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# A PLAN FOR THE PRESERVATION, ENHANCEMENT, AND MANAGEMENT OF THE SENSITIVE NATURAL RESOURCES OF SINAI

APRIL 1981

SINAI DEVELOPMENT STUDY - PHASE I

PERFORMED FOR THE ADVISORY COMMITTEE FOR RECONSTRUCTION
OF THE MINISTRY OF DEVELOPMENT

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# EXECUTIVE SUMMARY

This working paper proposes a plan to preserve, protect, and enhance the sensitive natural resources of Sinai. Included are descriptions of flora and fauna; the types of environmental impacts anticipated from the development of infrastructure, mining and industry, agriculture, tourism, and population centers; and the six areas proposed for dedication.

Among the sensitive natural resources in Sinai, six areas are recommended for dedication. If this recommendation is adopted, it will result in the dedication of approximately 20 percent of Sinai for preservation and management.

The largest single area recommended for dedication is the colorful and mountainous area of southern Sinai. The proposed Sinai National Park would encompass the rugged mountainous terrain which makes up much of the lower peninsula. The proposed park would include the monastery of St. Catherine, Mount Serbal, Mount Musa (Moses), Ras Mohammed, and much of the habitat of a number of the rare, threatened, and endangered endemic plant species, as well as the endangered Sinai leopard and Dorcas gazelle and other rare wildlife species.

Lake Bardawil, an internationally recognized resting, feeding, and breeding habitat for wintering and migratory shore and land birds; Lake Malaha, a smaller but comparable avian habitat; and the mountainous region of Maghara are proposed as wildlife preserves because they provide habitat for rare endemic and other wildlife species.

The spectacular coral reefs along the Aqaba coast from Elat to Sharm El Sheikh, which shelter a variety of fish and offer a delightful paradise to the underwater diver, are proposed to be a coastal preserve.

Tiran Island is recommended for dedication as a wildlife sanctuary. The endangered dugong and the endangered green and leatherback sea turtles, as well as a number of bird species including a large population of osprey and the rare sooty falcon, are known to inhabit the island.

Areas considered to be highly sensitive and extremely sensitive, and a large proportion of areas considered to be sensitive, have been included among the regions recommended for dedication. If any of these areas are proposed for development, the environmental impacts and benefits derived from the projects should be thoroughly investigated.

# A PLAN FOR THE PRESERVATION, ENHANCEMENT, AND MANAGEMENT OF THE SENSITIVE NATURAL RESOURCES OF SINAI

## 1.0 INTRODUCTION

This environmental working paper is presented as one of the deliverables for Task 13, Environmental Aspects, of the Sinai Development Study, Phase I. The information presented herein is an integral part of the total development study in that preservation of the natural biological, aesthetic, and cultural resources is essential for maximum development of Sinai.

This paper is divided into three sections:

- 1.0 Introduction
- 2.0 Sinai Development: The Environmental Challenge
- 3.0 Dedication of Ecologically Sensitive Natural Areas in Sinai.

The purpose of this working paper is to identify sensitive natural resources and to propose a plan for their preservation, enhancement, and management that will be compatible with other development activities. The sensitive natural resources include rare, threatened, and endangered species; unique and highly valuable wildlife and vegetative habitats; and aesthetic and cultural resources of high value. Additionally, a general strategy for minimizing the environmental impacts of various types of development activities is discussed.

# 2.0 SINAI DEVELOPMENT: THE ENVIRONMENTAL CHALLENGE

The development of Sinai--largely a barren, unspoiled peninsula--offers a special opportunity to preserve and protect the environment while also planning for the long-term growth and economic health of Egypt. If carefully planned, the elements of infrastructure, mineral resources and industry, agriculture, tourism, and the environment can be molded to benefit each sector and contribute to the best possible development of Sinai. This section presents the environmental characteristics of Sinai--the potential environmental problems inherent in comprehensive development of the peninsula--and the types of development of special concern.

## 2.1 BIOTA OF SINAI

### 2.1.1 Sensitive Vascular Plants

The floristic diversity of Sinai is represented by approximately 270 plant species that are "special" to Sinai and are not known in other parts of Egypt (L. Boulos, personal communication, April 2, 1981). Thirty-nine taxa (31 species and eight varieties) are endemic to Sinai; that is, these species are found in nature only in Sinai--they grow nowhere else in the world. Table 2-1 lists these plant species and their general distribution. Included in the table are eight endangered and four threatened plant species. (An "endangered" species is one that is on the verge of extinction, and a "threatened" species is one that is likely to become endangered.)

The greatest threats to vegetation in Sinai are from overgrazing, the uprooting of shrubs for firewood, and the cutting of trees. The northwest Sinai ecosystem, for example, has for many generations been under grazing pressure by herds maintained by the Bedouins. From 1967 to 1978, the plant communities enjoyed gradual rehabilitation from overgrazing due to military activities during the Israeli occupation of Sinai. According to Boulos (1981), a very impressive range of perennial plants has developed in this region over the past few years.

### 2.1.2 Sensitive Wildlife

2.1.2.1 Birds. A great variety of birds pass through Sinai in route to Africa in autumn and return to the north again in the spring. Lake Bardawil, for example, is a saline lake in northern Sinai which is of international importance as a resting, feeding, and nesting area for many species of migrating water and land birds. During a 2-week fall survey, nearly 100 species of birds were observed using Lake Bardawil (I. B. Petersen and U. G. Sorensen, Ornithological Observations from the Bardawil Lagoon, North Sinai, Egypt, October 1979, mimeo.). Thousands of eagles and other birds of prey are also funneled across northern Sinai on their passage between Africa and Eurasia. These raptors are thought to fly along this route to avoid crossing open coastal water.

