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INDEPENDENT EVALUATION MISSION OF PROJECT

JOR/92/G31
JORDAN

CONSERVATION OF THE DANA AND AZRAQ PROTECTED AREAS AND THE STRENGTHENING OF THE ROYAL SOCIETY FOR THE CONSERVATION OF NATURE (RSCN)

28 MAY - 3 JULY 1996

EVALUATION TEAM

EVALUATOR	PRIMARY RESPONSIBILITY
THOMAS L: CRISMAN	TEAM LEADER AND AZRAQ
DONALD M: GORDON	RSCN
MARTYN G: MURRAY	DANA

I. EXECUTIVE SUMMARY AND MAIN FINDINGS

Evaluation of the Azraq and Dana projects and the institutional strengthening of RSCN were based on review of project documents and reports; interviews with governmental and university project staff and private sector tourism operators and detailed site visits. In addition, the evaluation team held discussions with the British, Canadian, and United States embassys. A full schedule of activities of the team during the Jordanian visit are included in the annexes. Finally, following the site visit, discussions were held with Ian Andrews, a noted authority of birds of the Azraq wetland and author of the most complete bird guide to Jordanian birds, and Dr. Wolfgang Schneider of the Hessisches Landesmuseum in Darmstadt, Germany, a noted authority on the fishes of Jordan including the Azraq wetland. Although Thomas Crisman served as mission leader and primary evaluator of Azraq, Martyn Murray as primary evaluator of Dana and Donald Gordon as primary evaluator of RSCN, all three individuals participated in the evaluation of all three components including document review, interviews and site visits. The following evaluation is truly a concerted effort based on lengthy discussions among team members.

AZRAQ OASIS

Through designation as a Ramsar wetland site in 1977, the international importance of the Azraq Oasis for global biodiversity and conservation was officially recognized. Groundwater extraction in the Azraq Basin to meet municipal and agricultural needs had expanded rapidly to a point that the entire wetland was essentially dessicated by 1992. The top priority of the project initially was to find sufficient water to bring the mostly dessicated Azraq wetland from the brink of complete biological disaster. By mid 1994 enough water to establish a core area of wetland around the Shishan springs and Ramsar site had been found. A number of biological surveys were conducted during this project that have provided a reasonable understanding of the species composition and biodiversity of the wetland. The restoration effort at Azraq is one of the first in the world to examine how wetland ecosystems respond to reflooding. Although the system is markedly different than it was twenty years ago, data on plant succession following reflooding will provide valuable information on how to manage wetland habitats for maximum conservation of local and migrating species. The results of this effort should serve as a model for wetland management throughout the Mideast and North Africa.

The mathematical models being developed by this project will provide Jordan with the analytical tool necessary to formulate sound management policies for their limited water resources. The establishment of a monitoring program for groundwater quantity and quality will provide data necessary to alter models to account for changes in groundwater quantity and utilization demands. Experimental retention structures have been built in several small wadis surrounding the Azraq wetland as demonstration sites for groundwater recharge with surface water runoff, and the efficiency of these is being monitored in detail.

A survey of the quantity and quality of groundwater in the Azraq Basin has been completed as have maps of irrigation water quality and soil salinization and a survey for soil chemical profiles has been completed. A great deal of effort has been made to get this information to local farmers, and this has helped greatly to make them feel that the Azraq project is a cooperator rather than a threat to their existence. Guidelines for agricultural development are nearing completion and should be well received.

An EIA (environmental impact assessment) unit has been established in the General Corporation for the Environment, but its future effectiveness is still uncertain. The EIA unit could play a major role in ensuring environmental protection in light of expanding

development. Currently, the EIA appears to remain weak both in ecological understanding and the ability to affect compliance with ecologically sustainable developmental practices.

The reserve headquarters is functional, plans for the visitor center have been completed, and construction of trails and observation towers and rennovation of the Roman wall are planned. Tourism will undoubtedly increase exponentially at Azraq, as it has at other important conservation and historical sites in Jordan as a direct consequence of the Mideast Peace Acord. Although infrastructural elements will have been completed at Azraq by the end of the current project, the site and community are not prepared for an unforeseen onslaught of tourists, and it is likely that uncontrolled access to the wetland will undermine the ecological successes obtained with current funding.

Establishment of the Friends of Azraq has provided a mechanism whereby the local community has become empowered in environmental affairs of the Azraq Oasis, and open dialogue is now possible among various interest groups for resolving conflicts between environmental conservation and regional development. Based on the current momentum level, this organization will likely gain strength and cohesion in the future and serve both as an effective environmental watchdog for the wetland and as a recognized emissary to the Jordanian government. It is likely that this organization will expand into the area of socio-economic concerns and help chart the course of regional economic development, especially related to an expected increase in ecotourism and the need for supporting infrastructure.

DANA RESERVE

Evaluation of the Dana project component was based on review of project documents and reports, interviews and discussions with RSCN staff, governmental representatives, embassy staff, university staff, and private tourism operators, and detailed site visits. The main findings of the evaluation have been set against the seven outputs of the Dana project component which are listed in the project document.

1. The Dana Nature Reserve was legally established in December 1993 and RSCN has been granted full legal authority to manage the natural resources in the reserve core area.

2. An attractive multi-purpose field station has been constructed near to Dana Village. It is now fully furnished and operational. Field staff have been equipped with 4-wheel drive vehicles and radio communications.

3. Fully professional baseline field surveys have been conducted for a number of key species and major taxonomic groups and the opportunity used to train Jordanian graduates in survey techniques. There has been little attempt to integrate these findings into a larger view of Dana's ecosystems or to understand how grazing livestock impact on ecological processes.

4. The rangeland study has revealed 52 Bedouin families with 8,000 - 9,000 livestock within the reserve. The study has made recommendations for controlling grazing, but did not investigate socio-economic needs of the Bedouin. The impact of livestock on plant and animal communities in the vicinity of permanent water was not assessed.

5. The project is commended for its socio-economic developments at Dana Village. Provisions for managing tourism have provided the reserve with a source of revenue which will hopefully sustain future operations.

6. The project has renovated the Dana terraced gardens and harvested and marketed the first organically grown crops. This achievement has helped to invigorate the village community which had been dwindling in size.

7. The shuttle bus system at the Campsite and the bus park at Dana Village, both of which were established by the project, are effective means of attracting visitors, whilst at the same time limiting disturbance and damage to the reserve and village. A draft management plan has been produced which defines key strategies for the reserve in terms of zoning schemes and specific action plans. The management plan is weak in the areas of law enforcement and community participation by the Bedouin.

A number of recommendations are made by the evaluation team.

1. In order to meet the growing regional threat of unsustainable developments which has been brought on by the signing of the Peace Accord with Israel in September 1994, it is recommended that RSCN should make provision for the legal establishment of a buffer zone around the reserve. It will be important for the future conservation of biodiversity in Dana that incompatible land-uses are controlled and sustainable socio-economic initiatives are assisted, within this buffer zone. In particular it will be necessary to limit the development of mass tourism and to encourage the growth of nature tourism.

2. Management needs to be guided by a better understanding of the ecological processes which underpin Dana's unique biodiversity. It is recommended that a scientific committee be established to guide the development of an applied research programme in Dana. Furthermore, it is recommended that a research program be established to provide data on woodland regeneration and the successional trends in plant and animal communities associated with permanent springs.

3. Reducing flock sizes and strictly controlling livestock movements is a priority for reserve management. It is recommended that a vigorous outreach programme be initiated to ensure that the Bedouin families can participate in the reserve's conservation programme.

4. Survey reports indicate a possibly high incidence of hunting, baiting, trapping and poisoning in the reserve. It is recommended that the number of rangers be augmented so that the frequency of patrols can be increased and a closer liaison achieved with the local population.

INSTITUTIONAL STRENGTHENING OF RSCN

The project has been successful in implementing most of the institutional strengthening aspects it set out to achieve. The end result is an organisation which is accountable, efficient, and well focussed in meeting it's mandate. Institutional strengthening has supported infrastructural development at headquarters and at reserve level, in providing the latest in office equipment and technology, and has strongly supported human resources development through an active recruitment and training programme. The operating procedures and policies of the organisation are now of a highly professional nature.

Institutional strengthening of RSCN has been extended to great effect to Dana Wildlife Reserve and, increasingly, to a number of other protected areas in the country. The activities of the various Sections within RSCN have supported efforts at the site level, and the extension of procedures and the working ethos of the organisation to Dana is beginning to yield tangible socio-economic benefits. Through proper long-term management, Dana could indeed become a fully self-sufficient model, integrating conservation and sustainable development aspects.

Although progress at Azraq Wetland Reserve has been commendable in terms of wetland rehabilitation, integration of effort between the Azraq Wetland Reserve subcomponent of the Azraq project and RSCN has been less than optimal. This, in part, has been a result of not having a sub-project manager to ensure proper integration and extension of RSCN capacity building activities to Azraq. Nevertheless, in order to ensure the effective long-term management of Azraq in both a scientific and managerial sense, in line with developments at other reserves, this will necessitate priority action on the part of RSCN in the coming months.

Extension of the project for a period of 12-18 months would be warranted from an institutional strengthening perspective on two counts: (i) to enable consolidation of progress made thus far, ensuring that the depth and breadth of the organisation, in terms of expertise and staff compliment, continues to develop; and (ii) enabling RSCN to meet it's mandate in the face of rapidly increasing demands and responsibilities, brought about through the introduction of new laws and policy, the need to manage steadily increasing tourist demands and development pressures in and around the reserves, and in collaborating with and supporting other agencies in the development of their own institutional capabilities, through training and other initiatives, in support of environmental management. Clearly, however, any expansion in activities on the part of RSCN during a potential project extension would need to be taken in line with the organisation being able to sustain a high level of service and commitment in the foreseeable future.

II. PROJECT CONCEPT AND DESIGN

A. PROJECT CONTEXT

AZRAQ OASIS

Azraq Oasis is a large wetland complex located approximately 80 km east of Amman at the lowest point of a 12,700 sq km transboundary drainage basin joining Jordan (94% of total basin area), Syria (5%) and Saudi Arabia (1%). Historically, the system consisted of three distinct habitat types: 1) springs/open pools at the northern and southern extremities of the complex, 2) a central wetland complex of emergent vegetation interspersed with open water areas and 3) a broad outer band to the east and south consisting of a vegetation devoid mudflat that exhibited seasonal flooding during pronounced winter rainy periods. Until recently, the Azraq Oasis has served as a major stopping point for migratory birds following the West Palearctic-Afrotropical flyway. The international biological uniqueness of the Azraq Oasis was recognized in 1977 when 7,372 ha of the wetland and adjacent mudflat were declared a Ramsar Convention site. During the 1960's, 28 species of water birds bred in the wetland and waterfowl populations exceeding 340,000 were often recorded during winter.

Jordan is a desert to semi-desert country with 95% of the area receiving less than 20 millimeters rainfall annually. With a rapidly expanding human population and few surface water alternatives, the nation has had to rely almost totally on groundwater to meet both municipal and agricultural water needs. Numerous wells have been constructed throughout the Azraq basin, and direct extraction from the springs and pools of the Azraq Oasis has been integral components of the municipal water supply for Amman. Both the State of the Environment Report (1990) and the National Environmental Strategy (1992) recognized the uniqueness of the Azraq Oasis and the extent of ongoing environmental degradation. The NES went so far as both to identify the rehabiliation of Azraq Oasis as one of the most urgent priorities in the conservation of wildlife and habitats in Jordan and the depletion and salinization of groundwater and low efficiency of irrigation as major contributors to the environmental

problems of Azraq. Water extraction expanded to a point recently that natural discharge for the four main springs of Azraq fell from 10.49 million cubic meters in 1981 to approximately 300-400,000 cubic meters in 1991. Both springs at the northern end of Azraq ceased flowing out in 1987 and one of the two springs supplying the wetland from the south stopped during August 1992.

DANA RESERVE

The Dana Wildlands covers an area of about 308 square kilometres on the eastern slope of the Jordan Rift Valley, where the desert lowlands of Wadi Araba in the west are connected to the Sharrah mountains in the east by the steeply dissected terrains of Wadis Dahal, Dana, Ghuweib and Hamra. The wide range in elevation (100 - 1,500m above sea level) is associated with marked gradients in rainfall and temperature, and four distinctive but contiguous biomes are recognised: 1) Mediterranean semi-arid vegetation, dominated by Juniper and oak, occurs above 800m elevation where annual precipitation averages 300mm; 2) Irano-Turanian mid-altitude steppe consists of scattered shrubs with occasional Juniper; 3) Acacia sub-tropical vegetation is found at lower elevations, dominated by *Acacia* spp. but with dense vegetation near water sources; and 4) Sand dune desert vegetation, with mean annual precipitation of <50mm supports xerophytic shrubs and scattered *Acacia tortilis*. In 1993, the fauna of Dana Wildlands was known to include remnant populations of ibex. Other large mammals known (or thought) to occur included two species of gazelle, grey wolf, striped hyaena, red fox, wild cat, caracal, honey badger and porcupine. The avifauna was known to include a number of species with relatively restricted ranges and a high diversity of breeding raptors. The international biological uniqueness of Dana Wildlands was recognised in September 1989, when the Minister of Agriculture declared this land area as the Dana Nature Reserve and again in December 1993 when the Prime Minister's Cabinet formally agreed that the area be allocated for the Ministry of Agriculture - to be used by the Royal Society for the Conservation of Nature (RSCN).

Numerous archaeological sites are witness to a long history of human influence on the reserve area. The most visibly important sites are the Nabataean copper mining centre of Feinan and a series of occupational remains from the Hellenistic to the early Islamic periods. The Village of Dana which is located in an easily defended position at the head of Wadi Dana, dates back at least as far as the XVI century. A main feature of Dana Village is the terraced gardens where five main springs provide an abundant supply of water year round. The population of Dana declined during the 1970's when the majority moved to the newly founded town of Quadessya in search of jobs and better services. Five other settlements, ranging from 50 - 12,000 inhabitants occur in the proximity of the reserve, and some 52 families of Bedouin pastoralists graze their animals within the reserve either seasonally or permanently. Located 5 km north of Quadessya is the Rashadyia Cement Factory Plant which employs approximately 1200 workers to produce Portland cement. Actively used limestone and shale quarries are located at the edge of Wadi Dana together with a crusher system. The Natural Resources Authority has recently conducted intensive mining explorations in Wadi Dana and the Feinan area to assess the feasibility of copper and manganese extraction.

INSTITUTIONAL STRENGTHENING OF RSCN

Deterioration in the state of Jordan's environment led to preparation of a State of the Environment report (1990) and to the development of a National Environment Strategy for improved management of the nation's natural resources (1992). Top priorities of the strategy included: (i) strengthening of the Royal Society for the Conservation of Nature (RSCN); (ii) rehabilitation of the Azraq Oasis; and (iii) expansion of the protected areas system, with specific reference to the Dana

Wildlife Reserve.

Mandated by the Government of Jordan, RSCN is a private, non-governmental organisation with public service status.RSCN was established in 1966 under the patronage of HM King Hussein, the Honourary President, and is the only non-governmental organisation in Jordan dedicated to the conservation of nature and natural resources. Specifically, RSCN is responsible for nature conservation and wildlife protection, the management of protected areas, and providing support to the Jordanian programme for conservation education. In carrying out it's mandate, RSCN collaborates with the ministries of Planning, Municipal and Rural Affairs and the Environment, Agriculture, Water and Irrigation, Public Works, Energy and Mineral Resources, and Tourism and Antiquities.

Prior to the project, the capability of RSCN to deliver its mandate in a timely and effective manner was hindered by an organisational structure which was inappropriate to meeting rapidly changing and expanding demands, inadequate staffing and funding levels, and a programme which lacked clear direction and targets for the organisation. The project therein provided substantial support to re-align and strengthen RSCN's institutional capacity to successfully implement the Dana and Azraq conservation management plans, increase the scope of the organisations environmental education programme to reach all sectors of Jordanian society, and extend conservation initiatives throughout the country.

B. PROJECT DOCUMENT

1. THE PROBLEM AND THE TECHNICAL APPROACH

AZRAQ OASIS

With a rapid expansion in groundwater extraction within the Azraq Basin during the past two decades natural discharge for the four main springs of Azraq fell from 10.49 million cubic meters in 1981 to approximately 300-400,000 cubic meters in 1991. The northern portion of the Azraq wetland totally dessicated during 1987 following cessation of flow in the two source springs. One of the two springs supplying the southern portion of the wetland including the Ramsar site stopped discharging in 1990, and flow in the second spring ended in August 1992. With the exception of two small stagnant pools at the southern springs, the entire Azraq wetland became totally dessicated by December 1992 and fires were a frequent occurrence in formerly vegetated wetland areas. The final disruption to the water supply for the Azraq wetland came in 1992 when the principal seasonal surface water input to the system, Wadi Rajil, was dammed to promote groundwater recharge.

The primary focus of the Azraq project component is to establish a sustainable basis for the utilization of the water resources of the Azraq basin for both municipal and agricultural needs, while at the same time ensuring water of sufficient quanitity and quality to conserve the internally recognized biodiversity of the Azraq wetland ecosystem. Restoration and rehabilitation of the wetland system was to be achieved by: 1) providing groundwater from other sources to replace the defunct spring discharge, 2) preparation and implementation of a management plan for the Azraq Wetland Reserve and 3) improved management of the seasonally flooded mudflat (qa) wetland. The Azraq component seeks to demonstrate how the problem of competitive water resource needs for humans and nature can be resolved through integrated water resource menagement with a focus on groundwater. The project also addresses the priority issue in arid lands, water supply, and emphasizes an integrated 'wise ues' approach to the utilization of a scarce resource. A long term research component is also

included that focuses on new technologies for groundwater recharge in arid regions, with a look to broad application in similar regions worldwide.

DANA RESERVE

Four socio-economic and tribal groupings of resident and nomadic peoples graze their domestic animals (mainly goats, but also some sheep, donkeys and camels) inside the Dana reserve. In 1993, it was estimated that 2,500 - 5,000 head of livestock grazed within the reserve for at least part of the year. In addition to these groups of pastoralists, two new communities were becoming established at the reserve's boundary at the mouth of Wadi Dana. Preliminary assessments suggested that overgrazing had substantially reduced the abundance of all but the most resistant plants of the herb layer and was preventing or slowing the regeneration of Cypress and other trees. Overgrazing was also thought to be accelerating soil erosion from steep valley walls. Other threats to the biodiversity of the reserve included the quarrying activities on the ridge above the northern boundary of the reserve, and the possibility that mining for copper and manganese would be initiated in Wadi Dana and Feinan. This latter would permanently scar some of the principal natural features of the reserve, cause substantial erosion and pollution problems and entail construction of approximately 50 kilometres of road inside the reserve.

The primary focus of the Dana project component is to replace unsustainable utilization of the reserve's natural resources with sustainable development initiatives, which address the social and economic needs and aspirations of the communities living in close proximity to the reserve, without conflicting with the objectives of conservation. The shift towards sustainable utilization was to be achieved by the preparation and implementation of a conservation and management plan. This would entail: 1) collection of detailed ecological information; 2) assessment of threats to biodiversity posed by livestock grazing and fuelwood collection; 3) construction of accommodation and research facilities at Dana Village; 4) preparation of a management plan for the reserve and associated economic developments and training of field staff in the skills necessary for its implementation; and 5) initiation of complementary economic development activities amongst the local communities. The principal development activities were to be the re-establishment of terrace-garden agriculture as the basis of the Dana Village economy, and sustainable grazing regimes combined with small-scale primary and cottage industries for both pastoral and agricultural communities. The advantages of conservation would be underscored by the establishment of Dana Reserve as a tourist destination demonstrating two different traditional Arab cultures living in harmony with diverse ecosystems and a rich history.

INSTITUTIONAL STRENGTHENING OF RSCN

The context for undertaking this project was well presented, as was justification for focusing on the Dana Wildlife Reserve and Azraq Oasis. Azraq oasis once represented an outstanding example of an oasis wetland in an arid region and was especially important for migratory birds. In recognition of this importance, the site was established as a Ramsar wetland in 1977. Following degradation of the area, the primary objective to this subproject was the restoration and rehabilitation of the aquatic ecosystems in and around the wetland reserve. This was to support both the sustainable use of water resources and the conservation of biodiversity. The Dana Wildlife Reserve is an important site for endemic and endangered species of flora and fauna, and comprises three distinct but contiguous biomes. The Dana project has been viewed as an important model in conserving biodiversity by addressing socio-economic needs of local communities living in and around the reserve. The project document provides a concise description on the current state of knowledge, issues and threats facing these two areas.

The successful management of these sites is clearly linked to the institutional capacity and strengthening of RSCN in the project document. Capacity building encompasses improvements to both scientific and managerial competence at RSCN, which is then extended in support of reserve management and development.

Mechanisms identified to ensure the integration of project subcomponents include the establishment of an Interministerial Steering Committee to provide overall coordination for the project and to ensure the effective collaboration between the many agencies involved, particularly at the Azraq Oasis. Further, by virtue of the new Protection of the Environment Law (No. 12 of 1995), a Council for Environment Protection has been created and will play an increasingly important role in ensuring coordination between relevant agencies (with representation from the President of RSCN) dealing with environmental issues. A Management Unit was created to administer the Azraq project as a whole, and a small Steering Committee, comprising staff of RSCN and the Azraq subproject was established to oversee the implementation of the Azraq Wetland Reserve subcomponent. The Dana component is supported by the Dana Forum, representing a wide range of stakeholders who advise on the management and development of the reserve. A special Scientific Advisory Committee was also to be established; unfortunately, this met with limited success, in part due to a lack of in-country expertise and commitment to form such a committee.

2. OBJECTIVES, INDICATORS AND MAJOR ASSUMPTIONS

AZRAQ OASIS

The Azraq project component consists of six immediate objectives:

1. Rehabilitation and management of Azraq Wetland Reserve
2. Establishment of an environmental impact assessment unit within the General Corporation for the Environment and improved implementation of the Ramsar Convention in Jordan
3. Establishment of guidelines for agricultural development in the Azraq Basin
4. Investigation of groundwater resources in the Azraq Basin and development of a water management plan for the basin
5. Support for long-term research on the conservation and management of water resources in arid and semi-arid regions
6. Strengthen the capability of RSCN to manage the Azraq Wetland Reserve and reserves in Jordan and to foster environmental education and public awareness

In order to meet the above project objectives, a number of success indicators have been proposed including:

1. Restoration of a core area of the wetland around the springs to a near natural condition with maintainance of biodiversity intact.
2. Repair of existing infrastructure at Azraq, construction of a new reserve headquarters and visitor center, and development of a well trained staff.
3. Provision of scientific, educational and recreational opportunities for national and foreign visitors
4. Establishment of a small EIA unit within the General Corporation for the Environment capable of meeting the nation's EIA needs.
5. Guidelines for agricultural development in the Azraq Basin will be developed based on sustainable utilization of limited space and ground water resources.
6. A water management plan for the Azraq Basin will be completed by the end of the project.

7. Compilation of published reports and guidelines relating to water harvesting, artificial recharge of surface runoff and treated waste water, and water conservation and management practices in arid and semi arid lands.
8. Strengthening of the capability of RSCN to manage the Azraq Wetland Reserve and reserves in Jordan and to foster environmental education and public awareness

Throughout the project document there are a number of assumptions that are critical to the successful completion of the Azraq project component. The first assumption is that sufficient water can be found or reallocated from current usages to supply the Azraq wetland with water of appropriate quality and quantity to maintain an intact functioning ecosystem to support regional conservation and migratory birds. The second assumption is that the structure and functioning of the ecosystem will return intact once the dessicated wetland is reflooded. The third assumption is that the government of Jordan will ensure needed allocations of water to the Azraz wetland regardless of future alterations in private and public sector demands for water.

DANA RESERVE

The Dana project component has the broad objective:

> to ensure conservation of the biological diversity of all ecosystems occurring in the Dana reserve area.

A single immediate objective is identified in the project document:

> Preparation and Implementation of the Dana Conservation and Management Plan.

Strictly speaking, this is a method for formulating and carrying out objectives rather than a true objective or goal. The 'end of project situation' and other sections of the project document suggest the following major project objectives:

1) to survey the reserve boundary and prepare and enact legislation which formally establishes Dana as a protected area, and officially identifies RSCN as responsible for its management;

2) to assess the biological diversity of the reserve;

3) to quantify existing threats to biodiversity from livestock grazing and fuelwood collection;

4) to address the economic needs of livestock owning communities impacting on the Dana reserve ecosystem and concomitantly to introduce conservation measures;

5) to re-establish terrace garden agriculture as the basis of the Dana village economy;

6) to establish Dana as a tourist destination featuring diverse ecosystems and a rich history of human occupancy;

Success indicators for meeting these objectives are not specified in the project document.

Two implicit assumptions underlie the Dana project component which are critical to its successful completion. The first assumption is that human activities in areas surrounding Dana reserve will have minimal impact on biodiversity within the reserve, and hence good management within the reserve area will be sufficient for conservation purposes. The second

assumption is that native plant and animal communities of Dana will recover naturally following a reduction in grazing intensity by livestock and fuelwood collection.

INSTITUTIONAL STRENGTHENING OF RSCN

The Dana/RSCN and Azraq subproject documents were presented in a manner which linked immediate objectives, outputs and activities. In addition, there was a section entitled Expected End of Project Situation.

The projects (Azraq and Dana/RSCN subprojects) were monitored through a series of quarterly and annual reports, Project Performance Evaluation Reports, audits, and tripartite reviews. In the case of the RSCN/World Bank contract for the implementation of the Dana project, this component was monitored through a Schedule of Payments (quarterly) and Conditions of Issuance.

A number of assumptions were inherent to the project documents. These included the following:

1. Full integration of the Azraq and RSCN/Dana subcomponents into one project, given their differing historical origins;

2. The successful restructuring of RSCN to enable the organisation to fulfil its mandate more effectively;

3. Coordination and implementation of the Azraq Wetland Reserve and Dana subprojects through a restructured RSCN;

4. Integration of effort between the many agencies involved in the Azraq Oasis project;

5. Establishment of the detailed ecology of the Azraq Wetland Reserve and Dana Wildlife Reserve by the end of the project;

6. Sustainable socio-economic activities to be established in and around Dana Wildlife Reserve.

In theory, implementation of the Azraq and Dana subcomponent through a restructured RSCN was a viable assumption. The time frame (3 years) for establishing the detailed ecology at both sites was probably optimistic, as was establishment of fully sustainable socio-economic activities around Dana.

III. PROJECT IMPLEMENTATION

A. ACTIVITIES

AZRAQ OASIS

Activities listed in the project document for each of the six objectives of the Azraq project component were:

1. Rehabilitation and management of Azraq Wetland Reserve

a. Provide 1.5-2.5 million cubic meters per year of water to the wetland from wells and continuously monitor water quality
b. Extend the boundary of the wetland reserve to include the two Shishan springs abandoned by the Water Authority

c. Repair fencing around reserve and extend this to include the Shishan springs
d. Remove feral horses and water buffalo, abandoned infrastructure, and rubbish from the reserve
e. Produce a comprehensive management plan for the Azraq Wetland Reserve and introduce a system of strict zonation controlling access and use.
f. Implement wetland practices to maintain wetland fauna and flora and reintroduce extinct aquatic biota
g. Establish a visitor center complete with appropriate educational awareness exhibits, renovate the Roman wall, install nature trails, board walks, observation towers and other basic infrastructure for public use
h. Promote tourism
i. Provide on-the-job training for reserve staff in wetland management techniques, a study tour for three RSCN personnel to visit reserves and institutions in the United Kingdom, and participation by an RSCN staff member at the Fifth Ramsar Conference of Ramsar in Japan.

2. Establishment of an environmental impact assessment unit within the General Corporation for the Environment and improved implementation of the Ramsar Convention in Jordan

a. Develop a four-person core unit, back-stopped with seconded government personnel and contracted non-governmental experts
b. Prepare and enact national EIA legislation
c. Undertake EIAs for proposed development projects in Jordan as needed
d. Conduct impact assessments of the Wadi Rajil Dam as well as initial scoping of all proposed dams in the Azraq Basin
e. Conduct a socio-economic assessment of land uses and practices in the Azraq Basin and how these impact overall management of land and water resources
f. Investigate past and present salt extraction, aquacultural activities, assess their environmental impact, and propose a set of guidelines for their future operation
g. Investigate current uses of agricultural chemicals, assess their environmental impact, and propose a set of guidelines for their future use
h. Establish a permanent monitoring procedure at the Ramsar site
i. Identify possible conflicts of interest between development activities in the region and maintenance of the ecological character of the Ramsar site
k. Establish institutional mechanisms whereby conflicts of interest can be open to debate and resolution
l. Prepare a management plan for the Ramsar site and other significant wetlands in Jordan
m. Prepare informative and educational materials on Ramsar Convention and implications in Jordan for dissemination to schools, universities and the mass media, and prepare a display on the Ramsar Convention and the Azarq Ramsar site to install in the proposed visitor center at the reserve
n. Provide on-the-job training for staff of the EIA unit and Ramsar Office and fellowships and training courses for DOE staff in environmental impact assessment; support participation of DOE staff in international seminars, workshops and conferences on environmental impact assessment; provide in-country training workshop on policies and procedures for environmental impact assessment.

