

PROPOSAL FOR REVIEW

PROJECT TITLE: REPUBLIC OF YEMEN: CONSERVATION AND SUSTAINABLE USE OF THE BIODIVERSITY OF SOCOTRA ARCHIPELAGO

GEF FOCAL AREA: Biodiversity

GEF ELIGIBILITY: Under financial mechanism of Convention (Convention ratified February 21, 1996)

TOTAL PROJECT COSTS: US\$ 12,957,900

GEF FINANCING: US\$ 4,944,700

GOVERNMENT CONTRIBUTION: US\$ 500,000 In kind

CO-FINANCING/PARALLEL FINANCING: US\$ 13,200 British Government
US\$ 2,500,000 UNDP (Exact figures to be confirmed)
US\$ 3,000,000 UNICEF, WHO & others

ASSOCIATED PROJECT: Government of Yemen: Transport Development for Socotra
US\$ 2,000,000

GEF OPERATIONAL FOCAL POINT: Environmental Protection Council (EPC)

GEF IMPLEMENTING AGENCY: UNDP

EXECUTING AGENCY: Government of the Republic of Yemen and UNOPS

LOCAL COUNTERPART AGENCY: High Committee for Development of Socotra

ESTIMATED APPROVAL DATE: January 1997

PROJECT DURATION: 5 years

GEF PREPARATION COSTS: US\$ 25,000 UNDP
US\$ 9,950 RBGE Expedition Fund

COUNTRY AND SECTOR BACKGROUND

National Priority of Global Significance

1. The flora and vegetation of the Socotra Archipelago is of outstanding global significance. Over a third of its plant species are found nowhere else, ranking it amongst the top ten island groups in the world. Many of these endemics are remnants of ancient floras which long ago disappeared from the African-Arabian mainland. Others have evolved bizarre growth forms making the Socotran landscape one of the worlds most remarkable. What makes Socotra of even greater global significance is that unlike most other island groups its environment has remained virtually untouched by modern development. There is no evidence of recent extinctions and the vegetation appears unchanged since the island was first explored by botanists in 1880.

2. Situated where the Arabian Sea merges with the Indian Ocean, the marine communities of Socotra Archipelago demonstrate distinct biogeographic characteristics of the two major marine biogeographic zones. The fact that in key fish indicator groups, only species belonging to one or other of the bio-geographic zones are present while their sister taxa being absent, indicates that the marine communities are distinct, unique and well-established. Although much of the Somalia coast is still to be explored, the varied shallow marine substrates of the Socotra Archipelago are believed to be highly significant in maintaining gene flow between the Arabian region and the rest of the Indian Ocean. Their present pristine state, unaltered by coastal pollution or over-exploitation, is remarkable and suggests that unwitting alteration or careless development could have considerable regional or even global impact on marine biodiversity. Socotra Island has been rated as being one of the highest priority areas in the Arabian Seas region which warrants protective management (Kelleher, *et al* 1995)¹.

3. In January 1996, the Council of Ministers of the Government of Yemen declared Socotra Island as a special natural area in need of protection. In the same Council Decision, a Higher Committee for the Development of Socotra was formed to review development projects in Socotra, starting with the most urgent tasks such as the building of airport runway, a seaport and roads. In March 1996, shortly after Yemen's ratification of the Biodiversity Convention, a National Workshop on the Biodiversity Convention, was organized by the Environmental Protection Council with support from IUCN. In the workshop, Socotra was highlighted as a priority site needing major conservation efforts. In the NEAP - National Environment Action Plan² completed in May 1996, the management of Socotra as a National Protected Area, the first of the country's, was listed as one of the four priority actions of its Habitat Management Action Program. The recent Government

¹ Kelleher, G., Bleakley, C. and Wells, S. 1995. A Global Representative System of Marine Protected areas. Volume III. The Great Barrier Reef Marine Park Authority, the World Bank, and the World Conservation Union (IUCN).

² Environmental Protection Council (1996). National Environmental Action Plan, the Republic of Yemen.

request for UNDP and GEF assistance in the preparation of the Master Plan of Development of Socotra Archipelago, indicate strong Government commitment for environmental protection and biodiversity conservation while promoting development of the islands. One of the major outputs of the present GEF project will therefore be a zoning system of the island group to be implemented within the framework of the Master Plan, which will protect its global biodiversity from intensified land use, exploitation, and development anticipated.

4. The present proposal will enable the Government of Yemen to achieve its national priority for conserving the globally significant biodiversity of Socotra Archipelago by absorbing the incremental cost required on top of the baseline secured for the basic rural and social development (including water supply, health, education, sanitation and environmental management, etc) of the people of Socotra through Government and international agencies (UNDP, WHO, etc). The integrated approach of the project allows it to fall well in line with two Biodiversity Operational Programs; (i) the Arid and Semi-Arid Ecosystems and the (ii) Coastal, Marine, and Freshwater Ecosystems. The activities of the project will focus on the conservation and sustainable use of outstanding endemic biodiversity in the dryland ecosystems, as well as the coastal and marine biodiversity of global biogeographic significance. Sustainable use of biodiversity will be encouraged through strengthening of traditional resource management practices and Government capacity to enforce regulations.

5. The present project emphasizes community-based approaches to sustainable resource management while at the same time strengthen and builds upon Government and international resources and interest for Socotra. Such partnerships and multi-level approaches are truly in line with CoP guidance "...Recommends, for more effective implementation of its policies, strategies and programme priorities, that the Global Environment Facility explore the possibility of promoting diverse forms of public involvement and more effective collaboration between all tiers of government and civil society.....". The 1995 CoP also endorsed "integrated marine and coastal area management as the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biodiversity", CoP (1995)³.

6. The intricate partnerships with substantial Government and multilateral agencies (UNDP, UNICEF, WHO) programs targeting at basic infrastructural, social and economic development, and environmental protection will ensure the holistic integration of conservation, environment, and development efforts, for the sustainable management of the globally significant biodiversity of Socotra while ensuring benefits for the local people. The anticipated global environmental benefits cannot be overemphasized. The following sections describe the globally significant biodiversity of Socotra Archipelago, and the present and potential threats it is facing.

³ Conference of the Parties to the Convention on Biological Diversity, Second meeting, Jakarta, 6-17 November 1995. Committee of the Whole, Agenda items 5 and 6.3.

The Socotra Archipelago

7. The Socotra Archipelago, consisting of Socotra and three outlying islands, Abd al-Kuri, Samha and Darsa, is situated some 400 km south of Yemen and 250 km from the Horn of Africa. The archipelago is administered under the Aden Governorate of the Republic of Yemen. The long isolation of the islands from the African continent has resulted in very high levels of endemism on the islands. The archipelago has been described by the World Wide Fund for Nature and many others as an "Indian Ocean version of the Galapagos", based on the high degree of endemism and unique vegetation types of the islands. In terms of biodiversity conservation, the entire archipelago should be treated as a single priority hotspot with exceptional biodiversity under threats, similar to the core zone of a protected area.

Terrestrial Biodiversity

(a) *High Plant Endemism*

As a result of the island's long-time isolation from Africa and Arabia, there is an exceptionally high level (30%) of endemism of the plants found on Socotra Archipelago. Of the 850 plant species found on the island group, at least 277 are endemic. In comparison with the Arabian region, which contains 3418 recorded plant species, 17% of which are endemic, Socotra has a much higher level of endemism. Eleven genera of plants are endemic to Socotra and one additional genus is endemic to Socotra and the mainland of Yemen (Miller, 1991⁴). Seven of Socotra's endemic plants are listed in the IUCN Red Data Book (3% of the total). In the March 1996 GEF project formulation mission⁵, the terrestrial team discovered 15 plant species new to science, including a new frankincense tree and a new Hibiscus shrub.

(b) *Significant Plant Species*

(i) Taxonomically isolated palaeo-African and palaeo-Indo-Malesian plant relics from the Pleistocene include: the famed Dragon Blood Tree *Dracaena cinnabari*, whose deep red resin has strong medicinal properties; the Cucumber Tree, *Dendrosicyos socotrana*, the only tree in the cucumber family; *Punica protopunica*, the only wild relative of the commercially important pomegranate; and *Dirachma socotrana*, one of only two species in its family which, notably, is a subendemic family (Miller, 1991). The hybrid parent of the winter-flowering begonias, *Begonia socotrana*, is one of several horticulturally important plants on Socotra and is also included in the IUCN Plant Red Data Book. Annex 4 lists all recorded endemic plant taxa of the

⁴ Miller, A.G. (1991) Checklist of Socotra. Unpublished.

⁵ Miller, A., M. Morris and D. Alexander, 1996. Mission Report (Terrestrial Team) for the Conservation and Sustainable Use of Biodiversity of Socotra Archipelago, Yemen, 24 Feb - 17 April 1996.

Socotra Archipelago, and their IUCN status, while the colour plates in Annex 10 display some of these species in a renowned scientific journal.

- (ii) Socotra was famed in ancient times as the source of treasured incense, gums, resins and other plant products. Some of the more famous Socotran plant products which were once of commercial importance included resin from the Dragon Blood tree, frankincense which were taken by dhow from Socotra and then by caravan across Arabia to Egypt and beyond, Socotran aloes, gums and resins. Current trade in these products is not commercially important. However small-scale trade persists, primarily with Aden and to some extent with Oman and the United Arab Emirates. This trade has not been quantified; thus, little is known of the actual extent of trade. Increasing interest in natural products is an evident global trend and some day there may be a recurrence in the commercial importance of some of Socotra's plants.

(c) *Significant Bird Species*

Socotra is home to six endemic species of birds (*Nectarinia balfouri*, *Cisticola incanus*, *Passer insularis*, *Onychognathus frater*, *Cisticola haesitetus*, *Emberiza socrotana*), of which the latter three are globally threatened. Birdlife International has identified 22 Important Bird Areas on Socotra Archipelago, the number is likely to increase with extended surveys. Large numbers of the Bulwer's Petrel (*Bulweria fallax*), a Middle East endemic seabird occur in the waters around Socotra. In addition, Socotra is the single most important breeding area in the Middle East, perhaps even in the world, for the Egyptian Vulture (*Neophron percnopterus*). Recent work has suggested that the buzzard (*Buteo subspecies*) that breeds on Socotra is, in fact, a full species. If this proves true, even greater importance will be attached to this isolated island breeding population. Socotra holds a significant proportion of the world population of the Forbe-Watson's Swift, *Apus berliozzi*, which is a near endemic, occurring also in Somalia. Lastly, Socotra is home to a viable population of the Middle East endemic, the Golden-winged Grosbeak (*Rhynchospiza socrotanus*). Birds of prey are commonly caught to supply the trade to the Gulf countries, especially the United Arab Emirates.

(d) *Reptiles and others*

As on many isolated islands, the terrestrial vertebrate fauna of Socotra is abound with reptiles. The lizard fauna is richer on Socotra Island than on any equivalent island. All of them are endemic. Three new species of reptiles have been described recently, and many appear to have very limited ranges which require careful assessment of their conservation needs. Several endemic fresh water crabs, new species of endemic butterflies and dung beetles have been recorded. The latter suggests that there were large mammals on the island before domesticated livestock.

Marine Biodiversity

(a) *Biogeographic Significance*

Findings from the March 1996 project formulation mission⁶ reveal that the islands represent a major overlap between the Arabian and Indian Ocean marine biogeographical areas, with endemics from both regions represented. This is not simply a site where adjacent faunas mix; in key fish indicators, only species belonging to one or other of the bio-geographic regions are present, their sister taxa being absent. This points to a distinct, unique and biologically well-established community. Although much of the marine ecosystems of the Somalia coast is still to be explored, the varied shallow marine substrates of the Socotra Archipelago are believed to be highly significant in maintaining gene flow between the Arabian region and the rest of the Indian Ocean. Annex 5 lists the major marine taxa recorded during the project formulation mission.

(b) *Fish*

The Socotran waters are rich in both pelagic and demersal fish. The former, which form the basis of the archipelago's commercial fisheries, consist of the tunas, kingfish (*Scomberomorus commersoni*) and shark. Their abundance is testament to the seasonal upwelling that fuels the food chain beneath these carnivores. However, it is the shallow water marine fish communities that are more important indicators of the archipelago's unique and important bio-geographic position mentioned above. For instance, Arabian endemics such as the butterflyfish *Chaetodon melapterus* and *C. vagabundus pictus* occur in Socotra, as do the Indian Ocean *C. lunula* and *C. auriga*. This picture of mingling distinct regional faunas is repeated in the triggerfish and surgeonfish, and to lesser extent the angelfishes and other families. Annex 5 includes a non-exhaustive list of fish species recorded by the marine team of the project formulation mission in March 1996.

(c) *Coral*

Despite the lower temperatures associated with the upwelling, coral is surprisingly widespread through the Archipelago, with cover varying from less than 5% to 80%. Although no biogenic reefs have been recorded, as many as 30 genera may be represented, including all the common western Indian Ocean species. On the northern coast of Socotra, the dominate genera are branching, and include *Acropora* spp., *Stylophora* spp., and *Pocillipora* spp., whilst further offshore the massive and foliose corals such as *Porites* spp., *Montipora* spp., *Favites* spp., *Platygyra* spp. and *Goniopora* spp. dominate. On the southern coast, coral communities are few and give

⁶ MacAlister Elliott and Partners Ltd., 1996. Mission Report (Marine Team) for the Conservation and Sustainable Use of the Biodiversity of Socotra, 19 Feb - 20 March 1996.

only sparse cover mainly on offshore patch reefs, and may reflect the severe exposure received on the south-west monsoon.

(d) *Marine Flora*

Socotra Island supports a rich macroalgal flora, especially on the exposed *Nogid* coastline which reflects the high nutrient availability through upwelling. Seagrass beds are not common, although small, locally significant coverage is found on both the northern and southern coasts. On the north coast, *Halodule* spp. can be found offshore of Hadibo and in Khor Girmah, whilst on the southern coast *Cymodocea serrulata* coverage of up to 100% occurs on some quite exposed areas. Socotra Island also contains some of the tallest examples of mangrove *Avicennia marina* in the Arabian region, standing up to 10 metres high.

(e) *Marine Turtles and Mammals*

Four, possibly five species of sea turtle are found in the Socotran waters (the green turtle *Chelonia mydas*, loggerhead turtle *Caretta*, hawksbill turtle *Eretmochelys imbricata*, Olive Ridley *Lepidochelys olivacea* and possibly the Leatherback Turtle *Dermochelys coriacea*), all of which are considered endangered species by the IUCN. Two, and possibly three species use the Archipelago for breeding, and it is probably one of the few remaining, relatively undisturbed breeding sites left in the world. Dolphins are common throughout the archipelago, most frequently the common dolphin *Delphinus delphis*. Many other cetaceans migrate through and inhabit these waters, including the sperm whale *Physeter macrocephalus*.

The People of Socotra

8. The total population of the Socotra Archipelago is estimated from 50,000-80,000, with the vast majority on Socotra Island where the two main towns Hadibo the capital and Qalansyia are located. The livelihood of the majority of the people on the island is dependent on livestock. The coastal populations rely more on fishing and date cultivation, or are involved in trade in the two main towns for their livelihood, while the people of the rural interior are almost all pastoralists. Since people of the coast seasonally graze their livestock in the interior, while the rural people of the interior come down to the coast seasonally to fish and have family members permanently settled on the coast, the population of the island must be treated as a single entity. The fact that goats are still being worshipped indicates an ancient culture by which people and goats have always lived and depended on each other in harmony with nature. For instance, seasonal transhumance and rotational grazing permit the periodic resting of the rangelands. Such traditional methods of land and livestock management is still playing a major role in the conservation of the island's vegetation.

9. Other regulatory mechanisms include controlled livestock breeding (most male goats are killed at birth to maintain milking herds, adult male goats wear a flap to prevent successful mating during drought years), unwritten laws against cutting of live trees,

protection of riverbanks and erosion control devices for cultivation. Socotrans have traditionally used many natural products found in their environment, including medicines from plants, and continue to use them today. Traditional management systems have impeded over-exploitation of the natural resources on which the people directly depend. Tribal governance systems remain strong.

10. The majority of the land on Socotra Islands is still tribally owned, with individuals owning land enclosed for cultivation. Traditionally in the rural interior, pastoralist land owners and land users have equal rights of usufruct. The land owners cannot cede or sell any of this communally used land without agreement of the land users. Neither the land users nor the land owners can introduce new settlers or incomers or seasonal grazers without the agreement of the other.

11. The coastal population is highly dependant upon fishing; around 2,600 of the estimated 10,500 people in coastal villages are fishermen, which accounts for the majority of working males and their dependents. This fishing force does not take into account the seasonal fishermen from the inland parts of the islands. The artisanal fleet consists of around 650 fibreglass skiffs that have rapidly replaced the traditional wooden *hourri*. These principally target the shark, kingfish and tuna, which are then salted, dried and sold on the mainland. Until the late 1980's, these catches were all passed through the island's Government run fishing co-operative or *tawaniyah*, but this is now almost entirely bypassed. With such a limited market for marine products and the absence of official fisheries regulation, an unusually effective traditional fisheries management system has evolved. Based around the elected village leaders or *muqqadims*, a local fishing policy is maintained and re-evaluated on a seasonal basis, often in consultation with other village groups. Rules on gear usage and restrictions, fishing rights, timing and stock management are formally agreed and then policed. Infringements are rare, with peer pressure an important regulator.

12. There is increasing settlement on the coast because of the proximity to water, schools, jobs, etc. Health services, including reproductive health and family planning services, are mostly unavailable to people in the interior region of Socotra and minimal on the coast. Reliable figures do not exist, but field enquiry suggests that the infant mortality rate is alarming. Respiratory diseases, especially tuberculosis, intestinal illnesses and malaria are widespread; Socotrans are experiencing the highest incidence of some of these diseases compared to the rest of the country.

Threats to Terrestrial Biodiversity - Present and Anticipated

13. The two main threats on the terrestrial biodiversity already observed are over-cutting of timber species and localized overgrazing. Over-cutting of timber species is likely to increase with the demand for better housing. Habitat destruction and land degradation are important threats anticipated to emerge if development of the islands proceed in the absence of effective landuse and development plans with environmental considerations. Land clearance and degradation near to the coastal settlements are likely to spread to more remote areas when roads are build on an *ad hoc*, uncontrolled manner. Over-extraction of ground water to meet the growing demand can also have profound impacts on the natural vegetation.

The following paragraphs describe in more detail the root causes and trends of the various observed and anticipated threats on the islands' terrestrial biodiversity.

(a) *Cutting and Over-collection of Plants*

- (i) Traditionally, the cutting of live wood for timber is strictly controlled. Anyone cutting a tree on another's land without permission would have to submit to beating or pay a fine. In the past, the supply of locally available dead wood was adequate for building purposes as the majority of the rural pastoralist lived in the many caves of the karstic limestone areas. However this is becoming inadequate as the pastoralist begin to build permanent stone houses which require wooden pillars and roofing beams. The increasing construction of roofed byres similar to human houses for livestock further aggravate the problem. The construction of human and livestock shelters serve as physical indicators of claimed or existing traditional residential and grazing rights. Now live wood is cut to supply the ever growing demand for timber, although strict controls still exists for certain species, such as *Maerua angolensis* and *Metaporana obtusa* which are both Socotran endemics categorized as endangered by IUCN, and *Ziziphus spina-christi*, an important livestock fodder tree which also provides a major source of vitamin C for many islanders.
- (ii) Traditional control on the cutting of live wood for fuel still retains. However as the major permanent settlements along the coast expand, there will be an increased demand for firewood, possibly leading to live wood cutting.
- (iii) There is at present no sign of over-exploitation of plants with ethnobotanical values. Traditionally a number of plants were collected for local use and for export. Plant products are still only collected from within an individual's own tribal area, and any outsider must seek permission before harvesting. While the local market for plant products is steady at present, there is only a very small and irregular overseas market for frankincense, aloe juice and Dragon's blood resin. However, this situation could change if an international market were found for any of the islands' plant products before any effective export control is in place. Commercial interest on the aloe juice of Socotra has been expressed.

(b) *Overgrazing*

No recent census on the number of goats, sheep, cattle and camels on Socotra islands is available. There are localized grazing impact on the vegetation in some of the coastal areas of Socotra. The movement of pastoralist from the interior to the coastal plains is beginning to weaken the traditional management practices, and to exert more pressure on the coastal vegetation. However, on the whole, overgrazing is not a widespread issue at present. Furthermore, it is anticipated that development will bring

in new job opportunities to the younger generations of Socotrans and grazing pressure is not likely to increase over time.

Threats to Marine Biodiversity and Fisheries Resources - Present and Anticipated

(a) *Over-exploitation of marine resources*

- (i) Shark fishery is the only fishery showing noticeable decline and will likely decline further if continue to be exploited at the present rate. The recovery of shark populations from over-fishing is extremely slow due to their low fecundity and late age of maturity. The disappearance of sharks, being on the top of the food chain, may lead to serious irreversible ecological impacts. Given the present dependence upon dried shark, the socio-economic consequences alone would also be disastrous. No other fishery stocks appear to be currently threatened, but a number are increasingly being exploited. The lobster fishery is at risk, since again, late maturation and slow growth makes these high value crustaceans vulnerable to poor management.
- (ii) Though not yet observed, threats from unregulated industrial fishing in the absence of effective monitoring, control and surveillance, is anticipated. The impacts on biodiversity will be the results of over-exploitation as well as gear-related habitat loss. Indiscriminate trawling is highly damaging to valuable spawning and feeding substrates, and is a serious problem on the Hadramaut and Al Mahra coasts of the mainland. Improved knowledge of the substrate and habitat types in the shallow coastal waters, especially the patch reefs south of Socotra, would allow targeted control and protection of sensitive or critical habitats.
- (iii) The capture of turtles is a common traditional practice providing the needed supplementary food for the people during the monsoon. Socotra represents an important breeding and feeding reserve for at least three of the globally endangered species, the Green Turtle *Chelonia mydas*, Loggerhead Turtle *Caretta* and Hawksbill Turtle *Eretmochelys imbricata*. The actual contribution of Socotra to regional numbers needs assessment so that suitable conservation strategies can be considered.

(b) *Coastal development*

- (i) Socotran Archipelago's coastal environment is as yet pristine; the virtual absence of land-based pollution sources, minimal coastal development and a high energy wave climate has meant little or no impact to date. However, the island is apparently at a watershed in its development. Together with a mainland fishery that is now fully exploiting the main commercial stocks, Socotra will be coming under increasing development pressure over the next decade. Therefore, the potential threats are of greater concern than existing issues. Coastal development can be a real threat to the inshore coastal

environment. The recently begun port construction near to Hadibo was started without an environmental impact assessment. The anticipated expansion of the Hadibo harbour, together with other coastal works, is likely to cause considerable environmental impacts. The exposed nature of the Archipelago's shores means that coastal development will be restricted to sheltered areas, which are frequently sites of high biodiversity. There is an urgent need for a proactive, holistic management plan based on zonation of habitat sensitivity and the development of appropriate environmental impact assessment procedures prior to significant development initiatives.

- (ii) Increasing urbanization at a few major coastal settlements is likely to result in elevated pollution levels. Serious threats could appear from eutrophication resulting from increased domestic sewage production, and an increase in non-biodegradable solid wastes such as plastics. These can interfere with a number of biological processes, including turtle breeding. These need to be addressed through integrated coastal zone management initiatives which coordinate urban development, waste treatment and environmental protection, within the Master Plan.

(c) *Transmigration and Population Pressure*

While there is no reliable population growth figures for Socotra, the traditionally high national population growth rate of 4.4% per year (World Bank 1994)⁷ is a warning signal for the natural resources of the islands. It is difficult to predict the population trend, considering the upcoming development activities for the islands. While some mainland nationals may be drawn to the islands during development, it is expected that improved external transport facilities will also bring Socotrans to the mainland for better job opportunities. Nevertheless it is important that mechanisms are put in place to secure a sustainable natural resource base for the people should the population increases significantly. The Archipelago's marine life is the only substantial biological resource remained to be developed for the islanders of this poor arid land of practically no (or extremely low) agricultural potential. The risk of ecosystem productivity and biodiversity loss caused by intensive, short-term exploitation is high in the marine sector.

PROJECT OBJECTIVES

14. The long-term objective of the project is to conserve the endemic and globally significant biodiversity of Socotra Archipelago. The tools are community-based, sustainable use of biodiversity, and implementation of a zoning system which will integrate biodiversity conservation, environmental management and development objectives in a holistic manner.

⁷ World Bank (1994). Trends in Developing Countries 1994.

Specific Project Objectives

1. Zoning system for the Master Plan for Development of Socotra Archipelago.
2. Sustainable plant resource management.
3. Sustainable marine resource management.
4. Ecotourism development.
5. Environmental awareness and education.
6. Institutional strengthening and capacity building.

PROJECT DESCRIPTION

15. The multi-facet objectives of the project require a holistic integrated resource management and development strategy, driven by the local communities, and building on sound ecological and socio-economic bases. In view of the fragile natural and socio-economic environments of Socotra Archipelago which are prone to development impacts, the islands-wide approach by putting in place a comprehensive zoning system covering the terrestrial and nearshore marine areas is crucial. The request for assistance from the Government in the formulation of the Master Plan for Development of Socotra Archipelago has provided a unique, timely opportunity whereby GEF could effectively influence major development decisions, to take into account global biodiversity. The key is to demonstrate that conservation, environmental management and development are interdependent rather than mutually exclusive options. The commitment of the Government and support from donor agencies for basic rural development of the islands will provide the needed conditions for the success of the present GEF project.

16. On the local scale, activities at targeted areas of high biodiversity values and environmental sensitivity, will focus on community-based management of natural resources, building on traditional practices on livestock and fisheries management. With support from the National institutional and regulatory framework which are strengthened through the project, these locally driven activities will put the Master Plan for Development of Socotra into action by effectively implementing the zoning system developed. The outputs and momentum generated through this project will be sustained and further developed as the fifteen year Master Plan supported by UNDP matures and the human capacity gradually builds up.

17. Furthermore, the organization of the project promotes decentralization by encouraging locally elected village councils to take lead of on-site activities. This decentralized organization, enhanced by extensive public awareness programs across the islands, will ensure maximum community participation and ownership to the project, hence strengthen the sustainability of the project. The development of ecotourism and other alternative livelihood also contributes to sustainability as it takes away some of the pressure on the natural resources by generating alternative income for the local people and the incentives for environmental protection.

Project Component 1. Zoning System for the Master Plan for Development of Socotra Archipelago

18. The present project recognizes the Socotran Archipelago as a single, high priority conservation area within the Republic of Yemen. As explained in the sections on threats, the large scale, irreversible impacts on the biodiversity of the archipelago are likely to result from the much needed development efforts envisaged. In view of this and the fragility of the ecosystems and socio-economic conditions of the islands, a zoning system which defines areas of biodiversity conservation, traditional resource management, and rural development priorities, is essential. Some areas, such as the coastal plains near major settlements can be zoned to allow urban expansion. Strict protected areas within the islands are not feasible at present due to the local transhumant and resource management traditions. Top-down interventions for full preservation will lead to resentment and failure. However, target sites of representative, high biodiversity value and/or are threatened, have been identified where major community-based efforts for protection, sustainable use and monitoring of biodiversity will be initiated as described in components 2 and 3. Regular monitoring of these sites will give early warning of various environmental impacts in the different parts of the islands. Strict protection of the target sites will only be enforced in extreme cases, as a last resort.

Issues and Obstacles:

- ▶ Information on biodiversity and natural resources of the islands is insufficient for pinpointing areas of highest conservation priorities. Information on the marine and freshwater ecosystems and the terrestrial fauna, is especially lacking.
- ▶ The complex and dynamic traditional land-ownerships and user rights situation on the islands is not well documented.
- ▶ The current and potential impacts of intensified resource use, infra-structural development and population growth/dynamics, on different parts of the islands are not studied.
- ▶ There is little local awareness of Government plans for development of the islands, and little stakeholder involvement in the planning and decision making processes.

Activities to Remove Obstacles:

(a) Terrestrial Biodiversity and Social Inventory and Analyses

- (i) Collate existing information on the terrestrial fauna and fresh water ecosystems of Socotra Islands. Conduct a detailed, multi-disciplinary biodiversity, ecological and resource survey on these taxa and ecosystems to fill existing information gaps. The survey will last 1-2 months and may be repeated to take into account seasonal variations. Complete the compilation of information on the terrestrial flora and its exploitation in the Ethnoflora of Socotra. The survey results and compiled data will be input into a GIS

system to be developed at the Technical Secretariat of the High Committee for the Development of Socotra (Component 6), and made available to institutions and researchers concerned.

