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LIVESTOCK PRODUCTION IN SINAI

A Preliminary Assessment

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EXECUTIVE SUMMARY

This Working Paper on Livestock Production in Sinai is presented as a part of the agriculture sector review and strategies for future development. Documented knowledge of livestock production in Sinai is scant, but this is not particularly surprising since it has never been considered an area of high potential or of great economic importance. Within Sinai, however, the livestock sub-sector is of relatively high importance, compared to other sources of income. A three-month survey of the agricultural sector of Sinai has been undertaken by the Desert Institute, Cairo, to enhance and update knowledge about Sinai agriculture.

The main constraint to increasing livestock production in Sinai is the lack of water: any type of forage production is limited by the low annual precipitation; there is a lack of available quality water for irrigation to produce fodder crops or other crops which by-products may be used for animal feed; and watering places for livestock are few and far between. Any major development in improving livestock production must be tied to other agricultural developments which in turn depend on the supply of irrigation water.

The main species of domestic animals in Sinai are sheep, goats and camels. Present production is low either on a per animal or per feddan basis. Ideas for improving production are presented and range from those requiring small monetary or technical inputs to those requiring major capital expenditure and high technology.

LIVESTOCK PRODUCTION IN SINAI

A Preliminary Assessment

1.0 Review of Knowledge and Observations

1.1 Introduction

The purpose of this paper is to present a preliminary assessment of what is known and what has been observed by the author about livestock production in Sinai, to describe briefly those factors which are apt to be important in any attempt to improve production in the region (Section 1.0) and finally to present a strategy for development (Section 2.0). In order to understand the potentialities and limitations for development of Sinai, a brief description is given for the geography, climate, topography, vegetation, un-domesticated mammals, people, infrastructure and finally the present production of domestic livestock. A 3-month survey of soils, vegetation, livestock, hydrology, geology, and geo-morphology is presently being carried out by the Desert Institute, Cairo. This survey will undoubtedly present more accurate and up-to-date information than presented here. But for the moment, this report will assist in gathering together needed information and concurrently will give other readers the opportunity for correcting errors and false assumptions found herein.

Because of lack of precipitation, improvement of any type of agriculture will be extremely difficult unless additional and larger sources of water are found. Since there are other areas in Egypt which may have a higher agricultural potential than Sinai, it is important to point out that the government's main goal is to increase the population and activity in the region so as to build up a protective barrier against other nations and ideologies and to produce more food and materials for a growing population in Egypt and the world. Throughout history, Sinai has been a crossing point between Asia and Africa for invading armies. Its barren sandy plains in the north gave ample room for maneuvering large armies without fear of being molested, and its rugged mountains in the south gave protection to the armies once in place. Indeed, to the outsider interested in history, Sinai still holds evidence of occupation by the Pharoahs, Romans, Arabs, Turks, and Jews, as well as Napolean who also claimed Sinai as part of the French empire.

The government plans to strive for as high a degree of self-sufficiency as possible within Sinai itself, thereby putting emphasis on internal development rather than trying to support Sinai's increasing population from the Nile Valley.

1.2 Geographical Description

Sinai essentially lies between the north latitudes of 31° and 28° with small portions north and south of these limits and between the east longitudes of 32° and 35°. It is bounded by the Mediterranean on the north, the Suez Canal and Gulf of Suez on the west, the Red Sea on the south, the Gulf of Aqaba and Israel on the east and comprises some 61,000 Km^2, linking Africa to Asia.

1.3 Climate

Most of Sinai is considered temperate desert (mean temperature of cold-

est month being below 18°C and annual precipitation under 300 mm). For ease of interpretation of information, Sinai has been divided into six climatic zones: 1 - north, 2 - plateau, 3 - mountain, 4 - east Suez Canal, 5 - east of Gulf of Suez, and 6 - Gulf of Aqaba Coast. The mean annual rainfall ranges from about 250 mm in the northeast to less than 25 mm in the southwest. In general, most of the precipitation falls from November through March with the heaviest fall from October to January. During the months of June, July and August, there is generally no rainfall. The number of days in which rainfall exceeds 10 mm/day varies from about 3.6 at El Arish in the northeast to less than .5 in the south. The maximum amount of precipitation in one day varies from 30 mm in various areas of central plateau and certain western and southern coastal areas to around 70 mm in the mountains around St. Catherine. The average minimum winter temperature varies from about 15° C in the extreme south to around 0° - 5° C in the mountains around St. Catherine. The maximum winter temperature ranges from around 20° C in the extreme northeast to around 0° - 5° C in the south central mountains around St. Catherine. The average maximum summer temperatures range from around 35° C in the central plateau and the extreme south to around 20° C in the St. Catherine mountains (See Appendix A).

1.4 Topography

The topography of Sinai varies from coastal plains in the southwest, west, and north to the igneous and metamorphic rocky mountains in the south central area of the Peninsula. Osborn and Helmy, 1980, have summarized various sources of information on the topography as follows: "Steep mountains of igneous and metamorphic rock skirted on the north and west with remnants of cretaceous or Nubian sandstone form the southern third of the Peninsula or Sinai proper. Prominent peaks of this region are Gebels Serbal (2,070 m), Umm Shomer (2,586 m), Musa (2,228 m) and Catherine (2,637 m), the highest mountain in Egypt. Rocky wadis drain these mountains eastward, abruptly into the Gulf of Aqaba, and westward gradually over the broad, sandy plain of the El Qaa Plain into the Gulf of Suez. Wadis Isla, Hebron, Feiran and Sidri are the most extensive of the western drainage systems.

"A high plateau of cretaceous, Eocene and Miocene limestones dominates central and part of northern Sinai. Gebel Egma (1,620 m), a plateau itself, forms the southern extremity of northward dipping Badiet el Tih (Desert of Wanderings) Plateau, which averages between 700 and 900 m elevation. The 500 m high sandstone cliffs of Gebel Dhulal (1,570 m) form the southern scarp of El Tih. Tributaries of northward flowing Wadi el Arish drain most of the surface of El Tih. Northern limits of the plateau are marked by a series of prominent mesas, ranging from 370 to 1,094 m elevation, between which extend dunes and plains of the northern desert. These sand and gravel plains and belts of northwest southeast oriented dunes, 80-100 m in height, cover a triangular area from the Isthmus of Suez eastward to Rafa. This area, together with the plateau to the south, is called El Tih or, in combination with the region north of Wadi Tumilat, the Isthmic Desert (Hassib, 1951; Tackholm, 1974).

"The Mediterranean coastal desert of Sinai or Nile-Sinai Mediterranean Littoral (Meigs, 1966), is not as distinctive a region as is the Western Mediterranean Coastal Desert of Egypt. In contrast, the former desert receives less rainfall, is more sparsely vegetated (Zohary, 1944), and is low, featureless, and slowly subsiding. Two shallow saline lakes, Sebakha el Bardawil and Birhet Serbonis (Sea of Reeds) enclosed by offshore bars, occupy the central sector of the coast.

"The Isthmus of Suez, a low, sandy, and scantily vegetated neck of land connecting Egypt with Sinai, contains Lake Timsah and Great and Little Bitter Lakes, which are connected and traversed by the Suez Canal. The Isthmus lies in the northwest branch of the great Rift Valley and has, in times past, fluctuated in elevation and separated the adjoining land masses. Thus, a partial barrier exists here to the interchange of African and Asian faunas."

The principal drainage systems divide Sinai into the following hydrographic basins: North Coast, East Gulf of Suez, Gulf of Aqaba, El Arish, and El Girafi. Following fairly closely to the above drainage systems are the principal alluvial deposits (Appendix B). Although accurate appraisal of groundwater is presently lacking, and plans for transporting Nile River water, and development of water diversions in the Wadis have not been finalized, knowledge of the alluvial deposits do give some idea of the potential for food crop and forage production.

It is easily observed that the area of alluvial deposits is about 10% of the total surface area of Sinai, and the present speculation on availability of ground or surface water for irrigation is that the probability of locating sources of water large enough for irrigation is small. Present knowledge of the soils gives further evidence of the limited potential of Sinai for a large proportion of it to be cropped. The soil mapping that has been done to date is limited and, therefore, should be used only as an indication of potential, from the soils standpoint, but does give a benchmark for further refinement. The existence and depth of impervious subsoil layers can well limit the potential and length of time that certain areas might be farmed under irrigation before they are salted.

1.5 Vegetation

In general, perennial vegetation in Sinai is limited mainly in wadis and catchments of the drainage systems. These areas cannot maintain a continuous vegetation, since they only receive water irregularly which is a principal difference between these deserts and the so-called "rain deserts" that receive enough precipitation to sustain a continuous, though sparse, vegetation. The plateaus and mountain slopes have the least vegetation because of the exposure to wind, sun and evaporation. The wadis, however, are exposed to lower wind velocities, less sun exposure, collect run-off water and usually have more favourable sub-strate, therefore sustaining a greater plant life. Sand sheets and soils of depressions often support some vegetation in otherwise barren country (Osborn and Helmy, 1980). An occasional rain will give rise to vegetation from seed, but such sporadic rainfall limits species and cover producing shifting and tenuous populations. Such circumstances along with variable and uncertain water supplies promote the transhumant type of animal production.

It is important to note that the 61,000 km^2 (approximately 15,250,000 feddans - 1 feddan equals about 1.1 acres) carries about 105,000 sheep and goats, 9,000 camels, around 415 horses and cattle and probably about 1,000 donkeys. This yields a present density of about 1 goat or sheep to around 80 feddans and 1 camel to around 600 feddans. This type of generalization is dangerous and must not be misused in planning strategies.

Osborn and Helmy, 1980, have cited three basic types of desert vegetation: accidental, ephemeral, and perennial, which are associated with water sources of the same nomenclature. Vegetation in Sinai is more of the ephemeral type, although there is some of the other two types. Perennials are found wherever there is suitable soil in wadis, basins or rock cre-

vices and where there are accumulations of water, although meagre. Acacia trees, for example, are known to exist in catchment basins in areas where the effective precipitation is less than 1 mm every 15 years (Osborn and Helmy, 1980, citing Bagnold, 1954). Much of the vegetation in Sinai is classed ephemeral. Although annual precipitation is limited, it is fairly predictable.

The following brief summary of vegetation in Sinai has been given by Osborn and Helmy, 1980: "The littoral zone or coast of Sinai, studied by Zohary (1935, 1944) and Kassas (1955), is 10 to 15 Km wide and consists of dunes alternating with sand plains and serrir (pebble desert).

"Typical perennial coastal dune plants of 50 to 100 percent frequency are: Ammophila arenaria, Polygonum equisetiforme, Lotus creticus, and Moltkopsis ciliata(=Moltkea Callosa). Plants predominating on sand plains are: artemisia monosperma, haplophyllum tuberculatum (=H. Longifolium), Panicum turgidum, Pituranthos tortuosus, Urginea maritima, and Cynodon Dactylon. Inland dunes and slope-piled dunes on mountains are vegetated with Panicum turgidum, Stipagrostis scoparia (=Aristida scoparia), Thymelaea hirsuta, convolvulus lanatus and Noaea mucronata. Lygos raetum (=Retama raetam) also occur on these dunes. Dominant plants on serrir where enough moisture accumulates are Anabasis articulata or Hammada elegens (=Halaxylon salicornicum). These two species, incidentally, extend from sea level to 1000 m elevation. Vegetation in plateau and mountain areas is confined chiefly to wadis, although higher peaks in southern Sinai are vegetated because of orographic moisture.

"Haim and Tchernov (1974) listed Artemisea inculta (=A. Herbaalba), Hammada elegens (H. articulata in their text), and Anabasis articulata as dominants on the southern El Tih-Gebel Egma area, which in their opinion, is a transition zone. On the higher mountains above 1500 m, artemisia inculta was noted as being the dominant plant. With the exception of a few shrubs, the vegetation of Sinai mountains and wadis is essentially the same as that in comparable situations in the eastern desert. Further coverage of the vegetation of Sinai is given by Zohary (1935, 1944, 1954), who considered the Peninsula on the whole to be in Saharo-Sindian territory on the basis of the large number of plant species belonging to this element.

"Saline areas around brackish springs and wells (e.g., Ayun Musa, Wadi Sudr, Bir Hassana, and Bir Kussaima) are distinguished by mound-forming Tamarix nilotica (=T. mannifera), Nitraria retusa, and Zygophyllum album, together with Alhagi mannifera (=A. maurorum) and clusters of date palms (Zohary, 1944). The same plants occur at similar sites in Egypt."

1.6 Un-domesticated Land Mammals

There are relatively few wild species of land mammals in Sinai (Osborn and Helmy, 1980), but there is concern of the possibility of further disappearance and perhaps extinction of such groups as the Dorcas Gazelle, Ibex and Cheetah, if there is further agricultural and industrial development and an increase in human population. For the most part, the habitat of these species is restricted to the mountainous regions, where there is little likelihood of large developments. In fact, agricultural developments at lower elevations would increase the feed base for goats and sheep and probably decrease the frequency with which the flocks traverse the mountainous areas, thus lowering the pressure of domesticated species.

Although there are occasional reports of predator attacks on the flocks of

sheep and goats, they do not seem to constitute a great hazard at the present. However, in the case of the several species of rodents, it is possible that increased agricultural production and confined animals feeding in certain areas could lead to increased populations, thus constituting a real problem in the future. (See Appendix C)

1.7 People

The most recent estimations (1980) of population (Table 1) for the whole of Sinai (including territories still occupied by Israel) stand at 203,000 (Gadalla, 1981).

TABLE 1 - ESTIMATIONS OF HUMAN POPULATION, 1960 & 1980*

Administrative Counties**	Pop. 1960	Pop. 1980
El Arish	48,750	91,531
Bir Abd	12,100	22,717
El Hasna	15,000	28,163
Nakhl	12,000	22,530
Sheikh Zweid & Rafah***	26,308	38,129
TOTAL	114,158	203,070

* Source: Gadalla, 1981

** Each county includes a town serving as administrative seat and several surrounding villages and settlements.

*** Territories still occupied by Israel.

Gadalla, 1981, has classified Sinai societies into three major types:

1 - Semi-urbanized cities and towns,
2 - Small settled communities, and
3 - Semi-nomadic (transhumance) and nomadic Bedouin tribes.

A survey of the small settled communities conducted by the Ministry of Social Affairs in 1976 indicated that the average family size is around 4.3. All three types have some importance in studying strategies for improvement of animal production, since even in the cities some people keep livestock for their own needs and small sales. In addition, some heads of family, who reside in cities or villages, control flocks of goats and sheep and herds of camels which follow nomadic patterns. Gadalla, 1981, points out that 50-70 percent of the Sinai population are Bedouins but that not all Bedouins are nomadic. Some are now sedentary, and others are transhumant (having a more or less permanent residence, but their flocks and herds move about the Peninsula in search of feed and water and return to the site of residence for a portion of the grazing cycle). Gadalla refers to this practice as semi-nomadic and indicates that "the majority" of Bedouins still lead a nomadic or semi-nomadic life in that "they depend mainly on livestock raising and practice agriculture during a certain season of the year." He points out that "probably pure nomadism is practiced only by a small group, while most herdsmen are limited in movement, in terms of space, more than real nomads."

Gadalla, reporting on the survey conducted by the Ministry of Social Affairs in 1976, indicates the following percentages of families owning given numbers of each of the three species of livestock (Table 2). There were 1,620 families surveyed during and after the Israeli occupation. The table indicates that over 50% of the families owned flocks which contained no more than 19 goats, 2 sheep and 1 camel. Flocks containing a larger number of goats (over 20) were not uncommon, but there appeared to be reduction in the numbers of goats and sheep in the flocks after the end of the occupation. It should be noted here that many flocks observed in the field are composed of animals belonging to various owners.