3. Establishment of guidelines for agricultural development in the Azraq Basin

a. Inventory of current agricultural activities, irrigation practices and fertilizer use in the Azraq Basin

b. Determine return flow through soil strata to assess influence of irrigation practices on ground water quality
c. Prepare soil salinity and irrigation water quality maps for all cultivated areas as well as for the Azraq Wetland Reserve for the latter
d. Provide a study tour for staff to visit regional institutions tackling similar problems in arid regions
e. Prepare a set of guidelines for agricultural development in the Azraq Basin

4. Investigation of groundwater resources in the Azraq Basin and development of a water management plan for the basin

a. Review previous and ongoing studies on the geology, hydrology, hydrogeology, meteorology and soil science of the Azraq Basin and develop a work plan for studies to complement these
b. Conduct an inventory of all boreholes and wells in the area surrounding Azraq Oasis, select representative wells for monitoring and establish a monitoring program for water levels, withdrawal practices and water quality
c. If needed, drill a maximum of four new monitoring wells
d. Update Ministry of Water and Irrigation database with data collected by this project
e. Conduct modelling studies groundwater flow, water quality and possible migration of saline/brackish water in aquafers.
f. Provide on-the-job training for Ministry of Water and Irrigation staff and formal training for government staff in sampling and chemical analysis of groundwater and modelling of limestone and fractured rock aquifers. Training for the latter will also include fellowships abroad for remote sensing analysis
g. Use modelling tools to forecast future water needs in the basin and develop options to ensure sound management of water resources in light of future needs and supplies
h. Prepare a water management plan for the Azraq Basin

5. Support for long-term research on the conservation and management of water resources in arid and semi-arid regions

a. Compile data on geology, hydrology, hydrogeology, meteorology and topography for sites for field studies of water harvesting and artificial recharge of surface runoff and treated waste water.
b. Preparation of the site, construction of dykes and installation of monitoring devices for water flow
c. Monitor flow in major wadis
d. Collection of climatological data including rainfall
e. Perform soil surveys
f. Develop a mathematical model of rainfall/runoff to calculate water harvesting and artificial recharge potential in the study area
g. Chemical analysis of water for select depths in soil profiles, calculation of leach requirement to minimize soil salinization and assess changes in water quality of treated waste water and surface runoff during soil infiltration
h. Prepare guidelines for identifying areas with potential for natural recharge of groundwater
i. Perform enironmental impact assessments in field study areas and assess present practices regarding design and implementaiton of water harvesting and artificial infiltration schemes in similar arid regions
j. Conduct and participate in local and international seminars and training courses in related fields

k. Prepare reports on guidelines for water harvesting, artificial recharge of surface runoff and treated waste water and water conservation and management practices in arid and semiarid regions.

6. Strengthen the capability of RSCN to manage the Azraq Wetland Reserve and reserves in Jordan and to foster environmental education and public awareness

This objective was cost shared by the Azraq and Dana project components, and the activities connected with it were included as part of the Dana and institutional strengthening of RSCN components.

DANA RESERVE

A. ACTIVITIES

Activities listed in the project document for each of seven outputs for the Dana project component were:

1. Legal provision for the management of all natural resources in the reserve core area.

a) Survey reserve boundary considering possible extensions to include whole watersheds and the unsettled desert ecosystem to the west.
b) Prepare and enact legislation to formally establish Dana as a protected area and RSCN as the legally empowered management authority.

2. Provide basic equipment and facilities for reserve management, field staff and researchers at Dana.

a) identify suitable site for a laboratory and accommodation.
b) construct facility.
c) purchase essential project equipment (vehicles, camping gear, optical equipment.

3. Assessment of the biological diversity occurring in the Dana reserve core area.

a) Initiate applied postgraduate research studies (conducted by Jordanians) aimed at producing:
   - I) comprehensive inventory and map of the floral communities of the Dana Reserve area.
   - ii) ditto for invertebrate and vertebrate populations.
   - iii) a study of the status, distribution, seasonal and circadian (i.e. 24 hour) ranges, biology, ecology and population dynamics of endangered animal populations. (NB species which may have endangered populations include: ibex, two gazelle subspecies, wolf, striped hyaena, porcupine, honey badger, hyrax and caracal, lesser kestrel, Arabian babbler, blackstart, Tristam's grackle, fan-tailed raven, Syrian serin & Sinai rosefinch, possibly Houbara bustard, possibly amphibians and invertebrates in isolated springs and water courses.
   - iv) comprehensive inventory and map of all geological systems, soil types and ground and surface water sources occurring in the reserve area.

b) training of reserve staff in wildlife monitoring; establish work plan for monitoring and recording the status of endangered species.
c) If possible, conduct two low level aerial surveys of topography and vegetation for input into GIS.

4. Quantify existing threats to biological diversity from livestock grazing and fuelwood collection in the Dana reserve core area.

a) initiate postgraduate research by Jordanians to produce assessment of impact by domestic and wild herbivores on reserve biodiversity, and biomass productivity of principal plant species (collaborate with overseas research institute).
b) introduce standardised system to monitor livestock and their ownership in the reserve.
c) undertake a socio-economic study which will:
   I) number, origins and occupancy of social groups using reserve for grazing and firewood collection.
   ii) quantify livestock and fuelwood use;
   iii) assess economic significance of use for different social groups
   iv) produce practical recommendations for socio-economic development initiatives to bring locals into sustainable / conservation goals of reserve.

5. Address the economic needs of communities impacting on the Dana reserve ecosystem.

a) implement recommendations of 1.4 c iv) and monitor local perceptions and attitudes through involvement with communities.
b) appraise feasibility, acceptability and impact of small-scale income generation projects. Prepare schedule for implementation and budget.
c) Implement 1.5 b).

6. Re-establish agricultural production in the Dana terrace gardens as the basis of the Dana village economy.
a) map ownership of gardens; establish landowner representative organisation; negotiate and formalize agreements regarding inputs;
b) rehabilitate terrace walls, establish new terraces, construct small vehicle access track; install drip irrigation systems;
c) conduct market survey of cash crops; provide horticultural extension services; make available seed, vines, trees;
d) establish marketing systems;

7. Establish reserve facilities and management procedures which ensure conservation of biodiversity, and which encourage recreational and educational activities based on the sustainable use of the natural and archaeological features of the reserve.

a) Undertake a review and survey of known archaeological sites, if appropriate restore a site (e.g. copper mines or aqueduct) to enhance tourism.
b) Prepare educational materials featuring history of human occupancy of reserve and environs.
c) appraise private sector involvement in tourism development;
d) prepare a **conservation management plan** consisting of an updateable Reserve Manual for management and field staff detailing zones, trails, species distributions etc, and a continuously updateable Reserve Plan of the current activities, the requirements for training and equipment, and the programmes for species re-introductions etc.

e) Implement the conservation management plan.

INSTITUTIONAL STRENGTHENING OF RSCN

Institutional Strengthening of RSCN (Immediate Objective II: Upgrade the Institutional Capability of the RSCN so as to Facilitate Implementation of the Dana and Azraq Conservation Management Plans, Initiate Similar Endeavours in other Jordanian Reserves and Increase the Scope of the Environmental Education Program to Include all Sections of Jordanian Society)

Activity 2.1.1 Institutional Needs Assessment of RSCN

Conducted as a preparatory phase to the current project. The Institutional Needs Assessment made provision for:

- the reorganisation of RSCN, including the creation of two new sections and a reduction in the number of Committees to three;
- revamping the conditions of service and appointments procedure; and
- recommendations with respect to fundraising, marketing and financial security; working practice; staff development; and the delivery of training.

Activity 2.2.1 Implement recommendations of the Institutional Needs Assessment

The Institutional Needs Assessment formed the blueprint for organisational development at RSCN during the project. A Membership Survey was conducted and has formed the basis for expanding membership categories and initiating a major membership campaign.

Activity 2.2.2 Adopt new management structures and systems as recommended in the Institutional Needs Assessment

Two new RSCN functional sections were created: the Research & Surveys Section and Fundraising & Public Relations Section, in addition to a new Conservation Division. An organogram of the current structure of RSCN is provided in Annex I. Sectional responsibilities and roles are clearly defined through work plans (and the corporate three year development plan for RSCN), and monitored through weekly and monthly meetings. Each section head/reserve manager is responsible for his/her own budget, and a Policy and Procedures Manual for RSCN is currently under development.

Fundraising and marketing of RSCN activities has progressed slowly to date, but this is being redressed through a well-focused Fundraising and Public Relations Section. Further, training for sectional heads is being provided to support a re-orientation of activities with self-sufficiency targets in mind.

Activity 2.2.3 Introduce new staff terms and conditions

In accordance with the Institutional Needs Assessment, salaries have been upgraded (the project has provided a top-up for certain positions) and private health insurance plans for each member of staff have been introduced. However, work still needs to be done to improve conditions of service for staff working on lower grades and less permanent conditions of service. An appointments procedure has been instituted.

Activity 2.3.1 Establishment of long-term financial security

The Fundraising and Public Relations Section is responsible for diversifying and increasing income sources for RSCN. A government-brokered Trust Fund of one million Jordanian Dinars has been created, with the interest going to RSCN. The project contributed 25,000 Jordanian Dinars for the establishment of this Trust Fund. In addition, the government

contribution has recently been increased from 125,000 Jordanian Dinars to 200,000 Jordanian Dinars per annum, or about 25% of core income.

In order to establish long-term financial security, it is estimated that a Trust Fund target of 2-5 million Jordanian Dinars needs to be established, with revenue being realised from other sources such as eco-tourism, government contributions, increased membership, and marketing of services and consultancy. International support will continue to be important to enable consolidation of progress already made and to allow expansion into priority project areas.

Activity 2.4.1 Purchase of equipment

Office equipment has been purchased, including a CAMRIS GIS system. Some technical problems have been experienced with the system, but it is performing adequately in support of conservation management activities undertaken by RSCN. Long-term development and maintenance of the system are potential issues.

Activity 2.4.2 Training in GIS

Training in the CAMRIS GIS system was provided to staff by an international consultant from the United States. This system is being used and developed at headquarters as well as at the Dana Wildlife Reserve. The CAMRIS system has been used to prepare maps and materials for the management plan of the reserve.

Activity 2.5.1 Creation of a staff development strategy

A system of planning by objectives has been introduced, as have annual work plans and performance reviews for the organisation as a whole and individual sections of RSCN. Individual performance reviews are planned for the future. Following the Institutional Needs Assessment, an evolving programme of training has been introduced to build relevant skills. All Sectional Heads have been appointed, and a forthcoming priority for senior management is a formal review of recruitment needs to build depth in the organisation.

Extension to Dana Wildlife Reserve and other protected areas (Immediate Objective I: Preparation and Implementation of the Dana Conservation and Management Plan)

Activity 1.2.1 Establishment of the Dana Centre

The Dana Centre is almost finished, exceptions being completion of the coach park, and development of the interpretation facility for which designs have been prepared. The Dana Centre comprises visitor services, research facilities, accommodation, and space/workshop facilities for the Wadi Dana project. A separate bunk house is to be secured for use by researchers, a tea shop is being contemplated for Dana village, and an information hub, advertising the reserve, is to developed. The Friends of Dana have provided funds for much infrastructural development in the village.

Activity 1.2.3 Purchase of project equipment

Vehicles, camping gear and other project equipment has been purchased/acquired in support of research and visitor centre/campground activities. Information is managed using a CAMRIS GIS system, which is fully compatible with the system being used at RSCN headquarters.

Activity 1.3.1 Post-graduate research studies

Research studies have been facilitated by the Research and Survey Section of RSCN, in collaboration with Dana reserve management and the Reserves Section of the Society. Research and surveys have included: analysis of environmental impact of Jordan cement

factories; socio-economic study of Dana reserve; baseline ecological survey; survey of archaeological resources; and studies on carnivores, rangeland and livestock, birds, invertebrates, rodents, desert gazelles and the Cypress forest. Results of these surveys have supported preparation of the Dana Wildlife Reserve Management Plan.

Activity 1.3.2 On-site training for Dana Reserve staff

The reserve manager has received a full programme of management training encompassing time and team management, financial management, assertiveness training, report writing, and preparation of strategic plans. This training has been conducted mostly at RSCN headquarters in association with other reserve managers and section heads. Reserve rangers have received instruction in ecology for conservation; human impacts on protected areas; interpretation; monitoring techniques; as well as on-the-job training. Vocational on-the-job training has been provided for Dana Centre staff in such areas as fruit drying, horticulture, silversmithing, pottery, jewellery-making and accounting.

Activity 1.7.2 Prepare educational materials

Development of the interpretation facility at the Dana Centre is ongoing and will include educational materials covering biological and archaeological features. To date, the Public Awareness Section has had little involvement in the development of the Centre, but has been instrumental in preparing design specifications for the visitor centre and preliminary educational materials for use at Shoumari Wildlife Reserve.

Activity 1.7.4 Prepare a plan and field manual for use by all reserve management and field staff

A draft management plan for Dana Wildlife Reserve has been prepared, and will serve as a template for other reserves in the country. The reserve manager at Dana is currently receiving on-the-job training in management planning. The Policy and Procedures Manual being developed at RSCN headquarters, in collaboration with reserve managers, will be extended and applied at the site level.

Extension of RSCN activities to the Azraq Wetland Reserve (Immediate Objective I: Restoration of the reserve to a natural or near natural condition)

Activity 1.2 Rehabilitation of the Azraq Wetland Reserve Much infrastructural development (eg. construction of perimeter fencing, removal of rubbish, feral horses and water buffalo) has occurred, in addition to employing staff to police and manage the area. Although the services of a Wetland Management Expert and Wetland Conservation Specialist have been utilised since 1994, and a Steering Committee has overseen the subproject, coordinated development of the reserve has been hindered by the absence of a sub-project manager.

Activity 1.3 Implementation of the management plan A draft management plan for the Azraq Wetland Reserve was completed in June 1996. Nature trails and other facilities are being developed, and renovation of the Roman wall and other archaeological sites is scheduled for completion in 1996. A ranger station has been renovated from the old pumping house, and further work on the rangers stations (2) is budgeted for 1996. Access to the reserve by the public is currently prohibited to enable recovery of the wetland ecosystem. Designs for the visitor centre have been prepared; construction of the centre and development of appropriate educational awareness exhibits is planned for the 1996 financial year. The project is yet to make use of a conservation awareness/educational specialist.

Activity 1.4 Training for staff of the Azraq Wetland Reserve The training budget for Azraq Wetland Reserve is currently underspent, with more training clearly needed in wetland conservation and management techniques. Study tours for three RSCN personnel has been

scheduled for the 1996 and 1997 financial years, while formal training (eg a fellowship) in wetland conservation and management techniques for the manager of Azraq Wetland Reserve is to occur during 1996/1997 through the University of Jordan. On-the-job training occurs in an ad hoc fashion through research activities of national and international consultants. Funds have been spent to support RSCN participation in the Fifth Conference of the Contracting Parties to the Ramsar Convention, held in 1993.

Immediate Objective II: Establishment of an Environmental Impact Assessment Unit within the General Corporation for Environment Protection

Activity 2.4 Preparation of educational materials A wide range of educational/media materials have been prepared on the Ramsar Convention, wetlands conservation, and the biodiversity at Azraq. This has not involved assistance from RSCN, although RSCN has collaborated in running an environmental awareness camp for school children at Azraq. A display (including video presentation) on the Ramsar Convention and the Azraq site are to feature in the visitor centre of the reserve.

Immediate Objective VI: Strengthen the Capability of the Royal Society for the Conservation of Nature to manage Azraq Wetland Reserve, Dana Reserve and other protected areas in Jordan, and to foster environmental education and public awareness.

Activities and Outputs are covered under the Dana section of the project document. These are outlined above.

B. QUALITY OF MONITORING AND BACKSTOPPING

AZRAQ OASIS

The five subprojects of the Azraq project component fall within the intestests and responsibilities of three governmental ministries, a private non-governmental organization (RSCN) and an academic institution (University of Jordan). Restoration and management of Azraq Wetland Reserve will be the responsibility of the RSCN, while establishment of an EIA unit and implementation of the Ramsar Convention will reside with the General Corporation for the Environment, Ministry of Municipal and Rural Affairs and the Environment.. Guidelines for agricultural development will be prepared by the Ministry of Agriculture, and studies on water resources of the Azraq Basin will be conducted by the Water Authority of Jordan, Ministry of Water and Irrigation. Finally, long term studies on water conservation and management will be the primary responsibility of the Water and Environment Research Study Center (WERSC), University of Jordan. The national office of UNDP will execute the contract. Overall coordination of the Azraq project will be through a Project Steering Committee, an interministerial committee established under the umbrella of the Ministry of Municipal and Rural Affairs and the Environment to coordinate both the Azraq and Dana project components. It will be chaired by the minister of Municipal and Rural Affairs and the Environment, with committee members representing the Ministries of Planning, Agriculture, Water and Irrigation, Social Affairs, and Tourism and Antiquities as well as the RSCN, WERSC and UNDP. In addition to quarterly and annual project reports, a Tripartite Review consisting of representatives from the UNDP, World Bank and Jordanian government will review the project on a annual basis. A final project review will be conducted by a group of outside experts appointed by UNDP.

DANA RESERVE

Management, implementation and backstopping of the Dana project is the responsibility of the RSCN. Their technical support for the project includes the supply of necessary equipment, key personnel, technical consultants and training programmes. The Dana Forum comprises an advisory group of "stakeholders" in the area, including representatives from the local community, RSCN, the municipality, police, cement factory and district government. The Forum which meets quarterly is the principal vehicle of communication for representatives of the local authorities, the local community and RSCN. No scientific advisory committee has been constituted. The Dana project is subject to periodic reviews in accordance with the policies and procedures established by the UNDP for monitoring project execution. In addition to quarterly and annual reports prepared by the RSCN, a Tripartite Review with representatives of the Government of Jordan, the RSCN, UNDP and the World Bank reviews the project biannually. A final project evaluation will be conducted by an independent group of experts appointed by UNDP.

INSTITUTIONAL STRENGTHENING OF RSCN

Project partners have played an active role throughout this initiative. This has included site visits, reporting, and participation in meetings and tripartite reviews. The UNDP resident representative also serves on the Interministerial Steering Committee which overseas both the Azraq and Dana subprojects.

Results of the tripartite reviews conducted throughout the project were generally consistent with the issues and progress identified in the course of the independent evaluation. However, a number of recommendations from these reviews have yet to be taken up, particularly with respect to integration of effort between the Azraq project and RSCN. These include ensuring that RSCN takes full management responsibility for the Azraq Wetlands Reserve, and that a sub-project manager be employed as a matter of priority.

IV. PROJECT RESULTS

A. RELEVANCE

AZRAQ OASIS

Through designation as a Ramsar wetland site in 1977, the international importance of the Azraq Oasis for global biodiversity and conservation was officially recognized. Groundwater extraction in the Azraq Basin to meet municipal and agricultural needs had expanded rapidly to a point that the entire wetland was essentially dessicated by 1992. The actions taken by the current Azraq project component are considered to have been the emergency fix that was needed to stave off total biological disaster for the wetland. The immediate action of the Azraq project to secure water for the wetland has provided a safety gap until a sustainable management plan for the area can be developed. The development of an EIA unit within Jordanian government is the vitally needed by the country, especially as development pressures for limited water resources are rapidly expanding. Agriculture has been recognized as a major competitor with the Azraq wetland for water, and agricultural guidelines being developed through this project should promote more efficient use of water resources by local farming operations. Development of mathematical models for present and future scenarios will help chart the course of water policy at the national level. Finally, the RSCN is in great need to build the capacity to manage wetland resources and reserves in Jordan. Currently such capacity is totally lacking in Jordan.

DANA RESERVE

The exceptional diversity of ecosystems, the biogeographical richness of the flora and fauna, and the unique history of human occupation in Dana Wildlands were recognized to be of global importance in 1976 when the area was selected to become a nature reserve. Increasing demands of the local population had led to severe overgrazing by livestock, particularly goats, which together with the cutting of branches from trees and shrubs for firewood had severely degraded the natural rangelands and woodland habitats of the area. These threats are widespread in Jordan and in the wider region. One of the most important roles of the current Dana project component is to provide a model of sustainable pastoralism which can be applied elsewhere. The actions taken by the current project are limiting environmental threats and diversifying the economy of local peoples without disrupting social communities. An important means of diversifying the local economy is through development of cultural and nature tourism. The Dana project component has revitalized the terraced gardens and the community spirit at Dana Village, substantially increasing the flow of visitors to the area, and thereby providing additional opportunities in support services for these visitors. At the same time, the project has introduced mechanism for limiting tourist numbers and the damaging consequences of uncontrolled mass tourism. The RSCN will need to expand its capability to manage nature tourism as an effective means of sustaining its conservation of protected areas while simultaneously sustaining the social culture of local communities.

INSTITUTIONAL STRENGTHENING OF RSCN

As part of the preparatory assistance to the project, an Institutional Needs Assessment was conducted. This Assessment provided the basis for an ambitious programme of infrastructural development at both RSCN headquarters and reserve level, particularly at Dana and Azraq. It also made provision for upgrading technological capability, particularly through installation of computer systems, and for substantial investment in human resources development, manifest in an evolving and responsive programme of training and staff development.

Institutional strengthening of RSCN was entirely appropriate given that this organisation has been given responsibility for managing the protected areas in the country, as well as responsibility for wildlife protection, and playing an important role in environmental education. Capacity building of RSCN was therefore the most suitable mechanism to ensure extension of managerial and scientific expertise to the reserves, enable RSCN to fulfil it's role and meet future demands.

B. EFFICIENCY

AZRAQ OASIS

Overall, the project has developed a reasonable efficiency ratio for input funding to project output. Several key product deliverables including the Azraq Reserve management plan and water resource models are either in draft form or still being developed. The evaluation team was impressed by the efforts of the project director to save money where possible on individual activities of the project. Three cases are noteworthy. Special effort was made to obtain functional vehicles for the project without elaborate expenditures for top of the line models. The project initally had proposed construction of two wells adjacent to the Azraq wetland to supply water to the system. This idea was rejected in favor of an innovative and very cost effective option to rennovate an old pipeline to deliver groundwater from a well field north of the wetland. The cost savings to the project of this action alone has been substantial. Finally,

the director has put considerable effort generally to keeping the cost of the visitor center low including lobbying for volunteer services in the center design.

DANA RESERVE

The Dana project component has performed with acceptable economy in their community development work, their rangeland studies and their intensive survey programme. The project team was impressed with the ingenuity and innovation displayed in the socio-economic developments at Dana Village and Centre, and in the tourism developments at the Visitor Centre and the Campsite. The project has made great use of human skills and enterprise to re-establish terraced grasslands and to provide cost-effective workshops, attractive local products and promotional materials while forwarding the philosophy of conservation. Several important tourist developments, such as the control of access points and the planned information hub only by bringing in additional outside funds. The Dana Centre itself blends in with its surroundings. It is well situated, impressively designed and attractively furnished. As is made clear in previous reports, the increased cost of the foundation work for the Centre could not have been anticipated and was met from non-project sources. The project has produced a draft final management plan and gathered a significant amount of ecological, socio-economical and archaeological information from field surveys. Several species of animal and plants were recorded for the first time in Jordan, and a number of new archaeological sites were surveyed. Much of this work was carried out by junior researchers from various Jordanian universities with the assistance of workers from European universities and institutes many of whom contributed on a voluntary basis.

INSTITUTIONAL STRENGTHENING OF RSCN

For the RSCN/Dana component of the project, the Global Environment Facility allocated US$ 3.3 million to be disbursed over a three year period. With respect to the US$ 3 million allocation for Conservation of Azraq Oasis, US$ 929,135 was allocated for the restoration and management of the Azraq Wetland Reserve, which included an institutional strengthening component for RSCN.

Key inputs to the RSCN/Dana component included (i) professional staff training and recruitment of necessary expertise; and (ii) infrastructural development and purchasing of equipment. Much of this initial input was guided by the Institutional Needs Assessment.

Staff training and recruitment of necessary expertise Re-organisation of RSCN has resulted in the advertising and filling of key staff positions to enable RSCN to fulfil its mandate, and place it in a strong position to flexibly meet future demand. These positions have been filled through a combination of hiring permanent managerial and scientific Jordanian staff, academic consultants, and by employing short and medium/long-term expatriate staff where appropriate. The operating procedures and orientation (planning by objective) of RSCN have been re-shaped and standardised, giving staff a much clearer understanding of where the organisation is headed. These changes have occurred over a relatively short period of time.

Regarding the Azraq project, approximately US$ 1.5 million has been spent, leaving another US$ 1.5 million to the end of the project. With specific reference to the wetland reserve, funds were saved by not drilling two additional wells, and are currently underspent on construction of the visitor centre, in being without a subproject manager, and in not using all of the allocation to the training budget. Spending over the next year or so will be in accordance to the main criteria and the rescheduling scheme for the subproject.

Infrastructural development and equipment Construction of the Dana Centre was somewhat

delayed, a consequence of needing to lay a much stronger foundation due to soft substrate. This translated into additional cost which was provided by a grant from the Japanese JICA, amounting to some 60,000 Jordanian Dinars. The Dana Centre is now almost fully operational. At RSCN headquarters, office equipment has been installed, and software tools adapted for use by the organisation.

At Azraq, funds have been spent on restoring the wetland and renovating structures such as the ranger station at the old pumping house. Upgrading of reserve headquarters and construction of the visitor centre are scheduled for the 1996 financial year.

C. OUTPUTS

AZRAQ OASIS

A total of eighteen output products have currently been developed by the Azraq project component. Most of the completed reports have focused on limnology, surveys of individual faunal and floral elements, the physical and chemical environment, and water resources. None of these studies have taken the broader integrative view of the Azraq basin or wetland, and the biological reports are weak on ecological interpretation and ecosystem level interactions. A calendar and some posters have been prepared for public distribution. It appears that most of the early effort on this project was spent in obtaining water for rehabilitation of the dessicated wetland, and several of the project components were delayed until recently due either to a lack of sufficient staff time or the need to have water in the wetland. The agricultural and salt extraction guidelines are either nearing completion and/or are awaiting implementation. As noted also by the Tripartite Review of March 1996, the long term water studies planned for this project are lagging, and the water modelling effort has recently begun. The wetland management plan is in draft form. The wetland area has been cleaned of trash, plans for the visitor's center are complete, but infrastructure to support visitors including picnic areas and trails have not been started. Finally, coordination with RSCN is extremely poor and staff training in wetland management has been weak to date.

DANA RESERVE

Overall the Dana project component has produced outputs on schedule and to an acceptable standard. Three important milestones were: (a) the agreement reached in January 1993 between the National Resources Authority and RSCN to suspend mining excavations and road constructions and the use of heavy machinery in Dana; (b) the legal establishment of the Dana Nature Reserve by the Government of Jordan in December 1993; and (c) the completion of construction of the Dana research and visitor centre in December 1995. A total of 15 survey reports have been completed. Most of these constitute essential baseline studies of major taxonomic groups of plants and animals, rangeland management studies and descriptions of the physical environment. None of these reports take a broader ecosystem view of the major habitats and their management, and they are weak on the ecological processes which underlie the biodiversity of the area. The rangeland study provides useful baseline information on the numbers of livestock using the reserve's rangeland (much higher than expected), and their ownership, and provides recommendations for limiting grazing pressure on the reserve. It is weak on assessment of the social and economic needs of the Bedouin and on mechanisms for community participation in conservation and sustainable pastoralism. This is particularly true in the case of the Azazme who are entirely dependent on their livestock and the reserve's rangeland. By contrast the socio-economic team working with the residents of Dana Village have successfully provided for the economic and social needs of the community. Their efforts in establishing product lines for nature jewellery, traditional pottery and dried fruit, herbs and

jams provides a useful model for other projects in the region. Agricultural production based on an organic system of crop management has been re-established on the terraced gardens at Dana Village with the renovation of the arterial irrigation system. The project has succeeded remarkably well in reinvigorating the village. The evaluation team was concerned that insufficient attention was given to the linkage between these socio-economic developments and the conservation of biodiversity in the reserve. There was no assessment of the impact of the renovation of terraced irrigation on the availability of permanent water in upper Wadi Dana.

The draft management plan for Dana constitutes (a) a compendium of environmental maps and information about Dana, (b) a useful account of the conservation status of the area, © a listing of 15 management objectives together with some 200 management actions which provide practical directions for organising conservation efforts, (d) plans for zoning the reserve, (e) plans for developing tourism and (f) additional miscellaneous plans and information in the form of annexes. Overall it is strong in documenting environmental information, in planning for tourism and zonation and in practical conservation measures, but it is weak in mechanisms for community participation by Bedouin families, law enforcement strategy, in-service staff training requirements, and financial planning. The ecological context for conservation management is poorly developed, and the organisation and layout of the draft Management Plan is confusing. Despite these weaknesses, the Management Plan represents a considerable achievement and will play a vital role in reserve management .

INSTITUTIONAL STRENGTHENING OF RSCN

Disbursement of funds under the RSCN/World Bank contract for the Implementation of the Dana Project is conditional upon completing a number of activities, outputs and targets, many of which exceed or are extensions of outputs presented in the original project document. Comment on the 9th through 12th Schedule of Payments and Conditions of Issuance therefore follows to the end of the project cycle.

