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SOMALIA

1979

Country Environmental Profile

For
The Agency for International Development

By

Edward McGowan and J. Morgan Bromley- McGowan

Mr. Morris McDaniel
Room 2450, n.s.
AFR/DR/EAP
AID/W

Dear Sir:

Attached is the final report entitled Somalia 1979: Country Environmental Profile. The report treats issues generally not discussed by the authors in the Initial Environmental Examinations conducted in the field. Such Initial Environmental Examinations are, however, considered as a necessary part of the overall final report, including such recommendations as found in the IEE's. In addition to the discussions and recommendations of the IEE's, there are several important issues with recommendations for mitigation found in the final report.

This report conforms, in part, to the format for an Environmental Assessment. Departures from the E.A. format have been made for clarity and brevity.

We have examined the comments submitted by the Mission and those submitted by AID/W relating to the draft report. After discussion with the appropriate staff members of both AID/W and the Mission, we believe all points have been clarified to the satisfaction of all parties concerned. Not included within this report are a series of photographs taken in the field. These pictures, as well as a study of tree sections to elucidate the last three-hundred years of Somali weather will be forthcoming upon their completion.

Respectfully,

Edward McGowan

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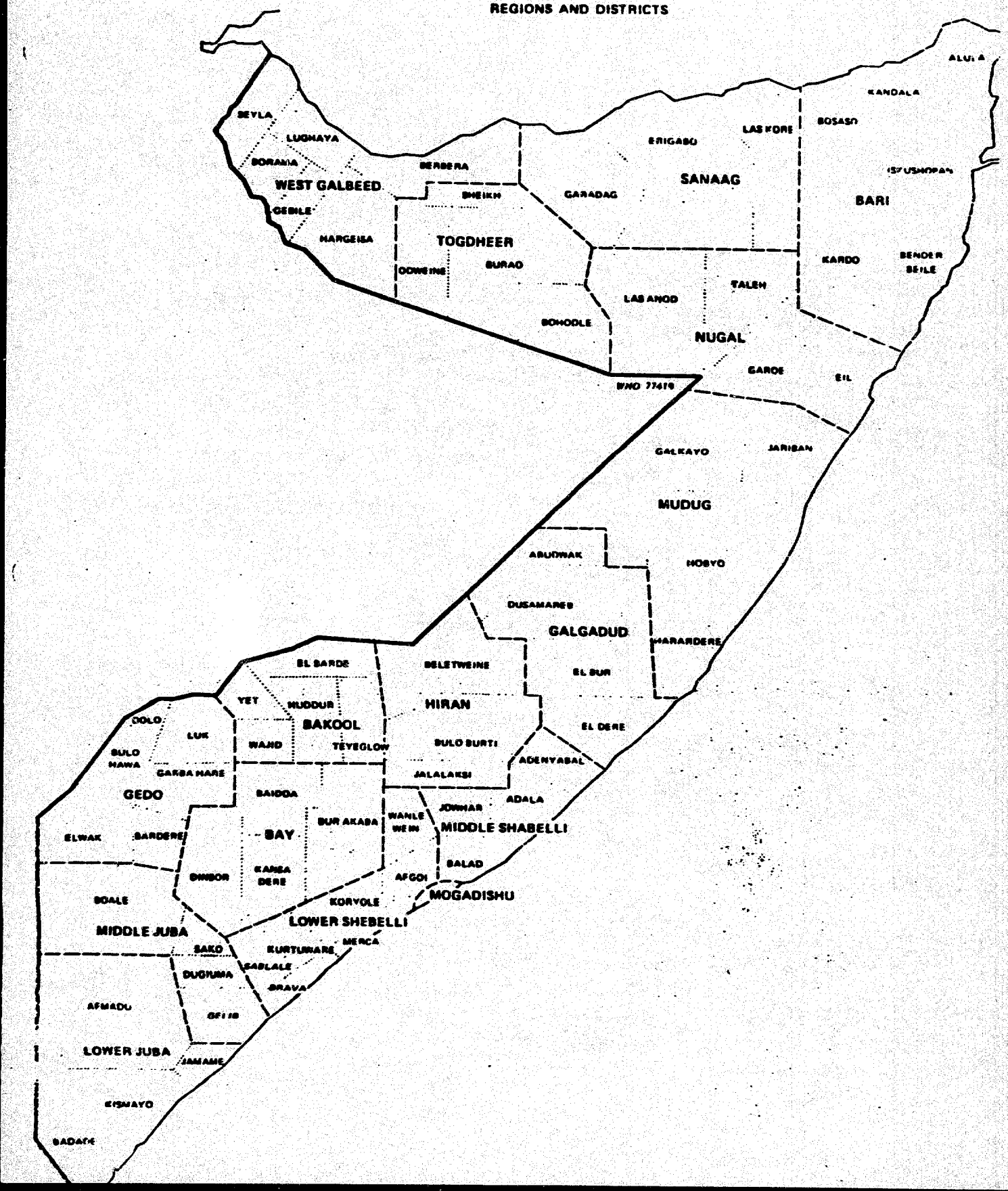
SOMALI DEMOCRATIC REPUBLIC
REGIONS AND DISTRICTS



SUMMARY

Somalia, by current standards, is a poor country presently incapable of self sufficiency. The following summary is intended to provide a cogent overview of the environmental and natural resource problems which most seriously impede the quest for sustained economic development. Because an exhaustive, region-by-region inventory was clearly out of the question within fiscal and temporal constraints, it was necessary to rely heavily upon situations and available data which can be said fairly to be representative of circumstances at large. In compiling the summary, attention was given to answering such questions as:

- Which environmental and natural resource limits have had the most adverse impact on the country's prospects for sustained economic development?
- To what extent have the development projects failed to achieve projected goals because of insufficient attention to environmental and natural resource considerations?
- To what extent have deelopment projects actually created environmental problems because of inadequate environmental planning?
- What are the most apparent ways in which institutional deficiencies have impeded the establishment of effective environmental management?

SUMMARY OF ENVIRONMENTAL AND NATURAL RESOURCE PROBLEMS AFFECTING DEVELOPMENT

I. Productive Environmental Resources

A. Water

Water is scarce; its source, rainfall, is often erratic and insufficient. Runoff is inefficiently utilized and often high in mineral content, thus affecting both crop choice and yield as well as soil longevity. Development programs do not seem to fully appreciate many of the environmental limitations.

B. Forests

In the traditional Western sense, forests do not exist. There are vast stretches of woody vegetation between the two major rivers. Their value lies not in timber but rather as forage, habitat, soil stabilization, water shed, sources of local building materials, and fuel wood. Some areas also serve as habitat for the tsetse fly. These areas are also an impediment to both agri- and livestock production.

In the more arid areas, large woody species are less frequent. Some forest remains in the northern range, but its principal economic value is habital and soil stabilization. Management of these resources will require considerable attention to environmental issues.

C. Grasslands

Forage production and soil stabilization are the principal productive uses for this resource. Wildlife habitat in most areas exists only as a consequence of nonuse by man. Most grassland carrying capacities have been exceeded. Continued

utilization of this resource will require sophisticated guidance to conserve existing production.

D. Wildlife

Somalia once had a rich fauna and flora. Pressures from the expanding human and livestock populations have much diminished the resource. Where man and livestock cannot successfully exist, wildlife exists. Hunting for profit has caused the loss of wildlife in certain areas. This area needs review.

E. Fisheries (coastal, marine, inland)

Fisheries are mostly confined to artisinal efforts principally of near-shore ocean species. The resource limits are not known and the economic viability for both domestic and foreign markets has many problems--both social and technical.

Inland fisheries are few and as yet do not show any economic potential. Aguaculture may have some promise for local consumption, but remains undeveloped.

The principal determinant in fisheries will be a favorable inventory, including thorough understanding of the Indian Ocean's currents and ecology, and the acceptance of responsibility for management of the resource.

F. Coastal Zone (estuaries, coral reefs, beaches)

The coastal zone is extensive but has few major estuaries, or coral reefs. Beaches around the more modern seaboard urban centers hold vast potential for tourism. A major upwelling exists near the tip of the Horn and is valuable to fisheries. The area needs attention.

G. Croplands

Water and soils suitable for agriculture are scarce. The area of Somalia is approximately 637,000 square kilometers and the total rainfed farming is estimated at some 4,200 square kilometers or 6/10 of 1 percent. Flood irrigation is estimated at 943 square kilometers, with controlled irrigation estimated to comprise but 341 square kilometers--5/100 of 1 percent of the country's area. Total cropped area presently equals 5,400 square kilometers. Because of the two rainy seasons (Gu-April and Der-October) crops such as sorghum, maise, cotton, and sesame can be double cropped.

There is little developed irrigation. Continuous and reliable crop production in Somalia awaits such development. Presently, irrigated agriculture is restricted by the limited availability of water of good quality and regular supply. Soils suitable for irrigated agriculture amount to approximately 52,520 square kilometers or approximately one magnitude more than presently utilized. Soils of moderate suitability for irrigation include an additional 29,090 square kilometers. Of these soils, only 22,600 square kilometers or 27 percent fall within an agro-climatic zone generally accepted as sustaining rainfed agriculture. Thus, the potential increase in the area capable of rainfed cropland is about one half magnitude. Extensive land clearing and preparation will be needed in order to make use of this potential. Environmental problems which will accompany this development are considerable.

H. Natural areas (wilderness preserves)

There are several preserves specified by law. Provision for others are found in some of the major development projects under proposal.

I. Genetic Resource (flora and fauna)

The flora and fauna have changed over time. There has been an encroachment and expansion of woody species replacing grasses. This is attributable to increasing livestock pressures, introduced animal species, introduced animal diseases and effective efforts in control of diseases in livestock.

With adequate management of resources and careful coordination of programs, economic development potentials for both croplands and livestock are encouraging. Market feasibility studies are needed.

J. Cultural resources (historic sites, buildings, monuments)

Permanence is noted in the historic cities such as Mogadiscio and Merca. Unfortunately, ancient structures are basically viewed for their utility. Once falling into disrepair and disuse, they are left to the elements. Coastal climates rapidly attack most building materials. A national museum and archives exist in the capital city. As most of the people are of nomadic background, there is little accent on permanence. There is a rich oral tradition.

II. Problems Attributable to Production of Residuals

A. Industrial pollution (including agro-industrial waste)

The country is in its infancy in terms of industry. Consequently, there is little pollution--as yet. A potential for industrial pollution exists in the new petroleum refinery, the proposed cement plant, and various mineral extraction programs, as well as proposed major water schemes, irrigation projects, and intensified and expanded crop production.

Currently there is little use of farm chemicals and principal pollutions are confined to nonpoint runoff problems associated with flood agriculture, salinity problems associated with irrigated agriculture, water and wind erosion associated with overgrazing, and ground water polution associated with sewage disposal from large urban concentrations. The capital, with vehicle licenseplates somewhere in excess of 25,000, is experiencing traffic congestion and some air quality reduction. Data bases need to be established to begin the monitoring processes. Donors should include provisions for this capability in programs.

B. Accumulation of agricultural chemicals in the environment

As stated above, uses of agricultural chemicals except for locust and bird control are not a regular part of subsistence production. The state-owned farms and private capital intensive farms are mostly under controlled irrigation (341 square kilometers total) and some agricultural chemicals are used. Of this total area approximately 212 square kilometers are confined to the Lower Shebelli. Only during extremely high flood conditions does the Shebelli join the Juba. At such times, any runoff would eventually reach the Indian Ocean--carrying some portion of the farm chemicals.

On the Juba, which does empty into the Indian Ocean, approximately 129 square kilometers of irrigated agriculture exist. Some portion of the agricultural waste, runoff and carry-off of agricultural chemicals would reach the Indian Ocean.

As programs are developed to expand agriculture, more of these materials will ultimately end up in

the estuary of the Juba and the Indian Ocean. Attention to the attendant problems is needed. Donors must consider this in their programs.

Wind borne toxicants contribute as much to global pollution as do water borne. In dry land situations, as well as situations causing vapor loss of farm chemicals from large areas, the ultimate depository is again the Indian Ocean. Its currents and the monsoons must be thoroughly considered as programs for development are initiated.

C. Mine tailings, well contamination

Uranium and other mineral extractive procedures are expected to lead to tailings, removal of overburden and local disruption of the environment. Certain extractive processes will produce both air and water pollution. Aquifiers may become contaminated through improper well drilling and casing or the pumping of fluids to maintain production. Tailings from radioactive extraction are expected to present a hazard.

D. Toxic substances

As discussed above, mineral extractive processes are expected to produce some potentially toxic substances. Intensified agricultural and livestock production and vector control must assume the increased use of toxic substances. Fisheries production of a commercial nature will require ammonia, as will other refrigeration systems needed to handle agricultural output. The new refinery as well as proposed pesticide formulation plant will produce toxicants. Monitoring systems generally do not exist. They are vital to continued development.

E. Marine and coastal pollution

As port usage increases, as the refinery comes into production, one can assume an increase in pollution from ocean-going vessels. As mentioned above, water transport and air transport of agriculturally related byproducts are expected to be found to some degree in the Indian Ocean and Gulf of Aden. Currents of air and water, some directionally specific and fairly narrowly confined, may eventually concentrate certain undesirable substances. Again this speaks of the need for monitoring and data gathering.

III. Issues Associated with Urban Areas

A. Solid waste

Urban centers are growing at a rapid rate. New centers in the form of resettlement areas are under trial. Currently, consumables are mostly basic necessities and are delivered in bulk. Consumer products, individually packaged are not a major part of the Somali life. In a country where empty bottles are still valuable, there is not a solid waste problem of note. Most things are recycled because of economics. As more people are settled and the country eventually shifts from subsistence agriculture solid waste will become an issue. It is not too early to begin thinking about it.

B. Sewage disposal

Cities are either on septic systems, or discharge via outfalls. Sewage treatment and sewer systems are virtually non existent. Mogadiscio's ground water supply was contaminated some time ago--hence the new water system. In the reclaimed flood plains, special attention must be given to water tables and sewage disposal--Kurtunwaarre

is an example. In the fishing villages, fish processing wastes as well as human waste is a problem which can only grow. Proper attention is needed.

C. Air pollution

Mogadiscio needs city planning. Auto traffic is getting out of hand. Licenses issued now exceed 25,000. Vehicle emissions are affecting air quality to some degree. As new industrial complexes are proposed, possible air pollution controls must be incorporated in the overall cost/benefit ratios.

D. Water pollution

A major constraint to increasing production from the human resource is poor water quality and quantity. Removal of these constraints will enable the country to reduce its dependence on outside agricultural produce. As with any reduction in factors affecting human health, population changes must be recognized and development plans should incorporate this recognition.

E. Adequate water supply

Somalia is a water deficient country--most areas have inadequate water supplies. Those with currently adequate supplies will be faced with inadequacy as population growth rates accelerate from the reduction of health problems, increased production and migration to urban centers.

F. Land use planning

There will be a need for land use planning and qualified land use planners. Neither exist to a large degree under current conditions.

G. Noise

Noise has yet to become a problem. It can be avoided for the most part through proper land use planning.

H. Disease vectors

With better water, proper planning and education, disease endemic areas can support healthy functional populations. The coastal zone is mostly free of malaria. The area of greatest potential development--the interriverine area has malaria, trypanosomiasis, and shistosomiasis. These diseases and their vectors can only be controlled.

I. Transportation facilities

Somalia has an efficient transport network where roads exist. Unfortunately many areas of potential development do not have adequate access. Intra-city transport at this time in development is reasonable. When human and economic schedules are more demanding as development progresses, public transportation in large urban complexes will need scheduling and organization. Trucking supplies using cooperatives are well within the capacity to meet demand.

J. Energy supply

Currently, with the exception of charcoal and animal dung, energy consumption is dependent upon foreign sources. Energy supply will continue to be a major problem. Fuel wood supplies are already exceeded in many areas. Conservation measures and efficient use of fuel sources need stressing. Much reduction in fuel consumption is possible through training in use as well as better technology.

IV. Environmental Health

Environmental health must be considered in relation to development

from two perspectives. First, development must not adversely affect health. This must be considered from short-term and long-term view. Short term adverse effects might include acute intoxication from the initial learning sequences of handling farm chemicals. Long term adverse effects might include the development of stress diseases within settled nomadic peoples.

The second perspective is that of causing a gradual--or sharp as in the case of vaccination--reduction in morbidity and mortality. This must be accomplished only upon assuring that the salvaged human or animal resource will not outstrip the carrying capacity of the habitat. The government's absorptive capacity to monitor and manage programs from a coordinated perspective is the key to success. Several donors have discussed this. Donor coordination needs strengthening along such lines. AID/Bank projects have recognized this and the effort needs continuing attention.

CRITICAL ASSESSMENT OF INSTITUTIONAL CAPABILITIES TO RESPOND TO ENVIRONMENTAL AND NATURAL RESOURCE PROBLEMS

I. Policy

A. Has the government articulated a basic policy regarding environmental and natural resource management?

Decision making and central policy are mixed with inexperience in this area. With guidance from donor organizations, based on an internal need, resource planning is progressing. At times, however, the internal needs and lack of experience or technical support cause resource planning to assume an exploitative mode that ignores long term utilization or turns a deaf ear to external wisdom gained from unfortunate experience.

B. Does the government's stated policy influence its short- and long-range program planning?

One must keep in mind that management received much of its training in the martial arts--not civic arts. One must also bear in mind that the recent tutelage did not encourage internal management, or with crash programs, long-term perspectives. With the above perspective, government has made some extremely progressive moves. From an environmentally sound perspective, there is much need for assistance in all programs.

C. Are legal requirements or other administrative mechanisms ensuring that policy will be taken into account in the government's routine activities?

Many programs which would provide meaningful measures have yet to be implemented. Speculation is possible, however, based on other presently functioning factors.

The training of manpower for the responsibilities to be undertaken is not adequate. The educational philosophy in many instances does not recognize the need for quality as well as quantity. Functionaries are often ill prepared for the exceedingly difficult task of development and reconstruction of their country. As a consequence, a disjointed incremental approach is seen. In certain instances laws are seemingly in direct conflict with orderly progression and fiscal soundness needed to assure program effectiveness and environmental consciousness.

D. Have the country's environmental and resource problems been addressed adequately in the government's basic development budget?

Environmental concerns and rapid development are often perceived to be in conflict. This is because donors, as a whole, are just beginning to appreciate that environmental concerns are one-in-the-same with overall long-term program soundness. Requests for the removal of multidisciplinary experts such as development anthropologists, social soundness analysts, and environmental scientists are not uncommon. Donors need to recognize the need for these experts and tactfully explain such need. An education of donors is needed first.

II. Agency Structure; Decision-Making Procedures

A. Has clear government regulatory authority been established to respond to environmental and natural resource problems of significance to the country?

In some instances law is available, but regulatory agencies are ill equipped, understaffed, or lack sufficient training to accomplish the intended objective. The question also presumes some type of monitoring capacity which would enable regulatory authorities to recognize problems--few exist, fewer are capable of functioning, fewer yet actually function. The concept is fairly new among advanced nations. Somalia will require patient help.

B. Has any agency been assigned principal responsibility for making and implementing national policy with regard to the environment and natural resources?

The State Planning Commission and its Technical Division attempt to coordinate and do program planning and analyses. They have not as yet reached the structural capacity foreseen by their architects. The Planning Commission lacks the requisite power within the political structure. While it has some exceptionally bright management, talents are often diverted by priorities which are misaligned with its goal. Thus, the agency has yet to achieve full credibility and influence within the government.

C. Are activities of different agencies adequately coordinated? Are there mechanisms for resolving conflicts between the proposed activities of different agencies?

Activities are not as well coordinated as they appear on organizational charts--some charts bearing no resemblance to reality. From an environmental and resource management perspective, much coordination is yet to be accomplished. Mechanisms for resolving conflicts may not exist or are not resource-management-sound.

D. Are government decision-making processes generally open or closed to public participation?

The answer is mixed and the country is just returning to peace time status and Western ways.

E. Do government officials seek and obtain all relevant data prior to making decisions?

From a "crash" program perspective, much data is extraneous, and its gathering time consuming. As these programs fail, as factories and

industries close, these economics are being questioned. To survive, the country must begin to obtain relevant data--but this requires being able to determine relevancy and the capacity to utilize data in decision processes--including program effectiveness monitoring.

III. Manpower and Training

A. Are qualified people available in adequate numbers?

Until recently, there was no written Somali. Today a written language exists. Training has been and continues in foreign tongues--English and Italian predominate. Entrance to training depends more on influence and association than aptitude. High graduation rates are encouraged by government and policy--even though quality suffers greatly. Policies for assuring permanent placement of all graduates, labor codes seeking high public employment, and a general lack of competency, place the country's development programs in serious jeopardy. Government seems to recognize the short comings of this approach but is unable to make necessary corrections. Donors must assist the government to obtain a more mature perspective in this matter.

B. Have local training programs been established to assure availability of adequate manpower resources?

Programs have tended toward problems of resettlement and retraining. Proposals for establishment of local training are currently being considered. Their success will depend in part upon fully understanding the social constraints and cultural changes necessary. Donors must pay more attention to social and cultural mechanisms which will ultimately affect development.

IV. Attitude of the Public

A. Is better environmental management generally perceived by the public as an important national priority?

The public is keenly aware of the diminishing natural resource base under traditional modes. It is doubtful that it is perceived as an important national priority as the concept is reasonably sophisticated. Resource development is a stated goal of the government.

B. Are non-governmental organizations addressing environmental and natural resource problems?

Such organizations do not generally exist--as we would consider them. Nomadic groups, cooperatives, and associations do work toward self interest increases in resource utilization, and if basic survival is not a question, do look for a renewable aspect.

C. Has environmental education been added to the public education curriculum?

Koranic law teaches an environmental consciousness. The basic sciences are taught and concepts are introduced. The university does have courses in some environmentally-related subjects. Many more are planned to cope with manpower problems associated with current development problems and programs. Donor sponsored educational programs must be carefully designed to assure adequate environmental input.

sedentary farmers and craftsmen (Sab). The Sabs represent about twenty percent of the population.

Religion

The religion is Sunni Moslem of the Sha-afi sect.

Language

Dialects vary from region to region but are intelligible to people of other regions. Recently a written script was developed and literacy is claimed to be fifty percent. English and Italian are still the languages of official business because the Somali language has few technical words.

Political Structure

A military coup in 1969 took over the government with former chief of the Armed Forces, Mohammed Said Barre, as President. The Supreme Revolutionary Council (SRC) has been replaced by the Central Committee of the Somali Socialist Revolutionary Party. Key political figures have not changed. Somalia claims a program of Scientific Socialism aimed at reducing tribalism and corruption in government. It intends to modernize the economy with the help of public sector programs. Primary goals are education, religious reform, government work programs and nationalization of basic methods.

Legal System

Islam remains the foundation of the legal system and links it to the rest of the Arab world whose resources are important to the economy of Somalia.

INFRASTRUCTURE

Physical Infrastructure

Because of the long North/South--East/West configuration, communication links in Somalia are expensive to establish, and costs of operation are high.

Roads

Often existing roads leading to rural areas are in poor condition, contributing to the high costs of transportation. Vast areas of livestock and agricultural potential have difficult access. Particularly, there is a lack of farm-to-market and feeder roads.

Railways

The country has no railways.

Ports

Mogadiscio berths shipping up to 50,000 tons.

Waterways

Inland waterways do not play a role in modern transportation. Ocean shipping is the major method of transportation between the north and south.

Airways

Air transport is very important for access to remote areas. There are 28 usable domestic airfields, and three major airports: Mogadishu is the center of the air transportation network. Hargeisa in the North, and Kismayo in the South are of international standard. Domestic air passenger transport has increased slightly since 1970 while domestic air freight has declined. Both international passenger traffic and

D. Are there any special cultural obstacles to the introduction of improved environmental and natural resource management practices?

Many of the leaders of villages or nomadic groups are elders. Most information to these people will pass through young graduates: with the age barrier can the egg tell the chicken how to scratch? With nomads, quantity rather than quality of animal is important. Large numbers per family unit are needed. Culturally the people are considerably out of phase with the carrying capacity. A cultural situation also exists with agriculturalists. Perhaps one of the larger problems lies with the culturally elite receiving education and not relating to the people for whom they were educated.

E. Is there resistance in some localities to the imposition of national policy for cultural reasons?

Insufficient social analyses have been conducted to answer this question.

F. Do agricultural extension workers furnish information regarding environmental consequences of the improper use of agricultural chemicals?

The agricultural extension is in a state of disrepair--and as such, is not viable. Programs for revising it must include such information and training in the consequences of improper use of agricultural chemicals.

V. Data Gathering and Research

A. Has the government established effective programs for gathering data about environmental and natural resource trends?

Under scientific socialism one would expect to see such programs. While the government recognizes the desirability and need for such programs, its internal capabilities do not now provide for these capacities. Consequently, much training and technical support is needed in this area.

B. Is the government able to evaluate environmental or other data in a meaningful way?

Again, the rate of absorption is exceeded and the country will need to rely on outside experts for the near term. Unfortunately, such experts are not generally available, nor seen by the government as totally necessary. Donors must set examples.

C. Have procedures been established to ensure that empirical data regarding environmental and natural resource trends are fully considered in related government decision-making?

Procedures are being established, but donors must encourage this so it will continue. The donor community must also provide more examples and guidance.

D. Does the government possess adequate facilities for monitoring and evaluating changes in its environment, both short- and long-term?

No, unfortunately this appears to need stiffening in the donor community programs as well.

VI. Environmental Impact Assessment

A. Has the government established a mandatory procedure for assessing the environmental consequences of proposed development projects?

No. It would be well for the donor community to assist in this area. Many projects have failed because of poor initial planning as well as failure to monitor progress. Others have failed because the natural resource base had been badly misjudged.

VII. Environmental Law

A. Is any agency of the government responsible for conducting a continuing review of environmental and natural resources legislation and for recommending improvements when needed?

It was difficult to assess this area. Much legislation is written by donor experts, many of whom have no legal or administrative training. Additionally, for many, their grasp of the English language or their capacity to translate is poor. The resultant documents are often poorly drafted and when enacted in this form contain many potential legal and administrative problems. The new Range Law is a case in point.