TABLE 2 - PERCENTAGES OF FAMILIES OWNING VARIOUS SPECIES OF LIVESTOCK* DURING AND AFTER ISRAELI OCCUPATION

No. of Livestock	Goats		Sheep		Camels	
	During Occupation	After Occupation	During Occupation	After Occupation	During Occupation	After Occupation
0	9.8	12.8	24.4	28.9	40.5	46.0
1	2.9	6.8	9.8	14.0	27.8	34.9
2	12.7	18.2	20.1	25.6	15.9	13.2
3-19	47.4	53.7	37.0	30.0	15.9	5.8
20-49	23.7	8.1	7.9	1.4	0.2	-
50	3.5	0.4	0.8	0.1	0.1	0.1

* Source: Gadalla, 1981

NOTE: It is not known whether those families surveyed were all rural, all urban, or randomly selected.

For clarification, the above indicates that, after Israeli occupation, of the 1,620 families owning some livestock, 12.8% owned no goats, 28.9% owned no sheep, and 46.0% owned no camels, while 53.7% of the families owned between 3-19 head of sheep and 5.8% owned between 3-19 head of camels.

The Bedouins's movement with their livestock depends upon the availability of feed and water, which, historically, is rather unreliable in amount. However, even though precipitation is scanty, the fall of what precipitation there is, is seasonal, causing a rather rhythmic movement of flocks. The grazing areas were traditionally divided among the clans and families, in the sense that each lineage had definite rights in specific areas. According to Shata, 1954, there were 15 distinct Bedouin tribes in Sinai (See Appendix D), but Gadalla, 1981, indicates that there are 15 in northern Sinai, 5 in central, and 7 in southern Sinai. There was some overlap of tribal areas, however, except with regard to hostile groups. In personal communication with several Bedouin groups, it was observed that, presently, there is little regard to grazing boundaries. In addition, there is close cooperation and association among distant relatives within tribes (1st and 2nd cousins) and good communication between tribes. Livestock rearing among the Bedouins is still regarded as the most honorable and important type of livelihood. Most raise some sheep, but flocks are comprised of goats as well. Camels are usually herded separately, but herds are not large except in the south.

Gadalla, 1981, reports that in traditional Bedouin culture, livestock raising is usually supplemented by agriculture or some other occupation and that, presently, there seems to be a trend toward a decline in pastoral nomadism in favor of agriculture and trade. He also indicates that the more interest there is in agriculture, the smaller the flocks they maintain. However, in a report prepared in January 1981, The Desert Institute, Cairo, indicates that the Bedouins (70% of the Sinai population) "Depend for their life on herding goats, sheep and camels" and that "they prefer living in temporary houses made from goat hair, and they use wool and camle hair in making blankets, rugs and floor coverings."

Conversations with the transhumant Bedouins in Sinai indicate that they are acceptable to change, but they want to be part of the planning. They want to be instrumental in guiding their own future.

1.8 Infrastructure

Access to Sinai from the rest of Egypt is at Suez, Ismailia, El Qantara, and Port Said by ferry. Pontoon bridges operate during the night for short periods and occasionally during the day at Suez and Qantara. A tunnel under the Suez Canal is being constructed at Suez. Delays must be expected at any of these points.

The principal asphalted roads are along the northern coast to El Arish and the eastern edge of the canal, Bitter Lakes and the Gulf of Suez to Ras Mohammed. These roads are subject to drifting sand which may render them unpassable for short periods. In the northern half of Sinai, hard surface roads (partly asphalted) provide access to most of the area. In the southern region, the main roads are those leading to the mines in the Wadi Nasib and Wadi Sidri areas and the one (newly asphalted) leading up Wadi Feiran to the Monastery of St. Catherine. Most of the inland roads of south Sinai are unasphalted and utilize the wadis for routing. A new paved road along the beach has just recently been opened from Ras Sharatib (South of Abu Rudeis) to just north of El Tor. Airports exist at the major population centers (El Arish, El Qantara, Bir Gifgafa, Nakhl, El Shatt, Ras Sudr, Abu Rudeis, El Tor and St. Catherine).

In the main population centers, electricity is furnished by diesel engine generators, with no link at present to the power supply at Aswan. Most small villages have no electicity. Water supplies at most population centers are presently supplied by wells (many of which supply water with rather high salt content) or by springs especially in southern mountain areas. A rough appraisal and summary of information taken from 1:250,000 topographic maps indicates that there are 602 wells, 95 springs and 57 cisterns, scattered throughout Sinai. The Desert Institute has produced a tentative map showing water points which shows a sparse scattering in the central area of Sinai (See Appendix E). This information is being updated by the present survey.

A water pipeline from Qantara has been constructed to Bir Abd and is planned to be completed to El Arish. It was also observed that a small pipeline was in existence between El Arish and Wadi Milieseal and believed to continue on toward Nakhl. This water is used solely for people and livestock and not used for irrigation.

Most of the food staples, fruits and vegetables are transported from the river basin and the Delta region. Some meat, milk and cheese is also transported from Suez or Ismailia, although some goats and sheep are slaughtered locally. Goat and sheep milk and cheese are available locally in limited quantities, but the hygiene and disease status is open to question. Privately owned stores are operated in the major population centers,

selling both local and imported products. A weekly (Thursday) Bedouin market operates at El Arish. The Bedouins trade camels, sheep and goats, as well as some jewelry, leather and wool products made at their camps for needed staple products, such as tea, sugar, salt, spices, etc. Both bartering of goods and selling and buying for currency are carried out.

1.9 Domestic Livestock

The most prevalent species of domestic livestock are goats, sheep and camels. There are fewer numbers of cattle, horses and donkeys. The estimated numbers of poultry in Sinai are not available, but observation indicates that there are chickens, turkeys, rabbits, ducks and geese. One occasionally sees pigeon "towers", where they are afforded space to nest and are periodically fed.

The Desert Institute, 1981, reported the following numbers of livestock in Sinai (Table 3).

TABLE 3 - ESTIMATED NUMBERS OF LIVESTOCK IN SINAI

Type	1950/1	1967/2	1978/3
Sheep	7,467	9,500	25,365
Goats	9,098	15,580	66,172
Camels	4,999	8,500	9,069
Cattle	819	1,250	160
Horses	119	250	256
Donkeys	3,277	1,275	-

Sources: 1 - Ministry of Agriculture, 1950
2 - General Desert Development Organization, 1967
2 - The Israeli Occupied Authorities, 1978

The Desert Institute, 1981, indicated that, in addition, a survey in North Sinai by the Ministry of Agriculture in 1979 showed that there were 16,832 sheep and 53,549 goats in the liberated areas. They also indicate the density for livestock is greater in North Sinai than South Sinai because of greater water and pasture resources and a larger number of inhabitants. A personal communication with the Chief of the Agriculture Department for North Sinai Governorate gave the following 1980 figures for the liberated portion of Sinai:

Sheep and goats	103,242	
Camels	3,766	
Cattle	171	(including 50 dairy cows near El Arish)
Chickens	about 5,000.	

At the present, most of the feed for the cattle, poultry and rabbits at El Arish is transported from the Nile basin, although some feed is locally grown (Berseem), and probably some by-products from other crops are fed. Also, currently, berseem is being transported from the Nile to a number of points along the Qantara—El Arish coast road for use by Bedouins for their camels, goats and sheep. Camels were observed eating this berseem but no sheep or goats, however, it is assumed that they too are fed from this source. It was learned at Bir El Abd that this hay is

transported from the Nile Valley by private traders and sold at 20 piastres per kilogram. This makes a very expensive feed (200 LE/ton), but it appears that many Bedouins are relying on this source.

Under the "improved" livestock sector, the Department of Agriculture at El Arish has presently an animal production station in operation. There are 13 Brown Swiss (8 adult cows, 1 heifer of 2 months, 1 bull calf of 2 weeks and 3 bulls) and some 25 local Egyptian Red type bulls for beef. All of the feed (Berseem) is transported from the Nile. They reported the cost as being LE 12 plus LE 6 per ton for transport, which appears to be extremely low. There are plans to expand this operations to a 250-cow unit, relying mainly on feed transported from the Nile. At present, the management is poor, but this is partially due to the incompleted facilities.

Adjacent to the dairy unit, there are recently completed buildings for a poultry farm. Both layers and meat chickens will be raised. As of the date of this writing, the facilities are unoccupied, but it is anticipated that the unit will be operating by new year, 1982.

In addition to the above, there are some (probably less than 50) cattle, privately owned. They are not well managed or fed; most of their sustenance comes from scavenging edges of fields, ditch banks, etc. Many of the private homes have chickens, some turkeys, ducks and geese. A recent innovation by the Mennonite Mission at El Arish is raising meat-type rabbits and distributing the offspring to local residents. Although private homes have kept rabbits in the past, they have generally been the local breeds which are small and not too prolific (3 or 4 per litter). The acceptance of the Mennonite program has been good.

The traditional Bedouin livestock production (transhumant) is still actively carried out in all of Sinai, but with a concentration (probably 75%) of the numbers of livestock and numbers of Bedouin families engaged in transhumant livestock production north of the El Tih escarpment. The proportion of goats, sheep and camels within the family owned groups appears to be slightly different between North and South Sinai. In the south, the flocks appear to be comprised of higher proportion of goats and less sheep. The proportion of camels appears about equal. Althought not accurately surveyed, visual appraisal and enumeration of 12 flocks by this observer would indicate the following flock sizes:

TABLE 4 - OBSERVATIONS ON SIZE OF FLOCKS AND HERDS

	North of El Tih Escarpment	South of El Tih Escarpment
Goats	40-50	30-40
Sheep	20-30	5-15
Camels	2-6	2-4

The above figures are not meant to be maxima or minima but a range of what the averages may be. Camels are usually herded separately from sheep and goats. Camel herds can be fairly large, 15 to 60, etc., but in such cases, camels from several owners comprise a herd. The detailed three-month survey of the agricultural sector of Sinai by the Desert Institute will give a more accurate account of the above.

It was observed around Wadi El Bruk and Wadi El Arish that the Bedouins were cultivating substantial areas of barley in the lower areas of wadis, where alluvial deposits presented an adequate soil. Some of these areas were hand cultivated, while others, mainly larger plots, were tilled by use of tractors. It was learned that most of the grain produced is consumed by the extended family, but in some cases, grain is traded or sold to other inhabitants or moving tribes; and some is transported, usually by camel or donkey, to villages where it is traded for food staples or sold for cash. The remaining straw and debris left in the fields is consumed by the animals belonging to the family.

Animal watering holes, wells and outlets along pipelines are few and scattered over wide areas. Sheep, goats and camels, during the wetter seasons, are often not watered, going for periods of one to two months without ever getting to a watering point. They survive on the moisture in the plants they eat or obtain an occasional drink in low areas where runoff water has collected. During the dry season (Summer), they are usually in the vicinity (a range of 50 Km or more) of a watering point; sheep and goats are watered every 2-3 days, while camels may go as long as 6 to 10 days without being watered. During the Winter, flocks may go 2 to 3 weeks without drinking, while camels may even exceed 30 days.

The transhumant movement of the flocks is highly varied. Through the mountainous areas, there are routes and tracks which are traditionally used; but in the plains and the wider wadis, flocks and herds tend to meander over the whole area. Although no consistent pattern of seasonal movement has been documented, it can be stated that during the months of some rainfall (December through February), flocks move to the edge of the wadis and plains, where they can take advantage of the newly emerging plant growth. During this time, camels usually graze the more salty vegetation, while the sweeter (less salty) growth is eaten in the Summer.

All flocks and camel herds are constantly herded: the flocks by the children (sometimes women) and the camels by younger men. During the day, they are allowed to graze at will in the general area desired by the herder, and at night, are gathered closely together near the campsite. There appears to be little necessity to pen animals at night, although some camels are either hobbled or tethered. Usually, the animals that are moving fairly large distances from the home base are males and those females not in lactation, although there are often a few lactating goats or sheep with the larger groups so as to supply some milk for the herders. The same can be said about the camel herds: one or two females are usually present for a daily milk supply. In either case, the animals are milked whenever the herder is thirsty or hungry, but usually early morning or late afternoon. Sheep and goats usually yield less than one liter of milk per day, while camels give 2 to 3 liters, depending on vegetation. Two families reported having camels which gave 7 to 8 liters of milk per day. If any concentrate feeding or application of medicines is done, it is usually accomplished at this time. Since many of the plants that are grazed have a fairly high salt content, little deliberate salting is necessary, either through the use of manufactured salt or by trekking to salt licks.

Shearing of sheep is usually done in April or early May. This is most often done by the male head of the family or one of the older sons, fairly early in the morning before it gets hot. A few are done each day until the job is completed. Sometimes, shears are used, but most often just a common knife is used. The wool is then cleaned and carded by the women and children at the campsite and spun as is required.

Although the Bedouins indicated in personal communication that there was no restriction of the breeding season of sheep and goats, it was apparent that the lambs and kids did not vary greatly (no more than 2 or 3 months difference from youngest to oldest) in age. This could be partly due to the natural seasonal breeding habits of the sheep and goats, but this is also controlled to some extent by the availability of rams and bucks. Many flock owners do not keep their own stud males and, hence, must rely on the availability of one from another flock. Some flock owners have the reputation of owning good studs and, indeed, make a business out of supplying stud services. Payment is usually by cash or in terms of so many lambs.

Since distances are great and flocks travel at the will of the herder, the lack of availability of a stud when needed may drastically reduce the lambing percentages. At present, there apparently are no reliable data on fertility percentages, lambing losses, later mortalities, etc. Some of the Bedouins(12 flocks) questioned by the author indicated that around 70-80 percent of the ewes and nannies in the flock give birth each year. In flocks of 20-30 of either species, there was usually one or two sets of twins,and deaths from birth to 3 months of age seldom exceeded two or three. Weakness at birth and diarrhea at around 2-3 weeks of age were given as the most common causes of death of lambs and kids. It is likely that several diseases are endemic to the region. Mention was made several times about pneumonia and catarrh in both sheep and goats.

The breeds of sheep and goats are both referred to as "Baladi" or local. Several flocks of sheep showed indications of crossbreeding, some showing Awassi characteristics and perhaps Baluchi. Researchers of the Desert Institute indicated, however, that introductions of Awassi breeding were small, if any, but may have occurred during the Israeli occupation. They indicated also that there probably had been Merino infusions. The goats showed little or no signs of any crossbreeding.

Fewer herds (7) of camels were observed, and information regarding them was more difficult to obtain. The largest herd was observed watering near Nakhl. It constituted 65 camels of all ages, which were owned by 7 or 8 families. Usually, the larger herds observed numbered between 10 and 20. Camels usually give birth once every 24 months. Abortions are not uncommon. From the observations and questions, it is estimated that about 80-85% of the cows give birth every two years. Death losses among calves appear to be small in good years, less than 2%; while in bad years, it reaches 20%.

As in the case of goats and sheep, many camel owners do not own a bull, so such services must be obtained from the owners of larger herds who maintain bulls. Apparently, those persons owning stud bulls and their camp locations are well known. The form of payment of breeding fees is unclear, but it is probably by cash settlement.

The breed was also referred to as "Baladi" and is typical of those found in other parts of Egypt and the Near East. However, in south Sinai, the adult camels appeared lighter in color than those in the north or in other parts of Egypt. They also appeared a little larger, but no weights were available or taken by the observer.