Item	Status	Link to project document & comments
9th payment Dana reserve boundary	established	Output 1.1: Dana legally established & boundary demarcated
Dana reserve management plan	draft	Outputs 1.3/1.4/1.5/1.7: Research results incorporated in the management plan
furnishing Dana Field Centre	essentially complete	Output 1.2
business plan for Dana Field Centre	draft	Output 1.7
recruitment of Centre manager and support staff	in place	Outputs 2.2/2.5: A direct extension of institutional strengthening of RSCN
finalisation of designs for interpretation facilities	near completion; awareness materials yet to be produced	Output 1.7
partnership agreement with	not established due to	Output 1.7

private sector tourist company	exclusivity question	
visitor reception facilities at reserve entrance tower	completed	Outputs 1.2/1.7
construction of alternative picnic site on reserve boundary	delayed due to re-allocation of land from Forestry to RSCN; boundary of site now being established	Outputs 1.2/1.7
tourist facilities around Dana village	bus park viewing point and entry toll booth under construction	Outputs 1.2/1.7
implementation of rangeland study recommendations	commenced: enclosures in place; first permits issued; grazing controls and zones discussed with Bedouins; monitoring initiated	Outputs 1.4/1.5
Dana Management Forum	wide representation of interest groups	Output 1.5
legal constitution of RSCN Trust Fund	accepted by the Board, subject to minor amendment; being processed by Ministry of Social Affairs	Output 2.3
recruitment of Director General, RSCN	Acting Director General in place	Outputs 2.1/2.2: Organisational changes as a result of adopting recommendations in the Institutional Needs Assessment
Section Head for Fundraising and Public Relations	recruited	Outputs 2.1/2.2: Fundraising and Public Relations was one of the sections added in the reorganisation
10th payment completion of long distance trail network in reserve	trail exists from campground to Dana Centre; routes around Dana village being negotiated	Output 1.7
membership system and recruitment campaign	new membership categories being introduced; campaign commenced	Output 2.2/2.3
targeted fundraising campaign	underway	Output 2.3
new hunting licence/quota system	not yet introduced; independent assessment of status of game species commenced	Output 2.5: Assessment facilitated by trained staff
wildlife unit in police force	networking & liaison with police underway	Outputs 2.2/2.5 Activity deriving from

		reorganised structure of RSCN and targeted work programme of the Law Enforcement Section
training workshop for customs officers in CITES	being organised as part of CITES workshop in October	Outputs 2.2/2.5
networking strategy for Nature Conservation Clubs	Phase I (toolbox with principle network) complete; Phase II about to commence	Outputs 2.2/2.5:
strengthening staff/honourary officer relationships	workshop involving staff and Board members conducted; staff/Committee workshop scheduled for June 1996	Output 2.5
strategic planning workshops for Board of Directors	scheduled for June 1996	Output 2.5
11th payment Policy & Procedures manual for RSCN	being developed	Outputs 2.2/2.5
incorporating structural & managerial changes into RSCN's constitution	need legal advice & to work closely with the Board of Directors; potentially in place by the end of the year	Outputs 2.1-2.5
maintaining socio-economic initiatives around Dana village	considering establishing a private company/corporation with Board representation	Output 1.5: Income generating projects implemented; implementation schedule & budget for the Dana project being prepared in line with RSCN procedure Output 1.6: agricultural production of Dana terrace gardens re-established Output 1.7
preparation of public awareness programmes for decision-makers' & women's sector	little progress with women's sector, none with decision-makers	Outputs 2.1/2.5: Awareness programmes to derive from reorganised RSCN structure
12th payment corporate three year development plan for RSCN	in draft; strategic planning workshop to feed into this process; anticipated Board approval in 6 weeks	Output 2.5: Follows on from initial Institutional Needs Assessment

As an extension of institutional strengthening activities of RSCN vis-a-vis the Azraq Wetlands Reserve, the major outputs were as follows:

Output 1.2 Rehabilitation of the Azraq Wetland Reserve Most of the activities under this output have been completed. Keeping a check on unsightly rubbish will be a priority in conjuncture with public awareness activities. The project has suffered from not having a sub-project manager to guide wetland management activities in the reserve and to facilitate/promote training of RSCN staff in wetland conservation and management techniques.

1.3 Preparation and implementation of a comprehensive management plan for Azraq Wetland Reserve Activities in support of this output are at various stages of completion. Finalisation of the management plan should provide a blueprint for setting policy and supporting future research and management of the site.

1.4 Training for staff at Azraq Wetland Reserve A full programme of training has yet to be implemented at Azraq with respect to wetland conservation and management techniques. Without this training, it will be difficult to develop an ecological framework to managing Azraq and extending the model to other wetlands of the country.

2.4 Promotion of the Ramsar Convention Activities under this output are partially complete; further development and extension of educational materials is ongoing, a Ramsar booklet will soon be published, and the continued development of a display for the visitor centre at Azraq Wetland Reserve is a priority.

D. IMMEDIATE OBJECTIVES

AZRAQ OASIS

An assessment of the progress towards completion of activities proposed for each of the six project objectives follows:

1. Rehabilitation and management of Azraq Wetland Reserve

Trash, feral horses and water buffalo have been removed from the Ramsar site and fencing has been extended to include the two Shishan springs. Plans for the visitor center are completed, but construction has not begun. Likewise the Roman wall has not been repaired, although responsibility for doing so has been accepted by the Ministry of Antiquities, and construction for trails and picnic areas has not begun. The promotion of tourism in the area is lagging, likely due to the lack of completed infrastructure and public access to the site. Some training of staff has been completed, but the overall understanding of wetland management techniques appears wanting. The comprehensive management for the Azraq Wetland is in draft form and should be finalized in the next several weeks. This document will be critical for the objective activity for implementation of wetland management practices to maintain wetland fauna and flora and to reintroduce extinct aquatic biota. To date the understanding of ecological conditions and processes in the wetland is too rudimentary to acheive successful completion of this activity goal. The failure to find a subproject manager for the wetland subproject has weakened both data collection and interpretation, and by extension, development of a sound management plan. In addition, there appears to have been only weak coordination with RSCN on this project phase.

2. Establishment of an environmental impact assessment unit within the General Corporation for the Environment and improved implementation of the Ramsar Convention in Jordan

An EIA unit has been established within the General Corporation for the Environment and EIA guidelines are becoming established. Investigations of salt extraction, aquacultural and agricultural activities, including chemical usage, have been completed, and guidelines are either awaiting completion or implementation. An overview socio-economic assessment has been made for the Azraq Basin, but these data have not yet been fully integrated into the broader scope of the project. A permanent monitoring procedure at the Ramsar site was called for, but has not been implemented to collect the most pertinent baseline data for environmental assessment. Likewise, understanding of the linkage between watershed developmental activities and the ecological response of the Azraq wetland is poorly known and is considered essential to correct prior to implementation of any management plan. The project director has done an impressive job at building linkages both to governmental agencies and the university and to the general public, including agricultural interests, in the area immediately surrounding the Azraq wetland. Establishment of the Friends of Azraq has been a very positive step in getting the public involved in the process of rehabilitation of the wetland ecosystem. The latter provides a participatory forum for all concerned parties and has led to a cohesive community to the wetland and ecosystem sustainable utilization. The wetland management plan is currently in draft form and needs further attention. Posters and calendars have been prepared for public dissemination, but integration of this program has not been coordinated with the public awareness section of RSCN. Such a coordinated effort would have greatly benefited the products coming from this activity of the Azraq project. Additional workshop training for EIA staff in environmental impact assessment is warranted.

3. Establishment of guidelines for agricultural development in the Azraq Basin

All activities of this objective appear to be on course. Inventories of agricultural activities, irrigation practices and fertilizer use in the Azraq Basin have been completed, Soil salinity and irrigation water quality maps have been prepared and guidelines for agricultural development in the Azraq are nearing completion.

4. Investigation of groundwater resources in the Azraq Basin and development of a water management plan for the basin

The activities proposed for this objective appear to be progressing reasonably. Data compilation for geology, hydrology, hydrogeology, meteorology and soil science studies in the Azraq Basin and development of a work plan for studies to complement these have been completed An inventory of all boreholes and wells in the area surrounding Azraq Oasis has been completed, monitoring wells have been selected and a monitoring program for water levels, withdrawal practices and water quality is in place.Modelling studies on groundwater flow, water quality and possible migration of saline/brackish water in the aquafers has begun and will lead to a water management plan for the Azraq Basin. Training abroad for remote sensing analysis has been completed.

5. Support for long-term research on the conservation and management of water resources in arid and semi-arid regions

Data have been compiled on the geology, hydrology, hydrogeology, meteorology and topography for sites for field studies for water harvesting and artificial recharge of surface runoff and treated waste water. Several demonstration sites and been developed, including construction of dykes and installation of monitoring devices for water flow, to promote

groundwater recharge. Chemical analysis of water for select depths in soil profiles, calculation of the leaching requirement to minimize soil salinization and guidelines for identifying areas with potential for natural recharge of groundwater have been completed and made available to local farmers for use. Development of a mathematical model of rainfall/runoff to calculate water harvesting and artificial recharge potential in the study area is ongoing. The component of this objective that appears to be weakly addressed is that of artificial recharge of groundwater with treated waste water. The results of this work could have broad application in the major urban areas of Jordan and should be addressed. Finally, several activities of this objective sought to foster international connections with similar working groups dealing with arid and semi arid areas. This activity has lagged and needs to be addressed.

6. Strengthen the capability of RSCN to manage the Azraq Wetland Reserve and reserves in Jordan and to foster environmental education and public awareness

One of the major weaknesses with the Azraq project component is the poor coordination with RSCN. This issue will be addressed in detail later in this report and recommendations will be made for correcting this in the immediate future.

DANA RESERVE

An assessment of the progress towards completion of six project objectives identified in section II.B.2 follows:

1) to survey the reserve boundary and prepare and enact legislation which formally establishes Dana as a protected area, and officially identifies RSCN as responsible for its management

Marking of the reserve boundaries was completed in 1995, but the boundaries have still to be ratified by the Lands and Survey Department.

2) to assess the biological diversity of the reserve

Baseline data have been compiled for hydrology, meteorology and geology of the site, and surveys conducted on the ibex and gazelle populations, large and small carnivores, rodents, avifauna, macro invertebrates and on the quality and biological value of permanent water bodies. These studies have recorded 555 species of plant and 565 species of animal, many of which have been found to have low population sizes in Dana Reserve and to be in need of active conservation. Management recommendations for conservation of each group have been formulated and management priorities for conservation of some key species are provided in the draft management plan. Baseline studies of the Cypress and Mediterranean Forests have been undertaken and conservation and protection measures are listed in the management plan. The herbarium at the Research Centre contains more than 2,000 specimens representing all plant species in the reserve, and a plant checklist has been prepared. Taken together this is the most comprehensive biodiversity survey to be undertaken in Jordan.

3) to quantify existing threats to biodiversity from livestock grazing and fuelwood collection;

The socio-economic survey of Bedouin families quantifies the number people and livestock within the reserve. The total number of animals (estimated at 8,000 - 9,000 head) is twice the number suggested in preliminary assessments. Although livestock clearly have a major impact, no information is available on the level of impact of grazing on rangeland or spring habitats. In the future valuable information will be obtained from 6 exclosures constructed in 1995.

4) to address the economic needs of livestock owning communities impacting on the Dana reserve ecosystem and concomitantly to introduce conservation measures

The process of integrating the Bedouin families into the sustainable development and conservation initiatives of the project is still at an early stage. Good relations have been established but a formal mechanism for community participation in sustainable pastoralism is missing. It has not yet been possible to diversify the economy of the Azazme who are totally dependent on grazing livestock within the reserve. A sophisticated zoning scheme has been prepared to limit Bedouin grazing pressure.

5) to re-establish terrace garden agriculture as the basis of the Dana village economy;

This objective has been largely fulfilled. Agricultural production has been restored, 15 farmers recruited, irrigation restored, a plant nursery established and harvesting and marketing of the first crops has been successful.

6) to establish Dana as a tourist destination featuring diverse ecosystems and a rich history of human occupancy;

Dana Reserve has enormous potential for tourism. With the signing of the Peace Accord with Israel in September 1994, the existing growth of tourism in Jordan has accelerated and the growing pressure on Dana is manifest. While some measures have been taken to both attract and inform visitors about Dana and also to limit tourist pressure on the ecosystem, there remains the need to develop a full tourism management strategy covering both the reserve and its surroundings.

INSTITUTIONAL STRENGTHENING OF RSCN

The RSCN/Dana subproject had two immediate objectives:

I. Preparation and Implementation of the Dana Conservation and Management Plan; and

II. Upgrade the Institutional Capability of the RSCN so as to Facilitate Implementation of the Dana and Azraq Conservation Management Plans, Initiate Similar Endeavours in Other Jordanian Reserves and Increase the Scope of the Environmental Education Program to Include all Sections of Jordanian Society. This objective was also covered under the terms of reference for the Azraq subproject.

Both objectives encompassed institutional strengthening elements. In reviewing the associated Outputs and Activities, the Dana/RSCN subproject has been successful in completing the majority of institutional strengthening aspects it set out to achieve. The consequence of this progress has been the creation of an organisation which is accountable, disciplined and progressive, reflected in a corporate culture which supports both teamwork and encourages individual initiative. In the absence of these changes, it is unlikely that RSCN could meet the ever increasing challenges and responsibilities being entrusted to the organisation, likely jeopardising its unique role in Jordanian environmental affairs.

Of fundamental importance has been the extension of institutional strengthening aspects to management at Dana. The integration and support the reserve receives from headquarters is important in ensuring that management of the site serves the best interests of both conservation and sustainable development initiatives of people living in the vicinity of the reserve.

RSCN involvement at Azraq spanned three immediate objectives:

I. Restoration of the Azraq Wetland Reserve to a natural or near-natural condition;

II. Establishment of an EIA unit within the General Corporation for Environmental Protection; and

III. Strengthening the capacity of RSCN, as outlined above.

One of the end-of-project situations expected of the Azraq Wetland subproject is for RSCN staff to have received on-the-job training and formal training in wetland management techniques and in conservation awareness/education. Further, RSCN should be fully capable of managing the Azraq Wetland Reserve and of developing and implementing management for any future wetland reserve. Although some training has been provided to reserve staff in conservation awareness/education, training in wetlands management techniques and conservation has been limited. Consequently, it is unlikely that RSCN staff would be fully capable of managing Azraq Wetland Reserve or other wetland sites, therein presenting a challenge to RSCN in the coming months of the project.

Of further concern, is the general lack of coordination and integration of RSCN capacity building efforts with the Azraq Wetlands Reserve subproject. More details are provided in the Findings section of this report, but the implication is that a tremendous amount of work will need to be done by RSCN in ensuring that the reserve is managed by a competent (in a scientific and managerial sense) and well-qualified staff, in a manner consistent with the approach being developed for reserve management at Dana and other sites.

E. EFFECTIVENESS

AZRAQ OASIS

The strong personal commitment of the project director to the conservation of the Azraq Oasis has been a positive factor in several regards. He has been extremely effective at mobilizing the local communities around Azraq through formation of Friends of Azraq. This group has provided a forum whereby all interested parties, including agricultural interests, can openly discuss issues critical to the long term sustainability of the Azraq system. Most of the leaders of the community have become engaged in this organization. Interactions with the average citizen, however, especially those at the lower end of the economic ladder, is less clear. It is felt that fencing of the Ramsar site and restricted access to the wetland in general will build a wall to the general public. Actions must be taken quickly to provide access to this natural resource or else the wetland could be viewed as a trophy of the elite. Such potential conflicts must be avoided. The public awareness effort of the project could have been more effective through closer cooperation with the public awareness section of RSCN.

The director has also been very effective at building bridges to and among governmental agencies and the universities. All feel that they are a part of the Azraq rehabilitation effort. Without such strong personal relationships, obtaining the water supply that was critical to stave off complete biological disaster at Azraq would likely have been delayed to a point whereby the ecosystem would have been lost forever. He is now working closely with government entities to reach an agreement for a permanent source of water for the wetland.

Mathematical models that are being developed by this project will be critical for future forecasting by the government of Jordan on water allocation and resource management. Data

for inclusion in these models are still be compiled, and the modelling effort has begun. These models will be critical for sound water management in Jordan and the Azraq Basin. The management plan for the Azraq Wetland is still in draft form and in need of more work if it is to be implemented. Of particular concern is the failure of this project in general to see the big picture of the Azraq ecosystem. A great deal of time has been spent getting information on the physical and chemical factors of the environment, but interrelating these with biological processes and species composition is weak. This is likely a reflection of the failure both to find a well based wetland ecologist to fill the wetland subproject manager post and to cooperate closely with RSCN on ecological issues. Without immediate incorporation of a strong ecological input, the effectiveness of the overall management plan to be developed by this project is in jepardy.

DANA RESERVE

The Dana project has been highly effective in their community development programme at Dana Village. The staff have captured the interest and support of the villagers many of whom have been encouraged and enthused by the work of the project. The Dana Forum is established as a mechanism by which the local community can influence the direction and extent of socio-economic developments and this will provide a useful model for similar projects elsewhere. The research and survey unit has been highly effective in conducting baseline surveys and studies of biodiversity. This has enabled the unit to identify a number of endangered animal species, and a problem of mortality among some tree species, and to prepare specific conservation plans for their management. The unit has also been instrumental in training many Jordanian graduates in survey techniques, and recruiting some onto the project staff. The unit has been less effective at providing the broader, integrative view of the ecosystems. It would also benefit from closer collaborative links with national and international academic institutions. The greatest challenge to project management concerns the nomadic people who graze their livestock in the reserve. The zoning scheme is to be commended, but more work is required to integrate the Bedouin with the conservation and sustainable management goals of the project and to assist them in diversifying their economy. The greatest asset of the project is the personal commitment and team spirit of its staff.

INSTITUTIONAL STRENGTHENING OF RSCN

Managerial competence in the organisation has developed quickly and has extended from senior management to reserve staff. For example, planning, administrative procedures, and financial accounting are all being developed at Dana Wildlife Reserve, reflective of practice at RSCN headquarters. Further, a business plan is currently being developed for Dana, representing an extension of Fundraising and Public Relations activities at RSCN. It is envisaged that the business plan will represent a template for use at other reserves attempting to achieve economic self-sufficiency. This, combined with development of the management plan for the reserve, and ongoing management planning will constitute an important model for extension to other reserves as they develop or are established.

Prior to the project, staff at Dana had no specific training or knowledge of basic flora and fauna monitoring techniques, or in managing community development activities to support conservation projects. Through the Reserves and Research & Survey sections of RSCN, baseline surveys have been conducted, numerous reports published, and rangers will soon be provided with training in the use of basic field equipment. Despite this progress, there are still significant gaps in both training and expertise needed (eg wetlands management) to establish ecological models in support of reserve management; the recent recruitment of an ecologist to support Dana and other reserves of the country should help address this weakness.

RSCN, particularly the Research & Surveys Section, has had a good relationship with Jordanian universities. Many staff of RSCN have come from the university system, and university support has been invaluable in conducting baseline surveys and research in the reserves.

Vocational training has been extended to local residents in Dana and Quadessyo villages, and includes horticulture, interpretation, fruit drying and silversmithing. This training is supported by workshop facilities at the Dana Centre, and an active marketing programme is beginning to yield significant financial returns. Considerably more extension work and liaison needs to be done with grazing communities in the lower part of the reserve. This is likely to require expertise in the areas of anthropology, sociology and ecology to establish a comprehensive picture of human-ecosystem interactions, from which recommendations for sustainable development can be made.

Apart from reorganisation and extension of RSCN activities to the reserves, project inputs have been used to develop an impressive array of outputs for use in management (eg. manuals); education, where there are currently over 100 video taps, publications and numerous posters for use by RSCN, Nature Conservation Clubs, and reserve management; science (published literature); and for planning purposes, through use of information technologies such as GIS. This is in addition to the production of management plans for Dana and Azraq.

Through a network of collaborating institutions at Azraq, including government and non-governmental agencies, universities, and local residents, there have been some impressive accomplishments in the rehabilitation of the wetland site, and in production of materials such as the management plan for Azraq Wetland Reserve. Unfortunately, the Azraq Wetland Reserve has not benefitted from the same degree of integration and extension of RSCN activities as has Dana.

F. CAPACITY BUILDING

AZRAQ OASIS

The greatest capacity building contribution of the Azraq project component has been in the area of forecasting for water resource allocations. The data collection and incorporation into mathematical models will be an essential tool for the government of Jordan in the process of developing sound management plans for the nation's water resources into the next century. Such models will be critical to allocating water to the Azraq wetland and for finding a permanent solution for a water supply.

An EIA unit will have been established within the General Corporation for the Environment. It's total incorporation within the daily operation of the GCE is not clear at present. If truly functional, the EIA will be a valuable tool for ensuring that proper environmental considerations are incorporated within all development proposals in Jordan. Governmental staff have been trained in the use of geographical information systems and field data collection, especially related to physical and chemical aspects of water resources. Guidelines for agricultural, salt extraction and aquacultural activities should have been developed by the end of the project and awaiting implementation.

The physical facilities of the Azraq Reserve should be in place by the end of the project. These include reserve offices, a functioning visitor center and hopefully trails and picnic areas and a restored Roman wall. Such facilities are critical if the area is to be developed for tourism. There is still a strong need to understand the linkage among facility planning, ecotourism and potential ecological impact to maximize the return on the investment, while having minimal ecosystem impact.

For apparently the first time, the people of the villages surrounding the Azraq wetland have becomed empowered in environmental issues related to the Azraq Oasis. Prior to establishment of the Friends of Azraq, there appears to have been little cooperation between the two villages of the area nor was there a mechanism for direct communication with governmental agencies responsible for water resources. The Friends of Azraq has become the environmental watchdog for the wetland and surrounding area.

Finally, the capacity building process could have profited greatly from closer cooperation between the Azraq project component and RSCN. As many components of the Azraq project will eventually be incorporated into the structure of RSCN, ways must be found immediately to blend these two projects together to improve overall efficiency and project output.

DANA RESERVE

The Dana Research Centre provides excellent facilities for short or long-term research projects, field training courses, workshops, conferences and seminars. It is well equipped with its own accommodation, catering facilities, conference/meeting room, large laboratories, library, herbarium, insectarium, GIS system, GPS units, full aerial photographic coverage of the reserve and international communications equipment. The Centre aims to become a focal point for study and exchange of information concerning applied research in Jordan, and to this end it is seeking to develop long-term collaborative programmes with Jordanian and international universities, as well as to attract individual students and research workers. These developments will greatly facilitate the capacity of the reserve's management to conserve threatened species and to manage arid habitats so as to rehabilitate natural processes and restore damaged ecosystems. The Centre will have an important role in transferring these capacities to other protected areas in Jordan, to neighbouring countries and beyond.

There is a strong need to establish a reputable scientific committee to guide the applied research programme being developed at Dana. There is a particular need to establish integrative studies and research into major ecological processes such as woodland regeneration, rangeland production and plant community dynamics, dispersal and colonisation of species found in spring communities, and to investigate the dependence of carnivores and raptors on the presence of livestock. If chosen carefully, this committee could also act as a catalyst for the research centre by assisting it to establish collaborative links within Jordan and at the international level.

As part of the process of conducting baseline surveys, a total of 23 Jordanian graduates were trained by project staff, overseas scientists and consultants in survey and assessment techniques. Skills acquired through training programmes are directly beneficial to the reserve and to RSCN as a proportion of those trained were later recruited to staff positions. Some of the skills acquired at Dana have already been applied elsewhere in Jordan.

INSTITUTIONAL STRENGTHENING OF RSCN

Recruitment at RSCN has been targeted at increasing the number of qualified staff able to support reserve management activities and the seven sections of RSCN. Total staff compliment currently stands at approximately 75; positions continue to be filled based on current and projected need. A case in point is current recruitment of a tourism development officer. There are also three committees and an elected Board of 11 members.

Through the duration of the project, training has been provided for all staff of RSCN, as Annex II

indicates. The training programme initially developed from the Institutional Needs Assessment and evolved according to need. It is recognised however that a formal review of training and recruitment needs, given changing external circumstances and demands being placed on RSCN would be beneficial.

With regards technology, computers have been installed at RSCN headquarters, Dana Wildlife Reserve and at the Azraq Oasis. Various software programmes have been introduced in support of both scientific and managerial tasks. All projects and accounts of RSCN are now computerised and maintained by the Financial Unit, a branch of the Administration Section set up in 1995/96. The CMS project planning system had to be abandoned due to being inappropriate to the needs of RSCN staff, and was replaced with Microsoft Works. The CAMRIS GIS system continues to be used and developed in support of biological research and surveys in the reserves, although this system is currently not being utilised at Azraq.

Issues related to the use of CAMRIS include the following:

- lack of a long-term maintenance policy with the supplier or other relevant body;
- integration and compatibility with other information management systems being used by government agencies, universities and other organisations involved in environmental protection and sustainable development activities; and
- wider application and use of the GIS system in support of educational activities of the Public Awareness Section of RSCN.

The RSCN/Dana subproject provided significant funds for infrastructural development at both RSCN headquarters and Dana Wildlife Reserve. Headquarters is now equipped with the latest in office technology, while the facilities and equipment at Dana now enable reserve staff to fulfil management, research, and extension obligations. Significantly, the management of a growing tourist demand has featured prominently in the planning and development of facilities at Dana. Restricting access to specified points in the reserve; limiting the number of overnight campers at the campsite area; strategic positioning of the Dana Centre to facilitate the needs of Dana village and coordinate park management activities; construction of a bus park and entry booth to the reserve away from the village area; restricting the use of private vehicles in and around the reserve; construction of an information hub on one of the access routes to Dana; and the planned establishment of a tourist impact monitoring system around Dana campsite are all strategies adopted to preserve the integrity of the local villages and the reserve, while at the same time providing a quality experience for tourists.

Azraq Comprising five subcomponents over a large geographic area, the Azraq Oasis project presented some severe challenges in ensuring inter-agency collaboration and integration of effort. The approach adopted to managing the project is presented in Annex III. Inherent in this structure is a mechanism for ensuring that counterpart agencies, responsible for the various subcomponents upon completion of the project, receive adequate supervision and training from permanent project staff and input from national and international consultants. A case in point is the Agriculture sub-project which has employed 7-8 permanent staff, involved 8 counterparts from the Ministry of Agriculture, and made use of four consultants to date. Sub-project managers are on loan from respective organisations, and it is likely that a number of project staff will be absorbed by these agencies at the end of the project. Input from local residents has recently been facilitated through the creation of structures such as Friends of Azraq, and preference is given to local people with regards employment opportunities.

This approach has worked to varying degrees of success, and some impressive outputs have resulted. From an institutional strengthening perspective, two major issues are of concern:

(1) long-term integration and sustainability of effort for the entire oasis, given that the Management Unit, serving in a coordinating capacity for the project, is a temporary structure. A strategic plan, outlining institutional responsibilities, as a means of ensuring sustainability of the project after termination of the current phase is yet to be developed; and

(2) integration of effort with RSCN in the rehabilitation and management of the Azraq Wetland Reserve, with specific reference to the ability of RSCN to manage Azraq in a manner consistent with that being developed at Dana and other reserves in the country.

The Azraq Wetland Reserve subproject has involved six permanent employees, including two from RSCN. Also supporting work at the reserve have been three scientific staff from Jordanian universities, in addition to a range of individuals brought in on short-term consultancies. Annex IV provides a breakdown of staff involved at Azraq Wetland Reserve.

G. IMPACT

AZRAQ OASIS

The impact of the Azraq project component was immediate. The top priority of the director was to obtain water for the wetland system to stave off a biological disaster. Rennovation of the old pipeline to bring water from the well field north of Azraq literally saved the Ramsar site. Vegetation began to return quickly to the system following reflooding, and the endemic fish species of the wetland was saved. Forces were mobilized within the local community to clean trash from the wetland, and the fencing for the Ramsar site was extended to include the two Shishan springs. Once the area was cleaned, secured and reflooded, considerable effort was put into biological species surveys for all principal biotic components of the ecosystem. Such data provide a basic understanding of the biotic structure of wetland and will be of value in future assessment of the ecosystem rehabilitation effort.

Considerable effort has been put into collection of physical and chemical data on groundwater resources for the entire Azraq Basin. A groundwater monitoring network that has been set up by this project will provide valuable inputs on changing conditions for all forecasting models. The mathematical models that are currently being developed have facilitated close cooperation between the university and governmental agencies for their successful completion. The data collection and incorporation into mathematical models will be an essential tool for the government of Jordan in the process of developing sound management plans for the nation's water resources into the next century. Such models will be critical to allocating water to the Azraq wetland and for finding a permanent solution for a water supply. The project has also build a number of control structures in Wadis to promote groundwater recharge during heavy rainfall events. These structures are now being closely monitored to estimate their effectiveness, and it is likely that they will provide an excellent model for distribution throughout Jordan and similar arid and semi arid zones.

The EIA unit that has been established within the General Corporation for the Environment is a first attempt to ensure that environmental considerations are part of all development proposals in Jordan. It is too early to what extent this unit will be consulted on developmental issues. Governmental staff have been trained in the use of geographical information systems and field data collection, especially related to physical and chemical aspects of water resources, but the effectiveness of staff training in wetland management options is questionable at present.

This project has strengthened ties between the government and local farmers and has provided a valuable service to the latter through surveys of soil chemistry and infiltration, agricultural chemicals and maps for soil salinity and water quality of irrigation waters. The ongoing program of dissemination of such information to farmers should help promote better land use practices and more efficient water use. These efforts will be aided by the guidelines for agricultural, salt extraction and aquacultural activities that should be developed by the end of the project and awaiting implementation. It was obvious to the evaluation team that agricultural interests in the area are beginning to view the Azraq Reserve in a more positive light, especially because of the above services provided by the project and the public forum offered through the Friends of Azraq.

Establishment of the Friends of Azraq has for the first time provided the people of the villages surrounding the Azraq wetland the organizational structure within which to become empowered in environmental issues related to the Azraq Oasis. Prior to establishment of the Friends of Azraq, there appears to have been little cooperation between the two villages of the area nor was there a mechanism for direct communication with governmental agencies responsible for water resources. It is especially noteworthy that potential adversaries, conservationists and agricultural interests, both participate openly in group debates and policy decisions. The Friends of Azraq has become the environmental watchdog for the wetland and surrounding area and should continue to serve this valuable function long past the completion of the Azraq project.

The socio-economic impact of the Azraq project component is difficult to analyze. Development of the tourism potential of the wetland awaits completion of a number of infrastructural elements. Plans for the visitor center are being finalized and construction is expected to begin soon. Construction of trails and picnic facilities has not begun. Placement of trails is critical to ecotourism success, especially bird watching. It is doubtful whether the current understanding of wetland ecology is sufficient to permit the best possible design for trail placement. Utilization of the wetland site is hindered by the restrictive access policy enforced for the Ramsar site. Finally, there is great need to train guides both on species identification and ecology and how to meet expectations of the informed ecotourist.