B. Are any important environmental or natural resource issues not currently the subject of statutory regulation?

The entire area of this body of law needs review and assistance. This would be an excellent area for donor assistance and would probably do more for long run self-sufficiency than many current spendings.

C. Have any existing environmental or natural resource laws proven to be ineffective?

A review to determine this should be undertaken. Unfortunately, recent changes and events within the structure, and limited time span do not provide sufficient experience upon which to base a reliable judgment.

D. If an assessment is possible, is the ineffectiveness of existing laws attributable to the statutes, a lack of enforcement personnel, to an unwillingness to back laws with credible enforcement, or to unrealistic standards?

Understanding the answer to "C" above, some indications may be applicable. Statutes, as stated in "A" above may not be well drafted, manpower certainly is an impediment, as previously discussed, and in certain cases, family ties override national interests.

With respect to standards, the data base upon which standards might be set is generally lacking.

E. Have laws regulating individual conduct been accompanied by government efforts to ameliorate resulting hardships (e.g., laws prohibiting the taking of wildlife, extraction of natural resources, cutting of firewood, etc.)?

Shifting from subsistence modes where resource utilization is generally in a survival-short-term decision-making framework, will require alternatives to such resources. The country is expansive. Consequently, regulatory authority is dificult to extend. One must also appreciate Islamic philosophy regarding "hardship." Resettlement of displaced per-

sons can be viewed as a major government commitment in this area. One, however, could question the government's capacity (not intent or willingness) to accomplish resettlement were it not for recent catastrophic events.

F. Do the laws addressed to pollution control establish clearly discernible obligations through some enforceable mechanisms (effluent limitations, stream quality standards, effluent charges)?

On the whole these concepts require a capacity for monitoring. As such, the lack of this capacity would preclude meaningful mechanisms.

G. To what extent does the country participate in treaty arrangements addressed to transnational environmental issues (e.g., pollution of international rivers and the sea, trading in protected animals and their products, overfishing)?

The UNEP is proposing to extend its regional approach to oceanic regional planning--e.g., Mediterranean Sea--to the Indian Ocean area. The proposal has not been offered for review by the participants. Somalia has agreements with other Arab nations, but these relate more to defense and trade, although some areas could be argued into the area of concern. A conference on rivers held by the U.N. was attended some time ago by Ethiopia and Somalia. Recent conflicts may have affected any agreements. Locust control appears to be one area where cooperation exists. Trading in animal products exists and contains no legal sanctions. Newly enacted regulations by Kenya against sale of certain animal products has caused the market to shift into Somalia.

H. What penalties are prescribed for violation of laws against misuse of the environmental or natural resource base?

In certain cases, penalties seem extreme by western standards. Justice may progress at the speed of a bullet. The range law contains sanctions for removal of natural resources. In general, however, this is a new body of law, and as such, needs guidance from experienced donor groups.

VIII. Remedial Effects

A. Has the government acknowledged any of the deficiencies identified in response to the questions above? Has it initiated remedial action?

Where deficiencies can be shown to cause adverse economic situations, remedial action is taken. Some externalities cannot be quantified under present systems. Others, because they cause no internal costs, are not acknowledged. This is an area where donor assistance is needed.

B. To what extent are the identified deficiencies being addressed in current AID activities?

It would be difficult to answer this question accurately. One must bear in mind that Somalia has recently acquired a mission. From a broader perspective, one may make some generalizations. While projects may be designed as country specific, there are often wider ramifications. For example, a drainage basin may include more than one country. Designers must appreciate the potential upstream rights to water or the affects of projects on downstream systems. Another example would be projects designed for nomadic peoples. In

the case of the latter example, both USAID-Kenya and Somalia will become involved in rangeland projects as well as water projects for nomads. As a potential for joint effort, the northern range in Kenya and the southern portion of Somalia are contiguous. This area offers the two missions and REDSO/EA an excellent opportunity for a coordinated effort.

BACKGROUND OVERVIEW

GEOGRAPHY

Location and Area

The Somali Democratic Republic covers a large area in eastern Africa, known as the Horn of Africa. It stretches along the Gulf of Aden and the Indian Ocean. It is bounded by Ethiopia on the west, Kenya on the southwest with the coast of Afars and Issas to the northwest. It has an area of approximately 637,000 square kilometers.

Topography

The coastal plain, the inland plateau and a mountainous area to the north are the three main types of relief that can be distinguished.

Climate

Climate is influenced by proximity to the Indian Ocean and the two monsoons.

Precipitation

The average annual rainfall between the two rivers may reach 500 mm, but for most of the country from latitude 5°0' north, it is less than 200 mm. The two rainy seasons are determined by altitude and the monsoons.

Temperature

The temperature is hot and humid most of the time along the coastal areas with the humidity dropping with progression inland. Evapotranspiration usually exceeds precipitation.

Vegetation

Most of the country except for the highlands and interriverine area can be described as desert scrub. Vegetation in the arid zones is determined more by soil type than by rainfall because of the limited precipitation and high evapotranspiration.

Wildlife

Somalia formerly had a rich variety of fauna. However many species such as the leopard and rhinoceros are being illegally hunted into extinction or severely threatened. The expanding need of man for rangeland and cultivation further threatens the wildlife population.

Natural Potential

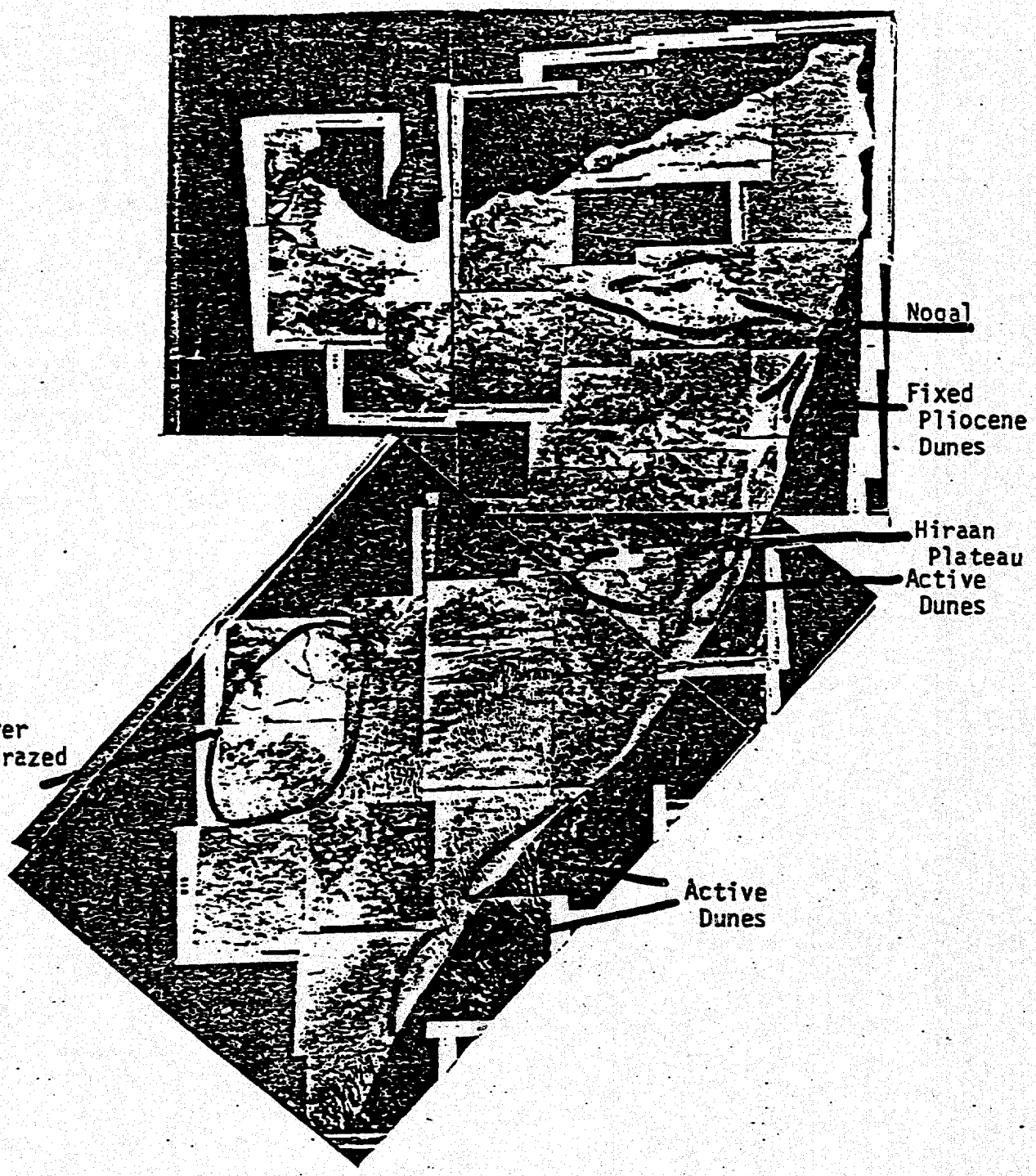
To reach Somalia's potential will require considerable investment, appropriate technology, and management.

Population

There has never been an accurate population census in Somalia. Knowledge of size, distribution and structure is therefore based on existing estimates. The total current population is estimated to be 3.5 million and has a growth rate potential of 2.6 percent. More than half are under the age of 15 years. Life expectancy is estimated to average 41 years. Approximately 2/3 of the population follow a nomadic way of life. The remainder are urban dwellers or are in sedentary agriculture. There are seven major urban areas with populations over 10,000. The larger major urban settlements were the traditional seaboard market centers.

Tribes

The Somali are unifed by language, religion and culture. Traditionally, cultural divisions arose between pastoral nomads (Smaal) and



This figure is an uncontrolled mosaic compiled from ERTS satellite photos, the dates of which range from the early through the late 1970's. From the overlay, this figure provides an overview of the extensive erosion, e.g., the Nogal Valley, Hiraan Plateau, the upper portion of the Juba's basin, and the southern portion which is adjacent to the Northeastern Province of Kenya. Also noted are the extensive areas of active dunes. Principal areas are on the coast north of Mogadiscio and from Merca south.

sedentary farmers and craftsmen (Sab). The Sabs represent about twenty percent of the population.

Religion

The religion is Sunni Moslem of the Sha-afi sect.

Language

Dialects vary from region to region but are intelligible to people of other regions. Recently a written script was developed and literacy is claimed to be fifty percent. English and Italian are still the languages of official business because the Somali language has few technical words.

Political Structure

A military coup in 1969 took over the government with former chief of the Armed Forces, Mohammed Said Barre, as President. The Supreme Revolutionary Council (SRC) has been replaced by the Central Committee of the Somali Socialist Revolutionary Party. Key political figures have not changed. Somalia claims a program of Scientific Socialism aimed at reducing tribalism and corruption in government. It intends to modernize the economy with the help of public sector programs. Primary goals are education, religious reform, government work programs and nationalization of basic methods.

Legal System

Islam remains the foundation of the legal system and links it to the rest of the Arab world whose resources are important to the economy of Somalia.

INFRASTRUCTURE

Physical Infrastructure

Because of the long North/South--East/West configuration, communication links in Somalia are expensive to establish, and costs of operation are high.

Roads

Often existing roads leading to rural areas are in poor condition, contributing to the high costs of transportation. Vast areas of livestock and agricultural potential have difficult access. Particularly, there is a lack of farm-to-market and feeder roads.

Railways

The country has no railways.

Ports

Mogadiscio berths shipping up to 50,000 tons.

Waterways

Inland waterways do not play a role in modern transportation. Ocean shipping is the major method of transportation between the north and south.

Airways

Air transport is very important for access to remote areas. There are 28 usable domestic airfields, and three major airports: Mogadishu is the center of the air transportation network. Hargeisa in the North, and Kismayo in the South are of international standard. Domestic air passenger transport has increased slightly since 1970 while domestic air freight has declined. Both international passenger traffic and

freight tonnage have increased.

Telecommunications

Domestic telephone communication is inadequate and often primitive except in Mogadishu and the few other urban centers. Generally, radio is the major means of communications. Somali language broadcasts are listened to on transistor radios, by nomads. Plans to establish direct international microwave connections with Nairobi and Rome exist, and upgrading of domestic services among urban centers is projected.

Energy

Most large towns have public electricity supplied, all of which rely on the use of fossil fuel for operations. The Juba river has a potential for hydroelectric production. Rural areas rely on fuel woods which are diminishing.

SOCIAL INFRASTRUCTURE

Education

Government priorities include a marked increase in the proportion of girls and women enrolled in school, an overall increase in students, and using programs of instruction geared to Somalia's particular social and economic needs. Technical education is to be emphasized with emphasis on usable, salable skills. Higher education is to be redirected to take full cognizance of environmental factors peculiar to Somalia. An easily written and readable form of the Somali language has been introduced to raise the literacy rate. The national budget includes funds for upgrading university level institutions and planning a new university. Presently Italian and English are the languages of instruction. Islamic schools teaching the Koran, are popular.

Nutrition

Protein malnutrition is common. The diet for nomads is primarily milk from cattles and camels with an absence of meat and vegetables. A conservative estimate of calories needed by nomads would be 2,000. Present level of consumption is thought to be below this figure. Agriculturalists consume a high portion of cereals in their diets. All diets are vitamin deficient.

ADMINISTRATION

Local Administration

Somalia is divided into fifteen regions, which are subdivided into 78 districts. Local government is encompassed within these 78 districts. Mogadishu comprises fourteen quarters functionally similar to districts and is in effect the sixteenth region. Regional and district councils include both national and local authorities as their members. The national government appoints the regional and district commissioners. Army officers are usually Council Chairmen. It is believed that pastoral nomads are not bound by the village system. Instead their councils include all adult males.

THE NATIONAL ECONOMY

Income

Somalia is classed by the United Nations among the 29 poorest countries in the world. The per capita income is estimated to be US $110. Some 80 percent of the population are involved in subsistance agriculture or are pastoral nomads. There is little evidence to suggest that farmers have been able to keep up

with needed growth. Somalia is presently importing staple foods and all consumer goods.

Exports

Export consist mainly of bananas and livestock. Canned meats and fish and fish products have declined because of factory failures. Forest products such as spices, frankincense, myrrh, and gum arabic,make up a minor portion of the export market.

AGRICULTURAL POTENTIAL

Progress in the foreseeable future is tied to agriculture and rural development. Traditionally, indigenous agriculture was limited to subsistence farming. There is a cultural bias against farming by the nobel cast Smaals of the north. The disdained sedentary farming is mainly practiced by the lower cast Sabs of the south. Dryland cultivation consists of durra (sorghum) in the northwest and the flood plain production of maize, with sorghum and vegetables between Juba and Shebelli rivers.

During Somalia's colonial times, Europeans established plantations in the Juba-Shebelli plain where bananas, sugar, and citrus were produced on irrigated land using more modern techniques. Nationalization of plantations to state-owned farms and coops is progressing under scientific socialism. However, a dearth of skills in the technical and management support systems as well as soil salinity problems are serious handicaps. Scarcity of equipment and delays in receiving inputs have not permitted a complete changeover.

Water for irrigation purposes is severely limited because of a high mineral content. High solar evaporation rates concentrate salts in soil and substantially reduce yields. Methods of removing these salts are only now being used. Bunding, a way of trapping rainwater behind earthen embankments in fields, is used in some areas to grow fast maturing strains of sorghum and maize. Spring rainfall may fail one year in four and fall rains are apt to fail every second year, thereby affecting production and reasonable planning.

Agricultural Settlements

More people are being resettled in government towns like Kutunwaarre where scientific, well managed agriculture will soon be a reality. Old prejudices are being overcome through the government retraining, therby reducing the affects of tribalism and sectionalism. It is planned that Somalia should become self sufficient. An end to the importation of staple foodstuffs is projected for such programs as the Kutunwaarre project in the early 1980's.

LIVESTOCK

Before the drought in 1974, pastoral nomadism was the way of life of over 60% of the population. It remains the Somali cultural idea. However, it has become increasingly difficult to sustain in the traditional manner. Wet season grazing is available only part of the time. Increasing human and animal populations have resulted in overgrazing and erosion quickly followed. Prior to the drought, animal population was estimated at 3 million head of cattle in the southern regions, 14 million sheep and goats, (11 million of which were in the North) and 2.5 million camels.

Tradition values herd size more than quality. Livestock is seen as a source of milk rather than meat and the livestock use of wells quickly throws a heavy burden on the environment.

The drought took the lives of 19,000--30,000 people and one million head of cattle, half a million camels and five and one half million goats and sheep. These statistics are staggering and should provide the impetus for popular acceptance of new farming techniques and a higher quality of herd management.

The climate of Somalia is determined primarily by the monsoon winds originating in the Asian continent and their influence on the Indian Ocean (see Figure 1, p. 19).

Except for the dry hot northern coastal area, the year is divided into four distinct seasons: two rainy seasons, each followed by a dry season. The first rainy season, which corresponds to the first lull between the monsoons, usually lasts from March to June, the second usually begins in September and ends in December with the start of the second monsoon. Seasonal changes are not entirely regular and rains may be erratic or fail altogether. The effect of altitude on rainfall and temperature is evident generally in the northwest, where altitude varies between 300 and 2000 m. For the northern part of the country, the highest temperatures occur during the summer, while the southern part experiences its highest temperatures in February-March and lowest values during mid-summer months. Temperature variation over the year is, however less pronounced, especially along the Southern Coastal Area. Along the coast, the local climate is also affected by land-sea air circulation. Windspeed for inland areas tends to be somewhat higher during summer as compared to the winter period. Sunshine duration closely follows the rainfall distribution. Mean relative humidity in coastal areas is high throughout the year (70-80%); the inland areas show lower values and, except during the rainy season, can experience very low daytime values.

Somalia, from a climatic perspective can be divided into four zones (Figure 3,p20)the north coast, the northern mountain area, the central/southern inland area, and the eastern coastal area.

Zone I: Northern Coast

This zone is comprised of a narrow strip of coastal land extending along the Gulf of Aden from Dijubuti east to the Tip of the Horn, thence southward along the coast of the Indian Ocean to the mouth of the Nogal River. (Figure 3, p. 20) Its climate is affected by (a) the shielding effect of the northern mountain range, (b) its proximity to the Arabian Peninsula and the major winds of the area (see Fig.1&2,P.19) and (c) the higher wind shear and water loss on the eastern side of the Tip (see Figure 5, p. 22). Mean relative humidity is from 75% in the winter to 50% during the summer. The mean annual evapotranspiration and water deficit for this zone are approximately equal - ie., 3000 mm, as rainfall is insignificant. Mean monthly temperatures range from 25°C in the winter to over 35°C in the summer. For a more detailed review of rainfall, evapotranspiration, and water deficit, the reader may turn to pages 23-32 and review Figures 9 to 45.

Zone II: Northern Mountain

This zone occupies that portion of Somalia which was formerly British Somalia, with the exception of the narrow coastal band comprising Zone 1. Altitudes in this zone vary from 200 m near the Haud to over 2000 m along the coastal range and border of the Ethiopian highlands. In this zone, climate and rainfall follow elevation, as shown by Figure 45, depicting the correlation between altitude

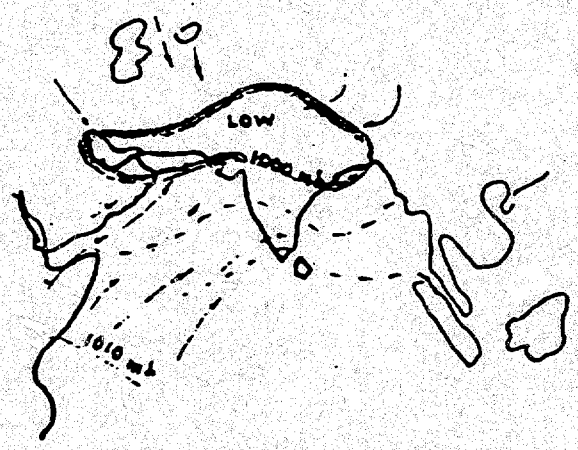


Figure 1

Southwest monsoon air movement toward low created by rising air mass in Asian subcontinent.

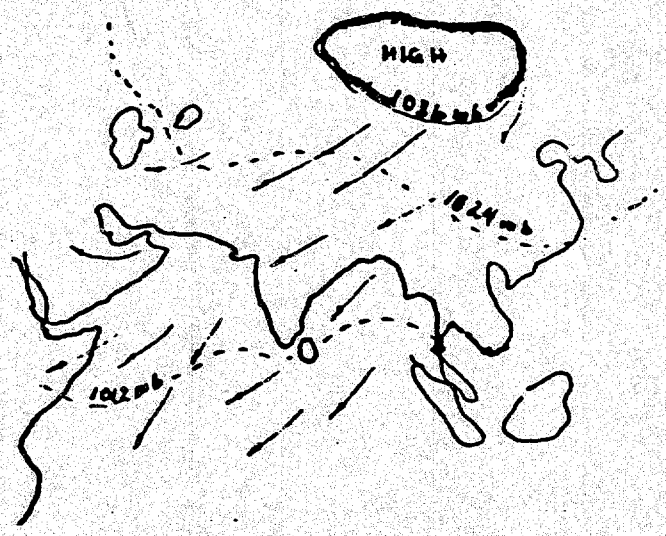


Figure 2

Northeast monsoon air is forced from region of high pressure resulting from cold land mass in Asia.

Four Climatic Zones

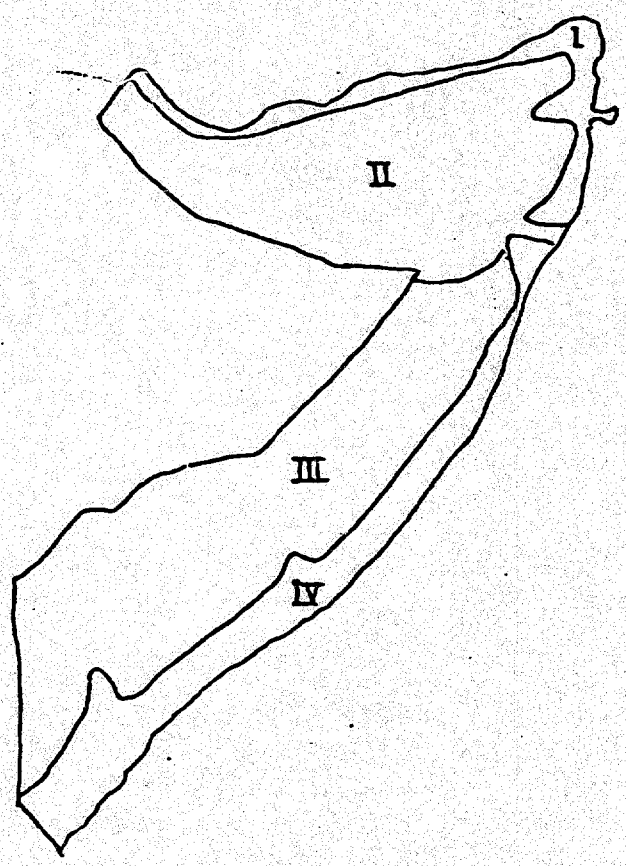


Figure 3 shows outline of the four climatic zones: I. Northern coastal area; II. Northern mountain area; III. Middle and central inland; and IV. Eastern coastal area.

Figure 3

and rainfall. Temperatures in the zone vary from an average of 15°C in the winter to 25°C in the summer, although snow and frost are not uncommon at higher elevations. Humidity ranges from 50 to 60%, which is slightly lower than found along the North Coastal zone. While the windrun is similar to the North Coast, insolation is somewhat lower. Evapotranspiration, as shown in Fig. 47, p.33 has a flatter curve and ranges from 125 mm during the winter to 185 in the summer. Rainfall peaks generally in May and September, but annual amounts can vary from 50 mm to in excess of 750 mm. Generally, rainfall data have shown a slight but progressive decline, as noted in the graphs for Hargesia (see Figure 51, page 35).

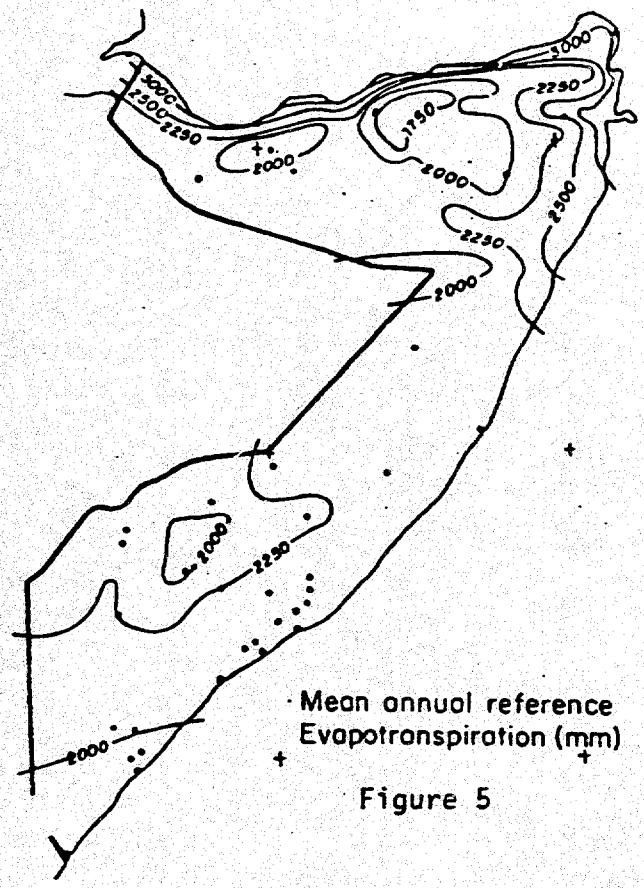
Zone III: The Middle and Southern Inland

This zone extends from approximately 2° south to 8° north and occupies the lands inland from the coast approximately 75 km. Temperatures peak in the southern portion in March with a mean of about 30°C. As one progresses northward, the temperature peaks later from April to May. Differences between summer and winter temperatures usually don't vary more than 4 to 6°C. Summer is the coolest period with relative humidity ranging from 50 to 60%. Humidity increases to 70 to 80% in the winter. Evapotranspiration follows this regime, being approximately 160 mm in the summer and increasing to 200 mm in the winter. Fig. 48, p.33 shows the rainfall peaks - April and October - as well as the evapotranspiration and water deficit.