Although camel wool is a valuable product, it appears that little effort is presently made to exploit it. Some is used by the Bedouins themselves but little is sold. Hides, apparently, are bartered and sold if not required for a family's own use.

2.0 Strategy for Improvement

2.1 General

Plans for improving production of the traditional livestock sector should be guided by the overall objectives of development of Sinai -- political, economic and environmental. Most livestock development plans, made for developing countries, pay a minor amount of consideration of political objectives; but in the case of Sinai, the political objectives appear to be important and warrant a value when economically appraising a livestock strategy. Most plans for improvement of livestock production in Sinai, when based on economic considerations alone, would be expensive compared to benefits received (high cost/benefit ratio).

The reasons for this are simple: the natural vegetation, for the most part, is so sparse that it takes many feddans to support one animal; climate, principally rainfall, is such that even by destocking (reducing numbers), little improvement in natural vegetation can be expected; water is scarce, and development of groundwater resources and catchment/spreading devices to take advantage of runoff water would be too expensive to develop for improvement of livestock production alone. Therefore, in general terms, improvement of traditional livestock production must be considered as an adjunct to some other development, which may not be economical itself. When considered in conjunction with livestock production, the two (or more) facets of development may prove to pay enough dividends over time (say, 20 years) to warrant the expense.

In North Sinai, the governor has stressed the importance of increasing the population and activity in the region so as to build up a protective barrier against other nations and ideologies and to have a high degree of self-sufficiency. In view of this, plans must be designed to try to improve livestock production, realizing that efforts for the most part must be in conjunction with other developments and keeping in mind that some developments may be a considerable departure from the traditional system now practiced.

As observed in the background paper on livestock production in Sinai, the traditional livestock sector can be divided into two main types:

a - Sedentary - those people raising livestock and some poultry near or in towns or villages who seldom venture far from their village and where animals and birds scavenge on by-products and forages growing along walls, fences, roads, ditches and canals; and

b - Transhumance - also termed semi-nomadism - those Bedouins who have a village or camp where they return each year during the dry season (normally for 2-3 months) but who spend most of the rest of the year in search of water and feed for their flocks of goats and sheep and a small herd of camels. In most instances, they have a few chickens with them, even on the longer treks.

These two types of production are discussed separately.

2.2 Sedentary Producers

For expansion of this type of livestock production, one of the greatest constraints is the present lack of development of water resources for the growing of forage and fodder crops. Since most sedentary producers in Sinai have sheep, goats,

chickens, and a few camels, they can rely to some extent on by-products resulting from increases in any type of agriculture: vegetables, fruit, grain crops, etc. However, this source of feed will not allow much expansion. Besides, it is seasonal and, in some cases, may prove to be uneconomical. An example of the latter has been the availability of molasses in sugar producing areas of African, Cuba, Colombia, Brazil and the southern United States. In these areas, molasses was being discarded into rivers and dumps. It became evident that this was a good feed for fattening livestock, so fattening areas sprung up around sugar factories. In some cases, competition for the molasses became so strong by numerous feeders, as well as the alcohol industry, that the price rose; and it became an uneconomical feed.

Consequently, if water availability for irrigation in Sinai around population centers increases, it is prudent for livestock producers to count on forage crops grown in rotation with food and fiber crops and to utilize by-products from these crops. If water availability is not increased, little can be done to improve production with the exception of increasing the utilization (through plantings) of desert forage and browse plants, such as the atriplexes. Farmers should be encouraged to rid their flocks and camel herds of non-productive animals, thereby increasing the amount of feed available to the productive animals. These two practices should be encouraged in any case.

Contrary to the opinion of some observers who see the goat as only destructive to the natural vegetation, goats are one of the most efficient converters of coarse roughages into milk and meat. To keep them from being destructive, proper management is necessary, which implies giving ample room for grazing and not grazing too long in one area. Indeed, the same applies to sheep and camels but to a lesser degree.

Traditional producers tend to keep a maximum number of animals for a given amount of available feed, thereby increasing the risk of destruction of shrubs and bushes when precipitation is below normal. Therefore, irrigation will have two effects on the traditional flocks around villages: one is increasing the vigor, livability and fatness of existing animals; and the other is to cause an increase in the size of the population unless controlled. Efforts should be made to restrict the latter until a reliable feed resource base is available. This can be done by responsible authorities and through education (extension) of the producers themselves.

At any rate, when planning an irrigation project, consideration must be given to the increased water requirements for feed and for the livestock themselves and not just for better husbandry of the existing flocks but for the anticipated increases in numbers. Assuming that irrigation water does become available around some of the population centers and, indeed, at some areas remote from villages, such as east of Bitter Lakes at New Mit Abul Kom, forages and fodder grains should be planned into the crop rotations.

Plans should be made to not only feed the forages green but to also conserve some of the forages in a dry state for dry-season feed. When planning acreages, allowances should be made for existing numbers of livestock and poultry in the area as well as for any planned expansions.

Since fairly high priority has been placed on irrigation and reclamation schemes at El Arish, New Mit Abul Kom and the northern El Qaa plain, the authorities over these areas should plan for an increased requirement in forage and feed grains for an increase in livestock and poultry production. It is also feasible to think of non-traditional advances such as a dairy/beef and poultry project at El Arish, at a later stage, the possiblitity and feasibility of each at New Mit Abul Kom; and at still a later stage, development at northern El Qaa plain. However, feasibility of the latter two would depend heavily on expected demand of livestock products by developing industry and tourism.

However, at all three locations and perhaps others, improvement of production of sheep, goats, poultry and camels should be considered at an early stage of development. Production of meat, milk and eggs will be improved by the production of a greater amount of forage and grains, but other approaches partially outside the traditional sedentary livestock sub-sector require consideration:

a. The introduction of Awassi rams and Saanen or Anglo-Nubian bucks to cross on the native breeds owned by traditional producers to increase milk production.

   The local breeds of sheep and goats in Sinai are not noted for high production of milk. However, with the scant diet they normally receive, they probably produce as well as any breed; but even with improved nutrition, their potential for milk production is not as high as improved breeds. They are well adapted to the harsh environment and appear to have good resistance to parasites and disease. The crossing of the native breeds to improved breeds should not be undertaken unless there is substantially improved nutrition and health management.

b. The setting-up of a milk recording scheme (production testing) for cooperating traditional producers so that they can accurately determine those ewes and nannies which are the highest producers. This allows for the culling of the poor producers and the selection of potential sires which are out of the highest producing dams in their own flocks.

   Although little information exists on the genetic variability of milk production in the sheep and goat breeds native to Sinai, information on other breeds would indicate that selection for milk production in these breeds, especially (and only) under improved nutrition, would yield positive results. Most of the selection practiced at the moment is done in a subjective manner on traits such as type, color, disposition, etc. There is probably some positive selection on milk production, livability and fertility at present, but not done in an accurate manner so as to yield the greatest results.

c. The encouragement of private cooperatives or government operated livestock farms which would be operated in conjunction with the development schemes.

The planned irrigation and reclamation schemes offer the opportunity for high technology livestock and poultry production units, which may be privately owned or operated by the governmemt. If the land reclamation or costs of setting up the irrigation schemes are not totally charged to the livestock production unit, a profitability from livestock can generally be realized. Such schemes encourage the offtake of unproductive animals from the ranges, thereby reducing the grazing load and making more feed available for the remaining animals. Modern diary and/or beef feeding operations require special attention, regarding such factors as high summer temperatures, high humidity (especially when inconjunction with high temperature), poor quality of water and poor and inconistent quality of forage and concentrates.

d. Increasing camel production, both in numbers of the population and the production of milk and meat per camel.

The knowledge about methods to improve production of meat and milk from camels is limited. Most recent research on camels has been aimed at disease, endo and ecto parasite control. Some early work (early 1900's) on the nutrition requirements of camels and their ability to walk and run long distances without feed or water was done by the British Army. Workers in Australia, Egypt, Kenya and India have studied the metabolism of camels in relation to other animals, but little applied research on ways to increase milk and meat production has been carried out. Two basic facts are apparent: a) camels are better adapted to the very arid tropics than probably any other domestic species of mammals; and 2) there is a demand in Egypt for camels, both as pack animals and for meat. In addition, among the Bedouins, some of the milk is always used for human consumption; the rest being left for the calf. People in the sedentary livestock sub-sector around villages have few camels. If crop by-products were available, their ability for increasing numbers and production per unit would be enhanced.

e. Increasing poultry (eggs and meat) production.

The quickest way to increase available meat is through the production of poultry. At present, there are only a few chickens (around 5,000) in all of Sinai, but there is a considerable demand for eggs and chicken meat. The setting up of industrial poultry units at 3 or 4 sites in Sinai (EL Arish, Abu Rudeis, El Tor) could be done rapidly, and private poultry companies indicate that they can yield up to 30% year on the investment, over a 5-8 year period. Even if such indications are overly optimistic and feed would have to be imported from Ismailia, such operations can fill the gap on meat and eggs until other production becomes feasible and probably not be burden to the economy.

The local breeds of chickens are hardy but are not prolific producers of eggs. The local backyard production of eggs could be rapidly increased if improved breeds were made available to householders. However, as in the case of improved breeds of sheep and goats, "improved" breeds of chickens require a higher level of nutrition and are less tolerant to diseases; but householders should be encouraged to use the improved breeds and better management practices.

f. Encouraging backyard rabbit production.

Although of a much smaller scale than any of the preceeding ideas on improvement of sedentary livestock production, there appears to be a successful precedent set for the encouragement of producing rabbits for meat. The Mennonite group, who is in El Arish under a Canadian Aid (CIDA) grant, have initiated a small program of rabbit production, utilizing improved meat breeds. The program is new, and feed is transported from Cairo; but the acceptance of the program has been good. Due to their prolificacy, such a program can multiply in size rapidly and, like poultry, fill a gap for meat until other programs are in operation.

g. Increasing animal health and medicine-dispensing facilities.

Whatever plans are proposed for improvement in production of traditional sedentary livestock sub-sector, there should be a concurrent improvement in the animal health practices. This would entail at least four (and hopefully more) small animal health units at El Arish, Nakhl, Ras Sudr and El Tor, where animal health supplies can be obtained and from which veterinarians or animal health assistants could be dispatched if there were an outbreak of an epidemic. Often times, planners feel that such developments are too expensive; but a small preventive action may restrict the spread of disease, which could cause great economic damage in a short time. In other developing countries and areas, this type of activity has been linked with rural livestock marketing activities.

h. Improvement of the traditional livestock marketing and trading structure.

With plans for increasing the human population in Sinai and still a good demand for livestock and poultry products in other parts of Egypt, the demand for such products in Sinai will probably continue for some time. However, good market incentives will encourage producers to produce more and be more efficient about it. This is especially true, if they feel they are not being shorted or cheated in the market place.

2.3 Transhumant Producers

Due to their movements and livestock management techniques, the transhumant Bedouin producers present a difficult problem, when designing a strategy for improvement of this sub-sector. In considering it, the principal livestock species are goats, sheep and camels with lesser numbers of chickens and donkeys, which are of less economic

importance. Although there are a few cattle in Sinai, none are involved in the transhumant sub-sector.

The major constraint to improvement is the lack of edible forage other than perennial browse, succulents, trees, and a few annual plants due to the low annual rainfall. Although soils are probably adequate for a greater variety of plants and a denser coverage in the wadis and on the plains in much of Sinai, there are rock outcroppings throughout; and in the mountains in the south, the lack of soil may present an additional constraint.

There are some predators in all of Sinai, especially in the southern mountains; but the amount of mortality of the sheep, goat and camel population does not appear to present a major problem. Poisonous plants are not considered a great detriment to livestock, although there are some of which the Bedouins are careful and seem to know the proper antidotes.

Since animals are not kept in closures for long periods and the density of animals in Sinai as a whole is low, disease and parasite levels are not high. However, at certain times of the year, ticks and lice in goats and sheep and tick and mange in camels are more than a hindrance, because they sap the strength of the animals. Outbreaks of diseases in all three species are not uncommon.

Although not necessarily constraints, other factors which need consideration in planning a strategy for the traditional livestock sector are the traditions, attitudes and structure of the clan/tribe/family relationships. Any proposal for change must meet with at least partial approval of the people involved or little success will result. Although the planner and implementor may think the Bedouins are apathetic or show lack of enthusiasm toward so-called "progressive developments," it is more likely outright disapproval or having hurt feelings; they were not considered or heard in the planning and decision-making process. Early discussions with leaders will not only help pave the way for future actions but may also present different economic values on what should be given priority, bringing about important ideas and avenues of approach for strategies and resulting in a greater chance of success.

It can probably not be denied that, over the past centures, livestock have caused some deterioration in the flora of Sinai. Even if the animals themselves have not, their herders have noticeably cut and finally destroyed many of the trees and bushes. At present, good arid lands species of forages, trees and bushes are rare. It is obvious that the plains and wadis provide much of the forage, while the mountains and widespread areas of uplands and sand dunes provide practically no sustenance to the existing animal populations.

In addition to plans proposed for improving production of the sedentary sub-sector, improvement of camel production, animal health facilities and livestock marketing will also improve production in the transhumant sub-sector. There are some obvious ways to try to improve transumant animal production:

a - Water-spreading - On the higher level reaches of some of the wadis (Wadis El Bruk and Wadi El Arish, for example), some simple water-spreading could be tried, in order to try to divert some of the smaller flows to a wider area than just the wadi

itself. Such would involve the use of a large caterpillar tractor, to build small but sturdy catchment dams and small diversion ditches bladed out on the contour. Such a technique, if successful, would allow for greater growth of the shrubs, bushes and perhaps even grasses. In addition, such an activity may allow for the seasonal planting of barley. At present, along Wadi El Bruk and other wadis, there is evidence of the planting of considerable stretches of barley. The grain is used for human consumption (usually the extended family); and the refuse is used for stuffing mattresses and quilts, for fire fuel and, of course, for livestock feed. Water-spreading would allow for greater stands of what is planted now and would increase the areas. Such an activity should be tried in a relatively small area; and, if successful, the areas could be increased in size, and new areas could be tried.

b - Introduction of improved species of arid land forage and fodder plants - Introductory trials have been carried out in Egypt on arid land, adapting species of plants which may have some practicability in Sinai. Among these are Atriplex numelaria and A. Lucoglata. A. numelaria is presently being tried at the Desert Institute station at Abu Rudeis, under severe conditions. Two species of Atriplex, which are native to Sinai, are A. halmis and A. ferinosa but are not particularly widespread. All four of these "salt-bush" species are edible by goats, camels and sheep, during drought or dry seasons. Trial plantings of these should be made in appropriate areas of Sinai, especially in conjunction with water-spreading techniques. It must be kept in mind that annual rainfall in Sinai is, for the most part, under 250 mm, and much of the traditional livestock sector falls within the 25 mm to 100 mm range. Additional investigations as to other plants useful to Sinai need to be made.

c - Grazing reserves - The transhumant Bedouins utilize, in a general but lax sense, grazing reserves. Through trial and error and by historical fact, they know areas which are best to graze at particular times of the year. In fact, they leave areas ungrazed, saving them for dry periods when other grazing is short. However, often times such areas are over-grazed, when they are used and are not given long enough rests. Alternatively, other clans or tribes may "invade" such reserves and use them before the original group has a need. Such an invasion usually winds up in a dispute or, rarely, a fight. By having contact with the heads of clans and tribes, agreements may be reached to reserve certain areas and to utilize them only by agreement and advanced notice to all concerned. In some cases in other developing countries, "grazing associations" have been organized where all groups are represented and take part in discussions and decision making. If all parties know and respect the boundaries of such reserves, fences are not required, except in cases where areas within the reserve are to be further protected because of previous damage or where new plantings need protection.