The greatest threat to birds in Sinai is man. In northern Sinai, for example, the annual harvest of quail along the Mediterranean coast is tremendous. As the exhausted quail arrive in Sinai after completing the long flight across the Mediterranean, they are met by a series of

TABLE 2-1

Vascular Species Endemic to Sinai[a]

| Scientific Name | Distribution in Sinai[b] MC | NS | SS |
|---|---|---|---|
| **Caralluma sinaica (Decne) A. Berger | | X | X |
| Bufonia multiceps Decne | | | X |
| **Dianthus sinaicus Boiss. | | X | X |
| Silene leucophylla Boiss. | | | X |
| Silene odontopetala Fenzl var. conjesta Boiss. | | | X |
| Silene schimperiana Boiss. | | | X |
| Phagnalon sinaicum Bornm. & Kneuck. | | | X |
| **Scorzonera drarii Tackh. | | | X |
| Scorzonera mollis M. Bieb. var. glabrata Bornm. | | | X |
| **Ipomoea sinaica Tackh. & Boulos[c] | | | X |
| Arabidopsis kneukeri (Bornm.) O. E. Schulz | | | X |
| Rorippa integrifolia Boulos | | X | |
| *Torularia aculeolata (Desf.) O. E. Schulz[c] | | | X |
| *Juniperus phoenicea L.[c] | | X | |
| Pterocephalus arabicus Boiss. | | X | |
| Pterocephalus sanctus Decne | | | X |
| Euphorbia bivonae Steud. var. sinaica Hadidi | | X | |
| *Centaurium malacianum Maire | | | X |
| Lophochloa pumila (Desf.) Bor var. glabrescens Tackh. | X | | |
| **Stipagrostis drarii (Tackh.) De Winter[c] | | X | |
| Hypericum sinaicum Hochst. | | | X |
| Hypecoum dimidiatum Del. | | | X |
| Ballota kaiseri Tackh. | | | X |
| Nepeta septemcrenata Ehrenb. | | | X |
| Otostegia fruticosa (Forssk.) Brig. var. kaiseri (Tackh.) Tackh. | | | X |
| Phlomis aurea Decne | | | X |
| *Thymus decussatus Benth. | | X | X |
| Astragalus camelorum Barb. | X | X | |
| Astragalus spinosus (Forssk.) Muschler var. Kneuckeri (Freyn) Tackh. Boulos | | X | |
| Vicia sinaica Boulos | X | | |
| **Leopoldia logistyla Tackh. Boulos | X | | |

TABLE 2-1 (cont'd)

| Scientific Name | Distribution in Sinai[b] MC | NS | SS |
|---|---|---|---|
| *Leopoldia salah-eidii* Tackh. Boulos | X | X | |
| *Polygala sinaica* Botsch. | | X | |
| *Primula boveana* Decne | | X | |
| *Delphinium bovei* Decne | X | X | |
| *Rosa arabica* Crep. | | X | |
| *Anarrhinum pubescens* Fresen | | X | |
| *Kickxia scariosepala* Tackh. Boulos | | X | |
| ****Verbascum kaiseri* Tackh. | | X | |
| ****Veronica musa* Tackh. Hadidi | | X | |
| *Bupleurum falcatum* L. var. *linearifolium* (Boiss.) Tackh. | | X | |
| *Fagonia boulosii* Hadidi var. *crameri* Hadidi | | X | |

---

**Species is endangered.

*Species is threatened.

[a]SOURCE: L. Boulos, personal communication, April 2, 1981.

[b]MC = Mediterranean coastal region of Sinai, located north of Route 6.

NS = Northern Sinai, located south of Route 6 and north of El Egma escarpment, which roughly traverses Sinai between Abu Zenima and Elat.

SS = Southern Sinai, south of El Egma escarpment.

[c]Not endemic to Sinai.

mist nets 5 meters high that extend along the beach for a distance of some 25 to 30 kilometers. A governmental decree regulates the netting of quail, but like other laws intended to protect wildlife, they are infrequently observed and rarely enforced, and as a result only a few quail make it past the nets.

2.1.2.2 Mammals. The abundance of certain mammals in Sinai has declined over the years, and some species are on the verge of extinction. The following species merit special protection (I. Helmy, personal communication, April 5, 1981):

Ibex (*Capra ibex nubiana*)

Hare (*Lepus capensis sinaiticus*)

**Sinai leopard (*Panthera pardus jarvisi*)

Wildcat (*Felis sylvestris tristrami*)

Ruppell's sand fox (*Vulpes ruppelli ruppelli*)

**Dorcas gazelle (*Gazella dorcas saudiya*)

Fennec fox (*Fennecus zerda*)

Striped hyena (*Hyaena hyaena dubbah*)

Hyrax (*Procavia capensis syriaca*)

Caracal (*Caracal caracal schmitzi*)

Desert hedgehog (*Paraechinus dorsalis dorsalis*)

**Dugong (*Dugong dugon*).

Three of these species, the Sinai leopard, Dorcas gazelle, and dugong, are listed as endangered (**).

According to Helmy (1981), the military and market hunters have been particularly hard on wildlife in Egypt. Military abuses have resulted in the slaughter of wildlife--personnel have been known to machine gun a herd of gazelle, killing or maiming seven or eight regardless of sex or age. Commercial hunters from Europe are also a threat to wildlife. They come with coolers and orders for wild game and make a business of supplying meat to eager buyers. Hunting by Bedouins to provide food and eliminate predators can also be a problem. The extent of Bedouin hunting is difficult to assess; during the Israeli occupation of Sinai, it was apparently controlled.

2.1.2.3 Reptiles. Of the reptiles in Sinai, two species of sea turtle deserve special protection because they are listed as endangered (**):

**Leatherback sea turtle (*Dermochelys coriacea*)

**Green sea turtle (*Chelonia mydas*).

There is evidence that these sea turtles are using Tiran Island, located 6 kilometers southeast of the southern tip of Sinai.

2.1.2.4 Fish. A number of very colorful and beautiful fish need to be protected; these fish are found primarily along the Aqaba coast.

### 2.1.3 Coral

The coral along the Aqaba coast from Ras Mohammed to Elat provides a rich variety of color and form--these reefs are among the most beautiful in the world. In recent years, "bomb" fishing has resulted in serious loss of coral. It takes many, many years for coral reefs to develop and they cannot be regenerated in a lifetime.

## 2.2 TYPES OF DEVELOPMENT OF CONCERN

### 2.2.1 Infrastructure

2.2.1.1 Roads. The construction of a road into a formerly inaccessible area can create a tremendous impact by providing easy access to people who would not normally go there and by facilitating further development. Although the construction can have its own impacts, especially if sensible methods are not used, it is generally the ease of accessibility which causes the greatest harm to the biota. Roads provide a greater opportunity for hunting and trapping and also increase the number of animals that are killed by vehicles. "Road kills" can be significant in rural areas, especially where the road cuts across frequently used wildlife trails. Since most mammals are nocturnal, hitting a large animal can be dangerous to the driver of the vehicle as well.

