat (mangroves), Ras Al-Hadd (turtles), Daymaniat Islands (coral reefs) and Khawr Salalah (bird sanctuary), habitat restoration (mangroves and coral reefs) and environmental awareness programme (Fouda, 1996; IUCN, 1996).

Building Capacity for Biodiversity Management

1. Ministry of Regional Municipalities and Environment (MRME). MRME is the focal point for all environmental policies and programmes. It has good resources and facilities (infrastructure) capable of executing conservation programmes. A total of 9 Ph.D., 9 M.Sc. and 109 B.Sc. personnel are currently working at MRME in different disciplines of environment. The main active institutions dealing with the marine environment are the Directorate General of Environmental Affairs (the departments of Environmental Plauniug, Permits, Monitoring, National Conservation Strategy, Coastal Zone Managemeut, Inspection and Control: Laboratories, Research and Studies), and also Directorate General of Nature Reserves and Directorate General of Public Relations and Guidance.

The Directorate General of Nature Reserves is in charge of implementing marine conservation programme. However, it does not have fish specialists and suffers a shortage of trained technical staff. There are currently 13 staff working in the field (as rangers in protected areas or technicians collecting data), on environmental policies and management; none hold Ph.D.'s in any field of marine enviromnental study. In the past, MRME has relied on large numbers of expatriates while at the same time training Omanis, both at home and abroad. However, cutbacks in Government funding have created severe limitations over the last few years and this is expected to continue in the future.

2. *Marine Science and Fisheries Center (MSFC), Ministry of Agriculture and Fisheries (MAF).* This center was established in *1986* with the objectives of carrying out research on various aspects of marine science and fisheries to help the nation in its efforts to the development of fisheries and also advise on the formulation of policies and on the legal aspects of fishing activities. Of the 50 personnel working at MSFC, there are no Omanis holding Ph.D's; although, 12 Omanis hold M.Sc. degrees and 12 Omanis hold B.Sc. degrees. The Center has seven departments: Oceanography, Marine Ecology, Large Pelagic Fish, Small Pelagic Fish, Demersal Fish, Food Technology and Mariculture. It has a well established aquarium and library. Facilities include laboratories (S), research vessel, aquarium, museum, computer facilities and limited teaching facilities. The center is currently executing several' research projects dealing with fish biology, ecology, stock assessment, mariculture, and fish quality.

3. *Sultan Qnboos University (SQU), Department of Fisheries Sciernce & Technology and Department of Biology.* SQU was established in 1986. Two departments are involved in teaching and research in marine science and fisheries: the Department of Fisheries Science and Technology at the College of Agriculture and Department of Biology at the College of Science. The Fisheries Science and Technology Department has a total staff of 24 and offers 3 l related courses in fisheries, marine ecology, oceanography, environmental management, population dynamics, computer, aquaculture, and fisheries technology. Members of the fisheries faculty and staff conduct basic and applied research on fish taxonomy, fisheries biology, coral reef management, mangroves, oceanography, marine ecology and aquaculture. Facilities at the Department include 2 teaching laboratories, 2

research laboratories, a Tilapia fish farm, a fishing boat and a library. The Department has made an intensive reference collection on fishes, coral reefs and other invertebrates. It has also holds a fish database which includes fishes of Oman and other neighboring countries. It communicates and exchanges information with the ICLARM FishBase. The Department of Biology has three staff who are involved in teaching and research on the marine ecology of Oman and is currently offering an M. Sc. course in Environmental Sciences.

4. *Natural History Museum, Ministry of National Heritage and Culture.* This museum was established in early 1980's and has a fine collection of marine mammals, molluscs, coral reefs and other wildlife. However, very few specimens are available on fishes.

5. *Directorate General of Fisheries Resowces (DGFR), Ministry of Agriculture and Fisheries.* DGFR, established in 1974, is the administrative body responsible for organizing the exploitation. protection and developmeut of living-aquatic resources in the Sultanate. It is also responsible for enforcement of the provision of the Marine Fishing and Living Aquatic Resources Protection Law, and the executive regulations issued according to it. DGFR has many departments and sections including marine affairs, fisheries resources, fisheries extension, fisheries statistics, fisheries research fund, fisheries surveillance, licensing; 'fishermen encouragement fund, quality control and industrial fisheries. There are more than 150 persons working at DGFR, but no Omani employees hold Ph.D degrees.

DISCUSSION

The present study is the second compilation of Oman's fishes. To improve our understanding on fish biodiversity and conservation, the role of fish taxonomy for conservation and fisheries work should be emphasized. There are few fish taxonomists in the Sultanate. Further, the bureaucratic delay and lack of information exchange with different institutions on regular basis has been a major factor that hindered our knowledge on fish fauna. Although, important fish &ides have been published recently (Debelius 1993; FishBase, 1995, 1996: Al-Abdessalaam, 1995; Randall, 1995), confusion and inaccurate fish identification still face fishery scientists working on stock assessment studies. Research institutions dealing with fish, fisheries and conservation should coordinate their work to facilitate dissemination of information. Several problems were encountered while

prepatitig this fish list. It was found that many species were listed with matty synonyms, different authors, some misidentified or with insufficient morphological descriptions. Such problems made identification and vetificatiou more difficult. In addition, many species in Randall (1995) were given status of new records, even though they were included iu FAO identification sheets for Western Indian Ocean. Similarly, some species which were newly recorded for Oman by Randall (1995) were not listed in the ICLARM FishBase twice - yearly updating.

The major yrobletns of artisanal fishery in Oman are the overfishing of some commercial species and the degradation of coastal habitats. Although several measures already exist, there is no specific policy or management plan for atty commercially exploited species. There is an urgettt need for plans containing directives and specific actions to meet the goal of maximizing the social and econotnic benefits resulting from hatvestiug fish while conserving stocks to ensure sustainable levels. Plans should also be developed to establish protected areas for nursery and spawning of fishes.

Oman has policies, legislation, administrative and management structures dealing with conservation of marine and fisheties resources. It evolved its environmental programme through tlie followittg three stages: a) documenting its living marine resources, identifying imtnediate threats and ptiotity action; b) establishing institutions and a policy framework for conservation, and c) developing strategic and systematic framework for environmental management. Considerable financial resources were allocated to environmental issues, however, very little was gained from econotnic point of view (IUCN, 1996). Development plans are now directed toward the following: a) moving towards implementation of policies, strategies and programmes developed for the environment; b) secutittg the financial resources for monitoring and managing environmental resources, and c) establishing the econotnic rationale for environmental investment. The major constraints facing implementing conservation programmes are: lack of adequate financial resources; inadequate human resources: and development boom attd diversification of the economy. However, effotts should be made by all concerned authorities to find ways of improving cottsetvatiott of fish biodiversity in Otnatt.

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Table 1. Breakdown of the two major classes of Oman Fishes

Taxa	Chondrichthyes		Osteichthyes		Total
	Number	%	Number	%	
Order	11	29.73	26	70.27	37
Families	25	15.24	139	84.76	164
Genera	50	9.62	470	90.38	520
Species	91	7.97	1051	92.03	1142

Table 2. Most Speciose Famiiies of Oman Fishes

Family	# of Genera	# of Species	% of the Total Fish Species
Gobiidae	38	69	6.04
Labridae	23	59	5.17
Carangidae	21	54	4.73
Serranidae	11	52	4.55
Apogonidae	7	37	3.24
Lutjanidae	9	36	3.15
Blenniidae	18	35	3.06
Pomacentridae	9	31	2.71
Clupeidae	14	26	2.28
Scorpaenidae	11	26	2.28
Carcharinidae	8	25	2.19
Syngnathidae	12	21	1.84
Chaetodontidae.	4	21	1.84
Scaridae	5	20	1.75
Haemulidae	3	20	1.75
Sparidae	11	18	1.58
Mullidae	3	18	1.58
Muraenidae	6	18	1.58
Acanthuridae	5	17	1.49
Sciaenidae	8	16	1.22
Pseudochromidae	5	16	1.4
TOTAL	231	635	55.43

SYSTEMATIC LIST OF OMAN FISHES

CLASS CHONDRICHTHYES		
ORDER SQUALIFORMES		
1.FAMILY ECHINORHINIDAE: Bramble sharks		
Echinorhinus brucus (Bonnaterre,1788)	Bramble Shark	GO
ORDER HETERODONTIFORMES		
2.FAMILY HETERODONTIDAE: Bullhead sharks		
Heterodontus ramalheira (Smith,1949)	Whitespotted Bullhead Shark	AS rare
Heterodontus sp.		AS
ORDER ORECTOLOBIFORMES		
3.FAMILY HEMISCYLLIIDAE: Bamboo sharks		
Chiloscyllium arabicum Guvanov,1980	Arabian Bamboo Shark	AG GO
Chiloscyllium griseum Muller & Henle,1838	Gray Bamboo Shark	AG GO
Chiloscyllium indicum (Gmelin,1789)	Slender bambooshark	GO
4.FAMILY STEGOSTOMATIDAE: Zebra sharks		
Stegostoma fasciaturn (Hermann,1783)	Zebra shark	AG GO AS RS
5.FAMILY GINGLYMOSTOMATIDAE: Nurse sharks		
Nebrius ferrugineus (Lesson,1 830)	Tawny Nurse Shark	GOASRS
6.FAMILY RHINCODONTIDAE: Whale sharks		
Rhincodon typus Smith,1828	Whale Shark	AG GO AS RS
ORDER CARCHARHINIFORMES		
7.FAMILY SCYLIORHINIDAE: Cat sharks		
Apristurus indicus (Brauer,1906)	Smallbelly Catshark	GO AS
Cephaloscyllium sufflans (Regan,1921)	Balloon Shark	AS
Halaelurus alcocki Garman,1913	Arabian Catshark	AS
Halaelurus boesemani Springer & D'Aubrey,1972	Speckled Catshark	AS
8.FAMILY PROSCYLLIDAE: Finback catsharks		
Eridacnis radclrffei Smith, 1913	Pigmy Ribbontail Catshark	AS
9.FAMILY TRIAKIDAE: Hound sharks		
Hypogaleus hyugaensis (Miyosi, 1939)	Blacktip topeshark	AG GO
Iago omanensis (Norman,1939)	Bigeye Houndshark	GO AS RS
Mustelus mosis Hemprich & Ehrenberg,1899	Arabian Houndshark	AG GO AS RS
10.FAMILY HEMIGALEIDAE: Weasel sharks		
Chaenogaleus microstoma (Bleeker,1852)	Hooktooth Shark	AG GO
Hemipristis elongatus (Kluzinger,1871)	Snaggletooth Shark	AG GO RS
Paragaleus sp.	Arabian Weasel Shark	AG GO
11.FAMILY CARCHARHINIDAE: Requiem sharks		
Carcharhinus albimarginatus (Ruppell,1837)	Silvertip Shark	AG GO*AS*RS record
Carcharhinus altimus (Springer,1 950)	Bignose Shark	GO AS RS
Carcharhinus amblyrhynchoides (Whitley,1934)	Queensland Shark	AG GO AS
Carcharhinus amblyrhynchos (Bleeker,1856)	Grey Reef Shark	AG
Carcharhinus'aniboinensis (Muller & Henle,1839)	Pigeye SharK	AG GO AS
Carcharhinus brevipinna (Muller & Henle,1839)	Spinner Shark	GO AS RS
Carcharhinus dussumieri (Valenciennes,1839)	Whitecheek Shark	AG GO
Carcharhinus fafciformis (Bibron,1839)	Silky Shark	GO RS
Carcharhinus hemiodon (Valenciennes,1839)	Pondicherry Shark	GO
Carcharhinus leucas (Valenciennes,1839)	Bull Shark	AG GO AS
Carcharhinus limbatus (Valenciennes,1839)	Blacktip Shark	AG GO AS RS
Carcharhinus longimanus (Poey,1861)	Oceanic Whitetip Shark	AG GO AS RS
Carcharhinus macloti (Muller & Henle,1839)	Hardnose Shark	AG GO AS
Carcharhinus melanopterus (Quoy & Gaimard,1824)	Blacktip Reef Shark	AG GO AS RS
Carcharhinus plumbeus (Nardo,1827)	Sandbar Shark	AG GO AS RS
Carcharhinus sorrah (Valenciennes,1831)	Spottail Shark	AG GO AS RS
Carcharhinus wheeleri Garrick,1982	Blacktail Reef Shark	AS RS
Galeocerdo cuvier (Peron & LeSeur,1822)	Tiger Shark	AG GO AS RS
Loxodon macrorhinus Muller & Henle,1839	Sliteye Shark	GO AS RS
Negaprion acutidens (Ruppell,1837)	Sicklefin Lemon Shark	GO AS RS
Prionace glauca (Linnaeus,1758)	Blue Shark	GO AS
Rhizoprionodon acutus (Ruppell,1837)	Milkshark	AG GO AS RS
Rhizoprionodon oligolinx Springer,1 964	Grey Sharpnose Shark	AG GO
Scoliodon laticaudus Muller & Henle,1838	Spadenose Shark	AG GO
Triaenodon obesus (Ruppell,1837)	Whitetip Reef Shark	GO AS RS
12.FAMILY SPHYRNIDAE: Hammerhead sharks		
Eusphyra blochii (Cuvier,1817)	Winghead Shark	AG GO
Sphyrna lewini (Griffith & Smith,1834)	Scalloped Hammerhead	AG GO AS RS
Sphyrna mokarran (Ruppell,1837)	Great Hammerhead	AG GO AS RS

Sphyrna zygaena (Linnaeus,1758)	Smooth Hammerhead	AG GO
ORDER LAMNIFORMES		
13.FAMILY ODONTASPIDIDAE: Sand tiger sharks		
Carcharias taurus Rafinesque,1810	Sand tiger shark	**GO** AS RS
14.FAMILY ALOPIIDAE: Thresher sharks		
Alopias pelagicus Nakamura,1936	Pelagic Thresher	GO AS RS
Alopias superciliosus (Lowe,1839)	Bigeye Thresher	GO AS
Alopias vulpinus (Bonnaterre,1788)	Thresher Shark	AS
15.FAMILY LAMNIDAE: Mackerel sharks		
Isurus oxyrinchus Rafinesque,1810	Shortfin Mako	GO AS RS
ORDER SQUATINIFORMES		
16.FAMILY SQUATINIDAE: Angelsharks		
Squatina africana Regan,1908	African Angelshark	GO' record
ORDER PRISTIFORMES		
17.FAMILY PRISTIDAE: Sawfishes		
Anoxypristis cuspidata (Latham,1794)	Narrow Sawfish	AG GO AS RS
Pristis pectinata Latham,1794	Largetooth Sawfish	GO AS RS
Pristis zijsron Bleeker,1851	Olive Sawfish/Longcomb sawfish	AG GO
ORDER TORPEDINIFORMES		
18.FAMILY TORPEDINIDAE: Electric rays		
Torpedo sinuspersici Olfers,1831	Marbled Torpedo	AG GO AS RS
Torpedo panthera Olfers,1831	Leopard Torpedo	AG GO AS RS
19.FAMILY NARCINIDAE		
Narcine sp.	Large eye electric ray	GO AS
Narke sp.	Electric Ray	GO
ORDER RAJIFORMES		
20.FAMILY RHINOBATIDAE: Guitar fishes		
Rhina ancyclostoma Bloch & Schneider,1801	Bowmouth Guitarfish	GO AS RS
Rhinobatos annulatus Smith,1941	Lesser Guitarfish	GO
Rhinobatos granulatus Cuvier,1829	Granulate Guitarfish	AG GO
Rhinobatos halavi (Forsskal,1775)	Halavi Guitar-fish	G O A S R S
Rhinobatos obtusus Muller & Henle,1841	Blue-spotted Guitarfish	A S
Rhinobatos punctifer Compagno & Randall,1987	Arabian Guitartish	GO RS
Rhinobatos salahlah Randall & Compagno,1995	Salahlah Guitarfish	AS new species
Rhynchobatus djiddensis (Forskal,1775)	Giant Guitarfish	AG GO AS RS
ORDER MYLIOBASTIFORMES		
21. FAMILY GYMNURIDAE: Butterflyrays		
Gymnura poecilura (Shaw,1804)	Variegated Butterflyray	AG GO AS RS
22.FAMILY MYLIOBATIDAE: Eaglerays		
Aefobatus narinari (Euphrasen,1790)	Spotted Eagleray	AG GO AS RS
Aetomylaeus nichofii Blegvard,1944	Banded Eagleray	AG GO
Rhinoptera javanica Muller & Henle,1841	Java Cownose Ray	GO
Rhinoptera jayakari (Boulenger,1895)	Oman Cownose Ray	GO AS
23.FAMILY MOBULIDAE: Mantas		
Manta birostris (Donndorff,1798)	Manta Ray	AG GO AS RS
Mobula diabolus (Shaw, 1804)	Devil Ray	GO AS
Mobula eregoodootenkee (Cuvier,1829)	Stingless Devil Ray	AG GO AS RS
Mobula thurstoni (Lloyd,1908)	Thurston's Devil Ray	GO AS RS
24.FAMILY DASYATIDAE: Stingrays		
Dasyatis kuhlii (Muller & Henle,1841)	Blue-spotted Stingray	GO AS RS
Dasyatis sp.	Oman masked ray	GO AS
Himantura gerrardi (Gray,1857)	Gerrard's Stingray	AG GO' record
Himantura imbricata (Bloch & Schneider,1801)	Scaletail Stingray	AG GO
Himantura jenkinsii Annandale,1909	Jenkins' Stingray (D. jenkinsii)	GO
Himantura uarnak (Forsskal,1775)	Darkspotted Stingray	AG GO AS RS
Pastinachus sephen (Forsskal,1775)	Fantail Stingray	GO AS RS
Taeniura lymma (Forsskal,1775)	Reef Stingray	AG GO AS RS rare
Taeniura meyeni Muller & Henle,1841	Blackblotched Stingray	GO AS RS record
Urogymnus africanus (Bloch & Schneider,1801)	Thorn Ray (U. asperrimus)	AG GO AS
ORDER CHIMAERIFORMES		
25.FAMILY RHINOCHIMAERIDAE: Longnose chimaeras		
Neoharriotta pinnata (Schnakenbeck,1931)	Deepwater Chimaera	**GO** AS
CLASS OSTEICHTHYES		
ORDER ELOPIFORMES		
1.FAMILY ELOPIDAE: Tenpounders		
Elops machnata (Forsskal,1775)	Tenpounder	AG GO AS'RS also in khawrs
2.FAMILY MEGALOPIDAE: Tarpons		