d - Use of improved rams and bucks and selection - As in the case of grazing reserves, the transhumant Bedouins in Sinai already practice some selection for improvement in their sheep and goat flocks and camel herds, probably more in sheep than the other

species. The traits they select for color, type, and disposition are not highly correlated with production of meat, milk or wool; but there probably is some positive selection for traits related to adaptability (vigor, normal breathing) and long life. The progress made in such selection, though, is slow because of poor measuring techniques and use of subjective rather than objective scores. Progress is often obliterated by a change in direction of selection or failing to select for a long enough period of time. At present, there is little incentive to select for production traits other than milk production because of their lack of sales. When they do sell or trade animals, little or no advantage is given to larger or faster growing animals or those who have better hair or wool. Since a large portion of their diet comes from milk and cheese, they should be encouraged to cull the lower milk producers. This would require some form of milk recording which would probably prove unsuccessful. If they are capable of improving the nutritional level of their flocks, through increased amounts of forage and perhaps the feeding of of some of the grain or protein supplement (if available), it may be possible to encourage the use of improved sires either of the native breeds through production testing of sires or the use of Awassi rams or Saanen or Anglo-Nubian bucks to cross on the native breeds. However, if the nutritional level of the flock is not improved, there is little advantage or even a disadvantage to use larger sires, because the nutritional requirements of the larger offspring would be greater than for the smaller animals. Also, the larger animals may not be able to survive under scanty feed conditions. Consequently, improvement of production through breeding requires careful thought and coordination with other development activites.

e - Formation of livestock production improvement associations - As mentioned earlier, any attempt at improvement of livestock production in Sinai should be handled in close cooperation with the Bedouins themselves. The formation of some type of associations gives a channel through which several avenues of approach to improvement can take place. Any of the above mentioned programs plus those mentioned under sedentary livestock production on animal health, livestock marketing and even camel improvement should be handled through or coordinated with the associations unless the clans or tribes are so organized to handle them and to coordinate such activities among the various clans, utilizing given areas within the clans themselves. Authority, responsibility and autonomy must be given to the associations so that they feel that they guide their own destiny. Little action can be expected from them, if they feel they are puppets of government or feel that the associations were set up only to force them into actions not their own.

Historically, Bedouins are known as free men, "wanderers of the desert." They are, like other free people, willing to discuss, compromise and act with other groups, provided they have the opportunity to express their ideas, wishes and demands and to offer resistance, verbal or physical, should no other recourse remain. Traditionally, they are livestock producers and only warriors when their family, flocks or herds are threatened. Quoting a Sudanese shiek in South Darfur: "We resist your

progress only if we do not consider it progress; we accept change in our traditions only if it improves our lives and does not offend Allah; we are not beggars or underprivileged; in fact, we own the earth, the sky and the rain; we listen to your advice, accept it if it is worthy; and appreciate your interest. Now, have a cup of tea!"

3.0 References

Boulos, L., 1981; personal communication, Cairo.

Department of Meteorology, Ministry of Military Affairs, A.R.E., Cairo, 1981.

Desert Institute, 1978; Preliminary Report on the Groundwater Resources in the Sinai Peninsula, Egypt; Part I; submitted by the Water Resources Department, Cairo.

Desert Institute, 1981; maps, figures and data on climate and physiography of Sinai; personal communication, Cairo.

Desert Institute, 1981; Sinai Development Study Project, Phase I; in press prepared for Sinai Development Study, Ministry of Development, Cairo.

Gadalla, S.,1981, personal communication, Cairo.

Gadalla, S., 1981, Local Communities of Sinai; in press prepared for Sinai Development Study, Ministry of Development, Cairo.

Haim, A., and E. Tchernov, 1974; The Distribution of Myomorph Rodents in the Sinai Peninsula; Mammalia, 38.

Hassib, M., 1951; Distribution of Plant Communities in Egypt; Fac. Sci., Fouad I University, Cairo; Bulletin No. 29.

Kassas, M., 1955; Rainfall and Vegetation Belts in Arid Northeast Africa; Plant Ecology, Proc. Mont. Symp (UNESCO), Paris.

Meigs, P., 1966; Desert Littoral of Egypt; UNESCO, Paris.

Nile Agriculture Development Comp., 1981; personal communication and visits to dairy and poultry farms, Cairo.

Osborn, D. J., and Helmy, I., 1980; The Contemporary Land Mammals of Egypt (including Sinai); Fieldians Zoology New Series, No. 5, Field Museum of Natural History, Cairo.

Shata, A. A., 1954; Contributions to the Geology of West Sinai Foreshore Province,with special reference to El Halufiya-El Zeita area; thesis submitted for degree of PhD., Cairo University, Giza.

Shata, A. A., 1981; personal communication, Cairo.

Supreme Committee for Sinai Development, 1980; New Sinai Encyclopedia, Ministry of Development, Housing & Reclamation, Arab Rebpulic of Egypt.

Tackholm, V., 1974; Students Flora of Egypt, Cairo University, Cairo.

Zohary, M., 1935; Die Phytogeographische Gliederung der Flora der Halbinsel Sinai; Beih. Bot. Centralbl., 52.

Zohary, M., 1944; Vegetational Transects through the Desert of Sinai; Palest. J. Bot.; Jerusalem, Ser. 3.

Zohary, M., 1954; Hydro-economical Types in the Vegetation of Near East Deserts; in Cloudsley-Thompson, J. L., ed., Biology of Deserts.

4.0 Appendix A - Climate of Sinai

TABLE A-1 - AVERAGE TOTAL RAINFALL (monthly) - mm.

Metero Region	Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total	Period
NORTH	El-Arish	20.3	17.1	12.8	6.1	3.2	0.0	0.0	0.2	0.6	6.0	16.2	22.2	104.7	1936-67
	Rafa	31.3	37.2	34.6	14.2	0.1	0.0	0.0	0.0	0.0	2.2	94.5	90.0	304.1	1953-56
	El-Maghara	12.0	9.7	8.0	0.0	0.0	0.0	0.0	0.0	trace	1.7	trace	12.3	43.7	1966
	El-Qusima	21.3	22.5	10.2	2.6	0.1	trace	0.0	0.0	0.0	5.0	13.2	22.2	97.1	1763-67
	Abu Agila	8.9	4.4	16.6	0.4	5.6	0.0	0.0	0.0	0.0	2.8	9.7	9.4	57.8	1940-48
MIDDLE PLATEAU	El-Kuntilla	8.1	2.3	2.9	0.9	3.9	0.0	0.0	0.0	0.0	2.0	2.6	4.3	27.0	1932-38 1944-47
	Nkhl	10.3	6.6	3.3	1.4	trace	trace	0.0	0.0	trace	3.8	7.6	5.2	38.2	1962-67
	El-Hasana	5.6	2.3	8.0	3.2	2.0	0.0	0.0	0.0	0.0	1.6	6.0	1.9	30.6	1939-47
MOUNTAIN	St. Catherine	1.5	1.4	13.2	7.8	6.2	trace	0.0	0.0	0.0	3.6	21.5	6.8	62.0	1934-37
WESTERN MARGIN OF SUEZ CANAL	Port Said	13.5	11.6	8.8	3.7	2.2	trace	0.0	trace	0.2	6.3	8.9	18.0	73.2	1941-75
	Ismailiya	6.6	1.6	7.4	1.3	[illegible]	0.0	0.0	0.0	0.0	2.3	7.7	2.9	33.3	1964-68
	Fayid	5.0	2.4	3.6	0.8	1.9	0.0	0.0	0.0	0.2	2.0	3.5	6.1	25.5	1941-73
	Kabrit	5.1	2.1	0.7	1.4	0.5	0.0	0.0	0.0	0.4	0.6	4.4	4.4	19.6	1961-67
	Suez	5.0	0.3	2.6	0.6	2.6	0.0	0.0	0.0	0.0	6.2	1.0	1.3	19.6	1964-73
MARGINAL AREA OF GULF OF SUEZ	Ras Sudr		1.3	2.3	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.8	1976-77
	Abu Rudis	4.8	0.1	0.2	0.2	trace	0.0	0.0	0.0	0.0	0.1	0.2	15.0	20.6	1961-67
	G. El-Tur	1.5	1.3	1.2	0.2	0.2	0.0	0.0	0.0	0.0	0.7	1.7	3.6	10.4	1919-69
MARGINAL AREA OF AQABA	Sharm El-Shikh	0.2	0.0	0.0	0.2	trace	0.0	0.0	0.0	0.0	0.0	0.0	23.4	23.8	1955

Reference: Department of Meteorology, Ministry of Military Affairs, A.R.E., January 1981.

TABLE A-2 - Average of Rainy Days (1.0 mm)

Metero Region	Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Period
NORTH	El-Arish	3.4	3.1	3.0	0.7	0.6	0.0	0.0	0.0	0.0	0.6	2.6	3.4	1963-67
	Rafa	3.5	5.0	5.5	2.0	0.0	0.0	0.0	0.0	0.0	0.7	10.0	8.0	1953-56
	El-Maghara	2.0	4.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	3.0	1966
	El-Qusima	3.8	3.4	3.4	0.8	0.0	0.0	0.0	0.0	0.0	1.2	1.5	3.0	1963-67
	Abu Agila	1.0	1.0	0.4	2.1	0.0	0.8	0.0	0.0	0.0	0.4	1.0	0.9	1940-47
MIDDLE PLATEAU	El-Kuntilla	1.4	0.6	0.6	0.3	0.3	0.0	0.0	0.0	0.0	0.2	0.7	0.7	1932-47
	Nkhl	2.2	1.8	1.6	0.8	0.0	0.0	0.0	0.0	0.0	0.8	0.6	1.6	1962-67
	El-Hasana	0.8	0.2	1.2	0.3	0.4	0.0	0.0	0.0	0.0	0.1	0.1	0.4	1938-47
MOUNTAIN	St. Catherine													
WESTERN MARGIN OF SUEZ CANAL	Port Said	3.2	2.6	2.5	0.6	0.3	0.0	0.0	0.0	0.0	0.9	1.9	2.7	1941-75
	Ismailiya	3.0	1.0	2.0	1.0	0.5	0.0	0.0	0.0	0.0	0.1	0.4	0.0	1964-75
	Fayid	1.0	0.6	0.9	0.3	0.4	0.0	0.0	0.0	0.0	0.4	0.6	1.2	1941-73
	Kabrit	1.6	0.7	0.1	0.3	0.7	0.0	0.0	0.0	0.1	0.1	0.5	0.8	----
	Suez	1.2	0.0	1.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.4	1965-73
MARGINAL AREA OF GULF OF SUEZ	Ras Sudr	0.3	1.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.3	0.0	0.3	1971-76
	Abu Rudis	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1961-67
	G. El-Tur	0.3	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.4	1931-67
MARGINAL AREA OF AQABA	Sharm El-Shikh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1955

Reference: Department of Meteorology, Ministry of Military Affairs, A.R.E., January 1981.

TABLE A-3 - Average of Rainy Days (10 mm)

Metero Region	Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
NORTH	El-Arish	1.1	1.3	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.7
	Rafa	---	---	---	---	---	---	---	---	---	---	---	---
	El-Maghara	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	El-Qusima	0.4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.2
	Abu Agila	---	---	---	---	---	---	---	---	---	---	---	---
MIDDLE PLATEAU	El-Kuntilla	---	---	---	---	---	---	---	---	---	---	---	---
	Nkhl	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
	El-Hasana	---	---	---	---	---	---	---	---	---	---	---	---
MOUNTAIN	St. Catherine	---	---	---	---	---	---	---	---	---	---	---	---
WESTERN AREA OF SUEZ CANAL	Port Said	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.4
	Ismailiya	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Fayid	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Kabrit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Suez	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0
MARGINAL AREA OF GULF OF SUEZ	Ras Sudr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Abu Rudis	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	G. El-Tur	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
MARGINAL AREA OF AQABA	Sharm El-Shikh	---	---	---	---	---	---	---	---	---	---	---	---

Reference: Department of Meteorology, Ministry of Military Affairs, A.R.E., January 1981.

TABLE A-4 - Average of the Minimum of Air Temperature

(centigrade)

Metero Region	Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
NORTH	El-Arish	8.5	9.1	10.8	13.3	16.1	18.9	21.3	21.9	20.4	18.5	14.4	10.2
	Rafa	7.8	9.5	9.6	12.6	14.9	18.4	20.5	21.2	19.0	17.6	13.2	9.3
	El-Maghara	8.7	9.7	10.4	14.2	16.2	18.9	19.5	20.4	18.7	17.7	16.2	10.0
	El-Qusima	6.3	7.6	8.9	12.0	14.7	17.9	19.8	20.0	18.1	15.9	12.7	8.4
	Abu Agila	---	---	---	---	---	---	---	---	---	---	---	---
MIDDLE PLATEAU	El-Kuntilla	3.4	3.3	7.4	7.8	10.3	11.4	15.7	16.5	14.6	11.8	9.0	6.4
	Nkhl	2.1	2.9	4.9	8.8	11.5	14.5	16.4	17.1	15.2	12.3	8.4	3.7
	El-Hasana	---	---	---	---	---	---	---	---	---	---	---	---
MOUNTAIN	St. Catherine	4.8	4.2	2.0	4.3	6.5	10.5	11.2	11.6	11.4	7.8	3.1	3.3
WESTERN MARGIN OF SUEZ CANAL	Port Said	11.2	11.5	13.3	15.6	19.1	22.2	23.8	24.4	23.5	21.4	18.0	13.1
	Ismailiya	7.0	7.8	9.8	13.4	16.7	19.9	21.1	21.2	19.3	16.3	12.8	9.1
	Fayid	7.8	8.3	10.2	13.2	16.5	19.7	21.4	21.7	20.1	17.1	18.6	9.6
	Kabrit	8.0	8.7	10.8	14.0	17.0	21.1	22.7	23.0	20.9	18.5	14.9	10.1
	Suez	10.4	11.5	13.2	16.2	19.3	22.4	23.6	24.1	22.6	19.9	16.5	11.8
MARGINAL AREA OF GULF OF SUEZ	Ras Sudr	8.1	10.1	10.4	14.6	18.0	19.6	21.4	21.2	18.9	18.3	14.1	9.5?
	Abu Rudis	11.0	12.2	14.3	17.7	20.9	24.1	25.2	27.6	24.9	21.9	17.3	12.7
	G. El-Tur	9.0	9.7	12.6	16.5	20.5	23.3	24.5	23.8	22.8	18.6	14.7	10.8
MARGINAL AREA OF AQABA	Sharm El-Shikh	15.8	16.6	17.7	20.7	24.1	26.1	26.7	26.6	26.0	22.8	20.0	15.9