- (ii) Inventorize and verify land-ownerships and user rights on the islands, especially those constituting permanent ownership and seasonal grazing and cutting rights. A clear system of land tenure and land use will be worked out as an urgent priority. The long term aim is to delineate certain known areas as being the responsibility of known groups of local people. A decision on boundaries would aim at giving specific groups of people with known numbers of livestock responsibility for the care of specific land areas, based on current realities and needs.
 - (iii) Document the traditional practices (e.g. rotational grazing, no cutting of live wood for fuel) pertaining to sustainable use of natural resources at sites lacking information. This is important due to the wide variations in traditional practices in different parts of the islands which means that survey results from one area cannot be simply extrapolated to other areas. This information is of great relevance to the development of the zoning plan, and will result in a Handbook of Traditional Land Management Practices. The Handbook will subsequently be used for promoting awareness at the local level, and also provide guidelines for the Government, planners, developers and resource managers.
 - (iv) Identify areas with tourism potential for subsequent management planning.
 - (v) Analyze the existing and potential threats of development in various parts of the islands. At sites of high biodiversity and/or of potential risk, specify the protective measures and management activities needed (e.g. enclosures for regeneration, reforestation, ecotourism, etc.) for incorporation in the zoning system of the Master Plan.
 - (vi) Throughout the inventories, local villagers will be consulted to obtain their views and understanding on development, environmental and socio-economic issues, and guidelines for drafting a socially acceptable zoning system. Such stakeholder opinions will be reflected in the survey reports.
- (b) Coastal and Marine Biodiversity and Social Inventory and Analyses
- (i) Conduct a detailed, multi-disciplinary biodiversity, ecological and resource survey of the coastal and marine areas of the archipelago to refine existing habitat and resource distribution maps. The survey will last 1-2 months and may be repeated to take into account seasonal variations. The survey results will be input into the GIS system at the Technical Secretariat and made available to institutions and researchers concerned.

- (ii) Identify areas of biodiversity significance or are spawning grounds important for fisheries, and are prone to degradation. These will become target areas for conservation efforts to be developed under component 3.
 - (iii) Inventorize traditional fishing grounds, fishing rights and practices of the different coastal villages of the islands, including both those pertaining to sustainable fisheries management (e.g. no fishing with nets during full moon) and those that are less desirable (e.g. use of indiscriminating fishing gear).
 - (iv) Determine current and potential resource user conflicts between Socotran fishermen and fishermen from the mainland and abroad. Incorporate this information into the zoning plan and the supportive legislation to reduce conflicts where possible.
 - (v) Identify indicator areas representing different coastal and marine ecosystems under present and/or potential threats, from both marine-based and land-based sources. The threats could be the results of industrial trawling, coastal development in the form of construction works, port development, coral and sand mining, coastal discharge or waste dumping.
 - (vi) Identify areas with marine-based tourism potential for subsequent management planning.
 - (vii) Throughout the inventories, local villagers will be consulted to obtain their views and understanding on development, environmental and socio-economic issues, and guidelines for drafting a socially acceptable zoning system. Such stakeholder opinions will be reflected in the survey reports.
- (c) Formulation and Implementation of the Zoning System for the Master Plan
- (i) Based on existing information on areas of high floristic conservation value, findings from the terrestrial and marine biodiversity and social inventories, public consultations, and development needs assessment from existing reports and government plans, develop an integrated zoning system for the management of natural resources of the islands. The management criteria and regulations within the specific zones will be stipulated accordingly. This zoning system will form the skeleton of the Master Plan for Development of Socotra under preparation by the Government, with assistance from UNDP.
 - (ii) In accordance with existing or anticipated national legislation, develop regulatory mechanisms for controlling possible impacts from development and exploitation activities, and develop land use (including coastal zones) and water use control policies for future development in the Archipelago. These should reflect the zoning recommendations to determine the level of detail

required in areas of varying environmental sensitivity. Preparatory activities and implementation of the Master Plan which are not directly related to biodiversity conservation, such as inventory and monitoring of ground water table for consumption, will be funded by the Government or other international agencies.

- (iii) Where degradation of the inter-tidal or sub-littoral environment has occurred or is envisaged as a result of coastal and land-based activities, develop integrated management systems incorporating the needed terrestrial interventions to combat the negative impacts.
- (iv) Develop a long-term monitoring program to monitor and evaluate the effectiveness of the Master Plan. Revise the zoning system and management when necessary.

Project Component 2. Sustainable Plant Resource Management

19. Traditional practices of the Socotrans have effectively preserved Socotra Island's natural/semi-natural conditions. However, such traditional resource management systems are faced with the challenge of changing social and economic environments as development brings access to economic markets, more "efficient" technology for exploitation (industrial fishing, water extraction), and possibly population influx and transmigration. External assistance is therefore needed to strengthen and adapt the traditional management systems to cope with the development changes induced largely by external forces. In order to achieve ecological and socio-economic sustainability despite the growing demands for natural resources and habitat degradation during the course of development, the direct and tangible biodiversity use values for the local communities must be realized and maintained. It is by harnessing the earning capacity of biodiversity that it can be conserved. Both target areas management with concentrated conservation efforts and island-wide management will be developed to sustainably manage the plant resources and biodiversity of the islands. Seven target areas of representative ecosystems with high and unique biodiversity and/or under threats have been selected (Annex 7). These target areas will also serve as demonstration sites from which villagers could learn and replicate similar efforts elsewhere.

Issues and Obstacles:

- ▶ The increasing urbanization and change from cave dwellings to permanent stone houses with wooden beams and roofing are escalating the demand for timber.
- ▶ The complete dependence on native timber and wood for construction and firewood are placing increasing pressure on the arid vegetation and over-cutting of some timber species (e.g. *Maerua angolensis* var. *socotrana* and *Ziziphus spina-christi*).

- ▶ Droughts often lead to heavy demand and over-exploitation of fodder plants (e.g. *Dendrosicyos socotrana*, *Euphorbia schimperi*, *Dactyloctenium* spp., *Trichocalyx* spp., *Commiphora socotrana*).
- ▶ There is little alternative income for the islanders. Livestock, ghee, dates and dried fish constitute almost the entire income source. The gathering of dead wood for firewood to sell in coastal settlements is a steady source of income for many pastoralist. The technical know-how to derive alternative income from non-timber plant resources is minimal.
- ▶ There is a risk of traditional practices eroding rapidly as a result of hasty development. There is a lack of understanding of traditional management and minimal national expertise in sustainable resource management.
- ▶ The transhumant traditions of the pastoralists, movement of livestock and seasonal exchange in labour forces among the inland and coastal communities make site specific management and monitoring of impacts difficult.
- ▶ Lack of adequate tools for monitoring the Socotran environment; for example user-friendly identification keys and manuals which will allow environmental monitoring using indicator plant species. The correct identification of plants is crucial to the monitoring process and the subsequent conservation actions.

Activities to Remove Obstacles:

Target Areas Management

- (a) Enclosures and Nurseries for Regeneration and Planting of Endemic, Exploited Species
 - (i) At each of the seven target areas (Annex 7), initiate dialogues with local villagers and resource users to understand the local social conditions including land ownerships, user rights and tribal management systems. Arouse conservation awareness and stimulate commitment through gatherings and personal contacts. Strengthen traditional livestock management practices which are self-regulatory (e.g. controlled mating).
 - (ii) Once trust is established, work with local villagers to set up enclosures of various sizes to exclude grazing and cutting pressure and to monitor plant regeneration. Local villagers will be encouraged to actively participate in the monitoring and to utilize part of the enclosures for their own planting. One such experimental enclosure has already been established during the 1996

project formulation mission undertaken by the Royal Botanical Garden of Edinburgh (*Euphorbia arbuscula*, *Commiphora ornifolia*, *Aloe perryi*, *Ziziphus spina-christi*, *Tamarindus indicus* and *Sterculia africana* have already been successfully planted or transplanted in a very small scale). Initially, enclosures will be established at the seven target areas, but more can be established in other parts of the island through community-driven initiatives as the project progress.

- (iii) Set up two nurseries for endemic and heavily exploited plant species, especially those used as timber and drought fodder, and/or those lacking regeneration such as *Dendrosicyos socotran* and *Maerua angolesnsis*. The two nurseries will be located respectively in Wadi Ayhaft, a relatively high rainfall area in the north and Qa'arah on the Noked plain, a low rainfall area in the south, so that plants across the range of ecological niches found on the island can be grown. The nurseries will provide seedlings for villagers nearby and afar to grow in enclosures, as well as allowing studies on conservation biology of species. The latter will be crucial to reforestation and habitat restoration programs. Nursery establishment may be extended to other areas at a later stage if needed.
- (iv) Launch reforestation/revegetation programs where necessary.

(b) Long-term Monitoring to Detect Impacts and Initiate Actions

- (i) Within each target area, establish a permanent 200 meter transect to detect early signs of change, using observations of local villagers and school children who have been taught the main indicator species and signs to note. The Ethnoflora of Socotra and other guides will be used as the main tool for identifying plant species to detect environmental change and human impacts. Such long-term monitoring will be expanded to the other areas. Based on previous studies, nineteen potential indicator sites (with 3 on the outer islands) representative of different vegetation types of the islands and under differing pressures, have been identified, including the seven target areas (Annex 6).
- (ii) If environmental degradation at the target areas are detected, hold discussions with the local community to design and implement appropriate remedial measures. Complete closure of parts of the target areas may have to be enforced in extreme cases to allow recovery. Similar actions may be taken at the other indicator areas if needed.

(c) Training

Provide on-the-job training to villagers on nursery management and vegetation monitoring so that they will become self-sufficient to continue these activities beyond the project period.

Island-wide Management

(a) Planting of Endemic, Exploited Species and Livestock Management

Building on the expertise and experience gained at the target areas, organize workshops and visits to promote widespread planting of endemic, exploited species through technical transfer and exchange of horticultural practices and fencing techniques among Socotrans in different areas. Promote also regulated livestock management during the activities. Initiate reforestation programs where necessary.

(b) Alternatives to Native Timber and Firewood

(i) Carry out feasibility studies on subsidized imported timber to reduce demand for native timber, especially before the nursery and reforestation programs become well established. Provide technical advice to the Government on the distribution of imported timber through the community linkages strengthened by other project activities, and based on understanding of the local pressure on the native species in different areas.

(ii) Carry out economic analyses and feasibility studies for developing low-tech renewable energy (solar and wind), and for subsidizing LPG (liquid petroleum gas) to reduce demand for native firewood. Based on the results of the feasibility studies, work with local institutions and coordinate with the GEF PRIF LPG Substitution Programme for Yemen and with UNDP, to leverage the necessary implementation costs and technology for the preferred energy strategy.

(c) Income Generation from Non-timber Plant Products

(i) There is a potential for small scale production and export of several Socotran plant products; e.g. preliminary bio-chemical analyses have revealed potential commercial value of endemic Socotran aloes. The present project will carry out research to identify potential markets, calculate sustainable yields, collection techniques, preferable strains or varieties, optimum conditions and collection areas. When proved to be ecologically and economically viable, set up local co-operatives to gather, plant and market the plants. Successful

production will lessen the pressure on the wild populations of economically valuable plant species. GEF will only pay for the initial studies. Once established, the co-operatives will generate funds from their own income to cover the recurrent costs.

- (ii) Develop measures to safeguard the intellectual property rights of the islanders and to ensure that any economic benefits derived from the exploitation of plants will benefit the islanders.
- (iii) Fumigation mixtures command a good price on the mainland where there is substantial expertise in their manufacture. Most scented wood species on Socotra (e.g. *Cephalocroton socotranus*, *Coelocarpum socotranum*, several *Boswellia* spp.) are widespread and common, and can be exploited sustainably. Carry out feasibility studies of their production on Socotra. If proved to be economically viable, assist villagers in forming co-operatives and arrange mainland women to teach their skills to Socotran women.
- (iv) Carry out detailed economic analyses, market assessment and feasibility studies for bee keeping and the production of honey (currently collected from wild bee colonies). If feasibility studies confirm the economic viability of honey production on Socotra, expand the present bee-keeping operations on the island. This activity will be carried out with UNDP support.
- (v) Develop credit schemes where necessary to support the above activities initially before revolving funds could pay for the recurrent costs.
- (vi) Establish a Socotra Conservation and Development Fund, using profits earned from the above activities, as well as those from ecotourism, fisheries development, research donations, Government and international contribution. This Fund will be used to sustain the conservation program and support activities needed as incentives or compensations for conservation.

(d) Training and Outreach

- (i) Provide vocational training for the development and management of the above mentioned income generating activities. Some of these activities may be supported by UNDP and other agencies.
- (ii) Organize environmental awareness activities across the islands to strengthen sustainable plant resource management (Component 5).

(e) Supportive Development Activities

- (i) Construct simple water catchment systems (e.g. *karifs*, *gabiya*) to assist planting where necessary. The enclosures, supported by water catchment systems, if located near schools and clinics, will become gathering places where environmental awareness, training and nutritional and health education can be promulgated. School students and other children could be taught to assist in planting and vegetation monitoring of the enclosure, as well as growing vegetables and fruits to improve the poor diet of the community. Other agencies such as UNDP and UNICEF are expected to support some of these related activities.
- (ii) Provide assistance to reconstruct traditional stone walls to control grazing, set up collection stations, and provide transport of palm materials from major date plantations to areas lacking such fencing material for enclosures and water catchments. In many parts of the island, the lack of fencing materials is a major constraint to maintaining a clean water supply and to successful planting of useful plants, due to contamination and damage by livestock. The Government's decision to build roads on Socotra Island will assist local transport for these activities.

Project Component 3. Sustainable Marine Resource Management

20. Sustainable marine resource management will be achieved through integrated conservation and development activities to be implemented in coherence with the zoning system of the Master Plan. As preventive measures and to minimize environmental impacts from development and exploitative activities, practical guidelines and monitoring programs will be developed for specific zones of the Master Plan which are representative of different coastal and marine ecosystems of various sensitivity to impacts. Stock assessments of declining species such as sharks and potential target species such as lobsters will provide the scientific bases needed for sustainable conservation and management of these species. Community empowerment and pricing control are essential tools for regulating fisheries exploitation by the local communities themselves, as mainland and foreign markets are increasingly open to Socotra. These will be supported by control of fishing activities by outsiders. Intensive conservation efforts will be applied to target areas of high conservation potential, involving the establishment of marine protected areas where appropriate.

Issues and Obstacles:

- ▶ Lack of practical experience on coastal zone, marine resource or protected areas management.

- ▶ Lack of environmental monitoring capability needed to detect environmental impacts in the coastal and marine environment.
- ▶ Lack of knowledge on the quantity or status of the various fisheries stocks (especially sharks) from which sustainable management may be promoted.
- ▶ No centralized fisheries arrangement or storage facilities that will allow the build up of local supply and pricing control capability. At present, commercial traders can command any price, quantity and type of catch from individual fishermen or fishing villages and hence control entirely the fisheries market and exploitation level.
- ▶ Heavy dependence on very few target fisheries means that over-exploitation of these target species will be disastrous to the subsistence livelihood of the Socotran fishermen. It also hastens the process of over-fishing and leads to ecological impacts.
- ▶ The dependence of turtle meat and eggs in the monsoon seasons and the lack of understanding of the status of turtle populations in the area.
- ▶ Lack of fisheries storage facility and poverty in general constitute to poor diet and hence demand for turtle meat and eggs when available. Post-harvest loss constitutes to a large proportion of the catch.
- ▶ Some indiscriminate fishing techniques with low efficiency and large proportion of bycatch are in use.

Activities to Remove Obstacles:

(a) Guidelines, Monitoring and Control of Development and Exploitation

- (i) Develop site-specific guidelines for development and resource exploitation in the coastal zones and shallow waters according to the sensitivity of the different ecosystems involved. These guidelines should be fed into the management framework of the different zones of the Master Plan. Organize technical workshops to assist the implementation of the guidelines.
- (ii) Liaise with other development agencies or potential investors or donors on the development of a monitoring, control and surveillance system for the fisheries activities in the area, especially those of foreign and mainland fishermen.
- (iii) At each of the indicator areas identified in Component 1, develop a monitoring program to detect changes in environmental quality and status of the ecosystems. If negative changes are detected, take appropriate remedial

actions. These actions may have to be taken beyond the indicator areas where the root causes of the degradation are borne.

(b) Community-based Fisheries Management

- (i) Carry out assessment and monitoring of stocks, current exploitation level and economics of shark fisheries. Develop sustainable management schemes for shark fisheries, taking into special considerations the social economic impacts on the local fishermen.
- (ii) Carry out stocks assessment and monitoring on rock lobsters. Develop sustainable management schemes for lobster fisheries in the area focusing on regulatory mechanisms exploitation by non-Socotran fishermen.
- (iii) Carry out stocks assessment and develop management strategies and strict regulatory mechanisms on reef fishery.
- (iv) Promote the use of selective fishing techniques to replace indiscriminate gears and possibly Fisheries Aggregating Devices (FADs) to divert fishing from sensitive shallow areas. Train an extension team of keen Socotrans to promote these techniques.
- (v) Develop village-based watch systems against damaging fishing practices and violation of regulations.
- (vi) Work with the fishermen to establish a centralized Socotran fishing cooperative among local village councils through which the selling of all fisheries products can be regulated and the price can be controlled by the local fishermen rather than middlemen or buyers from outside. These will in effect regulate and control exploitation pressure on the fisheries. Assist local fishermen with access to credit schemes necessary to set up the cooperative. Liaise with other development agencies or potential investors to leverage funds for building a simple cold store and fish market at the Socotran fishing cooperative outlet, and supporting internal transport between collection points.
- (vii) Promote simple methods of product treatment and storage to reduce post-harvest losses of dried fish and improve food hygiene. Combined with effective awareness campaigns, this will lessen the demand for dietary supplement from turtle meat and eggs. Train an extension team of keen Socotrans to promote these techniques. UNDP and other agencies will take the lead in this activity.

- (viii) Investigate the potential of resource diversification through feasibility studies of alternative marine resources such as low-tech aquaculture of seaweed and abalone. Liaise with other development agencies or potential investors to develop promising alternative resources while ensuring ecological sustainability and socio-economic benefits for the Socotrans.
- (ix) Promote environmental education outreach programs focusing on sustainable resource management and conservation, building on traditional beliefs and practices. These would be primarily aimed at the resource users, i.e. the fishermen, but would also target school children, women and local Government bodies.

(c) Target Areas Management

- (i) At each of the target areas of high conservation potential identified in Component 1, initiate in-depth dialogues with local villagers and resource users to understand the local social conditions and fisheries potential and constraints, including fishing rights, turtle exploitation and traditional fisheries management systems.
- (ii) Strengthen and adapt the island-wide activities in section (b) community-based fisheries management, to each target area, emphasizing iii, iv, v, vii, viii and ix.
- (iii) If necessary, work with the local communities to demarcate areas which need to be protected by temporary or permanent fishing ban, species and spawning aggregation protection, or limited access. Organize community watch systems to enforce protected areas regulations.
- (iv) At major turtle nesting sites and the villages nearby, launch turtle conservation programs, involving awareness campaign, research and monitoring of nesting turtles.
- (v) Develop alternative livelihood or other assistance as incentive or compensation for loss where necessary, building on activities in (ii). If it is an area with tourism potential, develop financial mechanisms including entrance fees, licensing and fines to assist the original fishermen, and to sustain management efforts beyond the project period (See component 4).
- (vi) Provide on-the-job training to Socotrans on long-term monitoring (fisheries and habitat status) and management.

- (vii) Monitor and document the social and ecological impacts of the marine protected areas, and disseminate successful stories to initiate replication elsewhere. Villagers who are convinced about these concepts will be encouraged to promote management practices to other villagers.

Project Component 4. Ecotourism

21. As an area of exceptional scenic value with its unique flora and fauna, the archipelago has a tremendous potential and attractions for eco/adventure tourism and scientific expeditions. Numerous requests and proposals from scientists in various fields to carry out inventory and research on the islands have been raised, but not materialized due to the islands' inaccessibility, language barrier and other logistic difficulties. Foreign and local public media, notably the BBC, a German TV and several major British newspapers (Annex 10), have reported on the natural history and conservation issues of Socotra and have aroused a great deal of interest on the islands both among scientists and the general public. Socotrans should be the key beneficiaries from ecotourism and scientific research, so that incentives for biodiversity conservation will be generated. Ecotourism profits and contributions from scientific expeditions will be channelled into the Socotra Conservation and Development Fund mentioned in Component 2.

22. Successful ecotourism and scientific expeditions require a cooperative approach between the private sector, scientific institutions, Government and the islanders, and should be developed in the context of the Master Plan and its zoning system. Control of tourism, especially that in the interior parts of the islands, should be initiated locally, and not by tourism developers and operators from outside. Scientific expeditions should be coordinated and supervised by the Technical Secretariat in Sana'a and the Local Management Committee (LMC) in Hadibo.

Issues and Obstacles:

- ▶ Lack of institutional framework, infrastructure and expertise in ecotourism development and limited experience in organization of scientific expeditions.
- ▶ Restricted access due to heavy monsoon from May to September.
- ▶ Possible conflicts between tourism development and traditional uses.

Activities to Remove Obstacles:

23. Develop an ecotourism management strategy for the islands, with specific guidelines for individual sites of tourism potential identified in Component 1, taking into account traditional land ownerships and user rights. In view of the short favourable season, the

fragility of the arid ecosystems and the cultural sensitivity of the tribal communities, both land and marine-based ecotourism on Socotra should be in the direction of high value, low impact. Off-track tourism involving bush camping and live-aboard diving/sailing which require little infrastructure on the islands will be preferable especially in the initial phase of the project.

24. Provide technical assistance to location selection and design of guest accommodation, transport and other facilities, to ensure minimal environmental impact. These should be specified in the management strategy. The actual infrastructural costs as well as external transport (i.e. construction of the airport and seaport, and subsidies for securing regular transport to the mainland) will be Government and privately funded.

25. Co-ordinate ecotourism activities with the Environmental Education Centre in Hadibo and the network of Environmental Extension Officers around the island (see Component 5). Develop marketing mechanisms through the Government tourism representative on Socotra island.

26. Establish regulatory and enforcement capability to control the impact of visitors, such as quota and seasonal restrictions. Regulate and control access and specimen collection carefully and monitor the impacts. Revise environmental guidelines and management regime to improve the situation when impacts are detected.

27. Develop economic mechanisms such as licensing or visitors fees to pay for recurrent expenses in managing the tourism areas. Channel income and contributions from visiting scientists into the Socotra Conservation and Development Fund to support conservation and environmentally related rural development activities on the islands. A society of scientists and conservationists, both local and abroad, may be established to further strengthen exchange of scientific findings and conservation experience and coordination of activities on the islands. Membership fees of the society could also contribute to the Fund.

28. Train Socotrans as nature guides and other support staff, with the help of staff at the Environmental Education Centre.

29. Promote small souvenir industries involving local women and traditional products such as pottery, frankincense and other natural gums, woollen rugs, palm mats, etc.

Project Component 5. Environmental Awareness and Education Program

30. In addition to the on-the-job or vocational training and awareness building exercises targeted for pastoralist and fishermen mentioned in project components 2 and 3, a comprehensive environmental awareness and education program is needed for all islanders. This is especially important for the younger generations as traditional practices may become erode or diluted by development and economic activities, and new challenges emerge.

Awareness building for mainland nationals is equally important in the process of integrating some of the traditional practices with modern management and Government policies. This program should be partly incorporated in the education program of the Master Plan under preparation with assistance from UNDP and other agencies.

Issues and Obstacles:

- ▶ Inadequate expertise in environmental awareness and education.
- ▶ Inadequate schooling facilities for wide dissemination of environmental education. The majority of the rural schools in the Socotran Archipelago are currently closed due to the lack of food, water and teaching supplies.
- ▶ Lack of comprehensive, user-friendly documentation on the traditional practices of the Socotrans in land-use and resource management.

Activities to Remove Obstacles:

31. Establish an Environmental Education Centre in conjunction with the LMC office in Hadibo for the general public, school children and tourists. In addition to a permanent educational display on the natural history, cultural heritage and sustainable resource management practices of Socotra, the education centre will also house interactive activities, training courses, workshops and social gatherings, and prepare educational materials for distribution to schools, villages and mosques. Building on the Ethnoflora of Socotra, develop targeted, user-friendly guides and materials needed for monitoring impacts from grazing and other pressures, and for the management of target areas. The centre will be run by a Senior Environmental Officer who would liaise with the relevant government authorities and departments, and regularly visit rural schools and villages.

32. Establish a network of Environmental Officers across the islands which reflects the present governmental administrative regions. These will be local pastoral/floral or fisheries experts who would be locally elected. They would report regularly to the Senior Environmental Officer at the Environmental Education Centre and would be responsible within their area for environmental education, supervision of environmental monitoring, planting and fisheries extension activities, regulated livestock management and the distribution of educational materials among the local population.

33. Train local teachers, especially the Baccalauriats who have already expressed interest in participating, basic ecology, environmental science, and awareness promotion skills.

Project Component 6. Institutional Strengthening and Capacity Building

34. A sustainable conservation project in Socotra requires not only an effective institutional structure on the islands, but also a great deal of national support in legislation, strategic planning and human capacity. The Archipelago is currently under the administration of the Aden Governorate, and has a local Governor and a few representatives of the Ministries on Socotra Island. The local village council system with locally elected village heads (*muqqadims*), *shaikhs* and the highly respected "wise men", play the key role of managing the islands. National support is still especially needed when addressing (i) legal framework and capability for the implementation of the Master Plan, (ii) export of endemic, threatened and commercially valuable species from Socotra and property rights issues, (iii) anticipated increase in exploitation of Socotran marine resources by foreign and mainland fishermen. Although Yemen does have a number of institutional strengthening related projects (Annex 8), there is as yet no international assistance tailor-made to address the above three issues upon which the viability and long-term sustainability of the present project for Socotra depend.

Issues and Obstacles.

- ▶ Inadequate national institutional capacity and technical expertise for conservation management of diverse ecosystems integrated with complex socio-economic issues and development needs.
- ▶ Lack of institution and human resources on Socotra Island with the capacity to develop and manage an island-wide integrated program for conservation and development.
- ▶ Legislative framework does not fully take into account traditional user rights and practices on Socotra and the protection of intellectual property right concerned with natural products.

Activities to Remove Obstacles:

(a) Institutional Building on Socotra

- (i) Work with the local Government and village council to establish a Local Management Committee (LMC) on Socotra Island for the planning and management of this project and other development, conservation and research activities on the islands. The LMC will be represented by the locally respected "wise men" and *shaikhs*, as well as Ministries representatives present on the island (e.g. Head of Education, Health, Port Authority). An office in Hadibo equipped with basic laboratory and computer equipment will be established, in conjunction with an Environmental Education Centre. The

full-time Chief Technical Advisor (CTA) at the LMC will provide technical and managerial advice to the LMC for planning and implementing project activities and other related initiatives.

- (ii) Organize workshops and gatherings for the regional village council leaders periodically to strengthen this local network which will play a major role in the planning, implementation and coordination of project activities and in mobilizing villagers to participate.

(b) Institutional Strengthening at National Level

- (i) Provide technical and managerial advice to the Technical Secretariat of the High Committee for Development of Socotra by the positioning of a full-time Technical Advisor in the Secretariat to work closely with the National Project Manager and the rest of the Secretariat members. The Technical Secretariat is an independent technical body composed of experienced national experts who advise the interministerial High Committee on technical matters concerning development and environment of Socotra. The Secretariat will serve as a crucial bridge between the policy making High Committee and the LMC which is responsible for the day to day work on the island. UNDP Yemen plays a major advisory role in the Technical Secretariat and will work with the LMC on the ground.
- (ii) Organize national workshops on protected area management, with case studies from representative protected areas abroad and discussions on their possible applications in Socotra.
- (iii) Enhance the information and technical capacities of national institutions involved in biodiversity conservation and resource management in Socotra, by providing them with relevant reference materials and actively involving them in the project. Provide herbarium equipment for national institutes actively involved in botanical research on Socotra.
- (iv) Develop database and GIS capability at the Technical Secretariat to store, analyze and present the ecological (terrestrial and marine), biodiversity, landuse and socio-economic information on Socotra islands. Transfer existing data on the vegetation and flora of Socotra Islands from the Royal Botanical Garden of Edinburgh into this GIS database, together with other available data on the fauna of Socotra. Input into the database legislation, bibliography, scientific institutions, researchers and development agencies concerned with Socotra. These GIS information will be made accessible to national and international researchers and resource managers, and will become an important longterm management tool for Socotra, both on the

island-wide and local scales. The databases will also be kept in Socotra where the data will be updated with additional survey results and other information.