Megalops cyprinoides (Broussonet,1782)	Oxeye	AS khawrs
3.FAMILY ALBULIDAE: Bonefishes		
Albula glossodonta (Forsskal,1775)	Roundjaw Bonefish	**GO** AS
Albula argentea (Forster,1801)	Silver Bonefish	GO AS
ORDER ANGUILLIFORMES		
4.FAMILY ANGUILLIDAE: Freshwater eels		
Anguilla sp.	Eel	AS Kwars
5.FAMILY MURAENIDAE: Moray eels		
Echidna nebulosa (Ahl.1789)	Snowflake Moray	GO RS rare
Enchelycore pardalis(Temminck & Schlegel,1847)	Dragon Moray	GO AS
Gymnomuraena zebra (Shaw & Nodder,1797)	Zebra Moray	GO AS RS
Gymnothorax chilospilus Bleeker,1865	Lipspot Moray	GO*AS record
Gymnothorax favagineus (Bloch & Schneider,1 801)	Honeycomb Moray	GO AS RS
Gymnothorax flavimarginatus (Ruppell,1830)	Yellowmargin Moray	GO AS RS
Gymnothorax herrei Beebe 8 Tee-Van,1933	Dwarf Brown Moray	AG GO AS RS
Gymnothorax javanicus (Bleeker, 1859)	Giant Moray	AG GO AS RS
Gymnothorax megaspilus Bohle & Randall,1995	Oman Moray	AS new species
Gymnothorax nudivomer (Playfair & Gunther,1867)	Yellowmouth Moray	GO AS RS
Gymnothorax phasmatodes (Smith,1962)	Phantom Moray	GO AS
Gymnothorax pseudothrysoideus Bleeker,1852	Highfin Moray	GO AS
Gymnothorax undulatus (Lacepede,1803)	Undulated Moray	GO AS RS
Pseudechidna brummeri (Bleeker,1859)	White Ribbon Eel	AS
Scuticaria tigrina (Lesson,1829)	Leopard Moray	GO AS
Sideria tlavocula Bohlke & Randall,1995	Palenose Moray	GO AS new species
Sideria grisea (Lacepede, 1803)	Grey Moray	GO AS RS
Sideria picta (Ahl,1789)	Peppered Moray	GO*AS RS record
6.FAMILY CONGRIDAE: Conger eels		
Conger cinereus cinereus Rupell, 1830	Moustache Conger	GO AS RS
Uroconger lepturus (Richardson,1845)	Longtail Conger	GO AS RS
7.FAMILY MURAENESOCIDAE: Pipe eels		
Muraenesox cinereus (Forsskal,1775)	Dagger-tooth Pike Conger	AG GO AS RS
8.FAMILY OPHICHTHIDAE: Snake eels		
Brachysomophis cirrocheilos (Bleeker,1857)	Spotted crocodile snake Eel	AS
Brachysomophis crocodilinus (Bennet,1831)	Crocodile Snake Eel	AS
Ichthyapus omanensis (Norman,1 839)	Oman Snake Eel	GO
Lamnostoma orientalis (McClelland,1844)	Oriental Snake Eel	GO
Muraenichthys gymnotus Bleeker,1864	Slender Worm Eel	GO AS
Muraenichthys schultzei Bleeker,1857	Schultze's Worm Eel	AG GO
Myrichthys colubrinus (Boddart,1781)	Ringed Snake Eel	GO AS RS
Myrichthys maculosus (Cuvier,1817)	Spotted Snake Eel	GO AS RS
Ophisurus multiserialis (Norman,1939)	Speckled Snake Eel	AS
Pisodonophis hoevenii (Bleeker,1853)	Hoeven's Snake Eel	AG GO
ORDER CLUPEIFORMES		
9.FAMILY CLUPEIDAE: Herrings,shads &sardines		
Amblygaster sirm (Walbaum,1792)	Spotted Sardinella	AG GO ASRS
Anodontostoma chacunda (Ham.Buch.,1822)	Chacunda gizzard shad	AG GO
Dussumeria acuta Valenciennes,1847	Rainbow Sardine	AG GO AS
Dussumeria elopsoides Bleeker,1849	Slender Rainbow Sardine	GO AS RS
Escualosa thoracata (Valenciennes,1847)	White sardine	GO AS
Etrumeus teres (De Kay,1842)	Red-eye Round Herring	AG GO AS RS
Herklotsichthys lossei Wongratana,1983	Gulf Herring	AG GO
Herklotsichthys quadrimaculatus (Ruppell,1835)	Fourspot Sardine	AG GO AS RS
Hilsa kelee (Cuvier, 1839)	Kelee Shad	GO AS record
Ilisha compressa (Randall, 1994)	Thin Ilisha(I. elongata)	AG
Ilisha melastoma (Bloch & Schneider,1801)	Indian Ilisha	AG GO' record
Ilisha megaloptera (Swainson, 1839)	Bigeye Ilisha	AG GO
Ilisha sirishai Seshagiri Rao, 1975	Lobejaw Ilisha	AG GO
Nematolosa arabica Regan,1917	Arabian Gizzard Shad	GO AS
Nematolosa nasus (Bloch, 1795)	Bloch's Gizzard Shad	AG GO AS* record
Ophistopterus tardoore (Cuvier,1829)	Tardoor	GO
Pellona ditchela Valenciennes,1847	Indian Pellona	GO* record
Sardinella albella (Valenciennes,1847)	White Sardinella	AG GO' record
Sardinella gibbosa (Bleeker,1829)	Goldstripe sardinella	AG GO AS
Sardinella longiceps (Valenciennes,1847)	Indian Oil Sardine	AG GO AS
Sardinella melanura (Cuvier, 1829)	Blacktip Sardinella	GO record
Sardinella sindensis (Day, 1878)	Sind Sardinella	AG GO AS
Spratelloides delicatulus (Bennett,1831)	Delicate Round Herring	GO AS RS

Spratelloides gracilis (Schlegel,1846)	Silverstripe Round Herring	GO AS RS
Tenualosa ilisha (Ham.Buch.,1822)	Hilsa Shad	AG GO
Tenualosa toli (Valenciennes,1847)	Toli Shad	AS record
10.FAMILY ENGRAULIDAE: Anchovies		
Encrasicholina devisi (Whitley,1940)	De Vis' Anchovy	AG GO AS
Encrasicholina heteroloba (Ruppell,1837)	Shorthead Anchovy	GO AS RS
Encrasicholina punctifer Fowler,1838	Buccaneer Anchovy	AG GO AS RS
Stolephorus commersonii Lacepede,1803	Commerson's Anchovy	AG GO AS
Stolephorus indicus (van Hasselt,1823)	Indian Anchovy	AG GO AS RS
Thryssa baelama (Forsskal,1775)	Baelama Thryssa	GO AS RS
Thryssa hamiltoni (Gray,1835)	Hamilton's Thryssa	AG GO
Thryssa mystax (Schneider,1801)	Moustached Thryssa	AG GO AS record
Thryssa setirostris (Broussonet,1782)	Longjaw Thryssa	AG GO AS RS
Thryssa vitrirostris (Gilchrist & Thompson,1908)	Orangemouth Thryssa	AG GO AS
Thryssa whiteheadi Wongratana,1983	Whitehead's Thryssa	AG GO
11.FAMILY CHIROCENTRIDAE: Wolf herrings		
Chirocentrus dorab (Forsskal,1775)	Blackfin Wolf Herring	AG GO AS RS
Chirocentrus nudus Swainson,1839	White Wolf Herring	AG GO AS RS
ORDER GONORYNCHIFORMES		
12.FAMILY CHANIDAE: Milkfishes		
Chanos chanos (Forsskal,1775)	Milkfish	AG GO AS RS
ORDER CYPRINIFORMES		
13.FAMILY CYPRINIDAE: Cyprinids		
Cyprinion microphthalmum (Day,1880)	Fresh water species commonly found inland bodies of water	
Garra barreimiae Fowler & Steinitz,1956	such as wadis and falaj.	
Garra longipinnis Banister & Clark,1977		
ORDER SILURIFORMES (Nematognathi)		
14.FAMILY ARIIDAE: Sea catfishes		
Arius bilineatus (Valenciennes,1840)	Roundsnout Sea Catfish	AG GO AS' record
Arius maculatus (Thunberg,1792)	Spotted Sea Catfish	GO AS" record
Arius tenuispinis Day,1877	Thinspine Sea Catfish	AG GO AS*record
Arius thallasinus (Ruppell,1837)	Giant Sea Catfish	AG GO AS RS
Arius dussumieri Valenciennes,1840	Blacktip Sea Catfish	GO AS
15.FAMILY PLOTOSIDAE: Catfish eels		
Plotosus limbatus Valenciennes,1840	Brown Eel Caffish	GO AS
Plotosus lineatus (Thunberg,1787)	Striped Eel Catfish	AG GO AS RS
Plotosusnkunga Gomon & Taylor,1982	Stinging Eel Catfish	AS record
ORDER SALMONIFORMES		
16.FAMILY ALEPOCEPHALIDAE: Slickheads		
Narcetes lloydi Fowler,1934	Slickheads	AS
17.FAMILY ASTRONESTHIDAE: Snaggletooths		
Astronesthes martensii Kluzinger,1871	Snaggletooths	GO AS RS
ORDER AULOPIFORMES		
18.FAMILY SYNODONTIDAE: Lizardfishes		
Saurida gracilis (Quoy & Gaimard,1824)	Slender Lizardfish	AG GO AS
Saurida longimanus Norman, 1939	Longfin Lizardfish	AG GO AS
Saurida nebulosa Valenciennes,1849	Nebulous Lizardfish	GO
Saurida tumbil (Bloch,1795)	Greater Lizardfish	AG GO AS RS
Saurida undosquamis (Richardson,1848)	Brushtooth Lizardfish	AG GO AS RS
Synodus binotatus Schultz,1953	Two spot Lizardfish	AS
Synodus dermatogenys Fowler,1912	Clearfin Lizardfish	GO AS RS
Synodus indicus (Day,1873)	Indian Lizardfish	AS RS
Synodus macrops Tanaka,1917	Triplecross Lizardfish	GO AS RS
Synodus variegatus (Lacepede,1803) (S. englemani)	Reef Lizardfish	GO AS RS
Trachynocephalus myops (Forster,1801)	Snakefish	AG GO
19.FAMILY HARPADONTIDAE: Bombay ducks		
Harpadon nehereus (Hamilton-Buchanan,1822)	Bombay Duck	AG GO AS RS
20.FAMILY CHLOROPHTHALMIDAE: Greeneyes		
Chlorophthalmus bicornis Norman,1939	Spinyjaw greeneye	GO AS
ORDER MYCTOPHIFORMES		
21.FAMILY MYCTOPHIDAE: Lantern fishes		
Benthosema fibulatum (Gilbert & Cramer,1897)	Spinnycheek Lanternfish	GO AS RS
Benthosema pteroum (Alcock,1891)	Spinycheek Lanternfish	GO AS RS
Bolinichthys longipes (Brauer,1906)	Lanternfish	GO AS
Diaphus arabicus	Lanternfish	GO AS
Diaphus meadi Nafpaktitis, 1978	Lanternfish	GO AS
Diaphus thiollierei Fowler,1934	Lanterntish	GO AS

Diaphus spp.	Lanternfish	GO AS
Myctophum spinosum (Steindachner,1867)	Spiny Lanternfish	GO AS RS
Symbolophorus evermanni (Gilbert,1905)	Evermann's Lanternfish	GO AS RS
22.FAMILY PARALEPIDIDAE: Barracudinas		
Lestidiops jayakari (Boulenger,1889)	Barracudinas	GO AS
ORDER GADIFORMES		
23.FAMILY BREGMACEROTIDAE: Codlets		
Bregmaceros nectabanus Whitley,1941	Codlets	GO AS
24.FAMILY MACROURIDAE: Grenadier		
Malacocephalus laevis(Lowe, 1843)	Soft Head Grenadier	GO AS
ORDER OPHIDIIFORMES		
25.FAMILY OPHIDIIDAE: Brotulas & cust eels		
Brotula multibarbata (Temminck & Schlegel,1844)	Bearded Brotula	GO
Neobythites sp.		GO
ORDER BATRACHOIDIFORMES		
26.FAMILY BATRACHOIDIDAE: Toadfishes		
Austrobatrachus dussumieri (Valenciennes,1837)	Flat Toadfish	AG GO
Batrachoides grunniens (Steindachner)	Frogfish	GO
Bifax lacinia Greenfield,Randall & Mee, 1994	Two-faced Toadfish	AS
ORDER LOPHIIFORMES		
27.FAMILY LOPHIIDAE: Goosefishes		
Lophiodes mutilus (Alcock,1893)	Smooth Angler	GO AS
Lophiomus setigerus (Vahl,1797)	Blackmouth Angler	GO AS
28.FAMILY ANTENNARIIDAE: Frogfishes, Anglers		
Antennarius coccineus (Lesson, 1830)	Freckled Frogfish	GO AS RS
Antennarius commersoni (Latreille,1804)	Giant Anglerfish	GO* RS record
Antennarius indicus Schultz.1964	Indian Frogfish	GO AS rare
Antennarius nummifer (Cuvier,1817)	Finacier Frogfish	AG
Antennarius pictus (Shaw & Nodder,1794)	Painted Frogfish	GO AS
Antennarius sarasa Tanaka,1916	Calico Frogfish	AS
Histrio histrio (Linnaeus,1758)	Sargassumfish	GO AS
29.FAMILY CHAUNACIDAE: Sea Toads		
Chaunax sp.	Sea Toad	GO
ORDER CYPRINODONTIFORMES		
30.FAMILY EXOCOETIDAE: Flying fishes		
Cheilopogon atrisignis (Jenkins,1903)	Glider Flyingfish	GO AS
Cheilopogon cyanopterus (Valenciennes,1847)	Margined Flyingfish	GO AS
Cheilopogon furcatus (Mitchell, 1815)	Spotfin Flyingfish	GO AS
Cheilopogon nigricans (Bennett,1840)	Blacksail Flyingfish	GO AS
Cypselurus naresii (Gunther,1889)	Pharao Flyingfish	AS RS
Cypselurus oligolepis (Bleeker,1866)	Largescale Flyingfish	AG GO AS RS
Exocoetus monocirrhus Richardson.1846	Barbel Flyingfish	GO AS
Exocoetus voliians (Linnaeus,1758)	Tropical Two-wing Flyingfish	GO AS
Hirundichthys coromandelensis (Hornell,1923)	Coromandel Flyingfish	GO AS
Hirundichthys oxycephalus (Bleeker,1852)	Bony Flyingfish	AG GO AS
Paraexocoetes mento (Valenciennes,1846)	African Sailfin Flyingfish	AG GO AS RS
Prognichthys brevipinnis (Valenciennes,1846)	Shortfin Flyingfish	GO AS
31 .FAMILY HEMIRAMPHIDAE: Halfbeaks		
Hemiramphus archipelagicus Collete & Parin,1978	Jumping Halfbeak	GO
Hemiramphus far (Forsskal,1775)	Spotted Halfbeak	AG GO AS RS
Hemiramphus marginatus (Forsskal,1775)	Blackedge Halfbeak	AG GO AS
Hyporhamphus dussumieri (Valenciennes,1846)	Dussumier's Halfbeak	GO
Hyporhamphus limbatus (Valenciennes,1846)	Congaturi Halfbeak	AG GO
Hyporhamphus sindensis (Regan,1905)	Sind Halfbeak	AG GO
Hyporhamphus unicuspis Collette & Parin,1978	Simpletooth Halfbeak	AG GO
Rhynchoramphus georgii (Valenciennes,1846)	George's Halfbeak	AG GO AS
32.FAMILY BELONIDAE: Needlefishes,garfishes		
Ablennes hians (Valenciennes,1846)	Flat Needlefish	AG GO AS RS
Platybelone argalus platyura (Bennett,1837)	Keeltail Needlefish	AG GO AS RS
Strongylura leiura (Bleeker,1850)	Banded Needlefish	AG GO AS
Strongylura strongylura (van Hasselt,1823)	Spottail Needlefish	AG GO AS
Tylosurus acus melanotus (Bleeker,1850)	Agujon	GO AS RS
Tylosurus choram (Ruppell,1837)	Red Sea Houndfish	GO AS RS
Tylosurus crocodilus crocodilus(Per.& LeSueur,1821)	Houndfish	AG GO AS RS
33.FAMILY CYPRINODONTIDAE: Killifishes (Toothcarps)		
Aphanius dispar (Ruppell,1828)	Arabian Pupfish	AG GO AS

34.FAMILY POECILIIDAE: Live bearers)		
Poecilia latipinna (Le Sueur,1821)	Sailfin Molly	AG GO
ORDER ATHERINIFORMES		
35.FAMILY ATHERINIDAE: Silversides		
Atherinomorus lacunosus (Forster,1801)	Hardyhead Silverside	AG GO AS RS
Hypoatherina temminckii (Bleeker,1853)	Samoan Silverside	GO AS RS
ORDER LAMPRIFORMES		
36.FAMILY VELIFERIDAE: Velifera		
Velifer hypselopterus Bleeker, 1878	Sailfin Velifer	GO AS
ORDER BERYCIFORMES		
37.FAMILY TRACHICHTHYIDAE: Slimeheads		
Hoplostethus sp.	Slimeheads	AS
38.FAMILY BERYCIDAE: Alfonsinos		
Beryx decadactylus Cuvier, 1829	Alfonsino	AS
Beryx splendens Lowe.1 834	Slender Alfonsino	AS
39.FAMILY MONOCENTRIDAE: Pinecone fishes		
Monocentris japonicus (Houttuyn,1782)	Pineapple Fish	AS RS
40.FAMILY ANOMALOPIDAE: Flashlight fishes		
Photoblepharon palbebratus steinitzi(Abe&Han.,1973)	Red Sea Flashlight Fish	GO AS RS
41.FAMILY HOLOCENTRIDAE: Squirrelfishes,soldierfishes		
Myripristis murjan (Forsskal,1775)	Pinecone Soldierfish	GO*AS RS record
Neoniphon sammara (Forsskal,1775)	Spot-fin Squirrelfish	GO'AS RS record
Sargocentron caudimaculatum (Ruppell,1838)	Tailspot Squirrelfish	AS RS
Sargocentron diadema (Lacepede,1801)	Crown Squirrelfish	GO*AS RS rare
Sargocentron rubrum (Forsskal,1775)	Redcoat	GO AS RS
Sargocentron seychellense (Smith & Smith,1963)	Yellowtipped Squirrelfish	AS
Sargocentron spiniferum (Forsskal,1775)	Sabre Squirrelfish	AS RS rare
ORDER ZEIFORMES		
42.FAMILY ZEIDAE: Dories		
Cyttopsis roseus (Lowe,1 843)	Rosy Dory	GO AS
Zenopsis conchifer (Lowe,1852)	Silvery John Dory	GO AS
43.FAMILY CAPROIDAE: Boarfishes		
Antigonia rubescens (Gunther,1860)	Indo-Pacific Boarfish	AG GO AS RS
ORDER SYNGNATHIFORMES		
44.FAMILY FISTULARIIDAE: Cornetfishes		
Fistularia commersonii Ruppell,1835	Smooth Cornetfish	AG GO AS RS
Fistularia petimba Lacepede,1803	Serrate Cornetfish	AG GO
45.FAMILY CENTRICIDAE: Shrimpfishes		
Centriscus scutatus Linnaeus,1758	Grooved Shrimpfish	AG GO
46. FAMILY SOLENOSTOMIDAE: Ghost Pipefish		
Solenostomus cyanopterus Bleeker,1852	Sea Ghost Pipefish	GO AS RS
47.FAMILY SYNGNATHIDAE: Pipetishes &seahorses		
Acentronura tentaculata Gunther,1 870	Pipehorse	AG GO AS RS
Bryx analicarens (Duncker,1915)	Pink Pipefish	'AG GO
Choeroichthys brachysoma (Bleeker,1855)	Shortbodied Pipefish	GO AS RS
Cosmocampus banneri (Herald & Randall,1972)	Ban&i's Pipefish	GO AS RS
Cosmocampus investigatoris (Hora,1925)	Investigator Pipefish	AG GO
Corythoichthys amplexus Dawson & Randall,1975	Darkbarred Pipefish	GO AS
Corythoichthys flavofasciatus (Ruppell,1838)	Yellowbanded Pipefish	AS RS
Corythoichthys haematopterus (Bleeker,1851)	Messmate Pipefish	AG
Doryrhampus aurolineatus Randall & Earle,1994	Orangestripe Pipefish	AS new species
Doryrhampus excisus excisus Kaup,1856	Biuestripe Pipefish	AG AS RS
Halicampus macrorhynchus Bamber,1915	Whiskered Pipefish	AS RS
Halicampus mataafae (Jordan & Seale,1906)	Samoan Pipefish	AS RS
Halicampus zavorensis Dawson,1984	Zavora Pipefish	AS
Hippichthys cyanospilus (Bleeker,1854)	Bluespeckled Pipefish	AS RS
Hippichthys penicillus (Cantor,1 849)	Beady Pipefish	AG GO
Hippocampus fuscus Ruppell,1838	Spotted Seahorse	GO AS RS
Hippocampus histrix Kaup,1853	Thorny Seahorse	GO RS
Hippocampus kuda Bleeker,1852	Yellow Seahorse	GO*AS record
Micrognathus andersonii (Bleeker,1858)	Shortnose pipefish	AG RS
Syngnathoides biaculeatus (Bloch,1785)	Alligator Pipefish	GO AS RS
Trachyrhamphus bicoartatus (Bleeker,1857)	Double-ended Pipefish	GO AS RS
ORDER DACTYLOPTERIFORMES		
48.FAMILY DACTYLOPTERIDAE: Flying gurnards		
Dactyloptena orientalis (Cuvier,1829)	Helmet Gurnard	AG GO AS RS