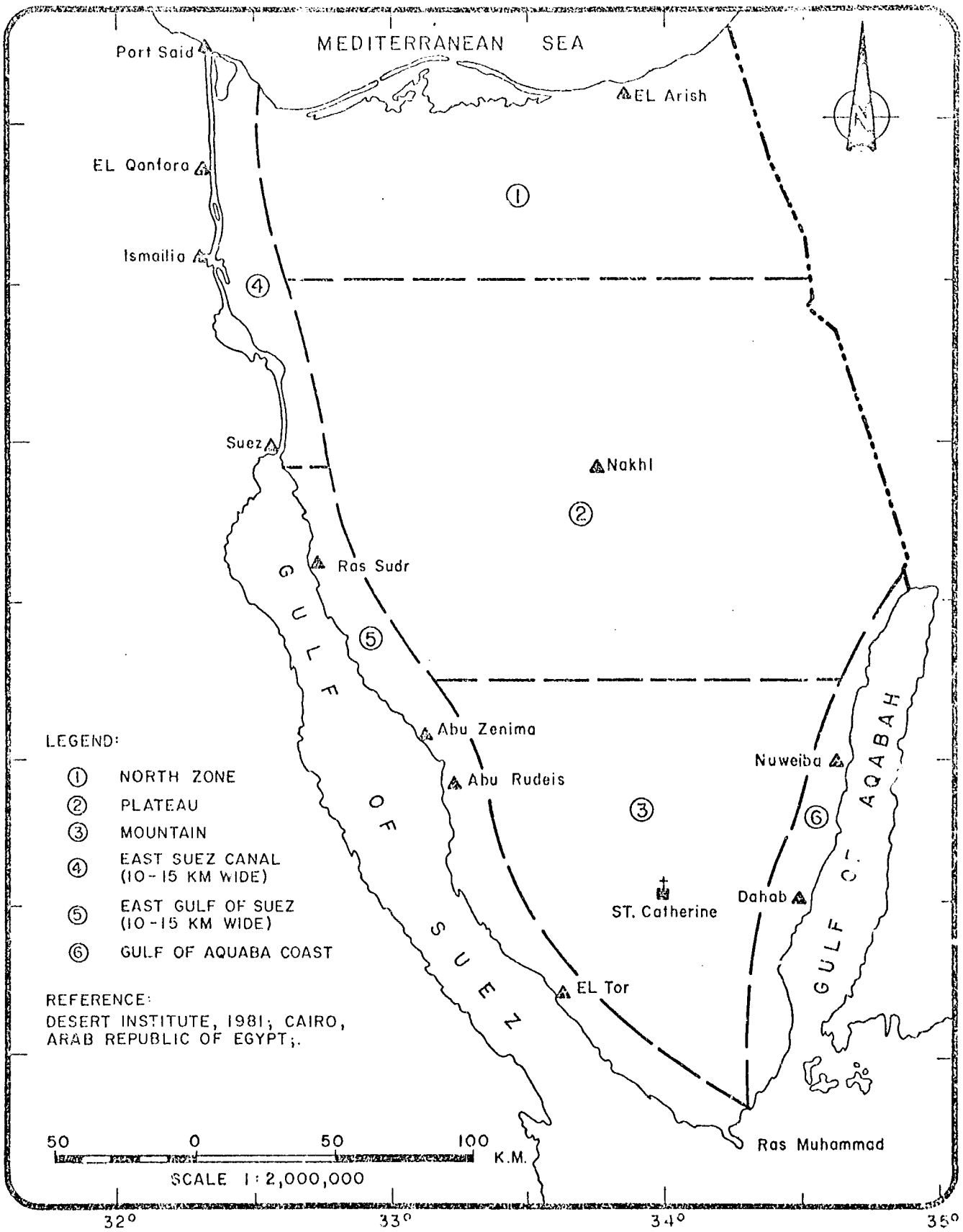
Reference: Department of Meteorology, Ministry of Military Affairs, A.R.E., January 1981.

TABLE A-5 - Average of the Maximum of Air Temperature

(centigrade)

Metero Region	Station	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
NORTH	El-Arish	19.2	19.9	21.3	23.7	26.9	28.9	30.6	31.1	29.9	28.5	25.3	21.4
	Rafa	20.2	21.8	21.5	23.9	26.7	29.2	30.9	31.5	30.4	28.7	24.4	19.9
	El-Maghara	19.0	19.4	21.8	28.3	29.4	32.9	33.2	33.3	30.2	28.7	27.3	19.3
	El-Qusima	17.5	19.1	22.1	26.4	30.2	33.5	34.0	34.0	31.3	29.3	24.4	19.3
	Abu Agila	----	----	----	----	----	----	----	----	----	----	----	----
MIDDLE PLATEAU	El-Kuntilla	18.7	20.2	24.6	27.2	31.1	35.2	36.5	36.7	34.4	31.4	25.0	25.6
	Nkhl	17.1	19.0	22.5	27.3	31.6	33.7	34.7	35.0	32.1	29.3	23.9	18.8
	El-Hasana	----	----	----	----	----	----	----	----	----	----	----	----
MOUNTAIN	St. Catherine	3.1	4.4	11.8	14.4	17.1	20.8	21.4	22.2	21.0	16.2	11.4	4.4
WESTERN MARGIN OF SUEZ CANAL	Port Said	18.1	18.8	20.4	22.6	25.7	28.6	30.4	30.9	29.5	27.4	23.9	19.9
	Ismailiya	19.7	20.9	23.5	28.8	31.8	35.3	35.4	35.1	32.8	30.0	25.8	21.8
	Fayid	20.0	21.2	24.1	28.3	32.1	35.0	35.4	36.0	33.0	34.0	26.0	22.0
	Kabrit	19.4	20.3	23.7	27.9	31.1	35.5	35.4	35.0	32.7	30.5	26.3	21.4
	Suez	19.2	21.4	23.4	28.1	31.0	33.7	34.5	34.6	31.8	29.2	24.6	20.3
MARGINAL AREA OF GULF OF SUEZ	Ras Sudr	19.1	22.4	23.1	27.1	32.4	34.4	35.5	34.5	32.5	30.1	25.3	21.1
	Abu Rudis	20.8	21.1	24.1	26.9	27.7	31.7	32.3	33.1	30.8	29.7	26.6	22.6
	G. El-Tur	21.1	21.7	24.2	27.9	30.7	33.5	34.6	34.8	32.6	29.6	26.6	22.5
MARGINAL AREA OF AQABA	Sharm El-Shikh	23.4	25.7	25.6	28.9	32.8	35.8	35.7	34.2	34.4	33.1	27.6	22.7

Reference: Department of Meteorology, Ministry of Military Affairs, A.R.E., January 1981.



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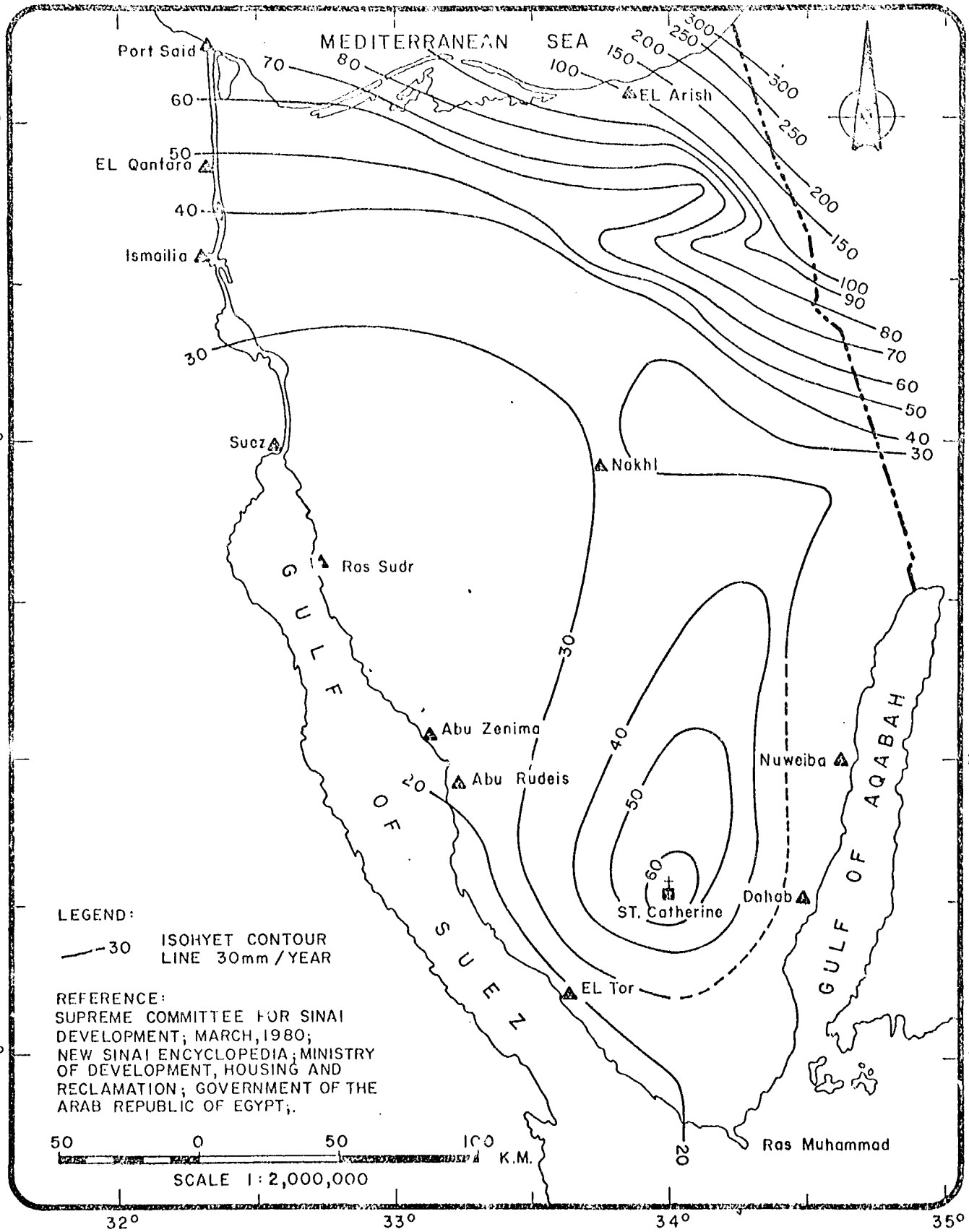
CLIMATIC ZONES OF SINAI

FIGURE A-1



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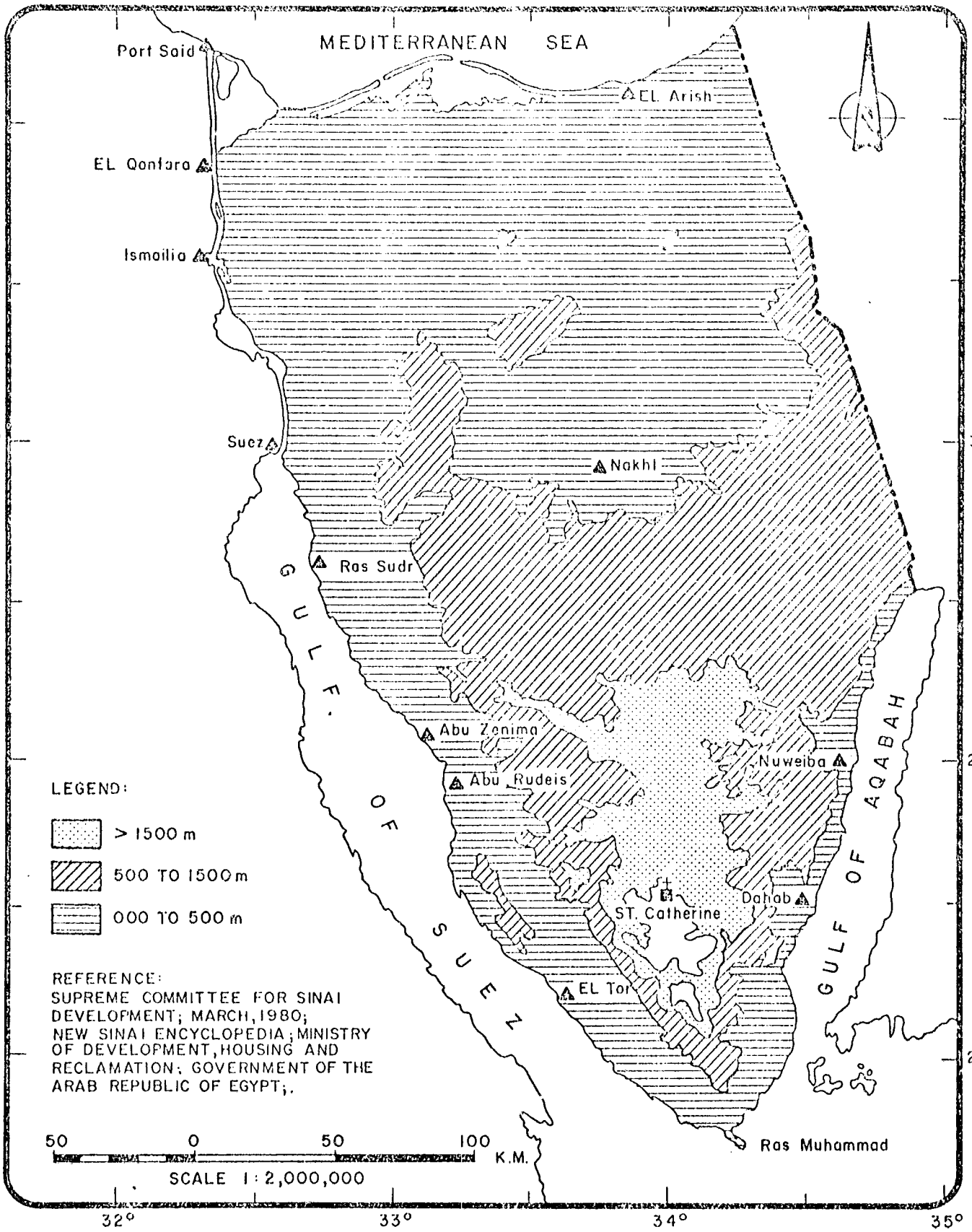
ISOHYET CONTOUR MAP OF SINAI