Overall, the fewer the number of roads the better. New roads should not be permitted in areas where wildlife is to be protected. If new roads are built, they should be as short as possible and planned with serviceability, economy, and environmental compatibility in mind.

2.2.1.2 Microwave Towers and Power Lines. The aesthetic impact of poorly sited microwave towers and power lines can be significant. To minimize interference with microwave beams, the sending and receiving towers are typically set on high terrain. This can be the top of a hill or even a mountain, and result in the placement of highly visible manmade structures in the middle of an otherwise natural setting. Transmission lines can also be unsightly. They are frequently located without regard to their visibility or sited so as to create the shortest distance from the source of power to the consumer. If this approach is used in Sinai, many of its wild, open, and scenic vistas will be lost. A siting study that considers environmental as well as economic impacts will help alleviate such problems.

Numerous birds of prey are likely to perch on power transmission towers and poles. It is essential that they be appropriately designed and insulated. If towers and poles are designed so that any part of the bird can simultaneously touch the live line and the ground--even for a second--electrocution will almost certainly result.

### 2.2.2 Mining and Industry

Mining and industry generate many of the same environmental problems. The primary difference between a mine and other industry is that minerals must be mined wherever they are found--the choice is not in the siting, but rather is largely one of economics. Once the decision to mine has been made, the question of how to mine with maximum economy and minimal impact to the environment must be resolved.

To minimize mining impacts, a field reconnaissance or cursory field sampling program should be conducted to identify the valuable biological and other natural resources located in the area to be affected by the mining operation. This information should then be incorporated into a mining plan that specifies how and when the mining is to be conducted. It is very important to locate the spoils material in areas where rain cannot wash it into a wadi and thus into the water supply; wherever possible, mine pits should be backfilled to avoid leaving large open holes after the mine is played out. The successful vegetative reclamation of strip-mined areas will probably be difficult to accomplish, but if the mine spoils are covered with a nontoxic material to form a suitable seedbed for native grasses and forbes, the area may be reclaimed.

Careful selection of an industrial site will generally ensure the reduction of both environmental impacts and construction and operation costs. Site selection depends on the particular needs of the facility. For example, a power plant should be built within proximity of a dependable fuel source, an adequate cooling water supply, and the power consumer. Other aspects of siting include characteristics of air quality and meteorology, identification of onsite or offsite locations where liquid and solid wastes can be safely disposed of, and the impact of site development on the ecology and land use of the area. Each of these impacts can be managed, and if the site is a good one, usually managed satisfactorily. But a poor site can be a never-ending source of financial and environmental headaches.

### 2.2.3 Agriculture

Agricultural development of Sinai requires arable land where there is sufficient rainfall or groundwater for irrigation of crops. In northwestern Sinai, there is also the possibility of using irrigation water diverted from the Nile. For the most part, agricultural development will take place in wadies and along the coastal plains where water is available and the soils are fertile.

Land which is not suitable for cropland is used for grazing of camels, goats, and sheep. In the spring, herbaceous grasses and forbes are abundant, but as the seasons progress and rainfall ceases, forage food in the desert also declines. It is during the drought periods--typically for 6 months or more--that shrubs and herbs are frequently overgrazed.

The environmental concerns regarding agriculture are related to the potential for overuse and contamination of groundwater, salinization and erosion of soil, loss of rangeland production, and impact to endangered, threatened, and endemic plant species resulting from overgrazing.

In arid regions, water use can be significantly reduced by employing dry-land farming practices and drip irrigation. Drought and salt-resistant species are most successful, and trees such as fig, olive, almond, castor bean, and apricot are frequently grown. Where wind erosion of cultivated fields is a problem, a windbreak composed of trees can be planted. Trees such as *Casuarina equesitifolia*, *Prosopis farcta*, *Tamarix* spp., and *Eucalyptus* spp. are used successfully for such purposes. Melons, too, can be planted on unstable dunes to help reduce the shifting of sand and promote stabilization, or can be used for fodder; nonirrigated melons are said to be very tasty.

## 3.0 DEDICATION OF ECOLOGICALLY SENSITIVE NATURAL AREAS IN SINAI

As in most places of the world, Sinai has some areas that would be more sensitive to development than others. To identify species and areas that are sensitive, the following people were contacted:

- Dr. Loutfy Boulos, Plant Scientist, National Research Center, Dokki
- Dr. Bertel Bruun, M.D., noted ornithologist, New York
- Dr. Hassan Hafez, Undersecretary, Ministry of Agriculture, Cairo
- Mr. Ibrahim Helmy, Field Research Supervisor, Department of Medical Zoology, U.S. Naval Medical Research Unit No. 3, Cairo
- Dr. Mohammed Kassas, Professor of Botany, Cairo University, Cairo.