In the southern area between the two rivers, the zone may be subdivided into a semi-arid sub zone and an arid sub zone. The semi-arid sub zone has two strongly defined rainy seasons, the first generally starts in March, peaks in April and ends in May; the second generally starts and peaks in October, ending in December. The amount of rain can vary considerably from established averages. The temperature is fairly even throughout the year averaging 25 to 30°C. Based on average figures, the coolest month is August, the warmest is April, differences averaging 2 - 4°C. Relative humidity decreases inland from 70 to 80% near the coast to 40 to 60% in the semi-arid sub zone and about 40% in the arid sub zone.

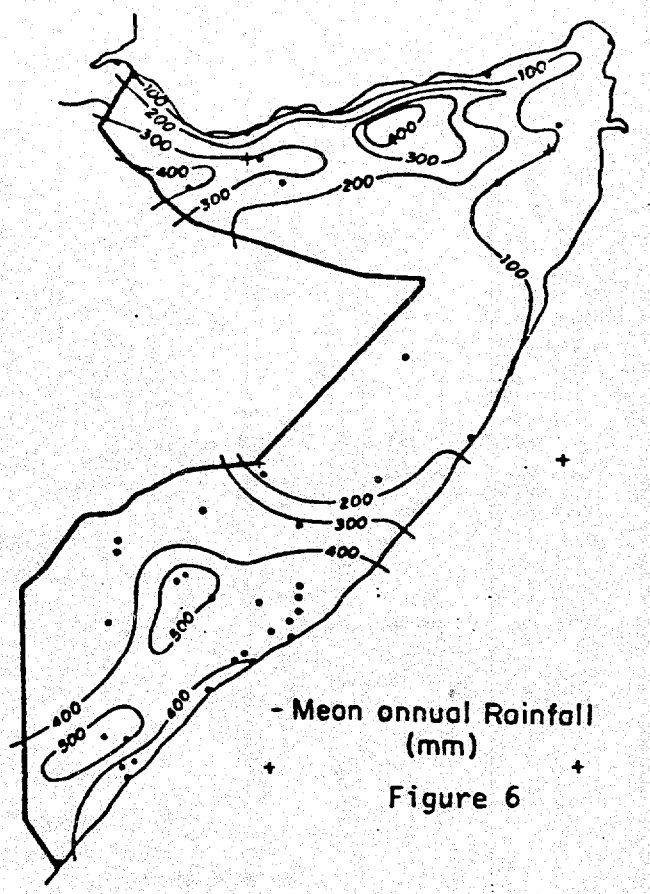
Zone IV: Eastern Coastal

This zone occupies the near coast portion of Somalia from Negro Bay south to the border of Kenya (Fig. 3, p.20) Principal influences are the proximity to water and direction of monsoon winds. Mean temperatures range between 24 to 28°C and relative humidity is maintained near 75% with little diurnal variation. Figures 21 to 44 indicate the varying values for water deficits, rainfall and evapotranspiration.



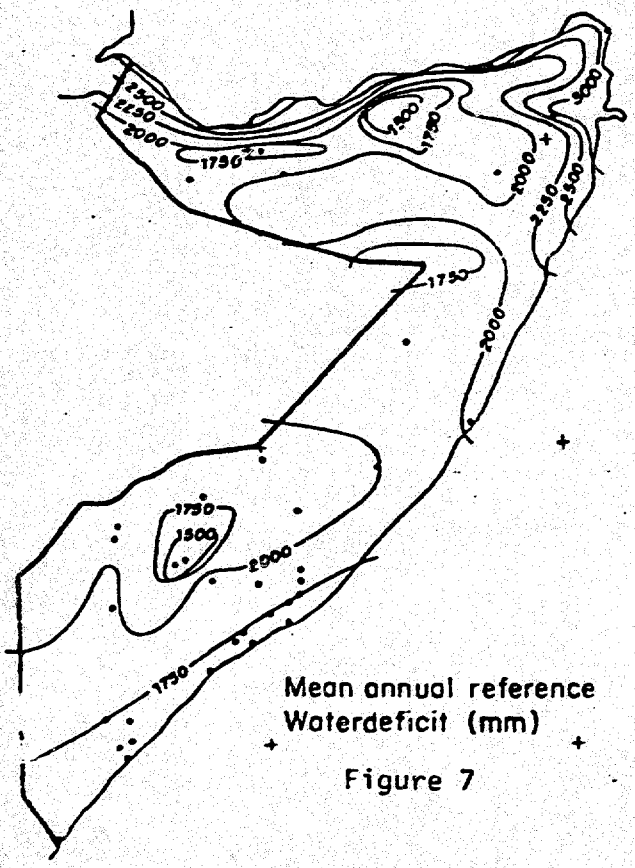
Mean annual reference Evapotranspiration (mm)

Figure 5



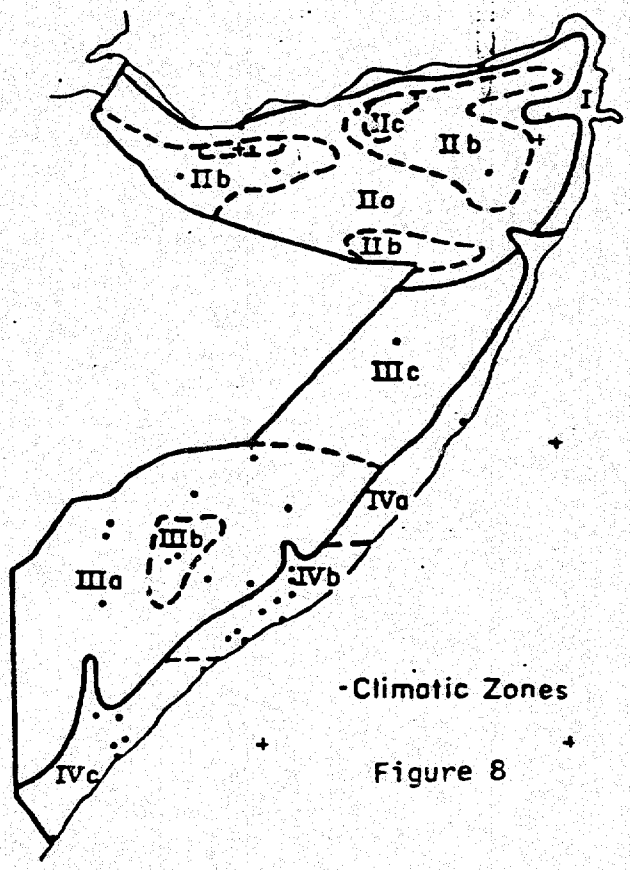
Mean annual Rainfall (mm)

Figure 6



Mean annual reference Waterdeficit (mm)

Figure 7

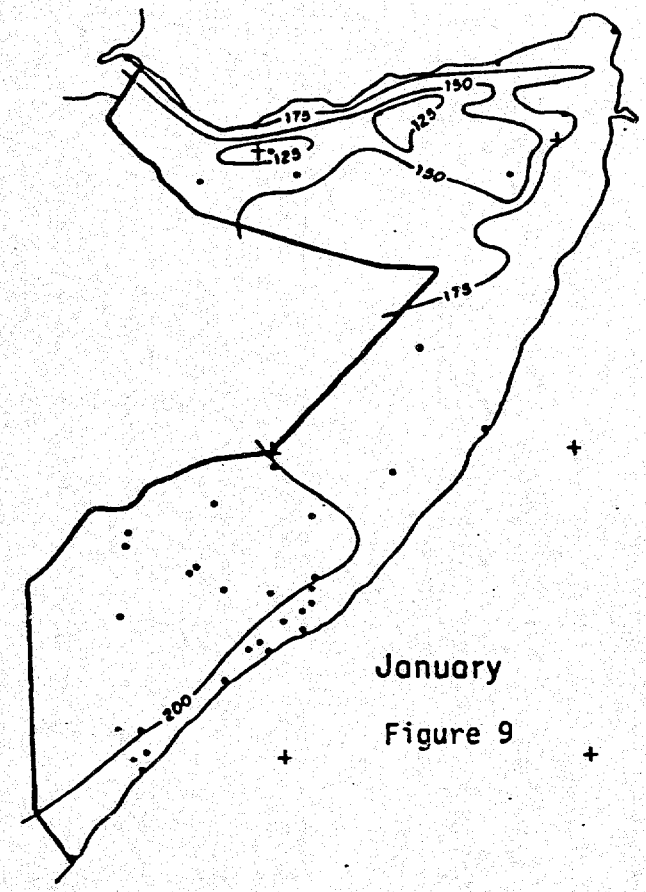


Climatic Zones

Figure 8

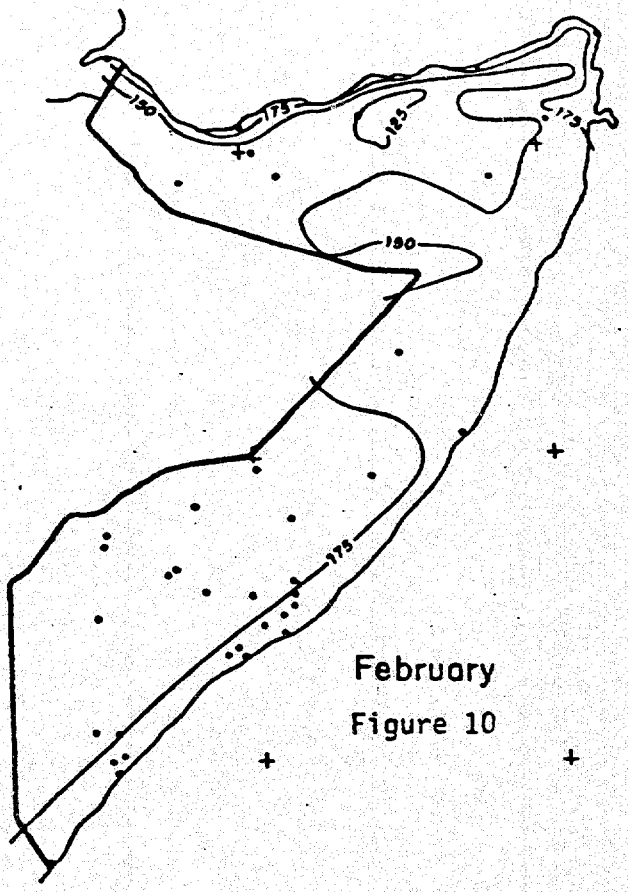
22

- Mean monthly reference Evapotranspiration (mm)



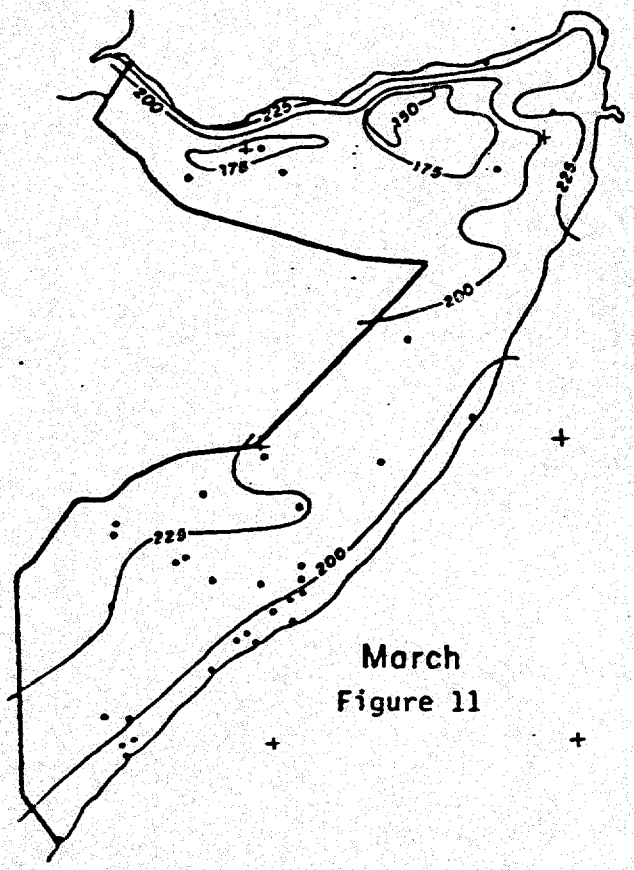
January

Figure 9



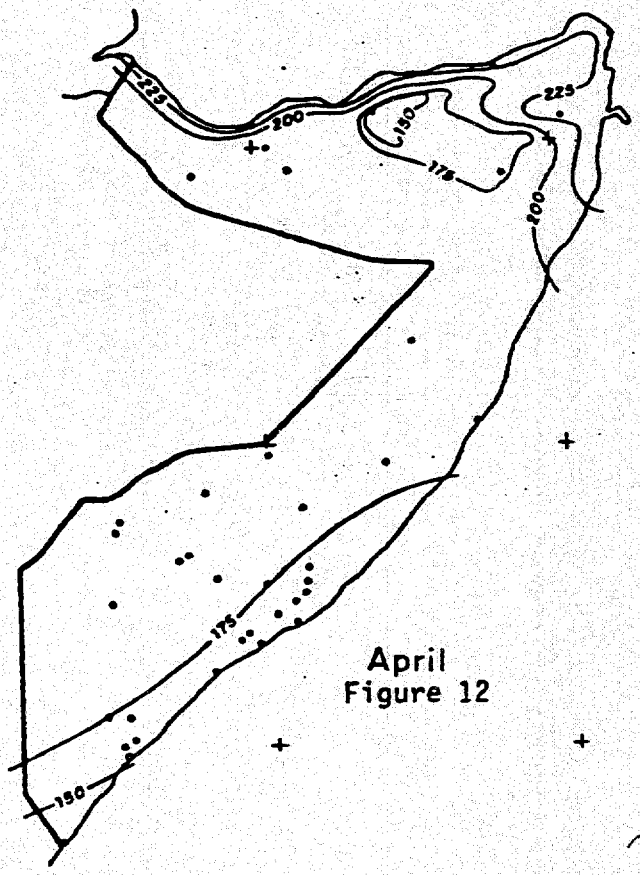
February

Figure 10



March

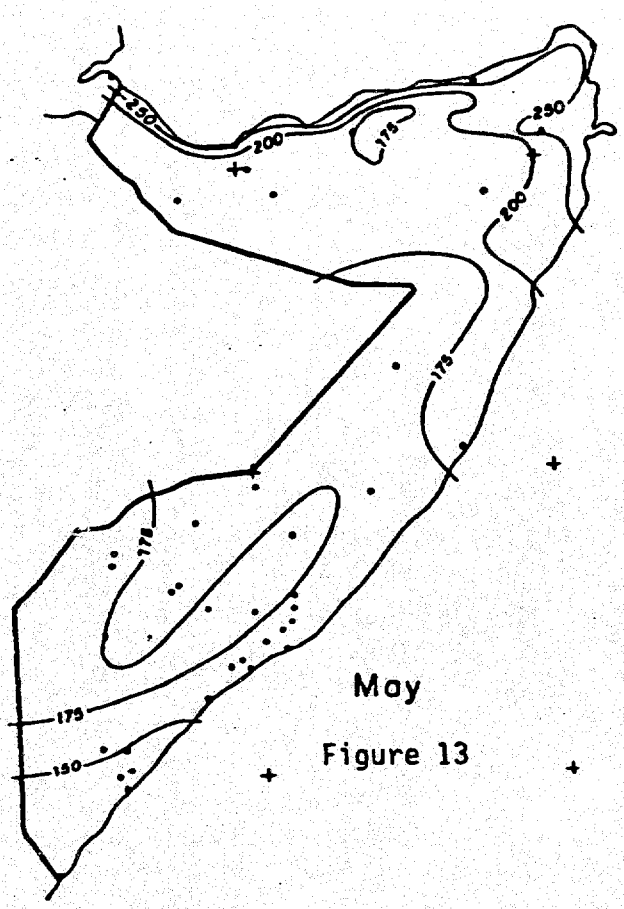
Figure 11



April

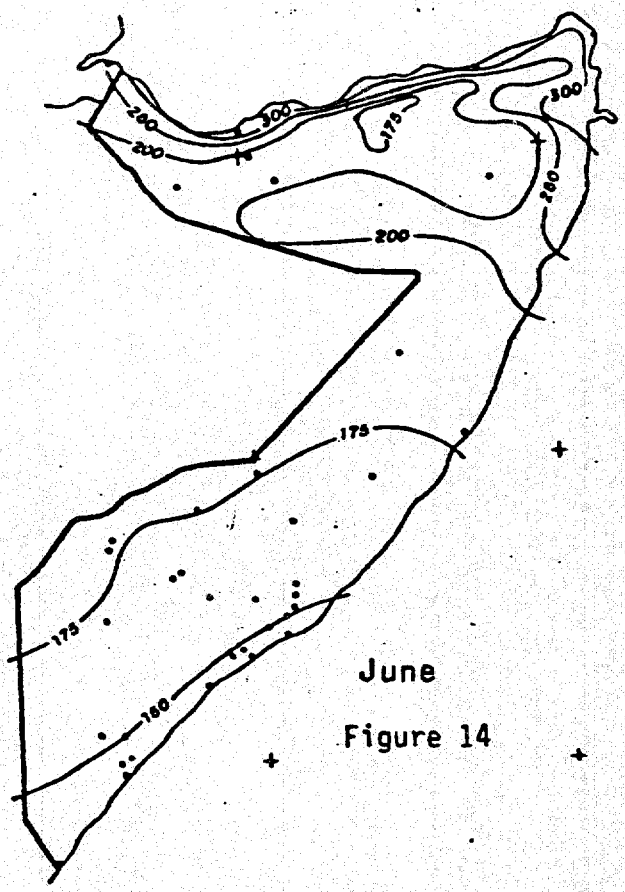
Figure 12

Mean monthly reference Evapotranspiration (mm)



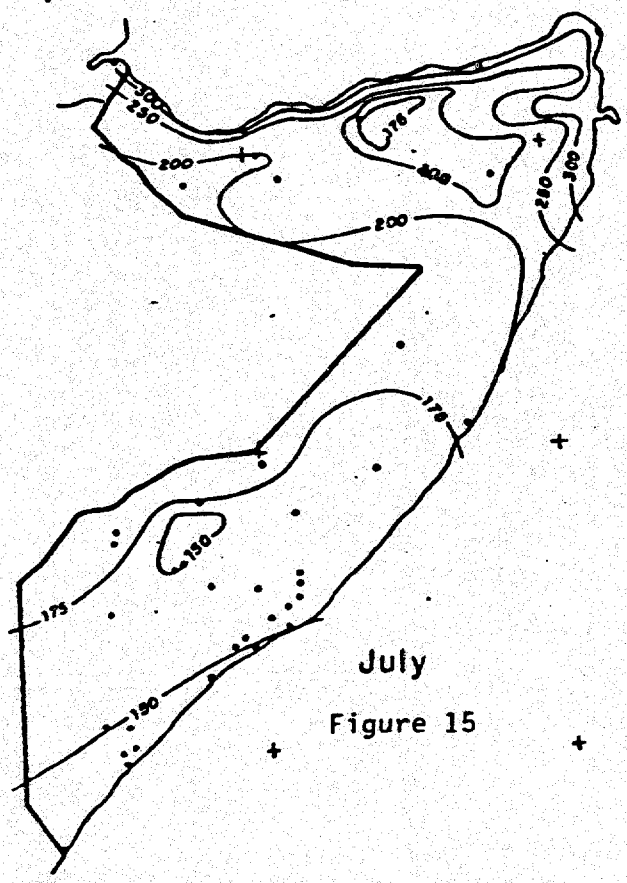
May

Figure 13



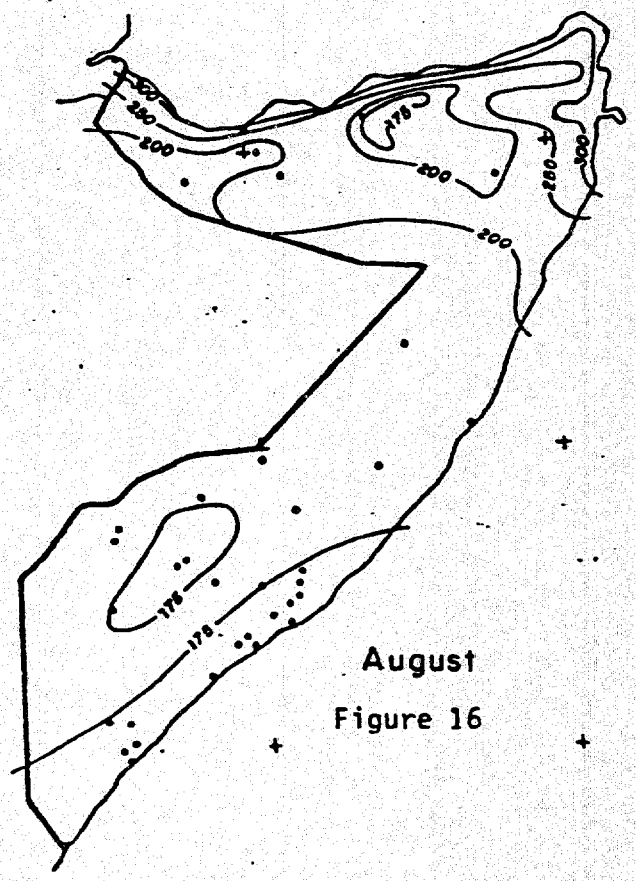
June

Figure 14



July

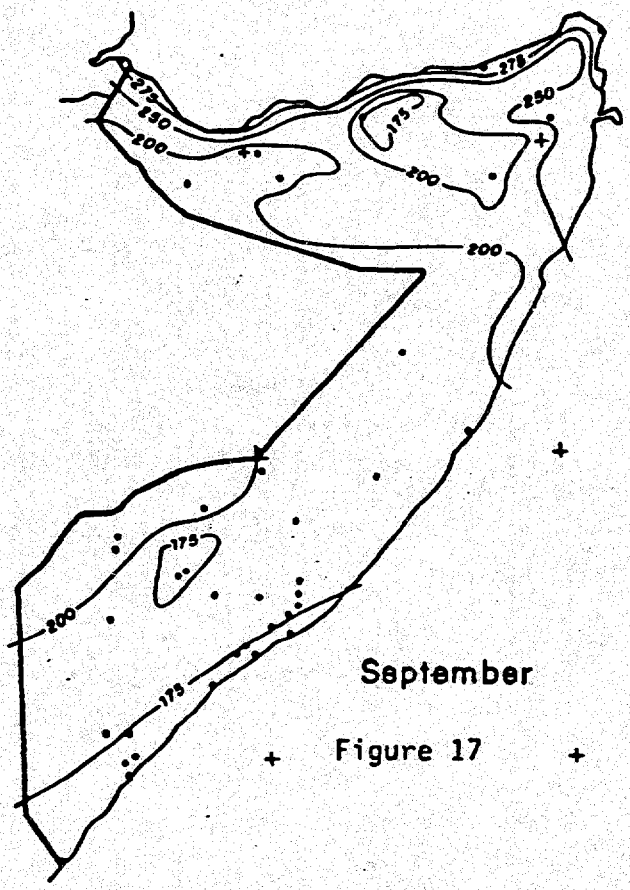
Figure 15



August

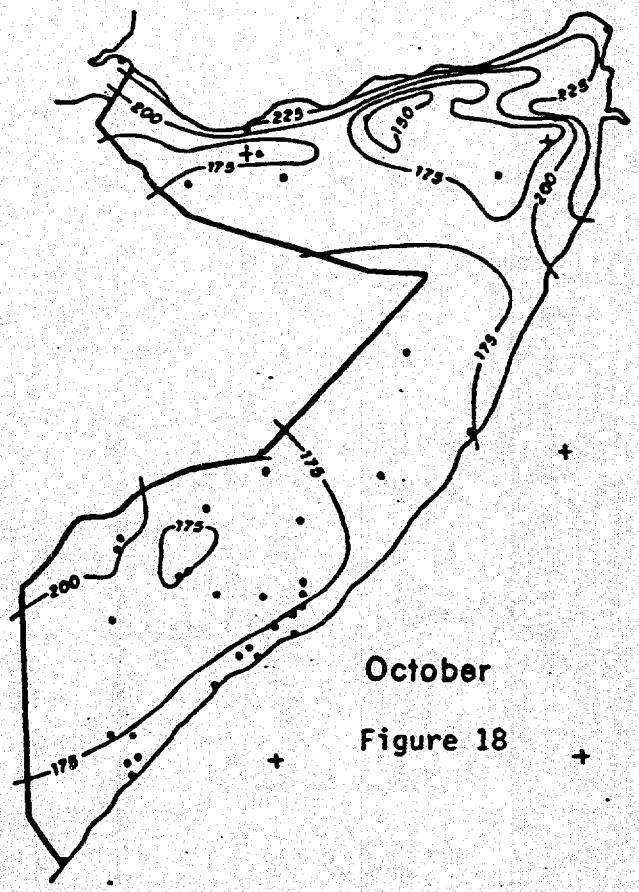
Figure 16

Mean monthly reference Evapotranspiration (mm)