FIGURE A-2



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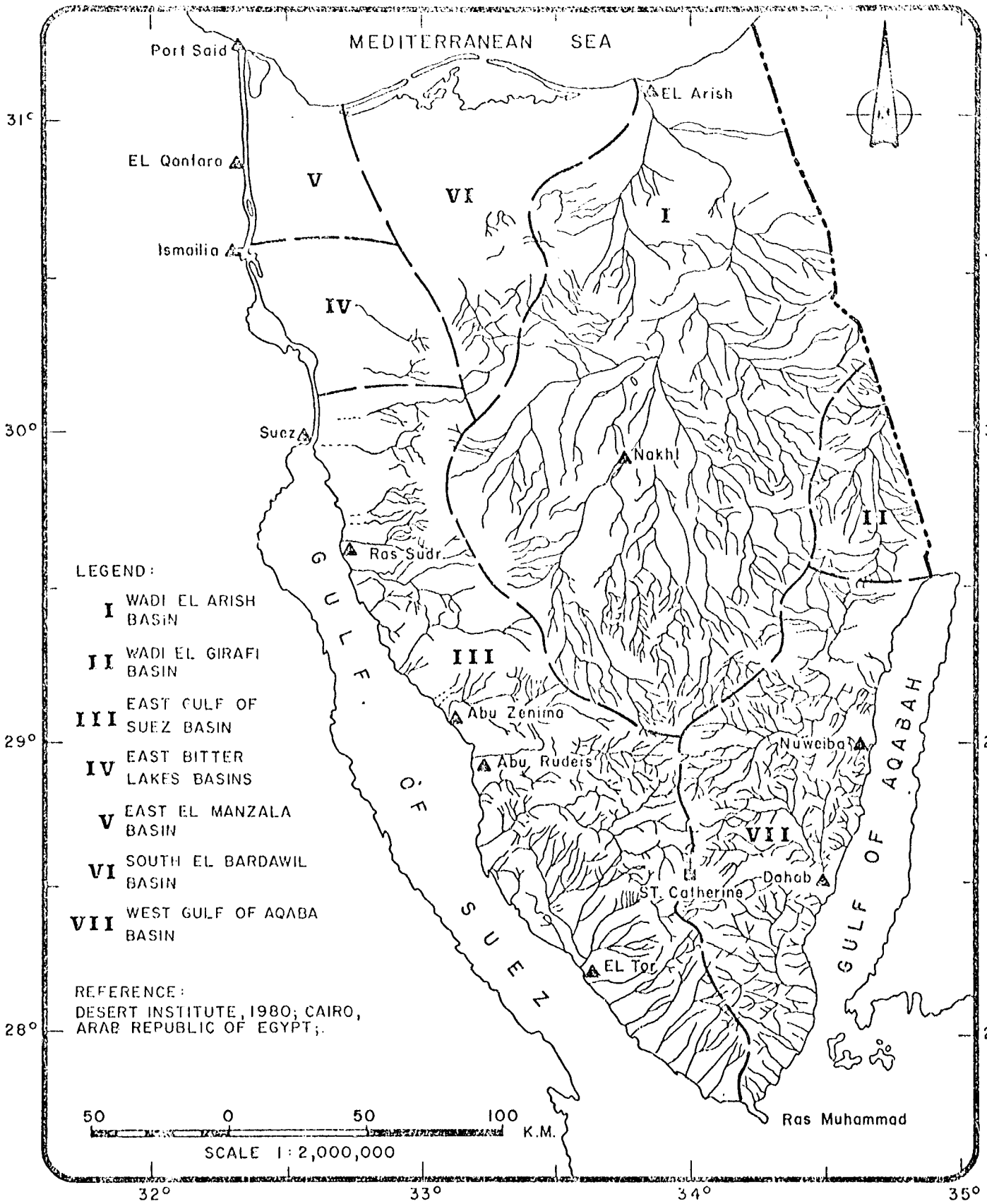
PHYSIOGRAPHY OF SINAI ELEVATION

FIGURE B-1



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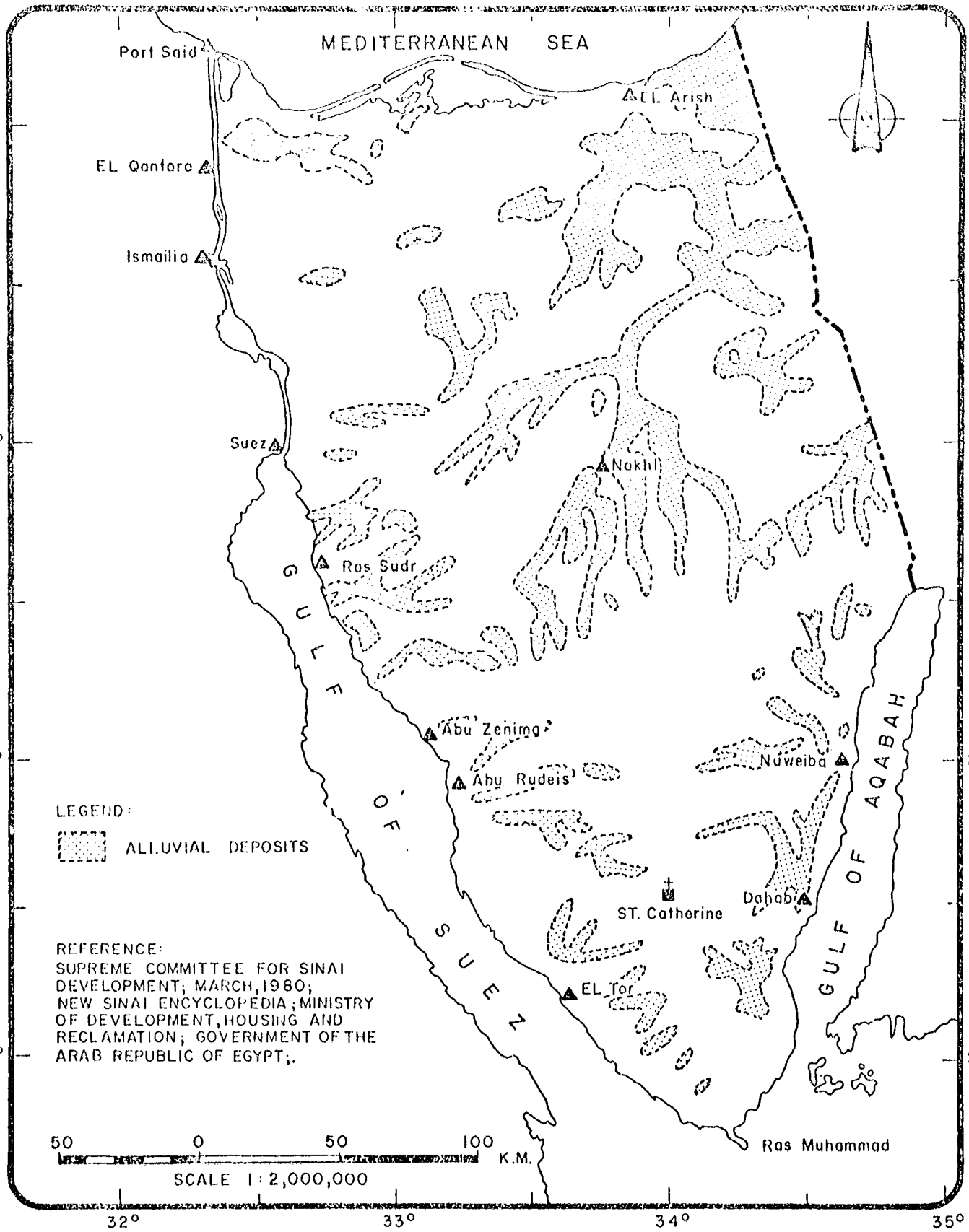
PHYSIOGRAPHY OF SINAI HYDROGRAPHIC BASINS

FIGURE B-2



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PHYSIOGRAPHY OF SINAI
ALLUVIUM DEPOSITS

FIGURE B-3

6.0 Appendix C - Un-domesticated Land Mammals of Sinai

Included here is a brief and general description of the non-domesticated land mammals of Sinai. Most of this information is taken from Osborn & Helmy, 1980. More detail and taxonomy may be taken from their work.

The information presented here is to serve as a guide for gathering further information on the wild animal species of Sinai, since recent data are scanty. It also shows that there is not a large number of wild species in Sinai and that the populations of the larger species are small. The attached maps are not meant to be definitive as to where land mammals are presently located but only to give an idea as to where Osborn & Helmy, 1980, made their collections of information. Their work is to be commended, but they would, most likely, appreciate further information to update their classification.

The reason for presenting this type of taxonomic information of non-domesticated species in Sinai in a report on animal production (domestic species) is to illustrate yet another restraint on production or perhaps a challenge to keeping a balance between development and the natural habitat At the same time, it is interesting to note the number of rodent species presently existing in Sinai and to keep in mind what may happen to their populations if greater amount of feed they can use become available through additional cropping and the feeding of animals in confinement.

The mammals are reported here by order and family for simplicity of organization, since Osborn and Helmy reported in this form.

Order: Insectivora - Hedgehogs and shrews (Figure C-1). Pelage spinous or soft. Muzzle forming flexible snout beyond mouth. Feet plantigrade, palm and sole naked, toes usually five.

The Hemiechinus auritus aegyptians, (Long Eared Hedgehog), is found principally in N.E. Sinai. It is a small hedgehog with long ears, face pale brown, white belly, tips of dorsal spines white. Adults length (head and body) average 181 mm, tail 24 mm.

The Paraechinus dorsalis dorsalis (Desert Hedgehog), found mainly in S.W. Sinai, has blackish dorsal spines, face, belly and limbs blackish with white marks on throat. Adults length (head and body) average 199 mm. tail 20 mm.

The Crocidura suaveolens portali (lesser white toothed shrew) is found in south central Sinai near St. Catherines Monastery. Back is dull brownish gray, venter and feet whitish, tail bicolored with bristles scattered along entire length. Adults length (head and body) 55 to 72 mm, tail 25 to 40 mm.

Order: Lagomorpha - Hares (Figure C-1). Ear long, prominent. Hind foot slender; sole densely haired; tail short, black above, white below; pelage solf wooly, yellowish to buffy gray.

Lepus capensis sinaiticus (Hare), is found in northeast, western and southern Sinai (Gebel Musa). Its back is grayish with anterior border of ear tip usually blackish. Adults (head and body) length average 389 mm, tail 70 mm.

Order: Rodentia - Rodents (Figure C-2 and C-3). Small to relatively large rodents. Fur soft. Seventeen species of Rodentia are listed here.

Gerbillus pyramidum floweri (Greater Gerbil), found in N.E. Sinai and along the east side of the Gulf of Suez opposite Suez. Pale cinnamon to tawny with indistinct dorsal stripe. Adults (head and body) average length 117 mm, tail 149 mm.

Gerbillus andersoni bonhotei (Andersons Gerbil), found in N.E. Sinai. Brownish orange in color with ear and sole pigmented. Adults (head and body) average length 97 mm, tail 126 mm.

Gerbillus gerbillus asyutensis (Less Gerbil), found in N.E. Sinai and along the east coast of Gulf of Suez. Small pale yellowish orange gerbil with ear and sole not pigmented. Adults (head and body) average length 88 mm, tail 123 mm.

Dipodillus dasyurus dasyurus (Rough-tailed dipodil or Wadi Hof Gerbil), found in north, northeast, west central, east central and southern mountains of Sinai. Yellowish brown, fur long and soft, long tail. Adult (head and body) average length 93 mm, tail 124 mm.

Dipodillus henleyi mariae (Henleys Gerbil or Pigmy Dipodil) found in southwest Sinai along Gulf of Suez coast. Small buffy brown with contrasting white areas above eye, behind ear and on rump. Adult (head and body) average length 66 mm, tail 88 mm.

Sekeetamys calurus calurus (Bushy tailed dipodil), found in west central Sinai and southern mountains near St. Catherine. Palm and sole, fur long and fluffy, dorsal hairs brownish yellow with blackish tips, sides yellowish to orangish, underparts and feet white. Adult (head and body) length average 119 mm, tail 144 mm.

Meriones crassus crassus (Silky jird), found along Gulf of Suez coast, north, central and northeast Sinai and in mountains near St. Catherine. Large jird with long soft dorsal pelage, back pale yellowish brown, side with narrow buff colored area, hairs of venter and feet white. Adult (head and body) average length 136 mm, tail 133 mm.

Meriones sacramenti (Negev Jird), found in extreme N.E. Sinai. Large with coarse pelage, back dark cinnamon brown, side with line of clear cinnamon, venter white. Adults (head and body) length average 155 mm, tail 151 mm.

Psammomys obesus terraesanctae (Fat Sand Rat), found in north Sinai. Large blackish to reddish orange rodent with yellowish side and belly. Adult (head and body) length average 170 mm, tail 130 mm.

Rattus rattus (House Rat), found in north Sinai, large, slender; back brownish; venter gray buff or white. Muzzle sharp. Adult (head and body) length average 180 mm, tail 219 mm.

Mus musculus praetextus (House mouse), found in north, west and southwest Sinai. Small, back gray or brownish, venter white to buffy. Adult (head and body) length average 84 mm, tail 84 mm.

Acomys russatus russatus (Golden spiny mouse), found in southwest Sinai. Back reddish orange,venter pale yellowish white. Adult (head and body) length average 111 mm, tail 70 mm.

Acomys cahirinus dimidiatus (Egyptian apiny mouse), found in southwest Sinai along Gulf of Seuz. Brownish cinnamon with white belly and feet. Adult (head and body) length average 108 mm, tail 109 mm.

Eliomys queranus melanurus (Garden dormouse), found in east and west central Sinai and in mountains near St. Catherine. Squirrel-like rodent. Back brownish, side gray, face with black mask. Adults (head and body) length average 124 mm, tail 114 mm.

Jaculus orientalis orientalis (Greater Egyptian Jerboa), found in southwest Sinai. Large with brownish-orange back, sides grayish. Adult (head and body) length average 148 mm, tail 224 mm.

Jaculus jaculus schlueteri (Lesser Jerboa), found in west and southwest Sinai. Orange to brownish cinnamon sides orangish. Adults (head and body) length average 107 mm, tail 181 mm.

Hystrix cristata (Crested Porcupine), found in north central Sinai. Back covered with long, round hollow black and white quills. Adults (head and body) length average 600 mm.

Order: Cornivora (Figures C-4 and C-5) - Family canidae - carnivores with dog-like features. Muzzle elongate; ears large, erect, pointed; legs long in proportion to body length.

Canus aureus lupaster (Jackal), found in northeast Sinai. Large blackish yellow dog with dorsal mane. Short tail. Adult (head and body) length average 872 mm, tail 312 mm.

Vulpes vulpes aegyptiaca (Nile fox), found in west central Sinai across Gulf of Suez from Suez. Large fox reddish to reddish brown, long bushy tail, relatively large ears. Adults (head and body) length average 578 mm (males) and 551 mm (females); tail 362 (M), 341 (F).

Vulpes rueppelli rueppelli (Rueppels sand fox), found in southwest Sinai. Small fox, grizzled reddish back with long bushy tail. Adults (head and body) length average 456 mm, tail 281 mm.

Fennecus Zerda (Fennic fox), found in northern Sinai. Small, buff colored, narros reddish clorsal stupe, relatively short tail. Adults (head and body) length average 367 mm, tail 205 mm.

Family: Hyaenidae - Large carnivores with body or legs striped or spotted. Muzzle relatively long. Hind limbs shorter than fore.

Hyaena hyaena dubbah (Striped hyaena), found in extreme north and souther Sinai. Body and legs transversely striped black and grayish dorsal crest of long black-tipped hairs. Relatively short tail. Adults (head and body) length average, 1,038 mm, tail 308 mm.

Family: Felielae - small to medium cats.

Felis sylvestris trestami (Wild cat), found in northeastern and southwestern Sinai. Slender similar to house cat. Dark grizzled buff, backs of ears dark. Relatively long tail with distal rings. No size measurements available.

Caracal caracal schmitzi (Caracal), found in extremem north and south of Sinai. Light reddish brown back and sides, venter white, short tail, ear with long back tuft. No size measurements available.

Acinoryx Jubatus (CHeetah), has been reported to have been see in north central Sinai. Large long-tailed cat. Grayish to yellowish dorsally.

Order: Hyracoidea (Figure C-6) - family Procaviidae - Rock hyraxes, grayish to yellowish or orangish brown dorsally, venter buffy.