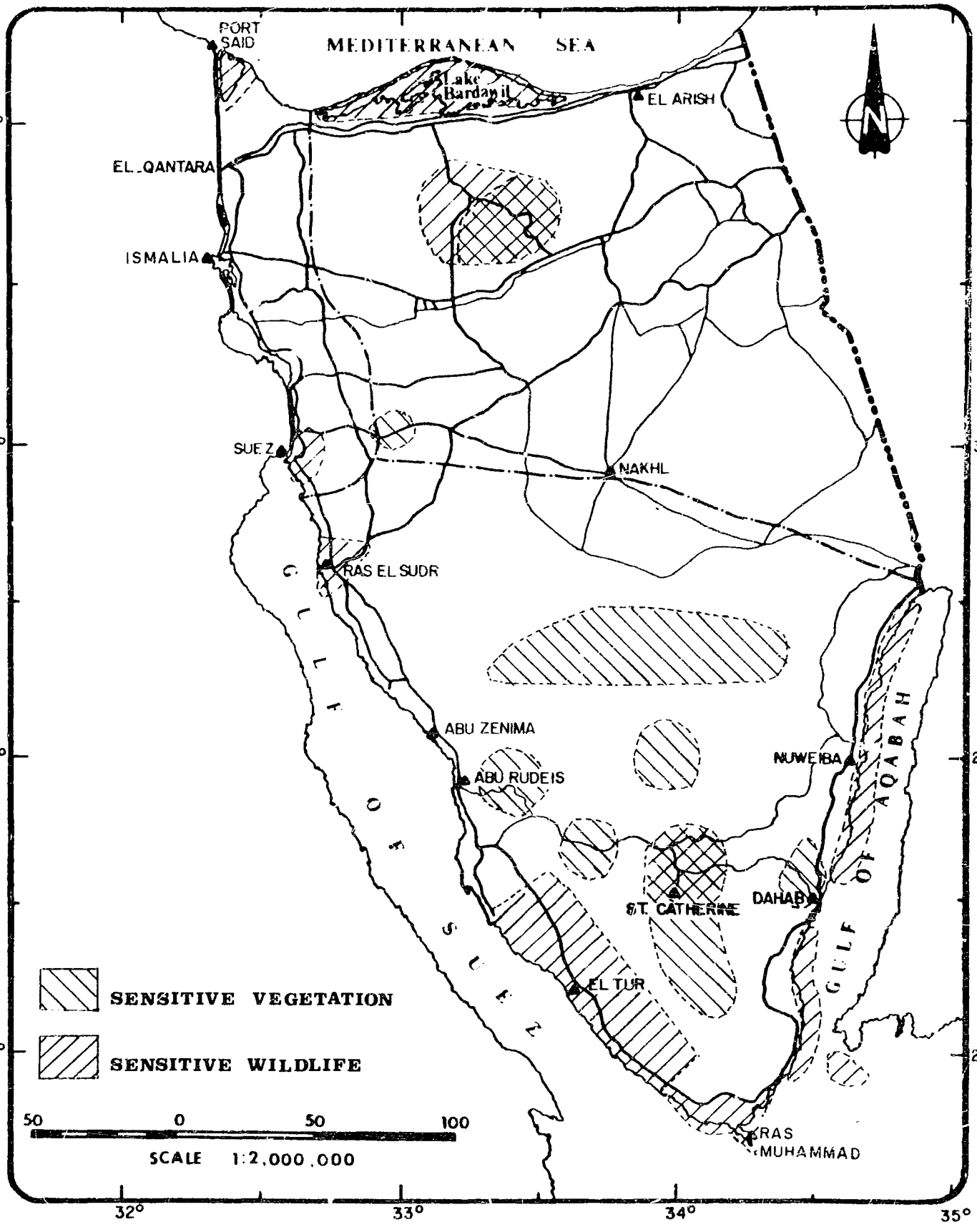
Boulos, Helmy, Kassas, and Bruun each identified locations where rare, threatened, endangered, or other valuable species are known to occur, and areas which should be considered for some level of protection. In addition, Bruun accompanied Dames & Moore personnel on a 2-week reconnaissance of north and south Sinai. The areas identified by Boulos, Bruun, Helmy, and Kassas as being of ecological sensitivity are presented in Figure 3-1. These locations were then shown to Agriculture Undersecretary Hafez, and possible methods of administering and enforcing environmental regulations within their boundaries were examined. Based on these discussions, slight boundary adjustments were made to facilitate proposed management--it is easier to control a block area than many small irregularly shaped areas.

### 3.1 CRITERIA FOR ENVIRONMENTAL SENSITIVITY

Each area identified as being ecologically sensitive was rated according to its overall environmental sensitivity. Areas were considered to be either nonsensitive, sensitive, highly sensitive, or extremely sensitive. The following criteria were used to determine the relative environmental sensitivity of an area:

- Occurrence of rare, threatened, or endangered species
- Uniqueness
- Cultural value
- Scenic quality
- Accessibility.

The location and degree of environmental sensitivity of natural areas in Sinai are shown in Figure 3-2.

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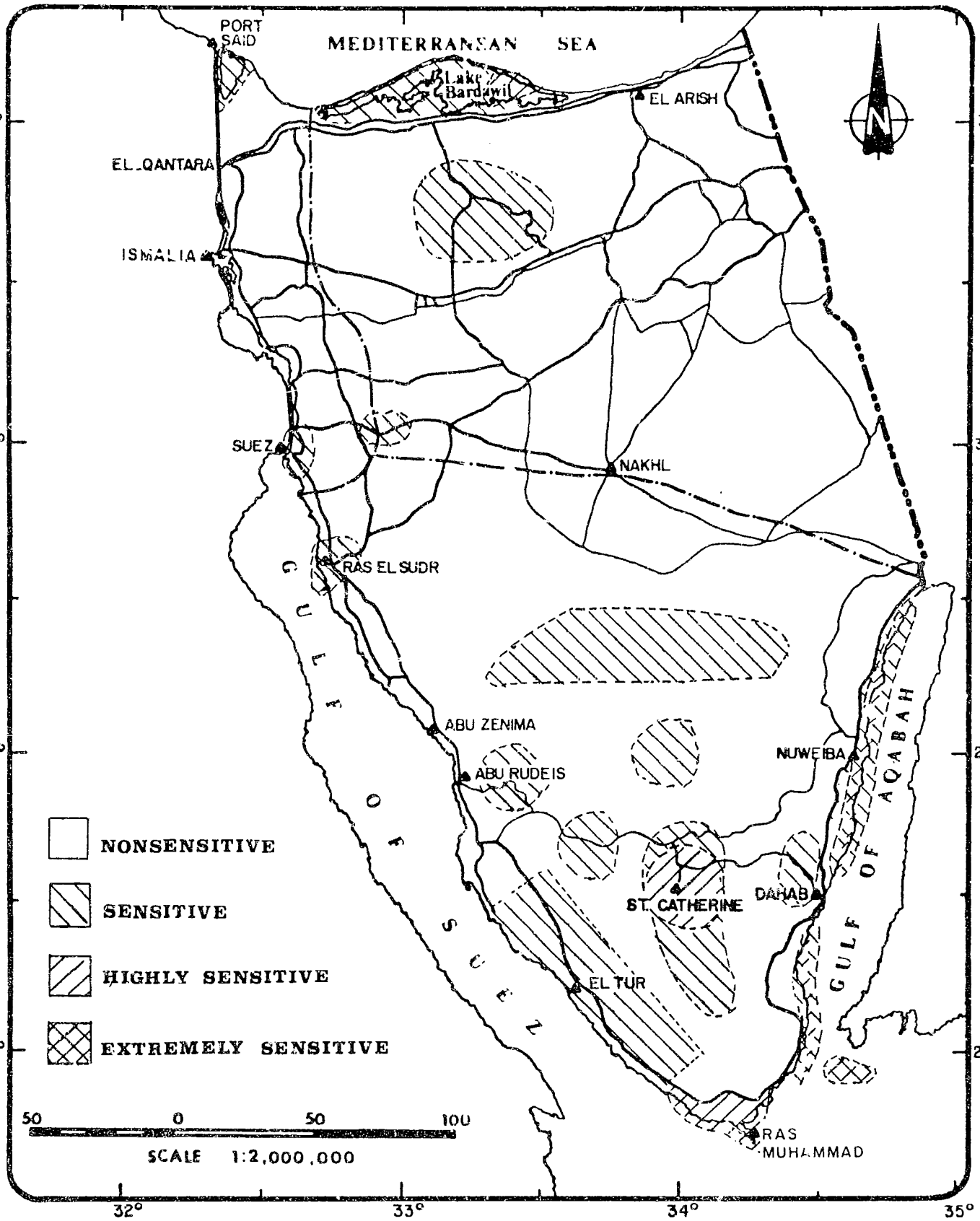
**LOCATION OF SENSITIVE VEGETATION AND WILDLIFE**