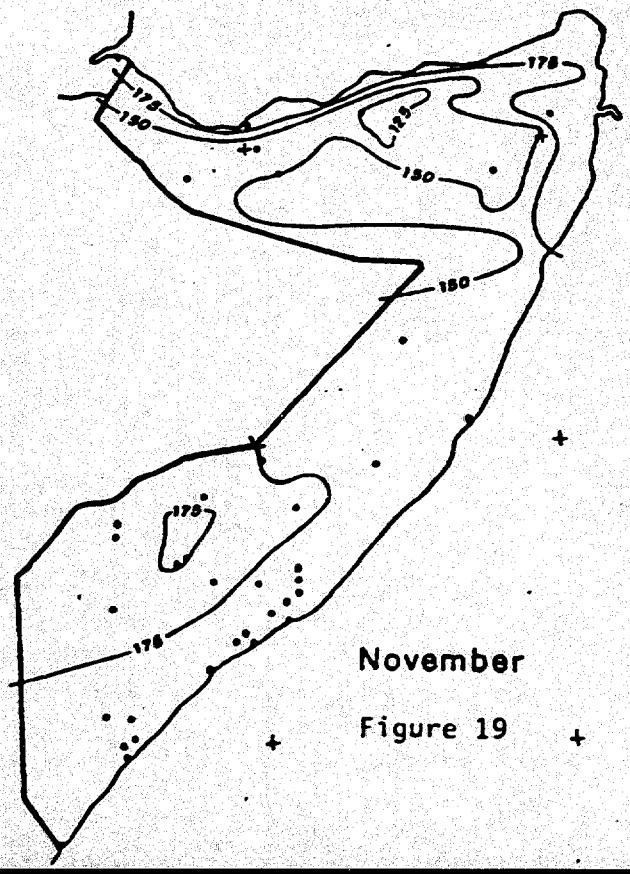
September

Figure 17



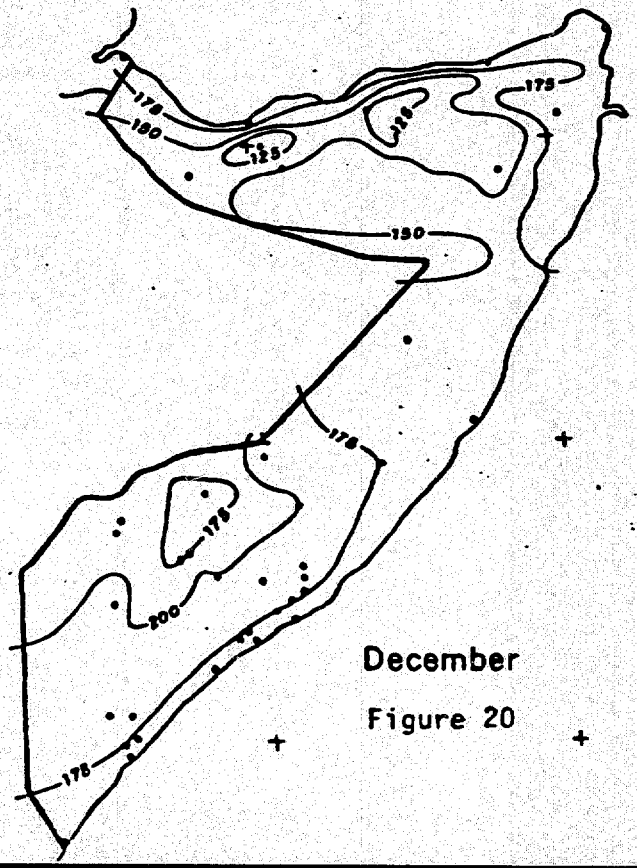
October

Figure 18



November

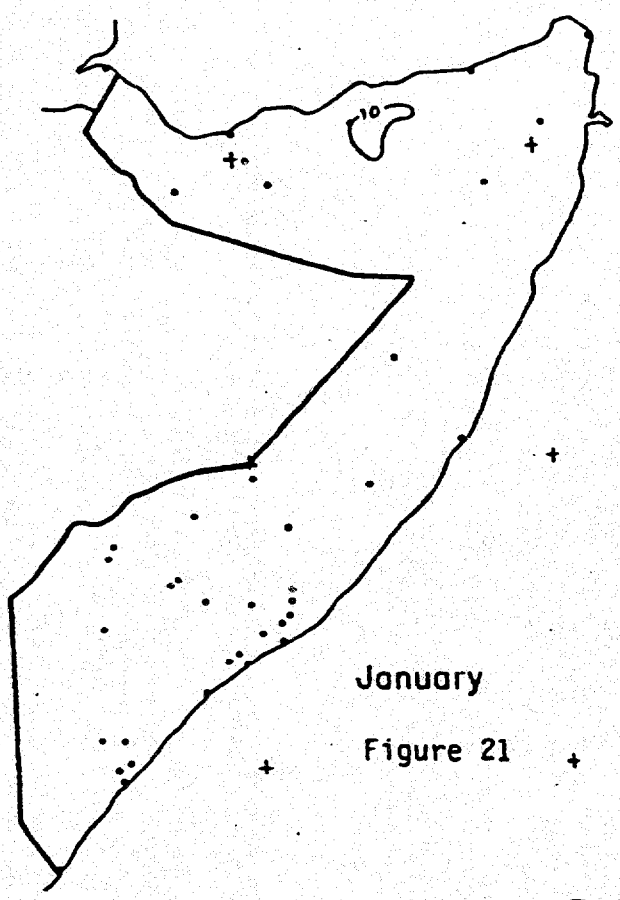
Figure 19



December

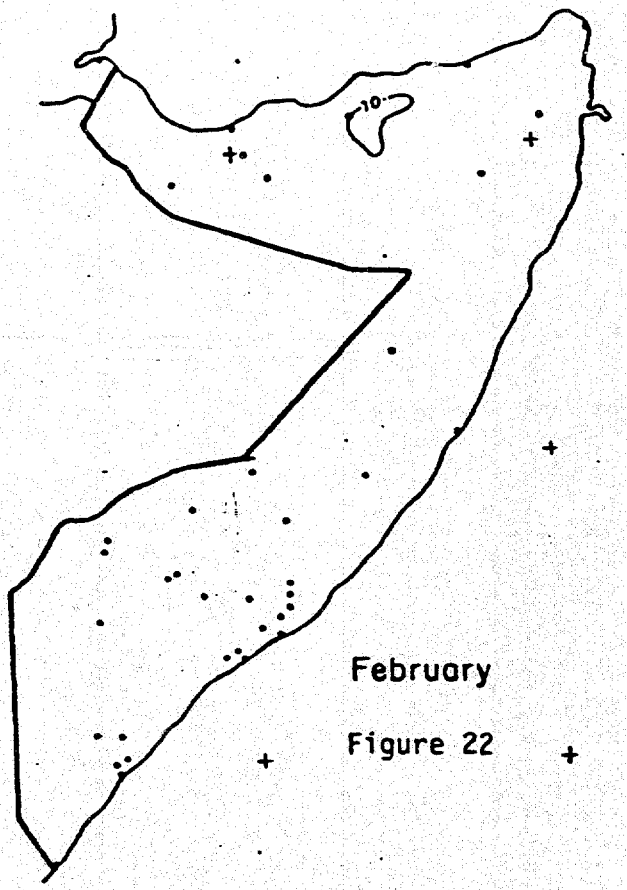
Figure 20

- Mean monthly Rainfall (mm)



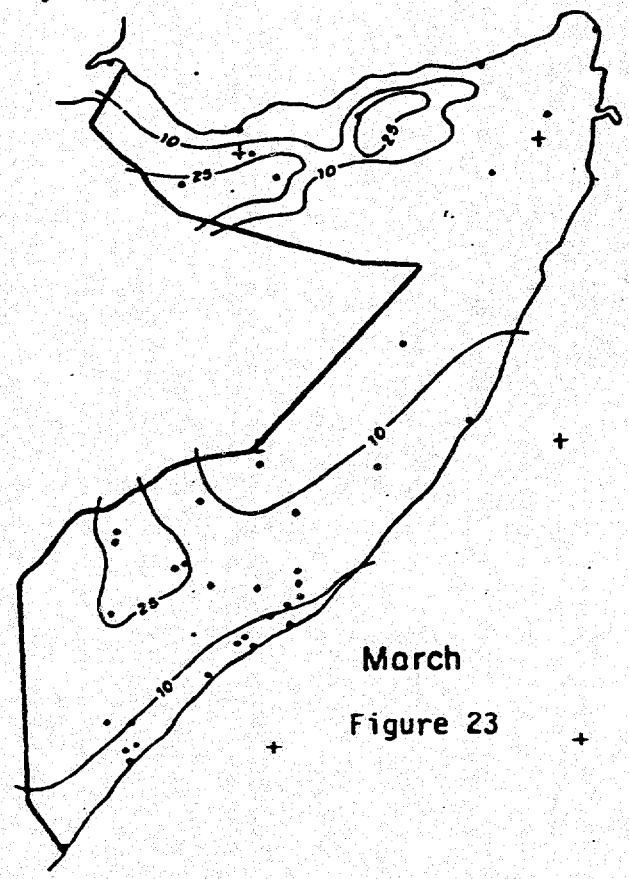
January

Figure 21



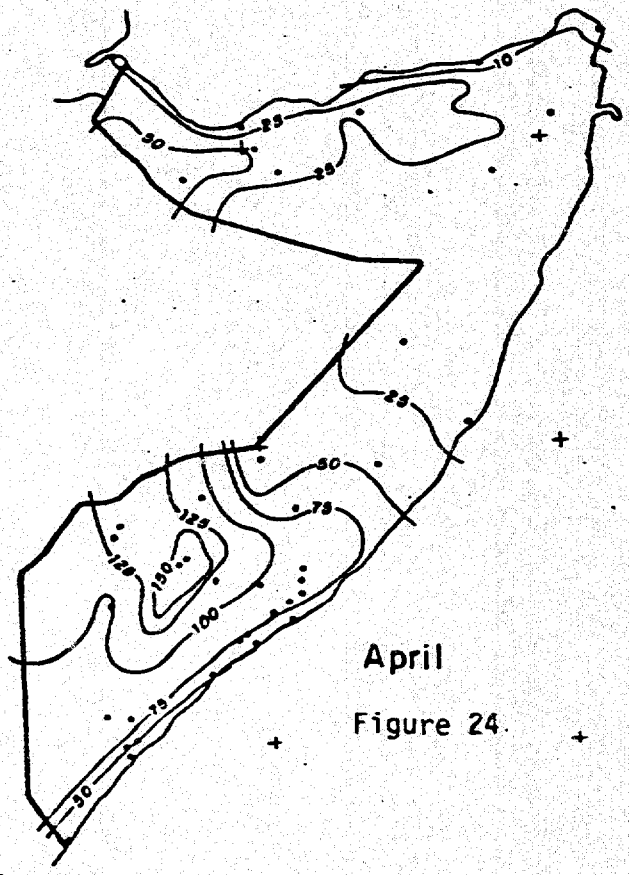
February

Figure 22



March

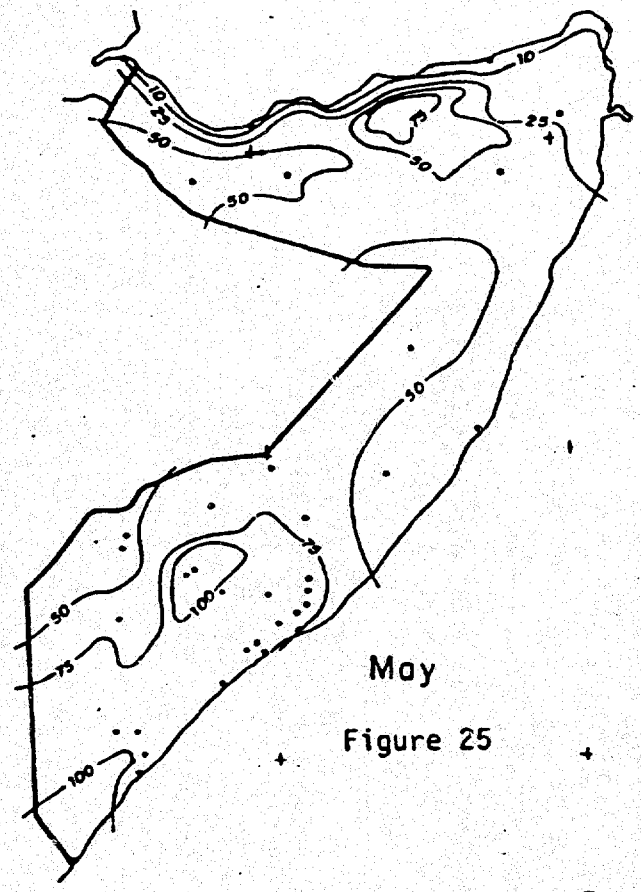
Figure 23



April

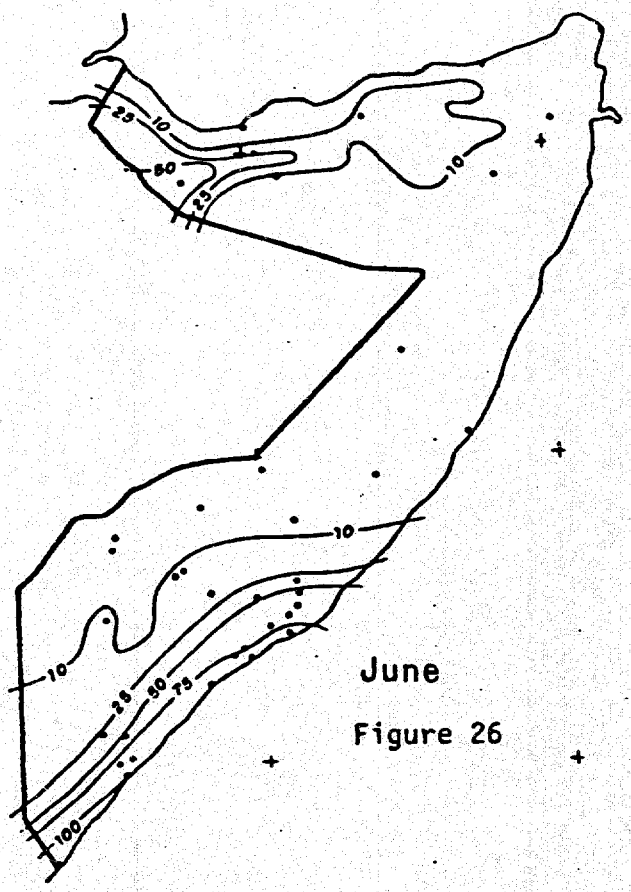
Figure 24

- Mean monthly Rainfall (mm)



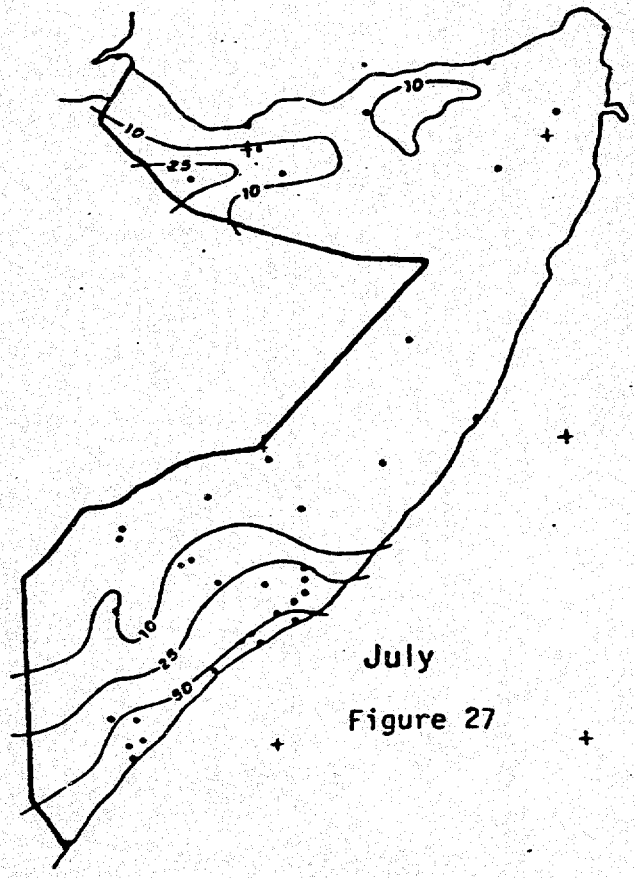
May

Figure 25



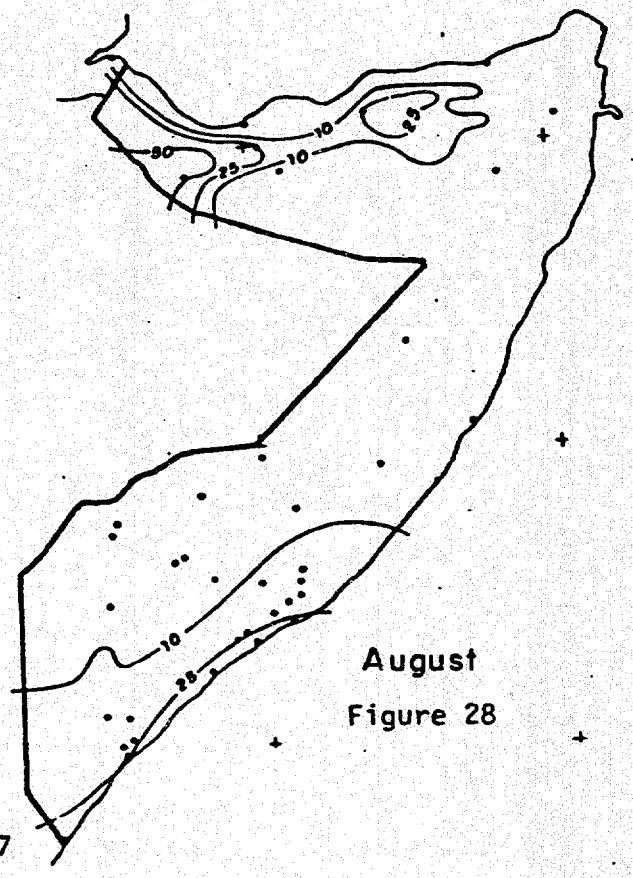
June

Figure 26



July

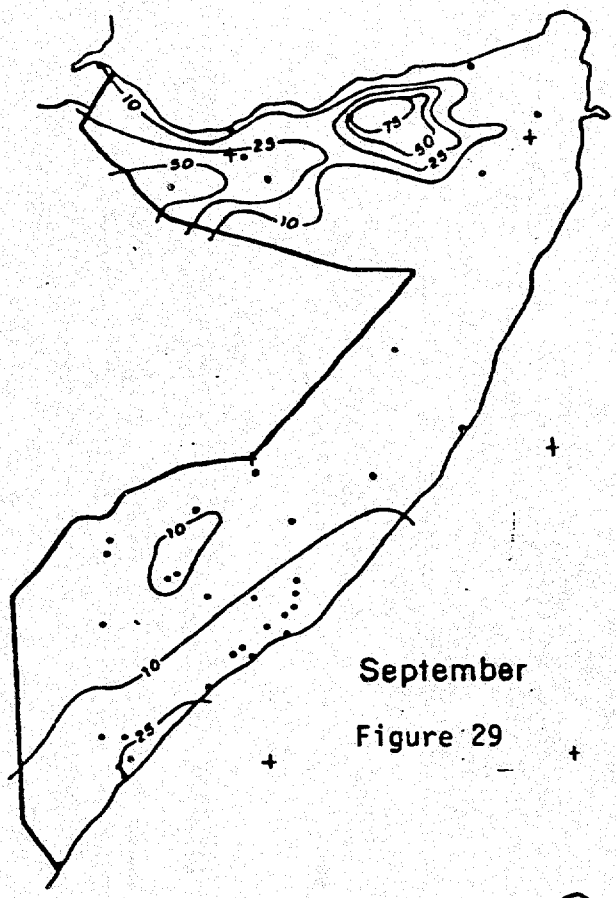
Figure 27



August

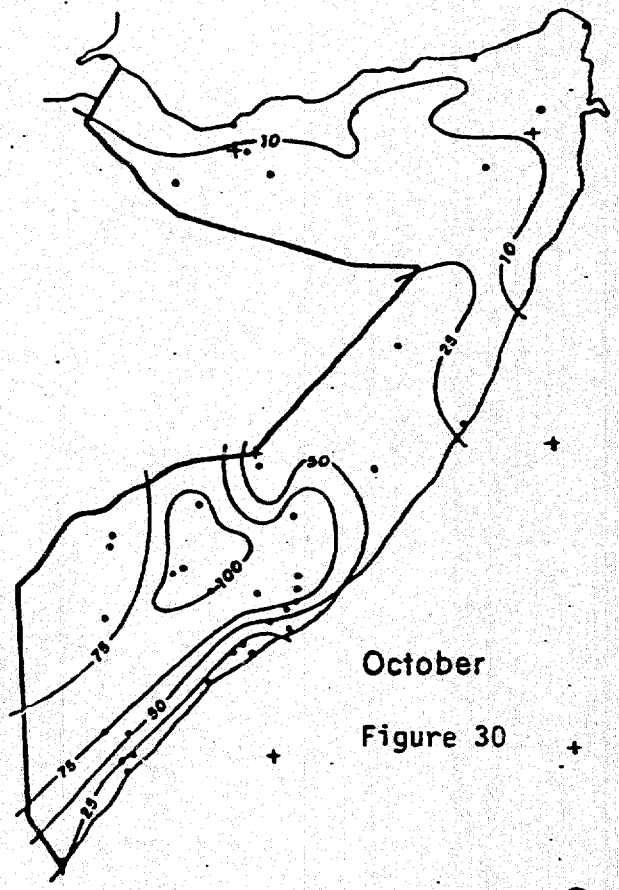
Figure 28

Mean monthly Rainfall (mm)



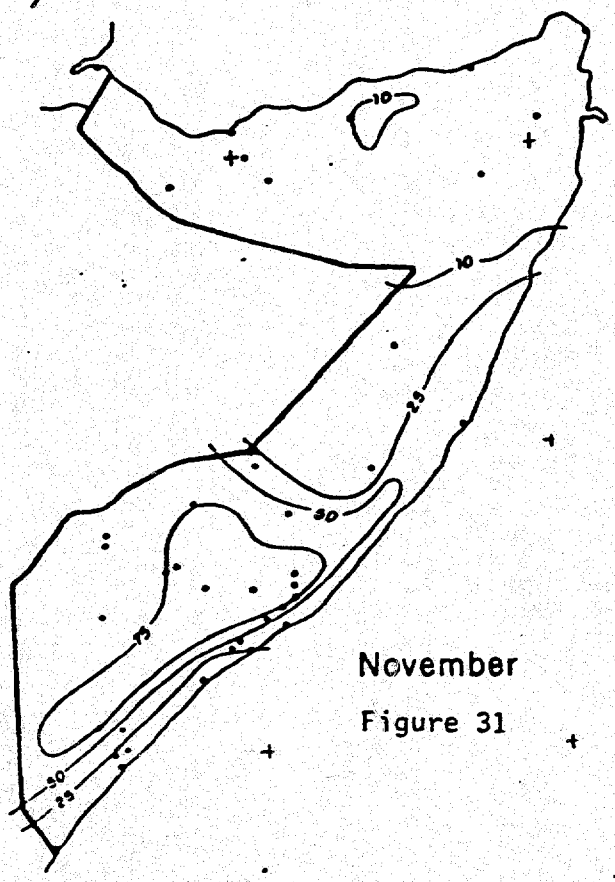
September

Figure 29



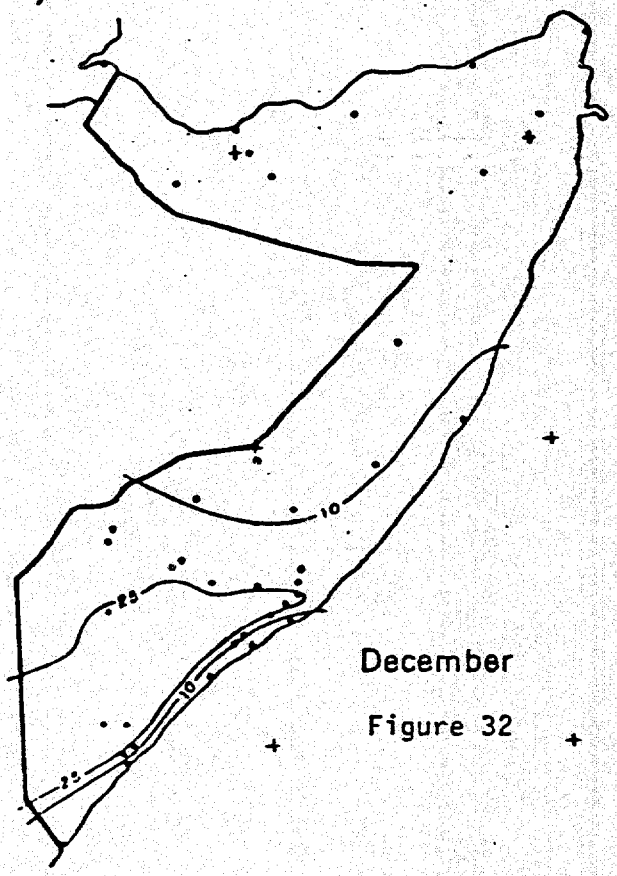
October

Figure 30



November

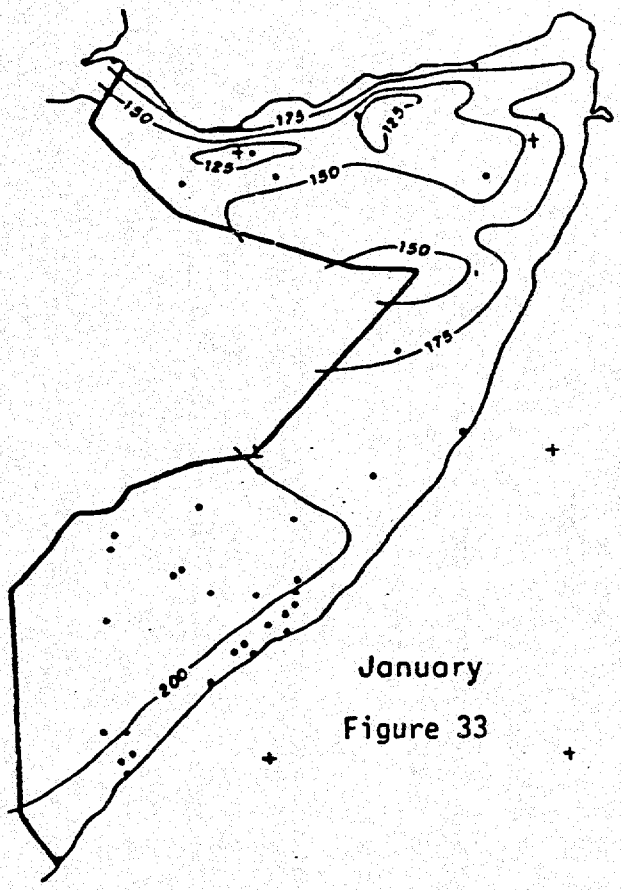
Figure 31



December

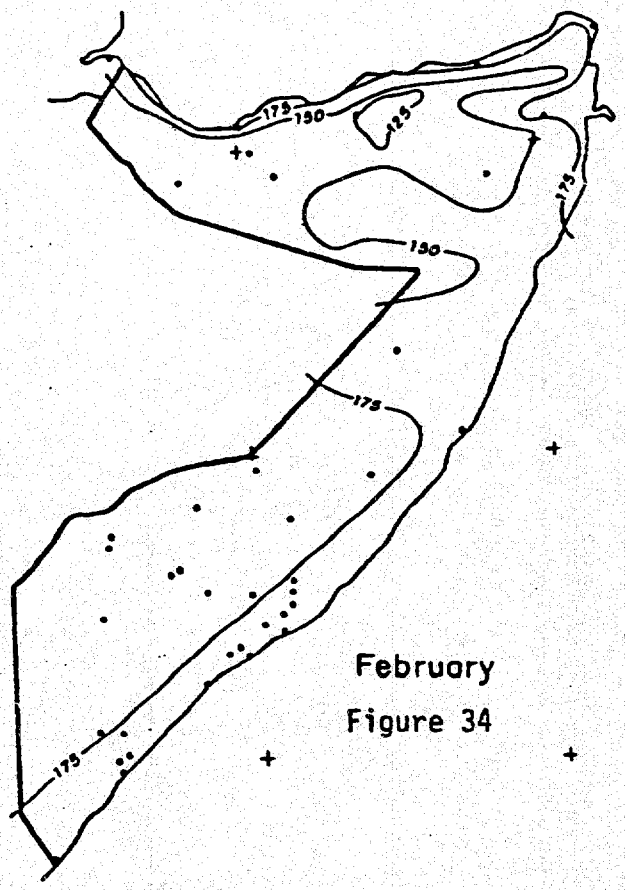
Figure 32

Mean monthly reference Waterdeficit (mm)