ORDER PEGASIFORMES		
49.FAMILY PEGASIDAE: Sea moths		
Pegasus volitans Linnaeus,1758	Longtail Seamoth	AG GO
ORDER SCORPAENIFORMES		
50.FAMILY SCORPAENIDAE: Scorpionfishes, rockfishes, stonefish		
Ablabys binotatus (Peters, 1855)	Indian Waspfish	AS
Apistus carinatus (Bloch & Schneider,1801)	Bearded Waspfish	GO AS RS
Brachypterois serrulata (Richardson1 846)	Serrate Liontish	GO RS
Choridactylus lineatus Poss & Mee,1995	Lined Stingfish	AS new species
Choridactylus multibarbus Richardson1848	Orangebanded Stingfish	AG GO AS RS
Minous inermis Alcock,1889	Longfin Stingfish	GO AS
Minous coccineus Alcock,1890	Onestick Stingfish	GO AS RS
Minous dempsterae Eschmeyer,Hallacher & Rao,1979	Obliquebanded Stingfish	GO
Minous monodactylus (Bloch & Schneider,1801)	Grey Stingfish	AG GO RS
Pseudosynanceia melanostigma Day,1875	Blackfin Stonefish	AG GO AS
Pterois antennata (Bloch,1787)	Raggedfin Turkeyfish	GO
Pterois miles (Bennett, 1828)	Military Turkeyfish	AG GO AS RS
Pterois mombasae (Smith,1 957)	Mombasa Turkeyfish	GO AS
Pterois radiata Cuvier & Valenciennes,1829)	Clear-fin Turkeyfish	GO AS RS
Pterois russelli Bennett,1831	Largetail Turkeyfish	AG GO
Pterois volitans Linnaeus,1758	Lionfish	GO RS
Scorpaenodes littoralis (Tanaka,1917)	Shore Scorpionfish	AS
Scorpaenopsis barbatus (Ruppell,1838)	Bearded Scorpionfish	AG GO AS RS
Scorpaenopsis diabolus (Cuv.& Valenciennes,1829)	Devil Scorpionfish	GO AS RS
Scorpaenopsis gibbosa (Buchanan & Schneider,1801)	Humphacked Scorpionfish	AS RS
Scorpaenopsis lactomaculata (Herre,1945)	Whiteblotched Scorpiontish	AG GO
Scorpaenopsis venosa (Cuvier,1829)	Raggy Scorpionfish	AG GO AS common
Snyderina guentheri Boulenger,1889	Guther's Wasfish	GO
Synanceia nana Eschmeyer & Rama-Rao,1973	Dwarf Scorpionfish	AG GO AS RS
Synanceia verrucosa Bloch & Schneider,1801	Stonefish	AG GO RS
Vespicula dracaene (Cuvier,1829)	Draco Waspfish	AG GO
51.FAMILY TRIGLIDAE: Searobins		
Lepidotrigla bentuviai Richards & Saksena,1977	Twohorn Gurnard	GO AS
Lepidotrigla bispinosa Steindachner,1898	Bullhorn Gurnard	AG GO AS RS
Lepidotrigla faueri Gilchrist & Thompson,1914	Prickly Gurnard	GO
Lepidotrigla omanensis Regan,1905	Oman Gurnard	GO AS
Lepidotrigla spiloptera Gunther, 1880	Spottedwing Gurnard	AG GO RS
Pterygotrigla hemisticta (Temminck & Schlegel,1842)	Blackspotted Gurnard	GO
52.FAMILY PLATYCEPHALIDAE: Flatheads		
Cociella crocodila (Tilesius,1812)	Crocodile Flathead	GO AS RS
Grammoplites scaber (Linnaeus,1758)	Rough Flathead	AG GO
Grammoplites suppositus (Troschel,1840)	Spotfin Flathead	AG GO AS RS
Papilloculiceps longiceps (Cuvier,1829)	Tentacled Flathead	GO AS RS
Platycephalus indicus (Linnaeus,1758)	ndian Flathead	AG GO AS RS
Rogadius, pristiger (Cuvier,1829)	Thorny Flathead	GO AS RS
Sorsogona melanoptera Knapp & Wongratana,1987	Obscure Flathead	GO
Sorsogona nigripinna (Regan,1905)	Blackfin Flathead	GO
Sorsogona prionata (Sauvage,1873)	Halfspined Flathead	GO AS RS
Sorsogona tuberculata (Cuvier,1829)	Tuberculate Flathead	AG GO
Suggrundus rodericiensis (Cuvier,1829)	Spiny Flathead	AG GO
Thysanophrys celebica (Bleeker,1854)	Sulawesi Flathead	AG GO AS
Thysanophrys chiltonae Schultz,1966	Longsnout Flathead	GO AS RS
ORDER PERCIFORMES		
53.FAMILY AMBASSIDAE: Glassies		
Ambassis gymnocephalus (Lacepede,1801)	Bald Glassfish	GO AS RS
Ambassis natalensis Gilchrist & Thompson.1908	Slender Glassy	GO AS
54.FAMILY SERRANIDAE: Grouper, seabasses		
Aethaloperca rogaa (Forsskal,1775)	Redmouth Grouper	AG GO AS RS
Anyperodon leucogrammicus (Valenciennes,1828)	Slender Grouper	GO AS RS
Cephalopholis argus Bloch & Schneider,1801	Peacock Grouper	GO AS RS record
Cephalopholis aurantia (Schneider,1801)	Golden Hind	GO AS
Cephalopholis boenak(Bloch,1790)	Chocolate Hind	GO AS
Cephalopholis formosa (Shaw & Nodder, 1804)	Blueiined Hind	GO AS
Cephalopholis hemistiktos (Ruppell,1830)	Halfspotted Hind	AG GO AS RS record/common
Cephalopholis miniata (Forsskal,1775)	Coral Hind	GO AS RS
Cephalopholis nigripinnis (Valenciennes,1828)	Dusky Hind	GO AS RS
Cephalopholis sexmaculata (Ruppell,1830)	Sixspot Grouper	GO AS RS rare

Cephalopholis sonnerati (Valenciennes,1830)	Tomato Grouper	GO AS
Dermatoleptis striolata Playfair & Gunther,1 867	Smooth Grouper	GO AS
Epinephelus areolatus (Forsskal,1775)	Areolate Grouper	AG GO AS RS
Epinephelus bleekeri (Vaillant, 1877)	Bleeker's Grouper	AG GO
Epinephelus caeruleopunctatus (Bloch,1790)	Whitespotted Grouper	AG GO AS
Epinephelus chlorostigma (Valenciennes, 1828)	Brownspotted Grouper	AG GO AS RS
Epinephelus coioides (Hamilton1 822)	Orangespotted grouper	AG GO
Epinephelus diacanthus (Valenciennes,1828)	Spinycheek Grouper	GO AS
Epinephelus epistictus (Temminck & Schlegel,1842)	Spottedback Grouper	GO AS RS
Epinephelus fasciatus (Forsskal,1775)	Blacktip Grouper	GO AS RS
Epinephelus faveatus(Valenciennes,1828)	Bigspot Grouper	GO AS
Epinephelus flavocaeruleus (Lacepede,1802)	Blue & yellow Grouper	AG GO AS
Epinephelus fuscoguttatus (Forsskal.1775)	Brown-Narbled Grouper	GO AS RS
Epinephelus gabriellae Randall & Heemstra,1991	Gabriella's Grouper	GO AS
Epinephelus hexagonatus (Schneider,1801)	Starspotted Grouper	GO AS
Epinephelus rndistinctus Randall & Heemstra,1991	Somali Grouper	GO*AS record
Epinephelus lanceolatus (Bloch,1790)	Giant Grouper	GO'AS RS record
Epinephelus latifasciatus(Temminck & Schlegel,1824)	Banded Grouper	AG GO AS RS
Epinephelus longispinis (Kner,1865)	Longspine Grouper	GO AS
Epinephelus malabaricus (Schneider,1801)	Malabar Grouper	AG GO AS RS
Epinephelus marginatus (Lowe,1834)	Yellowbelly Grouper	GO AS
Epinephelus merra Bloch,1790	Honeycomb Grouper	GO AS
Epinephelus morrhua (Valenciennes,1833)	Comet Grouper	GO AS
Epinephelus multinotatus (Peters,1876)	Whiteblotched Grouper	AG GO AS
Epinephelus poecilonotus (Temmick & Schlegel,1842)	Dot-dash Grouper	GO*AS record
Epinephelus polylepis Randall & Heemstra,1991	Smallscale Grouper	AG GO AS
Epinephelus radiatus (Day,1867)	Obliquebanded Grouper	GO RS
Epinephelus retouti Bleeker,1868	Red-tipped Grouper	GO'AS record
Epinephelus rivulatus (Valenciennes,1830)	Halfmoon Grouper	GO*AS record
Epinephelus stoliczkae (Day,1 875)	Epaulet Grouper	AG*GO AS RS record/common
Epinephelus tauvina (Forsskal,1775)	Greasy Grouper	GO AS RS
Epinephelus tukula Morgans, 1959	Potato Grouper	GO AS RS
Epinephelus undulosus Quoy and Gaimard,1824	Wavy-lined Grouper	GO AS
Grammistes sexlineatus (Thunberg,1792)	Sixline Soapfish	AS RS
Plectranthias vexillarius Randall,1980	Banner Anthias	GO
Plectropomus maculatus (Bloch,1790)	Spotted Coral Grouper	GO AS RS
Plectropomus punctatus (Quoy & Gaimard,1824)	Marbled Coralgroupel	AS
Pseudoanthias marcia Randall & Hoover,1993	Marcia's Anthias	GO AS new species
Pseudoanthias townsendi (Boulenger,1897)	Townsend's Anthias/Oman Fairy basslet	AG GO
Sacura boulengeri (Heemstra,1973)	Boulenger's Anthias	GO
Tosana niwae (Smith & Pope,1 906)	Threadtail Anthias	AG
Variola louti (Forsskal, 1775)	Coronation Grouper	AS'RS rare
55.FAMILY DINOPERCIDAE: Cavebass		
Dinoperca petersi (Day,1875)	Cave Bass	GO AS
56.FAMILY PSEUDOCHROMIDAE: Dottybacks		
Chlidichthys cacatuoides Gill & Randall.1 994	Cockatoo Dottyback	AS new species
Halidesmus coccus Winterbottom & Randall,1 994	Rooster Snakelet	AS new species
Halidesmus thomaseni (Nielsen,1960)	Thomasen's Snakelet	AS
Haliophis diademus Winterbottom & Randall,1994	Stars-&-Stripes Snakelet	AS new species
Haliophis guttatus (Forsskal,1775)	Spotted Snakelet	AS RS
Pseudochromis aldabrensis Bauchot-Boutin,1958	Arabian Bluestriped Dottyback	AG GO AS
Pseudochromis caudalis Boulenger,1898	Bandtail Dottyback	AG GO
Pseudochromis dutoiti Smith,1955	Dutoiti	AG GO
Pseudochromis linda Randall & Stanaland,1989	Linda's Dottyback	AG GO
Pseudochromis leucorhynchus Lubbock, 1977	Whitelip Dottyback	GO AS
Pseudochromis nigrovittatus Boulenger,1897	Blackstripe Dottyback	AG GO AS
Pseudochromis olivacens Ruppell,1835	Olive Dottyback	AG GO AS RS
Pseudochromis omanensis Gill & Mee,1993	Oman Dottyback	AS new species
Pseudochromis perscicus Murray,1887	Persian Dottyback	AG GO AS
Pseudochromis punctatus Kotthaus,1970	Blackback Dottyback	AS
Rusichthys sp.	Orangestriped Snakelet	AS
57.FAMILY PLESIOPIDAE: Longfins,roundheads		
Calloplesiops altiveles (Steindachner,1903)	Comet Longfin	AS RS
Plesiops mystaxus Mooi, 1995	Moustache Longfin	AS RS new species
Plesiops nigricans (Ruppell,1828)	Whitespotted Longfin	AS RS
58.FAMILY ACANTHOCLINIDAE: Spinny basslets		
Acanthoclinus indicus (Day,1888)	Scottie	AS

59.FAMILY TERAPONIDAE: Tigerperches		
Pelates quadrilineatus (Bloch,1790)	Fouriine Terapon	GO AS RS
Terapon jarbua (Forsskal,1775)	Jarbua	AG GO AS RS
Terapon puta (Cuvier,1829)	Spinycheek Terapon	AG GO AS RS
Terapon theraps (Cuvier,1829)	Largescale Terapon	AG GO AS RS
60.FAMILY KUHLIIDAE: Aholeholes, flagtails		
Kuhlia mugil (Schneider,1801)	Fiveband Flagtail	GO AS RS
61.FAMILY PRIACANTHIDAE: Bigeyes, catalufas		
Cookeolus japonicus (Cuvier,1829) (C. boops/C.cruentatus)	Bulleye	GO AS
Priacanthus blochii Bleeker,1853	Peony Bigeye	GO AS
Priacanthus hamrur (Forsskal,1775)	Goggle-eye	AG GO AS RS
Priacanthus tayenus Richardson1846	Purplespotted Bigeye	AG GO
62.FAMILY APOGONIDAE: Cardinalfishes		
Apogon aureus (Lacepede,1802)	Golden Cardinalfish	GO RS
Apogon coccineus Ruppell, 1838	Ruby Cardinalfish	AG GO AS RS
Apogon cookii Macleay,1853	Cooks Cardinaltish	GO RS
Apogon cyanosoma Bleeker,1853	Yellowstriped Cardinalfish	AG GO RS
Apogon dhofar Mee,1995	Dhofar Cardinalfish	AS new species
Apogon evermanni Jordan & Snyder,1904	Oddscale Cardinalfish	AS
Apogon exostigma (Jordan & Starks,1906)	Eyeshadow Cardinalfish	GO AS RS
Apogon fasciatus (Shaw,1790)	Twostripe Cardinalfish	AG GO RS
Apogon fleurieu (Lacepede,1801)	Flower Cardinalfish	AG GO RS
Apogon fraenatus Valenciennes,1832	Spurcheek Cardinalfish	GO RS
Apogon holotaenia (Regan,1905)	Copperstriped Cardinalfish	GO
Apogon lineatus, Temminck & Schlegel,1842	Ten-bar Cardinalfish	GO AS
Apogon multitaeniatus Ehrenberg,1828	Smallscale Cardinalfish	AS RS
Apogon natalensis Gilchrist & Thompson,1908	Manyline Cardinalfish	AS
Apogon nigripinnis Cuvier,1828	Bulls-eye Cardinalfish	AG GO' RS record
Apogon nrgrofasciatus Lachner,1953	Blackbar Cardinalfish	GO AS RS
Apogon omanensis Gon & Mee,1995	Oman Cardinalfish	GO AS new species
Apogon pseudotaeniatus Gon,1986	Doublebar Cardinaltish	AG
Apogon queketti Gilchrist,1903	Signal cardinalfish	AG GO AS RS
Apogon semiornatus Peters,1876	Obliquebanded Cardinalfish	GO RS
Apogon smithvanizi Allen & Randall,1995	Elongate Cardinalfish	AG GO.
'Apogon taeniatus Cuvier & Valenciennes,1828	Striped Cardinalfish	AG GO* RS record
Apogon timorensis Bleeker,1854	Timor Cardinalfish	AS RS
Apogon truncatus Bleeker,1854	Flagfin Cardinalfish	AG GO' RS record
Archamia fucata (Cantor, 1850)	Orangelined Cardinalfish	AG GO RS
Archamia pallida Gon & Randall,1995	Pale Cardinalfish	AS new species
Chelodipterus arabicus (Gmelin,1788)	Arabian Cardinalfish	GO AS RS
Chelodipterus macrodon Lacepede,1802	Largetooth Cardinalfish	AG GO AS RS
Chelodipterus novemstriatus (Ruppel,1938)	Twospot Cardinalfish	AG GO AS RS
Chelodipterus persicus Gon,1993	Persian Cardinalfish	AG GO AS
Chelobipterus quinquelineatus Cuvier,1828	Fiveline Cardinalfish	GO AS
Fowleria abocellata Goren & Karplus,1980	Mottled Cardinalfish	G O A S R S
Fowleria aurita (Cuvier & Valenciennes,1831)	Crosseyed Cardinaltish	AS RS
Fowleria variegata (Valenciennes,1832)	Variegated Cardinalfish	AG GO RS
Holapogon maximus (Boulenger,1887)	Titan Cardinalrish	GO AS
Rhabdamia cypselura Weber,1909	Swallowtail Cardinalfish	GO
Siphamia versicolor (Smith & Radcliffe,1911)	Sea-urchin Fish GO AS	
63.FAMILY ACROPOMATIDAE:Glow-bellies		
Acropoma japonicum Gunther,1859	Glow belly	GO record
64.FAMILY SILLAGINIDAE: Smelt-whiting		
Sillago arabica McKay & McCarthy,1 989	Arabian Sillago	AG GO
Sillago attenuata McKay,1985	Slender Sillago	AG GO
Sillago chondropus Bleeker,1849	Clubfoot Sillago	GO AS
Sillago indica McKay,Dutt, & Sujatha,1985	Indian Sillago	GO AS
Sillago sihama (Forsskal,1775)	Silver Sillago	AG GO AS RS
65.FAMILY MALACANTHIDAE: Sand tilefishes		
Malacanthus latovittatus (Lacepede,1798)	Blue Blanquillo	GO AS RS rare
66.FAMILY LACTARIIDAE: False trevalies		
Lactarius lactarius (Bloch & Schneider,1801)	False Trevally	AG GO AS RS
67.FAMILY POMATOMIDAE: Bluefishes		
Pomatomus saltatrix (Linnaeus,1766)	Bluefish	AS
68.FAMILY RACHYCENTRIDAE: Cobias		
Rachycentron canadum (Linnaeus,1766)	Cobia	AG GO AS RS

69.FAMILY ECHENEIDAE: Remoras		
Echeneis naucrates Linnaeus,1758	Sharksucker	AG GO AS RS
Remora remora (Linnaeus,1758)	Remora	GO
70.FAMILY CARANGIDAE: Jacks,trevallies,scads,etc		
Alectis ciliaris (Bloch,1788)	Threadfin Jack	A G G O A S R S
Alectis indicus (Ruppell,1830)	Indian Threadfish	AG GO AS RS
Alepes djedaba (Forsskal,1775)	Shrimp Scad	AG GO AS RS
Alepes kleinii (Bloch,1793)	Sharpbelly Scad(C. para)	AS
Alepes melanoptera Swainson, 1839	Blackfin Scad	AG GO
Alepes vari (Cuvier,1833)	Herring Scad	AG GO AS RS
Atropus atropus (Schneider,1801)	Cleftbelly Jack	AG GO
Atule mate (Cuvier,1833)	Yellowtail Scad	AG GO AS RS
Carangoides armatus (Ruppell,1830)	Longfin Jack	AG GO AS RS
Carangoides bajab (Forsskal,1775)	Orangespotted Jack	AG GO AS RS
Carangoides chrysophrys (Cuvier,1833)	Longnose Jack	AG GO AS RS
Carangoides coeruleopinnatus (Ruppell,1830)	Coastal Jack	AG GO AS RS
Carangoides equula (Temminck & Schlegel,1844)	Whitefin Jack	GO AS
Carangoides ferdau (Forsskal,1775)	Barred Jack	AG GO AS RS
Carangoides fulvoguttatus (Forsskal, 1775)	Yellowspotted Jack	AG GO AS RS
Carangoides gymnotethus (Cuvier,1833)	Bludger	AG GO AS RS
Carangoides hedlandensis (Whitley,1933)	Bumpnose Trevally	GO record
Carangoides malabaricus (Bloch & Schneider,1801)	Malabar Jack	AG GO AS
Carangoides praeustus (Bennett,1830)	Blacktip Jack	AG GO
Carangoides talamparoides Bleeker,1852	Imposter Jack	GO
Caranx heberi (Bennet,1 828)	Blacktip Trevally(C.sem)	AG GO AS
Caranx ignobilis (Forsskal,1775)	Giant Trevally	GO AS RS
Caranx lugubris Poey,1860	Black Trevally	GO
Caranx melampygus (Cuvier,1833)	Bluefin Trevally	GO AS RS
Caranx sexfasciatus Quoy & Gaimard,1824	Bigeye Trevally	AG GO AS RS
Decapterus kurroides Bleeker,1855	Redtail Scad	GO
Decapterus macarellus (Cuvier,1833)	Mackerel Scad	AG GO AS RS
Decapterus macrosoma Bleeker, 1851	Shortfin Scad	AG GO AS RS
Decapterus russelli (Ruppell,1830)	Indian Scad	AG GO AS RS
Decapterus tabl Berry,1967	Roughear Scad	GO AS
Elegatis bipinnulata (Quoy & Gaimard,1824)	Rainbow Runner	AG GO AS RS
Gnathanodon speciosus (Forsskal,1775)	Golden Trevally	AG GO AS RS
Megalaspis cordyla (Linnaeus,1758)	Torpedo Scad	AG GO AS RS
Naucrates ductor (Linnaeus,1758)	Pilotfish	AG GO AS RS
Parastromateus niger (Bloch.1795)	Black Pompret	AG GO AS
Scomberoides commersonianus Lacepede,1801	Talang Queenfish	AG GO AS RS
Scomberoides lysan (Forsskal,1775)	Doublespotted Queenfish	AG GO AS RS
Scomberoides tala (Cuvier,1832)	Barred Queenfish	GOrecord
Scomberoides tol (Cuvier,1832)	Needlescale Queenfish	AG GO AS RS
Selar crumenopthalmus (Bloch,1793)	Bigeye Scad	AG GO AS RS
Selaroides leptolepis (Cuvier,1833)	Yellowstripe Scad	AG GO AS RS
Seriola dumerili (Risso,1810)	Greater Amberjack	GO AS RS
Seriola rivoliana Valenciennes,1833	Almaco Jack	GO AS
Seriolina nigrofasciata (Ruppell, 1829)	Blackbanded Jack	AG GO AS RS
Trachinotus africanus Smith.1 967	African Pompano	GO AS
Trachinotus baillonii (Lacepede,1802)	Smallspotted Pompano	AG GO AS RS
Trachinotus blochii (Lacepede,1802)	Snubnose Pompano	AG GO AS RS
Trachinotus botla (Shaw,1803) (T.russelii)	Largespotted Pompano	GO AS
Trachinotus mookalee Cuvier,1832	Indian Pompano	GO AS' record
Trachurus indicus Nekrasov,1966	Arabian Scad	AG GO AS RS
Ulua mentalis Cuvier,1833	Longrakered Jack	AG GO AS RS
Uraspis helvola (Forster,1801)	Whitetongue Jack	AG GO AS RS
Uraspis segunda (Poey,1860)	Cottonmouth Jack	GO
Uraspis uraspis (Gunther.1 860)	Whitemouth Jack	GO
71.FAMILY CORYPHAENIDAE: Dolphinfishes		
Coryphaena equiselis Linnaeus,1758	Pompano Dolphinfish	**GO** AS
Coryphaena hippurus Linnaeus,1758	Common Dolphinfish	AG GO AS RS
72.FAMILY MENEIDAE: Moonfishes		
Mene maculata (Bloch & Schneider,1801)	Moonfish	AG GO RS
73.FAMILY LEIOGNATHIDAE: Slipmouths, ponyfishes		
Gazza achlamys Jordan & Starks,1917	Naked Ponyfish	**GO**
Gaua minuta (Bloch, 1797)	Toothpony	AG GO RS
Leiognathus bindus (Valenciennes,1835)	Orangefin Ponyfish	AG GO AS RS