**FIGURE 3-1**

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**ENVIRONMENTAL SENSITIVITY AREAS IN SINAI**

**FIGURE 3-2**

## 3.2 SELECTION CRITERIA FOR AREAS TO BE DEDICATED

As Sinai is developed, areas which are environmentally sensitive should be considered for some level of protection. The following selection criteria were used to determine if a sensitive area should be proposed as a park, sanctuary, or preserve:

- Level of environmental sensitivity
- Accessibility
- Definable boundary
- Compatibility with surrounding land uses and proposed development strategies.

Each area identified as being environmentally sensitive was considered for dedication. An area's accessibility strongly influences the impact of man and domestic livestock. Areas which are remote, roadless, or located in rugged terrain are considered to be less in need of protection. Another consideration is definable boundary--an area which is difficult to define will be equally difficult to protect and manage. Areas that can be defined by a recognizable landmark are considered better candidates for dedication. Finally, the general compatibility of the dedication with surrounding land uses and development strategies is considered. A successful development plan must take into account a broad range of interests and values.

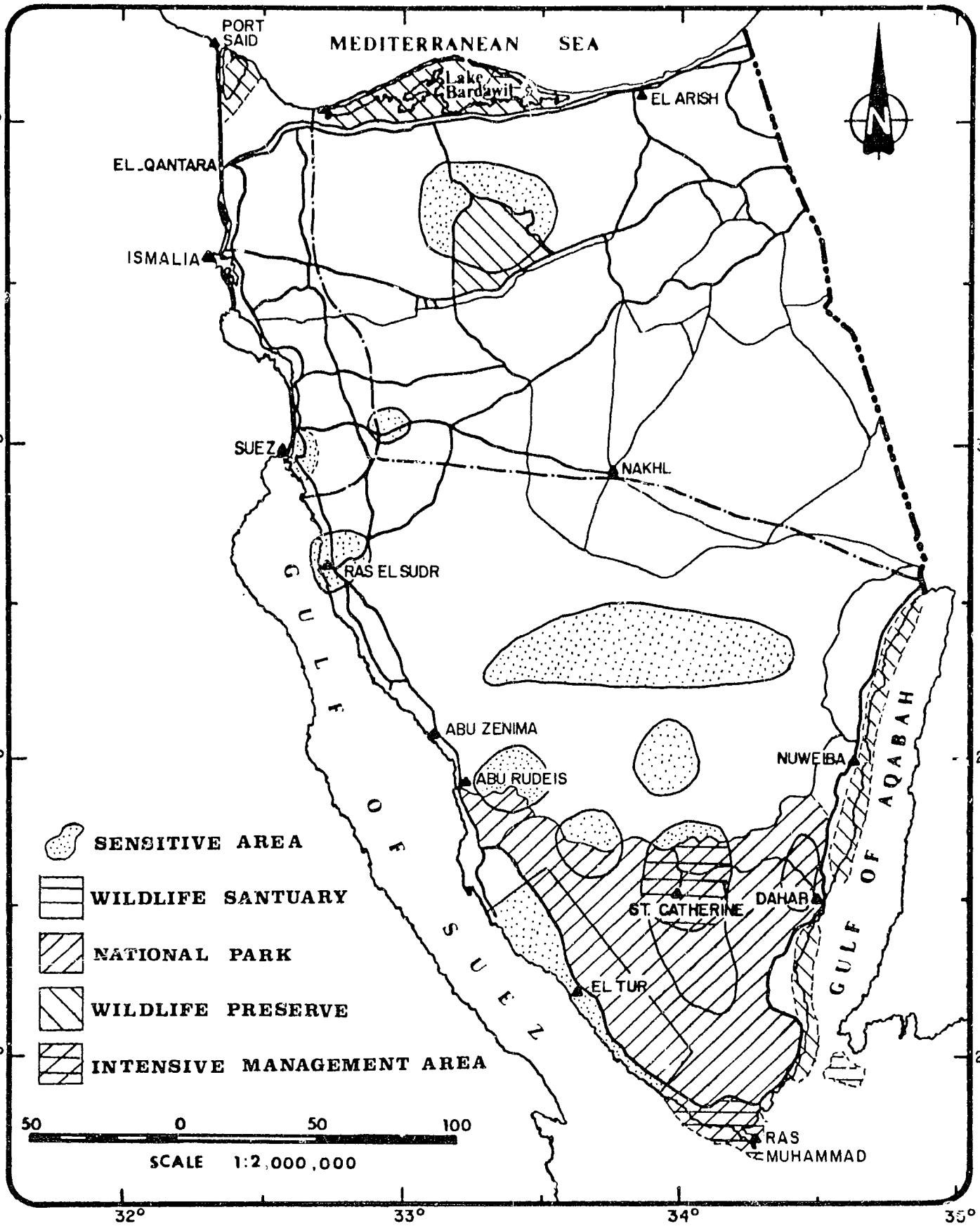
## 3.3 AREAS RECOMMENDED FOR DEDICATION

Three types of dedicated areas were considered for Sinai. The most restrictive type is the wildlife sanctuary. A sanctuary designation was considered for those areas that are extremely sensitive and where total protection is necessary to preserve the environmental resource. A second designation as a national park was considered for areas that had a variety of attractions and could accommodate visitors without destroying natural resources. Designation as a preserve was considered for areas where the sensitivity is primarily ecological and where preservation of the resources requires wildlife management.