(c) Legislative Framework

- (i) Develop the legislative framework needed for the implementation of the Master Plan for Socotra, especially on the regulatory mechanism and guidelines for development and exploitation in the different management zones. Also of particular importance is the regulatory mechanism on house constructions related to population growth and influx to the islands, as well as transmigrations within the islands which would put additional pressures on the natural resources of the islands. In the process, ensure the recognition of traditional land ownerships, user rights and traditional practices.
- (ii) Collaborate with the Biodiversity Enabling Activity project to identify "gaps" in the present national laws, sectoral legislation and their implementation which allow uncontrolled export of endemic and endangered species from Socotra, and violation of indigenous property rights. Assist the Government in revising the present legislation to fill the "gaps" identified.
- (iii) Review the implications of Government fisheries policy and regulations on industrial and subsistence fisheries around Socotra Islands. Propose needed legislative and institutional reforms or strengthening to sustainably manage the fisheries resources of Socotra area and protect the traditional fishing rights of the Socotrans.

(d) Training

- (i) Provide Socotrans and national staff responsible for the conservation management of Socotra with professional and technical training on conservation biology, coastal zone management, sustainable resource management, protected areas planning and management, GIS applications, environmental education and public awareness. Provide preparatory academic training to Socotrans prior to professional training where necessary.
- (ii) For customs and related officers, provide specialized training on the identification and export control of Socotran protected species and their products, and the import control of exotic species.

RATIONALE FOR GEF FINANCING

35. The high level of endemism of the plants found on Socotra Archipelago confers global biological significance on this island. Adding to this are the endemic bird species and reptiles and an unknown number of endemic invertebrates such as crabs and insects. The global importance of the Socotra Archipelago's biological significance has been long recognized by botanists and ornithologists from premier scientific institutions and organizations around the world (e.g. the Royal Botanic Gardens at Edinburgh and Kew, BirdLife International, World Wide Fund for Nature).

36. The marine biodiversity around Socotra Archipelago is globally significant due to its unique biogeographic features. Situated on the southern edge of the Arabian Sea and the north-western extreme of the Indian Ocean, the marine communities bear characteristics of both biogeographic regions. The co-occurrence of many species of reef fish from the two regions indicate a merge of the two biogeographic regions. The absence of their sister species, on the other hand, indicates that the communities are not simply mixtures of species from the two regions, but are unique to Socotra area. The shallow marine substrates of the Socotra Archipelago could play an essential role in maintaining gene flow between the Arabian region and the rest of the Indian Ocean, hence contribute significantly to global marine biodiversity.

37. In addition to its biological value, Socotra is also culturally important as it is the home of transhumant indigenous tribes which still maintain many traditional practices on resource management and landuse. The crucial point is that it is the continuing use of traditional practices by Socotrans which has preserved the island in its current state.

38. Yemen has signed and ratified the Convention on Biodiversity and has highlighted the importance of Socotra within the context of the National Environment Action Plan. Given the country's current financial and other resource constraints it is not possible for Yemen alone to undertake the necessary measures to ensure that its globally significant biodiversity is conserved. It is therefore the intention of this project to organize specific activities in which the global community can share the responsibility to conserve these unique species and ecosystems until Yemen itself is able to undertake conservation measures entirely or primarily with its own resources.

39. In early 1996, the Government has declared Socotra Island a special natural area in urgent need of protection, and has announced the allocation of YR 256 M (approx. \$ 2 M) for the initial infrastructure (transport) cost within of the longterm Master Plan for Development of Socotra Archipelago. The National Environment Action Plan (NEAP) was recently completed and approved by the Environment Protection Council of Yemen. In this document, the establishment of National Protected Area on Socotra was identified as one of the four priority actions of its Habitat Management Action Program.

40. There are tremendous basic needs such as health care, water supply, and education, to be met by the islanders. The many scientific expeditions and international aid agency missions have aroused hopes of development which have not subsequently materialized. This has caused discontent and resentment among the people of Socotra. Further delay of real actions will make implementations of project activities extremely difficult. The following paragraphs indicate the positive and pro-active responses now shown by the Government and international communities, and by the present proposal, to change the situation.

41. In mid 1996, UNDP Yemen prepared a Preparatory Assistance project document to assist the Government in the formulation and implementation of the Master Plan. UNDP Yemen will commit part of its upcoming Country Program funds into this process. The Preparatory Assistance project will focus on health, water and education which will contribute to rural development, environmental management and other components of the Master Plan, hence will complement well with the present GEF project focusing on biodiversity conservation. Together, the two projects will ensure that the Master Plan will indeed integrate biodiversity conservation with environmental protection and development.

42. The objectives and activities proposed in the present project are developed in line with the Biodiversity Operational Strategy, and specifically with the **two Operational Programs (i) Arid and Semi-Arid Ecosystems, and (ii) Coastal, Marine and Freshwater Ecosystems**. The activities of the project will focus on the conservation and sustainable use of the outstanding endemic biodiversity in the dryland ecosystems, as well as the coastal and marine biodiversity of global biogeographic significance.

43. The holistic approach integrating conservation and development, building on traditional resource management practices, and pooling expertise and resources from the various Government and international agencies (e.g. UNDP, UNICEF, WHO, FAO) during the development of the Master Plan for Socotra Archipelago, will maximize the outputs of the project in achieving global environmental benefits.

44. The economic analyses and marketing of certain alternative income activities to be undertaken during the project will serve as leverage to a broad spectrum of financial possibilities aimed at sustaining conservation activities and improving community livelihood. A series of other ongoing and planned projects and activities directly or indirectly relevant to Socotra, have been or are being undertaken by Government agencies, international development agencies and foreign scientific institutions (Annex 8). Of particular importance is the eight years of botanical, ethnobotanical and social studies carried out by the Royal Botanical Garden of Edinburgh. The various initiatives on Socotra have demonstrated a widespread interest and commitment for Socotra Islands which have contributed substantially to the formation of the present proposal and are expected to benefit and facilitate the implementation of the project.

SUSTAINABILITY AND PARTICIPATION

Government Commitment

45. The inclusion of Socotra as a priority in the NEAP's Habitat Management Action Programme confirms the Government's recognition of the urgent need for environmental management of Socotra.

46. The formation of the High Committee for Development of Socotra in January 1996 is an important breakthrough because until then, there were no clearly identified Government body with specific mandate for Socotra. The High Committee, chaired by the Deputy Prime Minister and Minister of Planning and Development, and consisting of the Minister of Transport, Minister of Construction, Housing and Municipal Planning, Deputy Minister of Petroleum, and the Chairman of EPC, will provide the essential, multi-disciplinary institutional framework upon which the present project will depend and develop. In turn, this five year project will strengthen this institutional framework to enable it to extend the project objectives beyond the project period. Together with community participation and empowerment, the sustainability of the project will be ensured.

47. The recent official recognition of the communally respected "wise men" and the responsible *shaikhs* of the locally defined administrative regions of Socotra managed by locally elected village council heads (*muqqadim*), indicates support from the Government for this traditional management system. The present project will build upon and strengthen this traditional system to ensure sustainability.

48. The Government's allocation of YR 256 M (approx. \$ 2 M) for the initial infrastructural cost of the Master Plan for Development of Socotra Archipelago is a clear sign of Government commitment for the development of Socotra. The transport infrastructure provided through this fund will facilitate the implementation of the present proposal tremendously. In kind contribution of the Government for this project is estimated at US\$ 500,000 and will cover the buildings of the LMC and the Environment Education Centre in Socotra, staff costs at the Technical Secretariat and LMC, as well as their transport cost.

49. The Government's request to UNDP and GEF for assistance in preparing the Master Plan, again indicates strong willingness and priority of the Government for environment, biodiversity conservation and social development of Socotra. The Master Plan will initially cover the first fifteen years of the development process of Socotra and will be extended subsequently. This long-term plan, with guidance and assistance from UNDP which has a longterm commitment for sustainable development and environment in the country, will provide the support for continued conservation activities beyond the project period.

Stakeholder Commitment

50. A vast number of persons, communities, and institutions was consulted during the formulation of this proposal. In brief, the consultative process included discussions with local Government officials including the local Governor, Socotran representative in the Parliament, representatives of the Aden Governorate under whose jurisdiction Socotra falls, Government fishing co-operative managers, Socotran fishermen, pastoralist, plant experts, teachers, merchants, medical staff and local leaders, representatives from various sectoral ministries, scientists, universities, bilaterals, local and international NGOs, UN agencies, Yemeni nature enthusiasts and the private sector. Annex 9 is a list of people consulted and some abstracts of the discussions.

51. Almost every single component of the project anchors on community participation. The institutional strengthening process of the project, for example, refers both to the Government and the village community structures on Socotra. Activities on the islands will be planned and implemented through the local village councils where local villagers will be the driving force of the activities. The design of the zoning system will be based primarily on traditional landuse coupled with natural habitats and biodiversity distributions. Information gathering during the biodiversity and social inventory will depend largely on consultation with local communities and village experts. The strongest community involvement and decision-making processes will be expressed through components 2 and 3, sustainable plant resource and marine resource management. Local villagers, be they pastoralist or fishermen, especially those in the target areas of the project, will take a leading role and be encouraged to undertake self-initiated activities such as planting of endemic and exploited plants, turtle conservation activities, or becoming education extension officers. Local communities will also be involved in all aspects of ecotourism development and will be the target group in the environmental awareness and education programme. The project will reach a large majority of the Socotran population through the Environmental Education Centre which will be located in Hadibo, the capital of Socotra, and will be open to the public.

52. The institutional strengthening process of the Technical Secretariat of the High Committee and of the Local Management Committee on Socotra, and the approach towards management decentralization, and public participatory efforts will also bring about sustainability of the project beyond the project period.

Financial Sustainability

53. Many of the project activities, such as ecotourism development, possible commercial uses of plant products, establishment of the Socotran Fishing Cooperative, and promotion of other alternative income generation activities, have high potential of bringing economic benefits to Socotra. The revolving funds, established by the local communities themselves or with the help of credit schemes initially, will pay for the recurrent costs of these activities.

54. The **Socotra Conservation and Development Fund** to be established through the project will capture some of the profits from the above activities, contributions (or research/expedition fees) from international scientific institutions with keen interest in Socotra, and possibly also licensing fees from non-Socotran fishermen, to support project activities and objectives in the long run. The amount of interest and commitment from the scientific and conservation communities is extremely encouraging.

55. The above mentioned Government commitments indicate strongly that Socotra is a priority for biodiversity conservation and sustainable development. The establishment of the inter-ministerial High Committee for Socotra chaired by the Minister of Planning and Development and the longterm Master Plan to be prepared specially for Socotra give good confidence to the conservation communities on the Government's longterm vision and responsibilities for Socotra, both politically and financially. The active involvement of the EPC and UNDP in the High Committee and the Master Plan will ensure the environmental soundness of the Master Plan and future development of Socotra.

56. The commitment and leverage effect of UNDP and interests from the donor communities will also enhance financially sustainability of the conservation and sustainable development objectives of the project both during and beyond the project period.

LESSONS LEARNED FROM TECHNICAL REVIEWS

57. The project has been under preparation during the past two years in close collaboration with scientists who have been conducting biodiversity research in southern Arabia for over a decade. The proposal thus benefits from an extremely strong scientific basis, and has benefitted from an interactive learning process throughout its development.

58. The first version of the proposal was drafted in March 1995 and was a preliminary project brief. The project brief was circulated extensively to those in scientific and donor circles who are familiar with the unique biological diversity of the Socotran Archipelago. The observations, critiques and suggestions received were subsequently incorporated into a new version of the project brief. This version was reviewed in Yemen by a UNDP chaired Project Appraisal Committee (July 1995), and a strengthened version was produced.

59. A new consolidated project proposal was produced in October 1995, and in November 1995, therefore, a first STAP technical review was conducted. Three STAP reviewers assessed the project. The reviewers made a number of recommendations, including: the inclusion of nurseries in the project to secure regeneration of endangered native plants; support to a feasibility study on eco-tourism; emphasis on the importance of transferring to Yemen the wealth of biological and botanical data which is housed in many international institutions in Europe as well as the need for training in the management of this data.

60. All reviewers stressed that any GEF initiative could not succeed unless non-GEF funding was made available to deal with development concerns specifically addressing the health, nutrition, transport and education concerns of the population.

61. Reviewers encouraged that scoping be done with respect to other island systems to ensure that lessons could be learned and mistakes avoided in the Socotra case. Reviewers made specific reference to St. Helena (UK - Atlantic), Galapagos (Ecuador) and Canary Islands (Spain - Atlantic). The activities which are presented in the project brief, therefore, builds on experiences learned in these and other island systems.

62. In addition, the reviewers encouraged active twinning arrangements be established both with an international institution as well as with a national institution (El-Kod). Moreover, the reviewers highlighted the importance of specifying further the kind of training and capacity building which the project would support.

63. All the comments and suggestions of these reviewers were then taken into full consideration by the mission which was fielded to Socotra in March 1996. The present project brief therefore reflects the many suggestions and constructive criticisms which the earlier drafts of the project received during preparation.

64. In view of the long preparation process, the present technical reviews (focusing respectively on the terrestrial and marine components) are therefore largely complimentary. One reviewer did request clarification with respect to the Government US\$ 2 million commitment. The text has been edited to clarify that the Government is committing a total of US\$ 2 million to then initial infrastructure (transport) cost of the Socotra Master Plan. The same reviewer is concerned about the time needed to build up the human resource capacity on the ground. This concern has been taken care of during the design of the project by placing a very strong emphasis on public participation, awareness and training for the Socotrans, active involvement of national experts, and institutional strengthening of the Government with the full time presence of the CTA in Socotra and the Technical Advisor in the Technical Secretariat. Furthermore, the twinning of this five year project with the longterm Master Plan (initially fifteen years) supported by a wider range of specialized agencies and donors, will carry the outputs and momentum of the project into the future.

65. Finally, one reviewer suggests that a technical advisory group be established which could meet every 12 - 18 months to review progress and priorities of the project. This mechanism is already part of UNDP monitoring procedures; the annual technical tripartite review meeting will indeed constitute both managerial as well as technical specialists, and will thus be able to monitor the progress of the project.

PROJECT FINANCING AND BUDGET

66. Of the total project cost of US\$12,957,900, US\$ 4,944,700 is being funded from the GEF. The indicative budget is included in Annex 1. In kind contribution from the Government is estimated at US\$ 500,000 for the buildings of the LMC and Environmental Education Centre on Socotra, and staff costs at the Technical Secretariat and LMC. As part of the Master Plan for Socotra, the Government of Yemen has already assigned YR 256 million (US\$ 2 million) for the building of the seaport, airport and roads, and for securing regular external transport. These transportation means are essential to the implementation and monitoring of the proposed GEF project. Numerous UN agencies including UNDP itself, are contributing to complementary activities that will help to ensure the success of the GEF project. Upon request by the Government, UNDP has engaged itself in a Preparatory Assistance (PA) Project of approximately US\$ 500,000 to assist the Government in formulating the Master Plan for Development of Socotra Archipelago. The downstream UNDP activities following the PA is estimated at US\$ 2 million, focusing on poverty alleviation and environment.

67. UNICEF, WHO and other agencies are expected to contribute a total of approximately US\$ 3 million towards education, rural infrastructure and public health. The British Government has confirmed the contribution of US\$ 13,200 for the building of traditional water catchment systems and plant enclosures. To ensure a successful conservation project for Socotra Archipelago, it is important to undertake some essential development activities in conjunction with the environmental conservation activities. GEF funds are not intended for this purpose, but as the GEF acknowledges that people's concerns must be taken into account in conservation initiatives, the GEF will be used in this case to leverage funds to pay for essential development activities instead of paying for them directly. The various alternative income development activities of the GEF project are aimed at overcoming the initial financial barriers over which the local communities will be able to sustain the activities.

INCREMENTAL COSTS

68. The incremental costs analysis, following GEF guidelines, is attached in Annex 1

ISSUES, ACTIONS AND RISKS

69. At present logistical difficulties exist in getting to the island, and, once there, getting around. Some of these difficulties cannot be overcome due to weather conditions. For approximately five months of the year, the island is not reachable by commercial airfreight or by sea due to the strong monsoon and the accompanying high winds and waves. However, while this will restrain a few of the project activities timewise, it is not expected to pose a

major problem, as the activities to be undertaken throughout the year will be implemented by local people and project staff who are residing on the island year-round. The Council of Ministers' allocated funds for external and internal transportation on the island, is a major breakthrough to solving the problems of transport. The implementation and monitoring of the project will greatly benefit from the above Government commitment.

70. Although Socotra has not been the focus of much attention, a number of missions to the island of various sorts have taken place over the years. Each one, because it is rare, has brought renewed hopes for assistance to the people of Socotra. Unfortunately, there is a general feeling that promises for assistance have not been kept and this has had a noticeable effect on the attitude of people. The present project will therefore involve local people in all aspects of decision making and in the implementation of the project activities, so that they are fully on board and are aware of any constraints, and can themselves help to address them accordingly.

71. There are anticipated and possibly unexpected environmental and socio-economic impacts on the islands caused by the upcoming development. The project is addressing these by working closely with the Government and UNDP in the formulation and initial implementation of the Master Plan so that environmental and socio-economic issues are taken into full account before and at the onset of development activities. The strong institutional and capacity building component, as well as the environmental awareness and education component are designed to install and develop the needed local and national capacity to tackle future challenges and changes without external assistance.

72. There is currently little coordination between Yemeni institutions with concerns relevant to this project. This is partly attributable to a general lack of necessary resources, few incentives, and little means to share results or accomplishments either within the country or abroad. The establishment of the GIS databases in the Technical Secretariat for the High Committee of Socotra, but open to use by national institutions and researchers, will promote data exchange and generate incentives for further studies and collaboration. Many institutions have lost essential equipment or the remaining equipment is in a state of disrepair and, as a result, have little means of conducting their day to day activities. The project will support these institutions to carry out the work of the project and will encourage greater collaboration and coordination among these institutions by providing the means in terms of essential equipment as well as meaningful incentives such as the means to publish and share information, both nationally and internationally. Twinning El-Kod Agricultural Research Centre with the Royal Botanic Garden in Edinburgh could be means of motivating staff and bringing it into the scientific community.

PROJECT IMPLEMENTATION AND INSTITUTIONAL FRAMEWORK

73. The project will be implemented by the High Committee for Development of Socotra, and specifically its Technical Secretariat which is a small Secretariat of national experts

experienced in resource planning and management, and devoted to the development and implementation of the Master Plan incorporating environmental and conservation objectives. The High Committee for Development of Socotra is chaired by the Deputy Prime Minister and Minister of Planning and Development, and consisted of the Minister of Transport, Minister of Construction, Housing and Municipal Planning, Deputy Minister of Oil and Mineral Resources, and the Chairman of EPC. Day to day implementation of project activities will rely on the LMC staff with advice and assistance from the CTA and National Project Manager, collaboration and active participation of the local village leaders, as well as substantial technical and political support from the Technical Secretariat and the High Committee.

74. Due to the multi-sectoral issues concerned with the project, a large number of Government agencies will be involved. Three of these agencies, Environmental Protection Council (EPC), General Directorate of Forestry and Desertification of the Ministry of Agriculture and Water Resources and Ministry of Fish Wealth are expected to actively participate in specific components of the project. Detailed descriptions of the mandate of these agencies are listed below.

75. Sub-contracts for specific technical services will be awarded to technical institutions within and outside of Yemen. As a general principle any sub-contracts with external institutions will specify closest collaboration with an existing institution in the country.

National Institutions

76. The Environmental Protection Council (EPC) is an inter-ministerial council with broad responsibilities to manage the nation's environment. The budget of the EPC is part of the Cabinet budget. As of 1995, the EPC is composed of a Chairman, appointed on a permanent basis, and Council members appointed on an ad hoc basis. EPC includes representation from the ministries with primary responsibility over natural resources management, or whose activities are potentially damaging to the environment. All Ministries, corporations, and authorities are obliged to follow the directives of EPC, each within its own mandate. The mandate of EPC encompasses: general policies to protect the environment, coordinate efforts of other national and international agencies, set up standards for control of air and water pollution and land degradation, formulate national environmental legislation and regulations and develop recommendations for ratification of international environmental agreements, and set up effective international cooperation and accommodate international environment funds, etc. In view of its central-coordinating role on environmental issues in the Government, its experience in formulating NEAP, the EPC will play an important role in the preparation of the zoning system for incorporation with the Master Plan.

77. The General Directorate of Forestry and Desertification (GDFD) is a Central Technical General Department at the Ministry of Agriculture and Water Resources, responsible for the country's forest and range resources. The GDFD has six directorates

including Natural Forests, Rangelands, Desertification and Afforestation, Nurseries, Watershed Management and a coordinating department. Each of the above directorate is composed of a number of sections at the regional level. The GDFD has close cooperation with development authority of projects and agricultural offices in Yemen, and has also established eight regional forestry sections responsible for field activities, but suffers from the acute shortage of trained professionals.

78. Ministry of Fish Wealth (MFW): The MFW has the mandate to manage the fisheries of the country. It has a research institute, Marine Sciences and Resource Research Centre (MSRRC) in Aden which has field offices in both Mukalla and Hodeidah, and will be running a new Coastal and Marine Environment Centre (CMEC formerly the Marine Pollution Centre) in Bureka, Little Aden. The MSRRC is currently supported by the EU Fisheries IV project through a full time Research Advisor and an Environmental Scientist.

79. El-Kod Agricultural Research Centre: The centre is under the Agriculture Research and Extension Authority of Dhamar which is under the Ministry of Agriculture and Water Resources. It was established in 1955. It currently has a herbarium containing approximately 900 specimens which are not well maintained due to the lack of financial resources and guidance to install sufficient cabinet and basic herbarium equipment. Researchers at El-Kod has succeeded in growing a number of plant species from Socotra and various areas of the mainland in its nursery. Given encouragement and initial guidance, the researchers at El-Kod can assist the Socotrans in establishing the nurseries and planting in the enclosures.

80. University of Aden: The University has developed interest to Socotra at early stages. The first scientific expedition took place to the Island was in 1980 with a team of highly experienced academic scientists. The survey included the whole Island of Socotra focusing on the physical, biological, social and agricultural components. A detailed scientific report of the expedition was published. Both the Faculty of Agriculture and Faculty of Education have showed interest in contributing to the tasks of this project, particularly on issues relevant the plant taxonomy and identification of Socotra endemic plant species. as well as to medicinal plants, respectively.

81. University of Sana'a: The Faculty of Agriculture has shown interest in conducting some of the socio-economic surveys together with locally hired people from Socotra. The Faculty of Science is very supportive to the present project and the marine scientists of its Oceanographic Department have shown keen interest in the marine surveys and monitoring.

External Institutions

82. Royal Botanic Garden in Edinburgh (RBGE): The RBGE is the world centre for the study of plants from the Arabian Peninsula, with many years experience in the region and is in a unique position to undertake botanical, ethnobotanical and conservation planning work

on Socotra. It has also built up a network of contacts with other institutes with interests in Socotra and with international agencies and organizations such as the WCMC, WWF and IUCN. Experts from the RBGE, undertook the botanical and social components of the project formulation mission⁸ for the present proposal. The team contributed substantially to the baseline information and design of project interventions of the proposal. It is hoped that it will work together with the national institutions and local communities on establishing the nurseries and enclosures proposed in the project and the subsequent monitoring, development of the Environmental Education Centre in Hadibo, preparation of the Traditional Resource Management Manual, and upgrading the herbarium at El-Kod Agricultural Research Centre

83. MacAlister and Elliott Partners (MEP): This consultancy company has been actively involved in the implementation of the EU/IDA/IFAD IV Fisheries project, especially in assisting the MFW in the fish stock management component which includes baseline inventory studies of the Gulf of Aden area, including the islands of Socotra and Perim. Three experts from MEP undertook the marine component of the project formulation mission⁹ in March 1996 for this proposal and contributed to substantial baseline information on the marine areas and fisheries aspects of the present proposal.

⁸ Miller, T. Morris, M. & Alexander, D. (cartographer) 1996. Mission Report (Terrestrial team) for the project formulation of the GEF/UNDP proposal "Conservation and Sustainable Use of Biodiversity of Socotra Archipelago, Republic of Yemen" (24 February - 17 April 1996).

⁹ MacAlister Elliott & Partners Ltd. 1996. Mission Report (Marine Team) for the Project formulation mission for GEF/UNDP proposal "Conservation and Sustainable Use of Biodiversity Conservation of Socotra Archipelago, Republic of Yemen" (24 February - 20 March 1996).

ANNEXES

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ANNEX 1: INCREMENTAL COST ANALYSIS

1. Broad Development Goals

Aware of the significant environmental problems facing the country, the Government of Yemen embarked on the development of a NEAP in 1991, with support of the World Bank and UNDP. The NEAP identified 19 priority actions under five categories: institutional, water resources, land resources, natural habitats, and waste management. The NEAP's Habitat Management Action Programme confirms the Government's recognition of the urgent need for environmental management of Socotra.

In January 1996 the Government formed the High Committee for the Development of Socotra chaired by the Deputy Prime Minister and Minister of Planning and Development and consisting of the Minister of Transport, Minister of Construction, Habitat and Municipal Planning, the Deputy Minister of Oil and Mineral Resources and the Chairman of the Environmental Protection Council (EPC).

In March 1996, the Government announced the allocation of the equivalent of \$2 million to Socotra for the construction of a seaport, upgrading of the airport and road-building as the most urgent activities in the process of formulating a Master Plan for Development of Socotra which will take into account environmental protection and conservation.

At the same time, UNDP was requested by the Government and agreed to provide assistance for the elaboration and implementation of the above mentioned Master Plan. UNDP has already committed its resources to the elaboration of this Plan as well as undertaken to provide initial funding for its implementation, from within its Country Programmes for poverty alleviation and environment.

Moreover, UNDP will play a central role in the coordination of a multilateral effort (involving UNICEF, WHO, FAO and others) ensuring the implementation of the various components of the Master Plan. By bringing a focus to the important conservation values in Socotra during the two year preparation of the present GEF project, UNDP has managed to leverage considerable interest from other non-GEF donors in the importance of the Socotra. This culminated in the International Conference on Socotra held in Aden in March 1996. The conference participants, consisted of scientists, donors and Government representatives, agreed on the extreme urgency of action for biodiversity conservation and sustainable development of Socotra. UNDP has since engaged with more donor agencies (AUS/ODA, Darwin Initiative and others), many of whom have expressed interest and willingness to commit resources to the implementation of the Master Plan for Socotra.

However, it is realized from all sides, that any development work to be carried out in Socotra must be done with a close view to the conservation and sustainable management of the fragile and unique ecosystems and natural resources upon which the people of Socotra has always depend.

2. Baseline

As the NEAP points out, there is not yet a Protected Areas Law in Yemen nor is there a regulatory framework for environmental management to support the 1995 Environmental Protection Law. Implementation of international treaty obligations is often beyond the capacities of the national agencies. In order to strengthen the institutional capacity of the Government of Yemen in the field of environment, the Government of the Netherlands has provided substantial assistance to the EPC which is currently seeking World Bank assistance to ensure future institutional support. In addition, a Biodiversity Enabling project has recently been approved by the GEF and this will go a long way towards ensuring that the EPC will have a better and fuller understanding of the biodiversity convention and the needed conservation measures.

The population of Socotra are acutely aware of the importance of sustainable management of their natural resources, vegetation and fisheries. Except for signs of localized overgrazing and overcutting, and a subtle decline in shark catches, the terrestrial and marine ecosystems of the archipelago represent some of the world's most undisturbed, pristine environments, largely due to the effective traditional resource management systems of the Socotrans. However, basic development needs, such as increasing demand for timber for local construction, fisheries development, road building and expansion of a few major coastal settlements, are likely to induce stress on the fragile and highly unique ecosystems and species of the Socotra Archipelago, unless a holistic plan is put in place early and implemented effectively.

The recent establishment of the High Committee for the Development of Socotra and the Government request to UNDP and GEF for assistance, indicate strong Government commitment for environmental protection and biodiversity conservation while promoting development of the islands. However the Government of Yemen has little financial capacity for conservation efforts on the Socotra archipelago where basic development needs of its people are yet to be met. In spite of severe resource constraints, the Government has set aside \$2 million to ensure the development of basic infrastructure needed for external and internal transport of the islands, and is ready to provide in kind contribution, estimated at \$ 500,000, to the GEF project in staff and management costs at the national and local levels.

Moreover, UNDP is committed to assisting the Government of Yemen prepare the Master Plan, and to elaborate especially on the rural development, social and environment components such as water supply, sanitation and alternative energy development. In addition, UNDP's leveraging and coordination role will bring together multilateral efforts (involving UNICEF, WHO, FAO and others) in taking care of the various development needs of the islands (such as health program by WHO, education and mother and child care by UNICEF, diet improvement by FAO). WHO is already developing a malaria control program for Socotra. All these will form a broad baseline upon which the present GEF project will manifest to secure the global biodiversity benefits in the process of development.