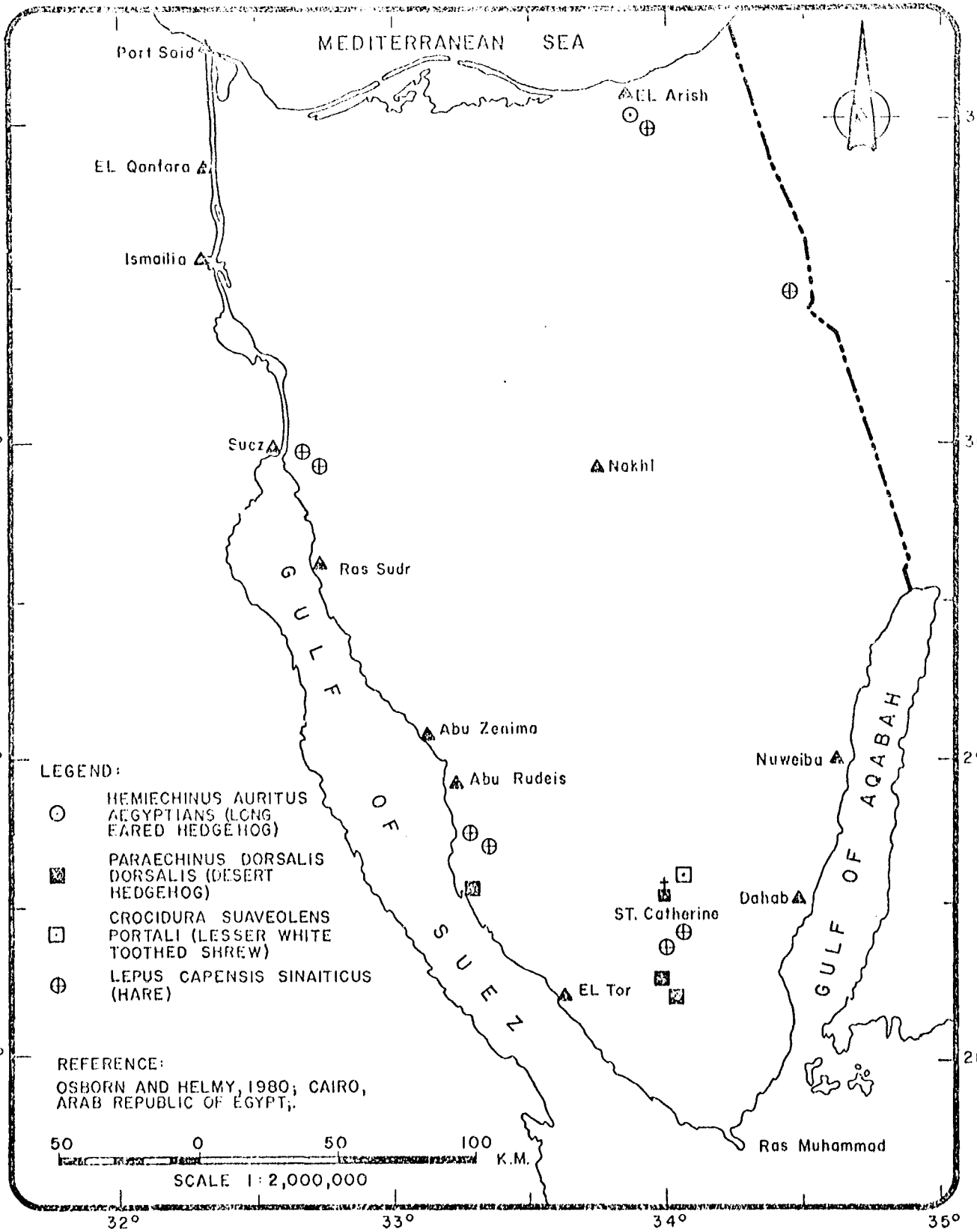
Procavia capensis syriaca (Hyrax), found in south and southeast Sinai. Orangish brown back, venter buff to pale brownish. Adults (head and body) length average 474 mm.

Order: Artiodactyla (Figure C-6) - family Bovidae-Genus-Gazella - small, slender antelopes with horns curving dorsally and posteriorly.

Gazella dorcus saudiya (Dorcus gazelle), found in northeastern Sinai. Pale reddish brown with distinct facial markings and a dusby nose, horns short and strongly curved.

Genux- Capra (Figure C-6) - large goat-like bovid with scimitar shaped horns, curving dorsally and posteriorly.

Capra Ibex nubiana (Ibex), found in western and southwestern Sinai. Upper parts brownish with contrasting black spinal crest and white leg markings. Beard present in male.



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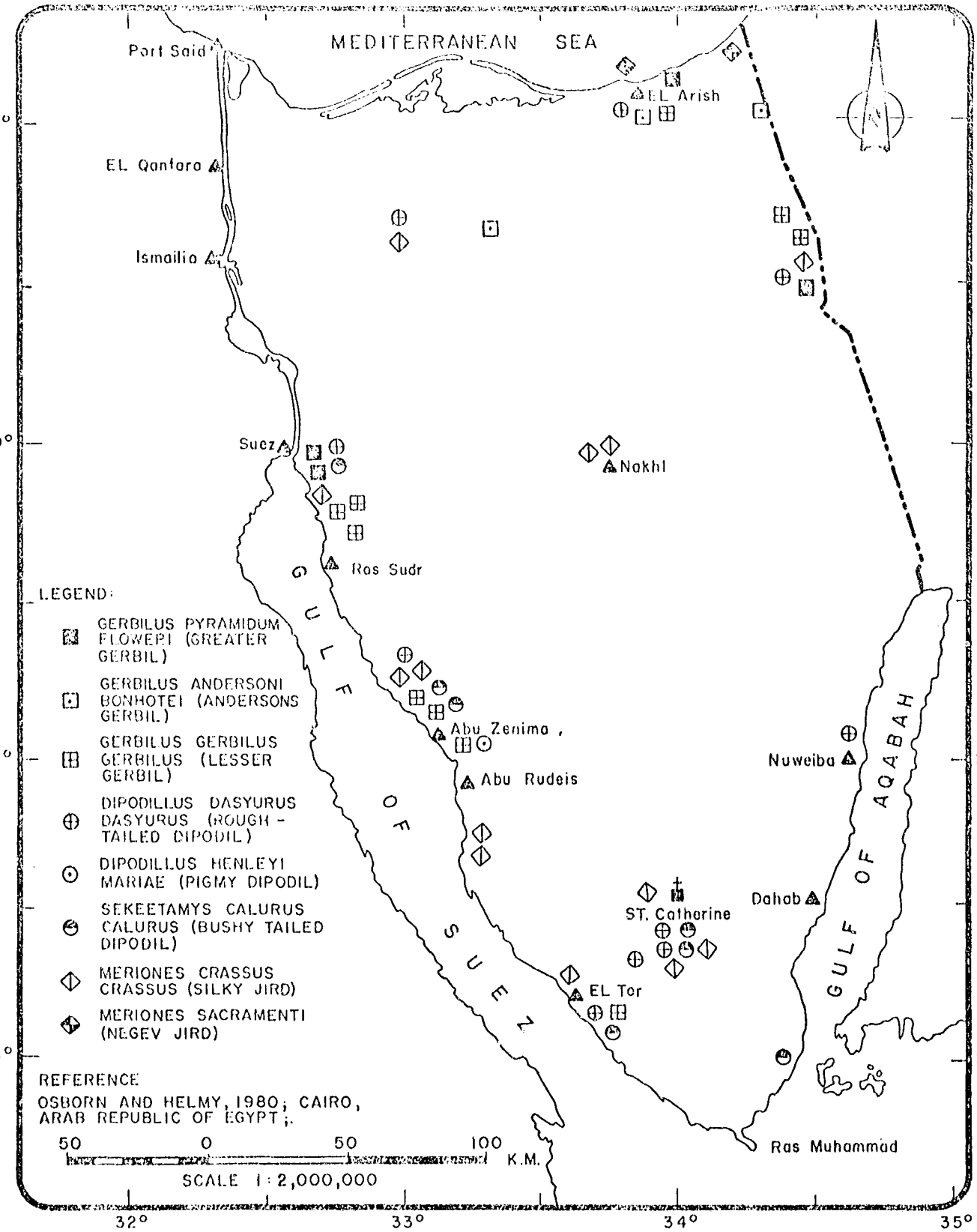
UN-DOMESTICATED LAND MAMMALS
HEDGEHOGS, SHREWS AND HARES

FIGURE C-1



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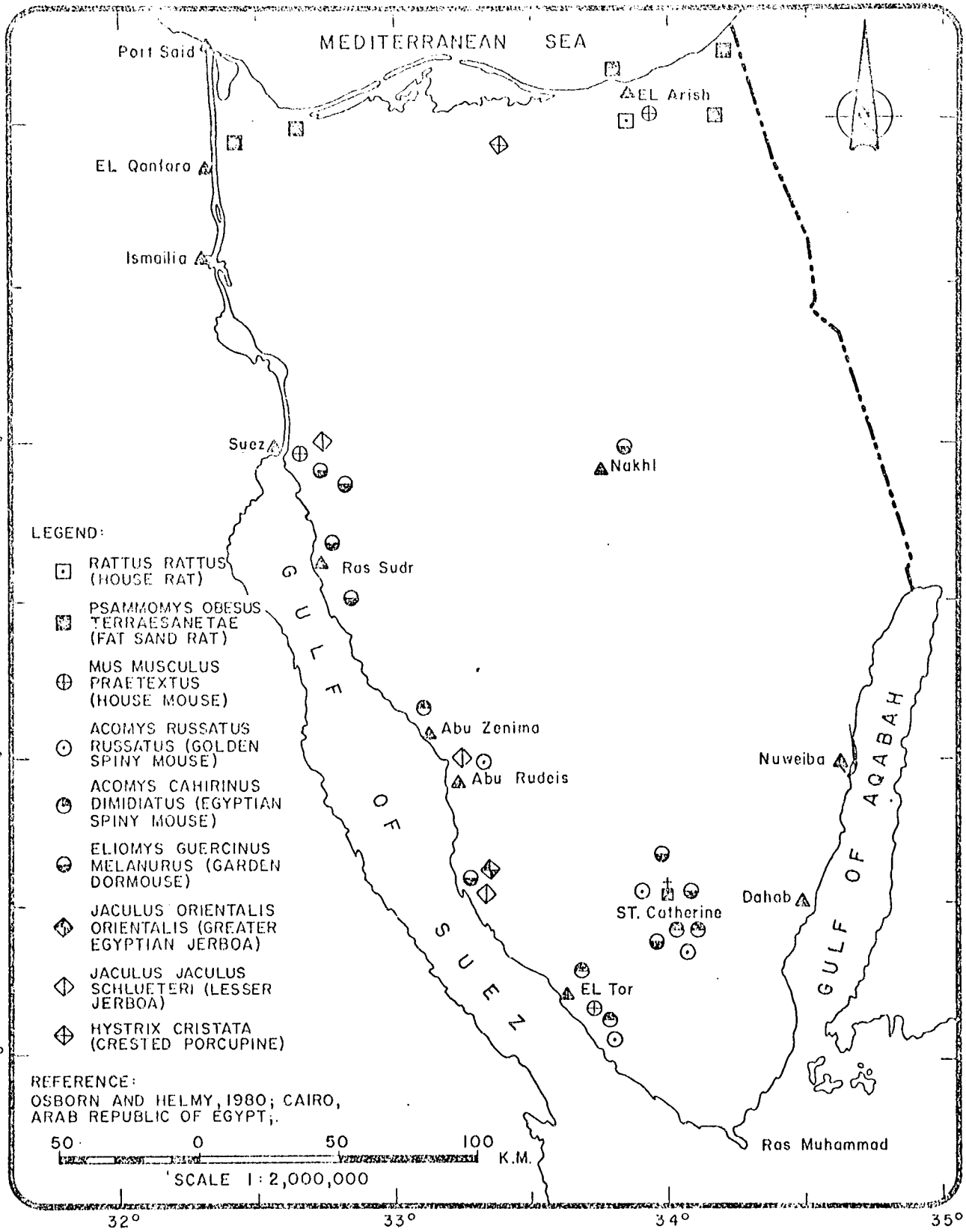
UN-DOMESTICATED LAND MAMMALS
GERBILS, DIPODILS AND JIRDS

FIGURE C-2



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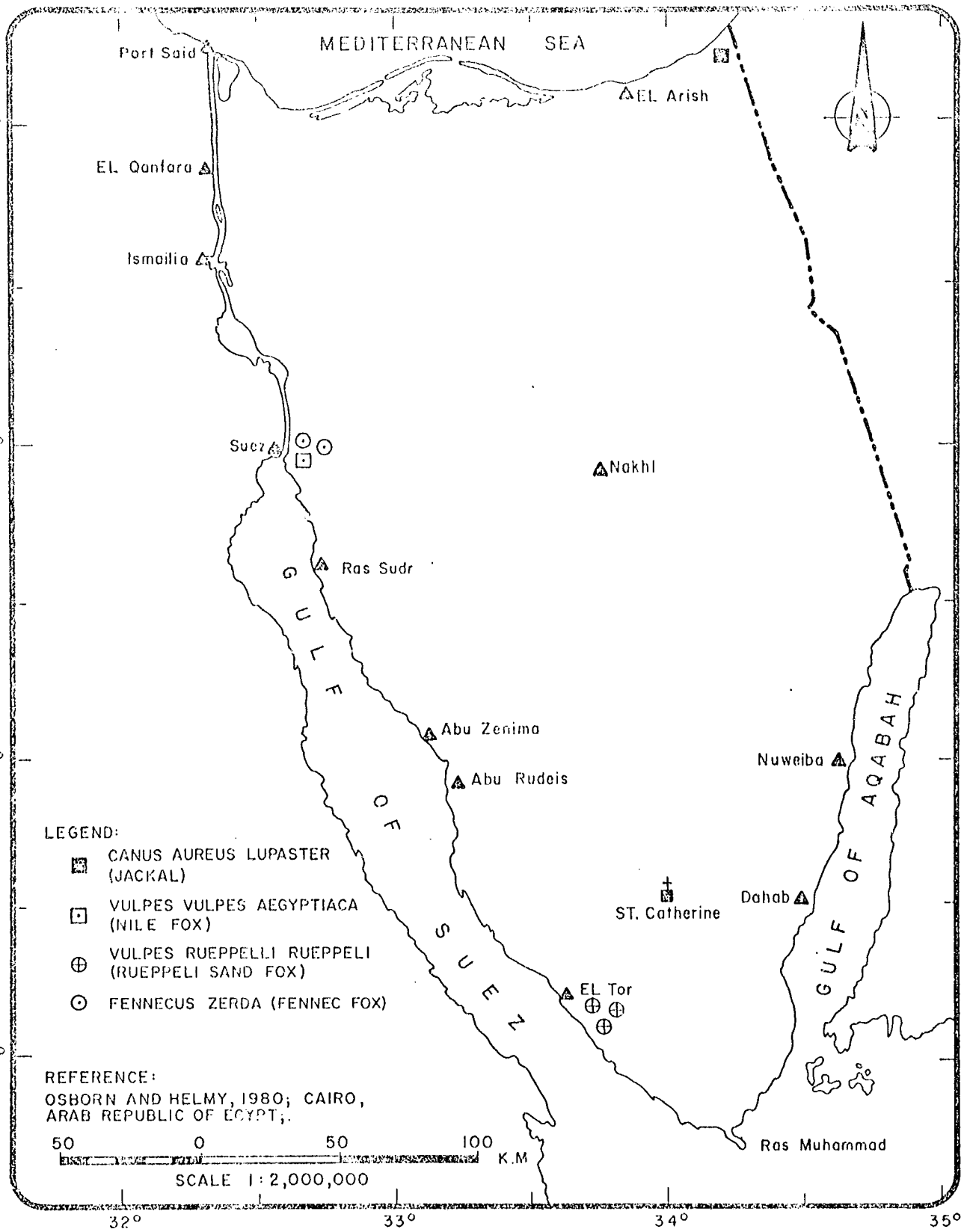
UN-DOMESTICATED LAND MAMMALS
RATS, MICE, JERBOAS AND PORCUPINES