Six areas, presented in Figure 3-3, were selected as meeting the four selection criteria and thus are recommended for dedication. A description of these areas and the rationale for why they were selected are presented in the following sections.

### 3.3.1 St. Catherine and Ras Mohammed

3.3.1.1 Description. The high mountain area in southern Sinai which includes Mount Catherine, Mount Serbal, and Mount Musa presents a landscape of exceptional flora and fauna and contains important archaeological and historical attractions. The sixth century St. Catherine's Monastery is located in a valley near the mountain of the same name. Its more than 2,000 priceless icons represent the entire development of this art form. The monastery library contains rare manuscripts and early theological works. Mount Musa is the traditional mountain of the "giving of the law" in Judeo-Christian belief and provides a spectacular view of the surrounding granite mountains, especially at sunrise.




Sinai Development Study Phase 1
Ministry of Development

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**LOCATION OF AREAS PROPOSED FOR DEDICATION**

**FIGURE 3-3**

Mount Serbal caps a strikingly beautiful jagged ridge of mountains and can be seen from long distances. It has long been regarded as a holy mountain.

The area surrounding St. Catherine supports a variety of rare plants and wildlife. The status of the endangered Sinai leopard at present is uncertain. Its former range included the St. Catherine area; field investigations must be conducted to determine if this rare species still exists. The area also supports desert hedgehog, hare, and ibex, as well as a large number of endemic plant species, some of which are threatened and endangered.

Ras Mohammed is composed of several finger-like projections of land that form an unusually beautiful contrast of barren land and sea set against a backdrop of the mountains of southern Sinai and the meeting of the Gulfs of Suez and Aqaba at the head of the Red Sea. Ras Mohammed is made up of ancient uplifted coral; at one of its extremities, a high bluff overlooks the sea and provides an ideal lookout for the sharks that are found in these waters. Among the hills at the tip of Ras Mohammed, mangroves can be found growing in an inlet--an unexpected sight. The mangrove that grows in this area and along the Aqaba coast is at the northernmost extension of its range.

Ras Mohammed also provides habitat for some birds. Osprey nest on the westernmost lobe, and the sooty falcon nest among the cliffs overlooking the Gulf of Aqaba to the east. The coral reef that encircles Ras Mohammed at the water's surface contains many kinds of coral and is the home of a number of brightly colored fish. Because of its unusual beauty, Ras Mohammed is a popular tourist spot.

3.3.1.2 Recommendation as a National Park. It is proposed that a national park be created to include the mountainous areas surrounding St. Catherine's Monastery and Ras Mohammed. This area is presented in Figure 3-4 (see map pocket). The proposed park boundary generally follows the major roads of the area, which bind together into one unit much of the biological and cultural features of south Sinai. A roadway boundary was chosen because it was felt that a definable perimeter would be easier to understand by the local Bedouins and tourists.

In addition, the proposed national park would include a number of island-like areas throughout southern Sinai that are known to contain many rare endemic plant species, some of which are threatened and endangered, and several rare and endangered wildlife species. A park of this size would offer protection to the endangered Sinai leopard and Dorcas gazelle, and the hare, caracal, wildcat, striped hyena, Ruppell's sand fox, hyrax, and ibex. Without some form of protection, increased use of this area would undoubtedly result in the extirpation of some of these species.

3.3.1.3 Proposed Management Policy. Within the confines of the national park, no hunting, killing, molesting, or removal of wildlife or vegetation should be permitted. To retain the beauty of the park and protect its cultural and biotic resources, no new roads should be built.

The potential for significant mineral deposits in the southern mountains of Sinai is recognized. The development of a major mineral deposit could greatly benefit the local inhabitants; if such a deposit

is discovered, however, an environmental impact statement should be prepared to evaluate the environmental and socioeconomic impacts and benefits before constructing any roads or other mining facilities within the park.

The grazing of livestock within the park can be permitted if the number of animals is limited to the carrying capacity of the rangeland. Agriculture currently occurs sporadically throughout the area; there is potential for expanding the agricultural acreage where sufficient runoff and groundwater occur. Where agriculture is feasible, new and existing developments should be encouraged within the park as long as wetlands and unique habitats are left intact and protected. Access roads to agricultural developments can be constructed, and a field survey of areas to be used for agriculture should be conducted to confirm their suitability and to identify areas that are to be protected. An environmental assessment should be prepared for each area planned for agricultural development.

Overnight camping should be permitted at designated areas to be appropriately marked for that purpose. Suitable toilet facilities should be built and maintained. Receptacles for trash should be placed at strategic locations throughout the park, and trash should be routinely collected and disposed of at an appropriate landfill dump. Park rangers should regularly police the area and be responsible for keeping the park grounds free of litter.

### 3.3.2 Lake Bardawil

3.3.2.1 Description. Lake Bardawil is an important stopover for birds migrating between Africa and Eurasia. The lake is a saline coastal lagoon and wetland complex bordering the Mediterranean Sea along northern Sinai. It is about 74 kilometers long and up to 20 kilometers wide, and is made up of a highly saline marsh at the western end, an open water lagoon in the central area, and a series of low sand islands at the eastern end. The narrow semicircular barrier beach that forms the northern boundary of Lake Bardawil also separates it from the Mediterranean. An artificially maintained inlet is located at the eastern end of the lake.

The influx of water from the Mediterranean is very important to the ecology of the Lake Bardawil system because it maintains the salt concentration at tolerable levels. The eastern island-cove complex is an internationally recognized breeding, resting, and feeding area for wintering and migratory birds. While the lagoon in the central area is a good source of fish, the western marshes provide excellent habitat for wintering flamingo, avocet, shoveler, and shelduk, as well as waders.