3. Global Environmental Objective

The flora of the Socotra Archipelago is of outstanding global significance. Over a third of its plant species are found nowhere else, ranking it amongst the top ten island groups in the world. Many of these endemics are remnants of ancient floras which long ago disappeared from

the African-Arabian mainland. Others have evolved bizarre growth forms making the Socotran landscape one of the worlds most remarkable. What makes Socotra of even greater global significance is that unlike most other island groups its environment has remained virtually untouched by modern development. There is no evidence of recent extinctions and the vegetation appears unchanged since the island was first explored by botanists in 1880.

Situated where the Arabian Sea merges with the Indian Ocean, the marine communities of Socotra Archipelago demonstrate distinct biogeographic characteristics of the two major biogeographic zones. The fact that in key fish indicator groups, only species belonging to one or other of the biogeographic zones are present while their sister taxa being absent, indicates that the marine communities are unique and well-established. Although much of the Somali coast is still to be explored, the varied shallow marine substrate of the Socotra Archipelago are believed to be highly significant in maintaining gene flow between the Arabian region and the rest of the Indian Ocean. Their present pristine state, unaltered by coastal pollution or exploitation, is remarkable and suggests that unwitting alteration or careless development could have considerable regional or even global impact on marine biodiversity.

Socotra has already been identified as a national priority site needing major conservation efforts, in the March 1996 Workshop on the Biodiversity Convention, organized by the EPC with support from IUCN. In the NEAP - National Environment Action Plan completed in May 1996, the establishment of Socotra as a National Protected Area, the first of the country's, was listed as one of the four priority actions of its Habitat Management Action Program.

The global environmental objective of the project is to prevent and reduce the possible loss of endemic and globally significant biodiversity of Socotra in the course of development, by putting in place a holistic Master Plan with a defined zoning system for management, promoting community-based, sustainable use of natural resources thereby alleviating pressures on the fragile natural resources and environment, and creating and strengthening the national and local institutional and human capacity needed for the sustainability of the project's longterm environmental objectives.

4. GEF Alternative

The GEF contribution to the present project will lay an important foundation for ensuring the conservation of the globally significant biodiversity of Socotra. The project weaves biodiversity conservation objectives with development priorities (infrastructural, health, education, etc.) into a holistic programme of management actions for the archipelago. The project builds on traditional land and resource management systems which have kept the ecosystems at a prime state for centuries, and work closely with the communities who are the principal natural resource users. Such traditional organization structures have recently been officially endorsed by the Government.

Building on the baseline resources and collaborating with other agencies, the GEF will provide the incremental costs needed to secure the global biodiversity while integrating conservation efforts with development. The strategy of the project will be from both the site level by concentrating conservation efforts at target areas with recognized global biodiversity and threats, and at the island-wide level by actively designing the zoning system of Master Plan and

supervise other policy framework for sustainable development of the islands. Efforts will also be given to strengthen the national institutional capacity needed to support many of the key environment and development issues of the islands. Costs of these activities at all three levels are incremental.

In view of the complex environmental and social economic issues of the archipelago, the project is designed in six components; (i) Establishment of a Zoning System for Natural Resource Management; (ii) Sustainable Plant Resource Management; (iii) Sustainable Marine Resource Management; (iv) Ecotourism; (v) Environmental Awareness and Education; and (vi) Institutional Strengthening and Capacity Building. The zoning system of the Master Plan will provide the legal and management framework for constraining development impacts on the environment and biodiversity by regulating land use, infrastructural development, and population transmigration both between the islands and the mainland and within the islands. The components on sustainable plant and marine resource management emphasize on target areas management by the local people while maintaining also an island-wide approach. Specific threats such as overcutting of timber species, overgrazing, turtle exploitation, shark fisheries and potential overexploitation of commercial plant and marine species, will be targeted by these two components. The key here is community based resource management with strong conservation objectives supported by incentives from improved livelihood and alternative income. The latter is also generated from ecotourism development which will also supply the Socotra Conservation Fund to enhance financial sustainability of conservation initiatives. The components on awareness and institutional building are crucial to the longterm sustainability of the project and more importantly, its longterm, global environmental objectives.

5. System Boundary

The islands share a number of endemic plant species and have their own also. The reef fish communities demonstrate subtle composition changes from the westernmost island Abd-al Kuri to the east, Socotra Island, but are noticeably different from those of the mainland. The project therefore recognizes the Socotran Archipelago as a single, high priority, conservation area that require concerted actions.

The project considers the physical system boundary to be the islands of Socotra, Abd-al Kuri, Samha and Darsa, their coastal habitats and shallow seas round each of the islands. In terms of marine biodiversity, the inshore areas of less than 20m deep will be the focus of the project where the zoning system will apply. However a larger area from the shore (beyond the 20m contour) will be included in the project to tackle mainly the exploitation pressures from outside fishermen.

The system boundary therefore encompasses all present and anticipated threats of both local and external origins. The threats identified as already present are cutting of timber species for house building, localized overgrazing mainly on the coastal plain, overfishing of sharks and turtle exploitation. Threats which may emerge with development include over-collection of commercial plants, overfishing, and environmental degradation from settlement expansion and construction work including road and port building. The underlying causes to the above listed threats are the gradual breakdown of traditional resource management systems and rapid development without environmental considerations. The project is designed specially to tackle

these two root causes as explained in section 4.

6. Incidental Domestic Benefits

The domestic benefits envisaged will be largely of a "risk" removal nature as successful implementation of the project will prevent depletion of pasture and marine resources upon which the local people depend for living. Measurable benefits arising from income generating activities to be promoted by the project (e.g. non-timber plant products and ecotourism) are only expected to yield benefits to the island population. This is especially true based on the poverty level and development needs of the islands and limited capacity of the Government to meet these demands. The absorptive capacity of the islands is large, leaving negligible economic benefit at the national level. In terms of fisheries, GEF resources will only be used to develop sustainable management strategies and capacity, targeting mainly at ecologically significant taxa such as sharks, and at the protection of habitats needed to support unique communities of biogeographic significance. Any incidental additional benefits gained from fisheries development are likely to be absorbed mainly by the islanders, and will also serve as one of the incentives of reducing pressure on the very limited terrestrial resources.

7. Costs

The GEF contribution is \$4,944,700 allocated as follows:

Zoning system for Natural Resource Management	\$ 530,820
Sustainable Plant Resource Management	\$ 1,034,500
Sustainable Marine Resource Management	\$ 1,027,600
Ecotourism	\$ 248,000
Environmental Awareness and Education Programme	\$ 451,500
Institutional Strengthening and Capacity Building	\$ 1,162,200
Project Support Services	\$ 490,080
Total	\$ 4,944,700

8. Incremental Cost Matrix

See below.

9. Agreement

Details of the technical content of the programme have been negotiated with the government of Yemen during the two year preparatory period starting with an initial mission to Socotra in March 1995.

Benefit category	Beneficiary/ stakeholder group	Baseline activities B	Alternative A	Incremental activity (+)/ cost (-) A - B
Global benefits	Global	<p>1. Limited, uncoordinated biodiversity & habitat inventory and monitoring.</p> <p>2. Traditional landuse practices protect the environments of Socotra which harbour unique ecosystems & species. Such management system is now put to the test of development.</p> <p>3. Traditional resource management practices protect vegetation & plant species from overgrazing & overcutting to some degrees.</p> <p>4. Traditional fishing practices & limited market access has prevented overfishing & habitat destruction of the marine environment.</p> <p>5. Limited institutional & human capacity for conservation management at both national & Socotran levels.</p>	<p>1. Augmented biodiversity & habitat (both terrestrial & marine) inventory & monitoring to provide sound bases for biodiversity management, early detection of impacts & initiation of remedial actions.</p> <p>2. Habitats with significant biodiversity protected effectively by implementing a zoning system in the Master Plan (covering terrestrial, coastal & marine ecosystems), with clear management guidelines, building on scientific knowledge base & traditional management practices.</p> <p>3. Enhanced protection & sustainable use of plant resources by strengthening traditional management practices & provision of alternatives, initially launched at target areas of recognized global biodiversity.</p> <p>4. Enhanced protection of the unique marine ecosystems of global biogeographic significance through sustainable, community-based fisheries management, strengthened fisheries control & effective habitat protection by means of the zoning system of the Master Plan.</p> <p>5. Strengthened institutional & human capacity at both national and Socotra levels by provision of technical advice, training, & equipment as conservation management tools. Extensive awareness & education program throughout the islands to promote biodiversity conservation & sustainable resource use.</p>	<p>+ d1</p> <p>+ d2</p> <p>+ d3</p> <p>+ d4</p> <p>+ d5</p>

Domestic benefits	National private and social	6. Subsistence fisheries limited by the lack of storage facilities, steady buyers and an island-wide management capability over non-local fishermen.	6. Improved livelihood & income of Socotrans through sustainable fisheries development by (i) establishing the information base on fisheries from stocks assessment; (ii) protection of spawning grounds; (iii) organizing a fishing cooperative with the capability of storage, management, price control & catch regulations (iv) resource diversification; and (v) building of control & surveillance capacity over non-local fishermen, with funds leveraged by the project.	+d6
		7. Subsistence level of plant resource use based primarily on livestock & limited harvest of plant products.	7. Sustainable plant resource use & development through regulated grazing, timber & firewood extraction, & planting, processing & marketing of plant products. Provision of related training & extension services.	+d7
		8. Limited tourism.	8. Extended ecotourism focusing on adventure tourism, research expeditions, & live-aboard diving, with minimal environmental impacts & maximum benefits to the local communities. Income also feeds into the Socotra Conservation Fund to generate financial sustainability.	+d8
		9. Limited environment, health, water and education programming.	9. Leveraged, coordinated efforts with stronger emphasis on environment & conservation, through important spearheading & coordination.	+d9

Domestic costs to secure global benefits	Private and social	10. Formulation costs of the Master Plan, with limited considerations on environmental protection and conservation.	10. Formulation costs of the zoning system within the Master Plan (involving biodiversity and landuse & ownership inventories & environmental assessments) to minimize impacts on globally significant biodiversity during the implementation of the Master Plan.	\$530,820
		11. Management of plant resources (timber, grazing pasture, firewood, & others of medicinal & industrial values) by traditional practices vulnerable to impacts from development and socio-economic changes.	11. Costs to strengthen and adapt traditional plant resource management practices to prevent biodiversity loss during development by (i) setting up enclosures & nurseries for regeneration & planting (ii) awareness & consensus building for sustainable livestock & plant resource management; (iii) building the local capacity for vegetation monitoring to detect impacts from overgrazing & overcutting, & generate community actions to counteract problems; (iv) alternative income & supportive development activities leveraged by the project; & (v) reduction of pressure on natural vegetation by imported timber & alternative energy development. Activities (i-iv) focus on target areas with recognized global biodiversity; (iv-v) at island-wide level.	\$1,034,500
		12. Costs of minimal fisheries management & resource protection currently undertaken by village groups & without control of fishing by non-Socotrans.	12. Development & implementation costs of sustainable marine resource management involving (i) target areas management with strong emphases on biodiversity conservation such as turtles; (ii) habitat protection for important biodiversity from coastal development & destructive fishing; (iii) environmental monitoring to detect impacts & initiate timely remedial actions; (iv) fisheries control & management focusing on declining species of important ecological role such as sharks; & (v) activities in items 5-7.	\$1,027,600

		13. Costs of minimal infrastructure and logistics for ecotourism.	13. Costs of comprehensive planning, initiation, monitoring & training on ecotourism development to minimize ecological impacts and disturbance to species of global significance.	\$248,000
		14. Costs of minimal environmental educational activities targeted on health & environment.	14. Costs of establishing an Environmental Education Center and a network of Environmental Officers, production of educational materials, & awareness promotion activities.	\$451,500
		15. Costs on building the institutional capacity needed for the implementation of the Master Plan, covering basic environmental & development needs, education & health facilities.	15. Costs of institutional & human resource capacity building essential to the longterm sustainability of the project & its global environmental objectives through (i) establishment of a Local Management Committee (LMC) on Socotra Island to implement the project & future activities; (ii) technical & advisory support to the LMC & Technical Secretariat of the High Committee for the Development of Socotra; (iii) enhancement of the technical capacities of national institutions involved in conservation activities in Socotra; (iv) regular workshops & gatherings among regional village council leaders; (v) professional & technical training on conservation & resource management; & (vi) development of legislative framework for the zoning system of the Master Plan to minimize resource use conflicts, regulate population transmigration & protect traditional rights, landuse & resource management.	\$1,162,200
			16. Project support services needed to effectively implement the project.	\$490,080
Incremental cost				\$4,944,700

Note: + d = delta signifying an incremental change in the provisions of an activity as part of the project.

INDICATIVE BUDGET

Component	Staff Costs	Sub-contracts	Equipment	Training	Misc	Total Cost US\$
1. Zoning System for Master Plan						
1.1 Terrestrial Biodiversity & Social Surveys	20440	148400	0	0	82000	250840
1.2 Coastal & Marine Biodiversity & Social Surveys	33800	139000	3000	21000	10000	206800
1.3 Preparation of zoning system	6680	0	15000	0	1500	23180
1.4 Monitoring	0	0	0	0	50000	50000
						0
GEF Contribution	60920	287400	18000	21000	143500	530820
						0
2. Sustainable Plant Resource Management						0
2.1 Target Area Management	547000	123000	77000	0	0	747000
2.2 Planting of endemic exploited species	13300	50000	24500	77000	10000	174800
2.3 Income generating activities	3000	28700	2000	8000	2000	43700
2.4 Alternatives for native timber & firewood	0	9000	0	0	0	9000
2.5 Training and Outreach	0	0	8000	10000	2000	20000
2.6 Monitoring	0	0	0	0	40000	40000
						0
GEF Contribution	563300	210700	111500	95000	54000	1034500
						0
3. Sustainable Marine Resource Management						0
3.1 Target Area Management	397000	0	310000	33200	35000	775200
3.2 Guidelines & monitoring for development & exploitation	0	20000	12000	8000	42000	82000
3.3 Community-based fisheries management	11800	38600	80000	30000	10000	170400
						0
GEF Contribution	408800	58600	402000	71200	87000	1027600

531

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1.028

Component	Staff Costs	Sub-contracts	Equipment	Training	Misc.	Total Costs US\$
4 Ecotourism						0
4.1 Ecotourism management strategy	0	120000	0	0	9000	129000
4.2 Training	0	0	0	32000	4000	36000
4.3 Monitoring	5000	0	60000	12000	6000	83000
GEF Contribution	5000	120000	60000	44000	19000	248000
5 Environmental Awareness & Education Program						0
5.1 Environmental Education Centre	12000	87500	120000	13000	23000	255500
5.2 Environmental Education Extension	6000	0	70000	96000	0	172000
5.3 Printing and Publication	0	0	6000	18000	0	24000
GEF Contribution	18000	87500	196000	127000	23000	451500
6 Institutional Strengthening & Capacity Building						
6.1 Institutional building (Socotra & Mainland institutions)	615000	0	242000	69200	10000	936200
6.2 Legal framework	0	78000	0	0	0	78000
6.3 Training	0	0	0	143000	5000	148000
GEF Contribution	615000	78000	242000	212200	15000	1162200
TOTAL GEF CONTRIBUTION	1671020	842200	1029500	570400	341500	4454620
Project services support						490080
TOTAL						4944700
Government of Yemen (In kind contribution)						500000
Government of Yemen (Transport development for Socotra)						2000000
UNDP						2500000
UNICEF, WHO, others						3000000
British Government						13200
GRAND TOTAL						12957900

Note: i) UNDP contribution through Preparatory Assistance Project to prepare the environment and community development component of the Master Plan for Development of Socotra Archipelago. The exact amount of the PA will be confirmed in August 1996.

The downstream funding from UNDP's upcoming Country Programme for Socotra is estimated at US\$ 2 million.

ii) UNICEF, WHO & others will contribute to education, infrastructure development and health care programmes in parallel with the Master Plan.

LETTER OF COUNTRY ENDORSEMENT BY DESIGNATED OPERATIONAL FOCAL POINT

(See Following Letter)

Republic of Yemen
Ministers Council
Environment Protection Council



الجمهورية اليمنية
مجلس الوزراء
جس حماية البيئة

Ref. () Date / / 19

تاريخ (١٩٨٨) التاريخ ٥ / ٥ / ١٩

Mr. Önder Yücer
Resident Representative
UNDP - Sana'a

In view of the globally significant plant and marine biodiversity of Socotra Islands, the Government of Yemen would like to request UNDP assistance in securing GEF funding for a project which will address the issues of conservation and sustainable use of the unique biodiversity of Socotra Islands.

With best regards.

UNDP SANA'A RECEIVED				
ON 27 MAY 1990				
NO	INFO	ACTION	DATE	INITIALS
RR				
DPR				
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ACTION TAKEN				
FILE NO. PRO/300/Socotra				
FILED BY:				

Mohsin Al-Hamadani
Chairman



TECHNICAL REVIEW (MARINE COMPONENT)

REPUBLIC OF YEMEN:
CONSERVATION AND SUSTAINABLE USE OF THE BIODIVERSITY
OF SOCOTRA ARCHIPELAGO

R. A. Kenchington
Senior Director, External Services
INTROMARC, Canberra, Australia

Overall impression

1. The proposal has been well prepared and is well presented. It clearly addresses an area of undoubted global significance in terms of terrestrial and marine biodiversity which are both currently in good condition.
2. The proposal addresses an opportunity to put in place a management regime which could avert damage which will otherwise occur with rapid population growth, accompanying resource demand and consequent threats of over exploitation of terrestrial and marine resources of the Socotra Archipelago.
3. The project is worthwhile. It will be challenging to implement.

Relevance and priority and background and justification

4. I am satisfied that the proposal. The mission reports establish a high priority in terms of the criteria of the conference of parties to the biodiversity convention and that this is recognised in national priorities of the Yemen Government.
5. There is a clear need for the project and the proposal and mission reports identify a situation in which such a project is particularly timely as the socioeconomic situation is likely to deteriorate and the threats to the biological diversity of the Socotra archipelago are likely to increase over the next ten years unless action is taken.

ANNEX 3

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Scientific and technical soundness

6. The material presented in the proposal and the marine team mission report is scientifically and technically sound. It indicates an environmental situation of great

interest and biogeographic significance. More specific consideration is given below in discussion of actions.

Objectives

7. The long term objective of the project is valid and relates clearly to the objectives of the Biodiversity Convention. The specific project objectives are valid.

8. It might however help to extend the environmental awareness and education objective to bring out the purpose which is to have the people of the Archipelago aware of, committed to and actively involved in the protection of their natural resource base and heritage.

Activities

Project component 1 : Zoning system for the master plan for development of the Socotra Archipelago

9. The approach and the coastal and marine biodiversity and social inventory activities are sound.

10. The outcome for the inventory activities should be designed to achieve a clear picture of the constraints and opportunities for management overall and for the various uses and activities which stakeholders may wish to undertake. With such a clear picture the development of zoning should be a reasonably transparent, rational and arguable process.

Project component 2: Sustainable Plant Resource Management

11. This is generally beyond my area of expertise. I note the importance of achieving sustainable plant resource and land use management and also note that the obstacle of there being little alternative for islanders is a general constraint which applies to the whole of the Socotra project.

Project component 3 : Sustainable marine resource management.

12. The activities appear well conceived. It will be particularly important in implementation to ensure that the emphasis on sustainability is enshrined as the central principle of management. It will be equally important to develop and implement policing and regulatory mechanisms to ensure that local management is not rendered irrelevant by outsider plundering of stocks.

13. As a tactical matter it should be noted that stock assessments, unless carefully managed and controlled, can trigger outside interest and encourage unscrupulous deals. It should similarly be noted that, unless carefully managed, the provision of cold store and freezer facilities can stimulate over fishing. It will be important to ensure that robust control systems are in place before major technological change is introduced.

Project component 4 : Eco Tourism.

14. Although there is clearly some potential for eco tourism in the Socotra Archipelago the field reports suggest that the potential is limited to a short season and to a highly specialised market. The activities appear reasonable but it could be suggested that some activities may pre-empt the outcome of market research and the development of a solid tourism strategy. I suggest an emphasis on the first two years on market research and development of a management strategy with a commitment to review and make specific decisions before proceeding with the other activities.

Project component 5 : Environmental awareness and education program.

15. In many ways this is the key to achieving conservation, sustainable development and protection of the unique biological diversity of the Socotra Archipelago. As mentioned earlier, the time frame for complete professional training is so long that for much of the next decade real protection must depend on the development of attitudes and capacities for local action at the village level.

Project component 6. Institutional strengthening in support for global biodiversity of Socotra.

16. The field report of the marine mission indicates that Socotrans are unaware of current national law. It seems to me that the most fundamental issue to be addressed is the 6th listed- No institution and human resources on Socotra Island with the capacity to implement national legislation. This is equalled or very closely followed by the 4th listed - Inadequate national institutional capacity.

17. While creating new legislation is important it will achieve nothing if the issues of implementation and enforcement are not clearly and urgently addressed. Addressing these issues may take longer than the development of legislation. I would thus place the institutional strengthening activities before the legislative reform and suggest a new sequence for the issues and obstacles and a consequent reordering of the activities.

18. Although it is listed as a separate activity stream, training must be seen as a critical element in the process of institutional strengthening. The discussion of training is valid and activities should be initiated urgently. **The Socotran situation appears particularly difficult** because of the low level of education of the local population. Because of this it must be borne in mind that the time to produce significant numbers of graduate or expert staff with any local association or familiarity with Socotra would be very long. In the immediate future the development of understanding and the capacity to take action at the local level by the local community will be absolutely critical to providing a foundation for implementation and long term success of the project.

Participatory aspects.

19. The project proposal has been developed with a strong element of stakeholder, particularly regional village community, participation in management. My comments above suggest that the importance of this role must be clearly supported through practical training at a scale and in a style which will communicate as directly as possible with the leaders and key individuals in the community. The essential point is that the leaders and the community must see themselves as owners and partners in the initiative and not simply as the means to implement a program developed elsewhere.

Global Benefits.

20. These have been covered in earlier comments but they can be summarised as high global benefits because of the high levels of endemism of the flora and fauna of the Socotra Archipelago, and the potential to develop a sustainable management regime before serious deterioration occurs.

GEF Strategies and Plans.

21. The proposal clearly reflects the considerations in developing operational programs outlined on pages 17-19 of the GEF Operational Strategy and directly addresses the objectives of the operational programs for arid and semi arid eco systems and for coastal and marine ecosystems. In relation to the marine environment, the Republic of Yemen

has identified Socotra as a potential priority marine protected area. This has been reflected in the report "A Global Representative System of Marine Protected Areas" (Kelleher et al 1995).

Repeatability.

22. The project addresses many of the characteristic issues of isolated island groups in which high levels of endemism, a limited resource base for socio economic development, and limited education levels of the local population are features. Successful implementation would add to the range of available models which could help to persuade

other small island and isolated communities seeking to secure the social and economic benefits of sustainable management and caring for their environment and resource base.

Capacity Building

23. The project directly addresses the UNDP GEF requirement to build or strengthen capacity to enable national bodies to handle the management tasks into the future. The actions proposed are reasonable but as noted earlier it is likely to take considerable time before they flow through into substantially increased capacity on the ground in Socotra. Also as noted earlier, it is important to parallel strengthening of national bodies with strengthening of the awareness and capacity of local communities. I believe the project provides the basis for doing both of these tasks.

Project Funding.

24. I have no detailed understanding of the costs of operating in an environment such as Socotra. With that qualification I accept that the overall level of funding appears to be appropriate.

25. I am somewhat concerned at the relative proportion of funding which is to be addressed to developing community information, education and management capacity. It may be the case that these issues are to be addressed with non-GEF funding.

26. Components 2, 3 and 4 have allocated funds for training, and outreach and community based management. Given the scale of the archipelago and the number of communities this appears to be inadequate. In component 5, nothing is allocated for extension. It is not clear what proportion of the funding for Institution Strengthening may be intended for community level activity. I would appreciate a short paper outlining measures and budget provisions to ensure that the training and education reach the communities at a practical level.

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27. One element of the program funding which is unclear is the role of the Yemen Government allocation of YR256M (approx. \$2 million). In paragraph 60, it appears that this amount of funding is being allocated for development of the master plan for Socotra. In paragraph 62 an identical sum of money is referred to as being allocated for the building of a seaport, airport and roads. Is there one package of YR256M or are there two?

Time Frame.

28. The objective of creating a zoning system for the master plan for the development of the Socotra Archipelago can clearly be achieved within the timeframe of the project. The other objectives refer to the establishment of programs which will have to run in perpetuity if the overall project objective is to be achieved. It must be recognised that to have a substantial capacity in place and operating on a sustainable basis will require a program considerably longer than five years. This is not to suggest that the project is poorly constructed or should not be strongly supported but rather to reflect that issues of environmental management and ecologically sustainable development require major institutional and attitudinal development which generally requires significant time to become a strongly accepted entity. By way of comparison I would note that even under the most favourable, economic and educational and public support circumstances it took over a decade for the institution building, training and implementation arrangements for the Great Barrier Reef Marine Park to become firmly established and accepted as part of the fabric of Australian society. I make this point to merely emphasize that it would be naive to expect that at the conclusion of a 5 year program the problems would have been fixed and that no further activity will be required.

Secondary Issues.

29. The activities of the project are obviously relevant to the broad objectives of the GEF international waters program. The linkages are not particularly close because most of the actions relate to the management of activities within the territorial sea and the EEZ of the Yemen.

30. There are linkages to other programs. As mentioned, the Socotra Archipelago is identified as a candidate site for a national contribution by Yemen to the Global Representative System of Marine Protected Areas (Kelleher et al, 1995). The area falls within the ambit of the Red Sea Gulf Region in the context of the UNEP Regional Seas Programme. Successful implementation of the project would provide a useful demonstration site and project for both of those programs. The broad concept of the project is not particularly innovative in that the concept of achieving conservation and sustainable use through integrated management, the involvement of stakeholder and the establishment of protected areas has been well accepted since the United Nations Stockholm Declaration in 1972. The specific issue of the Socotra will involve innovative approaches to working with the particular communities, social structures and resource usage patterns of the Archipelago.

Additional Comments.

31. I have provided a detailed technical review. I believe the project is a good one and would encourage GEF partners to support it. From experience, the dynamics of such projects can be hard to predict. Particularly where stakeholder involvement is critical, it may take some months or even years to reach the point at which a community is prepared to accept the necessary role in the management of their environment and resources. Once that acceptance has been reached there can be rapid progress. I believe that there could be merit in a proposal of this scope to have a technical management advisory group which could meet perhaps every 12-18 months to review progress and priorities in the light of experience.

R A Kenchington
Senior Director
External Services
13 June 1996

TECHNICAL REVIEW (TERRESTRIAL COMPONENT)

**REPUBLIC OF YEMEN:
CONSERVATION AND SUSTAINABLE USE OF THE BIODIVERSITY
OF SOCOTRA ARCHIPELAGO**

Peter H. Raven
Director
Missouri Botanical Garden
St. Louis, Missouri

1. OVERALL IMPRESSION

This is a comprehensive and exemplary project that deals with a very important area for biodiversity conservation. The project has been thoroughly thought out and considered in all aspects, including not only achieving an appropriate level of validity of the information to be gathered initially, but also a careful consideration and the development of a well thought out strategic plan for the implementation of this project. It is one of the best projects of its kind that I have ever reviewed, whether for GEF or other bodies.

2. RELEVANCE & PRIORITY

This is a very high priority project that deals with one of the most remarkable sets of plants in the world and one for which, given the relatively undisturbed state of Socotra, there is a very high probability for conserving adequately the biodiversity involved. In addition, it is clear that the surveys proposed in the early stage of the project will reveal the presence of additional highly endemic biodiversity that also ought to assume a reasonable level of conservation priority. In absolute terms this must be one of the most significant projects being proposed for terrestrial biodiversity anywhere (and I am emphasizing terrestrial biodiversity, as requested). What is really impressive about it, however, is the degree of preservation of that biodiversity now and, therefore, the high feasibility of achieving the desired results if the project is funded and implemented.

3. BACKGROUND AND JUSTIFICATION

Absolutely sufficient background and justification have been provided for this project in very nice concise format, which makes it easy to understand the dimensions of the problem and the strategies with which it is to be approached. It is very clear from the financial

commitment made by the government of Yemen to this program that it is highly (and appropriately) ranked within the national priorities and commitments. There is certainly a clear presentation of why the project should be undertaken, including an analysis of the priority needs involved, the threat to that biodiversity, and the existing institutional situation. As I have stated above, this is a truly excellent proposal, in my view.

4. SCIENTIFIC AND TECHNICAL SOUNDNESS

This project is as scientifically and technically sound as I can imagine, drawing heavily on both domestic and international expertise and well rooted in extensive investigations that have been made in the past. I can find no doubtful statements anywhere in it.

5. OBJECTIVES

Absolutely valid objectives, well thought out and characterized, and individually and collectively well formulated. The objectives can certainly be achieved within the activities as outlined. I was particularly impressed with the degree to which this project would strengthen national entities concerned with Socotra and biodiversity, generally, and the many realistic ways in which it looked towards (e.g., ecotourism) the long-term funding of these activities.