Leiognathus daura (Cuvier,1829)	Goldstripe Ponyfish	GO AS
Leiognathus decorus De Vis,1 884	Decorated Pony fish	AG GO
Leiognathus elongatus (Gunther,1874)	Elongate Ponyfish	GOrecord
Leiognathus equulus (Forsskaal,1775)	Common Ponyfish	AG GO AS RS
Leiognathus fasciatus (Lacepede,1803)	Barred Ponyfish	GO AS RS most common
Leiognathus oblongus (Valenciennes,1835) (L.berbis,L.lineolatus)	Oblong Ponyfsih	AG GO AS RS
Secutor insidiator (Bloch,1787)	Pugnose Ponyfish	AG GO RS
74.FAMILY GERREIDAE: Mojarras		
Gerres abbreviatus Bleeker,1850	Deepbody Mojarra	GO record
Gerres acinaces Bleeker, 1854	Longtail Mojarra	AG GO AS RS
Gerres filamentosus Cuvier,1829	Whipfin Mojarra	AG GO AS RS
Gerres oyena (Forsskal,1775)	Blacktip Mojarra	AG GO AS RS
Pentaprion longimanus (Cantor,1850)	Longfin Mojarra	AG GO* record
75.FAMILY EMMELICHTHYIDAE: Rubyfishes		
Erythrocles schlegelli (Richardson,1846)	Ruby Rover	Go record
76.FAMILY LUTJANIDAE: Snappers		
Aphareus furcatus (Lacepede,1802)	Smalltooth Jobfish	GO AS RS
Aphareus rutilans Cuvier,1830	Rusty Jobfish	GO AS RS
Aprion virescens Valenciennes,1830	Green Jobfish	AGGOASRS
Etelis carbunculus Cuvier,1828	Ruby snapper	AG GO AS
Etelis coruscans Valenciennes,1862	Ruby snapper	GO AS
Lipocheilus carnolabrum (Chan,1970)	Tang's snapper	GO
Lutjanus argentimaculatus (Forsskal,1775)	Mangrove Snapper	GO AS RS
Lutjanus bengalensis (Bloch,1790)	Bengal Snapper	AG GO AS RS
Lutjanus bohar (Forsskal,1775)	Twinspot Snapper	AG GO*AS RS record
Lutjanus coeruleolineatus (Ruppell,1835)	Bluelined Snapper	GO AS RS
Lutjanus ehrenbergi (Peters,1869)	Blackspot Snapper	AG GO'AS RS common
Lutjanus erythropterus Bloch,1790	Crimson Snapper	GO
Lutjanus fulviflamma (Forsskal,1775)	Dory Snapper	AG GO AS RS
Lutjanus fulvus (Schneider,1801)	Blacktail Snapper	GO AS RS
Lutjanus gibbus (Forsskal,1775)	Humpback Snapper	GO'AS RS record
Lutjanus johni (Bloch,1792)	John's Snapper	GO AS
Lutjanus kasmira (Forsskal,1775)	Bluesriped Snapper	GO*AS RS record
Lutjanus lunulatus (Parks,1797)	Lunartail Snapper	AG GO*AS RS rare
Lutjanus lutjanus Bloch,1790	Yellowlined Snapper	AG GO AS RS
Lutjanus madras(Valenciennes,1831)	Indian snapper	GO record
Lutjnus malabaricus (Schneider,1801)	Malabar Snapper	AG GO AS
Lutjanus monostigma (Cuvier,1828)	Onespot Snapper	GO AS
Lutjanus quinquelineatus (Bloch,1790)	Fivestripe Snapper	AG GO*AS rare
Lutjanus rivulatus (Cuvier,1838)	Specled Snapper	GO AS RS
Lutjanus russelli (Bleeker,1849)	Russell's Snapper	AG GO AS RS
Lutjanus sanguineus (Cuvier,1828)	Humphead Snapper	AG GO AS RS
Lutjanus sebae (Cuvier,1828)	Emperor Snapper	GO AS RS
Lutjanus vitta (Quoy & Gaimard,1824)	Brownstripe snapper	GO* record
Macolor niger (Forsskal,1775)	Black &white snapper	AS RS
Paracaesio xanthurus Bleeker,1869	Yellowtail blue snapper	GO AS RS
Paracaesio sordidus Abe & Shinohara,1962	Smallscale Snapper	GO*AS RS rare
Pinjalo pinjalo (Bleeker,1850)	Pinjalo	AG GO AS RS
Pristipomoides filamentosus (Valenciennes,1830)	Rosy Jobfish	AG GO AS RS
Pristipomoides multidens (Day,1870)	Goldbanded Jobtish	AG GO AS RS
Pristipomoides sieboldii (Bleeker,1852)	Lavender Jobfish	AG GO AS RS
Pristipomoides zonatus (Valenciennes, 1830)	Obliquebanded snapper	GO AS
77.FAMILY CAESIONIDAE: Fusiliers		
Caesio caerulaurea (Lacepede,1801)	Goldstriped Fusilier	GO AS RS
Caesio lunaris Cuvier,1830	Lunar Fusilier	AG GO AS RS
Caesio varilineata Carpenter,1987	Yellowstriped Fusilier	AG GO AS RS
Dipterygonatus balteatus (Valenciennes,1830)	Dwarf Fusilier	AS
Pterocaesio chrysozona (Cuvier & Valenciennes,1830)	Goldband Fusilier	AG'GO RS record
78.FAMILY NEMIPTERIDAE: Threadfin breams, spinecheeks		
Nemipterus bipunctatus (Ehrenberg,1830)(N.bleekeri)	Delagoa Threadfin Bream	AG GO AS RS
Nemipterus japonicus (Bloch,1791)	Japanese Threadfin Bream	AG GO AS RS
Nemipterus marginatus (Valenciennes,1830)	Red filament threadfin bream	GO record
Nemipterus peronii (Valenciennes,1830)	Notchfin Threadfin Bream	AG GO AS RS
Nemipterus randalli Russell,1986	Randall's Threadfin Bream	AG GO' AS RS common
Nemipterus zysron (Bleeker,1856)	Slender threadfin bream	GO* RS record
Parascolopsis aspinosa (Rao & Rao,1981)	Spotfin Bream	AG GO AS RS
Parascolopsis eriomma (Jordan & Richardson,1909)	Rosy Bream	GO AS RS

Parascolopsis townsendi Boulenger,1901	Townsendi's Bream	**GO** AS RS
Scolopsis bimaculatus Ruppell,1828	Thumbprint Bream	AG GO AS RS
Scolopsis ghanam (Forsskal,1775)	Dotted Bream	AG GO AS RS
Scolopsis taeniatus (Ehrenberg,1830)	Blackstreak Bream	AG GO AS RS
Scolopsis vosmeri (Bloch,1792)	Whitecheek Bream	AG GO AS RS
79.FAMILY LOBOTIDAE: Tripletails		
Lobotes surinamensis (Bloch,1790)	Tripletail	AG GO AS RS
80.FAMILY HAEMULIDAE: Grunts, sweetlips		
Diagramma pictum (Thunberg,1795)	Painted Thicklip	AG GO AS RS
Plectorhinchus flavomaculatus (Ehrenberg,1830)	Lemon Thicklip	GO AS RS
Plectorhinchus gaterinus (Forsskal,1775)	Blackspotted Thicklip	AG GO AS RS
Plectorhinchus gibbosus (Lacepede,1802)	Dusky Thicklip	GO AS RS
Plectorhinchus orientalis (Bloch,1793)	Oriental sweetlips	GO AS
Plectorhinchus pictus (Tortonese,1935)	Trout Thicklip	AG GO AS' record
Plectorhinchus playfairi (Tortonese,1935)	Whitebarred Thicklip	GO* AS RS record
Plectorhinchus schotaf (Forsskal,1775)	Minstrel	GO AS RS
Plectorhinchus sordidus (Kluzinger,1870)	Sordid Thicklip	AG GO AS RS
Pomadasys aheneus McKay & Randall,1995	Yellowback Grunt	GO*AS record new species
Pomadasys argenteus (Forsskal,1775)	Silver Grunt	AG GO AS RS
Pomadasys argyreus (Valenciennes, 1833)	Bluecheek silver grunt	GO AS
Pomadasys commersonni (Lacepede,1802)	Spotted Grunt	GO AS
Pomadasys kaakan (Cuvier,1836)	Javelin Grunt	AG GO AS RS
Pomadasys maculatus (Bloch,1797)	Saddle Grunt	AG GO AS RS
Pomadasys multimaculatum (Playfair,1866)	Cock grunter	AG GO AS RS
Pomadasys olivaceus (Day,1 875)	Olive Grunt	GO AS
Pomadasys punctulatus (Ruppell,1838)	Lined Grunt(P.furcatus)	GO AS RS
Pomadasys stridens (Forsskal,1775)	Striped Grunt	AG GO AS RS
Pomadasys taeniatus McKay & Randall,1995	Bronzestriped Grunt	GO* AS record new species
81.FAMILY LETHRINIDAE: Scavangers, emperors		
Gymnocranius grandoculis (Valenciennes,1830)	Blue-lined large-eye bream	AS RS
Lethrinus. borbonicus Valenciennes,1830	Snubnose Emperor	AG GO AS RS
Lethrinus erythracanthus Cuvier,1830	Yellowfin Emperor	GO* record
Lethrinus harak (Forsskal,1775)	Blackspot Emperor	GO AS RS
Lethrinus lentjan (Lacepede,1802)	Redspot Emperor	AG GO*AS*RS
Lethrinus mahsena (Forsskal,1775)	Mahsena	GO AS RS
Lethrinus microdon Valenciennes,1830	Smalltooth Emperor	AG GO AS RS
Lethrinus nebulosus (Forsskal,1775)	Spangled Emperor	AG GO*AS*RS
Lethrinus obsoletus (Forsskal,1775)	Orangestriped Emperor	GO AS RS
Lethrinus olivaceus Valenciennes,1830	Longface emperor	GO AS RS
Lethrinus semicinctus Valenciennes,1830	Blackblotch emperor	GO
Lethrinus variegatus Valenciennes,1830	Slender emperor	GO AS RS
Lethrinus xanthochilus Kluzinger,1870	Yellowlips Emperor	GO RS
Monotaxis grandoculis (Forsskal,1775)	Bigeye Emperor	AS RS
82.FAMILY SPARIDAE: Porgies, sea&reams		
Acanthopagrus berda (Forsskal,1775)	Picnic Bream	AG GO AS RS
Acanthopagrus bifascaiatus (Forsskal,1775)	Doublebar Seabream	AG GO AS RS
Acanthopagrus latus (Houttyn,1782)	Yellowtin Seabream	AG GO
Argyrops filamentosus (Valenciennes,1830)	Soldierbream	AG GO AS RS
Argyrops spinifer (Forsskal,1775)	King Soldierbream	AG GO AS RS
Boops lineatus (Boulenger, 1892)	Striped Boga	GO AS
Cheimerius nufar (Valenciennes,1830)	Santer Seabream	AG GO AS RS
Crenidens crenidens indicus Day	Karanteen Seabream	AG GO AS*RS record
Diplodus cervinus omanensis Bauchot & Bianchi,1989	Oman Porgy	AG GO AS RS
Diplodus sargus capensis (Smith,1846)	Cape Porgy	AS
Diplodus sargus kotschyi (Steindachner,1876)	Onespot Porgy	AG GO AS
Lithognathus mormyrus (Linnaeus,1758)	Barred Seabream	GO AS RS
Pagellus affinis Boulenger,1887	Arabian Pandora	AG GO AS
Rhabdosargus haffara (Forsskal,1775)	Haffara seabream	AG GO AS RS
Rhabdosargus sarba (Forsskal,1775)	Goldstriped Seabream	AG GO AS RS
Rhabdosargus thorpei Smith,1979	Bigeye stumpnose	GO
Sparidentex hasta (Valenciennes,1830)	Soabaity seabream	AG GO
Sparus aurata Linnaeus, 1758	Gilthead seabream	introduced (GO)
83.FAMILY SCIAENIDAE: Croakers, drums		
Argyrosomus amoyensis (Bleeker,1863)	Amoy croaker	AG GO
Argyrosomus heinii (Steindachner, 1907)	Arabian Sea Meagre	GO AS
Argyrosomus hololepidotus (Lacepede,1802)	Southern Meagre	GO AS
Johnius vogleri (Bleeker,1853)	Sharptooth croaker	AG GO

Johnius belangerii (Cuvier,1830)	Belanger's Croaker	AG GO AS
Johnius carutta Bloch,1793	Karut Crooker	AG GO AS
Johnius dussumieri (Valenciennes,1833)	Bearded croaker	AS
Nibea maculata (Scheneider,1801)	Blotched croaker	GO AS
Otolithes cuvieri Trewavas,1974	Lesser Tigertooth Croaker	AG GO AS
Otolithes ruber (Schneider,1801)	Tigertooth Croaker	AG GO AS
Pennahia anea (Bloch,1773)	Greyfin Croaker	AG GO
Protonibea diacantha(Lacepede,1802)	Spotted Croaker	AG GO AS
Umbrina canariensis Valenciennes,1843	Canary drum	GO
Umbrina rochus Valenciennes,1843	Obliquebanded Croaker	AG GO AS
84.FAMILY MULLIDAE: Goatfishes		
Mulloidichthys flavolineatus (Lacepede,1801)	Yellowstripe Goatfish	AG GO AS RS
Mulloidichthys vanicolensis (Valenciennes,1831)	Yellowfin Goatfish	AG GO AS RS
Parupeneus barberinus (Lacepede,1801)	Dash-dot Goatfish	GO AS RS
Parupeneus bifasciatus (Lacepede,1801)	Doublebar Goatfish	GO AS
Parupeneus cyclostomus (Lacepede,1801)	Goldsaddle Goatfish	GO AS RS
Paruoeneus heotacanthus(Lacoede.1801)(P.cinnabarinus)	Cinnabar Goatfish	AG GO AS RS
Parupeneus indicus (Shaw,1803)	Indian Goatfish	GO AS
Parupeneus macronemus (Lacepede,1801)	Longbarbel Goatfish	AG GO AS RS
Parupeneus margaritatus Randall & Gueze,1984	Pearly Goatfish	AG GO AS most common
Parupeneus pleurostigma (Bennett,1831)	Sidespot Goatfish	GO AS
Parupeneus rubescens (Lacepede,1801)	Rosy Goatfish	GO AS RS
Upeneus bensasi (Temminck & Schlegel,1842)	Bensasi Goatfish	GO AS
Upeneus doriae (Gunther,1 869)	Gilded Goatfish	AG GO
Upeneus pori Ben-Tuvia & Golani, 1989	Por's Goatfish	GO'AS RS record
Upeneus sundaicus (Bleeker,1855)	Ochreband Goatfish	AG GO
Upeneus sulphureus Cuvier,1829	Sulfur Goat-fish	AG GO AS
Upeneus tragula (Richardson,1845)	Freckled Goatfish	AG GO AS
Upeneus vittatus (Forsskal,1775)	Yellowband Goatfish	AG GO AS RS
85.FAMILY MONODACTYLIDAE: Monos		
Monodactylus argenteus (Linnaeus,1758)	Silver Mono	AG GO AS RS
Monodactylus falciformis Lacepede,1801	Cape Moony	GO AS RS
86.FAMILY PEMPHERIDAE: Sweepers		
Parapriacanthus ransonneti Steindachner,1870	Golden sweeper	GO AS RS
Pempheris vanicolensis Cuvier,1831	Vanikoro Sweeper	AG GO AS RS
Pempheris sp.	Red sweeper	AS
87.FAMILY KYPHOSIDAE: Sea chubs, rudderfrshes		
Kyphosus bigibbus Lacepede,1802	Grey Chub	GO AS RS
Kyphosus cinerascens (Forsskal,1775)	Highfin Chub	GO AS RS
Kyphosus vaigiensis (Quoy & Gaimard,1825)	Brassy Chub	GO AS RS
88.FAMILY EPHIPPIDAE: Spadefishes, batfishes		
Ephippus orbis (Bloch,1787)	Orbfish	AG GO
Platax orbicularis (Forsskal,1775)	Circular Platax	AG GO AS RS
Platax teira (Forsskal,1775)	Teira	AG GO AS RS
89.FAMILY DREPANIDAE: Drepanes		
Drepane longimana (Bloch & Schneider,1801)	Barred Siclefish	AG GO AS
Drepane punctata (Linnaeus,1758)	Spotted Sicklefish	AG GO AS RS
90.FAMILY SCATOPHAGIDAE: Scats		
Scathopagus argus (Linnaeus,1766)	Spotted Scat	AG
91.FAMILY CHAETODONTIDAE: Butterflyfishes		
Chaetodon auriga Forsskal,1775	Threadfin Butterflyfish	GO AS RS
Chaetodon austriacus (Ruppell,1836)	Exquisite Butterflyfish	AS RS
Chaetodon citrinellus Cuvier,1831	Speckled Butterflyfish	AS
Chaetodon collare Bloch,1787	Collared Butterflyfish	GO AS
Chaetodon decussatus Cuvier,1831	Sri Lanka Butterflyfish	GO
Chaetodon dialeucos Mee & Salm,1989	Oman Butter-fly-fish	GO AS endemic
Chaetodon gardineri Norman,1939	Gardiner's Butterflyfish	AG GO AS
Chaetodon jayakarai Norman,1939	Jayakar's Butterflyfish	GO RS
Chaetodon larvatus Cuvier,1831	Orangeface Butterflyfish	AS RS
Chaetodon leucopleura Playfair & Gunther,1867	Somali Butterflyfish	GO AS RS
Chaetodon lunula (Lacepede,1803)	Racoon Butterflyfish	GO AS
Chaetodon melannotus Bloch & Scheneider,1801	Bloch & Schneider,1801	GO AS RS
Chaetodon melapterus Guichenot,1862	Arabian Butterflyfish	AG GO AS RS
Chaetodon nigropunctatus Sauvage,1880	Blackspotted Butterflyfish	AG GO
Chaetodon semilarvatus Cuvier, 1831	Masked Butterflyfish	AS RS
Chaetodon trifascialis Quoy & Gaimard, 1824	Chevron Butterflyfish	AS RS
Chaetodon vagabundus Linnaeus,1758	Vagabond Butterflyfish	GO AS RS