DANA RESERVE

An immediate impact of the Dana project component was to secure for RSCN the legal provision for the management of all natural resources in the reserve. One of the first accomplishments of RSCN was to reach agreement with the Natural Resources Authority regulating mining explorations in the reserve, limiting them to geological studies and collection of small quantities of mineral materials without use of power equipment or explosives. The threat of mining for copper was considered by the project document to be "the most serious threat to the integrity of the Dana reserve". Given that the Natural Resources Authority declared in 1995 that copper mining in Jordan has become economically feasible due to the rise in copper prices and the reduction in processing costs, it is an important achievement. The impact of the project on the environmental infringements of the Rashadyia Cement Factory Plant has been more mixed. An independent analysis of the environmental impact of the factory by GTZ has produced practical recommendations for alleviating some of the environmental problems. The project has been able to take special actions to halt quarrying operations at the top of the escarpment slopes above Dana. However they have not yet been successful in moving the crusher system which is presently visible and audible from inside the reserve. Furthermore future quarrying operations are planned on the north side of the reserve in an area of native oak woodland which may be an important habitat for wolves utilising the

Dana reserve. Another area of concern is the possibility that blasting operations may affect the flow and/or quality of water emerging from the springs at Dana village and below in Wadi Dana.

The Dana project component has had an important socio-economic impact on some of the communities living in and around the reserve. At Dana Village, the project has revitalised the terraced gardens and provided employment opportunities for men, as farmers and guides, and for women in manufacturing and marketing. The Dana Forum provides an organisational structure within which the local community has become empowered to direct the reconstruction of their own village, almost abandoned at the outset of the project. It is also a vehicle for spreading awareness of critical environmental issues which will be of great importance for both the community and the Dana reserve. There is a need to link the economic developments at Dana more strongly with conservation measures in the reserve, including the control of fuelwood collecting, animal trapping, poisoning and hunting, overgrazing, and disturbance.

By promoting Dana as a nature reserve, the project inevitably attracts visitors and tourists to the site. An important management initiative has been to control visitor access at both the top and bottom of Wadi Dana so as to limit the number of vehicles , and avoid the worst excesses of off-road driving. The project has also provided tourist facilities which encourage responsible use of the reserve, including trails, guides, camping facilities and educational materials. There is an urgent need to develop a strategy for managing future increases in visitors and for containing commercial pressures for mass tourism developments. It is not easy to predict the socio-economic impact of increasing visitor numbers on local communities.

The socio-economic impact of the Dana project on the Azazme has been limited. These people depend entirely on grazing their livestock in the reserve and are suspicious of any talk of change which does not provide them with long-term security, and for some, the freedom of their traditional lifestyle. The project needs to develop nature tourism in lower Dana as a basic means of diversifying the economy of the Azazme, and to provide a mechanism for effective communication between RSCN and the Bedouin families.

The baseline surveys have revealed in the reserve the presence of several globally threatened species, such as the lesser kestrel (*Falco naumanni*) and Tristram's serin (*Serinus sysriacus*) for which conservation measures have been recommended , and indicate from indirect evidence the presence of the endangered Sand Cat (*Felis margarita*). As discussed in the previous section (G. CAPACITY), the Research Centre at Dana has started to have a useful impact at a national level in training graduates in survey and assessment techniques. It has the potential to play an important role in environmental educational of Jordanian school children, and a regional role in developing applied research into the conservation and management of dryland ecosystems.

INSTITUTIONAL STRENGTHENING OF RSCN

Two measures of impact are: (i) the changes brought about within RSCN as a result of the project; and (ii) how those changes have impacted on the management and functioning of reserves within Jordan, notably Azraq and Dana, in addition to promoting the wider mandate of RSCN in terms of wildlife protection/enforcement and environmental awareness in the country.

Staff of RSCN were consulted on their perception of changes to the organisation as a result of the project. Some general conclusions are as follows:

Before the project:

- slow procedures
- limited cash flow
- little equipment and vehicles
- few training courses
- framework for RSCN unclear
- no regular meetings or workplans
- sections not responsible for own budget
- low salaries and no health insurance plans

As a result of the project:

- staff numbers have increased
- delegation and lines of responsibility well organised
- improved morale and ingrained team spirit
- jobs well defined

On the whole, the institutional changes introduced have improved the modus operandi of RSCN from a staff perspective. This is generally consistent with the introduction of operational changes and structure to the organisation aimed at strengthening the ability of RSCN to deliver it's mandate in an effective manner.

The impact of the project on RSCN and it's extension activities may be illustrated by a number of case studies. For example, discussion with rangers in Dana revealed that they now have formal procedures for carrying out and reporting on their work, and that these procedures are fully endorsed and supported by headquarters. This support was particularly important at the Dana campsite when enforcing restrictions on the use of private vehicles.

The development of a strong team ethic is witnessed in the integration of effort between Sections of RSCN. For example, the Research and Survey Section facilitates surveys in support of reserve management and the development of management plans, and has been responsible for training around 25 individuals, many of whom have since taken up positions within the organisation. The Public Awareness Section has worked closely with the Fundraising and Public Relations Section in the preparation of water spots for television, while staff of the Law Enforcement Section have been trained to record environmental information within the context of their work - this is then fed back to the Research and Survey Section in support of monitoring activities.

Implementation of the project has caused a strategic shift in the way the Public Awareness Section operates; traditionally, the Section gave lectures to individual Nature Conservation Clubs and frequently visited schools; now, with more that 500 clubs established, RSCN facilitates a network of 28 regional coordinators, who run activities on behalf of RSCN. RSCN works with the regional coordinators in developing and providing educational materials (eg. tool box), and assists in the development of monthly work schedules for club leaders. Without project support, it is unlikely that many of Section's activities could be sustained in the face of escalating costs in the production of educational materials, and in administrating/supporting an ever increasing network of Nature Conservation Clubs.

Through the Fundraising and Public Relations Section, the mass media (newspapers, water spots on TV) is being used to reach the public with environmental messages. Further, the Jordanian news agency distributes to countries internationally, and information about RSCN and the conservation of biodiversity is distributed on internet and through the El Reem magazine.

The development of the Socio-economic Section of RSCN and extension of activities through the Wadi Dana project is beginning to yield tangible benefits. For example, around 55 people have now participated in jewellery making training; the Women's Stone Cooperative has received in excess of 1,500 Jordanian Dinars for their work; and more than 50 people have benefitted from training and infrastructural development during Phase I of the Terrace Garden project. Further, local residents of Dana and Quadessyo have been employed through the project, and following training in interpretation techniques, nine individuals now serve as nature reserve guides. In the lower part of the reserve, RSCN is working with the local Bedouin to identify economically and socially viable alternatives to livestock grazing.

The institutional strengthening of RSCN has contributed to the larger context of national efforts to conserve biodiversity at a number of levels. In terms of mechanisms to influence policy makers and provide support to the Government of Jordan in conserving biodiversity more broadly, the following are of note:

- under the new Protection of Environment Law (1995), RSCN is being asked to draft bye-laws with respect to protected areas, contribute to protected area policy, and will have responsibility for a broader enforcement mandate;
- by virtue of the same law, RSCN has representation on the Council of Environment Protection, a high level body responsible for coordinating environmental management in the county;
- RSCN is collaborating with and supporting government agencies, as illustrated in the following examples:
    - RSCN is increasingly being seen as an information provider to government; examples include support to the Planning Department in preparation of the National Environmental Action Plan; collaboration with the General Corporation for Environment Protection in preparing baseline information for the Convention on Biological Diversity; and RSCN is a member of the National Committee for Biodiversity, and has been involved in the Biodiversity Country Study process;
    - RSCN has been approached by the Ministry of Municipal, Rural Affairs and Environment on wider land use planning issues vis-a-vis buffer zones and grazing regimes outside of the protected areas network, particularly the development of a land use plan around Dana Wildlife Reserve;
    - RSCN is playing an advisory role to government on issues such as the Red/Dead sea assessment; and
    - Development of Wadi Rum is being discussed with the Ministry of Tourism.

Training, as part of the institutional strengthening of RSCN has been extended to other government agencies and the private sector on a number of occasions. Examples include the provision of training in ecotourism management with Ministry of Tourism staff, involvement of four individuals from Discovery Tour Operators in a programme on visitor management, and environmental awareness training for Forestry Department staff at Dana Wildlife Reserve. With development of internal expertise and capacity, RSCN is clearly moving into a position to provide a more formal programme of training in support of capacity building efforts in other institutions.

Sections within RSCN are also having an impact in influencing environmental management within their own spheres of influence. For example, the Law Enforcement Section works through the Hunting Committee to establish regulations and schedules for application country-wide. The Public Awareness Section has representation on the Curriculum Development Committee of the Ministry of Education, and has been instrumental in providing input and materials in support of the National Curriculum. Staff of the section have also worked with the Ministry in preparing a manual for Nature Conservation Clubs, and in running training courses/workshops for students and teachers. A measure of the impact which the Public Awareness Section is having is represented by the fact that there are now over 500 Nature Conservation Clubs in existence, comprising 20,000 members. In addition, about 1,500 students attended summer camp at RSCN reserves last year.

The work at Azraq is providing a vital contribution to national efforts at conserving biodiversity. Important achievements include the bringing together of multiple agencies to implement and manage a complex project. This integration of effort and networking has undoubtedly provided valuable insights as agencies increasingly work together to meet reporting requirements of international initiatives such as the Convention on Biological Diversity. The establishment of Environmental Impact Assessments (EIAs) is new to Jordan, and the production of materials such as an EIA manual will form a cornerstone in guiding development activities. Finally, the information being produced from the project is being used in support of decisions being taken by collaborating institutions, as well as other government departments, and is supporting environmental education activities by Nature Conservation Clubs, schools and other non-government organisations.

H. SUSTAINABILITY

AZRAQ OASIS

Three assumptions are implicit in the project document that dictate the overall success of the Azraq project component:

1. Water of sufficient quantity and quality can be found to maintain the wetland and associated biodiversity intact.

2. The structure and function of the wetland ecosystem will return intact following reflooding of the system.

3. The government of Jordan will ensure that there will always be sufficient water for ecological maintenance of the Azraq wetland.

Contamination of groundwater in the Azraq basin appears to be minimal, and mathematical models based on data compiled and collected as part of this project will provide the analytical basis for developing future scenarios of water management in light of alterations in consumption and utilization. Several governmental agencies have taken part in the development of these models and have thus tacitly accepted that they will form the basis of future water policy. The long term commitment of the government of Jordan to provide sufficient water to maintain the Azraq wetland, however, is by no means assured. Rapidly expanding human populations and diminishing water resources will put undue pressure on governmental officials to meet the immediate needs of the human population at the expense of the wetland ecosystem.

While it may be possible to obtain a long term commitment to supply the wetland with sufficient water, it is not clear what the minimum quantity of water is that is needed to support

the biotic structure and function of the Azraq wetland. An interrelated question regards the importance of seasonal water level fluctuations on wetland biota. The broad assumption that simply flooding the wetland will return the ecosystem intact is likely not valid. For example, while vegetation quickly returned to the wetland site once it was flooded, the almost complete dominance by one or two plants does not mimic what characterized the system prior to extensive pumping. By extension, we have no idea of how plant species composition and extent affects dissolved oxgen levels in the water column and thus the food and possible habitat of the endemic fish found in the system. In addition, there is no understanding of how exotic fish species entering the wetland from adjacent aquacultural operations impact the biodiversity relationships within the wetland.

The above examples illustrate clearly how this project has attempted to develop a management plan for a fragile aquatic ecosystem without understanding basic principles of aquatic ecology. Currently there is no capacity for aquatic ecology at the University of Jordan and that at the RSCN is very weak. There was provision for an aquatic ecologist as the wetland subproject leader, but this position was never filled. This is the one most unfortunate oversight of the project, as without a sound ecological footing, many of the objective goals of the project are weak at best.

The Azraq Reserve will return to RSCN control following the end of the current project. In order to assure effective management of the wetland, it is essential that RSCN develop a capacity in both aquatic ecology and basic hydrology to support not only the Azraq Reserve, but all aquatic sites within other reserves of the country. While the Azraq project has a strong capacity in hydrology, this component will not be incorporated within RSCN at the end of the funding period. In order to correct the ecological void of the current Azraq project component, it is recommended that RSCN take full control over ecological aspects of the project immediately and begin staff development for developing an aquatic ecology group within the Research and Survey section.

The Friends of Azraq has provided, for the first time, a mechanism whereby the local community has become empowered in environmental affairs of the Azraq Oasis and open dialogue is now possible among various interest groups for resolving conflicts between environmental conservation and regional development. Based on the current momentum level, this organization will likely gain strength and cohesion in the future and serve both as an effective environmental watchdog for the wetland and as a recognized emissary to the Jordanian government. It is likely that this organization will expand into the area of socio-economic concerns and help chart the course of regional economic development, especially related to an expected increase in ecotourism and the need for supporting infrastructure. While the current socio-economic data generated by this project provide a reasonable baseline of basin wide conditions, insufficient effort was made in generating detailed plans for future development of the tourism needs of the area.

The Azraq Wetland Reserve management plan is currently in draft form. While it recognizes the need for both additional ecological studies and continuous habitat management to encourage local biota and migratory birds, realization of these objectives is hindered by the lack of appropriate ecological data in the current database collected as part of this project. Once completed, the visitor center and trail system will facilitate ecotourism at the reserve, but more attention needs to be paid to development of support infrastructure in the surrounding villages and the incorporation of the local community in the design and implementation of the overall ecotourism operation.

DANA RESERVE

The developments at Dana Village and Dana Centre are of the highest quality and they will serve the project well in the future as it faces up to even greater environmental challenges. RSCN will shortly begin charging for use of its bus park above the Centre, and it can be reasonably anticipated that the reserve's management will soon become economically sustainable through revenue raised from visitors. Similarly it was reported to the evaluation team that the economic developments connected with the re-establishment of the terraced gardens at Dana Village will soon be showing a profit. On the social side, the Dana Forum is enabling for the first time real and effective communication between the villagers of Dana, the local authorities and RSCN. It will have an increasingly important role to play in helping to resolve disputes associated with the expanding local economy and also in easing the tensions generated between the traditional lifestyles, which form the principal visitor attraction at Dana Village, and the desire for modernisation. The Dana Forum could serve as a model for similar developments in a future buffer zone surrounding the reserve.

An implicit assumption in the project document regarding the future conservation of Dana Wildlands was that control over unsustainable utilisation of natural resources could be effected principally by management within the reserve area in consort with local communities. In recent years it has become well-recognised that sustainable conservation of protected areas requires strong management of the support zone (sometimes referred to as a buffer zone) surrounding the protected area, and complementary management measures may in some instances have to be extended to the regional scale, particularly where the protected area supports populations of migratory animals. To be sustainable over the long-term, the Dana Reserve will need to influence socio-economic developments in surrounding areas, seeking to limit mass tourism, off-road driving by 4-wheel drive vehicles, hunting and water-intensive agriculture, while promoting sustainable grazing, diversified and environmentally friendly economies, ehvironmental awareness and the protection of wide-ranging species such as wolves, Dorcas gazelle and large raptors. Following the signing of the Peace Accord with Israel in September 1994, tourism has been rapidly expanding in Jordan with more nationalities involved and more interest in ecotourism. There are now 400 tour operators in the country. It is likely that powerful commercial pressure to construct hotels in the Dana area will eventually emerge. By forming close alliances with the administrative authorities in surrounding areas, RSCN will be in a much stronger position to counter such threats and regulate developments. Beyond this there is clearly an opportunity to link to other projects and agencies working in the Wadi Araba region, given the current interest in regional cooperation. Such links would add considerably to overall efforts to promote environmentally sustainable tourism and environmentally sensitive developments in this region.

Another unstated assumption in the project document is that natural communities of plants and animals will recover if current levels of livestock grazing and fuelwood collection are reduced. While reduction in numbers, combined with the zoning system, will certainly assist the recovery of woodlands and open rangelands, rehabilitation of plant and animal communities in the vicinity of springs will require further conservation steps. Scarce water resources are of critical importance for livestock husbandry and consequently the vegetation near to springs will be heavily utilised even if livestock numbers are reduced. Various solutions are possible including the piping of a limited volume of water outside of the reserve, or closing off the area around certain springs entirely to livestock. Many wildlife species are dependent on access to springs, and may be sensitive to even low levels of human disturbance. Sustainable recovery of woodlands and spring communities will require strengthening of RSCN's present capacity for terrestrial ecology.

There is a need for tourist developments at Feinan and the lower end of Wadi Dana in order to provide and sustain opportunities for employment and for small scale 'cottage' developments amongst the Azazme. Suitable developments would include bird-watching and archaeological trails, and upgraded accommodation and catering facilities at the Feinan Camp.

INSTITUTIONAL STRENGTHENING RSCN

The long-term sustainability of RSCN and successful extension of activities depends on a number of factors:

- economic self-sufficiency;
- an organisational structure which has both breadth and depth of expertise to deal with increasing demand and a rapidly changing external environment; and
- having a clear role, relationship and rapport with collaborating institutions and local communities.

The strategic plan currently being developed by RSCN incorporates economic considerations as well as building institution strength through training and other initiatives.

Economic self-sufficiency Financial security will be realized, assuming continued growth in income through the Trust Fund and government contributions, increased revenue from the reserves through ecotourism and other activities, expanded membership and an active fund-raising campaign, continued project income through national and international support, and the marketing of goods (eg. El Reem) and services (eg. consultancy activities). It is anticipated that revenue from the nature reserves could significantly increase over the next two to three years; projections are 30,000 Jordanian Dinars for 1996 and 60,000 Jordanian Dinars for 1997. International support will continue to be important in enabling RSCN to consolidate progress already made and to meet increasing demand. Annex V provides a breakdown of RSCN income and expenditure, and support for special projects running to the 1998 financial year.Indications are that it will take three years to make a surplus on the initial investment made at Dana Wildlife Reserve.

The Fundraising and Public Relations Section, in collaboration with other Sections of RSCN, has been involved in a number of specific activities aimed at achieving economic self-sufficiency. These include the following:

- Preparation of a fundraising strategy. RSCN will also be looking to develop a network of local fundraising groups in connection with reserves throughout the country;
- Launching of a membership campaign, with a target of increasing membership to 600 in 1996. The membership campaign is being facilitated through the use of press releases and the media. A membership survey assessed the profile, perceptions and demand of RSCN members; RSCN is looking to diversify current membership, an important target audience being the corporate sector. A membership database is being developed to support the campaign; and
- Selling of goods will form an integral part of the fundraising strategy; goods produced from Dana village are marketed under the Wadi Dana label.

Organisational structure The restructuring of RSCN has been impressive over the past two and a

half years, and some concerns have been raised that the policies and procedures developed will be a lasting legacy; this is in the context of a somewhat inexperienced but enthusiastic staff. Clearly, continuity and support for the process of institutional strengthening is important, facilitated through the constant evaluation of training and recruitment needs. Maintaining the focus of the organisation will also be important. For example, the appropriateness of the Law Enforcement Section being responsible for the management of six forests around Amman could be questioned given limited staffing, and their responsibility for wildlife protection throughout the county.

Relationships Part of the independent evaluation involved discussing the mandate and activities of RSCN with relevant government departments, academic institutions, consultants, village communities, and multilateral and bilateral aid agencies (eg USAID). The aim was to assess the level of acceptance, interaction and collaboration with RSCN, and to discuss the future role and direction of the organisation. The relationship of RSCN, a non-government entity, with government organisations able to delegate authority or influence activities is clearly of paramount importance to RSCN's long-term viability, and in ensuring the development of integrated approaches to environmental management.

The response of government officials to RSCN was generally positive. The Ministry of Planning supported the role of RSCN and acknowledged the success of the Dana project, while the General Corporation for Environment Protection was supportive of RSCN's role in preserving wildlife and managing reserves throughout the country. There is a good relationship between the Law Enforcement Section and the police vis-a-vis reciprocal training in wildlife protection and law enforcement, while the Department of Education, Amman, outlined two potential roles for RSCN in future: (i) training teachers to be able to offer a class in environmental education every week; and, in the longer term, (ii) supporting and developing materials for a complete module on environmental education, coordinated through the Curriculum Development Committee. The Nature Conservation Clubs have been applauded from Canadian and British delegates, and USAID have been impressed with the team work ethic of RSCN.

Nevertheless, collaboration and integration of effort between RSCN and government departments needs constant attention. Examples include clarification of the role and working relationship with the Forestry Department in Dana Wildlife Reserve, and coordination of effort with institutions involved in the Azraq oasis project. Specifically, there has been little collaboration between the EIA subcomponent of the Azraq project and RSCN in preparing educational materials for either the wetland reserve or the larger Ramsar site, and staff working in the EIA unit were unaware of potential RSCN expansion into EIA work, focusing on ecological aspects.

At the community level, a number of mechanisms have been instituted to promote active dialogue and initiate a process of participatory management. Friends of Dana, Friends of Azraq, and the Dana Forum are all examples. RSCN activities are supported at the local village (Dana) level, and RSCN has worked closely with the Village Council in providing guidance on tourism development. The Law Enforcement Section has a good rapport with hunters in terms of law enforcement, soliciting feedback on wildlife schedules and procedures, and in discussing the role and service of RSCN to local communities.

At the first meeting of the Friends of Azraq, government officials endorsed their support for the conservation goals of the Azraq oasis. It has also been identified that the Friends of Azraq will work to support the activities of Nature Conservation Clubs, assist in the production of educational materials, and provide guidance in the management of the wetland reserve. Of significance to the long-term sustainability of the Azraq oasis will be further extension work with farmers to adopt new agricultural practices.

I. FUNDRAISING, CO-FINANCING AND RESOURCE MOBILIZATION

AZRAQ OASIS

Little attention has been paid to this activity. This is likely due to the immediacy of the need to perform stop gap measures to reflood at least a portion of the Azraq wetland. With the outpouring of public support for the project by commuity leaders, it is certain that local and national level funding opportunities can be identified and utilized once specific projects are outlined. More effort is needed to build bridges with internationally based conservation organizations to expand the funding base for the Azraq wetland conservation and ecotourism components.

DANA RESERVE

RSCN has been successful in fundraising and mobilizing resources for Dana project activities. Funds were raised to meet escalating building costs for the Dana Centre arising from unstable site conditions. These amounted to 90,000JD from the Japanese Development Agency for the accommodation block and 52,000 JD from USAID for the external works. Furthermore over 300,000 JD was raised by a group, Friends of Dana, with interests that are harmonious with those of the Dana component project. Sales from the product lines developed by the socio-economic team at Dana Village totalled $12,000 at the beginning of this year and are currently meeting the production costs. The opening of a shop at the Dana Centre and the possibility of a shop in Amman suggests that these developments will soon be profitable.

In future developments, there are opportunities for co-financing projects on rangeland management in the Wadi Araba region with CEDA and UNESCO.

INSTITUTIONAL STRENGTHENING OF RSCN

Within the context of fundraising approaches discussed above, co-financing of RSCN activities is an essential component in ensuring economic self-sufficiency. The table provided in Annex V provides a breakdown of aid and special projects being considered over the next three years.

Co-financed initiatives which have commenced or are about to begin include the following:

- JICA (Japanese) grant of 60,000 Jordanian Dinars for completion of the Dana Centre;
- British Aid supporting construction of the visitor centre at Shoumari Wildlife Reserve; and
- Canadian support for further media spots to raise environmental awareness.

In addition, discussions are ongoing with Canadian CIDA regarding potential support for a rangeland management scheme in the Wadi Araba area.

An important feature of the fundraising strategy of RSCN is to engage Sections in fundraising activities within their respective areas. A number of innovative approaches could be used to offset costs. For example, the Public Awareness Section could approach the US Information Service (USIS) for educational materials, to assist in recruiting suitably qualified expertise, or to help in the facilitation of workshops. On this note, the Public Awareness Section has discussed allocation of a small budget from the Ministry of Education to support the work of the Nature Conservation Clubs.

J. FOLLOW-UP

AZRAQ OASIS

The overall success of the Azraq project component and the long term ecological and socio-economic sustainability of the Azraq wetland are dependent on three unstated assumptions:

1. Water of sufficient quantity and quality can be found to maintan the wetland associated biodiversity intact.

2. The structure and function of the wetland ecosystem will return intact following reflooding of the system.

3. The government of Jordan will ensure that there will always be sufficient water for ecological maintenance of the Azraq wetland.

A valid network for monitoring groundwater quantity and quality has been established and should be fully functional by the end of this project. Computer models being developed will provide the analytical basis for sound water resource management in Jordan based on resource availability and projected utilization needs. There is still need, however, to gain assurance from the government of Jordan that water sufficient to meet the conservation needs of the Azraq wetland will be guaranteed in perpetuity.

As demands increase dramatically for a decreasing water resource, the decision for water allocation to the Azraq wetland may ultimately be based on perceived social and economic return to the nation for the quantity of water allocated. There is a great need to develop fully the socio-economic relations between the local community and the Azraq wetland. While the infrastructural components to support tourism at the wetland should be completed by the end of the project, including the visitor center, trails, observation tower and restoration of the Roman wall, there is great need to incorporate tourism within the local and national economy. Measures to integrate the people into the conservation effort with appropriate economic and social return are needed.

It is still unknown how much water is needed to maintain a fully functioning ecosystem at the Azraq wetland. Equally important, the role of water level fluctuations in the maintenance of the ecosystem is critical for understanding how to develop seasonal allocations of water to the wetland. Many biological processes in wetlands, including breeding cycles, are closely timed to expected seasonal water fluctuations. With stabilized water levels or non seasonal fluctuations in water stage, the life cycles of many species could be disrupted.
It is critical to determine the minimum quantity of water the wetland ecosystem needs and the timing of delivery required throughout the year.

Neither the Azraq project nor RSCN are in a position to predict ecological successional trends that will be expected in the Azraq wetland following reflooding, whether the biodiversity and ecosystem structure and function will remain intact, nor how to manage the system to ensure protection of biodiversity including the presence of endemic fish species. It has been assumed tacitly that reflooding the system will return biological structure intact. The plant structure of the wetland currently has little resemblance to what was there twenty years ago. There is a basic need to conduct detailed ecological studies aimed at identifying how key biological components will respond to a variety of water quantity and delivery timing scenarios. There is also a great need to develop expertise in how to manage wetland habitats in order to best

facilitate not only the local biota, but also migratory birds. The RSCN must be in a position to utilize an aerially restricted wetland at the maximum habitat efficiency for conservation. The project must begin to look at ecological issues in a broader integrative approach. It is suggested that RSCN take over the ecological aspects of the Azraq project immediately both to begin to develop expertise in aquatic ecology and to tackle the most pressing ecological issues in the wetland.

The former spring area at the northern area of the Azraq wetland is totally dessicated. There is some resentment by residents of the surrounding village that they have not been included in the ongoing rehabilitation effort of the wetland. The project should work to extended to begin rehabilitation of the northern springs and surrounding wetland. While the staff are developing their skills at ecological understanding and wetland habitat management, the lessons that they learned at the southern section of the wetland, including the Ramsar site, can be applied to the northern section of the wetland.

DANA RESERVE

In order to sustain conservation of biodiversity in the Dana Nature Reserve, two integrated follow-up projects are needed: one to support an expansion of conservation activities outwards into the support zone surrounding the reserve, and the other to fill important gaps in the conservation activities within the reserve. The area around Dana, and indeed all of Wadi Araba and the Eastern Rift Valley, are currently experiencing increased pressure from industrial developments, intensification of agriculture and a rapidly expanding tourism industry. A support zone needs to be legally established around the perimeter of the reserve to reduce the friction caused by a hard edge between incompatible land-uses. A full range of socio-economic developments and awareness campaigns would be required to secure the move towards environmentally sustainable developments in this zone. Many of the developments from the Dana project component could be used as models for this expanded project, including the Dana Forum, the re-established terraced gardens, and the baseline surveys. In addition it would be of critical importance to manage the development of nature-based tourism which could be used to support a diversified and sustainable lifestyle for the Bedouin and to contain the spread of commercial exploitative tourism. This expansion should provide much-needed protection for the desert habitat on the western edge of Dana, favoured by a remnant population of Dorcas gazelle (*Gazella dorcas isabella*) and other rare desert adapted species such as the Sand Cat (*Felis margarita*) and Sand Fox (*Vulpes rueppelli*). It should also be viewed as part of a wider regional programme in the Wadi Araba region aiming to provide protection for the top avian and mammalian predators and other mobile species unique to the area.

Plant and animal communities found at the heavily utilised springs at Dana bear little resemblance to what was there in the past. The Dana project is not presently in a position to predict ecological successional trends at major springs and along moist wadi beds once the present intensity of grazing pressure is reduced. There is also a serious problem of mortality in juniper and other trees in the reserve which may be related directly to livestock through browsing, and indirectly through grazing and trampling which accelerate soil erosion. This problem is not new to the area. According to the 1954 -1956 range classification of Jordan by Hunting Technical Services, Juniper were being severely checked by grazing animals 40 years ago, and the erosion problem was being exacerbated by increased exposure resulting from cutting for firewood. There is a clear need to conduct basic ecological research into those ecological processes at Dana which are being strongly influenced by grazing and browsing animals. The majority of animals grazing rangelands within the reserve belong to the Azazme. Whilst investigating management options for developing a sustainable system of pastoralism in

Dana Reserve, which is compatible with biodiversity conservation, the within-reserve follow-up project should also develop nature-tourism at Feinan and Wadi Dana so as to provide a base for a diversified economy for the Bedouin.

INSTITUTIONAL STRENGTHENING OF RSCN

Over the past three years, there have been a number of significant developments in Jordan and the Middle East generally which have had an impact on the role of RSCN in the management of nature and natural resources.