6. ACTIVITIES

The specific activities outlined seem to me to be appropriate -- very much more so than similar lists of activities I have seen in other GEF proposals. Strengthening the national institutions is absolutely fundamental to the success of this work, both pragmatically in the short run and in terms of the lasting significance of these efforts for preserving biodiversity preservation as the years go by. Both the legislative reform and the institutionally strengthening proposed are, therefore, in my opinion, of central importance. I could not imagine a program of this sort succeeding without them. Zoning the ecosystems ought to accompany the strengthening of the national institutions and be used as a basis for taking specific actions in relation to that zoning. I was particularly impressed with the principles proposed for implementing the zoning system for the master plan.

Project Component 2, concerning sustainable plant resource management, addresses both the economically relevant practices that are reducing the populations of some of these plants, and the strategies that have been appropriately derived from those earlier exercises that will be used to increase the supply of plants relevant for fuel wood, building timbers, and other resources significant for Socotra in life.

7. PARTICIPATORY ASPECTS

Stakeholder participation in this project is as good as I have ever seen involving, as it does, and by definition, essentially the whole population of Socotra; the relevant national institutions of Yemen; and cooperating bodies in the international community. It also has the potential of calling to the attention of the international conservation community the importance of the Socotran flora (and, I believe, fauna, also) and thus engendering further interest in and support for conservation in Socotra.

8. GLOBAL BENEFITS

These are extensive, given the extraordinarily interesting nature of the Socotran biodiversity and especially the plants, which is the group emphasized here.

9. GEF STRATEGIES AND PLANS

This project offers as good a fit with the goals of the GEF, its operational strategies and program priorities as any that I have ever seen.

10. REPLICABILITY

In terms of its intensive work with the resident peoples; its strengthening of national institutions; its enlistment of the international communities; and the self-reliance aspect of the work, I do believe that the project is replicable -- to biodiversity conservation, in general (the situation on the Canary Islands, or Hawaii, for example, are similar situations.) In addition, the attitude towards the interaction between local people, the native plants, and other elements in the biodiversity, the national institutions, and effective practical strategies, makes the project, it seems to me, a genuine model that would have even wider applicability.

In the narrower sense, the arid and semi-arid islands of the world, many of which have been much more damaged by human activities in the past, are suitable areas in which to consider replicating these activities. These include the other semi-arid islands of the Indian Ocean especially, but also those off the west coast of Mexico and in the Gulf of California, off the west coast of Central America; the Galapagos; and many semi-arid Caribbean islands, which are equally rich in endemic species. As mentioned above, however, many of those other areas have been much more damaged by human activities than Socotra, which makes intervention in Socotra all the more plausible.

11. CAPACITY BUILDING

Addressed in the best possible way that I could imagine in this proposals ranging from school and public education in the islands to the strengthening of relevant government institutions.

12. PROJECT FUNDING

Yes, as far as I can determine, the proposed level of funding is appropriate.

13. TIME FRAME

This seems to me to be perfectly reasonable.

14. SECONDARY ISSUES

- a. I cannot see any apparent linkages to other GEF focal areas.
- b. Socotra is so unusual, that I think the activities taken there do not have too great a regional significance except for islands of similar character elsewhere in the world.
- c. As to the degree of innovativeness in this project, I would say the detailed information base and the meticulous care that has been taken with local people, local institutions, biodiversity conservation, and practical strategies make it collectively highly innovative, even though none of these elements taken individually would seem to be unique.

15. ADDITIONAL COMMENTS

My enthusiasm for this project is essentially unbounded and I believe it should be funded at the very highest level of priority as soon as possible. I have not seen a better project of its type.

ANNEX 4: LIST OF ENDEMIC PLANTS OF SOCOTRA ARCHIPELAGO

To be published by Royal Botanical Garden Edinburgh

Checklist of endemic plants of the Socotra Archipelago, with IUCN conservation status

Summary

<i>Total flowering plants and ferns on Socotra</i>	850
<i>Endemic species</i>	255
<i>Undescribed new species</i>	22
<i>Total endemic species</i>	277

	<i>EX</i>	<i>E</i>	<i>V</i>	<i>R</i>	<i>I</i>	<i>K</i>	<i>NT</i>	<i>Total</i>
<i>Endemic taxa</i> (inc. subspp. and varieties.)	0	34	15	55	25	101	51	201

IUCN categories:

R	<i>rare</i>
NT	<i>not threatened</i>
K	<i>insufficient information on which to base a conservation status decision</i>
E	<i>endangered</i>
V	<i>vulnerable</i>
I	<i>intermediate (not common)</i>

ACANTHACEAE

Angkalanthus oligophylla Balf.f	R
Anisotes diversifolius Balf.f.	R
Ballochia amoena Balf.f.	NT
Ballochia atro-virgata Balf.f	K
Ballochia puberula Vierh.	K
Barleria aculeata Balf.f.	E
Barleria popovii Verdc.	E
Barleria tetraacantha Balf.f.	NT
Blepharis spiculifolia Balf.f.	V
Chorisochoa minor Vollesen	K
Chorisochoa striata Vollesen	K
Dicliptera effusa Balf.f.	R
Justicia rigida Balf.f.	V
Neuracanthus aculeatus Balf.f.	I
Rhinacanthus scoparius Balf.f.	R
Ruellia dioscoridis Napper	R
Ruellia insignis Balf.f.	NT
Ruellia patula ssp. kuriensis (Vierh.)	K
Ruellia paulayana Vierh.	K

Trichocalyx obovatus Balf.f.	NT
Trichocalyx orbiculatus Balf.f.	R

AMARANTHACEAE

Aerva microphylla Moq.	R
Aerva revoluta Balf.f.	R
Psilotrichum aphyllum C.C.Townsend	K (*ch*)

AMARYLLIDACEAE

Crinum balfourii Baker	I
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ANACARDIACEAE

Lanea transulta (Balf. f) A.R.Smith	V
Rhus thyrsoflora Balf.f.	NT

APOCYNACEAE

Adenium obesum Roem. ssp. sokotranum (Vierh.) Lav.	NT
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ASCLEPIADACEAE

Curroria macrophylla A.R.Smith	I
Cynanchum linifolium (Balf.f.) Bullock	NT
Duvaliandra dioscoridis (Lav.) Gilbert	E
Echidnopsis milleri Lavranos	R
Echidnopsis socotrana Lavranos	R
Ectadiopsis brevifolia Balf.f.	K
Mitolepis arbuscula A.R.Smith	E
Mitolepis intricata Balf.	R
Sarcostemma socotranum Lavranos	I
Secamone socotrana Balf.f.	R
Socotranthus socotranus (Balf.f.) Kuntze	I

BEGONIACEAE

Begonia socotrana Hook. f	V
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BORAGINACEAE

Cystostemon socotranus Balf.f.	NT
Heliotropium balfourii Guerke	K
Heliotropium cimalense Vierh.	K
Heliotropium dentatum Balf.f.	V
Heliotropium kuriense Vierh.	K
Heliotropium nigricans Balf.f.	K
Heliotropium odorum Balf.f.	R
Heliotropium paulayanum Vierh.	K
Heliotropium riebeckii Schweinf. & Vierh. (Borag.)	NT
Heliotropium shoabense Vierh.	K
Heliotropium socotranum Vierh.	K

<i>Heliotropium wagneri</i> Vierh.	K
<i>Heliotropium</i> sp. nov.	K
<i>Trichodesma laxiflorum</i> Balf.f.	NT
<i>Trichodesma microcalyx</i> Balf.f.	NT
<i>Trichodesma scotti</i> Balf.f.	V

BURSERACEAE

<i>Boswellia ameero</i> Balf.f.	NT
<i>Boswellia elongata</i> Balf.f.	NT
<i>Boswellia nana</i> Hepper	E
<i>Boswellia popoviana</i> Hepper	E
<i>Boswellia socotrana</i> Balf.f.	NT
<i>Boswellia</i> sp nov A	K
<i>Boswellia</i> sp nov B	K
<i>Boswellia</i> sp nov C	K
<i>Commiphora ornifolia</i> (Balf.f.) Gillett	NT
<i>Commiphora planifrons</i> (Balf.f.) Engl.	R
<i>Commiphora socotrana</i> (Bal.f.) Engl.	NT

CAMPANULACEAE

<i>Campanula balfourii</i> Wagner & Vierh.	NT
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CAPPARACEAE

<i>Cleome socotrana</i> Balf.f.	NT
<i>Maerua angoensis</i> DC.	
subsp. <i>socotrana</i> (Balf. f.) Kers	
var. <i>socotrana</i>	E

CARYOPHYLLACEAE

<i>Gymnocarpus bracteatus</i> (Balf.f) Petruss. & Thulin	NT
<i>Gymnocarpus kuriensis</i> (A.R.Smith) Petruss. & Thulin	NT
<i>Haya obovata</i> Balf.f.	NT
<i>Polycarpaea balfourii</i> Briq.	K
<i>Polycarpaea caespitosa</i> Balf.f.	K
<i>Polycarpaea hassalensis</i> A. Mill. (ined.)	R
<i>Polycarpaea hayoides</i> Chamberlain (ined.)	K
<i>Polycarpaea paulayana</i> Wagner	K

COMPOSITAE

<i>Dicoma cana</i> Balf.f.	R
<i>Helichrysum aciculare</i> Balf.f.	R
<i>Helichrysum arachnoides</i> Balf.f.	K
<i>Helichrysum balfourii</i> Vierh.	K
<i>Helichrysum nimmoanum</i> Oliv. & Hiern	E
<i>Helichrysum paulayanum</i> Vierh.	K

Helichrysum profusum (Balf.f.) Vierh.	K
Helichrysum rosulatum Oliv. & Hiern	R
Helichrysum sphaerocephalum Balf.f.	K
*var sarmentosum Balf.f	K
Helichrysum suffruticosum Balf.f.	K
Kleinia scottii (Balf.f) P. Halliday	I
Lactuca rynchocarpa Balf.f.	K
Launaea crepoides Balf.f.	K
Pluchea aromatica Balf.f.	E
Pluchea glutinosa Balf.f.	I
Pluchea obovata Balf.f.	R
Prenanthes amabilis Balf.f.	I
Psiadia schweinfurthii Balf.f.	K
Pulicaria diversifolia Balf.f.	NT
Pulicaria elegans Gamal-Eldin	E
Pulicaria lanata Gamal-Eldin	E
Pulicaria stephanocarpa Balf.f.	NT
Pulicaria vieraeoides Balf.f.	I
Sonchus racemosa (Balf.f.) Vierh.	K
Vernonia cockburniana Balf.f.	R
Vernonia unicata C. Jeffrey	K

CONVOLVULACEAE

Convolvulus grantii Balf.f.	K
Convolvulus sarmentosus Balf. f.	K
Cuscuta kuriensis Vierh.	K
Metaporana obtusa (Balf. f.) Staples	E
Seddera fastigiata (Balf.f) Verdc.	V
Seddera spinosa (Vierh.) Verdc.	V

CRASSULACEAE

Kalanchoe farinacea Balf.f	R
Kalanchoe robusta Balf.f.	R

CRUCIFERAE

Farsetia socotrana B.L.Burt	I
Hemicrambe townsendii Gomez-Campo	E
Hirschfeldia rostrata (Balf.f.) O.E.Schulz	R
Lachnocapsa spathulata Balf.f.	E

CUCURBITACEAE

Dendrosicyos socotrana Balf.f.	V
Eureiandra balfourii Cogn.	R

DIOSCOREACEAE

Dioscorea lanata Balf.f.	NT
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DIRACHMACEAE

Dirachma socotrana Schweinf. E

EBENACEAE

Euclea balfourii Hiern NT

Euclea laurina Hiern K

ERYTHROXYLACEAE

Erythroxyllum sp. nov. K

EUPHORBIACEAE

Cephalocroton socotranus Balf.f. NT

Croton elaeagnoides Balf.f. K

Croton sarcocarpus Balf.f. R

Croton socotranus Balf.f. NT

Croton sulcifructus Balf.f. R

Euphorbia abdelkuri Balf.f. E

Euphorbia arbuscula Balf.f. NT

var. *arbuscula* NT

var. *montana* Balf.f. R

Euphorbia hajirensis A.R.Smith R

Euphorbia kischenensis Vierh. R

Euphorbia kuriensis Vierh. K

Euphorbia leptoclada Balf.f. I

Euphorbia obcordata Balf.f. I

Euphorbia oblanceolata Balf.f. I

Euphorbia schweinfurthii Balf.f. K

Euphorbia socotrana Balf.f. R

Euphorbia spiralis Balf.f. R

Euphorbia sp. nov. aff. *kischenensis* V

Jatropha unicostata Balf.f. NT

Meineckia filipes (Balf.f.) C.L. Webster I

Tragia balfouriana Gillett NT

GENTIANACEAE

Exacum affine Balf.f. ex Regel NT

Exacum caeruleum Balf.f. E

Exacum socotranum Vierh. K

GOODENIACEAE

Scaveola socotrensis St. John K

GRAMINEAE

Aristida anaclasta Cope K

Dactyloctenium hackelii Wagner & Vierh. K

<i>Lepturus calcareus</i> T.Cope	K
<i>Lepturus pulchellus</i> (Balf.f.) W.M. Clayton	K
<i>Lepturus tenuis</i> Balf.f.	K
<i>Panicum rigidum</i> Balf.f.	K
<i>Panicum socotranum</i> T.A.Cope	K
<i>Rhynchelytrum microstachyum</i> Balf.f.	K

HYPERICACEAE

<i>Hypericum balfourii</i> N. Robson	R
<i>Hypericum fierense</i> N. Robson	K
<i>Hypericum scopulorum</i> Balf.f.	NT
<i>Hypericum socotranum</i> Good	
ssp. <i>socotranum</i>	R
ssp. <i>smithii</i> N. Robson	R
<i>Hypericum tortuosum</i> Balf.f.	V

IRIDACEAE

<i>Babiana socotrana</i> Balf.f.	R
<i>Romulea purpurascens</i> Tenore var. <i>edulis</i> Bak.	K

LABIATAE

<i>Lavandula nimmoi</i> Benth.	NT
<i>Leucas flagellifolia</i> (Balf.f.) Guerke	K
<i>Leucas kischenensis</i> (A.R.Smith) Sebald	K
<i>Leucas spiculifera</i> (Balf.f.) Guerke	R
<i>Leucas virgata</i> Balf.f.	NT
<i>Leucas</i> sp. nov. A. (Miller ined.)	K
<i>Leucas</i> sp. nov. B. (Miller ined.)	K
<i>Leucas</i> sp. nov. C. (Miller ined.)	K
<i>Orthosiphon ferrugineus</i> Balf.f.	K
<i>Plectranthus socotranus</i> A.R.Smith	E
<i>Satureja remota</i> (Balf.f.) Vierh.	NT
<i>Teucrium balfourii</i> Vierh.	R
<i>Teucrium sokotranum</i> Vierh.	NT

LEGUMINOSAE

<i>Acacia pennivenia</i> Schweinf.	V
<i>Arthrocarpum gracile</i> Balf.f.	R
<i>Arthrocarpum</i> sp. nov. A	E
<i>Arthrocarpum</i> sp. nov. B	E
<i>Arthrocarpum</i> sp. nov. C	E
<i>Crotalaria kuriensis</i> Vierh.	K
<i>Crotalaria strigulosa</i> Balf.f.	R
<i>Dichrostachys dehisca</i> Balf.f.	I
<i>Indigofera marmorata</i> Balf.f.	E
<i>Indigofera nephrocarpoides</i> J.B. Gillett	K

Indigofera pseudointricata Gillett	V
Indigofera socotrana Vierh.	E
Lotus mollis Balf.f.	K
Lotus ononopsis Balf.f.	NT
Ormocarpum caeruleum Balf.f.	R
Paracalyx balfourii (Vierh.) Ali	R
Paracalyx schweinfurthii (Wagner & Vierh.) A	R
Priotropis socotrana Balf.f.	E
Senna socotrana (Serr.-Val.) Lock	K
Taverniera sericophylla Balf.f.	R
Tephrosia odorata Balf.f.	E
Tephrosia sp. nov. A	K
Trigonella falcata Balf.f.	K

LILIACEAE (sensu lato)

Aloe perryi Baker	NT
Aloe forbesii Balf.f.	R
Aloe squarrosa Baker	E
Anthericum graptophyllum Baker	K
Asparagus africanus Lamk. var microcarpus Balf.f.	K
Dipcadi balfourii Baker	K
Dipcadi guichardii A.R.Smith	K
Dipcadi sp. nov A	K
Dipcadi sp. nov B	K
Dracaena cinnabari Balf.f.	NT
Iphigenia socotrana Thulin (ined.)	
Ledebouria grandifolius A.Mill. & D. Alexander (ined.)	
Urginea porphyrostachys Baker	K

MALPIGHIACEAE

Acridocarpus socotranus Oliv.	NT
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MALVACEAE

Hibiscus macropodus Wagner & Vierh.	K
Hibiscus malacophyllus Balf.f.	E
Hibiscus scottii Balf.f.	NT
Hibiscus stenanthus Balf.f.	E
Hibiscus socotranus G. Lucas	E
Hibiscus sp. nov. A.	K
Hibiscus sp. nov. B.	K

MELIACEAE

Turraea socotrana White	E
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MORACEAE

Dorstenia gigas Schweinf. ex Balf.f.	V
Dorstenia socotrana A.Mill. (ined.)	R

NYCTAGINACEAE

- Commicarpus heimerlii (Vierh.) Meickle R
Commicarpus simonyi (Heimerl. & Vierh.) Meickle. R

OLEACEAE

- Jasminum fluminense Vell. ssp. socotranum P.S.Green I

ORCHIDACEAE

- Holothrix socotrana Rolfe

PLUMBAGINACEAE

- Dyerophytum socotrana J.R.Edmondson (ined.) R
Dyerophytum pendulum (Balf.f.) J.P.Edmondson (ined.) R
Limonium kossmatii (Wagner & Vierh.) Verdc. K

POLYGALACEAE

- Polygala paulayana Vierh. K

PORTULACEAE

- Portulaca sp. nov. A. K
Portulaca sp. nov. B. K

PUNICACEAE

- Punica protopunica Balf.f. E

RESEDACEAE

- Reseda viridis Balf.f. NT

RUBIACEAE

- Carphalea glaucescens (Hiern.) Vatke K
Kohautia socotrana Brem. K
Neogaillonia puberula (Balf.f.) Lincz K
Neogaillonia putorioides (A R Smith) Lincz K
Neogaillonia thymoides (Balf.f.) Lincz K
Neogaillonia tinctoria (Balf.f.) Lincz K
Oldenlandia aretioides Vierh. K
Oldenlandia balfourii Bremek. K
Oldenlandia bicornuta (Balf.f.) Bremek. K
Oldenlandia ocellata Bremek. K
Oldenlandia pulvinata (Balf.f.) Bremek. NT
Placopoda virgata Balf.f. NT
Pseudomussaenda capsulifera (Balf.f.) Wernh. R
Pyrostria socotrana (A.R.Smith) D.M.Bridson K

RUTACEAE

- Thamnosma socotrana Balf.f. I

SAPINDACEAE	
<i>Allophylus rhoidiphyllus</i> Balf.f.	NT
SAPOTACEAE	
<i>Sideroxylon fimbriatum</i> Balf.f.	K
<i>Spiniluma discolor</i> (A.R.Smith) I. Friis	I
SCROPHULARIACEAE	
<i>Graderia fruticosa</i> Balf. f.	E
<i>Kickxia kuriensis</i> A.R.Smith	K
<i>Lindenbergia socotrana</i> Vierh.	K
<i>Xylocalyx aculeolatus</i> S. Carter	E
<i>Xylocalyx asper</i> Balf. f.	E
SOLANACEAE	
<i>Lycium sokotranum</i> Wagner & Vierh	NT
<i>Withania adunensis</i> Vierh.	NT
<i>Withania riebeckii</i> Schweinf.	NT
STERCULIACEAE	
<i>Sterculia africana</i> var. <i>socotrana</i> (K. Scum.) Fiori	NT
THYMELAEACEAE	
<i>Gnidia socotrana</i> (Balf.f.) Gilg.	NT
TILIACEAE	
<i>Corchorus erodiodes</i> Balf.f.	NT
<i>Grewia bilocularis</i> Balf.f.	K
<i>Grewia turbinata</i> Balf.f.	K
<i>Grewia</i> sp. nov. A.	
UMBELLIFERAE	
<i>Carum calcicolum</i> Balf.f.	I
<i>Carum pimpinelloides</i> Balf.f.	NT
<i>Nirarathamnos asarifolius</i> Balf.f.	E
<i>Peucedanum cordatum</i> Balf.f.	R
<i>Umbelliferae</i> sp. nov. A.	K
<i>Umbelliferae</i> sp. nov. B.	K
VALERIANACEAE	
<i>Valerianella affinis</i> Balf.f.	I
VERBENACEAE	
<i>Clerodendron galeatum</i> Balf.f.	I
<i>Clerodendron leucophloeum</i> Balf.f.	I
<i>Coelocarpum haggierensis</i> A. Mill. & Nyberg (ined.)	V

Coelocarpum socotranum Balf.f.
Priva socotrana Moldenke

R
K

VITACEAE

Cissus hamaderoensis A.R.Smith
Cissus paniculata (Balf.f.) Planch.
Cissus subaphylla (Balf.f.) Planch.

R
R
NT

PTERIDOPHYTES

Asplenium schweinfurthii Baker

R

Flora

Halophytes

Avicennia marina
Arthrocnemum macrostachium
Acuplex farinosa (found on Abd el Kuri)
Aeluropus lagopoides (grass on Sabkha)
Arzoon canariensis (Nogid)
Aerva microphylla
Commicarpus simonyi
Heliotropium socotranum (endemic)
Halopyrum mucronatum (grass)
Indigofera nephrocarpa
Limonium cyndrilifolium
Odysea mucronata (grass)
Pithecia stephanocarpa
Salvadora persica
Sueda monoica
Sueda sp
Tephrosia apollinea
Lamarisk cf muscatensis
Zygophyllum aff quaterensi
Zygophyllum sp 1 (cf *album*)

Macroalgae

Chlorophyta

Caulerp. occidentalis
C. serrulata
Chaetomorpha sp
Codium dwarkense
Codium sp
Cladophora sp
Dictyosphaeria cavernosa
Enteromorpha sp
Enteromorpha (?*flexuosa*)
Halimeda tuna
H. macroloba
Spongocladia vaucheriaeformis
Ulva (?*rigida tropica*)

Phaeophyta

Colpomenia sinuosa
Dictyota spp
Padina boryana
P. tetrastrumatica
P. gymnospora
Pocockiella variegata
Sargassum (?*binderi*)
Ulva sp "bladder kelp"
Ulva sp

Rhodophyta

Lithothamnium sp
 (?)*Chondria* sp
 Many species of encrusting and calcareous Rhodophyta not identified

Marine Angiosperms

Halodule uninervis
Halodule sp.
Cymodocea serrulata

Invertebrates

Porifera (sponges)

Ircinia sp.
Cliona sp
Hymedonema sp
Siphonochalina sp
Chondrillastra sp
 Many unidentified black, orange yellow and green sponges

Coelentrata

Hydrozoan ("false coral")

Millepora sp

Alcyonaria (soft corals)

Alcyonacea
 Alcyoniidae
Simularia sp
Sacrophyton sp
 Nephtheidae *Dendronephthya* sp
 Xenidae (?)*Anthelia glauca*

Zoantharia

Actiniaria (sea anemones)
 Strobilactidae *Strobilactis* sp
 Other unidentified species

(?) indicates identification uncertain

Scleractinian Corals (stony corals)

Acroporidae

Acropora hemprichii

A. humilis

A. (?) digitifera

A. cf danai

A. valenciennesi,

A. cathrata

(3 species of *Acropora* sp. not identified)

Montipora (?) tuberculosa

Pocilloporidae

Pocillopora verrucosa

Pocillopora spp.

Stylophora pistillata

Stylophora spp.

Poritidae

Porites sp.

P. solida

P. (?) lutea

Goniopora sp.

Siderasteridae

Pseudosiderastrea tayami

Siderastrea sp.

Siderastrea savignyana

Psammocora contigua

Coscinaraea sp.

Coscinaraea monile

Agariciidae

Leptoseris (?) mycetoseroides

Pavona sp.

Oculinidae

Galaxea fasciculata

Pectiniidae

Acanthastrea sp.

Mussidae

Echinophyllia sp.

Lobophyllia hemprichii

L. corymbosa

Merulinidae

Hydnophora sp.

Faviidae

Favia pallida

F. fava

Favia sp.

Favites sp.

Echinopora lamellosa

Echinopora gemmacea

Leptastrea sp.

Cyphastrea serailia

Plesiastrea sp.

Diploastrea sp.

Leptoria phrygia

Platygyra daedalea

Platygyra sp.

Goniastrea (?) retiformis

Dendrophyllidae

Tubastrea micracanthus

T. coccinea

Turbinaria misenterina

Fungidae

Cycloseris sp.

Fungia

Polychaeta

Serpulidae

Spirobranchus spp

Pomatoleios kraussii

Sabellidae

Sabellastarte sanctijosephi

Sipuncula

Eunicidae

Diopatra sp.

Other polychaeta to be identified

may include, Phyllodocidae,

Nereidae, Syllidae, Oweniidae.

Crustacea

Cirripedia (Barnacles)

Chthamalus ?malayensis

Chthamalus sp.

Euraphia sp.

Balanus sp.

Tetracalita squamosa

Malacostraca

(Stomatopoda - Mantis shrimps)

Gonodactylus demani demani

Squilla sp.

Isopoda
Ligia exotica
Cymodoce sp.

Natantia (shrimps)
Alpheidae (Snapping shrimps)
Athanas sp.
Alpheus djeddensis
Alpheus lottini
Alpheus (?)*frontalis*.

Palaemonidae
Pontoniinae (including cleaner shrimps)
Jocaste lucina
Periclimenes sp.
(Several Alpheidae and Pontoniinae remain to be identified)

Palinuridae (Spiny lobsters)
Panulirus sp.
P. versicolor
P. homarus

Anomura

Diogenidae
Clibanarius virescens
C. Signatus
Ceonobitidae (Land Hermit Crabs)
Ceonobita scaevola

Porcellanidae crabs
Pachycheles natalensis
Petrolisthes sp.
Petrolisthes (?)*carnipes*

Brachyura

Maiidae (Spider Crabs)
Menaethius monoceros.
Cyphocarcinus sp.
M. sp.1
M. sp.2

Dromiidae (Sponge Crabs)
D.sp.1

Leucosiidae (Pebble Crabs)
(?)*Philyra* sp.

Ocypodidae (Ghost Crabs)
Ocypode saratans
Ocypode sp.1 (cf. *rotundata*)
Ocypode sp.2 (cf *cordimana*)

Grapsidae (Shore Crabs)
Grapsis albilineatus
Metopograpsus messor
Grapsus sp.1
Grapsus sp.2

Portunidae (Swimming Crabs)
Portunus pelagicus
Portunus sp.

Xanthidae (Dark Fingereed Coral Crabs)
Epixanthus sp.
Actea sp.
Medaeus sp.
Trapezia (?)*cymodoce*
Trapezia spp.
Tetralia cavimana
Tetralia spp.
Cymo sp.
Pilodius sp.
Phymodius sp.
Pilumnus vespertilio
Pilumnus sp.

Hapalocarcinidae (Gall Crabs)
(?)*Hapalocarcinus* sp.
(?)*Cryptochirus* sp.
Several Anomuran and Brachyuran crustacea are yet to be positively identified.

Echinodermata

Asteroidea (sea stars)
Asrerina burtoni
Luidia sp
Linkia multiflora
Echinaster sp.
Ophidiaster sp.

Oreasteridae (Pin cushion star fish)
O. sp.1

Ophiuroidea (Brittle Stars)
Ophiactis savignyi
Ophiothrix savignyi
Macrophiothrix sp.
(Several Ophuroidea are yet to be positively identified)

Echinoidea (sea urchins)
Diadema setosum
Diadema sp.
Echinometra mathaei
Echinostrephus molaris (the
burrowing urchin)
(?)*Echinometra* sp. 1
Tripneustes gratilla

Holothurioidea (sea cucumbers)
Holothuria atra
Holothuria edulis
Holothuria sp. 1
Actinopyga mauritania

Urochordata (Tunicates - Sea Squirts)

Many large unidentified genera,
both colonial and solitary.

Bryozoa

Several unidentified genera, forms
include encrusting, branched erect
plates and "lace corals".

Mollusca

Gastropoda

Prosobranchia

Fissurallidae* (Keyhole Limpets)
Diodora ruepellii
D. funiculata
Emarginula sp.
Submarginula sp.