3.3.2.2 Recommendation as a Wildlife Preserve. It is proposed that Lake Bardawil be dedicated as a wildlife preserve, as shown in Figure 3-4 (see map pocket). Dedication of the lake as a preserve would protect its wildlife from increased human use of the area. Because of its exceptional value to birds, the island-cove complex at the eastern end of the lake has been identified as an intensive management area.

3.3.2.3 Proposed Management Policy. Except for commercial and recreational fishing, no hunting, killing, molesting, or removal of wildlife or vegetation should be permitted within the confines of the wildlife preserve. Thus, there would be no conflict between the lake's dedication

and proposed plans for construction of an inlet and expansion of the fishing industry. The prohibition against killing wildlife should include the netting of quail which are extensively caught along the coastal zone from east of Lake Bardawil to El Arish.

Certain settlements within the Lake Bardawil preserve should be permitted to continue. Other developments, such as opening a channel into the center of the lake and dredging of the lake, should be permitted only if an environmental impact statement indicates that the lake will not be significantly altered so as to reduce its benefit to the birds and other wildlife.

The island-cove complex at the eastern end of the lake should be preserved and protected in its present state, and visitors should not be permitted to enter this intensive management area during breeding periods.

It may be desirable to build a motel in the eastern corner of the preserve so that tourists can enjoy observing the birds. Careful siting of such a facility should be required, along with an assessment of its impact on the birds and the aesthetics of the area.

### 3.3.3 Lake Malaha

3.3.3.1 Description. Lake Malaha is a shallow saline lake that fluctuates with the level of the Mediterranean. The Suez Canal bypass, which was constructed recently to alleviate congestion at the Mediterranean end of the canal, passes through a portion of Lake Malaha. Much of the bypass dredge material was disposed of in the lake, effectively reducing the nesting, feeding, and resting habitat it provides to numerous migratory shorebirds, including the flamingo.

3.3.3.2 Recommendation as a Wildlife Preserve. It is proposed that Lake Malaha be dedicated as a wildlife preserve. The area to be included is shown on Figure 3-4 (see map pocket).

3.3.3.3 Proposed Management Policy. Within the confines of the wildlife preserve, no hunting, killing, molesting, or removal of wildlife or vegetation should be permitted. Unlike at Lake Bardawil, which is much larger, commercial fishing should not be permitted.

### 3.3.4 Maghara Area

3.3.4.1 Description. The Maghara mountain area has been identified as a habitat for sensitive vegetation and perhaps the ibex. Mountains are not commonly found in north Sinai, and thus this type of habitat is worthy of dedication. The Fennec fox has been reported to inhabit the open sandy areas west of Maghara, but this area has not been included in the preserve because it is very unlikely that the Fennec fox would be disturbed by modest development.

The coal reserves at Maghara appear to be developable, in which case an assessment of the environmental impact from mining will be required.

3.3.4.2 Recommendation as a Wildlife Preserve. It is proposed that the mountainous area known as Maghara be dedicated as a wildlife preserve. Figure 3-4 (see map pocket) shows the area to be included. The mountainous terrain in this area gives welcome relief to the predominant sandy topography.

3.3.4.3 Proposed Management Policy. Within the confines of the wildlife preserve, no hunting, killing, molesting, or removal of wildlife or vegetation should be permitted. Agricultural development in the valleys would be acceptable if properly managed.

3.3.5 Aqaba Coral Reefs

3.3.5.1 Description. The western shoreline along the Gulf of Aqaba contains some of the most spectacular coral reefs in the world. The reefs extend the entire length of the shoreline from Elat to Ras Mohammed. Skindiving and viewing the coral through glass-bottomed boats are very popular activities. Spearfishing is also a popular sport.

3.3.5.2 Recommendation as a Coastal Preserve. It is proposed that the coastal area extending along the western shore of the Gulf of Aqaba, as presented on Figure 3-4 (see map pocket), be dedicated as a coastal preserve. The combination of the blue sea and the pink, black, and red of the mountains is incomparable in nature.

3.3.5.3 Proposed Management Policy. To protect the coral, no explosive devices should be used for fishing or any other purpose without the approval of the Ministry and the South Sinai Governor. No commercial fishing should be permitted within the coastal preserve, but sportfishing and spearfishing could be permitted in areas where maintenance of the fish populations would not be jeopardized. Areas where swimming is especially dangerous should be so posted.

3.3.6 Tiran Island

3.3.6.1 Description. Tiran Island is a 79-square-kilometer island off the southeastern tip of Sinai, situated 6 to 8 kilometers across the Straits of Tiran. Since the island has no terrestrial carnivores, it has become an ideal breeding ground for various kinds of birds, including terns, gulls, and spoonbills. Also nesting on the island are 20 to 25 pairs of osprey (the largest colony in the world outside of the United States) and the rare sooty falcon. There is evidence that the endangered dugong and the endangered green and leatherback sea turtles are using the island.

3.3.6.2 Recommendation as a Wildlife Sanctuary. It is proposed that Tiran Island be dedicated as a wildlife sanctuary. Tiran Island and its surrounding waters (Figure 3-4, see map pocket) provide critical habitat for a variety of birds and for the dugong, leatherback sea turtle, and green sea turtle, all of which are listed as endangered. This area is recommended for total protection to ensure that its critical and delicate ecology is preserved.

3.3.6.3 Proposed Management Policy. Tiran Island should be preserved in its present state, and except for authorized management personnel and scientists conducting legitimate scientific investigations approved by the Ministry, no one should be permitted to visit the island. In

addition, no hunting, killing, molesting, or removal of wildlife (including coral) or vegetation from the island or its immediate waters should be permitted.

## 3.4 REQUIREMENTS FOR PROTECTION, MANAGEMENT, AND ENFORCEMENT OF DEDICATED AREAS

To preserve and protect the cultural and biological resources of the national park, wildlife preserve, coastal preserve, and wildlife sanctuary areas, it is essential to hire, train, and equip an adequate number of rangers. These personnel should be responsible for enforcing the policies and regulations for each of the dedicated areas. Since good communications with native inhabitants and tourists is an important aspect of enforcement, it would be desirable for rangers to speak both English and Arabic.

As is the custom in Sinai, rangers would serve on a rotational cycle of 20 days of work and 10 days of vacation. Permanent ranger facilities should be established at key locations to maximize interaction with the public. It would be ideal if a ranger station could be established at the Suez Canal University field station near St. Catherine.