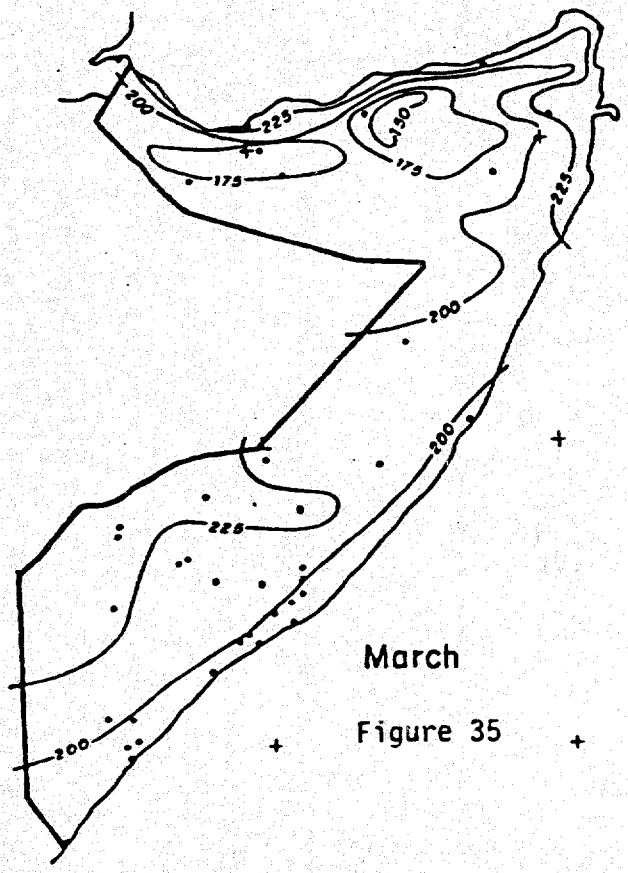
January

Figure 33



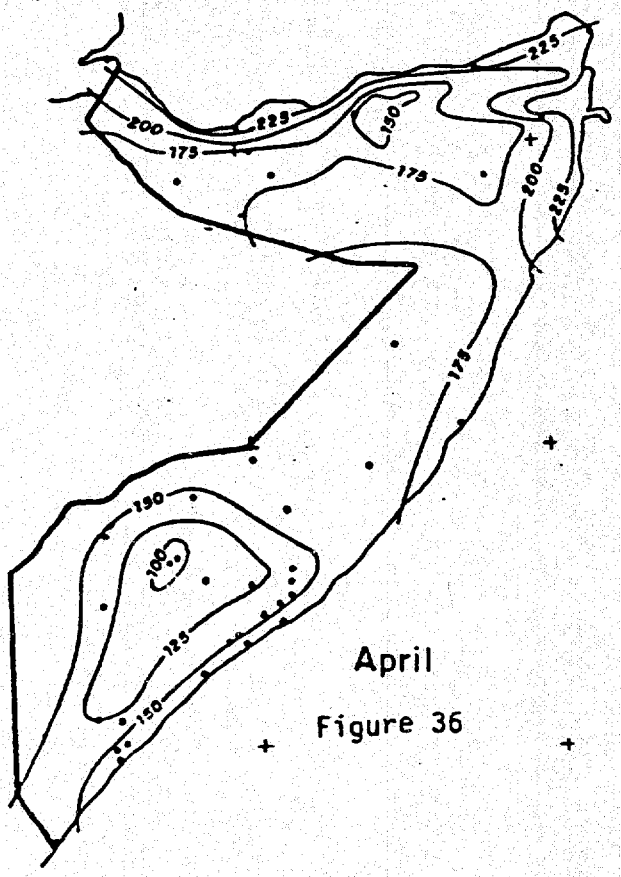
February

Figure 34



March

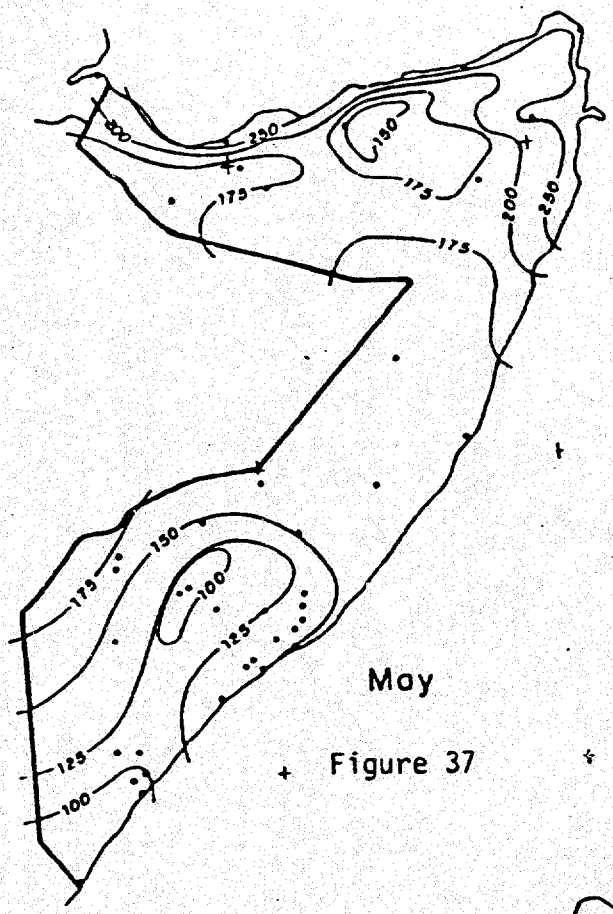
Figure 35



April

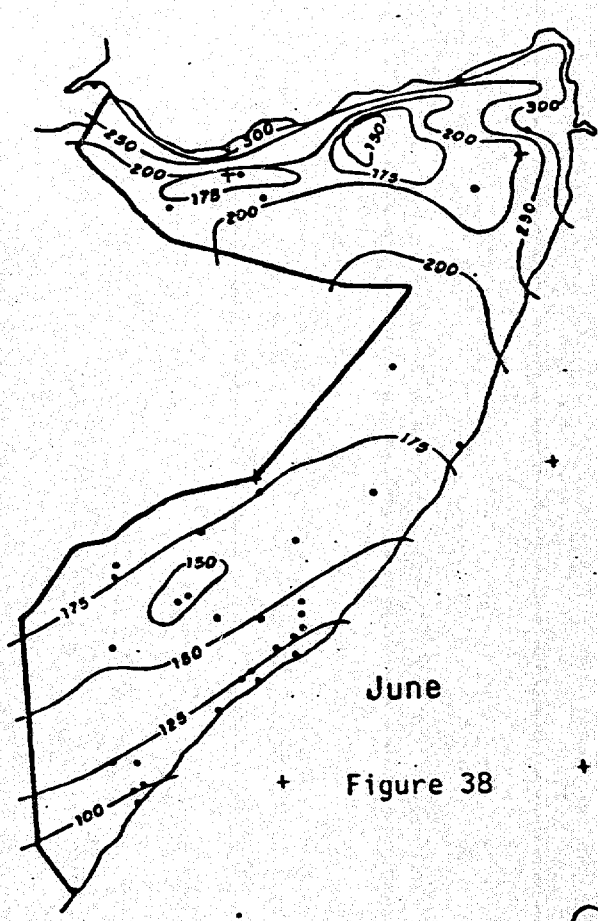
Figure 36

Mean monthly reference Waterdeficit (mm)



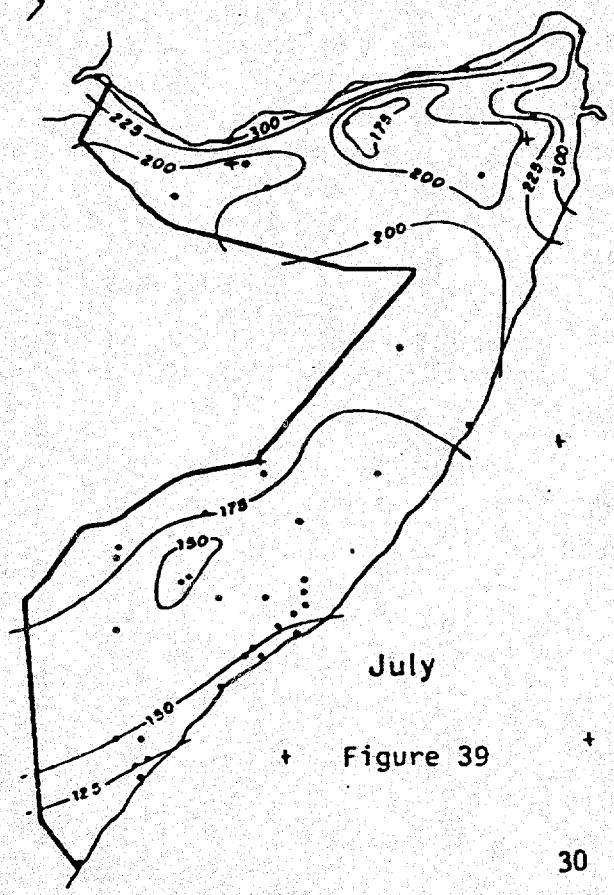
May

Figure 37



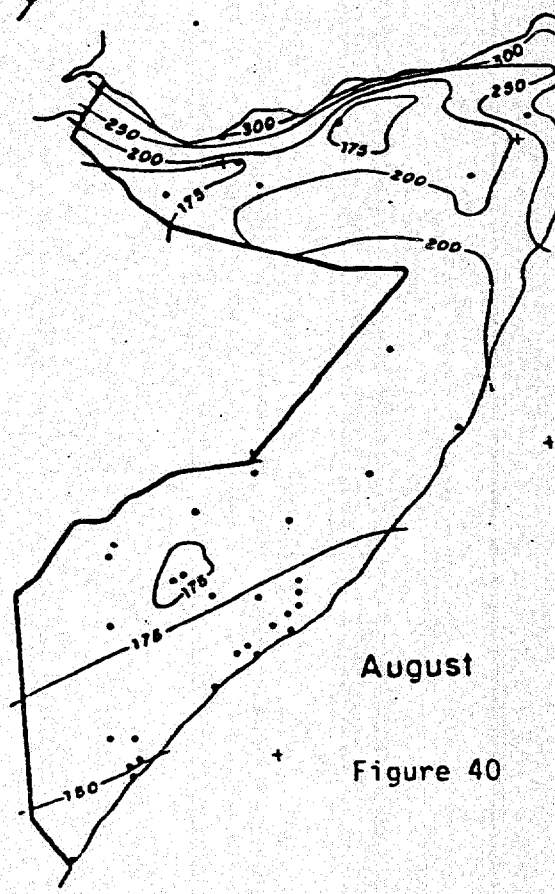
June

Figure 38



July

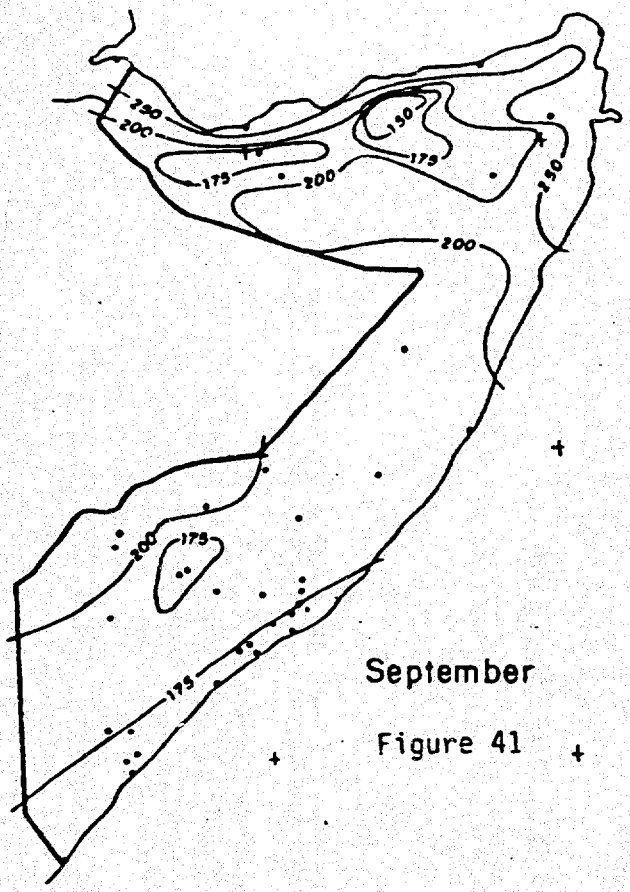
Figure 39



August

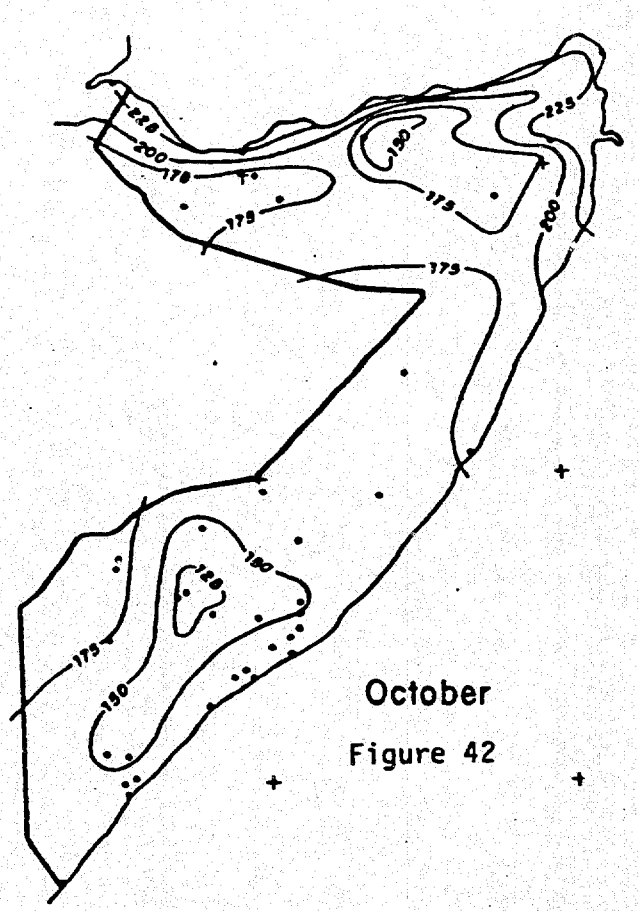
Figure 40

- Mean monthly reference Waterdeficit (mm)



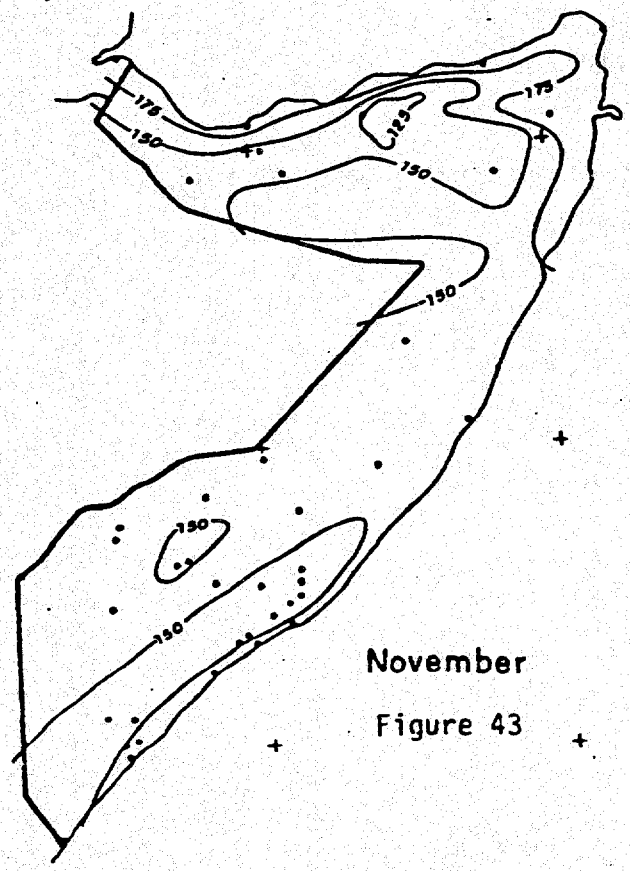
September

Figure 41



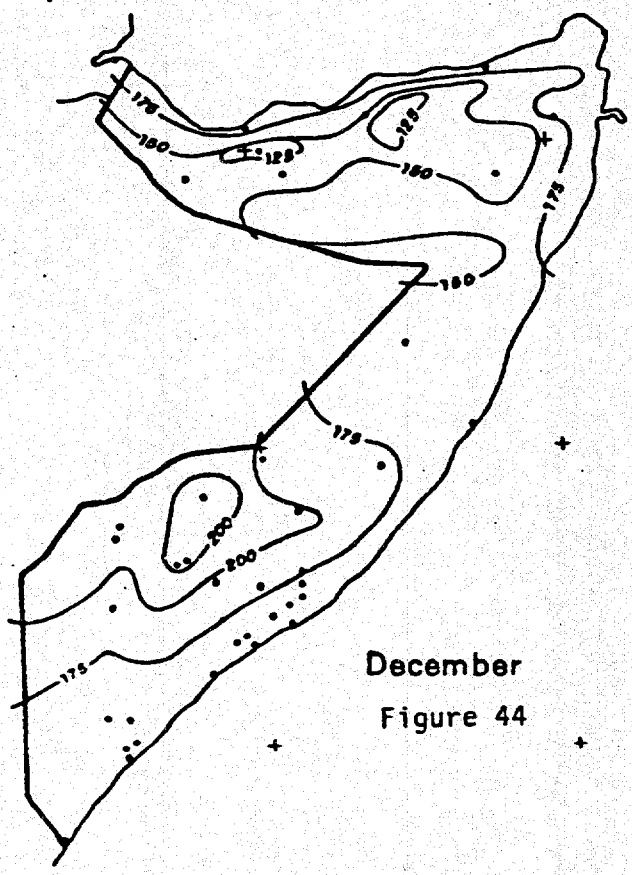
October

Figure 42



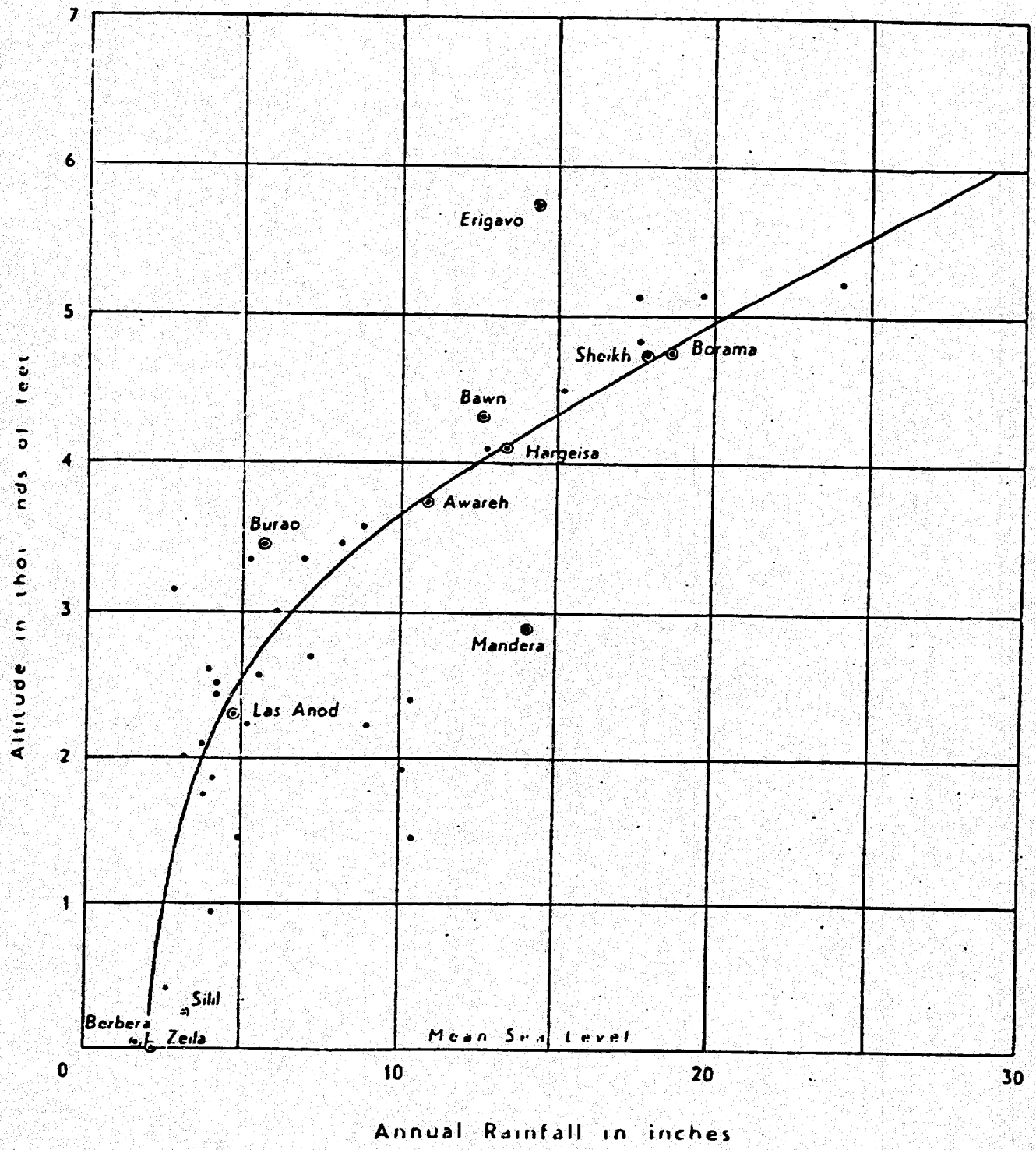
November

Figure 43



December

Figure 44



Rainfall and Altitude

Figure 45

Northern Coastal Area

Mean monthly temperature (Tmean) ranges from 25°C in winter to over 35°C in summer months. Mean relative humidity (RHmean) is from 75% in winter to 50% during summer. Winter and summer windrun is respectively 200 km/day and 300 km/day. Sunshine hours (n) remain high throughout the year. As a result, ETo is high to very high and varies between 200 mm during winter months to over 300 mm during summer months. Mean monthly rainfall (Pm) is insignificant. Therefore, reference water deficit (WD) for each month is equal reference evapotranspiration (ETo).

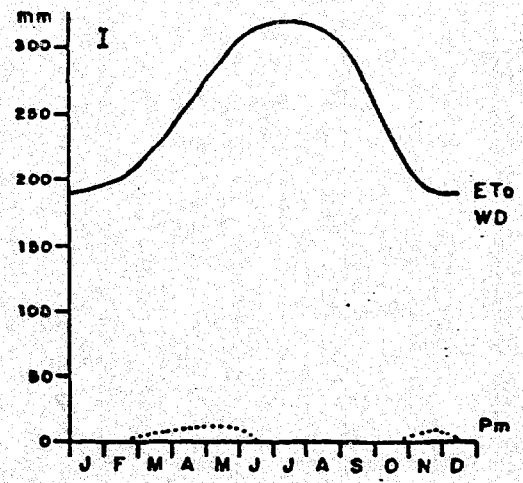


Figure 4

II. Northern Mountain Area

With altitudes varying between 200 m to over 2 000 m, mean monthly temperatures range from 15°C in winter months to 25°C in summer. Relative humidity during daytime is lower than for the coastal areas; RHmean is some 50 - 60%. Windrun is similar but sunshine duration is lower than for the Northern Coastal rea. ETo varies between 125 mm during w ter mouths to 185 mm during summer months. I area experiences a two-peak rainfall (May and September), with annual amounts varying widely from 50 to 750 mm. While a seasonal pattern can be identified, monthly amounts can vary greatly from year to year; for example for Hargeisha during May and August monthly rainfall may vary between 0 and 185 mm with mean of 70 mm. Due to changes in ETo and Pe over area, a subdivision in the climatic zone can be made according to altitude which is shown in Appendix 2.4 as IIa (200 - 800 m), IIb (800 - 1 500 m) and IIc (greater than 1 500 m).