Forcipiger longirostris Broussonet,1782	Big longnosed Butterflyfish	AS rare
Hemitaurichthys zoster (Bennett,1831)	Belted Butterflyfish	GO AS
Heniochus acuminatus Linnaeus,1758	Longfin Bannerfish	AG GO AS
Heniochus diphreutes Jordan,1903	Schooling Bannerfish	GO AS
92.FAMILY CICHLIDAE: Cichlids		
Oreochromis aureus (Steindachner,1864)	Blue-mouth Brooder Tilapia	introduced
93.FAMILY POMACANTHIDAE: Angelfishes		
Apolemichthys xanthotis (Fraser-Brunner,1951)	Yellow-ear Angelfish	AG GO AS RS
Centropyge acanthops (Norman,1922)	African Cherubtish	AS
Centropyge multispinis (Playfair & Gunther,1867)	Manyspine Cherubfish	GO AS RS
Pamacanthus asfur (Forsskal,1775)	Arabian Angelfish	AS RS
Pomacanthus imperator (Bloc,1787)	Emperor Angelfish	GO AS RS
Pomacanthus maculosus (Forsskal,1775)	Yellowbar Angelfish	AG GO AS RS
Pomacanthus semicirculatus (Cuvier,1831)	Semicircle Angelfish	GO AS RS
94.FAMILY PENTACEROTIDAE: Armorheads, boarfishes		
Histiopterus typus Temminck & Schlegel,1844	Sailfin Armourhead	AG GO AS RS
95.FAMILY POMACENTRIDAE: Damselfishes		
Abudefduf notatus (Day,1869)	Yellowtail Sergeant	AS
Abudefduf sexfasciatus (Lacepede,1801)	Scissortail Sergeant	AS RS
Abudefduf sordidus (Forsskal,1775)	Blackspot Sergeant	GO RS
Abudefduf vaigiensis (Quoy & Gaimard,1825) (A.saxatalis)	Indo-Pacific Sergeant	AG GO AS RS
Amphiprion clarkii (Bennett,1830)	Clark's Anemonefish	AG GO
Amphiprion omanensis Allen & Mee,1991	Oman Anemonefish	AS new species
Amphiprion sebae Bleeker,1853	Sebae Anemonefish	GO AS
Chromis flavaxilla Randall,1994	Arabian Chromis	AG GO AS RS new species
Chromis dimidiata (Kluzinger,1871)	Half- and-half Chromis	AS RS
Chromis pembae (Smith,1960)	Yellow-edge Chromis	GO AS RS
Chromis weberi Fowler & Bean,1928	Weber's Chromis	GO AS RS
Chromis xanthopterygia Randall & McCarthy,1988	Yellowfin Chromis	AG GO AS
Chrysiptera annulata (Peters,1855)	Blackbarred Damselfish	AS RS
Chrysiptera sheila Randall,1994	Sheila's Damselfish	GO AS new species
Chrysiptera unimaculata (Cuvier,1830)	Onespot Damselfish	GO AS
Dascyllus marginatus (Ruppell,1828)	Blackbordered Dascyllus	AG GO AS RS
Dascyllus trimaculatus (Ruppell, 1828)	Domino	AG GO AS RS
Neopomacentrus cyanomos (Bleeker,1856)	Regal Damselfish	GO AS RS
Nedpomacentrus miryae Dor & Allen,1977	Miry's Damselfish	GO AS RS
Neopomacentrus sindensis(Day,1873)	Sind Damselfish	AG GO AS
Plectroglyphiodon dickii (Lienard,1839)	Dick's Damselfish	AS
Plectroglyphidodon johnstonianus Fowler & Ball,1924	Johnston Damselfish	AG GO AS RS
Plectroglyphidodon leucozonus (Bleeker,1859)	Whitebar Damselfish	AS RS
Pomacentrus arabicus Allen,1991	Arabian Damselfish	GO
Pomacentrus aquilus (Allen & Randall,1980)	Dark Damselfish	AG GO AS RS
Pomacentrus caeruleus Quoy & Gaimard,1825	Caerulean Damselfish	AS RS
Pomacentrus leptus Allen & Randall,1 980	Slender Damselfish	AG GO AS RS
Pomacentrus sulfureus Kluzinger,1871	Lemon Damselfish	AS RS
Pomacentrus trichourus Gunther, 1866	Reticulated Damselfish	AG GO RS
Pemacentrus trilineatus Cuvier,1830	Threeline Damdelfish	AS RS
Pristotis obtusirostris (Gunther,1862) (P.jerdoni)	Gulf Damselfish	AG GO
96.FAMILY CIRRHITIDAE: Hawkfishes		
Cirrhichthys calliurus Regan,1905	Spottedtail Hawkfish	AG GO AS
Cirrhitichthys oxycephalus (Bleeker,1855)	Pixie Hawkfish	AS RS
Cirrhitichthys pinnulatus (Bloch & Schneider,1801)	Stocky Hawkfish	AG GO AS
Paracirrhites forsteri (Schneider,1 801)	Blackside Hawkfish	AG GO RS
97.FAMILY CEPOLIDAE: Bandfishes		
Acanthocephola abbreviata(Valen.in Cuv.& Valen,1835)	Yellowspotted Bandfish	AG GO
98.FAMILY MUGILIDAE: Mullets		
Chelon klunzingeri (Day,1888)(Liza carinata)	Kluzinger's Mullet	AG GO AS RS
Chelon macrolepis (Smith,1849)	Largescale Mullet	AG GO AS RS
Chelon persicus Senou,Randall & Okiyama,1995	Persian Mullet	AG GO new species
Chelon subviridis (Valenciennes,1836)	Greenback Mullet	AG GO AS
Crenimugil crenilabis (Forsskal,1775)	Fringelip Mullet	GO AS RS
Ellochelon vaigiensis (Quoy & Gaimard,1825)	Squaretail Mullet	AG GO AS RS
Liza melinoptera (Valenciennes,1836)	Otomebora Mullet	GO AS
Liza tade (Forsskal,1775)	Tade Mullet	AG GO AS RS
Moolgarda cunnesius (Valenciennes,1836)	Wedgesnout Mullet	AG GO AS RS
Moolgarda pedaraki (Valenciennes,1836)	Longfin Mullet	AG GO AS
Moolgarda seheli (Forsskal, 1775)	Bluespot Mullet	AG GO AS RS

Mugil cephalus Linnaeus,1758	Flathead Mullet	AG GO AS RS
Oedalechilus labiosus (Valenciennes,1836)	Thicklip Mullet	GO AS RS
99.FAMILY SPHYRAENIDAE: Barracudas		
Sphyraena acutipinnis Day,1876(S.africana)	Sharpfin Barracuda	**GO** AS RS
Sphyraena barracuda (Walbaum,1792)	Great Barracuda	GO AS RS
Sphyraena flavicauda Ruppell,1835	Yellowtail Barracuda	GO AS RS
Sphyraena forsteri Cuvier,1829	Bigeye Barracuda	GO AS RS
Sphyraena jello Cuvier,1829	Pickhandle Barracuda	AG GO AS RS
Sphyraena obtusata Cuvier,1829	Obtuse Barracuda	AG GO AS RS
Sphyraena putnamiae Jordan & Seale,1905	Sawtooth Barracuda	GORS
Sphyraena qenie Kluzinger, 1870	Blacktail Barracuda	GO AS RS
100.FAMILY POLYNEMIDAE: Threadfins		
Eleutheronema tetradactylum(Shaw,1804)	Four-finger Threadfin	AG GO AS
Polynemus plebeius Broussonet,1782	Striped Threadfin	AG GO*AS RS record
Polynemus sextarius Scheneider,1801	Blackspot Threadfin	AG GO AS RS
101.FAMILY LABRIDAE: Wrasses		
Anampses caeruleopunctatus Ruppell,1829	Bluespotted Wrasse	AS RS
Anampses lineatus Randall,1972	Lined Wrasse	AS RS
Anampses meleagrides Cuvier,1839	Spotted Wrasse	AS RS
Bodianus axillaris (Bennett,1831)	Axilspot Hogfish	AS RS
Bodianus diana (Lacepede,1801)	Diana's Hogfish	GO AS RS
Bodianus macrognathus Morris1974	Giant Hogfish	GO AS
Cheilinus bimaculatus Valenciennes,1840	Two spot Splendor Wrasse	AS
Cheilinus chlorurus (Bloch,1791)	Floral Wrasse	GO AS
Cheilinus diagrammus (Lacepede,1801)	Cheeklined Wrasse	GO AS RS
Cheilinus fasciatus fasciatus Bloch,1791	Redbreasted Wrasse	GO AS RS
Cheilinus lunulatus (Forsskal,1775)	Broomstail Wrasse	AG GO AS RS
Cheilinus trilobatus Lacepede,1801	Tripletail Wrasse	GO AS RS
Cheilinus undulatus Ruppell,1835	Humphead Wrasse	GO AS RS
Cheilio inermis (Forsskal,1775)	Cigar Wrasse	GO AS RS
Choerodon robustus (Gunther,1862)	Robust Tuskfish	AG GO AS RS
Cirrhilabrus rubriventralis Springer & Randall,1974	Social Wrasse	AS RS
Coris africana Smith,1 957	African Coris	AS RS
Coris aygula Lacepede,1801	Clown Coris	GO AS RS
Coris caudimacula (Quoy & Gaimard,1834)(C.caudimaculata)	Spottail Coris	GO AS RS
Coris formosa Bennett,1830	Queen Coris .	GO AS RS
Coris nigrotaenia Mee & Hare,1995	Blackbar Coris	AS new species
Epibulus insidiator (Pallas,1770)	Slingjaw Wrasse	GO AS RS
Gomphosus cueruleus Lacepede,1801	Indian Ocean Bird Wrasse	GO AS RS
Halichoeres dussumieri (Valenciennes,1839)	Bubbletin Wrasse	AG GO
Halichoeres hortulanus (Lacepede,1801)	Checkerboard Wrasse	GO AS RS
Halichoeres iridis Randall & Smith, 1980	Rainbow Wrasse	GO AS RS
Halichoeres lapillus Smith,1947	Jewelled Wrasse	AS
Halichoeres leptotaenia Randall & Earle,1994	Thinstriped Wrasse	AG new species
Halichoeres marginatus Ruppell,1835	Dusky Wrasse	GO AS RS
Halichoeres melas Randall & Earle,1994	Black Wrasse	AS new species
Halichoeres nebulosus (Valenciennes,1839)	Nebulous Wrasse	AS RS
Halichoeres scapularis (Bennett,1831)	Zigzag Wrasse	AS RS
Halichoeres signifer Randall & Earle,1994	Flag Wrasse	AS new species
Halichoeres stigmaticus Randall & Smith,1980	U-spot Wrasse	AG GO* rare
Halichoeres zeylonicus (Bennett,1831)	Goldstripe Wrasse	AS
Hemigymnus fasciatus (Bloch,1792)	Barred Thicklip Wrasse	GO AS RS
Hemigymnus melapterus (Bloch, 1791)	Blackeye Thicklip Wrasse	GO AS
Hologymnosus annulatus (Lacepede,1801)	Ring Wrasse	GO AS RS
Hologymnosus doliatus (Lacepede,1801)	Pastel Ringwrasse	AS RS
Labroides bicolor Fowler & Bean,? 928	Bicolor Cleaner Wrasse	AS
Labroides dimidiatus (Valenciennes,1839)	Black & Blue Cleaner Wrasse	AG GO AS RS
Larabicus quadrilineatus (Ruppell,1835)	Arabian Cleanerfish	AG GO AS RS
Leptojulis cyanopleura (Bleeker,1853)	Shoulderspot Wrasse	AG GO
Novaculichthys taeniourus (Lacepede,1801)	Rockmover Wrasse	AS RS
Oxycheilinus bimaculatus (Valenciennes,1840)(C.bimaculatus)	Twospot Wrasse	GO* AS common
Paracheilinus mccoskeri Rand.& Hamerlin-Vivien,1977	McCosker's Wrasse	AG GO
Pseudodax moluccanus(Valenciennes,1839)	Chiseltooth Wrasse	GO AS RS
Stethojulis albovittata (Bonnaterre,1788)	Bluelined Wrasse	AS RS
Stethojulis interrupta (Bleeker,1851)	Cutribbon Wrasse	GO*AS*RS common
Suezichthys caudovittatus (Steindachner,1898)	Tailband Wrasse	AG GO AS RS
Suezichthys gracilis(Steindachner & Doderlain,1877)	Slender Wrasse	AG

Thalassoma hardwickii (Bennett, 1828)	Hardwicke's Wrasse	AS RS
Thalassoma loxum Randall &Mee,1994	Slantband Wrasse	GO AS new species
Thalassoma lunare (Linnaeus,1758)	Moon Wrasse	AG*GO*AS RS common/abundant
Thalassoma lutescens (Lay & Bennett,1 839)	Sunset Wrasse	AS
Thalassoma purpureum (Forsskal,1775)	Surge Wrasse	GO AS RS
Xyrichtys bimaculatus Ruppell,1828	Twospot Razorfish	AG GO'AS RS record
Xyrichtys pavo (Valenciennes,1839)	Peacock Wrasse	GO AS RS
Xyrichtys pentadactylus (Linnaeus,1758)	Five Finger Wrasse	GO AS RS
102.FAMILY SCARIDAE: Parrotfishes		
Caiotomus carolinus (Valenciennes,1840)	Stareye Parrotfish	AS
Chlorurus sordidus(Forsskal,1775)(formerly Scarus)	Bullethead Parrotfish	GO AS common
Chlorurus strongylocephalus(Bleeker,1854)	Roundhead Parrotfish	AS
Hipposcarus harid (Forsskal, 1775	Longnose Parrotfish	AS'RS record
Leptoscarus vaigiensis (Quoy & Gaimard, 1824)	Slender Parrotfish	AS RS
Scarus arabicus (Steindachner,1902)	Arabian Parrotfish	GO AS
Scarus falcipinnis (Playfair,1867)	Falcate-fin Parrotfish	AS
Scarus ferrugineus Forsskal,1775	Rusty Parrottish	AG GO AS RS
Scarus frenatus Lacepede,1802	Bridled Parrotfish	AS RS
Scarus fuscopurpureus (Kluzinger,1871)	Purple-brown Parrotfish	AG GO AS RS
Scarus ghobban Forsskal,1775	Blubarred Parrot-fish	GO AS
Scarus gibbus Ruppell,1828	Heavybeak Parrotfish	AS RS
Scarus niger Forsskal,1775	Swarthy Parrotfish	AS RS
Scarus percicus Randall & Bruce,1 983	Persian Parrot-fish	AG GO AS
Scarus psittacus Forsskal,1775	Palenose Parrotfish	AS RS
Scarus rubroviolaceus Bleeker,1847	Ember Parrotfish	GO AS
Scarus scaber Valenciennes,1840	Fivesaddle Parrotfish	AS
Scarus sordidus Forsskal, 1775	Bullethead Parrotfish	AG GO AS RS
Scarus strongylocephalus Bleeker,1854	Indian Steepheaded Parrotfish	AS
Scarus zufar Randall & Hoover,1995	Dhofar Parrotfish	AS
103.FAMILY OPISTOGATHIDAE: Jawfishes		
Opistognathus nigromarginatus Ruppell,1830	Bridled Jawfish	AG GO
Opistognathus muscatensis Boulenger,1887	Robust Jawfish	GO RS
Stalix omanensis Norman,1839	Oman Jawfish	GO
104.FAMILY CHAMPSODONTIDAE: Gapers		
Champsodon capensis Regan,1908	Gaper	GO AS RS
Champsodon omanensis Regan,1908	Oman Gaper	AG GO RS
105.FAMILY PINGUIPEDIDAE: Sandperches		
Parapercis alboguttata (Gunther,1872)	Bluenose Sandperch	AG GO
Parapercis hexopthalma (Ehrenberg,1829(P.smithii))	Speckled Sandperch	GO AS RS
Parapercis maculata (Bloch & Schneider,1801)	Harlequin Sandperch	GO
Parapercis robinsoni Fowler,1929 (P.nebulosa)	Smallscale Sandperch	AG GO
106.FAMILY TRICHONOTIDAE: Sand divers		
Trichonotus arabicus Randall & Tarr,1994	Arabian Sand Diver	AG GO AS
Trichonotus setigerus (Bloch & Schneider)	Spotted Sandiver	AG GO
107.FAMILY URANOSCOPIDAE: Stargazers		
Uranoscopus dollfuri Bruss,1986(U.guttatus)	Dollfus' Stargazer	AG GO
Uranoscopus archionema Regan,1921	Stargazer	GO
108.FAMILY TRIPTERYGIIDAE: Triplefins		
Enneapterygius abeli (Klausewitz,1960)	Yellow Triplefin	GO AS RS
Enneapterygius hollemani Randall,1995	Holleman's Triplefin	AS new species
Enneapterygius melanospilus Randall,1995	Spotfin Triplefin	AS new species
Enneapterygius pusillus Ruppell,1835	Pixie Triplefin	GO RS
Enneapterygius ventermaculatus Holleman,1982	Bellyspot Triplefin	AG GO AS
Helcogramma fuscopinna Holleman,1982	Blackfin Triplefin	GO AS
Helcogramma obtusirostre (Kluzinger,1871)	Shortsnout Triplefin	AS RS
Helcogramma steinitzi Clark,1979	Red Triplefin	AG GO AS RS
Norfolkia brachlepis (Schultz,1960)	Scally-head Triplefin	RS
109.FAMILY CLINIDAE: Weedfishes,clinids,Whipfish		
Clinus sp.	Whipfish	GO
110.FAMILY BLENNIIDAE: Combtooth blennies		
Alloblennius parvus Springer & Spreitzer,1978	Blackthroat Blenny	AS
Alticus kirkii (Gunther.1 868)	Kirks Blenny	AG GO'AS' record
Antennablennius adenensis Frazer-Brunner,1951	Aden Blenny	AG GO AS RS
Antennablennius australis Fraser-Brunner,1951	Moustache Blenny	GO*AS*RS record
Antennablennius bifilum (Gunther,1861)	Horned Blenny	AG GO AS
Antennablennius hypenetes (Kluzinger,1871)	Arabian Blenny	AG GO AS RS
Antennablennius simonyi (Steindachner,1902)	Simony's Blenny	AG GO AS RS