Patellidae (True Limpets)
Cellana rota
Patella flexuosa

Trochidae
Euchelus asper
Granata sulcifera
Monodonta nebulosa
Clanculus pharaonius
Trochus erithreus
T. firmus
Tectus dentatus
Priotrochus sp.
Umbonium sp.

Stomatella sp
Stomatia sp.

Turbinidae
Lunella coronata
Turbo radiatus
Turbo jonathani
T. bruneus

Phasianellidae
(?)*Phasianella* sp

Neritidae
Nerita albicilla
N. debilis
N. adenensis
N. textilis
N. polita orbignyana
Smaragdia souverbiana

Littorinidae
Littoraria intermedia
L. glabrata
Nodolittorina natalensis

Planaxidae
Planaxis sulcatus

Cerithidae
Cerithium caeruleum
Cerithium sp.
Clypeomorus bifasciatus
Rhinoclavis kochi
R. sinensis
R. fasciata

Potamididae
Potamides conicus

Turritellidae
Turritella maculata
T. cochlea
T. sp.

Vermitidae
Serpulorbis sp.

Strombidae
Lambis truncata sebae
Lambis truncata truncata
Strombus mutabilis
S. (Tricornis) oldi
S. gibberulus
Three unidentified Strombidae, may
be juveniles

Cypracidae (cowries)

Cypraea mauritiana
C. grayana
C. annulus
C. cuarica
C. gracilis
C. (?)felina fabula
C. talpa
C. tigris
C. turdus

Ovulidae (egg cowries)

Ovula ovum

Naticidae (Moon snails)

Mammilla melanostoma
Natica sp.

Cassidae (Helmit shells)

Cypraecassis rufa

Ranellidae

Gyrineum natator
Cymatium parthenopeum
Cymatium sp.

Bursidae (Frog Shells)

Bufovia sp.
Bursa sp.
Tutafa sp.

Muricidae

Chicoreus banksii
Chicoreus ramosus
Hexaplex kuesterianus
Homalocanthus anatomica
Favartia sp.

Thaididae

Thais savignyi
Thais bimaculata
Thais tissoti
Thais sp.
Morula sp.
Purpura panama
Cronia konkanensis
(?)Nassa situla

Buccinidae

Cantharus sp.1
Cantharus sp.2
Engina sp.

Collumbellidae

Mitrella sp.
Pirene sp.

Nassariidae

Nassarius marmoreus
Nassarius sp.1
Bullia mauritiana

Fasciolaridae (the tulip shell)

Pleuroploca trapezium
Fusinus sp.

Harpidae

Harpa sp.

Vasidae

Vasum turbinellus

Olividae

Oliva bulbosa
Ancilla sp.

Cancellariidae

Scalpta sp.

Conidae (cone shells)

Conus taeniatus
C. striatus
C. virgo
C. tessulatus
C. flavidus
C. braeus
C. chaldeus
C. vexillum sumatrensis
C. nigropunctatus

Turridae

Unident sp.1

Teribridae

Terebra consobrina
T. maculata
Terebra sp.
Impages hectica
Hastula nana

Pulmonata

Siphonariidae (False Limpets)
Siphonaria sp.

Opisthobranchia
Nudibranchia
Chromodoris (?)annulata
Dendrodis ruba
Phyllidia bourguini

Polyplacophora (Chitons)
Acanthopleura vaillantii (syn.
haddoni)
Chiton peregrinus
Chiton sp.

Bivalvia

Arcidae
Acar plicata
Arca sp.
Barbatia sp1.
Barbatia sp.2
Anadara sp.1
Anadara sp2

Mytiloidea
Brachidontes variabilis
Perna picta
Musculus sp.
Lithophaga sp.
Leiosolenus sp.

Pterioidea
Pteria sp.
Pinctada radiata
P. margaritifera
P. cf nigra
Malvifundus sp.
Isognomon sp.

Ostrocoidea
Saccostrea cucullata
Lopha cristagali
Plicata imbricata

Pectinidae
Chlamys livida
Chlamys townendi
Chlamys sp.

Spondylidae
Spondylus marisrubri
Spondylus sp.

Lucinidae
Codakia tigerina
Ctena divergens
Anodontia edentula

Ungulimidae
Diplodontia sp

Carditoidea
Cardites bicolor
Begonia gubernaculum

Chamoidea
Chama brassica
C. Asperella
C. reflexa

Cardiidae
Plagiocardium pseudolima
Fragum hemicardium
Acrostergima lacunosa
Acrostergima assimile

Mactridae
Mactra sp

Veneridae
Periglypta sp.
Circe sp.
Circentia callipyga
Callista sp.
Pitar sp.
Dosinia sp.

Tridacnidae
Tridacna maxima
T. squamosa
T. gigas

There remains a number of bivalves
to be identified.

Vertebrates

Fish

Blenniidae

Istiblennius lineatus (rock skipper)
Istiblennius (?)*edentulus*

Acanthuridae.

Acanthurus dussumeri
Acanthurus gahhm
Acanthurus leucosternon
Acanthurus lineatus
Acanthurus mata
Acanthurus nigrofuscus
Acanthurus sohal
Acanthurus tennentii
Acanthurus triostegus
Ctenochaetus striatus
Zebрасoma desjardini
Zebрасoma xanthurum
Naso annulatus
Naso brachycentron
Naso brevirostris
Naso fageni
Naso hexacanthus
Naso lituratus
Naso unicornis

Balistidae.

Balistapus undulatus
Balistoides conspicillum
Balistoides viridescens
Melichthys indicus
Odonus niger
Pseudobalistes flavimarginatus
Pseudobalistes fuscus
Rhinecanthus assassi
Sufflamen chrysopterus
Sufflamen fraenatus

Chaetodontidae.

Chaetodon auriga setifer
Chaetodon collare
Chaetodon gardneri
Chaetodon kleinii
Chaetodon leucopleura
Chaetodon lineolatus
Chaetodon lunula
Chaetodon melannotus
Chaetodon melapterus
Chaetodon trifascialis

Chaetodon vagabundus pictus
Heniochus acuminatus
Heniochus diphreutes

Pomacanthidae.

Apolemichthys xanthotis
Centropyge acanthops
Centropyge multispinis
Pomacanthus imperator
Pomacanthus maculosus
Pomacanthus semicirculatus

Partial fish species lists.

Stegastomatidae

Stegasoma fasciatum

Rhincodontidae

Rhincodon typus

Carcharhinidae

Carcharinus longimanus
Galeocerdo cuvier
Triaenodon obesus

Sphyrnidae

Sphyrna sp

Rhinobatidae

Rhincobatus djiddensis

Dasyatidae

Taeniura melanospila

Myliobatidae

Aetobatus narinari

Mobulidae

Mantra birostris
Mobula sp.

Muraenidae.

Echidna nebulosa
Gymnothorax javanicus
Gymnothorax favagineus
Gymnothorax chilospylus
Siderea grisea

Antennariidae.

Antennarius sp.

Holocentridae.

Myripristis murdjan
Sargocentron spiniferum
Sargocentron caudimaculatum

Fistulariidae.

Fistularia commersoni

Scorpaenidae.

Pterois antennata
Pterois volitans
Scorpaenopsis diabolus

Serranidae.

Pseudanthias squamipinnis
Aethaloperca rogaa
Cephalopholis argus
Cephalopholis miniata
Cephalopholis sonnerati
Dermatolepis striolatus
Epinephelus fasciatus
Epinephelus fuscoguttatus
Epinephelus flavocaeruleus
Epinephelus tukula
Epinephelus stoliczkae
Variola louti
Variola albimarginata

Teraponidae.

Terapon jarbua

Priacanthidae.

Priacanthus blochii
Priacanthus hamrur

Apogonidae.

Apogon aureus
Apogon cyanosoma
Cheilodipterus quinquelineatus

Carangidae.

Caranx ignobilis
Caranx melapygus
Caranx sexfasciatus
Caranx lugubris
Trachinotus blochii

Lutjanidae.

Lutjanus argentimaculatus
Lutjanus bohar
Lutjanus coeruleolineatus
Lutjanus ehrenbergi

Lutjanus fulvus
Lutjanus gibbus
Lutjanus kasmira
Lutjanus monostigma
Lutjanus rivulatus
Macolor niger

Caesionidae.

Caesio xanthonota
Caesio lunare

Haemulidae.

Diagramma pictum
Plectorhyncus gaterinus
Plectorhyncus playfairi
Plectorhyncus pictus
Plectorhyncus schotaf

Sparidae.

Acanthopragus bifasciatus
Diplodus sargus capensis

Lethrinidae.

Lethrinus olivaceous
Lethrinus nebulosus
Lethrinus mahsena
Lethrinus variegatus
Monotaxis grandoculis

Mullidae.

Mulloidichthys vanicolensis
Mulloidichthys mimicus
Parupeneus barberinus
Parupeneus bifasciatus
Parupeneus cyclostomus
Parupeneus forskalli
Parupeneus indicus
Parupeneus macronema
Parupeneus rubescens

Pempheridae.

Pempheris oualensis

Kyphosidae.

Kyphosus vaigensis
Kyphosus cinerascens

Ephippidae.

Platax orbicularis

Monodactylidae.

Monodactylus argenteus

Pomacentridae.

Abudefduf sexfasciatus
Abudefduf vaigiensis
Abudefduf sordidus
Abudefduf septemfasciatus
Amphiprion bicinctus
Chrysiptera annulata
Dascyllus carneus
Dascyllus marginatus
Dascylus trimaculatus
Neoglyphidodon melas
Pomacentrus caeruleus
 (NB - lots more unidentified spp)

Cirrhitidae.

Paracirrhites forsteri
Cirrhitichthys oxycephalus
Cirrhitichthys callivirius

Sphyraenidae.

Sphyraena barracuda

Labridae.

Anampses meleagrides
Bodianus macrognathos
Cheilinus abudjubbe
Cheilinus fasciatus
Cheilinus lunulatus
Cheilinus trilobatus
Cheilo inermis
Coris africana
Coris aygula
Coris frerei
Epibulus insidiator
Gomphosus caerulea
Halicoeres dussumieri
Halicoeres hortulanus
Halicoeres marginatus
Hemigymnus fasciatus
Hemigymnus melapterus
Hologymnosus doliatus
Labroides bicolor
Labroides dimidiata
Thalassoma lunare

Scaridae.

(4+ spp unidentified)
Chlorurus strongylocephalus
Scarus ferrugineus
Scarus rubroviolaceus

Gobiidae

Amblyeleotris wheeleri

Microdesmidae.

Gunnelichthys monostigma

Zanclidae.

Zanclus cornutus

Siganidae.

Siganus sp.

Scombridae.

Scomberoides commersonianus

Monacanthidae.

Aluterus scriptus
Cantherhines sp.

Ostraciidae.

Ostracion cubicus
Ostracion cyanurus
Ostracion meleagris

Diodontidae.

Diodon liturosus
Chilomycterus reticulatus
Cyclichthys spilostylus

Tetraodontidae.

Arothron hispidus
Arothron nigropunctatus (2 colour morphs -
 grey (common), yellow (rare))
Canthigaster valentini
Canthigaster solandri

Marine Mammals

Delphinus delphis common dolphin
Physeter macrocephalus (sperm whale,
 skeletal remains)

Birds

Phalacrocorax nigrogularis (Socotra
 Cormorant)
Sula sp (Booby)
Sterna bergii (Swift Tern)
Sterna bengalensis (Lesser Crested Tern)
 (?)*Sterna attenuata* (Bridled Tern)

White Cheeked Tern (*S. Repressa*).
Larus fuscus (Lesser Black Backed Gull),
L. Hemprichii (Sooty Gull)
Ardea sp. (Heron)
Egretta sp. (Heron)
Neophron percnopterus (Egyptian Vultures)

Reptiles

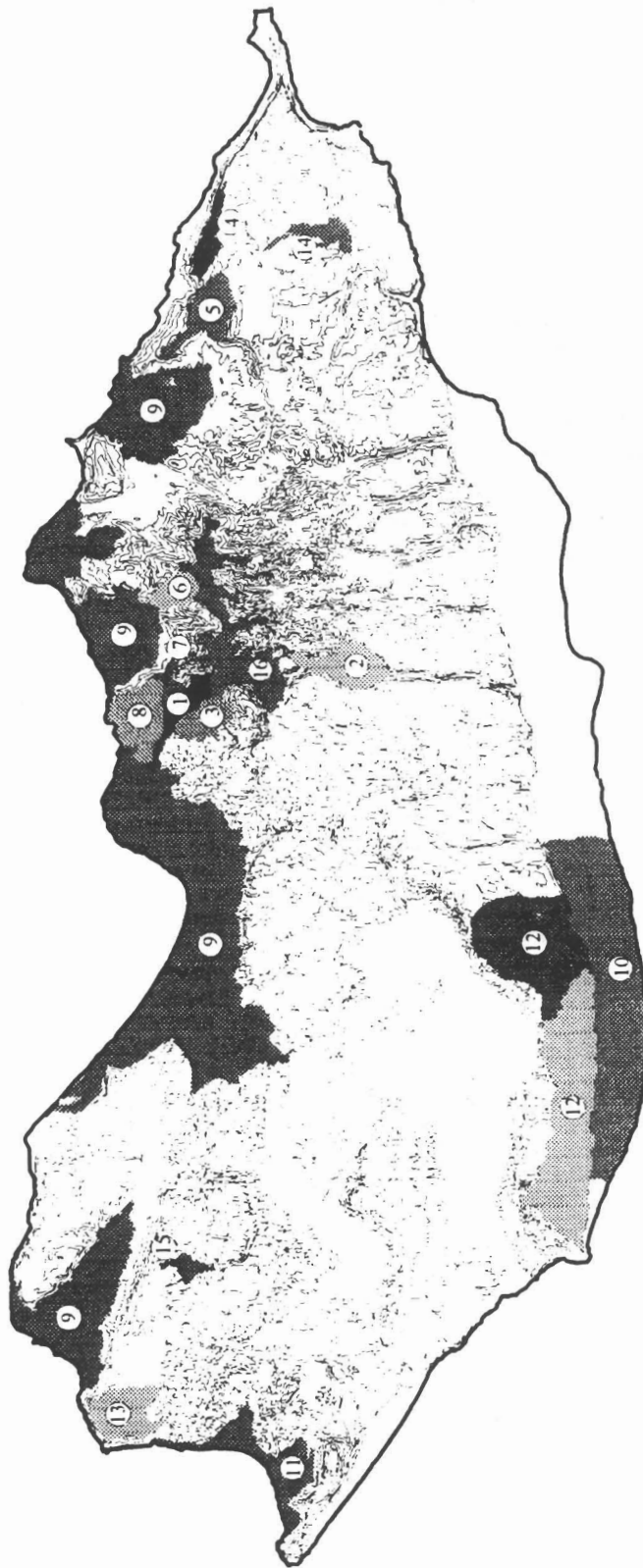
Based on presence of carapaces in fishing villages and anecdotal reports.

Chelonia mydas (Green Turtle)
Eretmochelys imbricata (Pacific Hawksbill Turtle)
Lepidochelys olivacea (Olive Ridley Turtle)
Caretta caretta (Loggerhead Turtle)
Dermochelys coriacea (Leatherback Turtle)

Floristic diversity of Socotra Archipelago, Yemen

ANNEX 6:

MAP 1: DISTRIBUTION OF 16 PROVISIONAL INDICATOR SITES ON SOCOTRA
(excluding 3 on outer islands)



KEY

- | | | |
|------------------------|--|--------------------------------|
| 1 Wadi Ayheft | 9 Northern coastal plains | 13 Western end Ma'alih plateau |
| 2 Firmihin | 10 Qa'arah (Noged plain) | 14 Killisen area |
| 3 Rugid | 11 Coastal plain at Shu'ab | 15 Wadi Ayek |
| 4 Hoq | 12 Limestone plateau above Noged plain (lighter area to be surveyed) | 16 High peaks of the Haggeher |
| 5 Hamadiro and Homhil | | |
| 6 Wadi Denegehan | | |
| 7 M. qadrihc'n Pass | | |
| 8 Reiged and Ras Hebaq | | |

ANNEX 7: TERRESTRIAL TARGET AREAS - THEIR BIOLOGICAL SIGNIFICANCE, THREATS/ISSUES AND ACTIONS PROPOSED

	Wadi Ayheft	Hamadiro & Homhil	Muqadrihon Pass	Reiged & Ras Hebaq	Qa'arah (Noged Plain)	Kilissan	Shu'ab
Natural Feature	Narrow, heavily-wooded valley of limestone and granite.	Upland piedmont plain & limestone/granite slopes with <i>Boswellia</i> & <i>Dracaena</i> woodland.	Dense, mixed deciduous & semi-evergreen woodland at junction between limestone & granite.	Limestone plateau vegetation & succulent shrubland	Coastal plain with open woodland.	Ravine in limestone plateau; the only permanent water catchment in the southeast part of Socotra Island.	Coastal plain with mangrove & other coastal vegetation.
Biological Significance	-Exceptional floristic diversity -Prime example of deciduous woodland.	-Open <i>Boswellia</i> woodland -Well developed <i>Dracaena</i> woodland of global significance.	-Highest floristic diversity on Socotra. -Several Red Data Book spp. in abundance	-Globally important succulent shrubland.	-Remnant of former coastal plain vegetation. -Former example of land management.	Formerly rich woodland now degraded.	-Prime example of coastal vegetation. -One of few areas of mangroves on Socotra
Threats/Issues	-Timber extraction -Road extension -Close proximity to Hadiboh & good water supply, hence prime site for development. -Land tenure	-No regeneration of <i>Boswellia</i> woodland -Over-grazing <i>Dracaena</i> resin extraction -Human population pressure	-Future timber extraction. -Close proximity to Hadibo and road.	-Close proximity to airport & Hadibo -Major road building -Overgrazing -Timber extraction on upper slopes.	-Lack of regeneration of <i>Commiphora ornifolia</i> & <i>Euphorbia arbuscula</i> . -Overgrazing	-Overgrazing -Drought leading to over-collection of some fodder trees -Land clearance for date cultivation.	-Road construction -Clearance of coastal vegetation for development of fishing settlement -Overgrazing
Actions/Recommendations	-"Wet" nursery -Enclosure (1, 5) -Reforestation -Ecotourism -Erosion control near roads	-Enclosure (2) -Reforestation -Ecotourism	-Enclosure (3) -Ecotourism -Control of logging	-Enclosure (3, 4) -Ecotourism	-"Dry" nursery -Enclosure (2) -Reforestation	-Enclosure (2, 5) -Reforestation -Upgrade water catchment near school & clinic	-Enclosure (2,3,5) -Ecotourism

Key for purposes of Enclosures: (1) - For regeneration of logged area; (2) - For regeneration of overgrazed area; (3) - To conserve threatened area; (4) - To monitor erosion; (5) - For regeneration after land clearance.

**LIST OF SOME ONGOING BIODIVERSITY AND ENVIRONMENT
PROJECTS AND ACTIVITIES**

1. In March 1996, the Government announced the allocation of YR 256 M (approx. \$ 2 M) for the initial development of the Master Plan for Socotra, covering the construction of a seaport, upgrading of airport and road building.
2. In June 1996, UNDP Yemen drafted a Preparatory Assistance Document to prepare a project which will assist the Government in the formulation and implementation of the Master Plan. UNDP Yemen will commit part of its Country Programme funds into this process. The Preparatory Assistance project will focus on the rural development and social services components of the Master Plan, hence will complement well with the present GEF project focussing on biodiversity conservation. Together, the two projects will ensure that the Master Plan will indeed integrate environmental protection and conservation with development.
3. A team from the Royal Botanic Garden Edinburgh (including a botanist and linguist/ethnographer) has visited the island several times in collaboration with members of the staff from El-Kod Agricultural Research Centre, and independently with Socotran experts five times since 1989. In March 1996, the team, with two new members, undertook the botanical and social components of the project formulation mission for the present proposal. The team contributed substantially to the baseline information and design of project interventions of the proposal. A detailed inventory of plants, traditional plant uses and land use on Socotra, which is being fed into an advanced data-base linked to GIS facilities, has been started and will soon culminate in the publication of the Ethnoflora of Socotra. It will also include innovative illustrated identification keys, descriptions and distribution maps for all species, as well as information on plant uses, land use, conservation and socio-economic issues.
4. The EU/IDA/IFAD IV Fisheries Project began in April 1992, and is designed to develop the country's fisheries sector. In addition to the provision of an IDA loan for the purchase of fishing boats, engines and the construction of fish landing facilities on the Hadramaut coast, the EU provides technical assistance to the Ministry of Fish Wealth to implement the project. This includes a fish stock management component, where a principal activity is to classify the coastal and marine environments of the Gulf of Aden coast, including the islands of Socotra and Perim. Eight person months of TA are being provided by the project's consultants, MacAlister Elliott and Partners Ltd, for this activity, which includes one month to cover the Socotra Archipelago. This TA, together with GEF support, enabled two experts to undertake the marine component of the project formulation mission in March 1996 for this proposal. Results of this mission contributed to substantial baseline information on the marine areas and fisheries aspects of the present proposal.
5. Zoologists from the University of Rostock has undertaken surveys on the fauna of Socotra Island, including the shallow coastal areas and macro-benthos. A database of the major

taxonomic groups has been established. This could be made accessible to the present project when building up the GIS database.

6. The GEF has recently approved the Biodiversity Enabling Activity project for Yemen. The main product of the project will be a National Biodiversity Strategy Action Plan. It is expected that the action plan, as well as the human capacity built up through this project will facilitate some of the activities of the present project.
7. The GEF project YEM/92/G31 "Yemen - Protection of the Marine Ecosystems of the Red Sea Coast" builds capacity for the Government in sustainable marine resource management through training and technical assistance in analysing the marine environment and developing resource management strategies, including marine protected areas management. Although the project focuses mainly on the Red Sea coast, some of the capacity in the form of National technical expertise and equipment for marine surveys and GIS, may be channelled into the Socotra project.
8. The GEF project YEM/93/G41 "Yemen Liquid Petroleum Gas (LPG) Substitution Programme" seeks to develop a master plan for increasing the use of LPG, particularly in rural areas where firewood is used for cooking, but also in other potential substitution applications. By halting the reduction of the forest cover, carbon sequestration and storage can be secured and harmful emissions of GHG can be reduced. Some of the findings and expertise generated from this project may contribute to the component of the present proposal which deals with the reduction of use of native firewood in Socotra.
9. FAO recently proposed a project (GCP/YEM/015/SWI - Forestry Development Project) to establish a small village forestry nursery on Socotra to grow native species for fodder, ornamental purposes, shade and wood. The proposed project will be locally managed, mostly by women.
10. British Gas has been exploring for oil off the shore of Socotra for three years unsuccessfully. The company has concluded exploration activities in April 1996.

Meetings held during RBGE Expedition to Socotra, February - April 1996

Introduction

The main purpose of the RBGE expedition was further field research on the botany (*Miller and Alexander*) and ethnobotany of the archipelago, combined with further research into pastoralism, landuse and rangeland management (*Morris*). However, some of the material researched is of relevance to the GEF project, and some meetings/ and or discussions were held with the GEF project in mind. Thus a brief report on such meetings or group discussions is given below.

It will be noticed that there is only one woman's name on the following list. This particular woman works for the Government and is happy to assist with information given under her own name. However, other Socotran women did not wish their names to be noted formally, so although, of course, many discussions - some lengthy and detailed - were held with women on the island, respecting their wishes, their names are not given here)

Apart from informal discussions held throughout the period of expedition fieldwork across the island with villagers, fisherman and pastoralists, and the more exhaustive work carried out with the local experts employed by the RBGE team, MJM also held more structured and detailed meetings with the following: -

Abdullah Salim Abū Furād : Works in the Directorate of Finance, Socotra.

Meeting with MJM in Hadibo. Mainly discussed recent political developments and changes on the island; the lack of health facilities on the island and the collapse of the immunisation system

Ahmad Sa'ad Ahmad : Muqaddim in the eastern area.

Meeting with MJM in Hadibo. Mainly discussed rising costs especially those faced by pastoralists; coastal development; rural community centres

Ali Sābir Ahmad Kowter : Head of the General Council, Socotra.

Meeting with MJM in Hadibo. Mainly discussed land disputes (Ali Sābir heads the department which looks into land disputes); water extraction and the need for a thorough hydrological survey; land enclosing and land purchase; the effect of recent political changes on landuse and land ownership the Government of Yemen's attitudes

towards, and rulings on, land tenure; town planning; communications; the development of rural community centres

Ali Sālim Sowqer : Personal driver and associate of the Governor of Socotra.

Meeting with MJM in Hadibo : Ali Salim worked for the last two governors, and is still employed to drive the present one, once his appointment is firmly established.

Mainly discussed recent political developments, increasing control by the military on the island, political factions within Socotra, manoeuvring of elections etc. within the various parties; communications; the future of tourism

Hasan Sarad Khamis. Tribal fisherman who has left pastoralism and settled on the coast.

Meeting with MJM on the eastern coast. Mainly discussed pastoralism / fishing; reasons for leaving pastoralism; pros. and cons. of fishing previous to 1970s and now; changes in fishing methods and productivity; strategies for keeping a foot in both camps (his elder brothers remain pastoralists and provide him with milk and meat products while he fishes and provides all family members with fish and cash input; marketable marine products other than fish; rules governing fishing and controls for over fishing .

Ahmad 'Eesa Qasim : Na'ib Mudir of in Customs.

Meetings with MJM in Kilissan and Hadibo. Mainly discussed potential development in the rural interior; date production; building costs in different parts of the island; tree felling; community work; water

Mā'behur Ali Māseh : The deputy *shaikh* of the Eastern peninsula.

Meeting with MJM in Kilissan. Mainly discussed the relationship between *muqaddims* / *shaikhs* / *'uqqāl* and Government and how this had developed and changed over the last few years; community labour; what he saw as the most pressing needs of the pastoralist sector; the relationship between date cultivation and pastoralism; water development; the development of rural community centres; communications inside and outside the island; the lack of education on the island

Ali Muqaddim Ahmad: Former driver and associate of the last Governor of Socotra, Bū Haqība.

Meetings with MJM in Hadibo and elsewhere on the island (he was our driver during the expedition). Mainly discussed recent political changes; the collapse of democracy and rule of law on the island; road building ; the spread of corruption; the impoverishment of many sections of society; the collapse of education in the interior;

the lack of health facilities and the main health problems present on the island; the development needs of the island; the many visits of "U.N." personnel to the island with no result

Ahmad Jum'ān Sa'ad : The recently appointed Director of Education on Socotra. *First meeting with MJM and Catherine Cheung in Hadibo, subsequent two meetings with MJM.* Mainly discussed the recent flour misappropriation affair; the necessity for up-grading the training of Socotran teachers; the necessity of training Socotrans to work in Socotra in all fields; the problems faced by education on the island at present : with few funds, little or no food to send to the rural schools, lack of ability to distribute water to the rural schools in order to keep them going; the need for further training to be carried out *in situ* on the island by professionals from the mainland; the need for funding; the need to combat illiteracy. At further meetings, which included other post-graduate Socotran teachers, we mainly discussed ways of improving rural education; the possibility of an Environmental Education Centre on the island with rural environment stations; the possibility of post-graduate teachers receiving further training abroad in environmental matters; the problems of English language teaching in schools; his disappointment over the Aden Symposium on Socotra, and its failure to allow time for real and productive discussion or to hear points of view from those present
Sa'id Ali Muhammad Bū Muhammad : Pastoralist and fisherman.

Meeting with MJM in Momi. Mainly discussed the conflicting interest of fishing and pastoralism; nutrition; land tenure

Sālih Ma'ād : Na'ib Mudīr of the Statistical Office in Hadibo.

Meeting with MJM in Hadibo; mainly discussed the methods of collection of island statistics and the very thorough 1994 island survey : the resultant papers were sent to Aden - the Hadibo office only received in reply round numbers of inhabitants, with no breakdown, or analysis of their work, nor did they make a copy of the filled in questionnaires at the time. 'Office' is a misnomer- he has a desk and 2 chairs and a single small and empty filing cabinet.

Hamūd Muhammad : A Yemeni married and settled on Socotra. As well as being an electrician, he is also the Government photographer.

Meetings with MJM in Hadibo, in his studio and twice in his home. He is the photographer on the current Government project of issuing identity cards to each and every adult man and woman across the island. The team of photographer and clerk are progressing gradually over the island bit - they have completed the major coastal settlements of the Northern side, and are next going to do the east. Take-up

of the chance to have an ID card is very good, since without them it will be impossible to leave the island or to get back on, or to benefit from various Government initiatives. Only a small number of the very old who say they have no desire (a) to have their picture taken, or (b) to leave the island, have so far refused to take up the offer. This seems the most promising avenue for getting finally a clear idea of the true population of Socotra (unless the original papers of the very thorough statistical survey of 1994 can be got from the Aden office)

Khamīs Salim : Fisherman and driver (he drove the Marine Team).