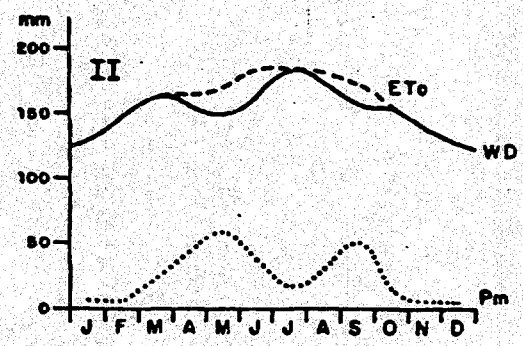


Figure 4

III. Mid-Southern Inland Area

The southern part experiences its highest temperatures during March, with Tmean = 30°C, shifting somewhat to April-May more northwards. The monthly range of Tmean is relatively small, between 4 and 6°C, with coolest temperatures recorded during summer. RHmean is some 70 - 80% during winter months and 50 - 60% during summer. Cloudiness follows the rain distribution closely with the highest sunshine duration in March. ETo is some 200 mm/month during winter, with subsequent decrease to 160 mm/month in June; during July to December ETo is some 180 mm/month. The area has a two-peak rainfall distribution with annual amounts varying from 150 to 500 mm/year. The begin- ngs and ends of the rainy periods have an eliable character. Based primarily on ETo and Pe, a subdivision can be made as shown in Appendix 2.4 with IIIc as the transition to the climate of the Northern Areas and IIIb with highest rainfall due primarily to the windward slope of the central mountain area.

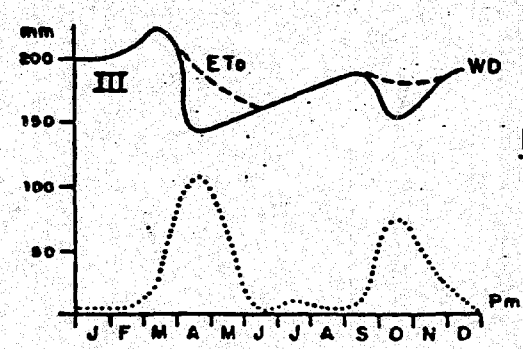


Figure 48

IV. Southern Coastal Area

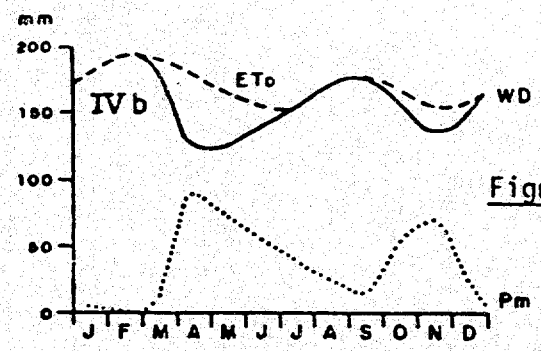


Figure 49

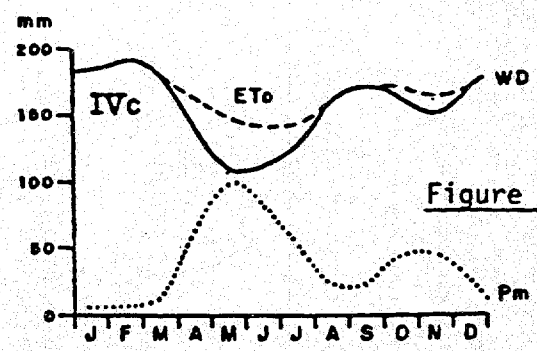
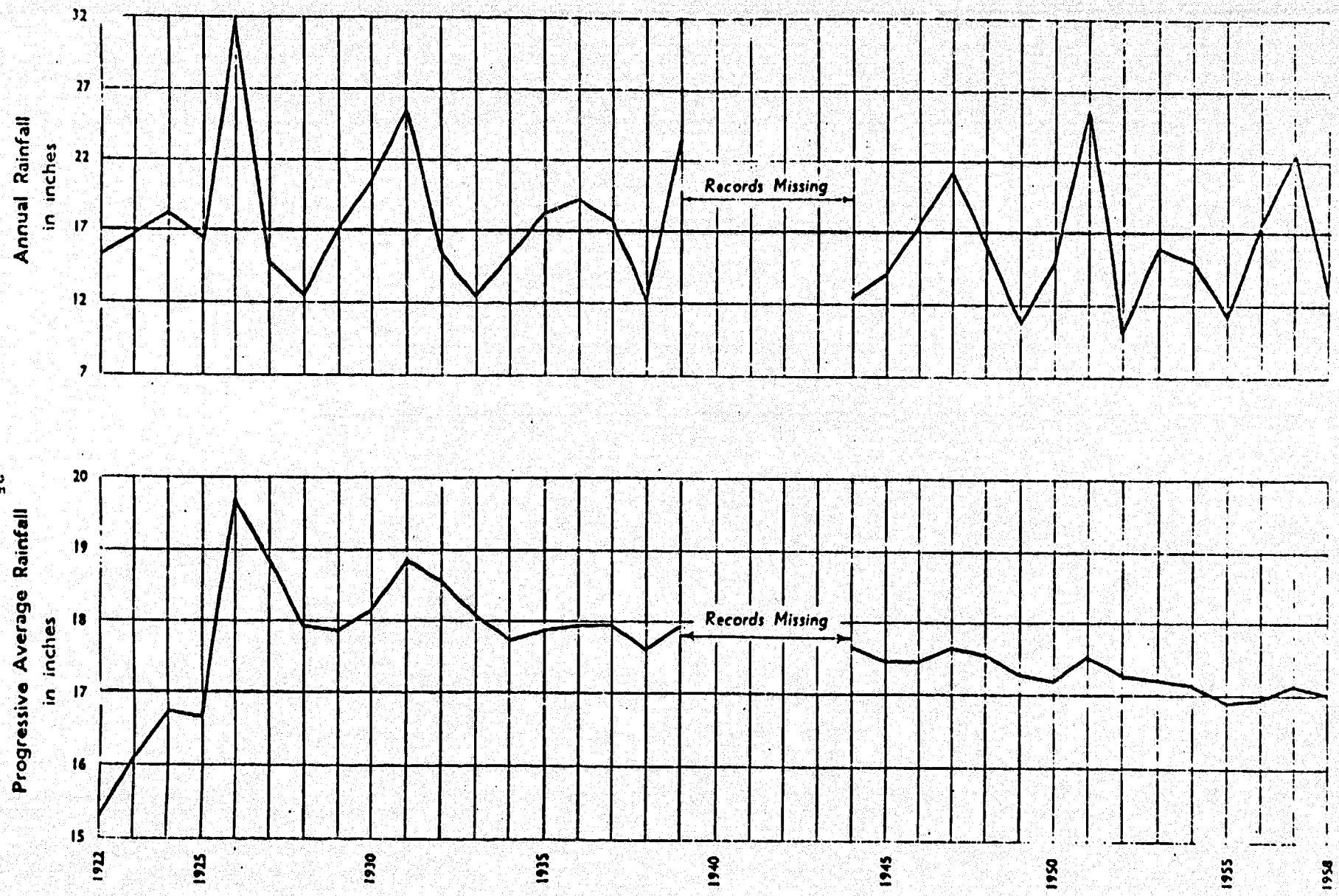


Figure 50

The range of monthly Tmean is small, 2 - 4°C, with highest values of Tmean during March-April of some 28°C and lowest values during mid-summer. RHmean is some 80% throughout the year with a 10 - 15% decrease inland. Wind direction is northeasterly during November-April and southwesterly in May-October. Lowest wind-speeds are recorded during transition months. Land-sea air circulation is experienced throughout the year. In the south near Chiamboni, southwesterly winds are recorded most of the year and rainfall here is highest. A shift in peak rainfall during April for the northern part of this area and in May-June for the southern part is noted. Second peak rainfall, October-November, is much less pronounced in the southern part. This shift in season gives rise to subdivision of the coastal area into three zones as given in Appendix 2.4.



Annual Rainfall at Hargeisa

VEGETATION

This section describes Somalia's natural vegative resources. It is divided into four major geographical sections: Northern Zone, Central Zone, Coastal Zone, and Interriverine Zone. These major zones are divided into more specific subzones as well as by vegetative type and vegetative cover classification/forage production. It is in this latter category that livestock carrying capacity is discussed, with an indication of whether or not the area is overgrazed.

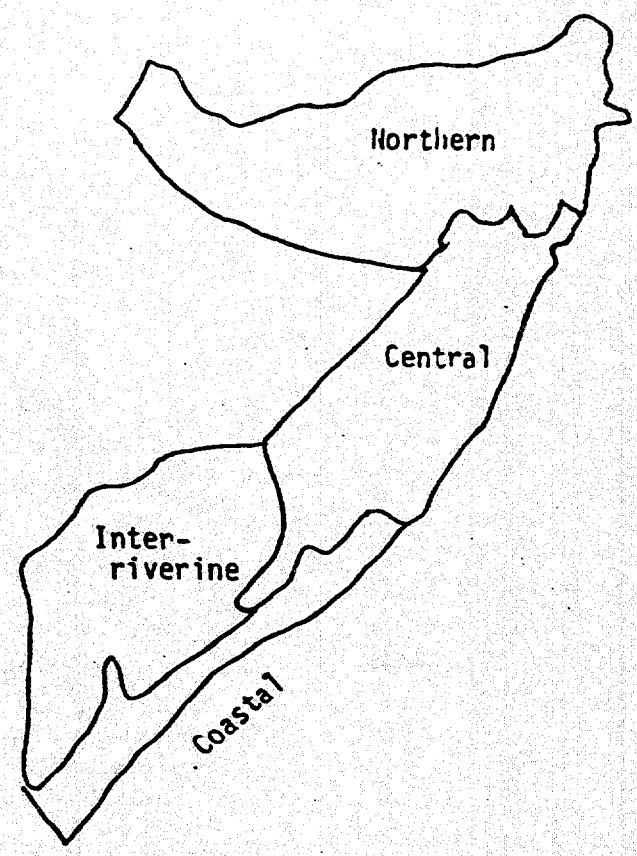


Table 1 below provides a summary of findings. It will be noted that the range carrying capacities of most areas have been exceeded. In summary of this section, the total estimated livestock requirement is about 9.5 million tons of TDN per year. The range production capacity is estimated at about 5.9 million tons. Crop residue and crop by-product production capacity are variously estimated between 100,000 to 500,000 tons annually. The short fall from these estimates is about 3 million tons.

TABLE 1
Showing Areas of Vegetation and Condition of Range

Area	Range within Carrying Capacity	Range Carrying Capacity Exceeded
Northern Zone		
Coastal plain	X	
Highlands & Maritime Range		X
Central Zone		
Haud		X
Hiraan Plateau	X	
Shebelli Flood Plain		X
Central Coastal Plains		X
Central Inland Elevated Plains		X
Coastal Zone		
Italia to Mogadiscio	X	
Mogadiscio to Kismayo		X
Interriverine Zone		
North of line between Bardera and Bulo Burti		X
South of line between Bardera and Bulo Burti	X	
From lower Shebelli to coast		X

When considering the feed requirements of animals, a distinction must be drawn between requirements for maintenance or the amount of nutrients required for preserving body temperature and metabolic processes when the animal is at rest and requirements for production expresses as growth, milk or work, etc. Whereas, maintenance requirements are not affected by size in itself, only by maturity. This is especially true of protein requirements, which also vary according to the particular channel of production. For example, milk production requires a diet of higher protein value than does meat requirement. For purposes of this report, two levels of food intake are considered--minimum production at 2.6 tons of dry matter per animal unit, and as an estimate based on mere survival, 1.6 tons of dry matter per animal unit for Somali nomadic herds.

These figures are derived from: (a) suggested daily nutrient allowances for growing and fattening zebu cattle, (b) calculations in Hunting Services reports, and (c) estimates in the reports by the Arab Organization for Agriculture Development.

Table 2

CARRYING CAPACITIES AT VARIOUS TONNAGES OF FORAGE

Forage Production Tons km^2	Carrying Capacity (AU/km^2) @ 2.6 AU Feed Requirement	Carrying Capacity (AU/km^2) @ 1.6 AU Feed Requirement
6--10	2.3--3.8	3.75--6.25
10--15	3.8--5.8	6.25--9.3
15--20	5.8--7.7	9.3--12.5
20--30	7.7--11.5	12.5--19
30--45	11.5--18	19--28
45--75	18--29	28--47
75--125	29--48	47--78
125+	48+	78+

The arid zone is little known from the botanical point of view. Vast areas are unexplored. Knowledge of the vegetation is scanty and is chiefly based on generic descriptions of the main formations (Engler, Negri, Chiovenda, Senni, Collenette, Chevalier). Detailed researches were devoted to the study of the vegetation of some areas northern Somalia (Gillett, Gilliland).

Studies on the vegetation have been hampered by different criteria. Coordination is extremely difficult also owing to the nomenclature of various plant-formations, as the same plant community was often indicated by several different names while the same name was used for different types of vegetation.

NORTHERN ZONE

The northern portion of Somalia, which was the British Protectorate, can be divided into three basic sub zones: 1) the coastal plain, 2) the maritime range and highlands, and 3) the high inland plateaus - northern Haud, Sarar, Sawl Haud and inner Nogal Valley. (see Figures 52 & 53, page 40)

I. Coastal Plain

The northern coastal plain and its dunes are easily distinguished on satellite photos. This portion of the coastal plain extends from Djibuti east to the tip of the Horn. The remainder of this sub zone runs south along the Indian Ocean to the mouth of the Nosal River.

The climate is particularly severe and the annual rainfall varies between 27.1 and 125.0 mm, with a long dry season of about 8 months. The annual mean temperature is about 30°. Abundant dews are recorded, but their influence is limited. Evapotranspiration is in excess of 3000 mm, leaving a water deficit equal to the evaoptranspiration level. (see Figures 6 and 7, p 22)

Geologically (see Figure 3, p. 20) the maritime plane is essentially composed of Pliocene-Lower Quaternary proluvial and marine sedements and coastal marine formation. The middle third of the maritime plain from Raskhanara to roughly Basso on the east is composed of Cretaceous undifferentiated and upper Precambrian inland series sandstone. The easternmost third is a mixture of Pliocene-Lower Quaternary and Miocene Scushuban and upper Daban series, interspersed with Ecocene Karkar series. From the tip south to the mouth of the Nogal River is predominantly Oligocene sedement.

Hydrogeologically, there is a line of permanent wells along the northern coast line dependent on an extensive underground water system. The prevailing depth to ground water is from 3 to 15 meters. Mineralization of ground water is fairly high, being 3 to 5 grams per liter. On the eastern coast line, depths and mineralization are similar.

Soils along the northern coastal plain are principally Calcaric Regosals (dune phase) with some extension of Xerosols, and Lithosols into the northern coastal plain. The eastern coastal plain is composed principally of calcic yermosols.

Vegetative Types: Northern Coast

Vegetative cover is poor, affording pasture only for a few months of the year during and immediately after the rains. The Somalia term for the area is "guban" or burnt land.

The principal types of vegetation on the northern coast are the plant communities of the coral beaches, sandy shores, deltas, and of the estuaries.

As mentioned above, the greatest part of the northern coast is represented by beaches in which the substratum is derived from recent coral rocks. The vegetation on the coral beaches is chiefly represented by saline plants (Chenopodiaceae, Zygophyllaceae, Plumbaginaceae, etc.). There are extensive areas of Suaeda fruticosa with frequent bushes of Tamarix nilotica. Suaeda fruticosa are the dominant species on the sheltered shores of Berbera harbour.

The vegetation of the sandy shores is often associated with estuaries and deltas, and therefore has a higher soil water content. On blown sands shrubby communities of Maerua sp. pl., Salvapersica, Tamarix nilotica, Indigofera oblongifolia, Calotropis procera, Zizphus hamur, etc., together with vegetation of herbs and grasses among which

Aeluropus lagopoides, Halopyrum mucronatum, etc. In sites of less salty water Pennisetum divisum, Panicum turgidum and Lasiurus hirsutus occur. Aeluropus lagopoides together with Sporobolus spicatus are found on deep moist sands. Pennisetum divisum and Lasiurus hirsutus are considered as good binders where blown sands occur. In the shore near Djibuti, formed of coral and calcareous materials, a sporadic vegetation with Suaeda monica and Tamarix sp. exists shelves formed by the coral substratum toward the eastern portion of the coast. The vegetation of the flat consists of sparse perennial herbs Limonium sp. pl., Heliotropium sp. pl., Arnebia hispidissima, etc.) with numerour ephermerals (Zygophyllum simplex, Dipterygium glaucum, Tribulus terrestris, etc.) when rains have fallen. Where boulders occur, occasional shrubs such as Adenium sp. and Acacia somalensis may be present.

Eremopogon faveloatus, Trichoaena teneriffae, and species of Eragrostis, Pnicum, Aristida, Cassia obovata, Blepharis edulis, Heliotropium pterocarpum, etc., with widely scattered Aerva tomentosa and Calotropis procera grow on the part of the Bugan which lies along the western and central coast up to an altitude of about 150 m. On eluvial soil, one finds Aerva tomentosa, Jatropha glandulosa and Farsetia longisiliqua among the woody herbs, and Cyperus conglomeratus and species of Aristida, and Enneapogon among the sedges and grasses. On deep sand almost pure cenosis of Eragrostis hararensis or Panicum turgidum is recorded.

Vegetative Cover Classification/Forage Production: Northern Coast

Between Loyada and roughly Berbera, the vegetative cover can be classed as 60 to 70 percent grass steppe and 11 to 20 percent grass plus shrub steppe. From Berbera east the vegetation can be classified as predominately dwarf shrub steppe with the grass thinning down to less than 20 percent at RasKhanara, east from this point vegetative cover is almost 100 percent dwarf shrub steppe. (Fig. 54,55,pp.41,42)

Average forage production is estimated to be 15 to 20 tons per square kilometer between Loyada and Berbera, dropping to less than 3 tons per square kilometer for the remainder of the distance to the tip of the Horn. (Fig. 54a)

Vegetative Types: Eastern Coast

On the coastal cliffs from the tip to Ras Hafun several species of grasses, alophytes, succulents and herbs exist. Between Bender Beila and Ras Hafun, species of Zygophyllum, Gnaphalium, Pupalia, Pulicaria, Aeluropus, Plumbago, Lindbergia, and Heliotropium are scattered on the sandy shores. In some places, thickets of Salvadora persica occur, and along the shore on the sea bottom grow several hydrophytes, among them Halophila stipulacea.

Vegetative Cover Classification/Forage Production: Eastern Coast

From a vegetative cover classification starting at the tip and moving to Bender Baila, cover is composed of 30 to 40% grass plus shrub steppe and 50 to 60 percent dwarf shrub steppe. From Bender Baila south to the Nogal, it is almost entirely dwarf shrub steppe.

Production of forage is low. From the tip south to Bender Baila, production is less than 3 tons. From Bender Baila to the Nogal production tonnage increases to no more than six tons per square kilometer. (See figure 54 and 55 pages 42 and 42)

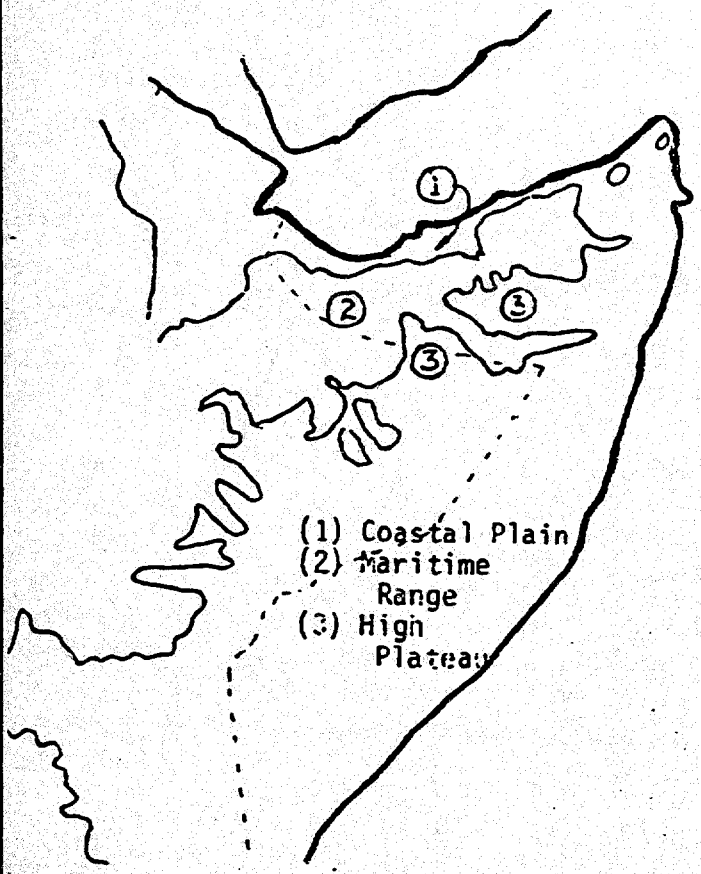


FIGURE 52

This figure provides an outline of the major geographic areas of the northern part of Somalia. The principal determinant is the maritime range which, because of its height, influences rainfall and wind. Because of climatic differences on northern and southern aspects more moisture remains on the southern side. As a consequence, forage production potential is high in the Haud and surrounding areas.

Figure 53, below shows the outline of the major forage producing areas of northern Somalia. All are dependent upon the drainage of the maritime range and the relation between altitude and rain. Records of rainfall for the recent past show a gradual but constant reduction since the 20^{s}. The combined effects of reduced rainfall, overgrazing and loss of ground cover have produced an encroachment of less desireable woody species. On a relative basis, the areas are now carrying more animals per unit of forage production, which may encourage greater proliferation of woody species.