Antennablennius variopunctatus (Jatzow & Lenz,1898)	Orangedotted Blenny	AG GO
Aspidontus taeniatus Quoy & Gaimard,1834	Mimic Blenny	AG GO AS RS
Blenniella periopthalmus(Valenciennes,1836) (I.periopthalmus)	Bullhead Rockskipper	AG GO AS RS
Cirripectes castaneus (Valenciennes,1836)	Chesnut Blenny	AS RS
Cirripectes filamentosus (Alleyne & Macleay,1877)	Filamentous Blenny	AG GO*AS* RS record
Ecsenius nalolo Smith.1 959	Nalolo	GO*AS RS record
Ecsenius pulcher (Murray,1887)	Gulf Blenny/Ornate Blenny	AG GO AS
Hirculops cornifer (Ruppell,1829)	Highbrow Blenny	AG GO AS RS
Istiblennius edentulus (Bloch & Schneider,1801)	Rippled Rockskipper	AG GO AS RS
Istiblennius flaviumbrinus (Ruppell,1830)	Pallid Rockskipper	AG GO AS RS
Istiblennius pox Springer & Williams,1994(I.lineatus)	Scarface Rockskipper	AG GO AS RS new species
Istiblennius spilotus Springer & Williams1 994	Spotted Rockskipper	GO RS new species
Mimoblennius cirrosus Smith-Vaniz & Spreitzer,1978	Fringed Blenny	AG GO AS RS
Oman ypsilon Springer,1 985	Oman Blenny	AS
Omobranchus elongatus (Peters,1855)	Cloister Blenny	AS
Omobranchus fasciolatus (Valenciennes,1836)	Barred Arab Blenny	AG GO AS RS
Omobranchus mekranensis (Regan, 1905)	Mekran Blenny	AG GO
Omobranchus punctatus (Valenciennes,1836)	Muzzled Blenny	AG GO
Parablennius opercularis (Murray,1887)	Cheekspot Blenny	AG GO AS
Parablennius pilicornis (Cuvier,1829)	Bushy-eye Blenny	AS
Parablennius thysanius (Jordan & Seale,1907)	Tassled Blenny	AGAS
Pereulixia kosiensis (Regan, 1908)	Kosi Rockskipper	GO AS
Petroscirtes ancylodon (Ruppell,1830)	Arabian Fangleblenny	AG GO AS RS
Petroscirtes mitratus Ruppell,1828	Highfin Fangleblenny	AG GO AS RS
Plagiostremus rhinorhynchos (Bleeker,1852)	Bluestriped Fangleblenny	AG GO AS RS
Plagiostremus townsendi (Regan,1905)	Townsend's Fangleblenny	GO AS RS
Scartella emarginata (Gunther,1861)	Maned Blenny	AS
Xiphasia setifer Swaison,1839	Snake Blenny	AG GO AS RS
111 .FAMILY ELEOTRIDAE: Sleepers		
Ophiocara porocephala (Valencienes,1837)	Flathead Sleeper	AS Dhofar khwars
112.Family XENISTHIMIDAE:Wrigglers		
Xenisthmus balius Gill & Randall,1994	Freckled Wriggler	AG new species
113.FAMILY GOBIIDAE: Gobies		
Acentrogobius audax Smith, 1959	Mangrove Goby	GO
Acentrogobius dayiKoumans,1944	Day's Goby	AG GO
Amblyeleotris aurora (Polunin & Lubbock,1977)	Aurora Partner Goby	AS
Amblyeleotris diagonalis Polunin & Lubbock,1979	Slantbar Shrimpgoby	AG GO RS
Amblyeleotris downingi Randall,1994	Downing's Shrimpgoby	AG GO new species
Amblyeleotris periopthalma (Bleeker,1853)	Blotchy Shrimpgoby	AG GO AS RS
Amblyeleotris sungami (Klausewitz, 1969)	Magnus' Shrimpgoby	AS RS
Amblyeleotris triguttata Randall,1 994	Triplespot Shrimpgoby	AG GO RS new species
Amblyeleotris wheeleri (Pallunin 8 Lubbock,1977)	Wheeler's Shrimpgoby	AS
Amblygobius albimaculatus (Ruppell,1830)	Tailspot Goby	AG GO AS RS
Amblygobius nocturnus (Herre,1945)	Orangestriped Goby	AG RS
Asterropterix semipunctatus Ruppell,1830	Halfspotted Goby	GO AS
Bathygobius meggitti (Hpra & Mukerji,1936)	Meggitt's Goby	AS
Boleophthalmus dussumieri Valenciennes,1837	Dussumier's Mudskipper	AG GO AS
Bryaninops natans Larson,1985	Purpleeye Dwarf Goby	AS RS
Bryaninops tigris Larson,1985	Tiger Goby	GO
Callogobius amikami Goren,Miroz & Baranes,1991	Clown Goby	GO AS new species
Callogobius bifasciatus (Smith,1958)	Doublebar Goby	AG GO AS RS
Callogobius plumatus (Smith,1939)	Feather Goby	AG
Coryogalops adamsoni (Goren,1985)	Adamson's Goby	AG GO
Coryogalops anomalus Smith, 1958	Anomalous Goby	AG AS RS
Coryogalops bulenjiensis (Hoda,1983)	Thinbarred Goby	GO AS
Coryogalops monospilus Randall,1 994	Onespot Goby	AG new species
Coryogalops tessellanus Randall, 1994	Tesselated Goby	AG GO AS new species
Coryphopterus inframaculatus Randall,1 994	Innerspotted Goby	AG AS new species
Coryphopterus neophytus (Gunther,1877)	Novice Goby	GO AS
Cryptocentroides arabicus (Gmelin,1789)	Arabian Goby	AG AS RS
Cryptocentrus fasciatus (Playfair & Gunther,1867)	Y-bar Shrimpgoby	GO
Cryptocentrus filifer (Valenciennes,1837)	Gafftopsail Shrimpgoby	AG GO
Cryptocentrus lutheriKlausewitz,1960	Luther's Shrimpgoby	AG GO AS RS
Cryptocentrus strigilliceps (Jordan & Seale, 1906)	Target Shrimpgoby	GO AS
Ego zebra Randall,1 994	Bighead Goby	AS new species
Eviota guttata Lachner & Karnaella,1978	Spotted Dwarfgoby	AG GO RS
Eviota pardolata Lachner & Karnaella,1978	Leopard Dwarfgoby	AG GO AS RS

ABSTRACT'

The rich and diverse fish resources of Oman constitute the main natural resource after oil and natural gas. A total of 1,142 species were identified, distributed among 520 genera and 164 families. Most of these are marine with broad geographical distribution; only four are freshwater species. The ichthyofauna of Oman is characterized by large number of species in several families, comprising 92.6% of the estimated total number of marine families of the whole Indo-Pacific region, and 49.9% of the world's marine families. The Arabian Sea and the Gulf of Oman are more diverse in fish species (- 1,000 fish species) than the Arabian Gulf (>500 fish species). More than 400 species are demersal, 5 11 species inhabit coral reefs and coastal lagoons, 2 are mesopelagic species and the remainder are pelagic (157), bathypelagic (30) and bathydemersals (7 species). Cm-rent fishing effort levels on some target species are either close to maximum sustainable yield or exceed it. A shift in species composition has resulted in declining landings of some high value fish (e.g., Sea bream and Grouper). A pilot aquaculture programme has just started with the introduction of sea bream, *Sparus aurata* Linnaeus, 1758, and tilapia *Oreochromis aureus* Steindachner, 1864. Fisheries management is hampered by lack of appropriate management regulations, enforcement and data on most stocks. Coastal habitats are being threatened by both natural and man-made impacts. Fisheries research programmes are directed to fish taxonomy, ecology, biology and stock assessment of some commercially important species. An extensive fish database and reference collection are currently being established. Local human resources are needed to support the rational development aud management of fishery resources.

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Eviota prasina(Klunzinger.1871)	Redspotted Dwarfgoby	AS RS
Eviota sebreei Jordan & Seale, 1906	Redstripe Dwarfgoby	AG AS RS
Favonigobius melanobranchus (Fowler,1934)	Blackthroat Goby	AS
Favonigobius reichei (Bleeker,1953)	Tropical Sand Goby	AS
Flabelligobius latruncularis (Klausewitz,1974)	Fan Shrimpgoby	AG GO AS RS
Glossogobius biocellatus (Valenciennes,1839)	Sleepy Goby	AS
Glossogobius callidus (Smith,1 937)	River Goby	AS
Gnatholepis anjerensis (Bleeker,1850)	Anjer Goby	AS RS
Gobiodon citrinus (Ruppell,1830)	Citron Goby	AS RS
Gobiodon reticulatus Playfair & Gunther,1867	Reticulate Goby	AG GO AS RS
Gobiodon canalis Lachner & McKinny, 1978	Checkered Goby	AG GO AS
Hetereleotris vulgare (Kluzinger,1871)	Common Goby	AS RS
Hetereleotris zonata(Fowler,1934)	Blackbar Goby	AS
Istiogobius decoratus (Herre,1927)	Decorated Goby	AG GO AS RS
Istiogobius ornatus (Ruppell,1830)	Ornate Goby	GO AS RS
Lobulogobius omanensis Koumans,1944	Oman Goby	GO
Oplopomus oplopomus (Valenciennes,1837)	Spinecheek Goby	GO AS RS
Oxyurichthys opthalmonema (Bleeker,1857)	Eyebrow Goby	GO
Oxyurichthys papuensis (Valenciennes,1837)	Frogface Goby	GO AS RS
Palutrus meteori(Klausewitz & Zander,1967)	Meteor Goby	AS RS
Papillogobius melanobranchus (Fowler,1934)	Blackthroat Goby	AG GO
Parachaeturichthys polynema (Bleeker,1853)	Ocellus-tail Goby	AG GO
Periopthalmus waltoni Koumans,1941	Walton's Mudskipper	AG GO AS
Pleurosicya micheli Fourmanoir,1971	Michel's Goby	GO AS
Priolepis cincta (Regan,1908)	Convict Goby	AG GO
Priolepis randalli (Winterbottom & Barridge,1992)	Randall's Goby	AG AS RS
Scartelaos tenuis (Day,1876)	Slender Mudskipper	AG GO
Trimma winterbottomi Randall & Downing,1994	Winterbottom's Goby	AG new species
Trypauchen vagina (Bloch & Schneider,1801)	Burrowing Goby	AG GO AS RS
Valenciennea helsdingenii (Bleeker,1858)	Railway Goby	GO
Valenciennea persica Hoese & Larson1994	Gulf Goby	AG GO AS new species
Valenciennea puellaris (Tomiyama, 1956)	Maiden Goby	AS RS
Valenciennea sexguttata(Cuvier & Valenciennes,1837)	Sixspot Goby	AG GO AS RS
Vanderhorstia mertensi Klausewitz,1974	Mertens' Shrimpgoby	GO
Yangeichthys nebulosus (Forsskal,1775)	Shadow Goby	AS
114.FAMILY MICRODESMIDAE: Wormfishes & Dartfishes\		
Gunnellichthys viridescens Dawson,1968	Yellowstripe Wormfish	AG
Parioglossus raoi (Herre,1939)	Rao's Dartfish	AG GO
Ptereleotris arabica Randall & Hoese,1988	Arabian Dart-fish	AG GO AS RS
Ptereleotris heteroptera (Bleeker,1855)	Spottail Dartfish	AS
Ptereleotris microlepis (Bleeker,1856)	Pale Dartfish	AG GO AS RS
Ptereleotris monoptera Randall & Hoese,1988	Monofin Dartfish	AS
115.FAMILY ACANTHURIDAE: Surgeonfishes		
Acanthurus dussumieri Valenciennes,1835	Eyestripe Surgeonfish	GO AS RS
Acanthurus gahhm (Forsskal,1775)	Monk Surgeonfish	ASRS
Acanthurus leucosternon Bennett,1832	Powder Blue Surgeonfish	GO
Acanthurus mata Cuvier, 1829	Bluelined Surgeonfish	AG GO AS RS
Acanthurus sohal (Forsskal,1775)	Sohal	AG*GO*AS RS common
Acanthurus tennentii (Gunther,1861)	Double-band Surgeonfish	AS' rare
Acanthurus triostegus (Linnaeus,1758)	Convict surgeonfish	GO
Acanthurus xanthopterus Valenciennes,1835	Yellowfin Surgeonfish	GO
Ctenochaetus strigosus (Bennett,1828)	Goldring Bristletooth	AS
Ctenochaetus striatus (Quoy & Gaimard,1824)	Lined Bristletooth	AS RS
Naso fageni Morrow,1954	Fagen's Unicornfish	AS
Naso lituratus (Forster,1801)	Orangespine Unicornfish	AS RS
Naso thynnoides (Valenciennes,1835)	Onekeel Unicornfish	AS
Naso unicornis (Forsskal,1775)	Bluespine Unicornfish	AS RS
Paracanthurus hepatus (Linnaeus,1766)	Palette Surgeonfish	AS
Zebrasoma scopas (Cuvier,1829)	Brown Sailfin Surgeonfish	GO
Zebrasoma xanthurum (Blyth,1852)	Yellowtail Tang	AG*GO*AS RS common
116.FAMILY ZANCLIDAE: Moorish idols		
Zanclus cornutus (Linnaeus,1758) (Z.canescens)	Moorish Idol	AG GO AS RS
117.FAMILY SIGANIDAE: Rabbitfishes		
Siganus argenteus (Quoy & Gaimard,1825)	Forktail Rabbitfish	GO AS RS
Siganus canaliculatus (Park,1797)	Pearlspotted Rabbitfish	AG GO
Siganus javus (Linnaeus,1766)	Streaked Rabbitfish	AG GO AS common

Siganus luridus (Ruppell,1828)	Squaretail Rabbitfish	AG GO AS RS
Siganus rivulatus (Forsskal,1775)	Marbled rabbitfish	GO*AS* RS record
Siganus spinus (Linnaeus.1758)	Little rabbitfish	GO record
Siganus stellatus (Forsskal,1775)	Brownspotted Rabbitfish	AS RS
Siganus sutor (Valenciennes,1835)	Shoemaker rabbitfish	GO record
118.FAMILY GEMPYLIDAE: Snake mackerels		
Gempylus serpens Cuvier,1829	Snake Mackerel	AS
Lepidocybium flavobrunneum (Smith,1849)	Escolar	GO AS
Neoepinnula orientalis (Gilchrist & von Bonde,1924)	Sackfish	GO AS RS
Ruvettus pretiosus Cocco,1829	Oilfish	GO AS RS
119.FAMILY TRICHIURIDAE: Cutlassfishes		
Eupleogrammus glossodon (Bleeker,1860)	Longtooth Cutlassfish	AG GO AS
Eupleogrammus muticus (Gray,1831)	Smallhead Cutlassfish	AG GO AS
Trichiurus auriga Kluzinger,1884	Pearly Hairtail	AS RS
Trichiurus lepturus Linnaeus,1758	Largehead Cutlassfish	AG GO*AS*RS abundant
120.FAMILY SCOMBRIDAE: Mackerels: tunas		
Acanthocybium solandrii (Cuvier,1831)	Wahoo	AG GO AS RS rare
Auxis thazard (Lacepede,1800)	Frigate Tuna	AG GO AS RS abundant
Auxis rochei (Risso,1810)	Bullet Tuna	AG GO AS RS
Euthynnus affinis (Cantor,1849)	Kawakawa	AG GO AS RS abundant
Gymnosarda unicolor (Ruppell,18938)	Dogtooth Tuna	GO rare
Katsuwonus pelamis (Linnaeus,1758)	Skipjack Tuna	AG GO AS RS common
Rastrelliger kanagurta (Cuvier,1817)	Indian Mackerel	AG GO AS RS abundant
Sarda orientalis (Temminck & Schlegel,1844)	Striped Bonito	AG GO AS RS common
Scomber japonicus Houttun,1782	Chub mackerel	AG GO AS RS common
Scomberomorus commerson (Lacepede,1801)	Narrow-barred Spanish Mackerel	AG GO AS RS abundant
Scomberomorus guttatus (Bloch & Schneider,1801)	Indo-Pacific King mackerel	AG GO AS RS rare
Scomberomorus lineolatus (Cuvier,1831)	Streaked seerfish	AG GO AS RS rare
Thunnus albacares (Bonnaterre,1788)	Yellowfin Tuna	AG GO AS RS abundant
Thunnus alalunga (Bonnaterre,1788)	Albacore	GO*AS RS common
Thunnus obesus (Lowe,1839)	Bigeye Tuna	GO AS
Thunnus tonggol (Bleeker,1851)	Longtail Tuna	AG GO'AS RS abundant
121 .FAMILY ISTIOPHORIDAE: Billfishes		
Istiophorus platypterus (Shaw & Nodder,1792)	Sailfish	AG GO AS RS
Makaira indica (Cuvier,1832)	Black Marlin	AG GO AS RS
Makaira nigricans Lacepede, 1802 (M.mazara)	Indo-Pacific Blue Marlin	GO AS
Tetrapterus angustirostris Tanaka,1915	Shortbill Spearfish	GO AS
Tetrapterus audax (Philippi,1887)	Striped Marlin	A G G O A S R S
Xiphias gladius Linnaeus,1758	Swordfish	G O A S R S
122.FAMILY CENTROLOPHIDAE: Medusafishes		
Psenopsis cyanea (Alcock,1890)	Indian Ruff	AS
123.FAMILY NOMEIDAE: Driftfishes		
Ariomma indica (Day.1 870)	Indian Driftfish	AG GO
Cubiceps sp.	Fathead	AS
Psenes squamiceps (Lloyd,1909)	Driftfish	AS
124.FAMILY STROMATEIDAE: Butterfishes		
Pampus argenteus (Euphrasen,1788)	Silver Pomfret	AG
Pampus chinensis (Euphrasen,1788)	Chinese silver pompret	AG
ORDER GOBIESOCIFORMES		
125.FAMILY GOBIESOCIDAE: Clingfishes		
Diademichthys lineatus (Sauvage,1883)	Urchin Clingfish	GO
Discotrema lineatum(Briggs,1966)	Lined Clingfish	GO AS RS
126.FAMILY CALLIONYMIDAE:Dragonets		
Callionymus carebares Alcock,1890	Indian Deepwater Dragonet	AG GO
Callionymus erythraeus Ninni,1934	Smallhead Dragonet	AG GO
Callionymus filamentosus Valenciennes,1837	Filamentous Dragonet	AG GO AS RS
Callionymus hindsii Richardson,1844	Hind's Dragonet	AG GO
Callionymus margaretae Regan,1906	Margaret's Dragonet	AG GO
Callionymus marleyi Regan, 1910	Marley's Dragonet	AG GO AS RS
Callionymus muscatensis Regan,1905	Muscat Dragonet	GO AS RS
Callionymus persicus Regan,1905	Persian Dragonet	AG GO AS RS
Diplogrammus pygmaeus Fricke,1981	Pygmy Dragonet	AG GO AS
Synchirops stellatus Smith,1963	Stellate Dragonet	AS
ORDER PLEURONECTIFORMES		
127.FAMILY PSETTODIDAE: Indian turbots		
Psettodes erumei (Schneider,1801)	Indian Spiny Turbot	AG GO AS RS

128.FAMILY CITHARIDAE: Large scale flounders		
Brachypleura novaezeelandica Gunther,1862	Widemouth Largescale Flatfish	AG GO
129.FAMILY BOTHIDAE: Left eye flounders		
Arnoglossus arabicus Norman,1939	Arabian Flounder	AS
Arnoglossus aspilos Blegvad,1949	Brown Flounder	AG GO
Arnogtossus tapeinosoma (Bleeker,1866)	Drab Flounder	AG GO
Bothus mancus (Brousonet,1782)	Peacock Flounder	AS
Bothus myriaster (Temminck & Schlegel,1846)	Oval Flounder	GO AS RS
Bothus pantherinus (Ruppell,1828)	Panther Flounder	GO AS RS
Engyprosopon grandisquama(Temminck&Schlegel,1846)	Biascale Flounder	GO AS RS
Grammatobothus polyophthalmus (Bleeker,1866)	Triangle Flounder	AG GO
Laeops guentheri Alcock,1890	Gunther's Flounder	AG GO
130.FAMILY PARALICHTHYIDAE:Shortfin Flounders		
Pseudorhombus annulatus Norman,1927	Ringed Flounder	GO
Pseudorhombus arsius (Hamilton,1822)	Largetooth Flounder	AG GO AS RS
Pseudorhombus elevatus Ogilby,1912	Deep Flounder	AG GO AS
Pseudorhombus javanicus (Bleeker,1853)	Javan Flounder	AG GO
Pseudorhombus malayanus Bleeker,1866	Malay Flounder	AG GO
Pseudorhombus natalensis Gilchrist,1905	Natal Flounder	GO
Pseudorhombus trioceilatus (Schneider,1801)	Triocellate Flounder	G O
131 .FAMILY SOLEIDAE: Soles		
Aseraggodes morrowi Chabanaud,1931	Morrow's Sole	AG GO AS
Euryglossa orientalis (Schneider,1801)	Oriental Sole	AG GO AS RS
Pandachirus balius Randall & Mee,1994	Piebald Sole	GO AS new species
Pandachirus marmoratus (Lacepede, 1802)	Moses Sole	AG GO AS RS
Solea elongata Day.1 877	Elongate Sole	AG GO AS RS
Solea stanalandi Randall & MacCarthy,1989	Stanaland's Sole	AS record
Soleichthys heterorhinos (Bleeker,1856)	Blue-edged Sole	GO AS
Synaptura commersoniana (Lacepede,1802)	Commerson's Sole	AG GO AS RS
Zebrias captivus Randall,1 995	Convict Zebra Sole	AG new species
Zebrias synapturoides (Jenkins,1910)	Indian Zebra Sole	AG GO AS RS
132.FAMILY CYNOGLOSSIDAE: Tonguefishes		
Cynoglossus acutirostris Norman,1939	Sharpnose Tonguesole	AS
Cynoglossus arel (Schneider,1801)	Largescle Tonguesole	AG GO AS
Cynoglossus bilineatus (Lacepede,1802)	Fourlined Tonguesole	AG GO AS
Cynoglossus carpenteri Alcock,1889	Carpenter's Tonguesole	AG GO AS
Cynoglossus kopsi (Bleeker,1851)	Kop's Tonguesole	AG GO
Cynoglossus lachneri Menon,1977	Lachner's Tonguesole	GO AS RS
Cynoglossus puncticeps (Richardson,1846)	Speckled Tonguesole	AG GO AS
Paraplagusia bilineata (Bloch,1787)	Bloch's Tonguesole	AG GO AS RS
ORDER TETRAODONTIFORMES		
133.FAMILY TRIACANTHIDAE: Triplespines		
Pseudocanthus striglifer (Cantor, 1849)	Longspine Tripodfish	AG GO
Triacanthus biaculeatus (Bloch,1786)	Shortnose Tripodfish	AG GO AS' common
134.FAMILY BALISTIDAE: Triggerfishes		
Abalistes stellatus (Lacepede, 1798)	Starry Triggerfish	AG GO AS RS
Balistoides viridescens (Bloch & Schneider,1801)	Giant Trigger-fish	GO
Canthidermis macrolepis (Boulenger,1887)	Largescale Triggerfish	GO AS RS
Melichthys indicus Randall & Klausewitz,1973	Indian Ocean Durgon	AS RS
Odonus niger (Ruppell,1840)	Redtooth Triggerfish	GO' AS RS abundant
Rhineacanthus assasi (Forsskal,1775)	Picasso Triggerfish	AG GO AS RS
Sufflamen albicaudatus (Ruppel,1829)	Whitetail Triggerfish	AS RS
Sufflamen chrysopterus (Bloch & Schneider,1801)	Flagtail Triggerfish(S.albicaudatus)	GO RS
Sufflamen fraenatus (Bloch & Schneider,1801)	Bridled Triggerfish	GO AS RS
135.FAMILY MONOCANTHIDAE: Filefishes		
Alutera monoceros (Linnaeus, 1758)	Unicorn Filefish	AG GO AS RS
Aluterus scriptus (Osbeck,1765)	Scrawled Filefish	GO RS
Amanses scopas (Cuvier,1829)	Broom Filefish	GO
Cantherhines dumerilii (Hollard, 1854)	Barred Filefish	GO AS RS
Cantherhines pardalis (Ruppell,1837)	Honeycomb Filefih	AS RS
Paraluteres prionurus (Bleeker,1851)	Mimic Filefish	GO AS
Oxymonacanthus longirostris (Bloch 8 Schneider,1 801)	Longnose Filefish	AS
Paramonocanthus sp.	Gulf Filefish	AG
Stephanolepsis diaspros Fraser-Brunner,1940	Lozenge Filefish	AG GO AS RS
Thamnaconus melanoproctes (Boulenger,1889)	Blackvent Filefish	GO
136.FAMILY OSTRACIIDAE: Boxfishes(cowfishes & trunkfishes)		
Lactoria cornuta (Linnaeus,1758)	Longhorn Cowfish	AG GO AS RS