Perhaps the most significant event was the signing of the Peace Accord in 1993. As a consequence, there are now more than 90 development projects proposed for the Wadi Araba area alone. In this same region, an international biosphere reserve is being considered, linking Dana to Hutzeva in Israel, and it is the location of a proposed CIDA-funded rangeland management scheme. In the context of both initiatives, it is likely that RSCN will be asked to play a leading role.

Other impacts of the Peace Accord have included an increase in tourist pressure and the threat from activities such as poaching. Currently, there are more than two million visitors to Jordan annually, and over the period 1994-1995, Discovery Tour Operators witnessed a 40% increase in tourist trade. Increases in tourist demand are being witnessed at Dana Wildlife Reserve, and RSCN has responded by implementing a number of mechanisms and safeguards to control tourism around the site. Institutionally, RSCN has responded by recruiting a tourism development officer.

As the institutional capabilities of RSCN have developed over the span of the project, there has been increasing pressure for the organisation to collaborate with other agencies and government departments in environmental management, and to extend capacity building and training initiatives. Towards this end, the establishment of a regional training and database centre, facilitated through the EcoPeace initiative, could be a timely development. It is envisaged that this centre would provide vocational training in areas such as protected areas management and environmental awareness.

Another significant development has been the passing of the Protection of Environment Law in 1995. As a result, the responsibilities of RSCN are likely to increase in the areas of wildlife protection, and protected areas planning and management. Further, it is anticipated that RSCN will oversee development of an expanded network of protected areas as outlined in the Environmental Action Plan; the number of sites is proposed to increase from five to twelve. For each of these sites, the development and implementation of management plans, and a programme of management planning for reserve staff will be required, as has been initiated to varying degrees at Dana and Azraq.

Collectively, these demands will necessitate an expansion in the capabilities and capacity of RSCN. Nevertheless, any extension in project funds to enable development in these areas must be matched to self-sufficiency targets for the organisation as a whole.

K. GLOBAL BENEFITS AND THEIR IMPORTANCE/RELEVANCE

AZRAQ OASIS

The global benefits of the Azraq project are both immediate and long term. Through designation as a Ramsar site, the international significance of the Azraq wetland was recognized. Wetlands are both rare in the arid zones of the world and undergoing serious ecological destruction as human water demands increase. This site is especially important for

migratory birds from at least two major flyways and is thus a critical intermediate site on the way to wintering grounds in Africa.

Reflooding of the Azraq wetland in mid 1994 saved the system from the brink of total ecological disaster. Although the rehabilitation effort is still in its infancy and in need of management fine tuning, the wetland can still serve as a stop over site for migratory species. The concerted effort to save this system through governmental and community mobilization is a good model for other wetland systems in arid or semi arid nations.

The long term contribution of the Araq project will be though knowledge gained on ecological succession and stability following reflooding and hopefully both the determination of minimum water requirements for wetland ecosystem function and skills on how to manage aerially restricted wetland habitats in order to maximize conservation benefits.

DANA RESERVE

Writing about the Middle East and the Mediterranean some 2,500 years ago, Plato noted that "*What now remains compared with what then existed is like the skeleton of a sick man, all the fat and soft earth having been washed away, and only the bare framework of the land being left.*" The degradation of the vegetation, as stocking rates have risen and wood-burning human populations have expanded, has occurred on such a sweeping scale that it is now very difficult for people to conceive that much of the poverty of their surroundings is man-made. This is why Dana Wildlands is such a uniquely important site for biodiversity conservation: if given the chance it will stand out as a beacon for the Mediterranean, the Middle East and Arabia of a landscape of mountains, wadis and plains, where it is possible once more to see the workings of nature on a large scale.

Through the workings of the Dana Research Centre, the scientific knowledge gained on managing fragile dryland ecosystems can be communicated widely within Jordan, other countries of the region and beyond. The understanding that Dana can bring to the world concerns on the one hand the nature of human impacts on ecological processes, which in turn underpin the rich biodiversity of the area, and how these processes and species can be best managed for conservation, and on the other the nature of socio-economic developments which will sustain local communities, enriching traditional lifestyles, without damaging fragile arid and semi-arid environments..

INSTITUTIONAL STRENGTHENING RSCN

A number of regional and global benefits are being realised and shared as a result of the work at Dana and Azraq, and as a consequence of the institutional strengthening of RSCN. An obvious example has been interest in the work of the Research and Surveys and Reserve sections of RSCN in identifying and subsequently managing important habitat types, and areas of importance to endemic and internationally threatened species of flora and fauna. In this regard, RSCN has important links with IUCN's Species Survival Commission, and is the management authority for CITES in Jordan. By virtue of the latter, information on species and trade in their products is exchanged routinely with institutions throughout the region, as well as further afield.

Other examples illustrating extension/collaboration vis-a-vis RSCN activities are as follows:

- research results of bird surveys are being fed into the BirdLife International network;

- countries of the region (Israel, Palestine) have shown an interest in the awareness materials developed by RSCN; such materials are also exchanged routinely with organisations such as the International Centre for Conservation Education (ICCE) in the U.K.;

- training has been provided for authorities of the West Bank in wildlife enforcement;

- work is being done with Wetlands International on the inventory of wetlands for Jordan;

- consultation is ongoing with UNESCO in the potential establishment of biosphere reserves in the country

- in 1996, a training course in interpretation is being developed with staff from Yemen and Palestine;

- collaboration in biodiversity research is being developed with Israeli universities;

- a working relationship in the exchange and management of biodiversity information is being developed with the World Conservation Monitoring Centre in the UK; and

- RSCN is playing an important role in Eco Peace, a consortium of non-government organisations dedicated to the protection and sustainable management of the environment in the region.

At an institutional level, the RSCN model has been studied, and a similar centre with government backing, has been established in Saudi Arabia. The socio-economic approach adopted at Dana is almost certain to provide a model for extension elsewhere in Jordan and throughout the region, while the work at Azraq provides important lessons for inter-agency collaboration in the management of wetland ecosystems.

V. FINDINGS OF THE EVALUATION

AZRAQ OASIS

Evaluation of the Azraq project component was based on review of project documents and reports; interviews with governmental, university consultants project staff, and private sector tourism operators and detailed site visits. In addition the evaluation team held discussions with the British, Canadian, and United States embassys. A full schedule of activities of the team during the Jordanian visit are included in the annexes. Finally, following the site visit, discussions were held with Ian Andrews, a noted authority of birds of the Azraq wetland and author of the most complete bird guide to Jordanian birds, and Dr. Wolfgang Schneider of the Hessisches Landesmuseum in Darmstadt, Germany, a noted authority on the fishes of Jordan including the Azraq wetland.

The project document provided a number of success indicators for meeting the six stated objectives of the project with their associated activities. These have been summarized as eight major indicators:

1. Restoration of a core area of the wetland around the springs to a near natural condition with maintenance of biodiversity intact

The top priority of the project director was to find sufficient water to bring the mostly dessicated Azraq wetland from the brink of complete biological disaster. By mid 1994 he had found enough water to establish a core area of wetland around the Shishan springs and Ramsar site. Only through his strong personal commitment to saving Azraq was this possible. He is to be commended especially for his efforts at obtaining cost benefit maximization through the rennovation of an existing water pipeline for delivery of water to the wetland from northern well fields rather than drilling expensive wells closer to the site.

A number of biological surveys were conducted during this project that have provided a reasonable understanding of the species composition and biodiversity of the wetland. These were completed largely through the use of university professors as consultants. While these have provided valuable baseline data, there has been little attempt to integrate this information into a broader ecological perspective. It has been widely assumed that reflooding the wetland will preserve ecosystem structure and function and thus biodiversity intact. Such an assumption not valid and is supported by the fact that the original habitat heterogeneity of the wetland has largely been replaced by monocultures of two or three species. It is unlikely that the revitalized wetland will have the same conservation value for migratory bird species as formerly. The failure to employ a aquatic ecologist as the wetland subproject manager has is largely responsible for the current lack of ecological understanding of the wetland and its relationship to water quantity and water level fluctuation. Currently there is no real capacity at either the universities or RSCN in either limnology or wetland ecology and management. At this point an international wetland expert is vitally needed to establish a program in wetland ecology that will provide the data needed both to determine water allocations to the wetland and how to manage the system for maximum benefit to local and migratory species and ecotourism.

2. Repair of existing infrastructure at Azraq, construction of a new reserve headquarters and visitor center and development of a well trained staff

The reserve headquarters is functional, plans for the visitor center have been completed, but construction of trails and observation and rennovation of the Roman wall have not begun, although responsibility for the latter has been assumed by the Ministry of Antiquities. The project director was extremely successful at mobilizing the local community around Azraq to help with the clean up of the site initially. Trash was removed and the fence extended at the Ramsar site to include the Shishan springs. The ponds at the Shishan springs were dredged to improve habitat, but unfortunately the edges of the ponds were left as a two meter vertical drop to the water. Vertical banks have limited conservation value, and these should be recontoured to promote habitat for shorebirds. This illustrates again that although much effort has been expended in this project, the lack of ecological understanding has hindered maximization of benefits to conservation.

The question of staff training remains problematic. While a number of training programs were proposed in wetland management, the lack of a wetland subproject manager has hindered this effort. The staff appear to be well trained in the daily operation of the reserve, but there appears to be a total lack of understanding of wetland management including biotic-abiotic interactions and maximization of habitat structure to meet conservation purposes. There has been poor coordination in the training effort with RSCN.

3. Provision of scientific, educational and recreational opportunities for national and foreign visitors.

International linkages with appropriate wetland scientists and managers has been weak. There has been little effort to engage foreign specialists to conduct research on critical ecological

issues at the wetland. Recreational opportunities for Jordanians have been extremely limited due both to the restrictive access policy for the wetland and the lack of adequate infrastructure to support visitors to the site. Likewise, socio-economic aspects of potential international tourism to the area have received little attention because the wetland is not really organized to receive visitors. There appears to be little understanding of the expectations of foreign ecotourists for a successful conservation oriented experience. Placement of observation towers and trails to maximize the ecotourism potential with minimal negative conservation impact needs to incorporate an international wetland manager familar with such practices.

4. Establishment of a small EIA unit within the General Corporation for the Environment capable of meeting the nation's needs.

An EIA (environmental impact assessment) unit has been established in the General Corporation for the Environment, but its future effectiveness is still uncertain. Staff appear to be poorly trained in basic ecological principles for conducting environmental impact assessments and it is unclear how they will be incorporated into all future developmental schemes. With such a small staff, they will likely operate only at the scale of large development. It is totally unknown how they will able to force changes in developmental schemes if significant environmental impact is likely to occur.

5. Guidelines for agricultural development in the Azraq Basin will be developed based on sustainable utilization of limited space and ground water resources.

The activities associated with this success indicator appear to be progressing well and will lead to a significant product. A survey of the quantity and quality of groundwater in the Azraq Basin has been completed as have maps of irrigation water quality and soil salinization and a survey for soil chemical profiles. A great deal of effort has been made to get this information to local farmers, and this has helped greatly to make them feel that the Azraq project is a cooperator rather than a threat to their existence. In a large sense, the Azraq project is serving as an agricultural extension service in the region. Guidelines for agricultural development are nearing completion and should be well received.

6. A water management plan for the Azraq Basin will be completed by the end of the project

This project task has been extremely successful at building up relationships between the universities and governmental agencies. The mathematical models being developed will provide Jordan with the analytical tool to formulate sound management policies for their limited water resources. Establishment of a monitoring program for groundwater quantity and quality is going well, and the resulting data will are considered essential for forcasting future water needs. This project aspect is the forte of the project director and should yield first class results of paramount importance for establishing future water allocations in the Azraq Basin. Assurances are still needed from the government of Jordan that essential water allocations for the Azraq wetland will be guaranteed in perpetuity.

7. Compilation of published reports and guidelines relating to water harvesting, artificial recharge of surface runoff and treated waste water, and water conservation and mangement practices in arid and semi arid lands

This component is closely coordinated with the previous component and also appears to be leading to valuable products. Retention structures have been built in several small wadis surrounding the Azraq wetland as demonstration sites for groundwater recharge with surface

water runoff. Monitoring devices have been installed at numerous locations in order to test the efficiency of such structures for promoting infiltration. Data collection has been hindered by the current drought conditions. The work with waste water as a recharge source is less well developed and needs to receive greater attention. International cooperation on the development of these sites appears to be marginal, but regional dissemination of project results are planned in the future.

8. Strengthening of the capacity of RSCN to manage the Azraq Wetland Reserve and other reserves in Jordan and to foster environmental education and public awareness

Cooperation and coordination with RSCN during the course of this project have been minimal. While the Azraq project will leave RSCN with physical infrastructure and staff, the level of ecological sophistication needed to manage the Azraq Wetland Reserve by RSCN is weak. There has been little attempt to incorporate RSCN staff into research design or wetland management training. The net result is that RSCN staff are not very familar with the Azraq wetland nor do they have the inhouse capacity to manage such a complex aquatic ecosystem. There is an immediate both to fully integrate RSCN into the Azraq project and to develop the professional expertise to be able to assess and manage aquatic ecosystems.

The Azraq project has produced some educational material including posters and a calendar, but their efforts could have been more far reaching had they cooperated with the public awareness section of RSCN. It is obvious that this lack of coordination has hindered dissemination of the message of the Azraq project throughout Jordan. It is essential that this oversight be corrected in the near future.

The director is to be commended for spearheading the establishment of the Friends of Azraq. This organization has provided, for the first time, a mechanism whereby the local community has become empowered in environmental affairs of the Azraq Oasis and open dialogue is now possible among various interest groups for resolving conflicts between environmental conservation and regional development. Based on the current momentum level, this organization will likely gain strength and cohesion in the future and serve both as an effective environmental watchdog for the wetland and as a recognized emissary to the Jordanian government. It is likely that this organization will expand into the area of socio-economic concerns and help chart the course of regional economic development, especially related to an expected increase in ecotourism and the need for supporting infrastructure. There is concern, however, that those community members at the lower end of the economic ladder may be missing the message of the Azraq project and may not view the project in the most favorable. The policy of total exclusion of people from the fenced wetland area may be building negative relations with the community, but these will be easily corrected once picnic and other recreational opportunities become available. It is essential that all components of the community feel that they are both contributors to and beneficiaries of the Azraq project.

DANA RESERVE

Evaluation of the Dana project component was based on review of project documents and reports, interviews with project staff, governmental representatives, university staff, and private sector tourism operators, and on detailed site visits. During the site visits, meetings were arranged with a local community leaders at Dana Village, and with several Bedouin families in the western part of Dana reserve where a British anthropologist, Alan Rowe, who is unconnected with the Dana project, assisted with interpretation. In addition the evaluation team held discussions with the British, Canadian and United States embassies (see schedule of

activities in the annexes). Finally following the Jordanian visit, discussions were held with Neil Munro, a noted authority on the soils and landscapes of Jordan who is also a co-author of RSCN's information booklet: 'The Dana Project', and with Ian Andrews, a noted authority on the birds of Jordan who is also the author of the most complete bird guide to Jordan.

The project document provides a number of outputs that relate to the one stated objective for the Dana project component. These are listed below together with the findings of the evaluation team.

1. Legal provision for the management of all natural resources in the reserve core area.

This crucially important step has been successfully taken with the establishment of the Dana Nature Reserve in December 1993 under Article 12A of the State Land Law No. 17 (1974) and Article 11 of Land Use Regulation No. 53 (1977). Under this legislation the RSCN has full legal authority to manage the natural resources in the reserve core area. The Society has used its new responsibility and authority effectively at Dana but has yet to assume full control of the reserve. The Forestry Department still exercises some responsibilities including its mandate to manage forest areas within the reserve, and to issues grazing permits to some Bedouin families (as of winter 1995/1996). The indications are that this matter will be resolved amicably in the near future.

2. Provide basic equipment and facilities for reserve management, field staff and researchers at Dana.

The Dana Field Station is a multi-purpose building complex for which the project can feel justifiably proud. It constitutes a research station, small conference centre, reserve office, visitor centre, village enterprises workshop, and accommodation block all rolled into one. It has been very ably designed to blend in with its surroundings and is most tastefully furnished. It is well equipped and fully operational. It is to the project's credit that unforseen Field staff were equipped with suitable 4-wheel drive vehicles and short wave communication radios all of which appeared to be in good condition.

3. Assessment of the biological diversity occurring in the Dana reserve core area.

A number of baseline field surveys were conducted during this project which have provided a reasonable understanding of the species richness of major taxonomic groups, and the distribution and population sizes of several key species. The surveys have been well organised, thorough and professional, and they have been completed according to schedule. Discovery of several species new to Jordan, and of several endangered species, have highlighted the global importance of the area for biodiversity conservation. The programme has been used as a vehicle to train Jordanian graduates in survey and assessment techniques, and several participants were subsequently recruited as project staff. Three has been little attempt to integrate these findings into a larger view of the ecosystems at Dana, or to understand how grazing and fuelwood collection impact on ecological processes, such as forest regeneration and the successional trends of plant and animal communities at permanent springs. The project has not benefited sufficiently from international collaboration with dryland ecologists and management specialists, and currently there is little capacity for drylands ecology and management at RSCN. A stronger link within RSCN between their Reserves Section and the Research and Survey Section would help to direct research towards applied questions concerning threats to biodiversity, and direct management towards conservation actions.

4. Quantify existing threats to biological diversity from livestock grazing and fuelwood collection in the Dana core area.

The study of rangeland management and livestock in Dana has provided important information on the numbers of people and their animals using the reserve. The study revealed a total of 52 Bedouin families within the reserve, comprising 524 people from 4 tribal groups, together with 8,000 - 9,000 animals. The number of livestock was twice that estimated in the project document emphasising the pressure from overgrazing within the reserve. Six permanent exclosures have been erected to monitor the level of damage from livestock grazing over the long-term. No provision has been made to measure the production or biomass of plants inside exclosures, relative to controls, or to measure the impact of different grazing regimes on tree regeneration, cover and species composition. The impact of livestock on the rich but vulnerable communities of plants and animals in the vicinity of permanent water has not been assessed. Brief inspections by the evaluation team suggested that the flora associated with permanent water was largely limited to a small number of toxic and indigestibly plant species. This illustrates again that a lack of ecological understanding is limiting the potential benefits of conservation efforts at Dana.

The rangeland study made recommendations for limiting the extent and intensity of grazing and these are currently being discussed with the Bedouin. The greatest challenge to the project is finding a solution for the Azazme tribe who are totally dependent on the reserve for grazing, and who own 70% of the livestock. Project staff have established good relations with several of the Azazme families but have not yet provided them with practical options in the way of alternative socio-economic developments. Fuelwood use was not quantified as part of the rangeland study.

5. Address the economic needs of communities impacting on the Dana reserve ecosystem.

The socio-economic developments of the project have been concentrated on the residents of Dana Village and on three quality product lines. By providing training, practical assistance and personal encouragement, the project has won many friends and succeeded in revitalising the village community which had been dwindling and losing all but the elderly. Great care has been taken to encourage the community to govern its own affairs and the Dana Forum has been set up to provide an important an effective mechanism for communication between the villagers, local government and the RSCN. Women are being assisted in a practical way by encouraging them to train in hand manufacture of jewellery, processing garden produce, pottery and shop management. Other villagers are employed as tour guides. Thus the project is to be commended for both its economic and social achievements at Dana Village. The decision to concentrate activities at Dana Village has had beneficial consequences. By seizing the unique opportunity to revitalize Dana Village, the project has provided itself with a model of socio-economic development that can be applied elsewhere in the area, and has also given itself a good opportunity to become sustainable through revenue collected from visitors.

The project has not yet addressed the socio-economic development needs of the Azazme. The issues surrounding this group are quite complex, but by no means insurmountable. The development of compensatory income generating activities in the Feinan and lower Wadi Dana areas is an important prerequisite for successful restoration of biodiversity at Dana.

6. Re-establish agricultural production in the Dana terrace gardens as the basis of the Dana Village economy.

Renovation of the arterial irrigation system together with pruning and fertilizing has revitalized the terraced gardens. The first crops of organically grown apricots, grapes, walnuts and herbs have been harvested, dried and packaged, and during the visit of the evaluation team, apricot jam was been produced. A plant nursery was also inspected. Products are being attractively packaged with recycled materials, and new markets are being explored in Amman. The possible impact of the renovated irrigation system on the permanent water in upper Wadi Dana has not been assessed by the project. It was noted that the gardens attract several bird species not found elsewhere in the reserve. The potential for damage to the water supply or the water quality at the springs which supply the terraced gardens, as a result of blasting and quarrying operations by the Rashdyia Cement Factory Plant, is not known. A survey by a hydrogeologist should be undertaken to assess this threat.

7. Establish reserve facilities and management procedures which ensure the maintenance and / or rehabilitation of biodiversity and which encourage recreational and educational activities based on the sustainable use of the natural and archaeological features of the reserve and environs.

The management of Dana reserve are aware of the need to control tourism lest it begins to control the management of the area, as it does in some of the more attractive wildlife parks in East Africa, for instance. Their shuttle bus system for transferring members of the public from the Tower gate to the Campsite is a simple but effective means of controlling visitor disturbance and damage to the reserve. The bus park at Dana Village is nearing completion and this will have a similar beneficial effect by controlling vehicle access to the village itself. Other tourist facilities have been developed, such as the hiking trails, information leaflets and booklet, and the Campsite itself. The recent survey by a team of archaeologists from the Centre of Field Archaeology at Edinburgh University, in association with the Jordan Ministry of Antiquities and RSCN identified 98 sites of archaeological interest. There is now scope for a wide variety of detailed site studies on virtually all the civilizations represented in Jordan.

The draft management plan provides a useful compendium of environmental information relating to Dana and defines key strategies for the reserve in terms of zoning schemes and specific action plans for conservation. The plan is weak in the area of law enforcement: success indicators for law enforcement actions have not been developed nor have the minimum necessary resources been identified. The present number of rangers can hardly be sufficient to control all illegal uses of resources, including wood cutting, hunting, trapping, and poisoning of animals, grazing in restricted areas, and water abstraction. It is also weak in the area of community participation by Bedouin families.

INSTITUTIONAL STRENGTHENING RSCN

Major findings were as follows:

Institutional strengthening of RSCN

- The overall result of the independent evaluation is that the project has been successful in completing the majority of institutional strengthening aspects it set out to achieve. This has resulted in an organisation which operates in a very timely and effective manner, is competent in a managerial sense, and is responsive to rapid changes in external environment. The staff are well motivated and have, for the most part, thrived under the reorganisation. Clearly, however, it will take more time and support to ensure that the changes "stick" and enable RSCN to meet ever-increasing demands.

- The demand and responsibilities being placed on RSCN are increasing, and will require an appropriate response in terms of staff numbers and expertise. Sections which are immediately vulnerable include Fundraising and Public Relations, Law Enforcement, and Public Awareness.

- The preoccupation of developing internal capacity at RSCN has precluded a wide extension of institutional strengthening activities, namely training, to other organisations. RSCN is rapidly approaching a point where it could provide assistance to others; a case in point would be training/capacity building support to the new General Corporation for the Environment.

- Related to the above, collaboration with other agencies could be improved to the benefit of all concerned. For example, there has been some interaction with the EIA subunit of the Azraq project, which also has responsibility for implementation of the Ramsar Convention, in the following areas:

    - running an Environmental Camp for 50 students from 25 Directorates of the Kingdom;

    - participation by subunit staff in RSCN courses in natural resources management and public awareness; and
    - RSCN staff have been invited to partake in EIA training run by the subunit/Corporation.

  Nevertheless, further benefits from increased collaboration could be realised: collaboration and sharing of expertise in conducting EIAs; the joint establishment of monitoring techniques; joint production of information for decision-making and educational purposes, particularly in areas of common interest re-Ramsar sites, protected areas and important wetland areas in the country; and the collaborative development of management strategies which incorporate sites having national and international status.
- The research strategy employed by RSCN has been to involve staff, international consultants, supervisors and support researchers from Jordanian universities. To date, approximately 25 Jordanian researchers, six supervisors and six international consultants have been used in conducting baseline surveys throughout the protected areas of Jordan. Despite the progress made in building the scientific foundation of the organisation, there are still significant gaps in both training and expertise needed (eg wetlands management) in order to: (i) establish ecological models in support of reserve management; (ii) institute long-term monitoring studies; and (iii) conduct basic research on a range of keystone species and critical habitats in the country. The linkages between human activities and ecosystem functioning need to be much more firmly established; a case in point being the impact of socio-economic development (particularly terrace gardens) activities in Dana village on the water regime of the reserve. Further, more extension work needs to be done to establish sustainable grazing regimes and identify viable economic alternatives for local communities dependent on this form of subsistence.

- The gaps in expertise experienced by RSCN partially reflects the general absence of applied ecology/environmental management programmes at the post-graduate level in Jordanian universities. However, as the in-house expertise of RSCN develops, this may afford opportunities for joint training with the university sector, and for providing scientific expertise to assist other environmental institutions in the country to build their own institutional capababilities.

- Integration of services within RSCN needs to be carefully monitored as the demands increase and programme of RSCN expands. Minor weaknesses observed include the Awareness Section having little input into the development of interpretation facilities at Dana, and software tools such as the CAMRIS GIS system not being utilised for wider educational application.

Extension of RSCN activities to Dana

- RSCN management has invested a tremendous amount of time and effort into extending institutional strengthening aspects to Dana Wildlife Reserve. This has been reflected in the development of a draft Business Plan for the site, in preparing a management plan, and in working with staff on management planning. These activities represent an extension of policies and procedures at RSCN headquarters and have involved the support and integration of staff input from various Sections of the organisation. Although the priority of RSCN has been establishment of the Dana "model", development and extension activities to the other reserves is rapidly picking up pace.

- Well planned and organised extension activities are beginning to yield tangible socio-economic benefits in Dana village. The dual goals of sustainable development and the conservation of biodiversity will be achieved through careful management of tourism impact and by instituting procedures which monitor and check the development of activities which impact on the integrity of the reserve.

Extension of RSCN activities to Azraq

- There have been some impressive results with respect to rehabilitation and development of the Azraq Wetland Reserve. This has involved varying degrees of cooperation between staff of the Azraq project and RSCN as the authority responsible for reserve management.

- Of fundamental importance to the long-term viability of Azraq Wetlands Reserve is full integration and coordination of effort with RSCN. A number of findings were of particular concern and include the following:

    - The continued absence of a sub-project manager for the Azraq Wetland Reserve subcomponent;

    - Evidently little collaboration between RSCN (involving relevant Sections of the organisation) and the Azraq project in the development of important documents such as the Azraq wetlands management plan, tourism management strategy, and strategic plan for resource mobilisation and financial sustainability of the wetlands programme;

    - Little extended benefit and integration of RSCN capacity building and training initiatives to institutions and individuals involved in the Azraq Wetlands Reserve subcomponent. While some reserve staff have attended training courses held jointly with RSCN in reserve management and ecological conservation, staff have generally not benefitted from the suite of courses and workshops in management training run by RSCN. Further, there has been far less sharing of expertise and experiences from the various Sections of RSCN (notably the Reserves, Research and Surveys, and Public Awareness sections) to Azraq than has been the case with Dana and other reserves. Administrative procedures, accounting and information management

systems (eg. CAMRIS) have all developed independently of those being employed at RSCN.

VI. RECOMMENDATIONS

AZRAQ OASIS

The rehabilitation of the Azraq wetland is of critical international importance. The site is one of the most important stop over places for migratory birds along two major pathways. It is therefore essential that funding for this project be continued. While human impact to the wetland led to near total destruction of the system prior to the current project, the major strides achieved in ecosystem rehabilitation under current funding will soon come under a new dimension of human pressure as a result of the Mideast Peace Acord. Tourism will undoubtedly increase exponentially at Azraq, as it has at other important conservation and historical sites in Jordan, as a direct consequence of better relations with Israel. Although infrastructural elements will have been completed at Azraq by the end of the current project, the site and community are not prepared for an onslaught of tourists, and it is likely that uncontrolled access to the wetland will undermine the ecological successes obtained with current funding. The rehabilitation efforts at Azraq are some of the first of their type in the world, and therefore the results of this pioneering effort will serve as an excellent restoration model for similar efforts throughout the world. For maximum benefit and experience transfer on a global scale, additional research dimensions are needed in order to develop a reproducible model for wetland restoration. The Azraq project component is at a threshold, whereby additional funding will ensure both the best management plan for sustainability of the biodiversity and ecological function of the wetland and maximum benefit on a global basis as a pioneering model for wetland management.

Conservation efforts at the Azraq wetland had two components. The first was a series of immediate actions to stave off imminent ecosystem total collapse by finding stop gap sources of water for reflooding the system. The second was to conduct numerous biological surveys to document species composition and general biodiversity. Because of the pioneering nature of the rehabilitation efforts, the project was in no position to predict the successional direction the ecosystem would go through during reflooding nor the possibility of a stable end point of biological structure. The global experience was insufficient to provide much insight into these processes. It is obvious that the current vegetative structure of the wetland is not similar to what characterized the system a decade ago and that it is likely to change. There is still critical need to collect additional unforeseen ecological data on key species and ecological processes in order to provide the best long term management plan for the Azraq wetland.

The mathematical models being developed as part of this project have extreme significance for Jordan and other semi arid and arid lands. These models will provide the analytical basis for establishing future water allocations in Jordan in light of changing water availability and human utilization demands. It is recommended that concerted effort be made to disseminate the results of these models throughout the arid portions of the world.

A new dimension to the Azraq project is the pending need to determine the minimum amount of water necessary to maintain ecosystem function and biodiversity levels. Data are needed on the relationship between both water level in the wetland and its intra and inter annual fluctuations and biological response. It is recommended that ecological data be collected on such relationships for key species including dominant aquatic plants. The key concerns throughout these investigations should be determination of minimum water requirements for the ecosystem and how corresponding plant community structure will affect the conservation

potential of the wetland. When combined with the above mentioned mathematical models, they will provide a valuable tool for water allocations for conservation needs throughout the Middle East and North Africa.