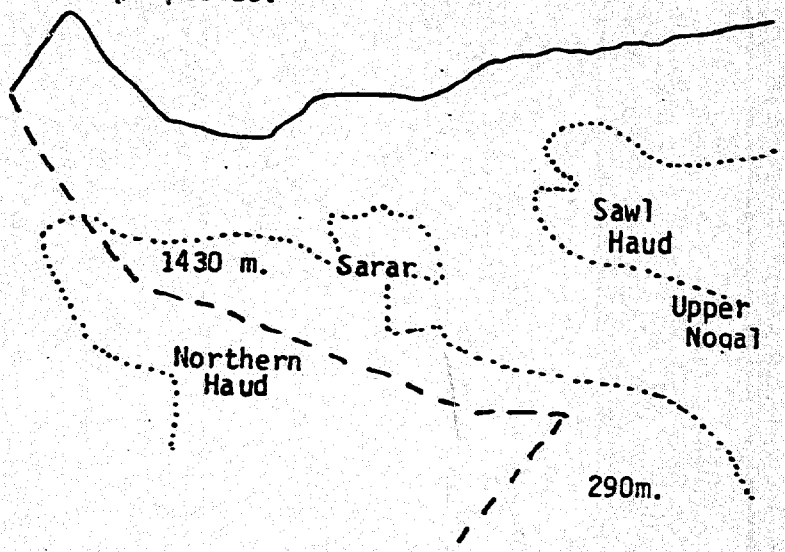


FIGURE 53

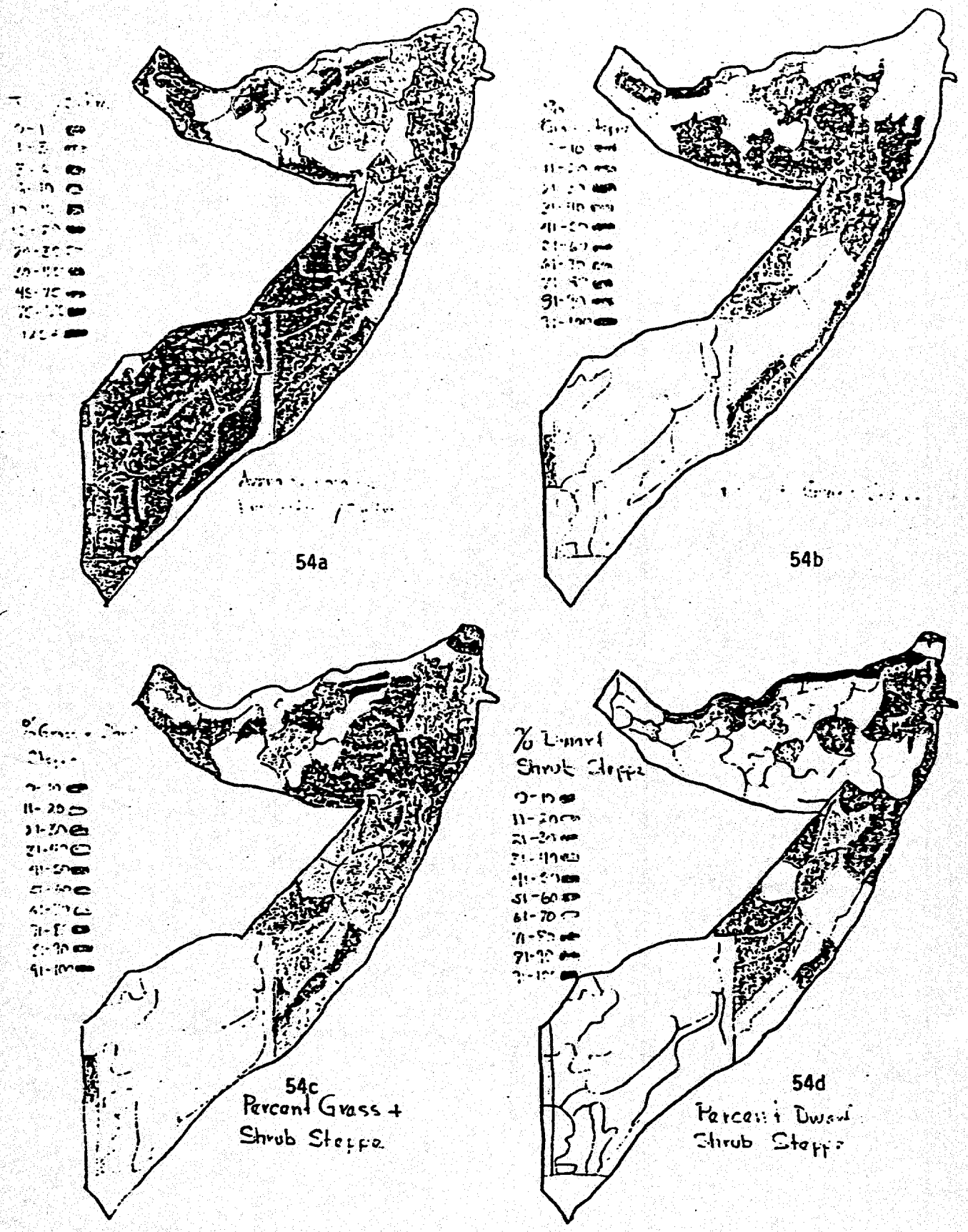
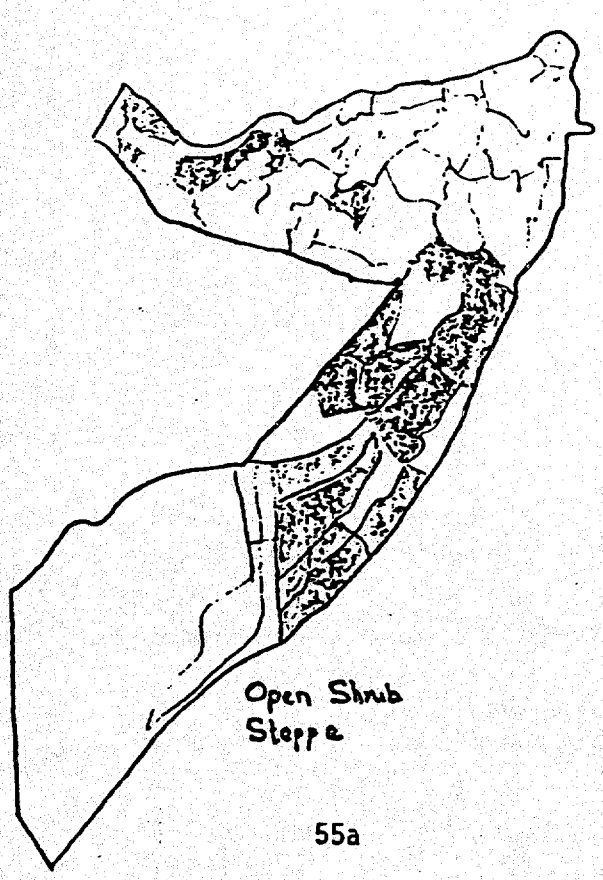
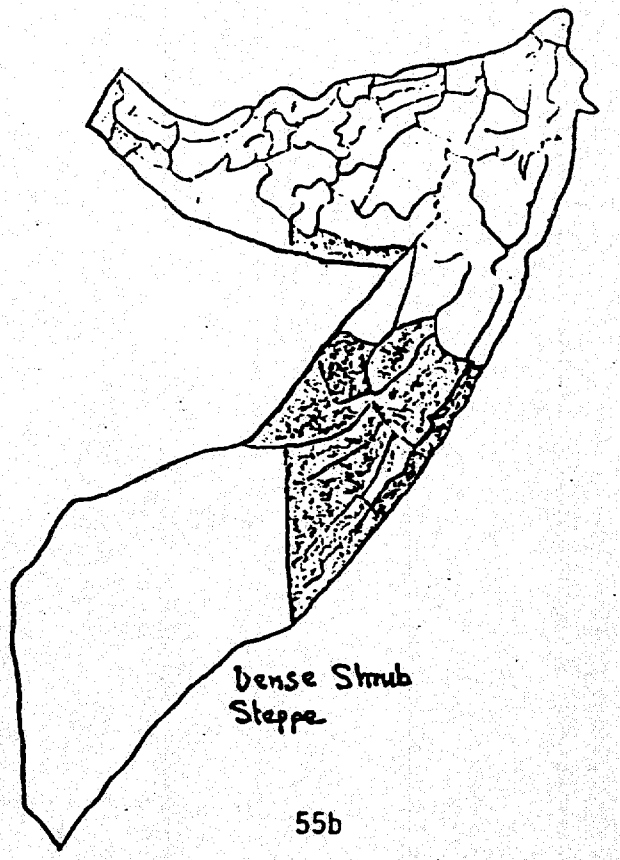

54a
54b
54c
Percent Grass + Shrub Steppe
54d
Percent Dwarf Shrub Steppe

Figure 54

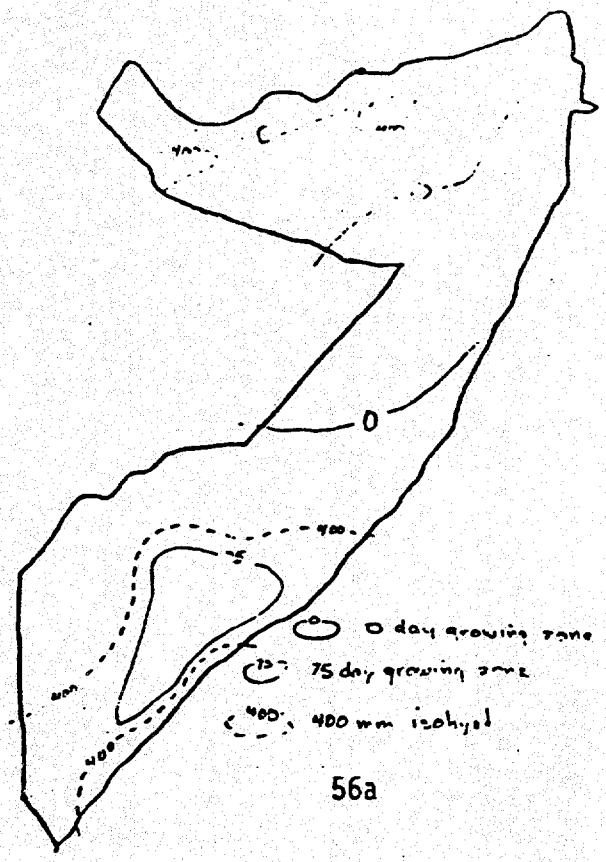


55a

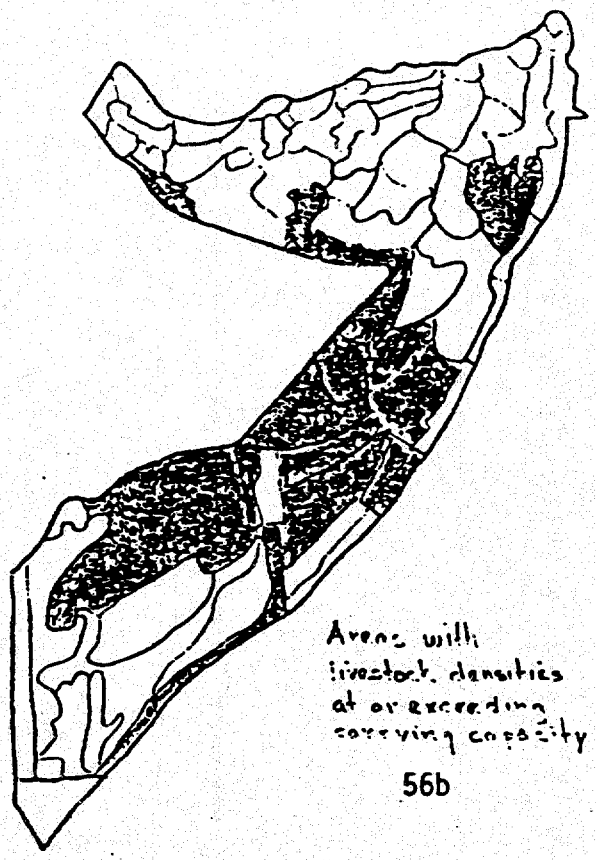


55b

Figure 55



56a



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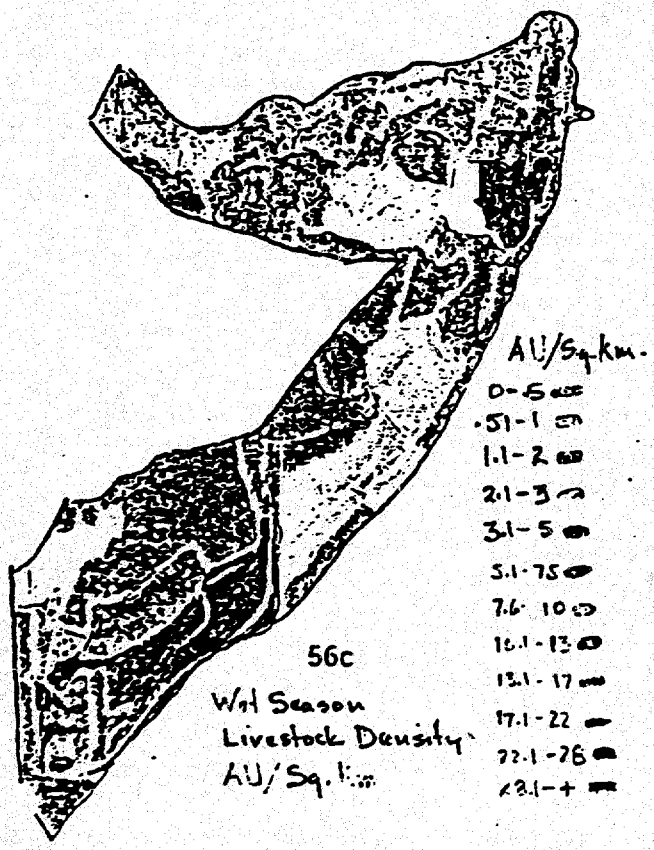

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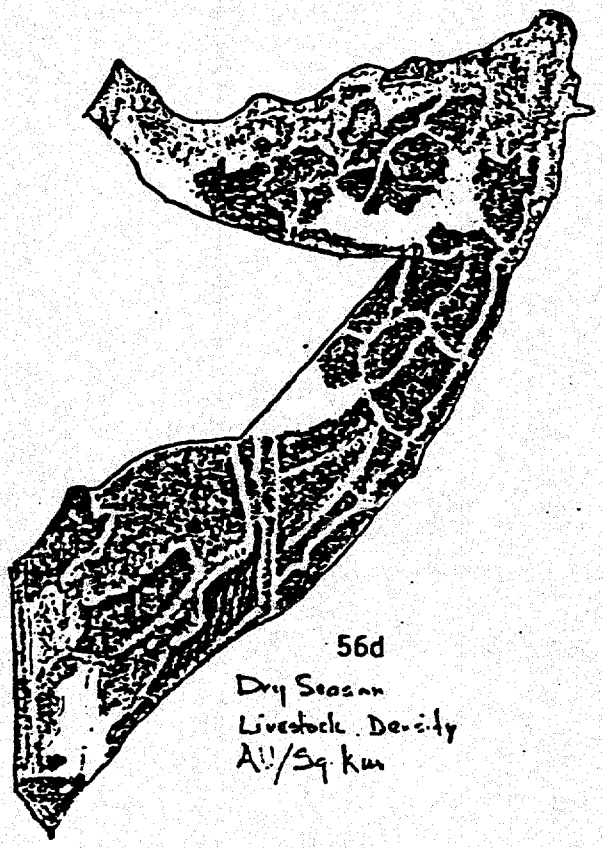


56d

figure 56

As noted from Figure 56, p. 43, the density of livestock is quite low for most of the area. Even so, based on calculations of animal units and forage per square kilometer, it would appear that the carrying capacity is exceeded. Forage production for the area between Logada and Berbera ranges from a high of 20 tons per square kilometer to a low of 3 tons. At the higher forage values the area could support about 8 animal units per square kilometer at a consumption rate of 2.6 tons and at a consumption rate of 1.6 tons, it could support 12 animal units. Wet season livestock density (Figure 56c) ranges from a low of 3 to a high of 13.

From the Tip south to the end of the zone, stocking densities are greater in the dry season. The computed carrying capacity of the eastern coast varies from less than one animal unit per square kilometers to no more than three. Inspection of Figures 54 and 56 tend to indicate that the area is not exceeded in grazing capacity.

II. Highlands of the Maritime Range

The maritime range is known in its wooded northern crest as Golis, and in its Southern slopes, where it meets the raised central plateau as Ogo. A grass plus shrub steppe cover predominates, varying in makeup from 30 percent to 80 percent in some areas. Grass steppe predominates in the Sawl Haud with grass plus shrub steppe predominating lower into the Upper Nogal.

Above 900 m in the Ogo plateau, and in coastal mountains above 840 m, soils are buff, reddish buff, grey or yellow loams, usually sandy. There are mostly alkaline or alkaline with pH values between 7.5 and 8.5 even when derived from rocks poor in lime. Salts are seen to concentrate near the surface of the soil which is found to have a higher pH value than deeper profiles.

Vegetation Types:

Open grassland and sedges occurring within Acacia Bussei association include Cyperus conglomeratus and species of Aristida and Enneapogon.

These grass cenoses occur in the depression of the Haud and on the edge of the Ogo plateau just south of the escarpment. Chrysopogon Paspalidium desertorum and Coelachyrum praeflorum are also important.

The plant communities of sandy soil occupy a large area on the inland plateau. Grasses appear extensively and among them Amphilophis radicans and Pennisetum orientale cover the ground over considerable areas. Cadaba mirabilis, is not especially common, but is present over the whole area. Some trees and shrubs, such as Acacia spirocarpa, Zizyphus hamur, Tamarix nilotica and Calotropis procera, occur near the tugs.

In the communities of the gypsum soils of the eastern areas ie., the Haded plateau and the slopes of the Nogal, large areas are covered with grassland vegetation which is represented by two kinds of cenoses. The first is composed chiefly of the short creeping Sporobolus somalensis, and Sporobolus ruspolianus, and of the short bunched Sporobolus longebrachiatus and Tripogon subtilissimum. They rarely exceed 30 cm in height. Bare ground is clearly evident everywhere. The second grass cenosis occurs far away from the permanent wells and drainage basins, and is constitued of Chrysopogon Aucheri together with Andropogon sp. (somal. Gogane). They reach a height of 30-80 cm and form bunches and mats. The groundcover is about 15% throughout all the year except in the flowering time when several ephermerals cover a part of the spaces among the perennial grasses.

On the low areas of the Nogal are communities of species of Suaeda, Salsola, Kochia, Lagenantha, which belong to the salt desert shrub. In some places these species are associated

with species of Sporobolus and Tripogon. Other communities of this kind are the Lagenantha nogalensis cenosis which grows in the eastern and south eastern Nogal basin. Together with this species we often find the three above-mentioned species of Sporobolus, Suaeda sp., Kelleronia sp., Convolvulus sp., Euphorbia cuneata, etc. A "sub-desert association" which belongs to this type of community as a kind of sub-desert shrub. It is formed of shrubs in very scattered form, which intervening baren gravel and sparse grasses and herbs. Boscia minimifolia sometimes attains to dominance. These communities are characteristic of the eastern parts of the Nogal.

Sub-desert shrub and grass vegetation occurs also in some areas of the Nogal valley.

Vegetative Cover Classification/ Forage Production: Highlands of the Maritime Range

Figure 52provides an outline of the Highlands. When this outline is mentally superimposed over Fig.54a -55b, pages 41--42, showing forage production and cover classification, the following obtains.

The composition of lower portions of the Nogal/Sawl Haud is composed of 70 to 80 percent grass steppe, but has an average forage production of 6 to 10 tons per square kilometer . Grass plus shrub steppe predominates in the Rigqabo, Las Kore, Basaso areas as well as in the Sheikh district. Forage production is exceedingly high for these districts, averaging better than 90 tons per square kilometers.

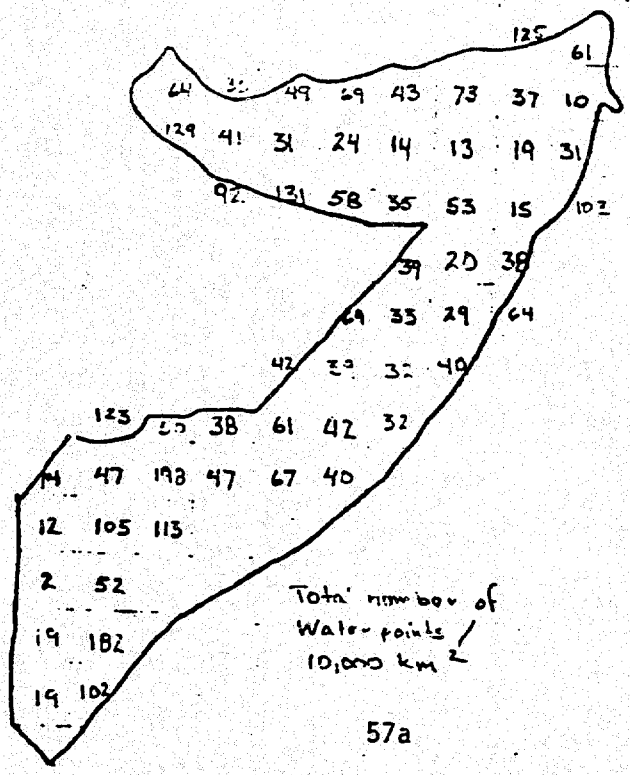
Further west in the Hargesia, Gebile, and northern portion of Borama districts, open shrub steppe (60 to 70 percent), dwarf shrub steppe (30 to 40 percent), and grass plus shrub steppe (30 to 50 percent) predominate. Average forage production is estimated between 15 and 75 tons per square kilometer.

Livestock densities for the highlands range between the maximum extremes: less than 1 to more than 28 animal units per square kilometer are 40 to 50 percent grass steppe/ grass plus shrub steppe. In the upper portions, the composition is grass steppe 70 to 80 percent and grass plus shrub steppe 40 to 50 percent.

To the north in the Iskushopan district and southern portions of Kandale, grass plus shrub steppe forms from 11 to 40 percent of the vegetative cover, with dwarf shrub steppe predominating at 50 to 90 percent. To the west, the Ogo/Haud upper regions are composed principally of grass steppe (50 to 60 percent).

Forage production for these areas ranges from 3 to 6 tons for the lower Nogal to a range of 6 to 30 tons for the upper Nogal/Sawl Haud. The Iskusshopan-Kandala districts are low in forage-ranging between 1 and 6 tons. The Ogo/Haud upper regions have somewhat higher forage values of 20 to 30 tons.

When animal densities are correlated with these areas, all show marked overgrazing. It is evident from reviewing the number of water points (Fig.57, page 46), that forage use is highly dependent upon temporary water. The Nomads are utilizing all available grass during the wet season. During dry seasons those nomads remaining in the area and their animals are existing on the remaining shrub steppe. The area's capacities in the dry season are also exceeded. In those areas prone to erosion, it is expected to continue as the land looses more cover. In other areas, encroachment of less



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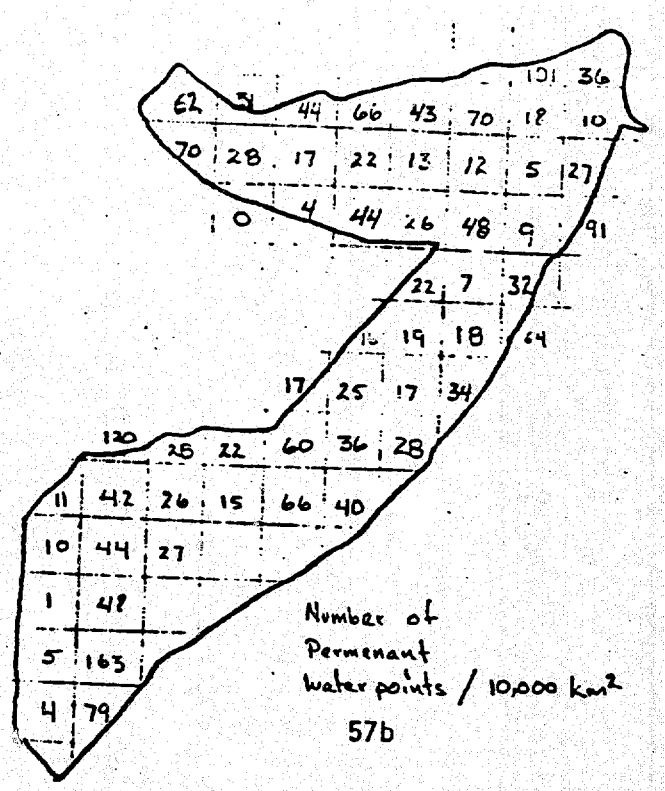

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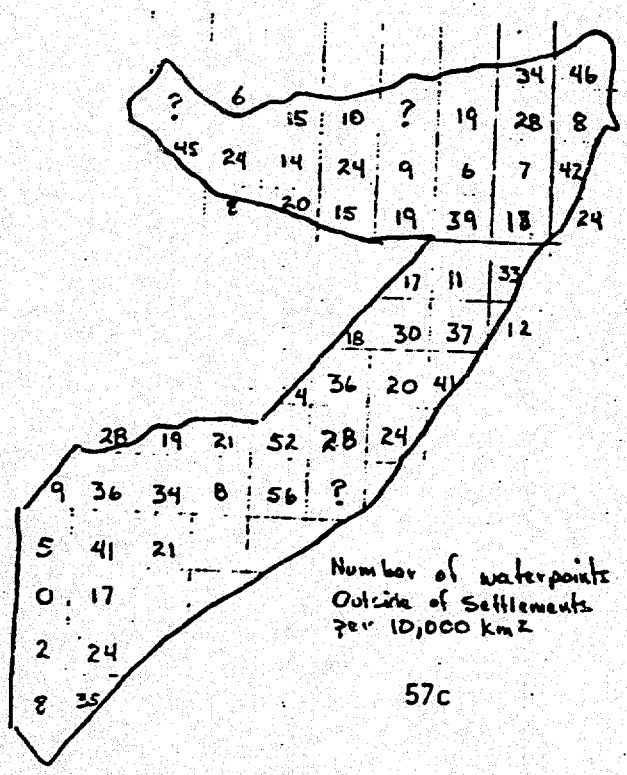


57c

Figure 57

desirable species is expected to continue. The net result is less range with less forage capacity.

Vegetation Types

A large belt of the Al hills and other areas of the eastern portion of the range contain species of Dracaena, Euphorbia, and Aloe. Two associations of shrub with trees exist: "The Boswellia hill scrub association", and "The short hill scrub association". The former consists of communities of rankincense trees Boswellia freereana and Boswellia sp. (somal.: Mohor Medu) together with Launoa obcordata, species of Commiphora, Euphorbia, Grewia, etc. The second association is formed of Acacia sp. A. Benadirensis A. somalensis, A. misera, Commiphora sp. (somal.: Tibbuk) C. Drakebrockmannii, C. hodai, Grewia erythraea, Jatropha sp. (somal.: Jilbildig), Cadaba glandulosa and some very sparse grasses (Chrysopogon Aucheri var. pulvinatus, Tetrapogon villosus, Cenchrus pennisetiformis, etc.). Communities with Boswellia freereana are recorded.

In the calcareous rocks of the Bosaso district one finds Senecio Gunnisii, Dracaena schizantha, Withania somnifera, and Launaea obcordata. Evergreen scrub attains greatest development at higher altitudes.

Buxus Hildebrandtii and Acokanthera Schimperi grow on a non-calcareous substratum at an altitude between 900 and 1300 m. At Duwi Pass on basalitic lavas are Gymnosporia luteola, Teclea pilosa, Rhus natalensis, Tarenna graveolens, Pavetta gardeniifolia, etc. Scattered trees are Cussonia Holstii, Ficus vasta, F. populifolia, and on rocks, Dracaena schizantha. Smaller shrubs are Coleus sp., Cadia purpurea, Clerodendron myrioides, Jasminum Steudneri, Trematosperma cordatum, Psiadia arabica, etc.; these do not form a layer beneath the large shrubs among which they grow. Climbers are represented by two species of Asparagus, Vigna nilotica, Tragia arabica var. parvifolia, Cissus Schweinfurthii, the most abundant, and Vigna sp. Among the herbs one finds Haemanthus abyssinicus, Cheilanthes coriacea, Actiniopteris radiata, Crassula galunkensis, Commelina benghalensis, and Selaginella rupestris. At an altitude of 1450 m Cadia purpurea, Euphorbia sp., Euphorbia sp. (somali: Angir), Trematosperma cordatum, and numberous herbaceaous plants exist. Together with Buxus Hildebrandtii and Acokanthera abyssinica, we note as common species Acacia etbaica, A. nilotica, Euphorbia cuneata, Cadia purpurea, Trematosperma cordatum and Coleus sp. This community is best developed on the north face of cliffs and ledges, wherever a secure foothold obtains.

Another community occurs on limestone rocky soils at a higher altitude (up to 1450 m), in the Libah Heleh range. Dominants are Buxus Hildebrandtii and Commiphora lughensis. Other common trees and shrubs are Dracaena schizantha, Commiphora ogadensis, Lannea malifolia, Pappea Radlkoferi, Olea chrysophylla, Sterculia Rivae, Grewis Tembensis, Canthium bogosensis, Combretum trichanthum and finally Mimusops kummel, which occurs at intervals of a few hundred metres, but which is conspicuous in the physiognomy of the community. Some small shrubs are present between the larger ones. Euphorbia infausta, Croton Cliffordii, Grewia Schweinfurthii, are abundant, and Periploca ephedriformis, Dodonea viscosa, Aloe Rivae, A. abyssinica and Adenia venenata are

frequent. Sanseviera abyssinica, Aloe somalensis and Haemanthus abyssinicus also occur.

In the eastern portion of the range are two more communities. The zone between 1150 m and the top of the slopes (sometimes attaining 1800 m and more), on the southern side of the Al Hills is covered by a growth largely composed of succulents: Euphorbia sp. (somali: Angir), Trematosperma cordatum, Euphorbia nigrispina, E. sp., and Buxus Hildebrandtii. Another community, which grows on cliff faces, is composed of Boswellia Carteri, Pavetta venenata, Ficus glumosa and is found in cracks and crannies. Grewia bicolor, Pistacea lentiscus and P. falcata grow where they can get a foothold. Crassula sp. and Kalanchoe sp. occur also.