FIGURE C-3



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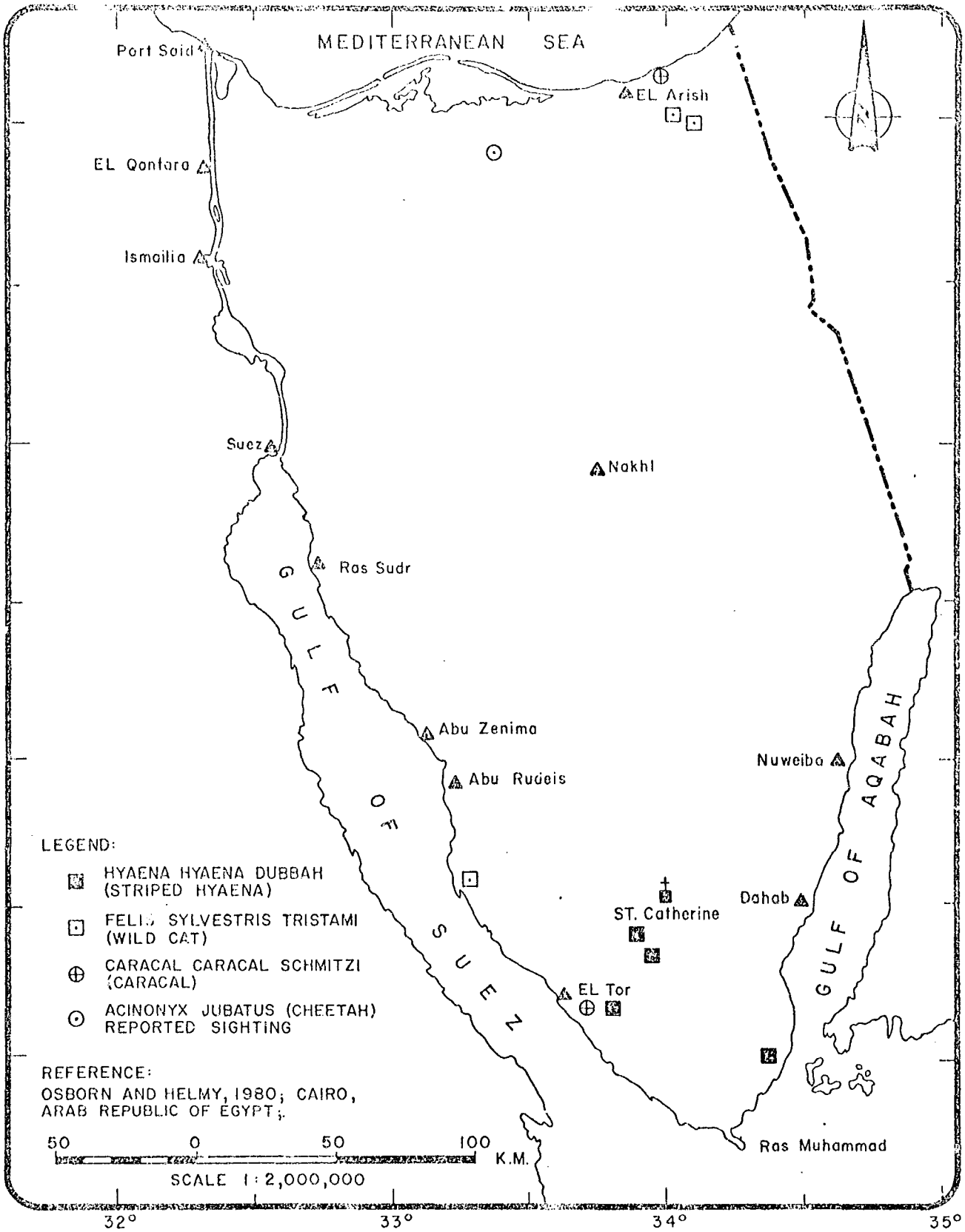
UN-DOMESTICATED LAND MAMMALS JACKALS AND FOXES

FIGURE C-4



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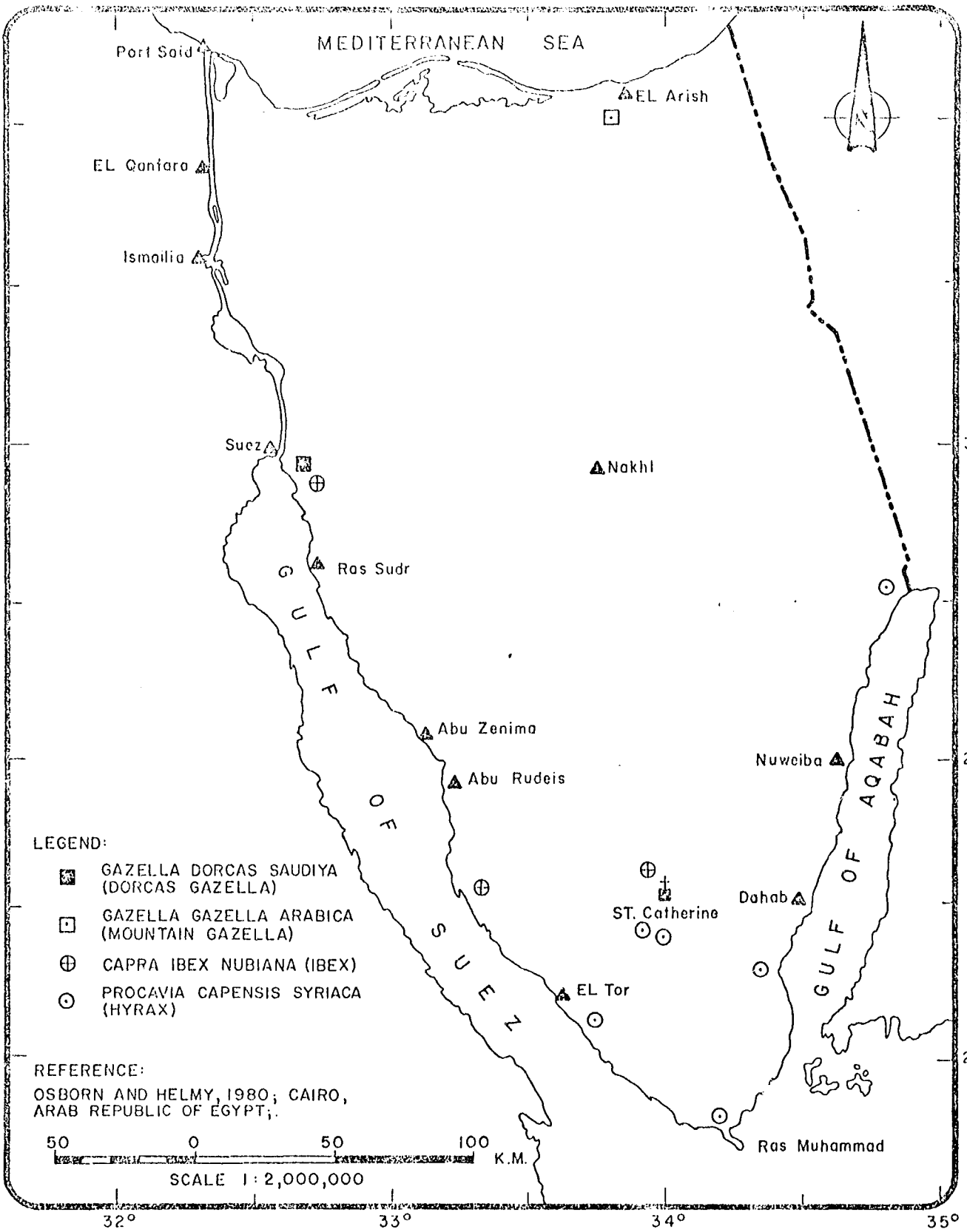
UN-DOMESTICATED LAND MAMMALS
HYAENAS, WILDCATS,
CARACAL AND CHEETAHS

FIGURE C-5



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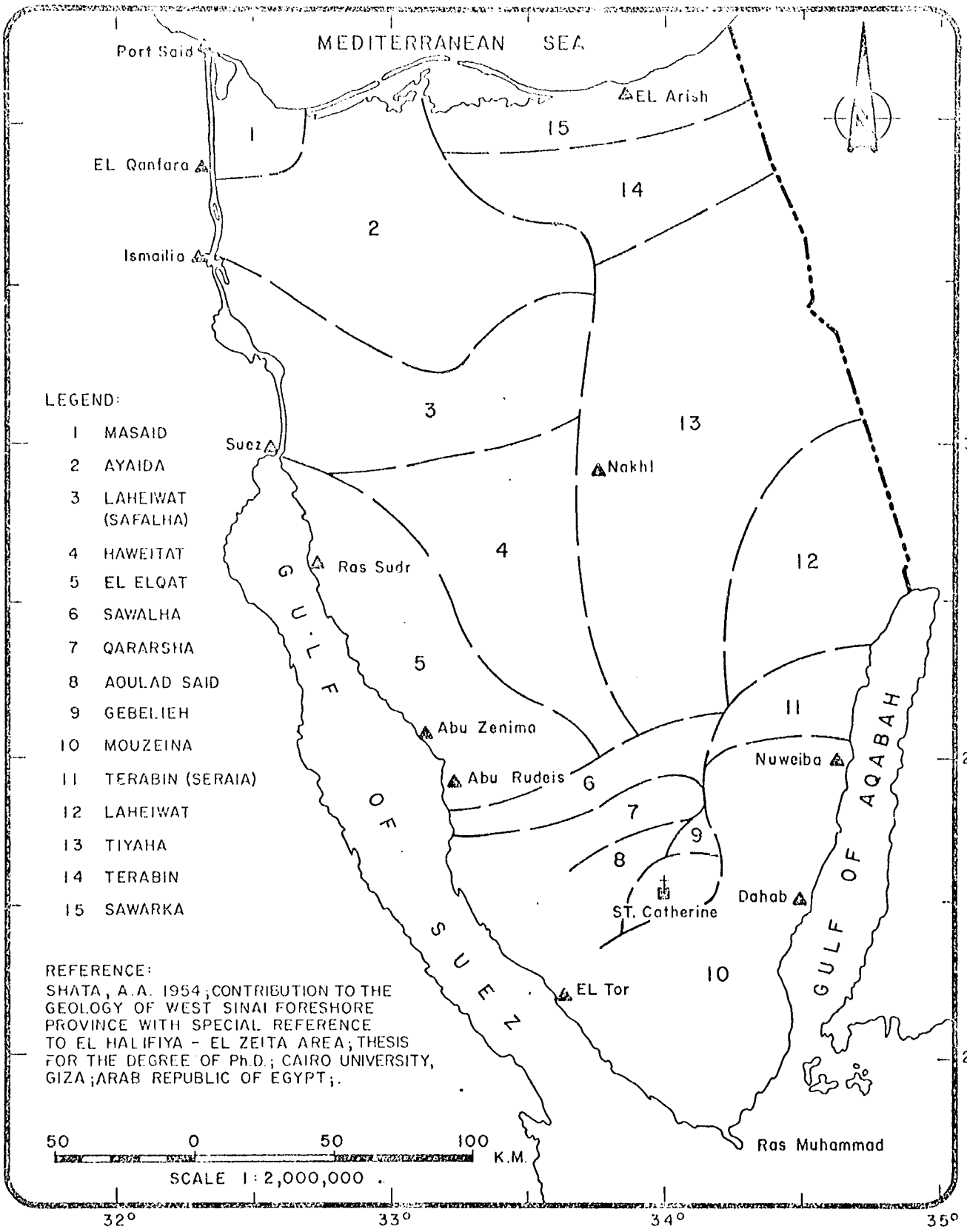
UN-DOMESTICATED LAND MAMMALS
GAZELLES, IBEX AND HYRAXES

FIGURE C-6



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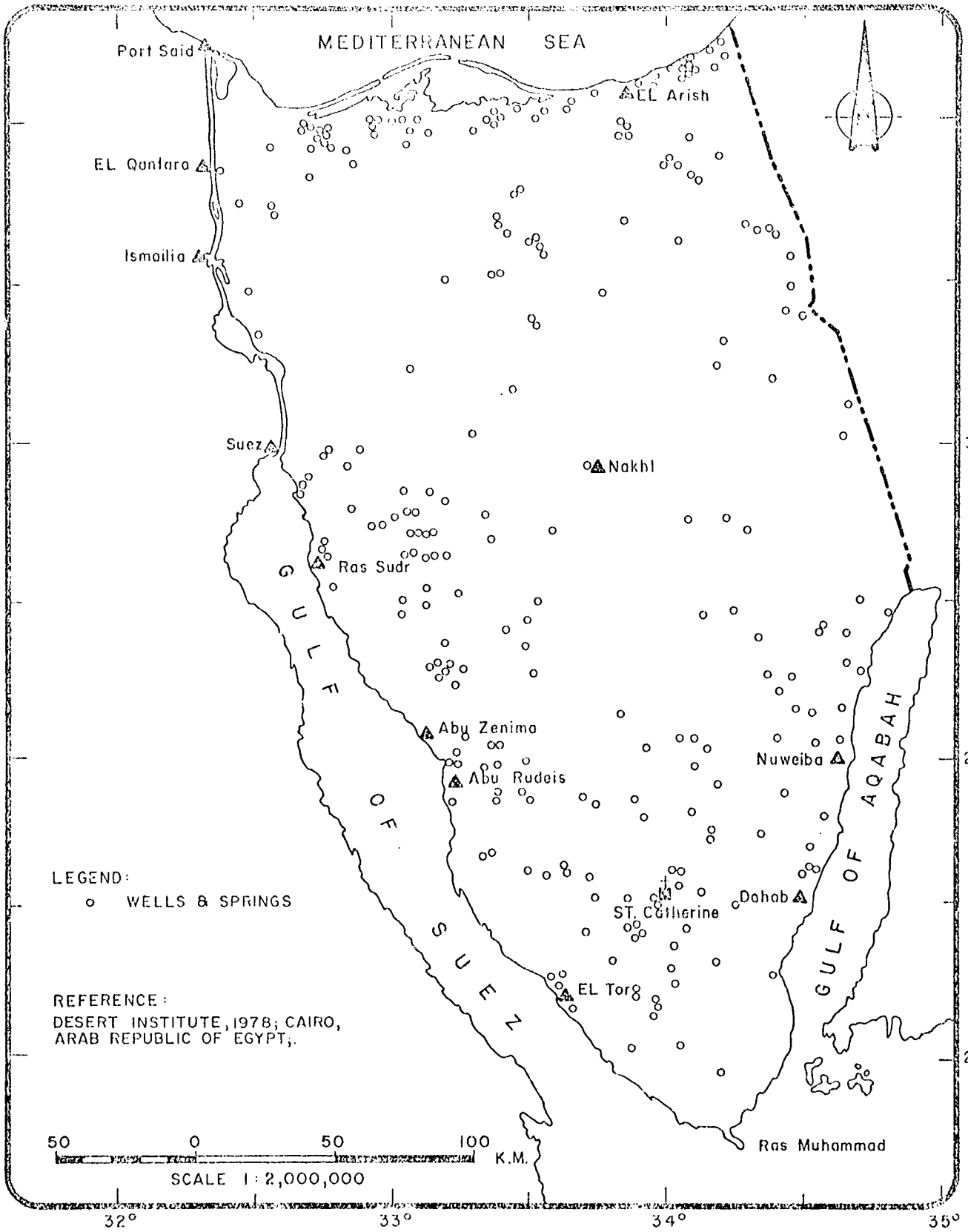
THE BEDOUIN TRIBES OF SINAI

FIGURE D-1



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DISTRIBUTION OF WATER POINTS OF SINAI

FIGURE E-1