Ostracion cubicus Linnaeus, 1758	Yellow Trunkfish	AG GO AS RS
Ostracion cyanurus Ruppell, 1828	Bluetail Trunkfish	AG GO AS RS
Ostracion meleagris Shawm1796	Whitespotted Trunkfish	AS
Tetrasomus gibbosus (Linnaeus, 1758)	Thornback Trunkfish	AG GO AS RS
137.FAMILY TETRAODONTIDAE: Puffer-fishes		
Arothron hispidus (Lacepede, 1802)	Whitespotted Pupper	GO AS RS
Arothron immaculatus (Bloch & Schneider, 1801)	Immaculate Puffer	GO AS RS
Arothron meleagris (Lacepede, 1798)	Guineafowl Pupper	GO AS
Arothron nigropunctatus (Bloch & Schneider, 1801)	Blackspotted Pupper	GO
Arothron stellatus (Bloch & Schneider, 1801)	Stellate Puffer	GO AS RS
Canthigaster coronata (Vaillant & Sauvage, 1875)	Crown Toby	GO AS RS
Canthigaster rivulata (Temminck & Schlegel, 1850)	Rivulated Toby	AS
Canthigaster solandri (Richardson, 1844)	Solander's Toby	GO AS RS
Canthigaster valentini (Bleeker, 1853)	Model Toby	GO AS RS common
Chelonodon patoca (Hamilton, 1822)	Milkspotted Pupper	AG GO
Lagocephalus guentheri (Ribeiro, 1915)	Diamondback Pupper	AG GO AS
Lagocephalus lunaris (Bloch 8 Schneider, 1801)	Lunartail Pupper	AG GO AS RS
Lagocephalus scleratus (Forster, 1788)	Elongate Pupper	AG GO
Torquigener flavimaculosus Hardy & Randall, 1983	Yellowspotted Pupper (T. hypselogeneion)	AG AS RS
138.FAMILY DIODONTIDAE: Porcupinefishes		
Chilomycterus orbicularis (Bloch, 1785)	Orbicular Burrfish	AG GO AS RS
Chilomycterus reticulatus (Linnaeus, 1758)	Spotfin burrfish	GO RS
Cyclichthys spilostylus (Leis & Randall, 1982)	Yellowspotted Burrfish	GO AS RS
Diodon holocanthus Linnaeus, 1758	Spiny Puffer	GO AS RS
Diodon hytrix Linnaeus, 1758	Porcupinefish	GO AS RS
Diodon liturosus Shaw, 1804	Blackblotched Porcupinefrsh	GO AS
Lophodiodon calori (Bianconi, 1855)	Blacklip Porcupine&h	AS
139.FAMILY MOLIDAE: Sunfishes		
Mola mola (Linnaeus, 1758)	Sunfish	GO RS

Legend: AG - Arabian Gulf
GO - Gulf of Oman
AS - Arabian Sea
RS - Red Sea

Department of Agronomy, Horticulture, Entomology and Plant Pathology

National Report of Biodiversity (Entomology)

In Entomology one research project was carried out which was aimed at reducing the pesticide use and the other has started which is environmentally friendly.

I. 1. Title: Management of whitefly, *Bemisia tabaci*

2. Summary of project. objective_ method:

The whitefly, Bemisia tabaci is a serious pest on tomato and other vegetable crops in Oman. It has caused extensive damage resulting in heavy losses in yields. On tomato its damage is two fold, one by direct feeding and covering the leaves with sooty mould and the other more serious by transmitting the virus disease resulting in leaf curl., shortening of leaves and stunting of plant growth. Experience in the recent past has shown that almost 100% of the tomato plants were affected by its damage resulting in heavy losses in yield. Indiscriminate use of pesticides by farmers to control this pest in tomato crop is leading to more resurgence of the pest and there is a need to develop an integrated pest management programme to check its damage to tomato crop.

Experiments were carried in the field to study the population fluctuations of whitefly, monitoring, incidence of virus infection, evaluation of different insecticides, survey of alternate hosts, screening of germplasm and integration of other tactics of control.

3. Name of investigator and Dept.:

Dr.K.M. Azam	Principal Investigator, Dept.of Agronomy, Horticulture, Entomology & Plant Pathology
Dr. Ali Zouba	Co-Investigator, Dept of Agronomy, Horticulture, Entomology & Plant Pathology

4. Starting and finishing: dates

September **1991** to April 1997.

II. 1. Title: Studies on the repellant, antifeedant, growth inhibiting and insecticidal properties of subtropical plant extracts against insects.

2. Summary of project, objective. method:

The aim of the project is to investigate possible biodegradable and environmentally safe chemicals extracted from the flora of Oman, which will contribute to the control of a wide range of insects that damage food crops.

Synthetic organic insecticides have played a great role in pest control, but their use during the last three decades has created ecological problems such as biomagnification of the residues in human body, pest resurgence, detrimental effects on non-target organisms and development of insecticide resistant strains of insects. In order to avoid the evil attendant with the use of synthetic insecticides, it is imperative to develop safer and rapidly bio-degradable substitutes. In this context, the search for pest control agents from natural sources needs to be intensified. Some plants are naturally resistant to insect damage. They produce campounds that are toxic to insects or that disrupt the insect life cycle. They are a vast cornucopia of defence chemicals comprising repellents, feeding and oviposition deterrents, growth inhibitors, stimulants and toxicants. At the same time, these plants are a natural part of the environment. Their compounds, even when isolated are reproduced in large quantities, are biodegradable and unlikely to cause damage to the environment.

Poda/seeds/leaves/bark, depending on their availabillity and characteristics will be collected from the plants to be studied, will be dried and powdered in a pulverizer. The powdered material will be soaked in and subjected to extraction with a variety of solvent of differing polarity index. The extracts will be tested for repellent, antifeedant, growth inhibiting and insecticidal properties against locust and stored grain insects.

3 . Name of investigator and department:

1.	Dr. K.M. Azam	Principal Investigator Dept. of Agronomy,Horticulture, Entomology & Plant Pathology.
2.	Dr.Robert Myhara	Co-Investigator Dept of Food Science

4. Starting and finishing dates:

June 1997 to June 2000.

III. Insect Taxonomy Collection

The Entomology section has a fairly large collection of insects representing 18 orders and 141 families. The collections are mostly exclusive from Oman representing different agrochmatic regions. The staff of the department undertakes field visits from time to time to collect insects and they are preserved for study. The important places from where collections have been made include Muscat, Salalah, Musandam, Mazara, Ibri, Nakhal, Wadi Sahtan, Wadi Bani Khalid, Jabal Shams etc. In addition the students are required to submit insect collection for their two courses viz. PROT 3524 - Introduction to Entomology and PROT 4022 -Integrated Pest Management during the Spring and Fall Semesters respectively. There is a continuous effort and ongoing programme for these collection.

INSECT COLLECTION IN ENTOMOLOGY LABORATORY
AGRICULTURE COLLEGE, SULTAN QABOOS UNIVERSITY

ORDERS AND FAMILIES

I. Apterygota (wingless insects)

1. COLLEMBOLA
   - Poduridae

2. THYSANURA
   - Lepismatidae

II. Pterygota (Winged insects)

A. exoterygota

1. EPHBMEROPTERA
   - Baetidae

2. ODONATA

   Dragonfly
   - Aeshnidae
   - Gomphidae
   - Libellulidae

   Damselfly
   - Coenagrionidae

3. PHASMIDA
   - Heteronemiidae

4. ORTHOPTERA
   - Acrididae
   - Tetrigidae
   - Tettigoniidae
   - Gryllidae
   - Gryllotalpidae
   - Pyrogomorpidae

5. MANTODEA
   - Mantidae
   - Eremiaphilidae
   - Empusidae

6. BLATTARIA
   - Blattidae
   - polyphagidae
   - Blattelidae
   - Blaberidae

7. ISOPTERA
   Termitidae

8. DERMAPTERA
   Forficulidae

9. HEMIPTERA
   Belostomatidae
   Naucoridae
   Gerridae
   Tingidae
   Miridae
   Nabidae
   Anthocoridae
   Reduviidae
   Lygaeidae
   Coreidae
   Alydidae
   Rhopalidae
   Cydnidae
   Pentatomidae
   Napidae
   Notonectidae
   Cimicidae
   Pyrrhocoridae
   Scutelleridae
   Thyreocoridae

10. HOMOPTERA
   Cicadidae
   Cicadellidae
   Membracidae
   Cercopidae
   Cixiidae
   Dictyopharidae
   Fulgoridae
   Delphacidae
   Coccidae
   Diaspididae
   Pseudococcidae
   Tropoduchidae
   Apididae
   Aleyrodidae
   Psyllidae

11. THYSANOPTERA
   Thripidae

B. Endopterygota

12. NEUROPTERA

- Ascalaphidae
- Myrmeleontidae
- Nemopteridae
- Chrysopidae
- Hemerobiidae
- Mantispidae

13. COLEOPTERA

- Cicindelidae
- Carabidae
- Dytiscidae
- Gyrinidae
- Styphylinidae
- Hydrophilidae
- Histeridae
- Scarabidae
- Buprestidae
- Elateridae
- Bostrichidae
- Anobiidae
- Nitidulidae
- Cuchjidae
- Coccinellidae
- Tenebrionidae
- Meloidae
- Oedemeridae
- Anthicidae
- Cerambycidae
- Bruchidae
- Chrysomelidae
- Curculionidae
- Scolytidae
- Cleridae
- Dermistidae
- Mordellidae
- Apionidae
- Lymexylidae

14. DIPTERA

- Tipulidae
- Cecidomyiidae
- Culicidae
- Ceratopogonidae
- Chironomidae
- Tabanidae

Asilidae
Bombylidae
Syrphidae
Diospidae
Tephritidae
Scathophagidae
Anthomyiidae
Muscidae
Calliphoridae
Sarcophagidae
Tachinidae
Psychodidae
Therevidae
Dolichopodidae
Agromyzidae
Drosophilidae
Hippoboschidae
Pipunculidae
Cecidomyiidae
Anthomyiidae

15. LEPIDOPTERA

BUTTERFLY
Papilionidae
Pieridae
Lycaenidae
Nymphalidae
Satyridae
Danaidae
Hesperiidae

MOTHS
Pyralidae
Arctiidae
Noctuidae
Plutellidae
Gelechiidae
Torticidae
Geometridae
Sphingidae
Psychidae
Gracillaridae
Lasiocampidae
Lymantriidae
Cosmopterigidae
Pterophoridae

16. HYMENOPTERA

Ichnemonidae
Braconidae
Chalcididae
Leucospidae
Evaniidae
Chrysididae
Sphecidae
Halichidae
Megachilidae
Anthophoridae
Apidae
Mutillidae
Pompilidae
Scoliidae
Vespidae
Formicidae
Mymaridae
Trichogrammatidae
Eulophidae
Aphelinidae
Enayrtidae
Torymidae
Pteromalidae

Department of Agronomy, Horticulture, Entomology And Plant Pathology

National Report of Biodiversity

I. Title: Improvement of date palm production

Summary:

This project involves several aspects, two of which are related to biodiversity.

(1) To study means of containing salinity along the Batinah coast and conserve the agricultural land.

Methods

I. Chemical treatment

After determining the salt level and causal elements, suitable fertilizers will be recommended.

II. Application of mulches to reduce evaporation

Investigators: Dr.Mahdi Osman ElMardi
Principal Investigator
Department of Agronomy, Horticulture, Entomology & Plant Pathology

Dr.Hayder A.AbdulRahman
Co-investigator
Department of Soil & Water Sciences

Starting Date : April 1993

Finishing Date : November 1995

2. To study the effect of treated sewage water on date palm.

Methods

Involves periodic 'analysis of soil and water and leaves and fruits of the date palms grown along the streets to determine levels of heavy and poisonous metals and determine means to avoid reaching toxic levels. These heavy metals could be originated from treated sewage water and from the combustion of motor vehicles. Special treatments will be recommended to avoid the poisoning effect of these metals.

Investigator: Dr.Mahdi Osman ElMardi
Dept of Agronomy, Horticulture, Entomology & Plant Pathology

II. Title: A systems research network to develop methodologies for correcting ecoregional salt stress.

Summary:

This project will include representative countries of the Gulf Region - Sultanate of Oman, United Arab Emirates and Qatar. A salinity research unit will be developed in each country. They will be coordinated by Sultan Qaboos University. Each unit will be constituted of specialized staff from the Ministries of Agricultureand the Universities to carry out a team work. The project also include the University of Arizona USA and the C.T.de Wit Graduate School for Production Ecology, Wageningen , The Netherlands.

Objectives:

1. To develop scientific, cultural methodologies and means to overcome salinity stress on citrus fruit trees and work on preserving the scarce agricultural land and irrigation water in salt affected areas.

2. To establish biotechnological methods for the investigation on the biology and control of Witches' broom disease of lime.

3. To develop operational methodology that will identify the scope of research in a network directed towards solving problems associated with salinity stress at representative sites of the ecoregion.

Several experiments on soil and water amendments to reduce salt levels will be conducted at the 3 different sites: In addition a group of rootstocks and orange scions proven salt tolerant will be tested under the 3 sites' environmental conditions.

Witches' broom disease of lime studies will involve short term and long term experiments to manage the disease without chemical control of the vector.

Investigators: from) U	1. Dr. Mahdi Osman ElMardi }	Dept.of Agronomy,Horticulture,
	2. Dr. Khaja M.Azam }	Entomology & Plant Pathology
	3. Dr.Hayder A.AbdulRahman}	Dept.of Soil &Water Sciences
	4. Dr. Salim Al-Rawahy }	
	5: Dr.Ali ElKharbotly }	Dept. of Agronomy, Horticulture, Entomology & Plant Pathology
	6. A Plant Pathologist	

Starting: Proposed to be funded by the participating countries and main support will be obtained from the Eco Regional Fund.

Finishing: 5 years duration.

Project Title: Biodiversity of Sandy Beach Macrofauna.

Aim and Scope: To describe infaunal species diversity patterns and sandy beach types around the coast of Oman. The project has covered the entire coastline and also examines biogeographic and community patterns.

Start Date: 1995
Finish Date: 1997

Principal Investigator: Professor A McLachlan,
Co-investigators: H. Al-Habsi, M. Fisher, S. Al-Shukari and A. Al-Habsi.

Relevant Publications:
McLachlan, A., Fisher, M., Al-Habsi, H., Al-Shukairi, S. & Al-Habsi, A., 1998. Ecology of sandy beaches in Oman. J. cstl. cons. (submitted)

Sponsor: SQU Colleges of Agriculture and Science

Project Title: Crustacean Macrofauna of the Khawrs of Oman.

Aim and Scope: To describe the crustacean community structure in relation to the flood cycle of the khawrs.

Start Date: 1995
Finish Date: Ongoing

Principal Investigator: Dr. David A. Clayton.
Co-investigator: Ms. Awatif Al-Kindi

Relevant Publications:
Clayton D.A. 1996. Ghost crabs of Oman (Crustacea: Brachyura: Ocypodidae) . Sultan Qaboos University Journal of Science and Technology, 1, 27-35.
Clayton D. A. 1997. Ecological succession in decapod crustacean communities of the Khawrs of Oman. Paper presented at International Conference on the Biology of Coastal Environments. Bahrain, 6-9 April 1997.
Clayton D.A. & Al-Kindi, A. 1998. population structure and dynamics of two scopimerine sand crabs *Scopimera crabricauda* Alcock 1900 and *Dotilla sulcata* (Forskål 1775) in an estuarine habitat in Oman. Tropical Zoology. In Press.

Sponsor: SQU College of Science.

عنوان البحث :

تحسين إنتاجية نخلة التمر

الملخص : الأهداف والطرق المتبعة

يتضمن هذا البحث عدة مجالات إثنان منها مرتبطة بالنظام البيئي:

١ – يهدف هذا المشروع إلى إحتواء مشكلة الملوحة على طول سـاحل الباطنـة والحفـاظ علـى الأراضي الزراعية .

الطرق المتبعة :

أ – المعاملات الكيميائية

التوصية بإضافة الأسمدة الكيماوية بعد تحديد درجة الملوحة والعوامل المسببة ...

ب – وضع أغطية الأرض المناسبة لتقليل تبخر الماء .

الباحثون :

١ – د / مهدي عثمان المرضي قسم المحاصيل والبستنة والحشرات وأمراض النبات

٢ – د / حيدر عبدالشافع عبدالرحمن قسم علوم التربة والمياه .

بداية المشروع : ١ إبريل ١٩٩٣ م .

نهاية المشروع : نوفمبر ١٩٩٥م .

٢ – ويهدف أيضاً إلى دراسة تأثير مياه الصرف المعالجة على نخلة التمر .

الطرق المتبعة :

إجراء التحاليل المرحلية على التربة ومياه الري بالإضافـة إلـى السعف وثمـار النخيـل المزروعة على جانبي الطرق لتحديد مستويات المعادن الثقيلة والسامة . ذلك لمعرفـة الوسـائل اللازم تطبيقها لتجنب وصولها المستويات الخطرة . وهذه المـواد يمكـن أن تتـأتى مـن ميـاه الصرف المعالجة كما تتأتى من عملية إحتراق وقود السيارات . وبناءً على هذه النتائج يمكن وضع التوصيات اللازمة لمنع حدوث تأثيرها السام .

الباحثون :

١ – د / مهدي عثمان المرضي قسم المحاصيل والبستنة والحشرات وأمراض النبات

٢ – د / سلامه بطرس سلامه قسم الكيمياء – كلية العلوم .

٣ – د / علي الخربوطلي " " " " " " "

٤ – د / سالم الرواحي قسم علوم التربة والمياه

٥ – د / حيدر عبدالشافع عبدالرحمن " " " "

بداية المشروع :

مقترح مقدم للتمويل بواسطة الدول المشاركة على أن يتم الدعم الرئيسي بواسطة صندوق البيئة الإقليمية (EcoresIenal Fund)

المدة : خمس سنوات .

BIODIVERSITY PROJECTS AS REQUESTED BY MINISTRY OF REGIONAL MUNICIPALITIES AND ENVIRONMENT

Andrew Gardner

1. Biogeography and mapping of the herpetofauna of Oman

Aims: To analyze the distribution of the reptile and amphibian faunas of Oman using GIS
To produce a set of detailed species distribution maps for all reptile and amphibian species in Oman
To write a field guide and handbook to the Oman herpetofauna
To photograph all species and varieties of Oman herpetofauna

Start: August 1987; ongoing

Personnel: Andrew Gardner. Data incorporated from publications, museum records and the records of workers, notably Michael Gallagher

Sponsored by: Sultan Qaboos University

2. Sytematics of the gecko genus *Asaccus* in Arabia

Aims: To describe new species and explore the evolutionary relationships within this genus.