Meetings with MJM in Hadibo and Muri. Mainly discussed increasing difficulty of making a living with a car as fewer pastoralists can afford to pay cash; pastoralism versus fishing; fishing communities building up livestock herds; the sending of coastal herds to pastoralist families to graze in bad years or in rain grazing; rural development; fisheries development

Shaikh Sa'ad Amir Ali: Recently officially appointed as Governor (Ma'mūr) of Socotra.

Meeting with MJM shortly after arrival in Hadibo. (Second meeting scheduled, but in the even, due to local politics and the problems arising over his appointment, he was absent for the rest of our visit trying to clarify matters in Sa'ā). Mainly discussed purpose of our visit (Ethnoflora); the *muqaddim* and *shaikh* system; the relationship between Ma'mūr, Aden and Sa'ā; religious education on the island. He showed me his letter of appointment and gave me a copy of the Government list of administrative regions and regional *shaikhs*.

Hamad Salim Bū Feheḍ and his son Ali Hamad : Originally a pastoralist in the east, then fishermen, and now owning the only trading dhow of the eastern coast.

Meetings with MJM in Hadibo, on the dhow, in Abd al Kuri and on Samha. Mainly discussed trade; communications; the changes in fishing over the past 20 years; the current financial and political situation; the lack of education and health facilities in the interior

Summuh Jum'ān Umar : (Female) Secretary to the Governor since early 1970s.

Frequent meetings with MJM in Hadibo. Mainly discussed deteriorating position of women on the island in recent years; the influx of new ideas to the island, especially as regards women and their employment; cash earning opportunities for women; nutrition; lack of health facilities on the island; lack of clear government on the island. She lives alone in her own house, which has become a meeting place for people from

all over the island, as well as for Government employees. Several valuable discussions were held here

Ghalib Ahmad Sa'id and his brother Salim : The *muqaddim* of Abd al Kuri.
Worked with MJM throughout our stay on Abd al Kuri. Mainly discussed livestock rearing on Abd al Kuri; relations between Abd al Kuri and the Hadhramaut; changes in fishing practices; deterioration of government support on Abd al Kuri; lack of potable water; lack of transport; changes on Abd al Kuri; possible development on Abd al Kuri

Sa'id Mansur Ahmad Mahsis : One of the elders of Samha island.
He worked with MJM throughout the stay on Samha. Mainly discussed fishing; changes in fishery practices; control of fisheries; fishermen from Hadhramaut working in bachelor camps on the island; the past and the present; local government by the elders on the island; local administration committees; possible development on the island.

Muhammad Salih Siyid : Employee of Ministry of Health in Public Health Department, was involved in the former immunisation programme.
Meeting with MJM in Hadibo and in the Haggeher foothills for dinner. Mainly discussed health problems on the island; health services and training; education; communications

Amir Ahmad Abdullah : Pastoralist who has left the west, married outside his tribe and settled with livestock in a rich wadi to the east of Hadibo.
Meetings with MJM in Hadibo and at dinner at his home. Mainly discussed harsh conditions in the west; the development of Hadibo; water; fishing versus pastoralism; vegetable cultivation; tree felling; date cultivation across the island

Sulaiman Salim Noh di Qishin : *muqaddim* of Kishshin.
Meetings with MJM in Hadibo and in Meyha and Di Midi. Mainly discussed *muqaddim* system; recent political changes and their effect on life on the island; the merits of sheep versus goats; drought survival strategies

Mubarak Muhammad Sa'ad : A soldier from the coastal village of Di Hamdh, working at Muri, currently in the radio room.
Several meetings with MJM in Muri on trips to the airport waiting for people or to meet with British Gas. Mainly discussed the army and changes in his job;

communications; fishing versus pastoralism; the lack of educational facilities or further training on the island; what the Aden Symposium on Socotra might produce.

Ahmad Ali Ramlahal : Pastoralist in the lower reaches of the Haggeher. Meeting chosen by him on our way to the high Haggeher. He wished to record his dislike of 'foreigners' wandering around his area and wanted Government to insist that no-one come into the interior without permission from the area *shaikh* and without having given clear explanations for his/ her reasons for the visit. I asked him to pass on the message to his area *shaikh* that I would be very glad to meet him and discuss our work with him. He came to see us, was very amicable, and played a very useful role in one of the group discussions held in the Haggeher. He said that Ahmad Ali was 'irrational' and had had a bad experience with visitors in the past.

Muhammd Ali Hammūdi Sowqer : In charge of Political Security on the island. Frequent meetings with *MJM* in Hadibo. He requested that I hand over letters of authority which permitted us to carry out the work we were doing, and then further letters of authority allowing us to remove dried plant specimens from the island. I explained that any letters we had had were handed over - at their insistence - to the military authorities as soon as we landed at the airport. I gave him a booklet and showed *Plants of Dhofar* to show him the sort of thing we hoped to produce on Socotra. While he paid no attention to the Marine Team (I suspect, as was suggested to me by one of his colleagues, because they had no arabic speaker with them), we saw a lot of him : our return visits for the odd day in Hadibo always included a visit from him to wherever we were staying. Our various remaining letters of authority from UNDP, Royal Botanic Garden etc. did not satisfy him, and he made leaving the island difficult for us. He finally allowed us to leave only on the promise of sending some authoritative letter to him on reaching San'a which gave us permission to remove dried plant specimens from the island. If we did not comply with this, he informed us that the plants would be removed from us at San'a airport. As a result I spent much time in San'a trying to get hold of such a letter, visiting various government department and the Ministry of Foreign Affairs offices. I finally had a very useful and productive meeting with *HE Ahmad Ali Al Akwā*, the Director of the Department of International Organisations in the Foreign Ministry, and received a suitable letter from him, a copy of which I faxed to *Muhammad Ahmad Abdullah*, the Director of Fisheries on Socotra, who was staying at a hotel in Makalla with a fax. He had promised to forward it to Muhammad Ali. Copies of this letter were also sent by HE to the Ministry of Public Health, Ministry of Agriculture, the Department of Security and the University of San'a.

Meetings in Sarra

The meeting with HE Ahmad Ali Al Akwār and others in his office was interesting and useful, and covered such matters as the development of Socotra, training for Socotrans, Yemeni scientists; the importance of information sharing; international aid organisations.

Muhammad Al-Araqi : Journalist of the Al Thawrah daily newspaper and author of several articles on Socotra (of which I collected copies). *Meeting with MJM in his house in Sarra*. Mainly discussed Socotra, development in general, the importance of publicity and journalism in influencing development and development priorities; Government policy; freedom of the press

GEF Biodiversity Conservation and Sustainable Development Programme

Annex Consultations undertaken by the Marine Team

Socotra Fishing Co-operative (Tawaniyah)

Ali Jamaan Mohammed, Accountant

Ahan Saad, Administrator

Village Leaders (Mukadams)

Saad Khamis (Hadibo, Suq and Serihin)

Abdullah Ahmed Abdullah (Eriyhan Dilishi)

Ibrahim Ashor (Eriyhan)

Ali Mubarraq (Idrisi)

Abdullah Hussain (Sugara)

Hadid Ahmed Saad (Mufraim)

Ahmed Hilli (Zehag)

Abdulla Alfian Salim (Stero)

Salim Saeed Dharan (Girmah)

Saeed Musalim (Betu)

Abdullah Hassan, Sheik (Shurubrub)

Obeid Salim Awad (Qalansya)

Ahmed Saad Mohammed (Zetmo)

Raib Ahmed, assistant to the Marmor, Bayt Issa (Abdul Kuri)

Fishermen

Achmed Haj (Diham)

Said Saad Sayeed (Nhodjdar)

Salim Amor Salim (Nhodjdar)

Abdul Rahman Salah Ahmed (Nhodjdar)

Khamis Said Thani (Hadibo)

Salim Abu Ali (Hadibo)

Abdullah Khamis Feraj (Hadibo)

Ali Amor (Eriyhan)

Abdullah Salim (Qubho)

Mubaraq Mamoud Mubaraq (Turbaq)

Mubaraq Saad Gamaan (Bidhola)

Mohammed Ali (Qalansya)

Mohammed Salim (Selmo)

Jamaan Ahmed (Rubha)

Mohammed Haj (Zetmo)

Ahmed Salah (Abdul Kuri)

Said Ahmed (Semha)

Mubarraq Hilal (Semha)

Pearl Fishermen

Saad Jumaan (Hadibo)

Jumal Jumaan (Hadibo)

Mubarraq (Qalansya)

Annex : Consultations undertaken by the Marine Team (continued)

Other Private Sector

Mohammed Ahmed, dried/salted fish trader

Adib Abdullah Hadid, caretaker, *Socotra Fishing and Sea Living Company* (defunct coldstore)

Ahmed Salim Fahad, dhow captain and dried/salted fish trader

Government Officials (Socotra Archipeligo)

Mohamed Salim, Public Health Inspector, Socotra Island

Ali Salah, Nurse, Health Department, Socotra Island

Ahmed Issa, Ports Authority, Socotra Island

Salah Ahmed, Doctor, Socotra Island

Ministry of Fish Wealth

Dr. Omar Subei, Research Director, Marine Sciences Resources Research Centre (MSRRC)

Feraj Mutleg, Head of Coastal Marine Environment Centre, MSRRC Aden

Other Government/Advisory Departments, Yemen mainland

Mr. HenkWim de Mooij, Resident Adviser, EPC

Mr. Paul Nichols, Monitoring Control and Surveillance Adviser, IV Fisheries Project

ANNEX 10

**COLOUR PLATES OF UNIQUE VEGETATION ILLUSTRATED IN A NEW SCIENTIST (1995) AND
A GUARDIAN NEWSPAPER (1996) ARTICLE**

SOCOTRA'S

Less than 250 kilometres off the Horn of Africa lies the forgotten island of Socotra, for centuries home to some of the world's most bizarre plants. Can the island join the 20th century without destroying itself, ask Diccon Alexander and Anthony Miller



AFTER three days and nights cramped on a shark fishing dhow in the middle of the Indian Ocean, with little to do but eat seafood and contemplate the next tropical storm, the sight of Socotra comes as a welcome relief. At first it is just a wisp of cloud on the horizon. A few hours later and the hazy outline of the island comes into view. Closer still and you are nearing the main settlement of Hadiboh, a parched town of squat houses set against towering mountains blanketed in cloud. It is then that you first glimpse some of Socotra's bizarre and beautiful plants—cucumber trees shining in the sun on the foothills of the mountains, and along the jagged skyline the mushroom-shaped silhouettes of Socotra's most famous plant, the dragon's blood tree.

This scene has changed little since the first scientific expedition in 1880. And

'Socotra's gene pool makes it an Indian Ocean version of the Galápagos'

the same skyline would have greeted the British botanist Quentin Cronk who "rediscovered" Socotra ten years ago. Scientists hadn't set foot on the island in two decades believing mistakenly that the environment had been destroyed by overgrazing. In fact, lack of development means that Socotra is much as it would have been in prehistoric times. "Socotra is one of the few dry, tropical islands left which is still relatively untouched by modern development," says Alan Hamilton of the World Wide Fund for Nature. "It represents a particular type of gene not really found elsewhere—a an Indian Ocean version of the Galápagos."

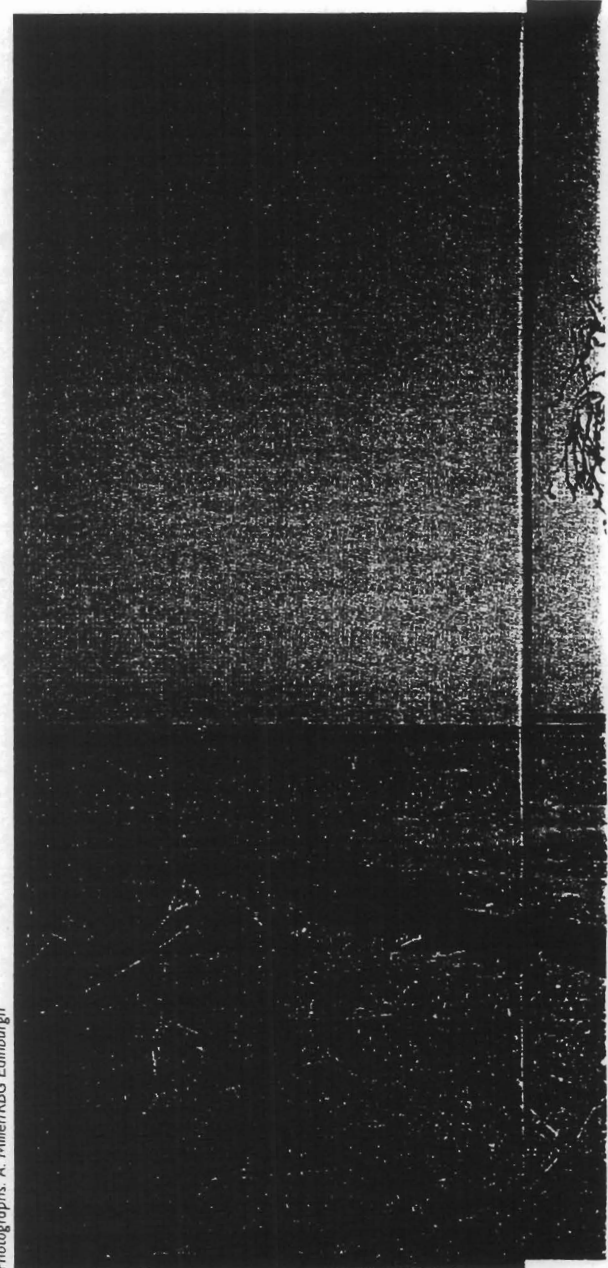
Isolation is the key to Socotra's pristine environment. It is only 240 kilometres from the Horn of Africa, but because

high winds and seas cut the island off for five months of the year, it is one of the most inaccessible places on Earth. Of the 850 plant species on Socotra, over a third are unique. Many of these endemic species are remnants of ancient floras which long ago disappeared from the African-Arabian mainland. This weird vegetation makes Socotra the tenth richest island in the world in terms of endemic plant species says the World Conservation Monitoring Centre.

Biologists find islands such as Socotra irresistible because they are "living laboratories" for the study of evolution and ecology. Islands represent a small part of the Earth's land area but a large part of its biodiversity, including about one-sixth of the total flora, so they are critical to global conservation. But these floras are particularly susceptible to extinction. For a start, they often cannot compete with weedy plants brought in from outside. And because they usually evolve in the absence of large grazing animals most of these plants lack anti-grazing defences such as thorns or poisons and are killed by livestock.

Socotra's rare species have escaped this fate. Relics of ancient species are so abundant that the island looks like most people's idea of a prehistoric world. Until at least 10 million years ago Socotra was part of the African mainland and, before that, part of the African-Arabian tectonic plate. Today the ancestors of plants from these ancient landmasses can still be found growing on the island.

Perhaps the most strikingly primitive plant is the dragon's blood tree (*Dracaena cinnabari*), sometimes called the "inside-out umbrella tree" because of its strange shape. Its nearest relative is the dragon's blood tree of the Canary Islands, also a relic of an ancient flora. Twenty million years ago the trees stretched



Photographs: A. Miller/RBG Edinburgh

MISTY FUTURE

from the Canaries, through the Mediterranean region to Southern Russia.

Legend has it that the tree sprung up from congealed blood shed by a dragon and an elephant as they fought to the death. Cinnabar, the crimson red resin from the tree's leaves and bark, was

highly prized in the ancient world. It was used as a pigment in paint, for treating dysentery and burns, fastening loose teeth, enhancing the colour of precious stones and staining glass, marble and the wood for Italian violins. Although it no longer has a commercial value, cinnabar

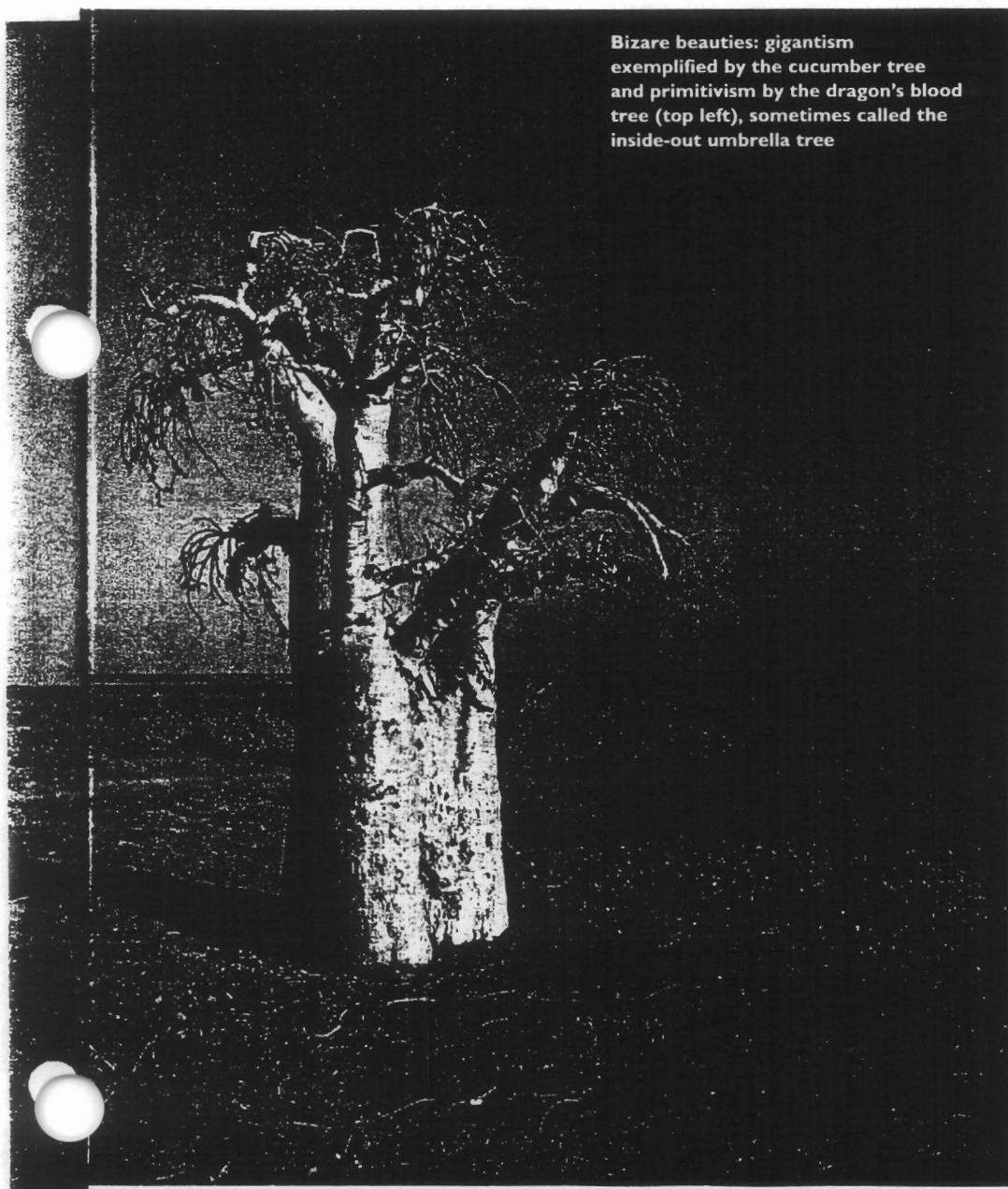
is an important resource for the 40 000 people who live on Socotra. They use it to cure stomach problems, dye wool, glue pottery, freshen breath, decorate pottery and houses and even as lipstick.

Many other Socotran plants are descendants of ancient species which have adapted to their new island environment. A varied landscape of semi-desert coastal plains, limestone hills and granite mountains, together with an extreme climate of low rainfall and hot summer winds of up to 70 miles per hour, create countless ecological niches and explain the wealth of endemic plants. Often these are restricted to highly localised habitats. The rugged granite pinnacles of the Haghier mountains, which rise to over 1500 metres and dominate the Socotran skyline, are a prime site. Heavy cloud hangs over the pinnacles during winter—hence Socotra's ancient name of "Isle of Mists"—bringing much-needed moisture to the pinnacle plants. The wealth of unique plants here include a species of woody cabbage (*Hemicrambe townsendii*) whose nearest relative is on the other side of Africa, in Morocco. New species are uncovered on every trip to the pinnacles, which are surrounded by almost impenetrable vegetation.

Below, on the rocky, exposed ridges and sheltered valleys of the limestone plateau grow exotic succulent trees. These include the Socotran fig (*Dorstenia gigas*) and the desert rose (*Adenium obesum* subsp. *sokotranum*). Their swollen bottle-shaped trunks keep the trees supplied with water during the summer droughts. Other plants in this habitat, such as a relative of the bluebell (*Ledebouria grandifolia*)—recently discovered in flower for the first time—cope with summer drought by hiding underground as bulbs until the rains begin.

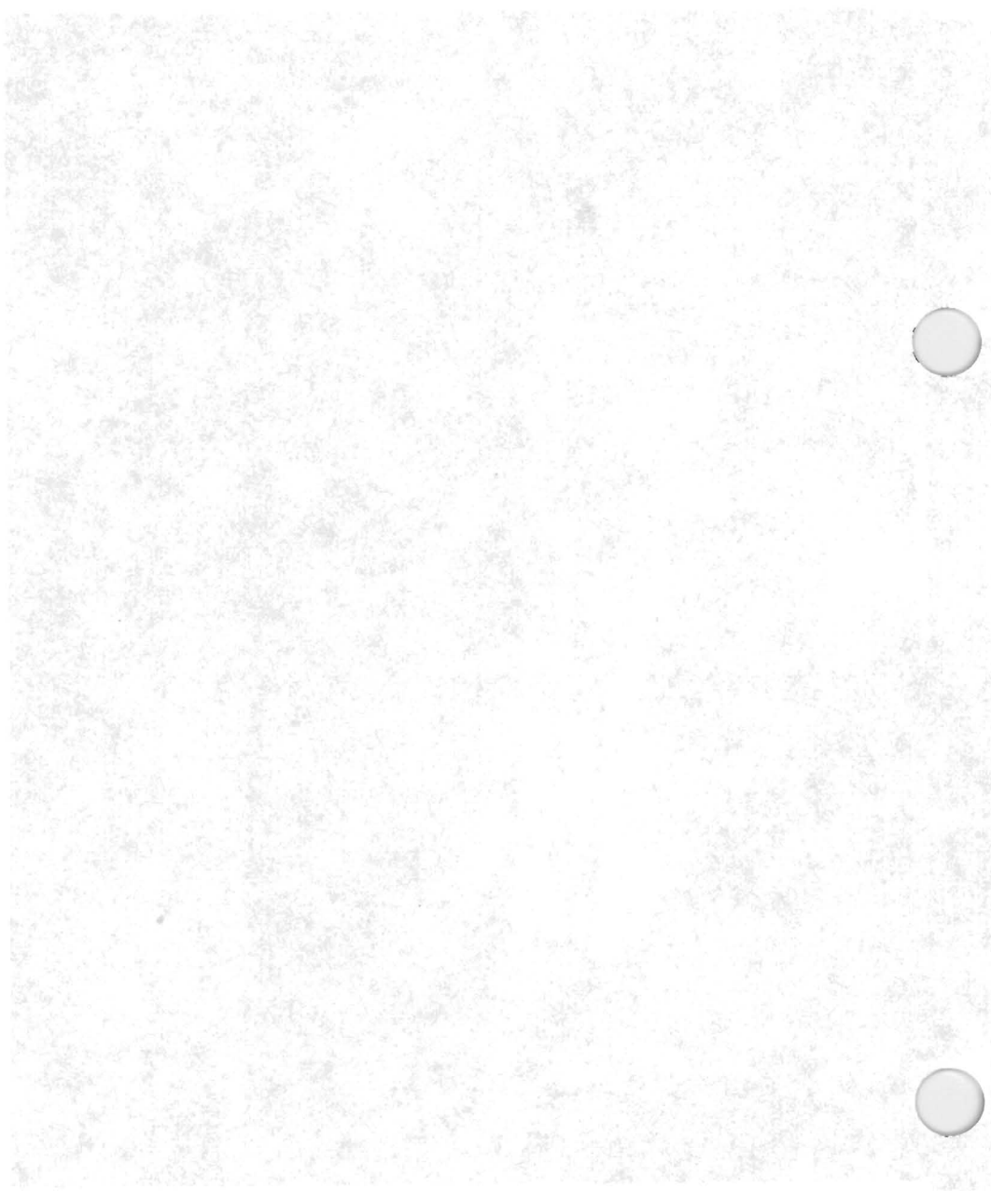
Socotra sports examples of gigantism—a curious phenomenon of island evolution. Until 10 million years ago, when the island was still part of Africa, any broad-trunked trees would have been destroyed by large herbivores like elephants and rhinoceroses. When Socotra broke away the absence of such herbivores and trees left a new ecological niche into which herbs and shrubs could grow, and grow. The most startling

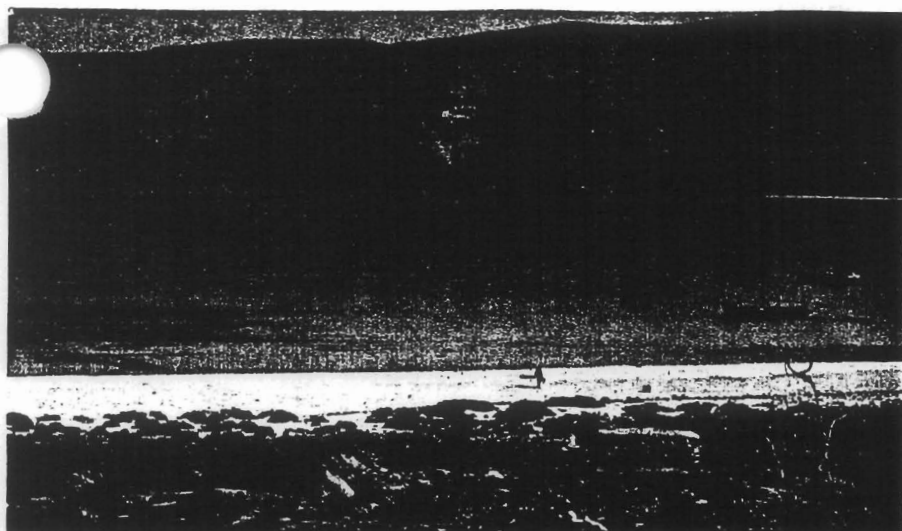
Bizarre beauties: gigantism exemplified by the cucumber tree and primitivism by the dragon's blood tree (top left), sometimes called the inside-out umbrella tree



INFORMATION

The following information is provided for your reference. It is intended to be a general overview of the project and is not intended to be a substitute for the detailed information provided in the attached documents. The information is provided as a service to the public and is not intended to be a substitute for the detailed information provided in the attached documents. The information is provided as a service to the public and is not intended to be a substitute for the detailed information provided in the attached documents.





example of gigantism is the cucumber tree (*Dendrosicyos socotrana*), found on the coastal plain. Most other members of the cucumber family are climbing plants or shrubs, but their Socotran cousin is a tree, up to four metres high with a bottle-shaped trunk and cucumbers hanging from its branches.

Socotra has been famous for its botanical riches for hundreds of years. As well as cinnabar, other products exported to the ancient Mediterranean region included resins of the local frankincense (*Boswellia*) and myrrh (*Commiphora*) trees, used in medicines and rituals, and the juice of the native bitter aloe (*Aloe perryi*), used as a purgative. By the 19th century news of Socotra's rich flora had reached the British Association for the Advancement of Science in London. In 1880 the Association launched the first ever scientific expedition to the island, led by the Scottish botanist Isaac Bayley Balfour who put Socotra on the map. In seven weeks Balfour collected more than 500 plant species, over 200 of which were new to science. But by 1967 a group of British botanists visiting the island came away believing that most

species faced imminent extinction from increasing human activity. If unchecked, goat-grazing and wood-cutting would rapidly destroy the natural vegetation. So many botanists gave up hope for the flora and visits to the island dropped.

Then in 1985 the island botanist Quentin Cronk resurveyed Socotra and found that the predictions of earlier scientists had been too pessimistic. Although there were still large herds of livestock and extensive wood-cutting, the environment was largely unspoilt. "Having seen the degradation overgrazing can cause," says Cronk, "I was staggered to come across a place which was in all probability substantially the same now as 1000 years ago." His discovery revived international scientific interest in Socotra. Specialists in Arabian flora have found many new species and traced almost all the previously recorded flora, including the only Socotran plant officially recorded as extinct by the World Conservation Union, the pink-flowered shrub, *Taverniera sericophylla*.

So why did Socotra's plants survive when the flora of many other islands have been destroyed by development?