It is recommended that a long term monitoring program be established for the Azraq wetland for the purpose of determining successional trends and management needs following reflooding. These data are considered critical to both the long term management plan for the wetland as well as the transfer of this experience to other the management of similar wetlands in the arid zones of the world.

It is recommended that the Azraq project develop closer coordination with RSCN especially in the areas of training, public awareness and ecology. To facilitate this effort, it is strongly recommended that RSCN take over all ecological research on the Azraq project immediately. Concurrently, RSCN should immediately develop permanent professional capacity in both aquatic ecology and wetland management and hydrology. The integration of these two disciplines within RSCN is considered critical to the management of Azraq, Dana, Mujib as well as several other reserves in Jordan.

Because of unforeseen biological changes following reflooding of the Azraq wetland, there is a critical need to expand the role of wetland management. The relationship between plant community types and general habitat heterogeneity and the response of endemic biota and migratory birds is poorly know. It is recommended that expertise be brought into the project in order to ensure that the habitat structure of the evolving wetland ecosystem will provide maximum conservation to both local and migratory species. Such a need was not possible to have predicted at the initiation of the current project and thus constitutes a new dimension to the study. Again, such information is critical for maximization of experience transfer from this site to similar wetland areas in the arid zone.

It is recommended that more effort be given to the impact of exotic species, especially fish, on the Azraq wetland. Aquacultural operations in the immediate vicinity of the wetland are already contributing species and if left unchecked, could introduce a major destructive element to the ecosystem.

The expanding importance of the EIA unit was unforeseen when it was proposed as part of the current project. As the fruits from the peace process grow, it is likely that the EIA unit could play a major role in ensuring environmental protection in light of expanding development. Currently, the EIA appears to remain weak both in ecological understanding and the ability to affect compliance with ecologically sustainable developmental practices. It is recommended that this new project dimension be recognized and that steps be taken to solidify the role and enforcement capabilities of the EIA unit.

The potential of tourism in the Azraq area has taken on a new dimension as a result of the peace accord. This is a situation that was totally unforeseen at the time of the initial conceptualization of this project. While the current project will have provided the infrastructure on site for meeting tourism demands, that of the surrounding community is insufficient. It is recommended that this new dimension for socio-economic development be recognized and that additional studies be initiated to help the local community meet the expected needs of a greatly expanded tourism potential. There is need to maximize the return of conservation generated funds to the local community.

Finally, establishment of the Friends of Azraq clearly demonstrated that if empowered, the local community can provide a valuable partner in conservation management and community

development. It is highly recommended that this valuable association be developed to the fullest because such organizations can ultimately provide a sustainable relationship with government for conservation and development issues of the Azraq Basin.

DANA RESERVE

Dana Wildlands is a uniquely important site, not only because of its present grandeur of landscape, biological variety, and long history of human occupation, but also because it can become a showpiece of an almost forgotten Arabian world in which the plains and wadis were filled with wildlife, and equally importantly, a place where human perceptions of their own relationship with nature can change. Under the Dana project, RSCN has assumed legal and operational control of Dana Nature Reserve, undertaken a comprehensive biological inventory, established close relations with local communities, instigated sustainable socio-economic developments, and through practical tourist developments, prepared the way for sustainability of its own management operations. At the same time, it has overseen the construction and furbishing of a multi-purpose Centre which aims to become a focus for applied research into the ecology and management of drylands ecosystems in the region. However, such is the pace of change in the Middle East that even these impressive achievements are not sufficient to secure the biodiversity of Dana Wildlands in the future.

The Eastern Rift Valley, and indeed all of Wadi Araba, are experiencing a surge in growth of industrial developments and commercial tourism brought on by the signing of the Peace Accord with Israel in 1994. It is recommended that RSCN develop and implement a special management plan which aims to give them environmental control and influence over a buffer area or support zone around the perimeter of Dana Reserve. The scope of the plan should include strategies for: a) controlling incompatible land-uses, including undesirable developments in mass tourism, agriculture, sport hunting, mining, quarrying and mineral extraction; b) promoting sustainable socio-economic developments that are compatible with biodiversity conservation, including the expansion of organic agriculture, sustainable collection of fuelwood, and the development of nature tourism; and c) providing environmental education and awareness amongst schools and the general public. The plan should make provision for the legal establishment of the buffer zone using mechanisms already in place, such as the Council for Environment Protection, and through collaboration with the General Corporation for Environment Protection. The plan should also make proposals for full collaboration with other development projects that are being planned in the region, particularly in so far as they increase the protection of wide-ranging animal species and other species inadequately protected by Dana Wildlands, constrain developments which will encourage unsustainable levels of visitors in the region, and assist the nomadic people of the region to move towards sustainable pastoralism by generating compensatory income activities.

The process of returning Dana Wildlands to a state of ecological health will take a number of years of careful and effective management. Understanding the ecological processes which underpin Dana's unique biodiversity, and how human disturbances disrupt those processes, is essential in order that management actions can be guided towards full rehabilitation of habitats and maximal conservation of biodiversity. It is recommended that a research program in drylands ecology be established to provide data on woodland regeneration, successional trends in plant and animal communities at springs, and the effect of human disturbance at springs on wildlife populations. It is also recommended that a scientific committee be established to guide the development of an applied research programme.

Reducing flock sizes and strictly controlling livestock movements in the reserve is a priority for reserve management In concert with the research programme, there needs to be a vigorous

outreach programme to provide socio-economic developments for the bedouin families who use the reserve as a grazing area, and to establish a mechanism which ensures their participation in the reserve's conservation programme. It is recommended that the socio-economic needs of the bedouin families be thoroughly assessed by a study team comprising a social anthropologist, a rangeland/livestock specialist, a drylands ecologist and a human health/nutrition specialist.

Survey reports suggest that there is an unacceptably high incidence of hunting, baiting, trapping, and poisoning in the reserve which includes key raptor species, smaller mammals, such as rock hyrax, and porcupine, and the larger problem mammals, notably the hyaena and wolf. More information is required on the frequency of illegal killing in the reserve. It is recommended that the number of rangers be increased so that more frequent patrols can be mounted and a closer liaison forged with the resident and surrounding population.

INSTITUTIONAL STRENGTHENING OF RSCN

Fundraising and financial security is a priority area for development at RSCN. At a macro level, following through on a well-balanced and diversified program of support is a vital role for the Fundraising and Public Relations Section. At a micro level, securing programmatic funds and aiming at self-sufficiency will need to be priorities of all relevant Section Heads.

Initiate a formal review of recruitment and training needs within RSCN. Areas of training identified include fundraising, electronic communications, management of ecotourism, monitoring techniques, wetland management, strategic planning, and the planning and management of operations on the ground.

Recruitment to RSCN in future will continue to be dictated by two factors: (i) filling positions in key growth areas such as tourism development; and (ii) building depth throughout the organisation. Building expertise at the senior management level and providing support for Sectional Heads are priority areas.

To improve conditions of service across all grades, this will necessitate (i) a mechanism to periodically review conditions of service; and (ii) introducing schemes to improve conditions of service (eg revenue sharing at Dana).

In order to develop the ecological expertise needed to conduct research, initiate long-term monitoring studies, and manage the protected areas of Jordan, RSCN needs to work with the university sector in developing post-graduate programmes and courses which can address this weakness. Potentially, RSCN could provide the field-based element to such applied ecology courses. In the immediate term, short-term international consultancies or exchanges with "twinned" institutions can prove to be an extremely effective strategy. The development of a regional training centre at RSCN, in collaboration with university staff, is a recommended course of action. Given that, involvement in training will need to be carefully reviewed given the staff and resource implications.

Integration of information management activities with relevant environmental agencies in the country, facilitated through mechanisms such as a Steering Committee, interagency workshops, user needs assessments, and establishment of a framework for the development of an integrated information management system. This strategy, aimed at identifying institutional roles, enhancing collaboration, and producing information of use to decision-makers, has yet to be adopted in Jordan. This process could be facilitated through the creation of information cooperatives, making

use of internet technology.

In order to support the development and long-term maintenance of information management systems at RSCN, arrangements (eg. maintenance agreements) need to be established with suppliers or other interested parties. In order to enhance the efficiency, integration and processing of information, RSCN should consider developing a networked system.

RSCN, in collaboration with relevant agencies, should consider hosting regional workshops to share experiences and lessons learnt; a first could be hosting an environmental education workshop for the region.

To liaise with Tour Operators and the Ministry of Tourism to establish the extent and type of tourism likely to impact on the reserves of Jordan, and develop appropriate strategies and feedback mechanisms to promote and manage ecotourism. Establishing a database for visitor records and routinely conducting visitor demand surveys would be important mechanisms to feed into evolving strategies.

In order to foster collaboration and good working relationships between RSCN and affiliated organisations, mechanisms need to be established to ensure that capacity building initiatives and the experiences gained by RSCN are extended to others and vice-versa. Such mechanisms could include joint training programmes, staff exchanges, and the development of collaborative project proposals for consideration by funding agencies.

Following termination of the Azraq oasis project, RSCN's role could be in a monitoring capacity, providing the Interministerial Steering Committee with input on issues and actions necessary to safeguard the biological resources of the basin and in promoting sustainable management.

In order to ensure the effective management of the Azraq Wetland Reserve, it is recommended that a strategic plan be developed and implemented by RSCN for the immediate incorporation of the reserve under its direction. Such a plan would make provision for building the institutional capacity of the reserve, particularly with respect to human resources development, in line with initiatives at Dana and other reserves.

In order to promote the further strengthening of RSCN over a project extension of 12-18 months, a reorganised structure is presented in Annex VI, incorporating the following features:

- The creation of two Directors' positions is two-fold: (i) to separate administrative management from the scientific role of the organisation; and (ii) to build staff capacity at the senior management level, guided by an expatriate development advisor. It is envisaged that these positions would be filled by Jordanian expertise.

- The creation of two vice-director positions is to ensure the development of sound ecological models in the context of both terrestrial and aquatic ecosystems in and around the protected areas of Jordan. It is likely that the terrestrial position could be filled by a local Jordanian, while an expatriate would be required for the aquatic position. Two responsibilities of the aquatic posting would be to serve in the capacity of sub-project manager for the Azraq wetland, and to groom one or two local Jordanian counterparts to fill the position at the end of the project.

- The Azraq Wetlands Reserve sub-project, along with the budget and associated reserve and ecological support staff would become the immediate responsibility of RSCN. The overall project manager for the Azraq oasis would be based at the General Corporation for

Environment Protection with responsibility for coordinating the various project subcomponents to completion of the current project phase and with added responsibility for developing a hydrological model for the basin area.

• Conservation initiatives of RSCN are to be guided by a Scientific Advisory Committee, including representation from the university community.

VII. LESSONS LEARNT

AZRAQ OASIS

Major lessons were learnt from the Azraq project component exist in three principal areas: water resource management, ecosystem restoration, and community involvement. The work at Azraq was truly a global pioneering effort in understanding the response of wetland ecosystem structure and function to reflooding following near complete dessication. It has raised a number of questions related to the minimum water requirements for wetlands to sustain ecological function and biodiversity as well as the role of intra and interannual fluctuations of water on these components. When fine tuned, this research will provide an excellent model for global dissemination regarding manage of wetland hydrology and plant community structure for maximum conservation value of local and migratory species.

The mathematical models for groundwater being prepared as part of this project will provide the government of Jordan with the sophisticated analytical tool to make sound management decisions for allocation of water resources well into the next century. Data collected by the established monitoring network will provide input for model fine tuning necessary to account for changing resource availability and utilization demands. The sophistication of these models and their development specifically for semi arid and arid environments make them especially applicable throughout the Mideast and North Africa.

The Friends of Azraq is an excellent example of how to organize and empower local communities in the areas of environmental protection, conservation and sustainable development. Prior to the formation of this organization, the local people were felt disenfranchized and powerless to stop the chain of events leading to the complete destruction of the wetland while they watched. It is felt that this organization will serve as an effective environmental watchdog long after the end of the current Azraq project, will serve as a vital link with govenmental agencies.

DANA RESERVE

The successes of the Dana project component owes much to the effective programme of training for project staff and their high morale.

The simultaneous support for the Dana project component and the RSCN has had a synergistic effect, improving the quality of operations on site and at HQ.

The quality of surveys and technical training has been enhanced by the mixing of European scientists with Jordanian graduates in field operations.

Involving Jordanian graduates in surveys has led to successful staff recruitment by RSCN.

Popularity of the terraced garden rehabilitation was engendered by trial demonstrations rather than by discussion.

Success of the socio-economic team owes much to the dynamic leadership of the section head who has extensive experience of community development and poverty alleviation with NGOs.

The shuttles bus system is proving to be an effective means of controlling visitor pressure.

An early start to participatory rural appraisals with Bedouin groups is essential to project success.

Ecology and socio-economics need to be closely integrated in both RSCN and the Dana project.

INSTITUTIONAL STRENGTHENING OF RSCN

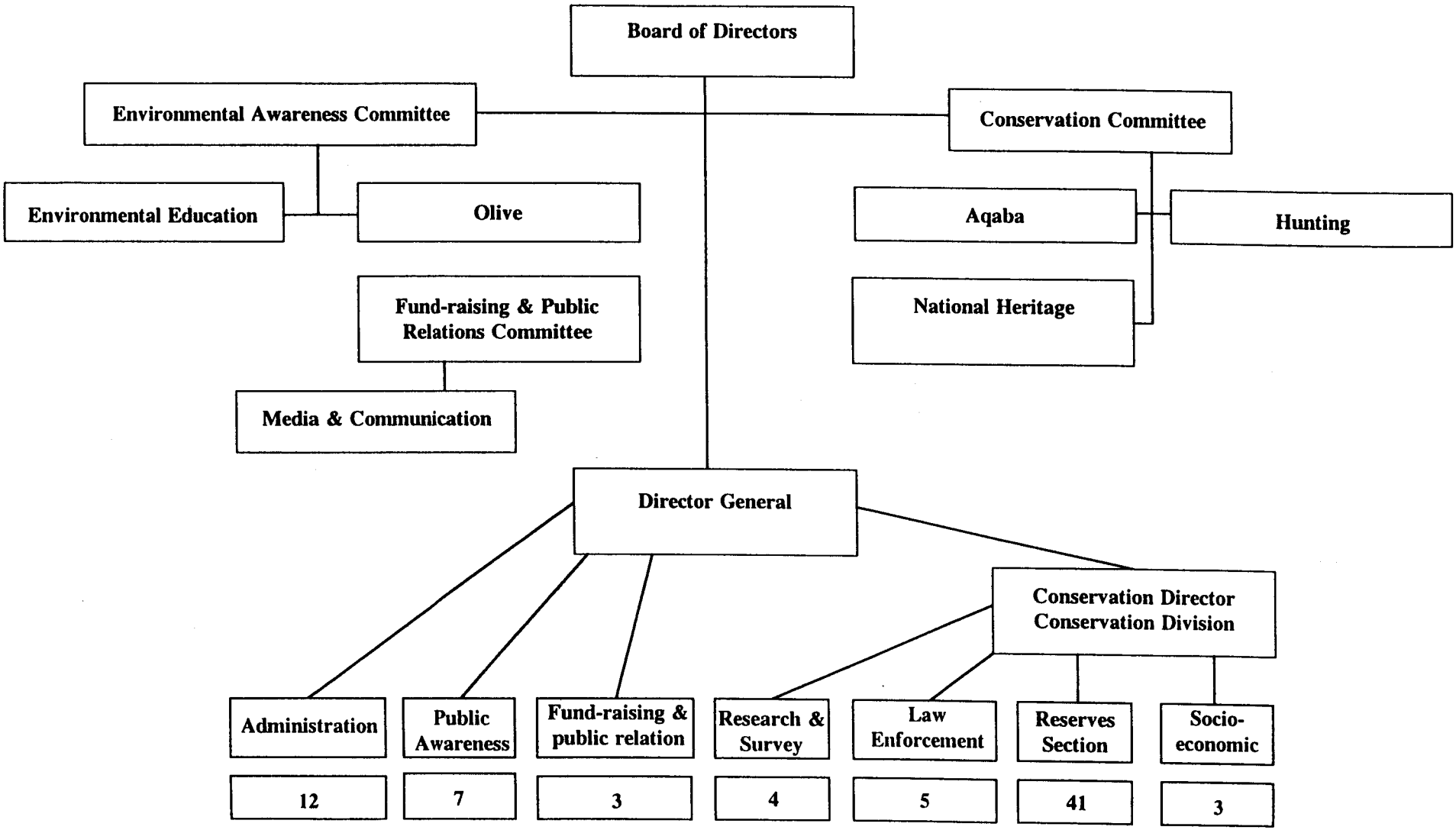
Throughout the project, a number of mechanisms have been utilised in sharing lessons learned. For example, research results and educational materials have been widely disseminated through national and international networks utilising media spots, published literature, and technologies such as internet. Progress on the project itself has been recorded through a series of reports, in the context of meetings and conferences, and through informal dialogues and exchanges between staff involved in the project and outside collaborating institutions.

The accomplishments of the Dana/RSCN and Azraq subprojects are notable, and the experiences gained would be of benefit to organisations looking to strengthen their own institutional capabilities; manage terrestrial and aquatic ecosystems in arid lands; develop socio-economic models which incorporate sustainable development and conservation aspects; and provide insights on interagency collaboration in the context of complex environmental problems, as exemplified at Azraq. To ensure a lasting legacy to this project, it is therefore recommended that a series of publications on these themes and others as appropriate be produced and made available to a wide user audiences.

VIII. ANNEXES TO EVALUATION REPORT

ANNEX I

CURRENT STRUCTURE OF RSCN - JORDAN



Current staff numbers shown above

ANNEX II

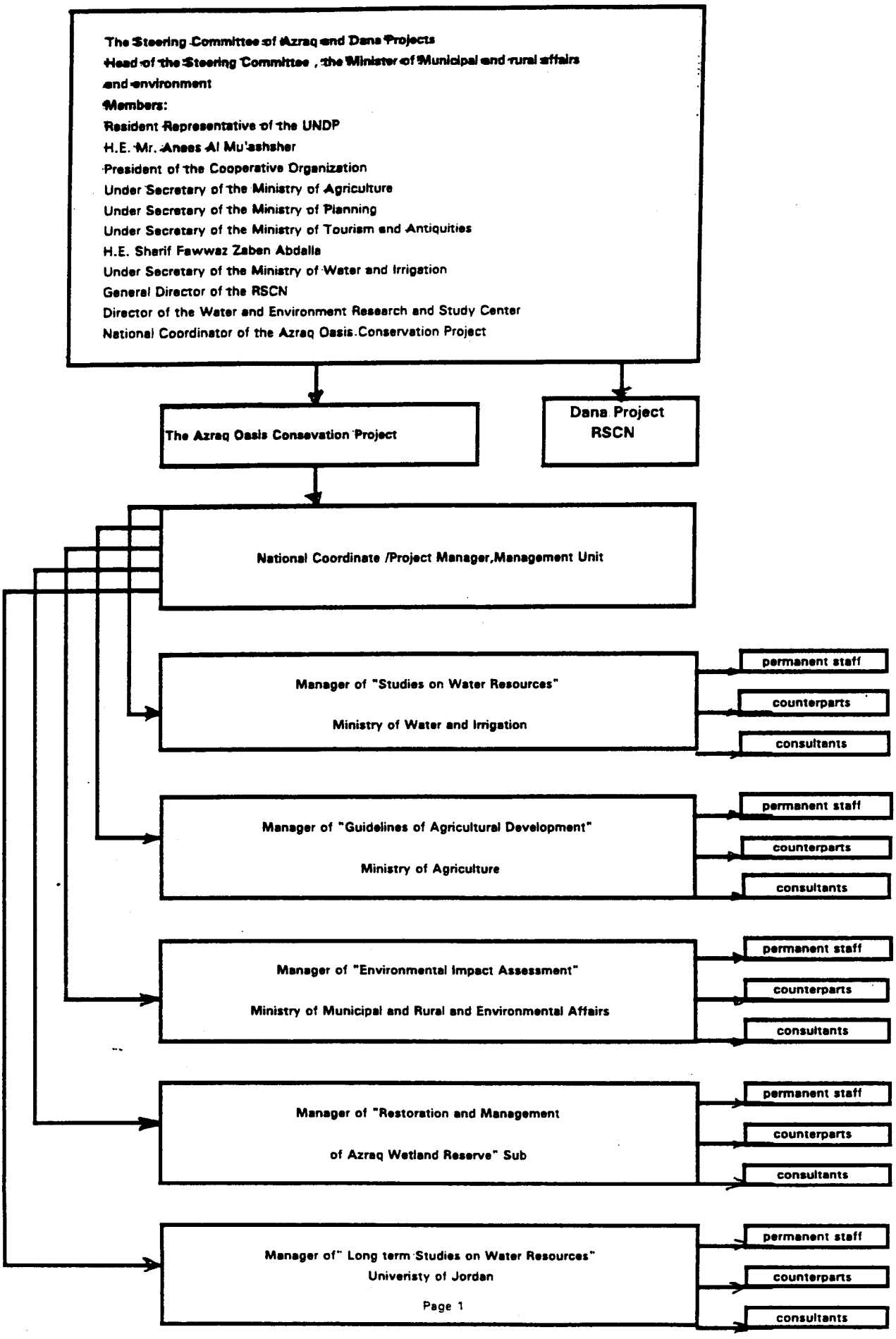
ORGANISATIONAL STRUCTURE	DANA RESERVE LINKS WITH HQ / CAPACITY BUILDING				
	Management mechanisms	Written information exchange	Training		Planned training
Conservation Division - Director of Conservation - Head of Reserves - Head of Research & Survey - Head of Wildlife Enforcement	Weekly section head planning meetings Monthly section head review meetings - summary to Board Weekly conservation division meetings Review procedures (eg Mujib tourist plan) (legislation) Inter-section presentations	Minutes newsletter reports Correspondence (Circulation file) Notice board	Management training - time & team management - financial management - manage human resources - operations & services - assertiveness - instructional techniques - report writing - performance reviews - preparation of strategic plan On the job training	Ecology for conservation guided walks & talks Human impact on protected areas Preparation of strategic plan/performance reviews monitoring techniques Periodic rangers workshops First aid	Management plans Interpretative planning Foreign study tour - Africa Fund-raising
- Reserve Managers	Monthly managers meeting			Counter part On the job training	
- Reserve Rangers	Weekly staff meetings			On the job training (eg survey teams) (rangeland study)	
- Dana Centre Staff	Weekly staff meetings Monthly steering group meetings			On the job training eg silversmith, fruit drying, horticulture, accounts	
- Dana Forum	Quarterly forum meetings				
- Local communities	Frequent meetings - almost daily				

→ Represents extent of training/information flow

ANNEX III

ANNEX 5

ORGANIZATIONAL STRUCTURE OF THE AZRAQ AND DANA PROJECTS



ANNEX IV

Wetland Reserve Staff

The permanent employees in the Wetlands Reserve Sub-Project

1. Mahmoud Yassein - Reserve Manger
2. Raji Hourani - Assistant reserve manager / lab tech.
3. Sallam Alquadi - Administrative assistant
4. Jehad Shishani - Ranger
5. Shareef Tarabieh - Driver / Ranger
6. Mahmoud Kiblawi - admin. support

Steering Committee

Dr. Ghaith H. Fariz - Azraq Oasis Project Manger
Mr. Chris Johnson - RSCN
Mr. Khaled Irani - RSCN Manager

Supporting Scientific Team

Dr. Alia Bouran - ecologist (fauna expert) - University of Jordan
Dr. Daood Issawi - taxonomist (flora expert) - University of Jordan
Dr. Zuheir Amre - invertebrates expert - Science and Technology University

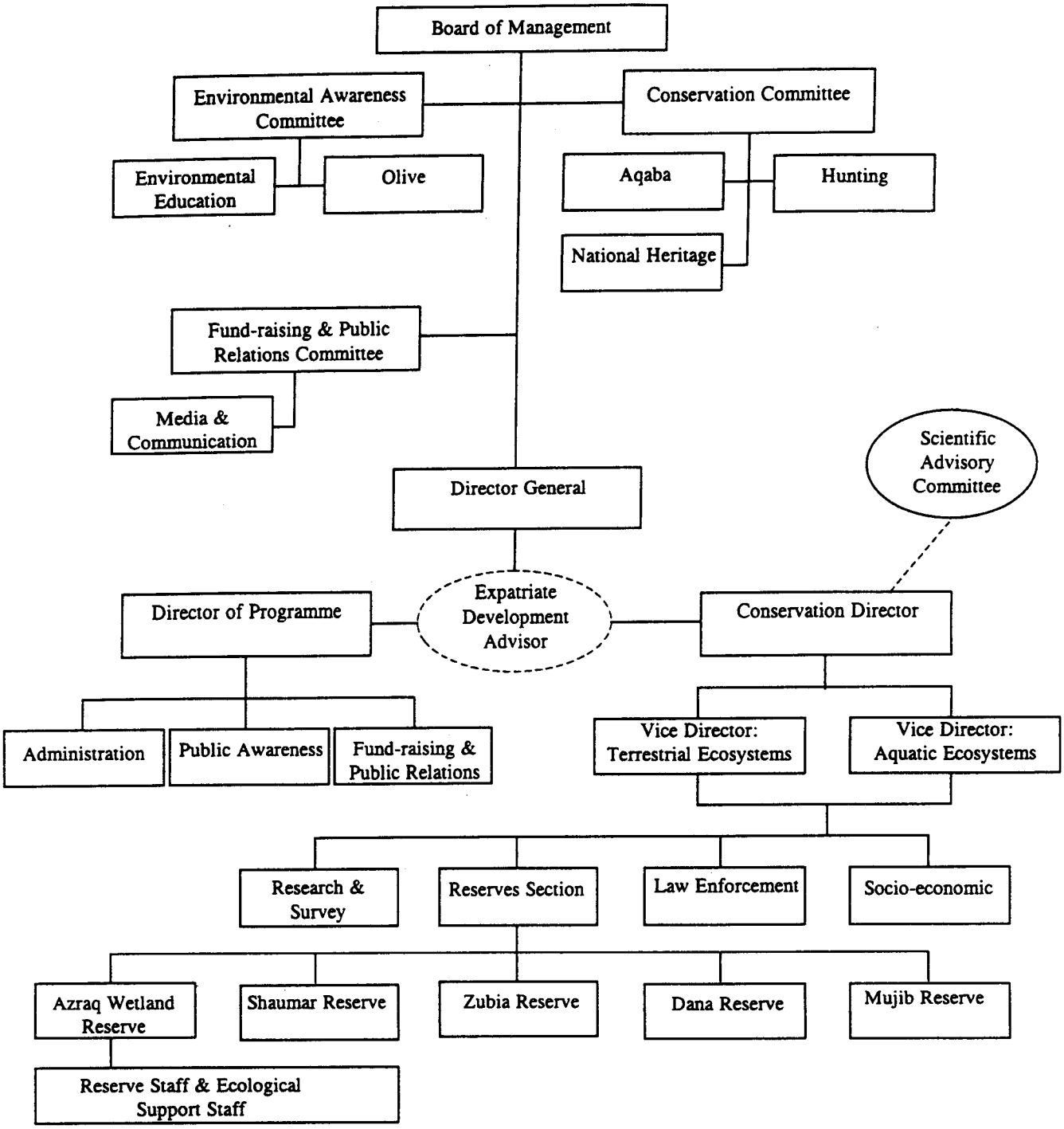
ANNEX V

RSCN Core Income and Expenditure

RSCN Core Income (Jds)	1995	1196	1997	1998
Government grant	125,000	200,000	200,000	230,000
Membership fee	3,250	6,000	15,000	17,000
Al-Reem sales & advertisements	7,750	12,200	25,000	27,500
Income from nature reserves	12,550	30,000	60,000	100,000
Contributory cost from projects	100,000	95,000	90,750	131,250
Donations & fund-raising	5,000	5,500	15,000	20,000
Services & consultancy	0	0	10,000	20,000
Interest from trust fund	0	40,000	110,000	130,000
Total Income	**253,820**	**398,700**	**525,750**	**675,750**
RSCN Core Expenditure (Jds)				
Payroll (Salary, Ins, soc sec, pd)	174,000	222,200	313,000	370,000
Running costs of reserves	22,450	100,000	131,500	179,600
Al-Reem production costs	3,389	10,000	25,000	25,000
Rent for office	16,000	22,000	22,000	25,000
Comp/radio/telephone support	0	7,000	11,000	15,000
Membership support	1,500	5,000	7,000	9,000
Stationary	1,290	8,000	10,000	12,000
Postage & telephone	14,000	16,000	18,000	20,000
Training & development	0	2,000	11,000	27,000
Refurbishment of office furniture	0	4,000	5,000	6,000
Fuel for vehicles	8,000	8,500	10,500	11,400
Maintenance of vehicles	226	8,500	11,000	13,000
Total Expenditure	**240,855**	**413,200**	**575,000**	**713,000**
Surplus (Deficit)	**12,965**	**(14,500)**	**(49,250)**	**(37,250)**
Special Projects				
GEF 1	635,000	1,200,000	poten. proj.	poten. proj.
USAID	30,000	0	0	
Japan	60,000	0	0	
GEF 2	0	0	1,000,000	1,000,000
Environmental information centre	0	0	40,000	15,000
Regional training centre	0	0	500,000	1,500,000
GIS	0	0	50,000	0
EIA Unit	0	0	25,000	10,000
IUCN Protected area project	0	0	100,000	0
Reintroduction unit/programme	0	0	100,000	100,000
Total Species Projects	**725,000**	**1,200,000**	**1,815,000**	**2,625,000**

ANNEX VI

Proposed Reorganisation of RSCN - Jordan



ANNEX VII

20 May 1996

TERMS OF REFERENCE

Independent Evaluation Mission of project JOR/92/G31 - Conservation of the Dana and Azraq Protected Areas and the Strengthening of the Royal Society for the Conservation of Nature (RSCN) 28 May - 3 July 1996

A. Background

A.1 Introduction

The aim of this project is to protect and conserve the biodiversity of the Dana Wildlands and the Azraq Oasis by developing and implementing conservation management plans. It also aims to strengthen the institutional capabilities of the Royal Society for the Conservation of Nature (RSCN), a non-governmental organization mandated by the Government of Jordan with national responsibility for nature conservation, management of protected areas, and support to the Jordanian programme for conservation education.