Start: 1992 Finish: 1994

Personnel: Andrew Gardner (SQU), Dr E.N. Arnold (Natural History Museum, London)

Sponsored by Sultan Qaboos University

3. Geographic variation and evolution in *Echis* vipers in Arabia

Aims: To describe geographic variation in Omani saw-scaled vipers using multivariate statistics. In particular to study the contact zone between *Echis carinatzrs* and *Echis pyramidum*.

Start: Specimens for this study have been accumulated since 1987, but critical gaps in the collection remain.

Personnel Andrew Gardner

Sponsored by Sultan Qaboos University

4. Geographic variation in *Hemidactylus* geckos in Oman.

Aims: To elucidate the taxonomy of the complex species groups of tuberculate *Hemidactylus geckos*

Start Specimens accumulated since 1987

Personnel: Andrew Gardner, Ameera Al Saifi

Sponsored by Sultan Qaboos University

عنوان البحث :

شبكة الأنظمة البحثية لتطوير منهجية إصلاح مؤثرات شدة التملح على البيئة الإقليمية

الملخص

يشمل هذا المشروع سلطنة عمان ، دولة الإمارات العربية المتحدة ودولة قطر التي تمثل إقليم الخليج . ويعنى بإنشاء وحدة لبحوث الملوحة في كل من هذه الدول ويتم التنسيق بين هذه الوحدات بواسطة جامعة السلطان قابوس . على أن تتكون كل وحدة من المتخصصين في الوزارات والجامعات وأن تكون كل منها فريق عمل . كما سينضم للمشروع كل من جامعة أريزونا بالولايات المتحدة الأمريكية وكلية سي . ت . ويت للدراسات العليا في علاقة الإنتاج بالبيئة – فاتنتجن هولندا .

الأهداف :

١ – تطوير الأنظمة البحثية في العمليات الزراعية اللازمة للتغلب على آثار شدة التملح في أشجار الموالح والعمل على المحافظة على الأراضي الزراعية ومياه الري الشحيحة في المناطق المتأثرة بالملوحة .

٢ – إنشاء طرق للتقنيات الحيوية في الكشف عن حياة ومكافحة مرض مكنسة الساحرة الذي يصيب الليمون .

٣ – تطوير العمليات المنهجية للتعرف على محورية البحث الشيكي الموجه لحل المشاكل المتعلقة بشدة الملوحة في المواقع التي تمثل البيئة الخليجية .

ستقام عدة تجارب لتخفيف درجة الملوحة في التربة والماء في المواقع الثلاث ، بالإضافة إلى إجراء الإختبارات اللزمة على أصول وطعم الموالح التي أثبتت مقاومتها للأملاح.

تتضمن الدراسات الخاصة بمرض مكنسة الساحرة التجارب طويلة المدى وقصيرة المدى دون إستخدام المبيدات الحشرية في مقاومة الحشرة الناقلة للمرض .

الباحثون :

١ – د / مهدي عثمان المرضي قسم المحاصيل والبساتين والحشرات وأمراض النبات

٢ – د / خاجه محمد أعظم " " " " " " "

5. **Characterization of the utilized niches of *Bufo* toads in Oman.**

Aims: To study the resource use and overlap between *Bufo arabicus* and *B dhofarensis* in Oman
Start 1996, ongoing
Personnel Andrew Gardner
Sponsored by Sultan Qaboos University

6. **Monitor and report changes in amphibian populations for the IUCN Declining Amphibian Population Task Force**

Aims To identify and report amphibian die-offs, threats to amphibians, etc within the context of the Declining Amphibian Population Task Force.
Start : 1994, ongoing
Personnel Andrew Gardner
Sponsored by Sultan Qaboos University

7 . **Biogeography of Juniper woodlands in the northern Oman mountains**

Aims: To map the juniper distribution and analyze the main parameters affecting the distribution and the condition of the woodlands.
Start: 1991, Finish 1995
Personnel Drs Andrew Gardner and Martin Fisher
Sponsored by Sultan Qaboos University

S. Ecology **of Juniper woodlands in Oman**

Aims: To assess the factors affecting tree condition, die-back and growth in' *Juniperus excelsa* in the northern mountains
Start: 1991, ongoing
Personnel Drs Andrew Gardner and Martin Fisher
Sponsored by Sultan Qaboos University

9. **Habitat partitioning in a montane lizard community**

Aims: To describe the reource partitioning between the species of lizards living in a mountain valley (Wadi Halfayn).
Start: 1987 Finish 1989
Personnel Dr Andrew Gardner, Mr Seyad Farook
Sponsored by Sultan Qaboos University

Sub: Biodiversity related projects in Oman

By: Professor Reginald Victor
Head, Department of Biology
College of Science, P.O. Box 36
Sultan Qaboos University, PC 123.

Tel, Off. +968 515 433
Tel. Res: +968 514 080
E-mail:

1. Project Title: Khawrs and springs study in Southern Oman – the environment and macroinvertebrates.

Aim and Scope: To describe the physical and chemical characteristics of three major khawrs and freshwater spring systems designated as conservation areas. Macroinvertebrate diversity of these systems in relation to flood cycles was studied.

Start Date: January 1992
Finish Date: January 1993

Principal Investigator: Professor Reginald Victor.
Co-investigators: Mrs. Jayanthi R Victor; Br. Nicholas V Clarke

Relevant Publications:
Victor, R., Victor, J R and Clarke, N V., 1997. Physical and chemical environment of Khawr Mugsayl, a coastal lagoon in southern Oman. *Journal of arid Environments, 36:* 1-14.

Victor, R and Victor, J.R., 1997. Some aspects of the ecology of littoral invertebrates in a coastal lagoon of southern Oman. *Journal of Arid Environments, 37: 33-44.*

Victor, R. 1995. Water associated dermatitis in Oman. *Journal of Wilderness and Environmental Medicine, 6: 423 – 426.*

Expected Publications:
Two papers on Khawr Sawli are in preparation.
Two papers on Khawr Rawri are expected.
Two papers each on Wadi Hinna and Ayn Tobruk are expected.

Sponsors: Planning Committee for Environment and Development in Dhofar Governorate; Sultan Qaboos University.

2. Project Title: The freshwater ecology of Wadi Muaydin.

Aim and Scope: To study the perennial lotic environment in Wadi Muaydin near Birkat al- Mawz with special reference to the ecology of invertebrates inhabiting riffle, run and pool biotopes.

Start Date: July 1991.
Finish date: April 1992.

Principal **Investigator/Supervisor:** Professor Reginald Victor
Co-investigator: Mr. Abdulla I.S. Mahrouqi

Relevant Publication:
Victor, R. and Al-Mahrouqi, A I S. 1996. Physical, chemical and fauna1 characteristic of a perennial stream in northern Oman.

Sponsor: Sultan Qaboos University

'3 **Project Title: An** ecological study of a sewage treatment continuum to recognize indicators of freshwater pollution.

Aims and Scope: To correlate waste water chemistry in various sections of a sewage treatment plant to its flora and fauna with a view of identifying tolerant and sensitive taxa. These taxa could then be used as indicators of surface water pollution in streams and aflaj systems.

Start Date: August 1992
Finish date: March 1993

Principal Investigator/Supervisor: Professor Reginald Victor
Co-investigator: Ms. Salma Al-Harassi

Relevant Publication:
Victor, R. and Al-Harassi, S. 1997. The ecology of wastewater in the open sections of a sewage treatment continuum under arid conditions. In: *Proceedings of the WSTA Third Gulf Water Conference. Towards efficient utilization of water resources in the Gulf.* Sultanate of Oman, 16-19 March 1997.

Sponsor: Sultan Qaboos University

4. **Project Title:** The ecology of Nakhl Thuwarah – a perennial wadi fed by thermal springs in northern Oman.

   Aim and Scope: An annual study conducted in five sections of this wadi at fortnightly intervals to evaluate, the physical and chemical environment, algal flora, invertebrates and fish. This study was expected to provide information on human impacts caused by recreational activities.

   Start Date: January 1990
   Finish date: December **1991**

   Investigator: Professor Reginald Victor

   Publications: Pending data analysis.

   Sponsor: Sultan Qaboos University

5. **Project Title:** Environmental studies on man-made mountain reservoirs in the Jabal Akhdar area with special reference to water quality.

   Aim and Scope: To survey the man-made reservoirs in the Jabal Akhdar area for drinking water quality using chemical, microbiological and biological characteristics. Classification of the reservoirs on the basis of water quality is hoped to plan management strategies for the efficient utilization of these reservoirs.

   Start Date: September 1996
   Finish Date: June 1997

   Supervisor: Professor Reginald Victor
   Graduate Student: Ms Samira Rajab Al-Ujaily

   Relevant Publications:

   Rajab, S. S. 1997. Environmental studies on man-made mountain reservoirs in the Jabal Akhdar area with special reference to water quality. *M.Sc thesis,* Sultan Qaboos University, Sultanate of Oman. 142pp.

   Victor, R. and Rajab, S.S. 1997. Reservoir limnology in the arid northern mountains of Oman. Problems and prospects. In: Proceedings of the #rd International Conference on Reservoir Limnology and Water Quality. Ceske Budejovice, Czech republic, August 1 l-15, 1997. (to be published in *Verh. Verein. Int. Limnol.)*

Victor, R. and Al-Ujaily, S.R. (in press) Water quality of mountain reservoirs in arid northern Oman with comments on management strategies. In: Goosen, M.F.A. and Shayya, W.H. (eds.) *Water Management, Purification, and Conservation in Arid Climates.* Technomic Pulishing Co., Inc.

Sponsor: Sultan Qaboos University and the Ministry of Water Resources, Sultanate of Oman.

6. **Project Title: An** environmental assessment of salinity stress on the farmlands of the Sur area

Aim and Scope: To study the chemical and biological factors behind salinity stress in three components of the farmlands namely, the water, soil and plants.

Start Date: August 1996
Finish Date: May 1997.

Supervisor: Professor Reginald Victor
Graduate Student: Ms Amina Abdulla Ismail Al-Farsi

Relevant Publications:
Al-Farsi, A.A.I. 1997. An environmental assessment of salinity stress on the farmlands of the Sur area. *M.Sc thesis.* Sultan Qaboos University, Sultanate of Oman. 74 pp.

Sponsor: Sultan Qaboos University and the Ministry of Water Resources

7. **Project Title:** Hot springs in the Sultanate of Oman

Aim and Scope: To study the physical and chemical environment and the biodiversity of hot springs.

Start Date: August 1996
Finish Date: June 1998.

Investigator: Professor Reginald Victor

Publications: Pending data analysis

Sponsor: Sultan Qaboos University

8. **Project Title:** Biology and ecology of the killifish, *Aphanius dispar* (Pisces; Cyprinodontidae)

Aim and Scope: A thorough study of this killifish, abundant in the Arabian Peninsula.

Start Date: January 1990
Finish Date: not known.

Principal investigator: Professor Reginald Victor
Co-investigators: Dr. Taher Ba-Omar: Histological studies relating to stress (ongoing)
Mr. Daniel Tobias: Histological aspects.
Dr. Sardar Farook, Chemotaxonomy and muscle protein variations
Mrs. Jayanthi R Victor, Feeding habits (ongoing)
Ms Narjes Al-Saigh, Foraging strategies (completed)

Relevant Publications:
Victor, R and Al-Saigh, A.N. 1995. Foraging site selection by a tropical cyprinodont fish *Aphanius dispar* (Ruppell). In: Timotius, K.H. and F. Goltenboth (eds.), *Tropical Limnology* Vol. III.' Satya Wacana University Publication, Salatiga,. Pp. 121-126.

Sponsor: Sultan Qaboos University.

9. **Project Title:** The ecology of a diesel contaminated falaj in Jabal Akhdar

Aim and Scope: To study the annual variation in the environmental and biological conditions of a falaj contaminated by diesel.

Start Date: January 1997
Finish **date:** December 1997

Investigator: Professor Reginald Victor

Co-investigators: Dr Jens Erikkson, Gravimetric analysis of diesel content (only)
Dr A. K. ElShafie, Biodegradation of diesel (only)
Publications: Pending data analysis.

Sponsor: Sultan Qaboos University

10. **Project Title: An** ecological assessment of an exotic tilapia outside culture conditions in Oman.

Aim and Scope: This study made use of a seemingly accidental introduction of a tilapia species in an ornamental pond. The population structure and growth of a parental stock comprising six individuals were analyzed. Implications of tilapia introduction in Oman were the motivating force behind this research.

Start Date: August 1994
Finish date: March 1995

Investigator/ Supervisor: Professor Reginald Victor
Student/ Co-investigator: Ms. Nabila Al-Makki

Sponsor: Sultan Qaboos University and Diwan of Royal Court.

11. **Project Title:** Control of nuisance blooms. Does decomposing rice straw reduce algal diversity?

Aim and Scope: Nuisance bloom is a severe problem in ornamental ponds and its control is difficult. A novel method of using rice straw as a part of pond substrates and its effect on algal blooms is studied.

Start Date: August 1994
Finish Date: March 1995

Investigator: Professor Reginald Victor
Co-investigator: Mr. Seyad Farook

Publication: Pending data analysis.

Sponsor: Sultan Qaboos University

12. **Project Title:** Charophytes of Oman.

Aim and Scope: To study the taxonomy and distribution of Charophyta based on Professor Victor's collections in the Sultanate of Oman.

Start Date: January 1990
Finish Date: Ongoing

Principal Investigators: Professor Reginald Victor, Sultan Qaboos University, Oman and Mr. M.I. Hussain, King Saud University, Riyadh, KSA
Co-investigator: Dr. Talat M. Khoja, King Saud University, Riyadh, KSA.

Publications: Part I is in draft stage for publication in *Nova Hedwigia.*

Sponsors: Sultan Qaboos University **(RV);** King Saud University **(MIH, TMK)**

13. **Project Title:** Marine Stingers of Oman

Aim and Scope: To study the stinging marine organisms dangerous to man in the Sultanate of Oman: The seasonality of stinger occurrences and medical treatment of marine stings are also considered.

Start Datk: January, 1993
Finish Date: not known

Investigators: Professor Reginald Victor (organisms)
Dr. Pratap Chand (medical treatment)

Relevant Publication:
Chand, P. and Victor, R. 1996. Marine stings in the Gulf Oman. In: Williamson, J.A., Fenner, P., Burnett, J.W. and Rifkin, J.F. (eds.) *Venomous and Poisonous Animals. A medical and Biological Handbook.* University of New South Wales Press, Sydney, Australia. Pp. 404-410. Pls. 18. 1A-18.11.

Sponsor: Sultan Qaboos University

December 31, 1997

Dear Professor Victor,

With regard to your request for information on Biodiversity projects in Oman I submit the following.

Project Title: Diversity of annual plants in gravel plain habitats.

Aims: This is a long term project (>5 years) that will quantify the number of species of annual plants in open gravel plain habitats and under samur trees (Acacia tortilis). Density, frequency in plots, biomass and several other measures of community will be made each year. Rainfall in the study area is measured each season, patterns of germination and phenology are also noted. Physiological studies could be incorporated if additional qualified academic staff join the Department. The project will establish the importance of the under-tree microenvironment to the maintainence of species diversity. This is especially relevant to the more global problem of deforestation and desertification.

Start Date: October 1996
Finish Date: undetermined

Investigators: Principle Investigator is Dr. Michael Robinson, Department of Biology, Sultan Qaboos Unviersity. Technical Assistant: Ms Amina Al Farsi

Sponsor: None

Projects

Details given following points a-e in your requesting letter.

1.

(a) Long-term monitoring of the condition and ecology of the montane juniper woodlands

(b) Aims to monitor the condition of the juniper woodlands, which are poor and have low viability in many areas. Are the woodlands undergoing an irreversible decline in some areas, or are they simply passing through a natural stage in the dynamics of woodland regeneration and decline?

(c) Began circa 1993 and will continue indefinitely.

(d) Martin Fisher and Drew Gardner, Dept Biology, SQU

(e) SQU

2.

(a) The feeding ecology of the Arabian tahr

(b) Document the diet of the tahr both quantitatively and qualitatively. What plant species does it eat and in what relative proportions? What is the nutritional status of the tahr rangelands?

(c) September 1997 - August 1998.

(d) Hassan al Mejeini, under the supervision of Martin Fisher, Dept Biology, SQU

(e) SQU

3.

(a) Database of the mammals of Oman

(b) Maintenance of a database of species sightings and collections for all mammals in Oman. Includes archival of the White Oryx Project mammal sightings on the Jiddat al Harasis

(c) Began circa 1996, to continue indefinitely.

(d) Maintained by Martin Fisher at SQU, with the input of many individuals and organisations.

(e) Personally maintained.

4.

(a) National Herbarium Database, Natural History Museum, al Khuwair

(b) Maintenance of a specimen database for the herbarium

(c) Started 1997, to continue indefinitely

(d) Database designed and maintained by Martin Fisher, data entry by staff and volunteers at ON.

(e) Personally maintained.

PROJECTS

Flora of Oman: An ongoing project to document and describe the approximately 1200 native species of higher and lower plants of Oman. Started in 1991 it is now about half complete. Illustrated and with distribution maps.

Plant Conservation in Oman. A study of the status of the threatened and vulnerable flora of Oman with recommendations for its conservation. Report. completedin 1995.

DATABASES BASED ON PROJECTS ON THE FLORA OF OMAN

Plant conservation in Oman

Datab[illegible] of the threatened flora of Oman, which includes the endangered, vulnerable and [illegible]ed species as defined in the IUCN Red Data Categories.

The information gathered formed the basis of a report on plant conservation in Oman (see under projects) and instigated the formation of a Plant Working Group under the auspices of the Ministry of Environment and Regional Municipalities to help with data collection and other information on the conservation status of the flora and critical habitats of Oman.

Flora of Oman and Vernacular Names

Based on extensive studies on the systematics, vegetation and biogeography of the flora of Oman and the Arabian Peninsula, a database is prepared of the flora of Oman. A separate database, which can be linked to the flora database is maintained for the vernacular names of Omani plants.

Recent publications related to the flora of Oman

Ghazanfar, SA (1994) *Handbook of Arabian Medicinal Plants*. 165 pp, 65 plates. CRC Press, Florida. USA.

Ghazanfar, SA (1997) *Trees of Oman: an illustrated guide to the native trees of Oman*. 67 pp, Directorate General of Nature Reserves, Ministry of Regional Municipalities and Environment, Oman.

Ghazanfar, SA & Fisher, M. (in press) *Vegetation of the Arabian Peninsula*.362 pp, Kluwer Academic Press, The Netherlands.

Ghazanfar, SA (1994) Novitates from the flora of Oman. *Edinburgh Journal of Botany* 51(1): 59-63.

Ghazanfar, SA & Rappenhoner, D (1994) Vegetation and the flora of the Island of Masirah and Shagaf. *Arab Gulf Journal of Scientific Research* 12(3): 509-524.

Ghazanfar, SA (1995) Coastal sabkhas: an analysis of the vegetation of Barr al Hikman. In: Khan, MA & Ungar, IA (Eds.). *The Biology of Salt Tolerant Plants*, pp. 277-283. Department of Botany, University of Karachi, Pakistan.

Ghazanfar, SA (1996) Aucher-Eloy's plant specimens from the Immamat of Muscat. *Taxon* 45: 609-626.

Ghazanfar, SA (1996) The genus *Dipcadi* in the Arabian Peninsula. *Kew Bulletin* Vol. 51(4): 803-807.

Alfarhan, AH & Ghazanfar, SA (1997) Medicinal plant conservation on the Arabian Peninsula: Two Case Studies. *Medicinal Plant Conservation*, Vol. 3. Newsletter of the IUCN, SSC MPSG.

Ghazanfar, SA (1997) Analysis of the vegetation of the saline, brackish and freshwater pools in Dhofar, Sultanate of Oman. *Proceedings of the V Symposium on Plant Life of South West Asia*, University Press, Izmir, Turkey.

Ghazanfar, SA & Gallaher, MD (in press). Lichens from the Sultanate of Oman. *Nova Hedwigia*.

Ghazanfar, SA (in press). Status of the flora and plant conservation in the Sultanate of Oman. *Biological Conservation*.

Duling, D., Ghazanfar, SA & Prendergast, HDV (in press) *Ziziphus hajarensis*, a new species from Oman. *Kew Bulletin*.