A small fleet of four-wheel-drive vehicles should be assigned to and maintained by the park rangers. Rangers should be expected to drive their own vehicles and be prepared to administer routine servicing and make minor field repairs. Each vehicle should be equipped with a shortwave radio with sufficient signal range to communicate with other units. It would be desirable to maintain a central, home base radio at the ranger station. Boats will be needed to patrol and protect coastal areas. Each boat should be similarly equipped with a shortwave radio built for marine use.

It is anticipated that the following number of rangers would be sufficient to protect the areas recommended for dedication:

| | |
|---|---|
| • Sinai National Park | 4 onsite, 6 total |
| • Lake Bardawil, Lake Malaha, and Maghara Wildlife Preserves | 2 onsite, 3 total (for each) |
| • Aqaba Coastal Preserve | 2 onsite, 3 total |
| • Tiran Island Wildlife Sanctuary | 2 onsite, 3 total. |

## 3.5 AREAS NOT SELECTED FOR DEDICATION

### 3.5.1 Mitla Pass

There are a number of sensitive plants growing in the vicinity of Mitla Pass. This pass has been the scene of many military battles, and portions of the area are still mined. Because of former use and continued military interest in this area, it is doubtful that it could be effectively managed.

### 3.5.2 Suez Area

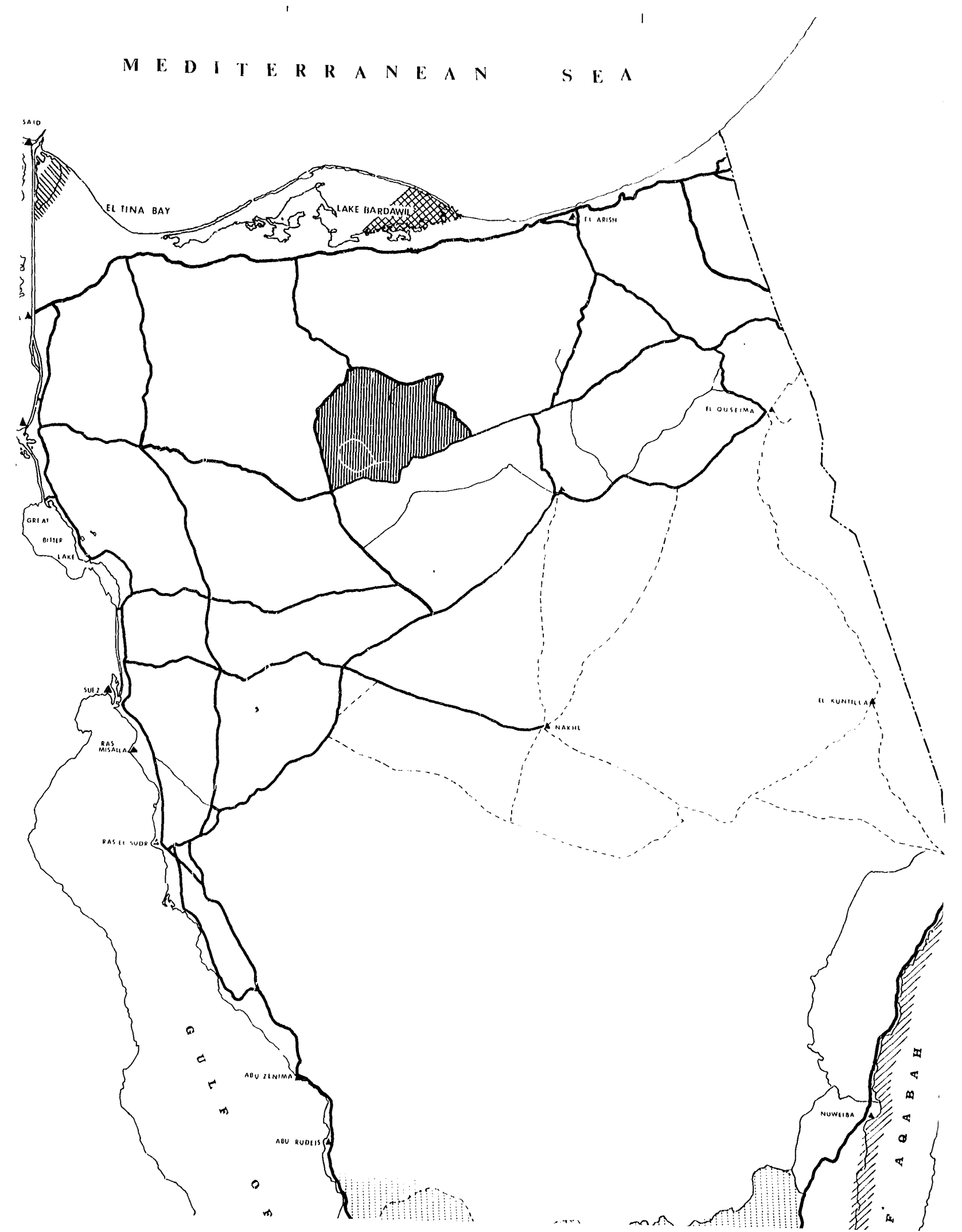
The sandy area on the Sinai side opposite Suez is the historic range of the Fennec fox. This fox is known in only a few areas in Sinai and since it has recently been sighted in the vicinity of Maghara, its continued existence in Sinai is less dependent on the Suez area.

### 3.5.3 Ras Sudr Vicinity

Bustards are known to inhabit the environs near Ras Sudr. This area is highly dissected by roads, which would make protection and management extremely difficult. Thus, the Ras Sudr area was not considered a suitable area for dedication.

### 3.5.4 El Tih Plateau

Two areas in central Sinai located within the El Tih Plateau support sensitive vegetation (one area straddles the El Egma escarpment). Both of these areas are remote, have no roads leading to them, and are located in a region that is not expected to be developed to any great degree. By their remoteness, a sufficient level of protection is already afforded, and additional dedication at this time would not serve a useful purpose.


MEDITERRANEAN SEA
SAID
EL TINA BAY
LAKE BARDAWIL
EL ARISH
EL QUSEIMA
GREAT BITTER LAKE
SUEZ
RAS MISALLA
RAS EL SUDR
NAKHL
EL KUNTILLA
GULF OF
ABU ZENIMA
ABU RUDEIS
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