Implementation of the project started in January 1994 and it is estimated that it will be completed by January 1997. The project is composed of three distinct components (i) Azraq Oasis; (ii) Dana Reserve and (iii) the strengthening of the RSCN. The Azraq component is executed by the Government and is supervised and backstopped by UNDP, while the Dana and institutional strengthening components are implemented by the World Bank through an RSCN subcontract. The full project is administratively and financially managed by UNDP. Two Tripartite Review Meetings (TPR) have been held, e.g. in February 1995 and in March 1996. Important achievements have been made at both the Dana and Azraq components of the project. However, the latest TPR recommended that sustainability of the project is essential and emphasized that RSCN's role is crucial in ensuring the continued future management of the wetlands. Furthermore, the project has lived through changing circumstances which are having a growing impact on the Dana and Azraq reserves through influx of tourism which has influenced both the scope and focus of project activities.

A.2 Description of the subsector

Dana Wildlands

A.2.1. The Dana Wildlands cover an area of about 308 square kilometres on the eastern slope of the Jordan Rift Valley between the Wadi Araba desert in the west and the summits of the Shara mountains in the east. This land area was declared by the Minister of Agriculture as the Dana Nature Reserve in September 1989 at the request of the RSCN, with the management of the reserve delegated to the RSCN in collaboration with the Department of Forestry. Dana was chosen for its indigenous flora and fauna as well as its special scenic beauty. The wide range in elevation (100 metres to 1,500 metres above sea level) within the reserve has resulted in the

inclusion of portions of three distinctly different but contiguous biomes: the Mediterranean Semi-Arid, Irano-Turanian and Saharan Tropical Arid Desert biomes. A geological fault has resulted in the presence of large areas of both sedimentary and basaltic igneous substrata. This diverse geology combines with a wide range in both elevation and precipitation to add to the diversity of microclimates and hence biodiversity.

A.2.1.1 Prior to the project, both the flora and fauna of the reserve had not yet been adequately surveyed. Information available then on endemic plants was not the result of a botanical survey but by an estimation made by a well-known Jordanian botanist. It is worth mentioning that the reserve contains the last remaining natural population of *Cupressus sempervirens* trees in Jordan.

A.2.1.2 Prior to the project, the remnant population of ibex and gazelles as well as resident populations of reptiles, amphibians and invertebrates had yet to be described.

Azraq Oasis

A.2.2. Much of Jordan is desert or semi-desert, with an arid climate. Over 95% of the land area has an annual rainfall of less than 200 millimetres (mm), while only 2% has more than 350 mm. The water resources are scarce, and in most cases insufficient to meet the growing demands of a rapidly increasing population. The precarious water situation has become a serious concern for the Government of Jordan.

A.2.2.1 Despite numerous studies and recommendations on the availability and quality of the nation's water resources, sound water management schemes have not been implemented which resulted in the gradual disappearance of the natural wetlands of the Azraq Oasis. The Azraq Oasis is located some 80 kilometres ESE of Amman at the heart of a large internal drainage basin, most of which (94%) lies in Jordanian territory, with the remainder in Syria (5%) and Saudi Arabia (1%). The highest relief in the basin is at a town in Syria with an elevation of 1,550 metres while the lowest point is in the Azraq Depression with an elevation of 500 metres. This depression is the natural base level for both surface water and groundwater which collect there to form the Azraq Oasis. The catchment area is drained by a number of wadis (bed or valley of a stream that is usually dry except during the rainy season when it can make an oasis). The wetlands formerly comprised a large area of permanent spring-fed marshes and pools, and a seasonally or intermittently flooded playa (flat-floored bottom of an undrained desert basin that sometimes becomes a shallow lake) wetland.

A.2.2.2 Until recently, Azraq Oasis was an outstanding example of an oasis wetland in an arid region, with few parallels in the world. The wetland supported a rich and varied aquatic fauna and flora characteristic of freshwater habitats and, with the loss of most natural freshwater wetlands in neighbouring Syria, Lebanon and Israel, constituted the only significant tract of its type within a very large region of the Middle East. The oasis was especially important for migratory birds, with up to a million birds using the oasis during the course of a single spring migration. The Azraq Oasis was recognized in 1977 when the Government of Jordan acceded to the Ramsar Convention and was thus included in the Convention List of Wetlands of International Importance. The Azraq aquifer is one of the principal sources of drinking water

for Amman, in addition to supplying water for irrigation within the Azraq basin. The extraction of water from the aquifer is at present far above the assumed safe yield.

A.3 National strategy

An increase in the rate of deterioration of Jordan's environment in the 1980s led to the preparation of a State of the Environment Report (1990) and the National Environmental Strategy (1992). The strategy was prepared by Jordanian experts working in consultation with IUCN and was funded by the USAID. Some of the priorities outlined in the National Environmental Strategy directly supported by this project include the strengthening of the RSCN; expansion of the protected areas system with specific reference to **Dana**; upgrading local community environments while providing economic opportunities; development of an environmental education programme; management and utilization of water and agricultural land; and research and excavation of archaeological remains for the purposes of enhancing tourism. The strategy also identifies the rehabilitation of **Azraq Oasis** as one of the most urgent priorities in the conservation of wildlife and habitats in Jordan. In the agricultural sector, the strategy has identified depletion and salinization of groundwater and low efficiency of irrigation as being major environmental issues in arid regions such as the Azraq Basin.

A.4 Reasons for GEF Assistance

A.4.1 The protection and conservation of Dana is of global significance. This arid/semi-arid area is at the junction of several major biogeographic zones (African, European and Asian), and consequently contains a unique combination of flora and fauna. The Dana project will be the first Jordanian initiative to conserve critical habitats and their biodiversity by addressing the social and economic needs of the communities who are living inside and around the reserve. However, the socio-economic issues which must be addressed at Dana (i.e., the shift from dependency on unsustainable livestock grazing practices to other forms of income) are problems which impede economic development and cause environmental degradation in many parts of Jordan. Thus, the experience gained will assist in planning initiatives aimed at balancing biodiversity conservation with economic development throughout Jordan and in neighbouring countries. Other innovative features of the project include the assignment of an NGO (the RSCN) as the implementing agency; the allocation of land to be protected by RSCN; involvement of local resident and semi-nomadic communities; and the revenue earning potential of the project as a whole.

A.4.2 The Azraq component of the project seeks to demonstrate how the problem of competitive water resource needs for human consumption, irrigation, and conservation of natural ecosystems can be resolved through integrated water resource management with a focus on groundwater. Azraq Oasis has outstanding biodiversity values which are seriously threatened, but which may still be restored through this project. The project also addresses a priority issue in arid lands (i.e., water supply) and places an emphasis on an integrated "wise use" approach to the utilization of a scarce resource. It also includes long-term research on new technologies for groundwater recharge in arid regions, which could have wide applicability in arid regions elsewhere in the world.

A.6 Institutional Framework for the subsector

The project is multidisciplinary, involving a variety of government departments as well as an NGO and an academic institution. The overall coordination for the project is provided by an Interministerial Steering Committee, chaired by the Minister of Municipal and Rural Affairs and the Environment. This committee includes as its members the Secretaries General of the Ministry of Agriculture, Ministry of Planning, Ministry of Social Affairs, Ministry of Tourism and Antiquities, and Ministry of Water and Irrigation or their representatives, as well as the President of the RSCN, the Director of the Water and Environment Research and Study Centre at the University of Jordan, and representatives of UNDP and the World Bank.

B. Purpose

The overall aim of this evaluation is to assess the achievements of the project in question on the basis of the objectives, activities and outputs as defined in the project document.

The project is composed of two distinct field components (Dana and Azraq) and each component will be reviewed in equal measure. In addition, the project is composed of an RSCN institutional strengthening component which the evaluation will also assess.

The consultants will not spend time assessing the broader environmental strategy in Jordan, but will only make references to how the present project fits within this strategy.

The aim of the evaluation is, therefore, to determine the

a) relevance
b) efficiency
c) effectiveness
d) impact (both national and global)
e) sustainability

of the project activities in the light of their objectives, and to use the results of the evaluation to assess the viability and scope of a possible extension phase. In this connection, it should be noted that the March 1996 TPR recommended that a 12-18 months extension phase be prepared for the project to ensure that the project achievements can be fully anchored in the country in view of the changed political circumstances. The evaluation team's recommendations on this point will be needed.

C. Methods

The Evaluation will be done through:

a) study of project reports and publications
b) study of other relevant literature
c) interviews with relevant project stakeholders, actors and partners
d) visits and observations at the project offices and project sites

All materials produced by the project will be available to the project evaluation mission team.

Other relevant literature to be studied include:

- Background materials on Jordan's history, geography, culture and natural resources
- national development plans
- Environmental plans and strategies, including the NEAP and other similar strategic documents
- Tourism related documentation
- World Bank Country Reports
- UNDP Country Programme
- any additional materials which may be identified during the mission

Interviews will be arranged with

- Royal Society for the Conservation of Nature
- Members of Cabinet Committee for Dana/Azraq
- Ministry of Planning
- General Corporation for Environment Protection (formerly Department of Environment)
- Ministry of Water and Irrigation
- Ministry of Agriculture
- University of Jordan
- Target beneficiaries and project stakeholders
- Project staff

C.1 Criteria for evaluation

The main criteria for the evaluation of the project will be to identify whether the project is achieving its objectives both in terms of national and global benefits. The project document includes a total of 18 outputs for the Azraq component and 12 outputs for the Dana component in addition to sections in the project document dealing with "Expected End of Project Situation." These will be used for evaluation of the project and its implementation in accordance with the following criteria:

a. **Efficiency**
This assesses how cost-effective the process of transforming inputs to outputs was.

b. **Effectiveness**
This is how well the project has used its results to achieve the stated objectives. (For example, the project aims to protect and conserve the biodiversity of the Dana Wildlands and the Azraq Oasis by developing and implementing conservation management plans. Is the Management Plan being implemented and achieving this objective?)

c. **Impact**
What changes have been caused by the project, for example in the status of species, in institutions and in human development and socio-economic conditions.

d. **Sustainability**

What is the likelihood that the results of the project will continue to be evident after the end of the project period and what forms for sustainability have been built into the project (socio-economic sustainability, environmental sustainability, financial sustainability, and human resource sustainability). In addition, aspects pertaining to local communities will also be assessed; e.g. how are local people involved in project decision-making/management; how do local communities perceive and work toward strengthening linkages between development and conservation.

e. **Global benefits**

What global benefits has the project captured?

- in terms of globally significant ecosystem conservation
- in terms of globally significant species conservation
- in terms of lessons learned or being learned (the specific lessons learned/being learned should be mentioned and if there are no lessons being drawn out of the project, mention should be made what hinders it)

f. **Replicability of lessons learned**

How could lessons learned be shared with others? (What are the mechanisms, formal and informal, to promote sharing of lessons learned, and what is the efficacy of these mechanisms?)

What does or could this project contribute to promote sharing of information regarding lessons learned (i.e., how can we best leverage learning)?

g. **Project's national context**

What does this project contribute in the larger context of national efforts to conserve biodiversity?

- Does the project, through its assistance to the RSCN, have an informal or formal mechanism to influence policy makers (both in formulation of policy, as well as in decisions regarding development projects)?
- Does the project assist the RSCN promote consideration of biodiversity conservation concerns in other Government departments?
- Does the project assist the Government of Jordan (GOJ) to conserve biodiversity outside of protected areas? - What can be done to enhance this contribution?
- How does this project assist the GOJ to meet its commitments under the Biodiversity Convention.

f. **Project performance**

Based on project performance indicators in the project document (Azraq component) as well as performance indicators which have been developed by the project teams (Azraq and Dana components), assess the extent to which the project has used these indicators as measurements of project success.

C.2 Contents of Report

The Evaluation report will be approximately 50 pages in length and will consist of the following sections (with the approximate length for each section as listed below in brackets):

I. Executive Summary and main findings (2-3)
II. Project Concept and Design
  A Project context (1-2)
  B. Project document:
    1. The problem and the technical approach (2-4)
    2. Objectives, indicators and major assumptions (2-4)
III. Project implementation
  A. Activities (6-8)
  B. Quality of monitoring and backstopping (2-4)
IV. Project Results (1-2)
  A. Relevance (1-2)
  B. Efficiency (1-2)
  C. Outputs (2-3)
  D. Immediate Objectives (2-3)
  E. Effectiveness (1-2)
  F. Capacity building (4-5)
  H. Impact (6-8)
  I. Sustainability (5-7)
  J. Fundraising, co-financing and resource mobilization (1-2)
  K. Follow-up (4-5)
  L. Global benefits and their importance/relevance (2-3)
V. Findings of the evaluation (6-8)
VI. Recommendations (3-4)
VII. Lessons learnt (3-4)
IIX. Annexes to Evaluation report will include:
  TOR
  Names and cv's of evaluation team
  Itinerary
  Lists of places, institutions and persons visited
  Plus other relevant findings.

C.3 Mission composition

The mission will be composed of three specialists:

- A biodiversity specialist (with experience in wetlands ecosystem) and team leader;
- A biodiversity specialist (with experience in dryland ecosystems); and
- An institutional specialist (with project management and community outreach experience).

C.4 Practical arrangements

Under the supervision of the UNDP Resident Representative, Jordan and in coordination with the two Directors of the two sub-projects, the evaluation team will:

a. Have full pre-mission briefing in New York by GEF/RBAS
b. Study all relevant project documentation
c. Prepare and distribute preliminary report of evaluation findings and recommendations in Amman
d. Hold meeting with UNDP, MoP, RSCN, MoWI, MoA, GCEP, Univ. of Jordan to discuss the preliminary report.
e. Hold meeting with GEF/RBAS and GEF/World Bank in New York to discuss preliminary report.
f. Prepare a final report with conclusions of the evaluation and the recommendations for future GEF activities in the field of biodiversity conservation in Jordan in general and in Azraq/Dana in particular.

Duration:	4 weeks during May-June 1996	
Location:	Home base, New York and Jordan	
Mission Itinerary:	Pre-mission preparation in home base:	28-31 May (4 days)
	New York pre-mission briefing:	3-4 June (2 days)
	Amman and field work Azraq/Dana:	6-20 June (14 days)
	Return to home base:	21 June
	Home base write-up:	24 June-2 July (7 days)

The final report will be received no later than 10 days after consultants' return to home base.

In accepting these terms of reference, the consultants also accept that the assignment can be carried out within the allocated number of days.

The Evaluation Report:
The Evaluation report will be submitted in the English language in paper and electronic form.

A total of 20 bound copies of the final evaluation will be submitted. In addition, a loose leaf master copy will also be submitted which can be used for subsequent copying.

GEF/RBAS
20 May 1996

ANNEX VIII

ITINERARY

INDEPENDENT EVALUATION MISSION OF PROJECT JOR/92/G31
CONSERVATION OF THE DANA AND AZRAQ PROTECTED AREAS AND
THE STRENGTHENING OF THE ROYAL SOCIETY FOR THE CONSERVATION OF NATURE
3 JUNE - 20 JUNE 1996

3 June	UNDP New York
	Overview presentations of RSCN, Azraq and Dana
	Inger Andersen — UNDP
	Cecilia Ricafrente — UNDP
	Eduardo Fuentes — UNDP
	John Fraser Stewart — World Bank
4 June	UNDP New York
	Review project documents
	Leave for Jordan
5 June	Arrive Jordan
6 June	Meeting with Director of Department of Water, Environment and Tourism, Ministry of Planning
	Meeting with Director General of RSCN
	Meeting with Mr. Anise Mouasher, President of RSCN
	Meeting with Section Heads of RSCN
7 June	Azraq field trip
	Visit RAMSAR site of Azraq
	Presentations of Azraq subprojects
8 June	Azraq field trip
	Visit Azraq north
	Visit large scale farming operation
	Visit water pumping facilities of Amman at Azraq
	Visit water recharge areas
	Visit Shumari Reserve
9 June	Discussions with Reserves and Research and Survey Sections of RSCN
	Travel to Dana Reserve
10 June	Dana Reserve
	Visit socio-economic projects on irrigation, natural products, handicrafts
	Visit with Dana village elders
	Visit to Dana Research Center and discussions with administration and research components
11 June	Petra
12 June	Presentations from Subprojects of Azraq Project: EIA, Fisheries, Hydrology, Socio-economy
	Discussions with Fundraising and Public Relations and Public Awareness Sections of RSCN
13 June	Attend opening of EcoPeace conference on Dead Sea
	Meeting with Director of General Corporation for the Environment
	Discussions with Administration and Law Enforcement Sections of RSCN
	Meeting with Discovery Travel and Eco-tourism Company representatives

14 June	Presentations from Subprojects of Dana Project Telephone conference with Inger Andersen of UNDP New York
15 June	Attend weekly planning meeting of RSCN section heads Meeting with Ministry of Education staff and head of Public Awareness Section of RSCN Discussions with staff of the Azraq Project: Outreach and Public Awareness, Biodiversity, Socio-economy, administration Presentation by Ghaith Fariz of the Azraq management plan
16 June	Discussions with Director General and Director of Conservation of RSCN Meeting with Minister of Municipal and Rural Affairs and the Environment and the Director of the General Corporation for the Environment Visit Mujib Reserve Arrive Wadi Feynan (Dana Reserve)
17 June	Tour Wadi Feynan (Dana Reserve) Visit Bedouin families Visit springs and grazing exclosures in Dana Reserve
18 June	Visit Jordan University Presentations of biodiversity surveys of Azraq project conducted by university consultants Meeting with British ambassador Meeting with USAID mission
19 June	Discussions with freshwater specialists of RSCN Meeting with Jorgen Lissner, UNDP Resident Representative Final meeting with section heads of RSCN Meeting with Canadian embassy
20 June	Leave Jordan

ANNEX IX

CURRICULUM VITAE

NAME: Thomas L. Crisman

POSITION:

Director
Center for Wetlands
Phelps Lab - Museum Road
PO Box 116350
University of Florida
Gainesville, Florida 32611-6350
Phone: (904) 392-2424 Home: (904) 375-7239
FAX: (904) 392-3624

AND

Professor
Department of Environmental Engineering Sciences
208 Black Hall
University of Florida
Gainesville, Florida 32611
Phone: (904) 392-4408
FAX: (904) 392-3076

D.O.B.: 15 September 1948

EDUCATION:

A.B. 1970 (Zoology-Geology) Indiana University
M.A. 1972 (Zoology) Indiana University
Ph.D. 1976 (Zoology-Limnology) Indiana University

EXPERIENCE:

11/95 - Present
Director
Center for Wetlands
University of Florida

8/88 - Present
Professor
Department of Environmental Engineering Sciences
University of Florida

6/94 - Present
Instructor
Summer Field Course in Tropical Ecology
Makerere University Field Station
Kibale Forest, Uganda

2/91 - 11/95
Associate Director for Environmental Programs
Center for African Studies
University of Florida

11/90 - 1/91
Visiting Professor
Institute of Environment
Makerere University
Kampala, Uganda

8/82 - 8/88
Associate Professor
Department of Environmental Engineering Sciences
University of Florida

5/87
Instructor
Course in Chironomid Taxonomy and Ecology
Department of Biology
University of Joensuu, Finland

10/86 - 8/87
Visiting Research Scientist
Karelian Institute, University of Joensuu, Finland
University of Copenhagen, Denmark

1/83 - 2/83
Instructor
UNESCO Postgraduate Course in Tropical Limnology
University of Zimbabwe
Harare, Zimbabwe

8/77 - 8/82
Assistant Professor
Department of Environmental Engineering Sciences
University of Florida

9/75 - 8/77
Post-Doctoral Research Fellow
Limnological Research Center
University of Minnesota

7/76 - 9/76
Lecturer
Department of Ecology
University of Minnesota

AWARDS AND HONORS:

1. Ford Foundation Travelling Scholar (Venezuela) 1974
2. Visiting Scientist, Australian Academy of Sciences 1978
3. Visiting Scientist, Polish Academy of Sciences 1987.

4. Named one of the top 100 researchers at the University of Florida, 1990.

5. Selected 1991-1992 Teacher/Scholar of the Year, University of Florida, 1992.

CONVENOR OF FOREIGN SYMPOSIA:

P. Schmidt, A. Goldman, T.L. Crisman and R. Cohen. Sustainability in Africa: Integrating Concepts. 1992 Carter Lecture Series, Center for African Studies, University of Florida. April 1992.

F.A.R. Barbosa and T.L. Crisman. Brazilian Program on Conservation and Management of Inland Waters. Federal University of Minas Gerias, Belo Horizonte, Brazil. April 1992.

FOREIGN WORKSHOP ORGANIZER/CO-ORGANIZER

1994. History of Land Use In Africa. Kibale Forest, Uganda. Co-organized with Boston University.

1994. Managing the Pantanal Wetland. Cuiaba, Mato Grosso and Campo Grande, Mato Grosso do Sul, Brazil.

1994. Biomanipulation of Lakes and Reservoirs. Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

PUBLICATIONS

Journals (Refereed): (Selected from 61 total)

Beaver, J.R., and T.L. Crisman. 1982. The trophic response of ciliated protozoans in freshwater lakes. Limnol. Oceanogr. 27: 246-253.

Beaver, J.R. and T.L. Crisman. 1989. The role of ciliated protozoa in pelagic freshwater ecosystems. Microb. Ecol. 17:111-136.

Haack, S.K., G.R. Best and T.L. Crisman. 1989. Aquatic macroinvertebrate communities in a forested wetland: Interrelationships with environmental gradients. pp. 437-454. IN: R.R. Sharitz and J.W. Gibbons (eds.) Freshwater Wetlands and Wildlife. DOE Symposium Series No. 61, USDOE Office of Scientific and Technical Information, Oak Ridge, Tennesssee.

Crisman, T.L. and J.R. Beaver. 1990. Applicability of planktonic biomanipulation for managing eutrophication in the subtropics. Hydrobiologia 200/201:177-185.

Keller, A.E. and T.L. Crisman. 1990. Factors influencing fish assemblages and species richness in subtropical Florida lakes and a comparison with temperate lakes. Can. J. Fish. Aquat. Sciences 47:2137-2146.

Beaver, J.R. and T.L. Crisman. 1990. Use of microzooplankton as an early indicator of advancing cultural eutrophication. Verh. Internat. Verein. Limnol. 24:532-537.

Beaver, J.R. and T.L. Crisman. 1991. Importance of latitude and organic color on phytoplankton primary productivity in Florida lakes. Can. J. Fish. Aquat. Sci. 48:1145-1150.

Beaver, J.R. and T.L. Crisman. 1991. Temporal variability in algal biomass and primary productivity in Florida lakes relative to latitudinal gradients, organic color and trophic state. Hydrobiologia 224:89-97.

Crisman, T.L. 1992. Natural lakes of the southeastern United States: origin, structure, and function. pp. 475-538. IN: C.T. Hackney, S.M. Adams, and W.H. Martin (eds.). Biodiversity of the Southeastern United States: Aquatic Communities. Wiley Press, New York. 779 pp.

Streever, W.J. and T.L. Crisman. 1993. A comparison of fish populations from natural and constructed freshwater marshes in central Florida. J. Freshwat. Ecol. 8:149-153.

Streever, W.J. and T.L. Crisman. 1993. A preliminary comparison of natural and constructed marshes in central Florida on the basis of meiobenthic cladoceran assemblages. Wetlands 13:229-236.

Fernandes, C.A. and T.L. Crisman. 1994. Lake Paranoa: Management approaches for a tropical urban reservoir. Verh. Internat. Verein. Limnol. 25:1301-1305.

Crisman, T.L., E.J. Phlips, and J.R. Beaver. 1995. Zooplankton seasonality and trophic state relationships in Lake Okeechobee, Florida. Arch. Hydrobiol. Beih. Ergebn. Limnol. 45:213-232.

Crisman, T.L., E.J. Phlips, J.R. Beaver, and C. Keenan. 1995. Bacterioplankton seasonality and environmental relationships in Lake Okeechobee, Florida. Arch. Hydrobiol. Beih. Ergebn. Limnol. 45:203-211.

Rood, B.E., J.F. Gottgens, J.J. Delfino, C.D. Earle, and T.L. Crisman. 1995. Mercury accumulation trends in Florida Everglades and Savannas Marsh flooded soils. Water, Air, and Soil Pollution 80:981-990.

Streever, W.J., T.L. Crisman and J.H. Kiefer. 1995. Constructing freshwater wetlands: A subtropical perspective. IN: F. Schiemer and K. Boland (eds.). Tropical Limnology. SBP Academic Press. (In Press).

Crisman, T.L. and W.J. Streever. 1995. The legacy and future of tropical limnology. IN: F. Schiemer and K. Boland (eds.). Tropical Limnology. SBP Academic Press. (In Press).

Havens, K.E., L.A. Bull, G.L. Warren, T.L. Crisman, E.J. Phlips and J.P. Smith. 1995. Food web structure in the pelagic and littoral regions of a subtropical lake ecosystem. Oikos (In Press).

Crisman, T.L. 1995. The role of biomanipulation in the management of freshwater ecosystems in MERCOSUR countries. (In Press).

Crisman, T.L., J.R. Beaver, and A.E. Keller. 1995. Bacterioplankton abundance in subtropical lakes relative to trophic state and humic color: comparison with temperate systems. Freshwater Biology (Accepted pending revision).

Crisman, T.L., J.R. Beaver, and J.K. Jones. 1995. The use of citizen-based Secchi disk monitoring programs for assessing point and nonpoint source pollution. Lake and Reservoir Management (Accepted pending revision).

Streever, W.J., D. Evans, C.M. Keenan, and T.L. Crisman. 1994. Spatial patterns of invertebrate populations in a constructed wetland and the importance to evaluation of mitigation. (Submitted).

Streever, W.J., K.M. Portier and T.L. Crisman. 1994. Chironomid populations in created an natural wetlands of central Florida. (Submitted).

Crisman, T.L., C.A. Chapman and L.J. Chapman. 1995. Lacustrine ecosystems and climate change: the subtropical-warm temperate transition. (Submitted)

Crisman, T.L. 1995. A historical perspective on biomanipulation in South America and projections for its use in lake and reservoir management. (Submitted).

Chapman, L.J., C.A. Chapman and T.L. Crisman 1995. The role of wetlands in the maintenance of fish faunal structure and diversity in the Lake Victoria basin. (Submitted).

Edited: (Selected from 15 Total)

Crisman, T.L. 1986. Eutrophication control with an emphasis on macrophytes and algae. pp. 200-239. IN: N. Polunin (ed.). Ecosystem Theory and Application. Wiley Press.

Kiefer, J.H. and T.L. Crisman. 1992. Design considerations influencing water quality and plant community structure in reclaimed freshwater marshes. pp. 74-85. IN: F.J. Webb, Jr.(ed.). Proceedings of the 19th Annual Conference on Wetlands Restoration and Creation. Hillsborough Community College, Tampa, Florida.

Streever, W.J. and T.L. Crisman. 1992. The effect of inter-wetland and intra-wetland variability on sampling strategies in faunal studies comparing natural and constructed wetlands. pp. 183-196. IN: F.J. Webb, Jr.(ed.). Proceedings of the 19th Annual Conference on Wetlands Restoration and Creation. Hillsborough Community College, Tampa, Florida.

Kiefer, J.H. and T.L. Crisman. 1993. Use of botanical indicators as success criteria for constructed freshwater marshes--form versus function. pp. 583-587. IN: M.C. Landin (ed.). Wetlands: Proceedings of the 13th Annual Conference of the Society of Wetland Scientists, New Orleans, LA. South Central Chapter, Society of Wetland Scientists, Utica, MS, USA. 990 pp.

ORAL PRESENTATIONS

Professional Meetings:

Crisman, T.L. and J.R. Beaver. 1989. Applicability of planktonic biomanipulation for managing eutrophication in the subtropics. Conference entitled: Biomanipulation Tool for Water Management. Amsterdam, Netherlands.

Fernandes, C.A. and T.L. Crisman. 1991. Lake Paranoa: Management of a subtropical urban reservoir. 11th Annual Meeting, North American Lake Management Society, Denver, CO.

Fernandes, C.A. and T.L. Crisman. 1992. Lake Paranoa: Management approaches for a tropical urban reservoir. 25th Congress, Societas Internationalis Limnologie, Barcelona, Spain.

Crisman, T.L. and W.J. Streever. 1994. Using the Florida experience as a model for lake and wetland management in the subtropics and tropics. International Conference on Tropical Limnology in Commemoration of the 65th Anniversary of the Ruttner-Thienemann Limnological SUNDA Expedition. Salatiga, Indonesia.

Streever, W.J. and T.L. Crisman. 1994. Constructing freshwater wetlands: the subtropical perspective. International Conference on Tropical Limnology in Commemoration of the 65th Anniversary of the Ruttner-Thienemann Limnological SUNDA Expedition. Salatiga, Indonesia.

Crisman, T.L. 1994. The role of biomanipulation in the management of freshwater ecosystems in MERCOSUL countries. Seminar on the Quality of Continental Waters of MERCOSUL, Sociedade Brasileira de Limnologia/Instituto Argentino de Recursos Hidricos/Instituto de Pesquisas Hidraulicas, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. (Invited Presentation).