Socotra's inaccessibility is one factor. Until recently there were just two weekly flights from Yemen to the airstrip outside Hadiboh—now even these have been suspended. Without an influx of people and technologies the Socotrans have had to use and protect their natural resources. They live by fishing, herding livestock, date cultivation and gathering plant products—a lifestyle that has changed little since the first settlers arrived over 2000 years ago. There are no ports,

Healthy growth: islanders want a harbour but still hope to protect such exotic species as the desert rose (near right) and the Socotran fig (far left)

proper roads, or sewerage facilities on the island, and Hadiboh has electricity for only a few hours a day.

With very little in the way of modern building materials and medicines, wild plant products are crucial to the survival of the Socotran people. So much so that they have developed a system for preventing over-exploitation of the island flora. These rules are enforced by a network of tribal elders who control, for example, the cutting of live trees and shrubs. The tribal elders also ensure that livestock are moved from one area to another to prevent overgrazing.

But just because the flora has survived until now, doesn't mean there is any room for complacency. Even with built-in safeguards, the balance between islanders and their environment is precarious. The problem is that Socotra's people are increasingly calling for the benefits that development would bring. Famine used to claim many lives during each summer drought—imports of milk powder, flour, cooking oil and rice, which began in the early 1970s, have largely put an end to that. But malaria and tuberculosis are still widespread and the infant mortality rate is 131 per 1000—one of the highest in the world.

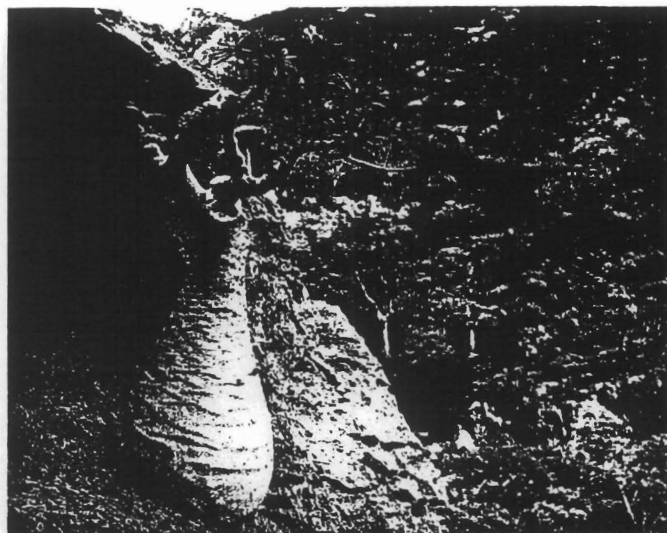
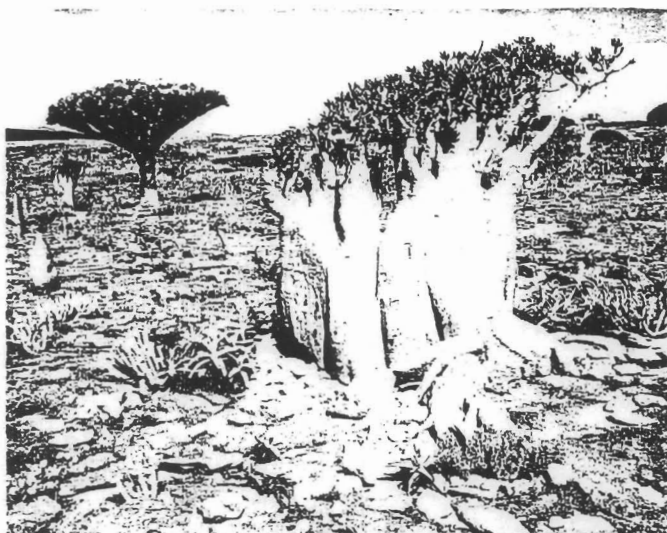
Better life

Miranda Morris, an ethnographer from St Andrews in Scotland, is one of a handful of Westerners to speak Socotran. She has visited the island several times to research its culture, and confirms that Socotrans want development. Many have relatives enjoying a better life in the Arabian Gulf. They say they want improved communications with the mainland, better healthcare and water distribution and imports of subsidised building materials to conserve trees on the island. Most importantly, they want a harbour that can be used in all weathers and freezer facilities so that they can earn a proper living from their fishing—the waters around the Socotran archipelago contain some of the richest fish stocks in the Indian Ocean. But Socotrans also recognise the dangers of uncontrolled development, particularly overgrazing. The people, says Morris, have "a clear understanding of the value to them of preserving the equilibrium between human and livestock numbers on the one hand, and the vegetation on the other". But is it possible to meet the needs of the islanders and still preserve Socotra's unique botanical heritage?

Development is certainly on the cards. Socotra is part of Yemen, and the gov-







ernment there has long-standing plans for the island. But action has been delayed by a lack of financial and other resources. The country has also been involved in a year-long civil war. Now, however, there is a new government keen to improve conditions on the island. This time the Yemeni government has joined forces with the United Nations Development Programme and put together a five-year conservation programme. If it goes ahead, it will be the first step towards giving Socotrans the development they want. First, however, Yemen must ratify the Convention on Biodiversity so that it can submit the programme to the Global Environment Facility (GEF), an international organisation that helps finance environmental projects. Ratification is imminent and there is a good chance the programme will be accepted. Eventually, it could get backing from British Gas. The company, which is currently looking for hydrocarbons off the coast of Socotra, has agreed to assist the conservation programme if exploration is successful.

The programme is good news for plants because it proposes research into natural ways to regenerate endangered species and the establishment of a nurs-

ery where seedlings can be grown before reintroducing them into the wild. If the programme goes ahead there will also be a survey to see how widespread and effective traditional land management practices are, as well as research to assess how changes in vegetation might affect people and their livestock. Experiences elsewhere have shown that ethnobotanical knowledge is one of the first casualties of modern development, so Socotra's programme is to include a plan to list local plant uses.

Field guide

A common problem for conservationists is the lack of comprehensive and user-friendly information on the plants they are trying to save. So botanists familiar with Socotra's flora are collaborating with Morris to prepare a field guide to plants and their traditional uses which they hope will serve as a model for conservation work elsewhere. At its centre is an illustrated plant identification key with cross-references to details on botany, ecology, and ethnobotany. The information will also be fed into a database, which will allow the project to analyse changing plant distributions and predict the impact of future development.

The GEF programme aims to build on the network of local village councils, and employ Socotrans in every aspect of the project. Some will train as guide naturalists to provide tours for the increased number of Yemenis who want to study botany, ecology and conservation in the region. Local people may also be involved in efforts to bring healthcare to highland communities and to put traditional medicine on a firmer footing by opening a pharmacy in Hadiboh. Perhaps most importantly, the project will screen products from certain endemic species for possible commercialisation abroad, as dyes, resins, gums and medicines.

With these plans comes renewed optimism for the future of Socotra. Development seems inevitable, and a sensitive approach could raise living standards for the people while preserving the unique plants that are their most important natural resource. If the programme does work it will be a rare success story for island conservation. If it fails, uncontrolled development could turn this fragile environment into a desert within a few decades. □

Diccon Alexander and Anthony Miller work at the Royal Botanic Gardens Edinburgh.

Island lives

THE number of endemic plant species on an island depends on its age, size, topography, climate, degree of isolation and geological history. The Canary Islands, for example, are home to over 500 endemic species—40 per cent of the flora. But Britain, which is over 30 times bigger, has only about 16 endemic plants—less than 1 per cent of the flora—according to figures from the World Conservation Union (IUCN). The reasons for this difference

include the Canaries' more diverse topography and warmer climate, and the fact that the islands have not experienced glaciations and have been isolated from the mainland for many more millions of years than Britain.

Broadly there are three types of island endemics—relict species, newly adapted species and adapted-relict species. Relict species are found on islands which, like Socotra, were once part of larger landmasses but have become isolated through continental drift

and changes in sea level. The species may die out on the mainland, leaving remnants of once widespread ancient floras on the island. Most of the plants of Madagascar and New Caledonia are relicts.

Newly adapted species are the product of accidental colonisation of an island by individual plants, which then adapt to the new environment. This type of endemic is commonly found on islands which have never been part of larger landmasses and are volcanic in origin, such as the Galápagos and Hawaiian Is-

lands. The third type of island endemic, adapted-relict species is the result of a second burst of evolution in the relict species.

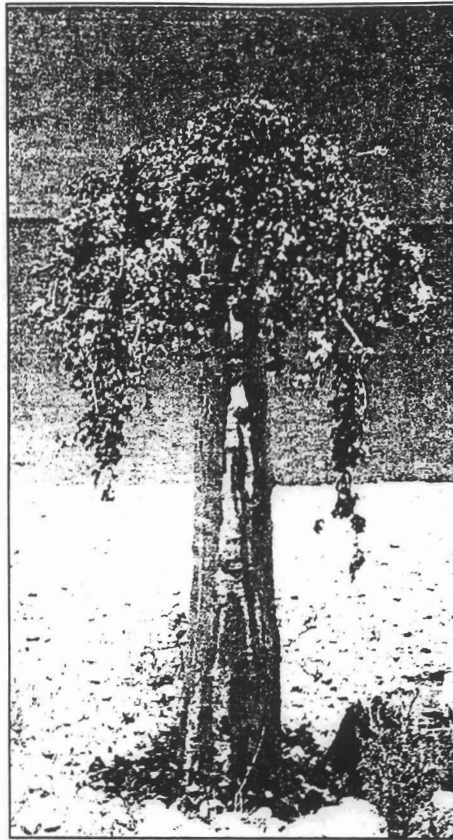
Today, island endemics make up a third of the world's threatened plants, and many are already extinct. On Saint Helena, alone, 96 per cent of the endemic flora is rare or threatened with extinction, says the IUCN. Seven endemic species are definitely extinct and another 50 or more are believed to have been wiped out since the introduction of goats in the 16th century.

ANNEX 11

DRAFT UNDP BROCHURE "SOCOTRA - GALAPAGOS OF THE INDIAN OCEAN",
(FOCUSING ON THE DEVELOPMENT NEEDS OF SOCOTRA AND THE GOVERNMENT AND
UNDP'S RESPONSE)

Island that time forgot now faces threat of the new

Paul Brown on a botanist's dream



Plants that died out millions of years ago elsewhere thrive on Socotra, a lost world in the Indian Ocean. Now scientists have drawn up plans to protect its unique species and the way of life of its 40,000 inhabitants against development plans



Endangered species . . . left to right, the cucumber tree, the Socotran fig, and dragon's blood trees which botanists fear could become victims of progress on the island

A GROUP of Edinburgh scientists are fighting for the survival of Socotra, a "lost world" in the Indian Ocean, where plants which died out millions of years ago everywhere else thrive.

It is the sort of place botanists dream about, so cut off that unknown plants still wait to be discovered and classified.

But with British Gas sniffing around for hydrocarbons, and the Yemeni government, which controls Socotra, wanting to build the island's first harbour, it is about to have a rude awakening into the 21st century.

The Royal Botanic Gardens in Edinburgh at the request of the Global Environment Facility (GEF), a branch of the World Bank, has come up with a blueprint to save the island's flora and fauna and the way of life of its 40,000 population.

A decision will be made on the scheme next month. It would mean money being provided for development but with scientists working alongside the local people to prevent the island being over-exploited.

The island — the size of Cornwall — is only 200 miles from the Horn of Africa. A third of the 850 species of plants found so far are unique.

For 2,000 years or so the island has been inhabited by a people who have modified their lifestyle to keep this strange vegetation alive. Cutting down a live tree is against village law and the number of their specialised miniature cattle and goats is limited to prevent overgrazing.

Anthony Miller, a botanist, who with a colleague, Diccon Alexander, is just

back from presenting the case for Socotra to the GEF, has been exploring the island by camel and on foot. The pair climbed some of the peaks on the island this winter and found 15 new species, including a new type of frankincense tree.

There is a cucumber tree and the dragon's blood tree, which 10 million years ago flourished across Africa. In the Middle Ages the crimson resin from the tree was called cinnabar and used as a pigment in paint and for treating dysentery and burns. At the time it was a mystery where it came from and its use has died out apart from on Socotra. The key to the survival plan is the role of Miranda Morris, one of the few westerners to learn Socotri, the local language. The islanders now want modern health care, electricity and clean water.

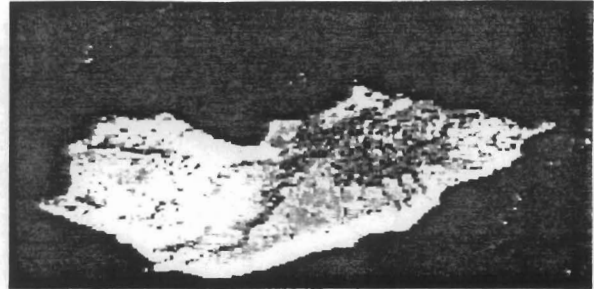
Ms Morris has made seven visits and studied the way of life of the local people, particularly how they use the plants for medicine and food. "They have uses for plants that we would never have understood and which I am trying to record in case anything goes wrong and the knowledge is lost."

The people have no written language so the history of the inhabitants, their legends and their poetry are being recorded before they are lost. So far British Gas has found no exploitable reserves but Mr Miller said: "Experience has shown that once these places are developed the vegetation is stripped and they turn to desert. Development is inevitable but it would be wonderful to save the best of this last remnant of a lost continent."

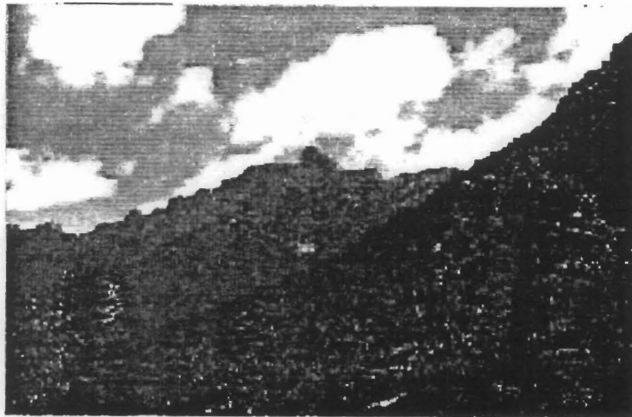
SOCOTRA- GALAPAGOS

of the Indian Ocean

A Botanical Treasure Trove



Dragon blood tree, Cucumber tree, Desert rose, Socotran fig, Frankincense, Aloe - these exotic names represent only a handful of the 280 plant species of Socotra Islands found nowhere else on earth. Endemic birds and reptiles also abound on these Islands, as do an inconceivable number of unique freshwater creatures and insects. Part of the Horn of Africa ten million years ago, the Socotra Islands now occupy a remote location 400 km south of Yemen and 200 km east of the Somali coast. They harbour a large number of species, now all but unknown elsewhere, that were once widespread on the African continent. The islands' long isolation from the mainland has also allowed ample time for distinct species to evolve. For centuries, their inaccessible location has protected the islands from irreversible human impacts, making this biological treasure trove the "Galapagos of the Indian Ocean".



Of the four islands of the archipelago, which is part of Yemen, Socotra is the largest, measuring 125 km by 42 km. The north-central mountain ranges and wadis mark the wettest and botanically richest section. A phenomenal number of endemic plant species are found only in the moist, densely vegetated valley of Muqadrihon Pass (*left*), the granite pinnacles of the Haggier Mountains, the rolling hills below, and the adjacent limestone plateaux. An example is a red-leaved frankincense tree belonging to a new, undescribed *Boswellia* species.

Spanning almost 80 km of the southern coast of Socotra Island is the Nogjd Plateau, which is 500 metres above sea level. Segregating this spectacular land mass from the Indian Ocean are vast coastal plains covered by sand and gravel with scattered trees and low shrubs, including several plant species unique to this part of the archipelago.

The smaller islands, Abd Al Kuri, Samha (*right*) and Darsa, share many endemics with Socotra, but also harbour their own flora. Abd Al Kuri alone holds fifteen species found nowhere else on earth.



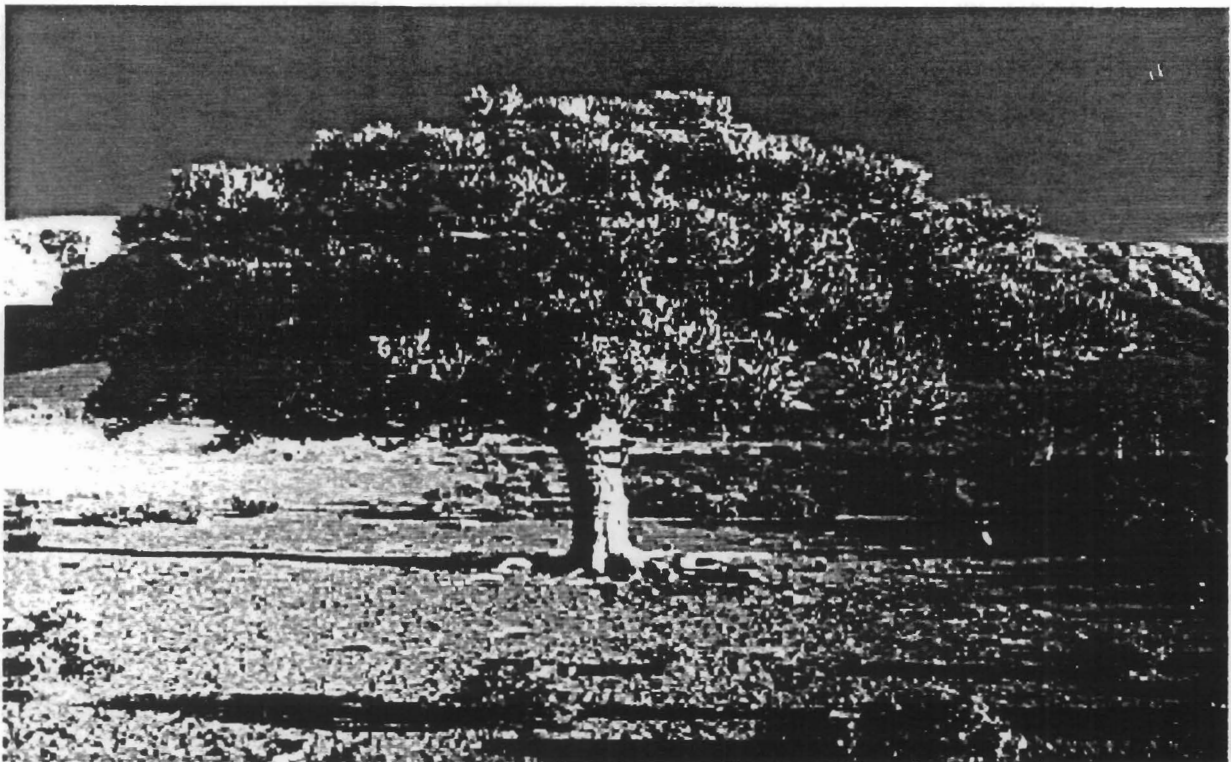
Plant Harvest

Since ancient times, Socotra has been famed for its treasured incense, gums, resins, aloe and other plant products. Early seafarers carried substances from its endemic plants to the mainland, where they were transported by caravans across Arabia to Egypt and beyond. Today, the red resin of the Dragon blood tree, *Dracaena cinnabari* (right), is still collected on a small scale for use in medicine, dye, glue and cosmetics. The tree's fruit, leaves and fibres provide a range of products, from materials to repair houses to fodder for livestock during droughts.

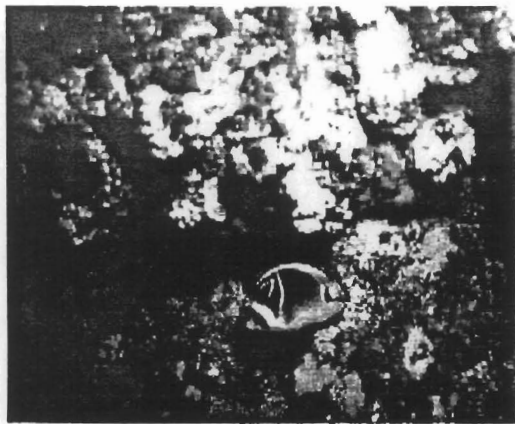


The Cucumber tree *Dendrosicyos socotranus* (left) is also endemic to the islands. At times of extreme droughts, its branches are cut, bit by bit, and pulped into animal feed - sometimes until the whole tree is consumed. Detailed studies are needed to determine why this species is not regenerating in some parts of the island. The Desert rose, like many other bottle trees, is characterized by a swollen tree trunk which stores water for the dry seasons.

This magnificent evergreen tree, *Euphorbia arbuscula* (below), provides vital fodder for pastoralists in extreme drought. It also provides timber, a rare resource on arid lands. Local villagers have tried to grow this important tree but are often unsuccessfully because they cannot afford the strong fencing materials needed to protect young seedlings from hungry goats. Other endemic plants such as the low shrub, *Croton socotranum*, also provide fodder, firewood and roofing materials.



Two Oceans Meet



The Arabian region has long been recognized as a center of marine endemism. The Somalia coast is believed to be a critical transitional area demarcating the two distinct biogeographic regions, the Arabian Seas and the Indian Ocean. The Socotra Islands lie right within this transitional band. The overlapping of the two biogeographic regions is indicated by the coexistence of Indo-Pacific butterfly fish such as *Chaetodon lunula* (left), and Arabian endemics such as *Chaetodon melapterus* (left below)



However the absence of the respective sister species of these fish suggests that Socotra's fish communities are not simply a mixture of species from the two biogeographic regions, but distinct communities unique to the area. The occurrence of similar patterns in several other fish groups further emphasizes the global biogeographic significance of Socotra.

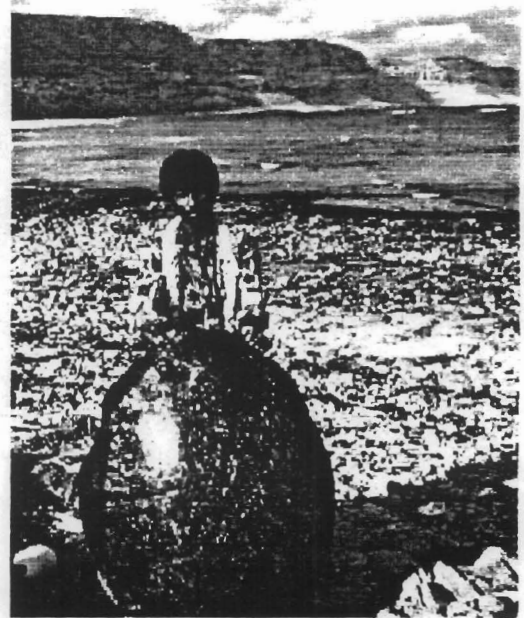
The shoreline of Socotra Island is extremely diverse. It is comprised of rugged rocky cliffs, windswept and scoured by pounding waves, rocky and sandy shores, boulder platforms overgrown by macroalgae, and miles of sand dunes with unpredictable shoreline behind. These provide abundant habitats for a large variety of life forms and communities - for example, the extensive coral fossil platform of the Nogid Plateau ends at Ras Qatanhin, the southwestern extreme of the island (bottom).



Fish Wealth

The people of Abd Al Kuri, Samhah, and the coastal villages of Socotra are subsistence fishermen, serving the needs of a relatively small population. Sharks, kingfish (*Scomberomorus commerson*) and tuna constitute the main catch. The fish are salted and sundried for sale to infrequent buyers from the mainland. Reef fish and lobsters are caught mainly for household consumption. For some villages, marine turtles provide a very important dietary supplement. During the summer months, when heavy monsoons make fishing impossible, they nest on the beaches, giving villagers access to them, as well as to their eggs. For five months of the year, the islands are cut off from the mainland by strong wind and high seas. However the annual upwelling during the southwest monsoons bring up nutrients from the sea bottom, providing rich nourishment to the area's productive marine resources

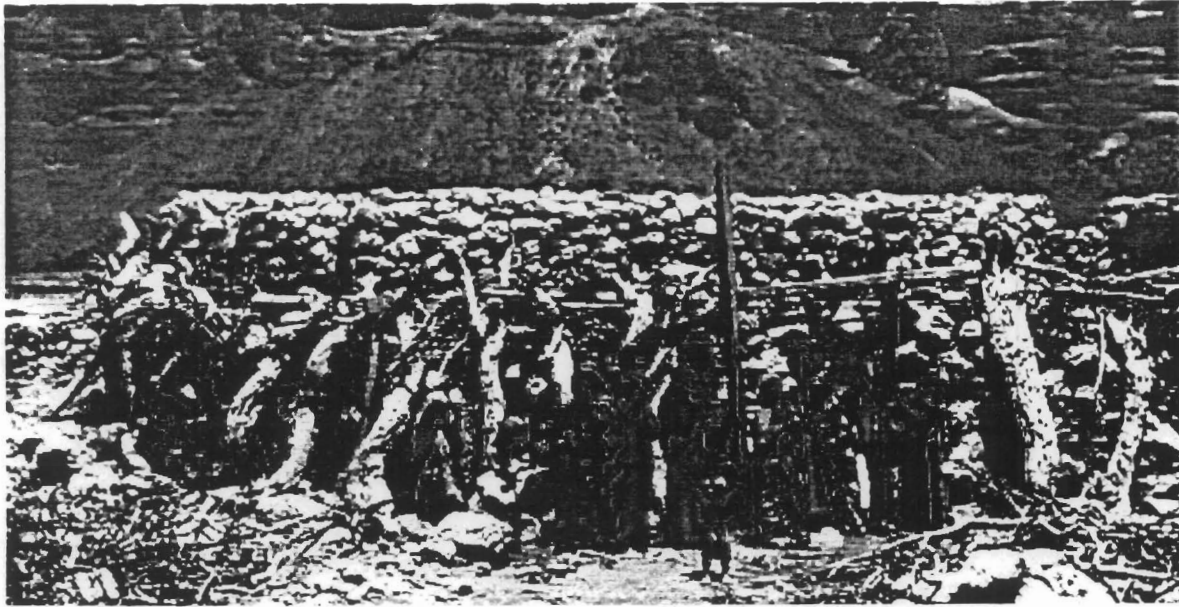
The resource base for sustainable fisheries remains as yet plentiful. The remoteness of the islands and the lack of post harvest facilities precludes overfishing, since access to commercial markets is limited. Only shark stocks are showing signs of decline, as the demand for shark fins (*below*) in the Gulf and Asian markets continues to expand. But it is likely that other highly priced sea products will be jeopardized in the near future. The depletion of resources elsewhere, such as lobsters off the mainland, is driving outside fishermen and traders to the vicinity of Socotra, which is, by comparison, an untouched haven too remote to be reached by effective rules and surveillance.



Though dependent on only a few target species the current subsistence level fisheries are crucial to the livelihood of the coastal population. People from the inland areas of Socotra also benefit from such fisheries by becoming seasonal workers during peak fishing seasons. Some even settle in the coastal region and become fishermen themselves.

Socotran fisheries presently adhere to traditional rules enforced by the local village councils (*muqadim*), that stress the need for conservation of marine resources by imposing limitations on fishing periods and gear (e.g. no fishing with nets during full moon and mid-days to "let the sea rest"). However these traditions are eroding as commercial fishermen from outside Socotra do not observe them and as economic incentives begin to take hold. A Sustainable Fisheries Management Program, supported by stocks assessment information, effective, enforced legislation, and environmentally sound, traditional management practices, is much needed in view of the social and economic changes foreseen.

The Forgotten People



While the fishermen are endowed with bountiful marine resources, and the occupants of the northern-central mountains of Socotra Island have rains and rivers which nourish the land for cattle and dates to grow, people of the dry interior rely solely on goats and sheep for livelihood. Throughout the islands, developments are needed in many sectors:

Water supply is a universal concern. Although there are locally constructed water catchment systems (*kareef*), costs for cement to line them and fencing materials strong enough to protect them from fouling by livestock, are often prohibitive for remote villages. Financial constraints also hinder the planting of fodder, timber and food crops. External assistance is needed to extend *kareefs* to additional areas.

Sanitation is a growing issue in major towns and coastal settlements. Contamination of drinking water are posing serious health hazards in some villages. Basic sewage treatment and quality control of well and *kareef* waters are much needed.

Health conditions on the islands leave much to be desired. Lack of basic health care facilities and education, malnourishment and imbalanced diet devoid of vegetables and generally poor living conditions all contribute to high mortality and morbidity. Tuberculosis, malaria, bruceilosis, giardia, amoebic dysentery and kidney ailments are common.

Housing patterns of the pastoralists are changing.

Traditionally caves are widely used during migration in search for water and pasture. The switch to stone houses with wooden beams is putting severe pressures on local timber. Several species such as the endemic tree *Maerua socotrana* are showing signs of overcutting. Nurseries for native trees, and subsidies for imported wood could alleviate pressure on the plants and improve people's living conditions.

Education opportunity is limited to the major towns, as food, water, books and teaching aids often fail to reach remote areas. Provision of these resources, as well as training of Socotran teachers, are key to establishing a human resource base which will cope with future environmental and social challenges.



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