Crisman, T.L. 1995. A historical perspective on biomanipulation in South America and projections for its use in lake and reservoir management. 26th Congress, Societas Internationalis Limnologie, Sao Paulo, Brazil.

Chapman, L.J., C.A. Chapman and T.L. Crisman 1995. The role of wetlands in the maintenance of fish faunal structure and diversity in the Lake Victoria basin. 26th Congress, Societas Internationalis Limnologie, Sao Paulo, Brazil.

Crisman, T.L. 1995. Transferring the subtropical experience in natural systems: Technology for treating wastes in tropical countries. Second International Conference on Ecological Engineering for Wastewater Treatment. Waedenswil, Switzerland. (Invited Presentation).

Universities and Institutions:

Crisman, T.L. 1980. Experimental use of Chinese grass carp for controlling problem aquatic weeds in Florida lakes. Pearl River Institute of Freshwater Products. Guangzhou (Canton), China.

Crisman, T.L. 1980. Testing of methodology for controlling eutrophication in Florida lakes. Institution of Hydrobiology, Academica Sinica, Wuhan, China.

Crisman, T.L. 1980. An overview of the status and environmental problems of Florida lakes. Department of Biology, Fudan University. Shanghai, China.

Crisman, T.L. 1983. Control of cultural eutrophication in Florida. Limnological Institute. Niewersluis, Netherlands.

Crisman, T.L. 1983. Zooplankton and ciliated protozoan communities of subtropical Florida lakes. Max-Planck-Institut fur Limnologie. Plon, West Germany.

Crisman, T.L. 1986. Management of subtropical lakes through biological manipulation. Department of Biology, University of Joensuu, Finland.

Crisman, T.L. 1987. Paleolimnology and its application to lake management. Institute of Hydrobiology, Academy of Agriculture and Technology, Olsztyn, Poland.

Crisman, T.L. 1992. Biomanipulation as a technique for lake management in the subtropics and tropics. Universidade Federal do Rio de Janeiro, Brazil.
Crisman, T.L. 1993. Natural treatment as an engineering alternative for sewage, agricultural runoff and mining reclamation. Universidad Autonoma de Chiapas, Tuxtla Gutierrez, Mexico.

Crisman, T.L. 1993. Problems and alternatives for the management and conservation of freshwater ecosystems in the tropics. Instituto Technologico y de Estudios Superiores de Monterrey, Tuxtla Gutierrez, Mexico.

Crisman, T.L. 1994. Biomanipulation as a lake management technique. Swiss Federal Institute for Environmental Science and Technology (ETH) and the Swiss Federal Institute for Water Resources and Water Pollution Control (EAWAG), Zurich, Switzerland.

Crisman, T.L. 1995. Constructed wetlands and their similarity to natural systems. Programa de Conservacion de la Biodiversidad y Desarrollo Sustentable in los Humedales del Este (PROBIDES), Rocha, Uruguay.

Crisman, T.L. 1995. Biomanipulation for controlling eutrophication in lakes and reservoirs. Universidad de la Republica, Montevideo, Uruguay.

Crisman, T.L. 1995. Tropical wetland problems. Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil.

SCIENTIFIC ADVISOR/VISITING SCIENTIST IN:

Brazil, China, Denmark, El Salvador, Finland, Mexico, Poland, Spain, Uganda, Uruguay

RESEARCH SPECIALIZATION:

Ecology, management and conservation of wetlands and lakes in the subtropics and tropics. Integration of natural ecosystems into the economic and social framework of developing countries. Technology transfer using natural systems for waste water management.

Donald M. Gordon

74 High Street
Horningsea, Cambridgeshire
CB5 9JG, ENGLAND
Tel(hm): 01223-863303
(wk): 01223-277314
Fax(wk): 01223-277136
email: donald.gordon@wcmc.org.uk

Birth Date: July 6, 1959
Citizenship: British & Canadian
Status: Married
Two children

Education

Institute of Linguists, London	**General Certificate (French language)** Obtained May, 1995.
Goldsmiths' College University of London	**Postgraduate Certificate in Education (Secondary - Integrated Science)** Completed July, 1990. Experience includes primary & secondary school teaching in inner London schools.
University of Manitoba	**Master of Natural Resources Management** Completed May, 1985. **Thesis:** *Caribou Management and the Caribou Management Board: Eskimo Point Perspectives.*
University of Toronto	**BSc (Honours - Biology)** Completed May, 1983.

Employment Profile

Training and Education Coordinator/ Senior Research Officer	**World Conservation Monitoring Centre (WCMC)**, 219 Huntingdon Road, Cambridge (July 1990-present).

As ***Training and Education Coordinator*** responsibilities have included the development of a Training and Education Strategy for the Centre, and serving as a focal point for an emerging Training and Education Programme. This comprises the development of curriculum materials in biodiversity information management, delivery of workshops for mid-career professionals throughout the world and in support of postgraduate courses in the university sector, mobilisation of information to reach wide audiences for educational purposes, establishment of effective partnerships, and the development of an attachment programme at the Centre. Support for this programme and a joint venture with Raleigh International involving training in the management of biodiversity information in Chile has recently been secured through the United Kingdom's *Darwin Initiative*. Responsibilities within the ***Capacity Building Unit*** also include project management and coordination of capacity building initiatives, development of guidelines for conducting national institutional surveys, and carrying out User Needs Assessments.

As ***Senior Research Officer*** in the ***Protected Areas Data Unit*** at WCMC, responsibilities include data management and analysis for Canada and the sub-Saharan Africa region; supervision of staff; coordination of biosphere reserve work; development of project proposals; production of reports for publication; assisting in the coordination of international meetings; dealing with information requests from aid and development agencies, consultants, NGOs and in-country officials; and developing extensive networks of regional contacts.

Teacher — **Junior, GCSE & 'A' Level Biology**
Colfe's Independent Secondary Day School,
London (May-July, 1989).

Responsible for teaching biology and assisting with the athletics program at the school. Teaching experience has also included lessons and lectures on conservation at secondary and tertiary institutions, and giving seminars to the general public.

Lecturer — **Wildlife Management & Park Planning**
Institute of Renewable Natural Resources,
U.S.T., Kumasi, Ghana (1986-1988).

Responsible for lecturing and assessing performance in wildlife/park management courses for degree and diploma students. Subjects taught included: Park/Zoo Design; Current Problems in Wildlife Management; Wildlife Management Techniques; Wildlife Utilization; and Multiple Land Use. Theoretical material was supplemented by practical field training at Mole National Park, Shai Hills Game Production Reserve and Owabi Wildlife Sanctuary. Supervised numerous Bsc and Diploma research projects, covering such topics as conservation initiatives in the country, visitor use in national parks, restocking of zoos, farm raiding by elephants, resettlement issues, location and enumeration of wildlife species, and management planning in protected areas. Served as a member of the Kumasi Zoo Advisory Board, liaised closely with the Department of Game & Wildlife in curriculum development, and was instrumental in establishing a link with the Natural Resources Institute, University of Manitoba, Canada. Prepared wildlife exhibits for the Indutech '88 International Fair, Accra.

Wildlife Researcher — **Shilo Military Range, Manitoba, Canada**
University of Manitoba (April-May, 1985).

Assisted in a study on the effect of disturbance on mating behaviour in Sharp-tailed Grouse. The study involved disturbing grouse off their dancing grounds and tracking their movements and behaviours through the use of radio telemetry. Important management implications for multiple land use.

Thesis Research — **Eskimo Point, Northwest Territories, Canada** (1983-1985)

Surveyed the perspectives of Northern residents towards caribou management in the communities of Eskimo Point, Rankin Inlet and Fort Smith, N.W.T. The research focused on aspects of communication and dialogue exchange between local users and the Caribou Management Board. Recommendations provided to assist in the development of a ten year management plan.

Agricultural Researcher — **Rankin Inlet, Northwest Territories, Canada** (May-Sept, 1982)

Assisted in pioneering work regarding the production of feasible vegetable crops for Arctic communities.

Ecologist — **Alexander Fiord & Lake Hazen, Ellesmere Island, Northwest Territories, Canada** (May-Sept, 1981)

Assisted in ecological research in a High Arctic ecosystem. Conducted final year BSc honours project examining the effects of elevation on the morphology of High Arctic plants.

Memberships

- Commission on Education and Communication (IUCN)
- WWF-U.K.
- Canadian Parks & Wilderness Society
- Raleigh International - Research & Conservation Committee
- Steering Committee, Biodiversity Chapter for Canada's *1996 State of the Environment Report*

Representative presentations at the following meetings

Toronto, Canada (1992) *A World Congress for Education & Communication on Environment & Development (ECO-ED)*

Nairobi, Kenya (1993, 1994) Workshops on the project *Availability of Biodiversity Information for East Africa*

Bangkok, Thailand (1993) *Seminars to the Asian Institute of Technology & Kasetsart University on WCMCs programme and activities*

Paris, France (1993) *Advisory Committee Meeting of the UNESCO Man and the Biosphere (MAB) Programme* and *MAB Bureau*

Beijing, China (1993) Meeting of the *Biodiversity Conservation Working Group*, Hainan Island, and seminars to institutes of the *Chinese Academy of Sciences* in *Kunming, Wuhan and Beijing*

Kumasi, Ghana (1994) Seminars to institutions involved in biodiversity information management and conducted a national *Institutional User Needs Assessment*

Kruger National Park, South Africa (1994) "African Heritage 2000". *IUCN/CNPPA Africa Region Working Session*

Seville, Spain (1995) *International Conference on Biosphere Reserves*

Banff National Park, Canada (1995) *CNPPA (Commission on National Parks and Protected*

Areas) North America Regional Meeting

Kathmandu, Nepal (1995) *Regional Consultation on Biodiversity Assessment, Monitoring and Management in the Hindu Kush-Himalayan Region*

London, England (1996) *Darwin Initiative presentation on the joint Raleigh/WCMC/NHM biodiversity project in Laguna San Rafael National Park, Chile*

Selected Publications

Gordon, D.M. Chapter 21: Ghana. In: IUCN (1992). *The Conservation Atlas of Tropical Forests: Africa* (Eds: Sayer, J.A., Collins, N.M., and Harcourt, C.S.). MacMillan Publishers Ltd., London. Pp. 183-193.

IUCN (1992). *Protected Areas of the World: A Review of National Systems - Vol. 3 - Afrotropical.* IUCN, Gland, Switzerland and Cambridge, U.K. 360 pp. Author of country reports for Anglophone Africa.

Gordon, D.M. (1993). ECO-ED: Rhetoric or Progress? In, *Futures 25 (1); 98-100.*

Gordon, D.M. (1994). Biodiversity and Monitoring Challenges, in *African Heritage 2000: The Future of Protected Areas in Africa* (Robinson, ed.). Proceedings of the IUCN Commission on National Parks and Protected Areas Regional Working Session. Kruger National Park, South Africa, 11-17 October 1994. NPB, South Africa. ix + 135 pp.

World Conservation Monitoring Centre (1994)(Compiler; Gordon, D.M. (Ed). *Availability of Biodiversity Information for East Africa.* Food and Agricultural Organisation of the United Nations, Dar es Salaam, Tanzania. Publication, User's Guide and Diskette.

Gordon, D.M. and Magin, C. (1995). *Guidelines for a National Institutional Survey.* WCMC, Cambridge, U.K. 73 pp.

Gordon, D.M. and Green, M.J.B. (1995). Towards a Biosphere Reserve Information Management System: WCMC's Perspective. Paper tabled at the Meeting of the Commission on Scientific Research, Monitoring and Networking. 2nd International Conference on Biosphere Reserves, 20-25 March 1995, Seville. 5pp.

Gordon, D.M. and Sheppard, D. (1995). The state of protected areas in the world. Draft. Paper tabled at the IUCN Commission on National Parks and Protected Areas (CNPPA) North American Regional Meeting, 14-19 October 1995, Banff National Park, Canada. 7pp.

Tye, H. and Gordon, D.M. (1995). *Financial investments in biodiversity conservation in developing countries. Financial and human investments in biosphere reserve management.* World Conservation Monitoring Centre, Cambridge, UK. 38pp. + annexes.

Busby, J.B. and Gordon, D.M. (in press). Towards a Framework for a Biodiversity Information Management System for the Hindu Kush-Himalayan Region: Integration and the Role of an Information Cooperative. WCMC, Cambridge, U.K. 8 pp.

CURRICULUM VITAE

NAME: Martyn Greer MURRAY **BORN:** 1949

PROFESSION: Ecologist **NATIONALITY:** British

PROFILE: Specialist in biodiversity studies with 23 years of field experience in wildlife research in Africa, S.E. Asia and Europe, extensive consultancy experience in protected area conservation, and substantial working experience of conservation agencies which has included analysis of protected areas and species information on international databases.

QUALIFICATIONS:
MA (Status), University of Cambridge 1987
PhD Zoology, University of Zimbabwe 1980
BSc (Hons) Zoology, University of Edinburgh 1973

KEY EXPERIENCE

Biodiversity Studies:

1995: Appointed Senior Advisor to the World Conservation Monitoring Centre, Cambridge.

1995: Guest lecturer on Science and Biodiversity at the Edinburgh International Science Festival.

1994: Co-founder and present member of steering committee of Edinburgh University's Biodiversity Unit, a Divisional Unit which aims to develop an applied science for biodiversity conservation;

1991: Director and Founder of MGM Environmental Solutions Ltd., a company established to provide consultancy services for biodiversity conservation and management.

1986: Appointed member of IUCN's Species Survival Commission (Antelope Specialist Group).

1970: Start of special interest in African biodiversity with visits/residence in 17 African countries.

Consultancies in Wildlife Conservation:

1996: Investigating site problems, writing Terms of Reference and evaluating Consultancy bids for the Protected Areas Development Programme (Ankasa, Bia and Nini Suhien rain forests) in Ghana;

1994: Advisor to the European Union on implementation of phase 2 of the "Projet de Developpement de la Region Nord" in Central African Republic;

1994: Strategy development for biodiversity conservation in Africa at EU/IUCN Vic Falls Workshop.

1993: Wrote Terms of Reference and evaluated Consultancy bids for the EU Oban Hills Programme, Nigeria.

1991: Evaluated Consultancy bids for the EU programme (ECOFAC) for conservation of rain forests in Congo, Gabon, Equatorial Guinea, Central African Republic, Sao Tomé and Cameroon);

1990s: Numerous other consultancies with EU, WCMC, IUCN, B&C wildlife trust and UNWIN.

Wildlife Research:

1994-1996: Honorary Fellow of Edinburgh University - GIS study of African mammal distributions; island biogeographical study of specialist insects of Scots Pine in the Scottish Highlands;

1985-1994: Senior Nuffield Research Fellow - long-term studies of wildebeest migration and of ecological separation of ungulates in Serengeti National Park, Tanzania;

1980-1985: Science Research Council Fellow - long-term field studies of figs and fig wasps in W. Malaysia, Sabah, Sarawak and Sumatra with analysis and writing at the University of Cambridge;

1974-1980: Yvonne Parfitt Wildlife Research Fellow - long-term studies on impala and woodland ecology in the Sengwa Wildlife Research Area, Zimbabwe.

1973-1974: Nature Conservancy Research Assistant - field studies of shelduck, Firth of Forth, Scotland.

Wildlife Teaching & Education:

1994-1996: Lecturer in community ecology (4th year Zoology honours course) University of Edinburgh;

1984-1996: Postgraduate supervisor and examiner - research projects include: reproductive ecology of Swayne's hartebeest (Ethiopia); ecology and conservation of leopard (Kenya, Tanzania and Namibia); polymorphism and fighting of fig wasps (South Africa); ecology of fire (Tanzania); satellite imagery and ungulate diversity (East Africa); and attitudes and beliefs in nature (UK).

1983,1994: Wildlife consultant for Unwin animal encyclopaedia & Victoria House children's nature books.

LANGUAGES:

English : mother tongue
French : working knowledge
Kiswahili : working knowledge

PROFESSIONAL CAREER:

Present: **A. Director of MGM Environmental Solutions Ltd.,** an independent company (founded in 1991) specialising in the provision of consultancy services for biodiversity conservation. Senior Advisor to the World Conservation Monitoring Centre, Cambridge.

Present: **B. Honorary Fellow of the Institute of Cell, Animal and Population Biology, University of Edinburgh. Member of Steering Committee of the Biodiversity Unit, University of Edinburgh.**

1996: Consultancy. Protected Areas Development Programme in Ghana. European Union (DG VIII). Conservation of rain forest in Bia, Ankasa and Nini Suhien Protected Areas. Preparation of terms of reference and evaluation of technical bids at pre-qualification and restricted invitation stages.

Research Project. Modelling past and future climate change on herbivore species diversity in Africa with satellite NDVI sensor imagery. M.Res. programme, University of Edinburgh (research assistant: D. Baird).

1995: Consultancy. World Conservation Monitoring Centre, Cambridge, UK. Analysis of gaps in Protected Area networks in Africa, tropical and insular Asia, Central America and South America, in relation to distributions of ecofloristic zones and moist forest types.

Research Project. Specialist arthropod biodiversity (deadwood beetles) in Native Scots Pine woodlands in the North-Western Highlands of Scotland (research assistant K. McKay). Carnegie Trust & Scottish Natural Heritage, UK.

Research Project. Investigating links between human psychological well-being and the experience of Nature (Research Assistant K. Bray). M.Sc. programme, Macquarie University, Australia.

Administration and Teaching. Member of Steering Committee of the Biodiversity Unit at Edinburgh University. Organisation of Conference on Scottish biodiversity (September 1996) and development of knowledge-based model of Native Woodlands. Teaching honours workshop in community ecology.

1994: Consultancy. Directing evaluation of problems on site and advising European Union on phase 2 of their Northern Region Development Project, Central Africa Republic.

Consultancy. Representing the European Union at the EU/IUCN Victoria Falls workshop on developing a strategy for protected areas and conservation of biodiversity in Africa, the Caribbean and the Pacific.

Research Project. Specialist arthropod biodiversity (leaf insects) in Native oak woodlands on islands of Loch Lomond. (Research Assistant K. McKay, University of Edinburgh).

Research Project. Integration of past Serengeti studies to investigate the rules determining the composition of ungulate communities in the Serengeti National Park, Tanzania. Nuffield Foundation.

Administration and Teaching: Establishment of the Biodiversity Unit spanning all departments and institutes in the Division of Biology at Edinburgh University; teaching 4th year honours workshop in Community Ecology.

1991-1994: **Senior Research Fellow, Research Group in Mammalian Ecology and Reproduction, University of Cambridge.**

1993: Consultancy. Global Security Programme, University of Cambridge. Wide-ranging review of economic and non-economic values of biodiversity.

Consultancy. Oban Hills Programme, Government of Nigeria and European Union. Preparation of terms of reference and evaluation of technical bids at pre-qualification and restricted invitation stages.

1992: Consultancy. World Conservation Monitoring Centre, Cambridge, UK. Taxonomic inventories project. Assessment of the state of knowledge of biodiversity in protected areas within all tropical countries of the world.

Consultancy. Directing evaluation of consultancy bids for the EU rain forest conservation project in Equatorial Guinea (Conservation et Utilisation Rationnelle des Ecosystèmes Forestiers).

1991: Consultancy. Conservation and Rational Utilisation of Forest Ecosystems in Central Africa (ECOFAC), European Commission. Evaluation of consultancy bids (Restricted Invitation) for this six-country programme of forest conservation. Proposals for project monitoring in Cameroon, Central African Republic, Congo, Equatorial Guinea, Gabon, Sao Tomé and Principe.

Consultancy. Management review of the Bedfordshire and Cambridgeshire Wildlife Trust, BCWT. Analysis of BCWT's past performance with recommendations for improving performance in reserve management, regional conservation, fund raising, education, membership, and departmental performance monitoring.

1991-1994: Research Project. Development of a model of energetics in free-ranging ungulates. Writing of scientific papers on the ungulate community in Serengeti National Park.

1985-1991: **Project Leader, Serengeti National Park, Tanzania. Nuffield Research Fellow, University of Cambridge.**

Research Project. Migration of wildebeest in the Serengeti-Mara ecosystem. Investigation of phosphorus deficiency in migrating animals in relation to mineral concentrations of green leaf on dry season pastures.

Research Project. Community ecology and species diversity of ungulates. Investigations of habitat selection, locomotion, daily activity, reproduction and body condition in free ranging wildebeest, hartebeest, topi, waterbuck and zebra.

Research Project. Comparative nutrition of grazing ungulates. Investigation of energy metabolism, diet selection, food intake and digestion in wildebeest, hartebeest and topi corralled at the Serengeti Research Institute.

Consultancy. Report on management recommendations for conservation of wildebeest migrations, Department of National Parks and Wildlife, Tanzania.

1982-1985: **Research Fellow, University of Cambridge. Member of Darwin College, Cambridge.**

Research project. Survey of attitudes, beliefs and arguments used in conservation of tropical rain forests across 400 respondents with experience of rain forest in all moist tropical regions of the world, University of Cambridge.

Research Project. Development of simulation models to study resource competition and animal conflict - in collaboration with the Department of Applied Mathematics and Theoretical Physics.

Research Project. Development of simulation models to study co-evolution of figs and fig wasps.

Research Project. Development of analytical models to investigate the influence of mating systems and dispersal on kinship in animal social groups.

1980-1982: **SERC Research Fellow, University of Cambridge, held at the University of Malaya, Kuala Lumpur.**

Research Project. Comparative studies of wild figs and fig wasp species in W. Malaysia, Sabah, Sarawak and Sumatra.

Research Project. Field investigations of the symbiosis between wild figs (dioecious and monoecious species) and their insect pollinators, W. Malaysia.

Research Project. Field investigations of life history, sexual selection and behaviour in fig wasps, W. Malaysia.

1974-1980: **Yvonne Parfitt Fellow, Department of National Parks and Wildlife, Zimbabwe and University of Zimbabwe.**

Research Project. Capture, tagging and age-determination of 450 impala in the Sengwa Wildlife Research Area, Zimbabwe.

Research Project. Long-term studies of the mating system, dispersal and social behaviour of individual impala in SWRA, Zimbabwe.

Research Project. Analysis of protein and enzyme polymorphism in impala to determine genetical variation within the SWRA population and the genetical distance between impala in northern Zimbabwe and Natal, South Africa.

Research Project. Studies of reproduction, body condition and mortality of impala in SWRA, Zimbabwe.

Research Project. Assisting the Department of National Parks in long-term studies of elephant movements, vulture population biology and lion radio-tracking, and in monitoring woodland vegetation and large mammal populations. SWRA, Zimbabwe.

Study Tour. Studies of moist forest and savanna parks in central and west Africa, including Rwanda, Zaire, Central African Republic and Nigeria.

Research Training. Postgraduate course in sociobiology delivered by W.D. Hamilton and R.L. Trivers at Harvard University, Mass., U.S.A. (1978-1979).

1973-1974: **Research Assistant, Nature Conservancy, Edinburgh.**
Research Project. Population dynamics of shelduck in the Firth of Forth with studies of territoriality, nesting success and duckling survival, and surveys of the invertebrate fauna available as food in tidal mud flats at Aberlady and Gosford Bays.

GEOGRAPHICAL EXPERIENCE (countries of work experience in italics)

Algeria, *Belgium*, Botswana, Cameroon, Canada, *Central African Republic*, France, *Ghana*, India, *Indonesia (Sumatra)*, Ireland, *Kenya*, Malawi, Morocco, Namibia, *Nepal*, Netherlands, Niger, *Nigeria*, Rwanda, *Sabah, Sarawak, South Africa*, Spain, Switzerland, *Tanzania*, *USA*, *West Malaysia*, *Zaire*, Zambia, *Zimbabwe*.

PUBLICATIONS

Balmford, A., Green, M.J.B. & M.G. Murray (in press). Using higher-taxon richness as a surrogate for species richness: I. Regional tests. **Proceedings of the Royal Society.**

Murray, M.G. (submitted). Harvesting energetics and resource competition in Serengeti ungulates. **Ecology**.

McKay, K.E. & Murray, M.G. (in press). A preliminary survey of leaf arthropods on oak trees on the islands of Loch Lomond. **Entomologist's Monthly Magazine.**

Murray, M.G. & Illius (in press). Multispecies grazing in Serengeti. In: J. Hodgson & A.W. Illius (eds). **The Ecology and Management of Grazing Systems**. CAB International.

Spurway, N.C., Murray, M.G., Gilmour, W.H. & Montgomery, I.D. (1996). Quantitative skeletal muscle histochemistry of four East African ruminants. **Journal of Anatomy** 188, 455-472.

Murray, M.G. 1995. Specific nutrient requirements and migration of wildebeest. In: **Serengeti II - Research, Management and Conservation of an Ecosystem** (ed. by A.R.E. Sinclair and P. Arcese), pp. 231-256. University of Chicago Press, Chicago.

Murray, M.G. 1993. The value of biodiversity. In: **Threats Without Enemies** (ed. by G. Prins), pp. 66-84, Earthscan Publications, London.

Murray, M.G. & Brown, D. 1993. Niche separation of grazing ungulates in the Serengeti. **Journal of Animal Ecology** 62, 380-389.

Murray, M.G. 1993. Comparative nutrition of wildebeest, hartebeest and topi in the Serengeti. **African Journal of Ecology** 31, 172-177.

Murray, M.G., Narasimha, M., Murgatroyd, P.R. & Prentice, A.M. 1992. An inverse relationship between the cost of static posture and the cost of locomotion? **American Journal of Human Biology** 4, 613-619.

Murray, M.G., Caro, T. & Dobson, A. 1992. Long-term research in the Serengeti. **Trends in Ecology and Evolution** 7, 108-110.

Murray, M.G. 1991. Maximising energy retention in grazing ruminants. **Journal of Animal Ecology** 60, 1029-1045.

Murray, M.G. 1990. Conservation of tropical rain forests: arguments, beliefs and convictions. **Biological Conservation** 52, 17-26.

Murray, M.G. 1990. Comparative morphology and mate competition in flightless male fig wasps. **Animal Behaviour** 39, 434-443.

Murray, M.G. 1989. Environmental constraints on fighting in flightless male fig wasps. **Animal Behaviour** 38, 186-193.

Murray, M.G. 1987. The closed environment of the fig receptacle and its influence on male conflict in the Old World fig wasp, *Philotrypesis pilosa*. **Animal Behaviour** 35, 488-506.

Murray, M.G. 1985. Figs (*Ficus* spp.) and fig wasps (Chalcidoidea, Agaonidae): hypotheses for an ancient symbiosis. **Biological Journal of the Linnaean Society**, 26, 69-81.

Murray, M.G. 1985. Estimation of kinship parameters: the island model with separate sexes. **Behavioral Ecology and Sociobiology**, 16, 151-159.

Murray, M.G. and Gerrard, R.J. 1985. Putting the challenge into resource exploitation: a model of contest competition. **Journal of theoretical Biology**, 115, 367-389.

Murray, M.G. and Gerrard, R.J. 1984. Conflict in the neighbourhood: models where close relatives are in direct competition. **Journal of theoretical Biology**, 111, 237-246.

Murray, M.G. 1982. Home range, dispersal and the clan system of impala. **African Journal of Ecology**, 20, 253-269.

Murray, M.G. 1982. The rut of impala: aspects of seasonal mating under tropical conditions. **Zeitschrift fur Tierpsychol**, 59, 319-337.

Dunham, K.M. and Murray, M.G. 1982. Fat reserves of impala, *Aepyceros melampus*. African Journal of Ecology, 20, 81-87.

Murray, M.G., Lewis, A.R., and Coetzee, A.M. 1981. An evaluation of capture techniques for research on impala populations. **South African Journal of Wildlife Research** 11, 105-109.

Murray, M.G. 1981. Structure of association in impala (*Aepyceros melampus*). **Behavioral Ecology and Sociobiology**, 9, 23-33.

Jenkins, D., Murray, M.G., and Hall, P. 1975. Structure and regulation of a shelduck (*Tadorna tadorna* L.) population. **Journal of Animal Ecology**, 44, 201-231.

Conservation Reports and Articles

McKay, K., Murray, M.G. & Blackman, S. 1996. Conservation and Restoration of Biodiversity in Caledonian Pinewoods - Species Diversity of Specialist Dead-wood Beetles in a Fragmented Habitat. **SNH**, Edinburgh, UK.

Murray, M.G., Green, M.J.B., Bunting, G.C. & Paine, J.R. 1995. Biodiversity Conservation in the Tropics: An Analysis of Gaps in Regional Habitat Protection and Funding. **WCMC**, Cambridge, UK.

Murray, M.G. 1992. Wanderlust (Serengeti wildebeest migration) **BBC Wildlife** 10, No 6, 24-27.

Murray, M.G., Green, M.J.B. & Walter, K.S. 1992. Status of plant and animal inventories for protected areas in the tropics. **WCMC**, Cambridge.

Murray, M.G. 1991. The great migration. **Scope** 24, 16-19.

Murray, M.G. 1984. Grazing antelopes. In: **The Encyclopaedia of Mammals: 2.** (Ed. by D. Macdonald), George Allen & Unwin, London, pp 560-571.

Murray, M.G. & Oldfield, S. 1984. Choosing a top ten. **IUCN Bulletin** 15, 79-82.

Murray, M.G. 1983. The secret life of fig wasps. **Malayan Naturalist** 36, 15-21.

Murray, M.G. 1982. Fireflies of Kuala Selangor. **Malayan Naturalist**, 35, 37-38.

Unpublished Theses

Murray, M.G. 1973. The regulation of shelduck numbers in Aberlady Bay. Unpublished Honours Thesis, University of Edinburgh.

Murray, M.G. 1980. Social structure of an impala population. Unpublished D.Phil. Thesis, University of Zimbabwe.

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