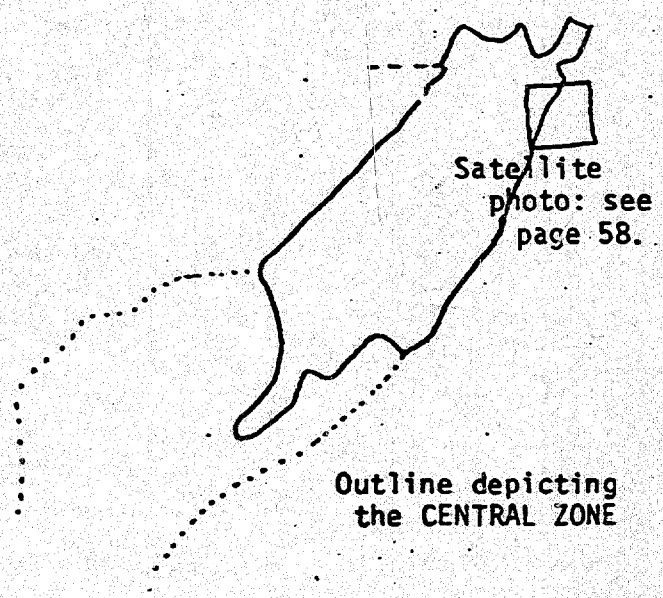
Starting in the east and working west, one notes a high wet season density of 22 to 28 animal units per square kilometer in the lower Nogal. The dry season density for this area drops to a range of 3 to 5. The estimated forage production ranges between 3 and 6 tons per square kilometer, which could carry a maximum of 1 to 2 animal units at a consumption of 2.6 tons and at a consumption rate of 1.6 tons, 2 to 4 animal units could be supported.

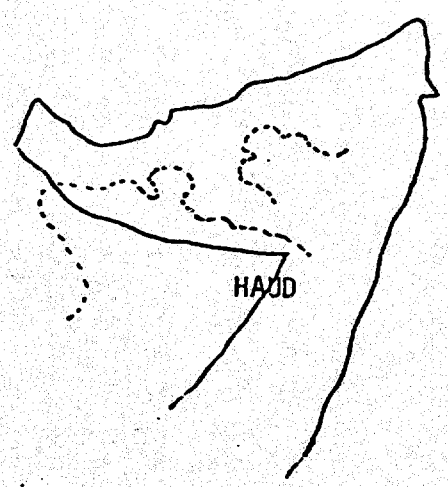
It would appear that the area is grossly overgrazed.

CENTRAL ZONE

The central zone (see below & Figure 54) has a number of distinct vegetation types. Rainfall in the zone ranges from about 100 mm in the extreme north to about 250 mm in the south (see Figure 58b). The major part of the region receives this rain distributed between two seasons; April to July and October to December. The rains may however, fail in either or both seasons and may also be erratic in their distribution. Droughts occur on the average of every five years.

In the north and central portions of the zone (Galguduud and Mudug regions), the soils are mostly sands over limestones at variable depth. In the south (Hiraan region), the soils while being mostly sandy are also influenced by the Shebelli floodplain. In the southeast, skeletal soils are common. Because of the low rainfall, soil type exerts the major influence on the vegetation of the area.





I. Haud

The Haud (Pronounced Howght) covers an area of about 119,000 square kilometers. Its altitude ranges 1,430 meters on top of the scarp in the Hargesia area, to about 290 meters at Galkayo. To the north and east, it is bounded by hill-forming Eocene limestones, the southern and western boundaries are topographically indefinite. Soils are of characteristic reddish loamy sands, which conceal the underlying Nubian (Cretaceous) sandstone. In the north lower Eocene, limestones appear and on the east, appear Middle Eocene limestones and syseous shales.

The Haud is largely brush covered with many species of Acacia and other trees up to a height of 6 to 10 meters, with much scrub and grass. There are some stretches of grassy plain mostly devoid of brush. The terrain consists mainly of plains, which to the casual observer appear flat, though in fact, are gently rolling and slope slightly to the southeast. On higher ground, vegetation is often more uniform and heavier than in depressed areas of valley and plain. This is more noticeable in the areas of greater relief in the east. For example, near the Ethiopian boundary (south--southeast of Los Anod) higher ground where surfaces are hard and sheet erosion is active. These areas are practically devoid of vegetation. The shallow valley-like waterways, without incised drainage, have a lesser cover of tree and bush and here grass is found. It is to be expected that grass would form the vegetative cover on lower ground where clay content is higher. In the more elevated tracts with less clay, tree and brush would predominate.

The principal shrub and tree species encountered are Acacia spp., Commiphora, Bossia, Cisus, and Indigophera over a rich grass and herb component consisting of Cenchrus, Aristida and Blepharis. Shrub foliage cover ranges between two and fifteen percent, a carrying capacity of one livestock unit per fifteen hectares is suggested.

Large areas of the Haud are overgrazed where ground water has been made freely available from boreholes. In these areas the grasses have been almost entirely removed and their place has been taken by shrubby species such as Aerva javanica and Indigophera. This substantially reduces the grazing capacity of the land.

At this point, the reader should again turn to the figures showing composite maps depicting the major vegetative types of percentages and also indicating estimated average forage production and livestock densities.

It will be noted from Figure 56c, that the Haud has a wet season animal density ranging from ten to seventeen animal units per square kilometer. In the dry season, as shown by Figure 56d, this drops to a density of three to thirteen animal units per square kilometer. Average forage production for the area, as shown in Figure 54a, ranges from six tons per square kilometer to 30 tons per square kilometer.

Using Table 2 above and Figure 54a, it is evident that the forage production of 6--30 tons per km^2 would support 2.3 to 11.5 animal units/km^2 at 2.6 tons/AU and about 4 to 19 AU/km^2 at 1.6 T/AU. After reviewing Figures 56c and 56d, it is evident that the density is in excess of carrying capacity. Nonetheless, as suggested by Pratt and Gwynne, animals can, through selection, substantially increase their nutrient intake by selective grazing.

Figure 59b, p.53 shows density of livestock in 1,000 animal units per 10,000 km^2. Note that the dry season density is roughly 64 percent of the wet season. It is evident from Figures 56c &56d, on page 43, that animals are moving to the interriverine areas during the dry season, which puts an additional stress on this area, especially if the area is to become intensified in irrigated and dry land farming. There is also some shift in populations to the northwest mountain regions to take advantage of the higher moisture and forage levels (see Figures 5 and 6 showing rainfall and evapotranspiration). These northern areas also correspond with areas (Figs. 60a-60c, page 51), which are moderately suitable for irrigation--again indicating the potential conflict between settled agricultural and nomadic peoples.

II. Hiraan Plateau

Inland from Itala, (Fig. 61, p. 55), approximately 55 kilometers and parallell to the coast is a plateau rising approximately 100 meters from the surrounding plain. The plateau covers an area of approximately 8,100 square kilometers and extends further inland approximately 150 kilometers. Its southwestern border parallells the Shebelli River.

The area can be described as an extensive plain of low undulating hills with occasional limestone relief reaching 100-150 meters. These limestone uplands carry a rich shrub and tree cover over relatively sparse grasses. Acacia spp., Commiphoa, Grewia and Bossia occur above Aristida and Tetrapogon. The soils are essentially shallow and skeletal with extensive red brown soils in the valleys. The present plant communities are resistant to erosion, but degradation is possible through overuse. This could be prevented by grazing manipulation and by limiting access to water. The World Bank assumes a carrying capacity for the area from one to eight livestock units per hectare. Figure 56c shows the wet season animal density as varying between eight and ten animal units per square kilometer. The dry season animal density, as denoted in Figure 56d , varies from three to seven animal units per square kilometer.

From Figures 54a and 54b , it is evident that a combined seasonal density for a carrying capacity at 2.6 tons consumption/animal until would be six to eighteen animal units per km^2. At 1.6 tons consumption, the carrying capacity could be nine to twenty-eight animal units per km^2.

It would appear then, that the area is within the minimum capacity consistent with animal minimal maintenance. This, however, does not allow for poor years, or any reasonable increase in production.

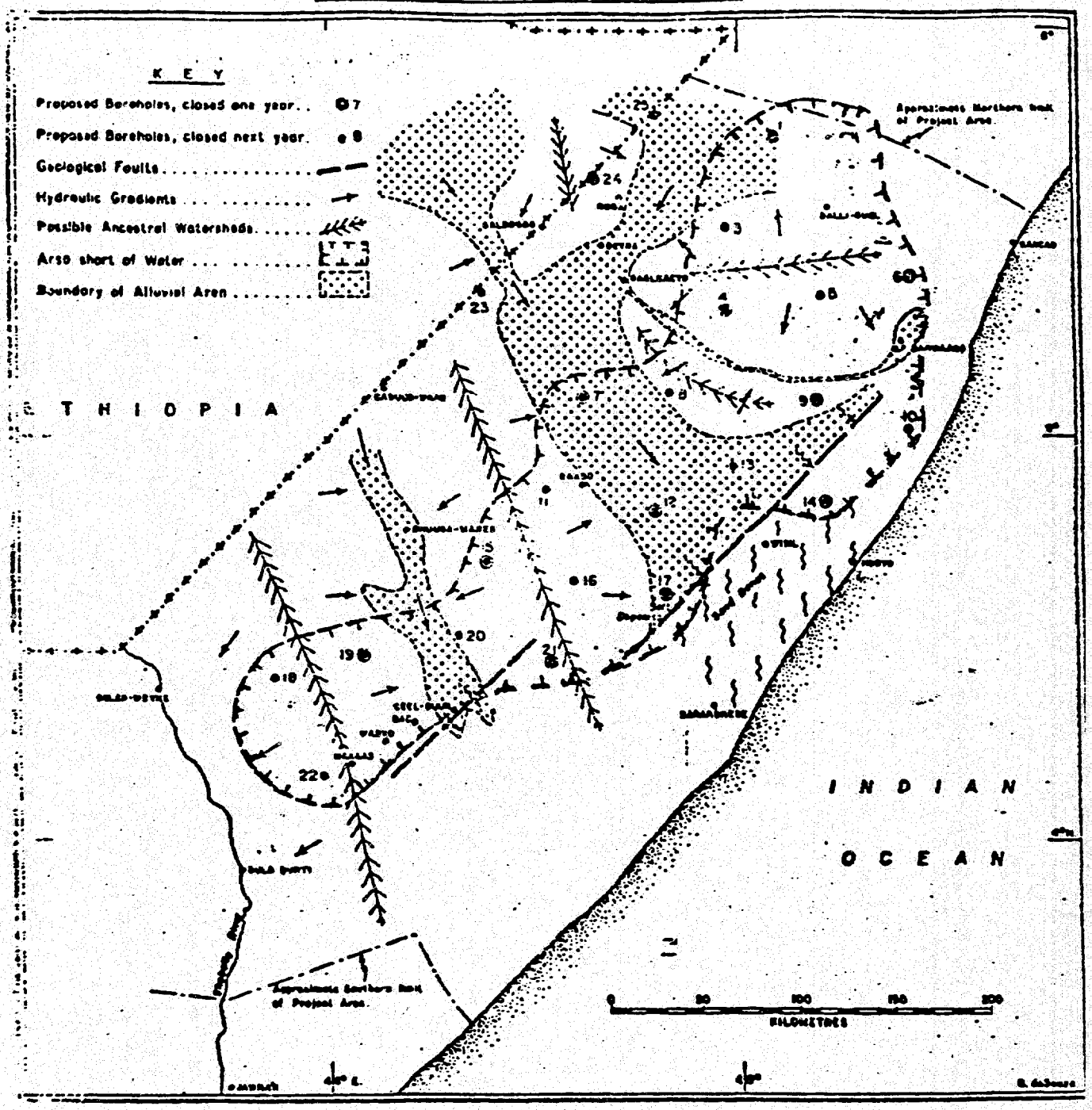
The vegetative cover, as depicted in Figures 54b , 54c , 54d , 55a

(text continues on p.56)

SOMALI DEMOCRATIC REPUBLIC

CENTRAL RANGELANDS LIVESTOCK DEVELOPMENT PROJECT

THE GAALKACYO AND DHUUSA MAREB ANCESTRAL DRAINAGE SYSTEMS AND FLOOD PLAINS.



This figure, from an early IBRD study of the Central Rangelands, indicates the areas found to be short of water and indicates the proposed well sites. It is of interest to note that the areas depicted as possible ancestral watersheds correspond well with old sailing charts. One such chart is attached immediatly after this figure.

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Entreprise contre les Portugais, de la Mer Rouge

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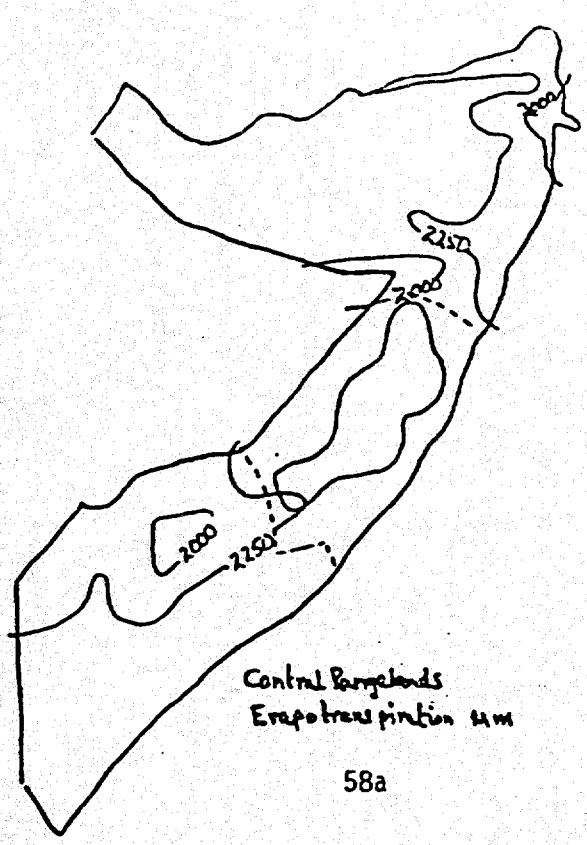
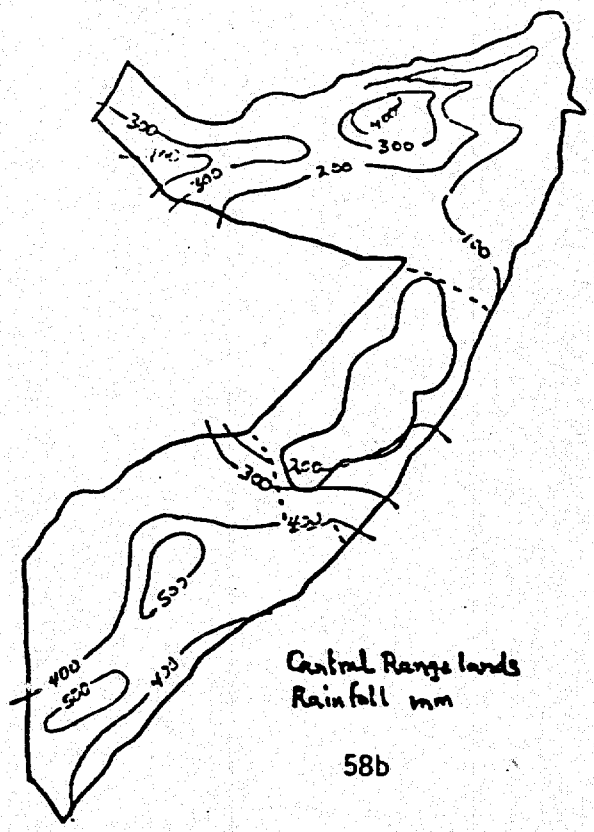


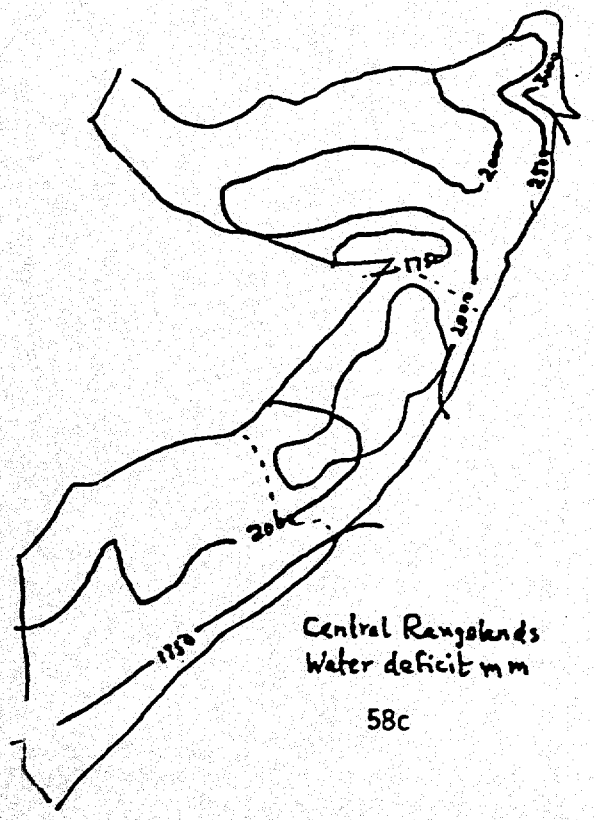
Central Rangelands
Evapotranspiration mm

58a



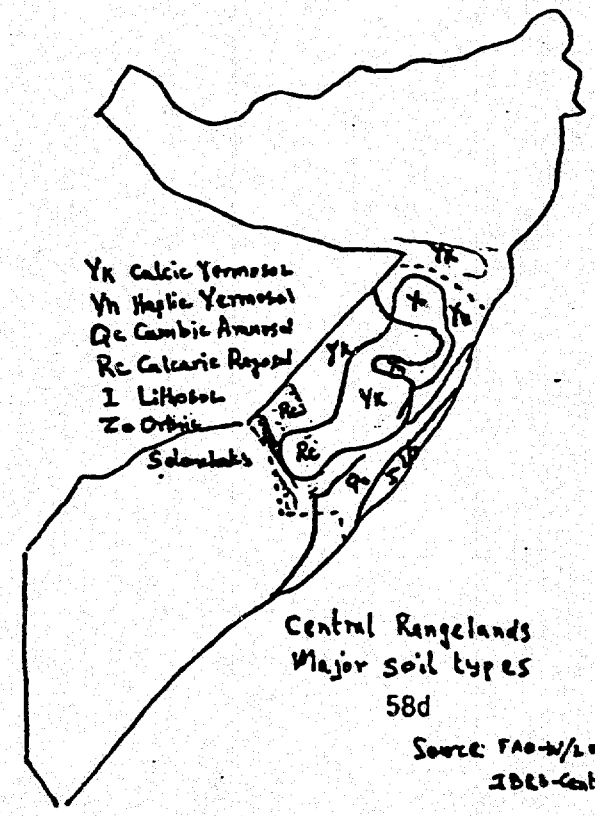
Central Rangelands
Rainfall mm

58b



Central Rangelands
Water deficit mm

58c

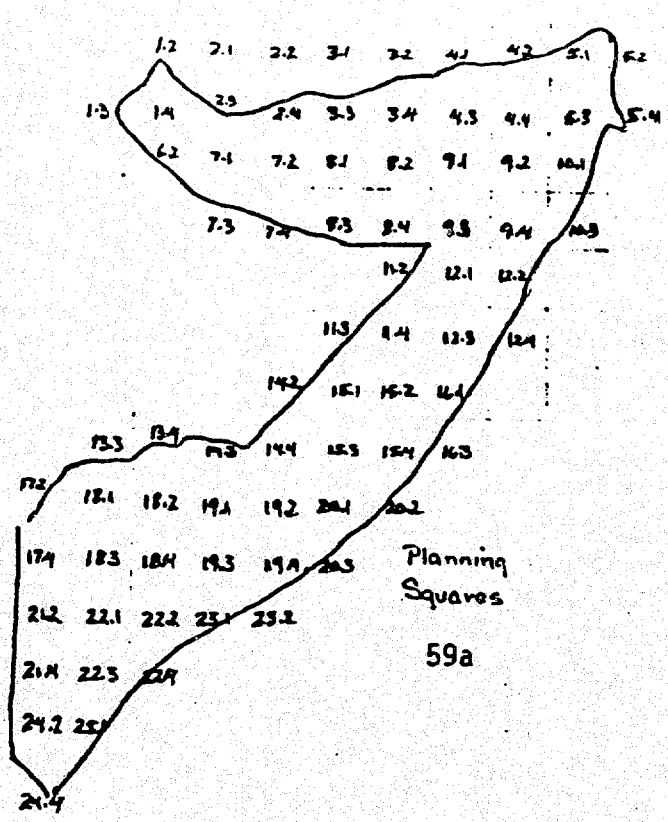


Central Rangelands
Major soil types

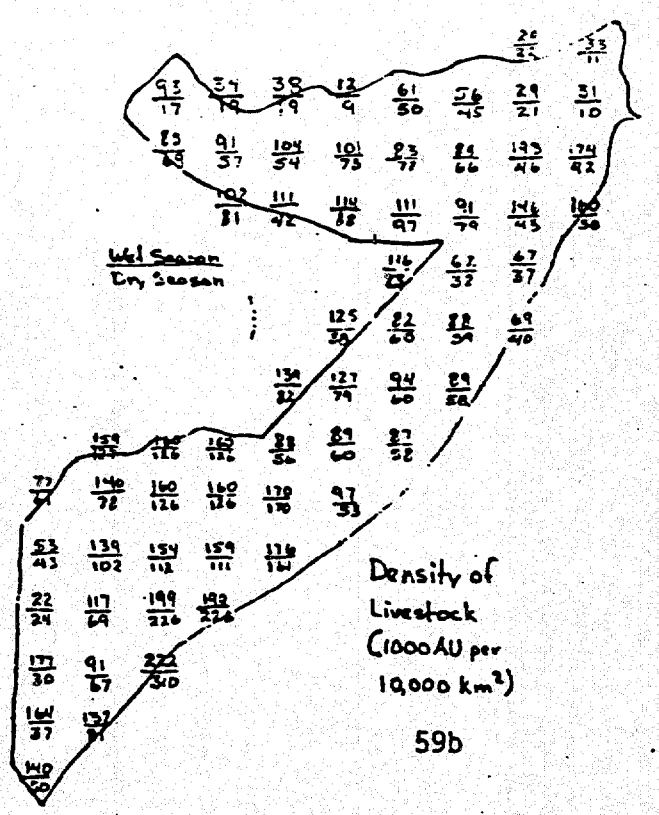
58d

Source: FAO-W/L0947
IDEB-Central Rangelands-71

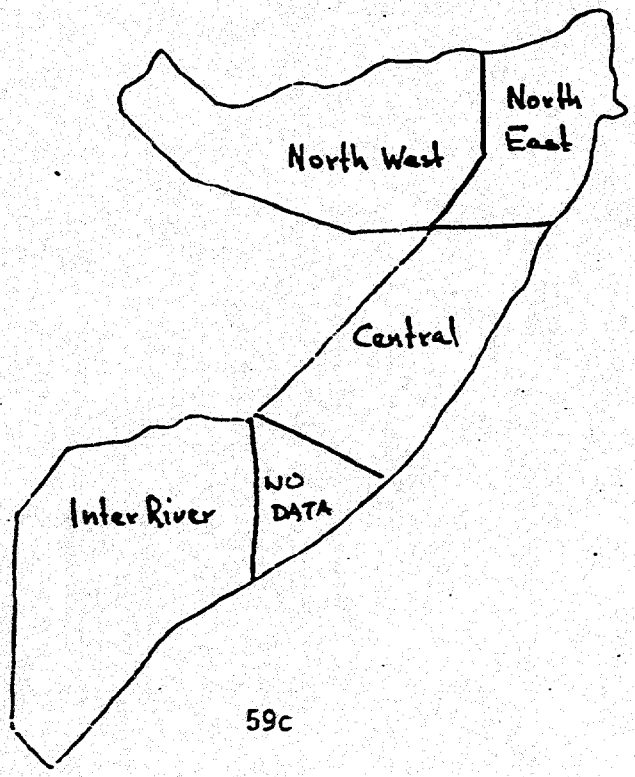
Figure 58



59a



59b



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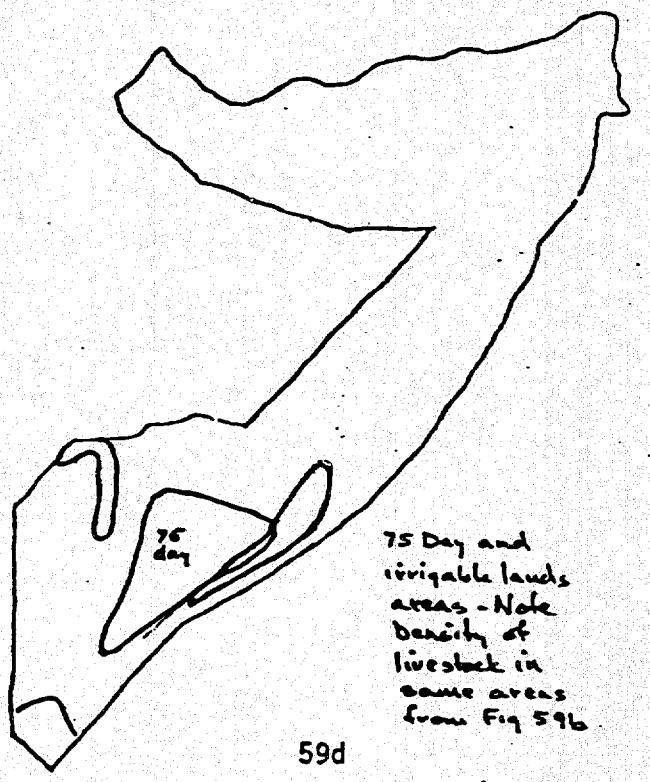

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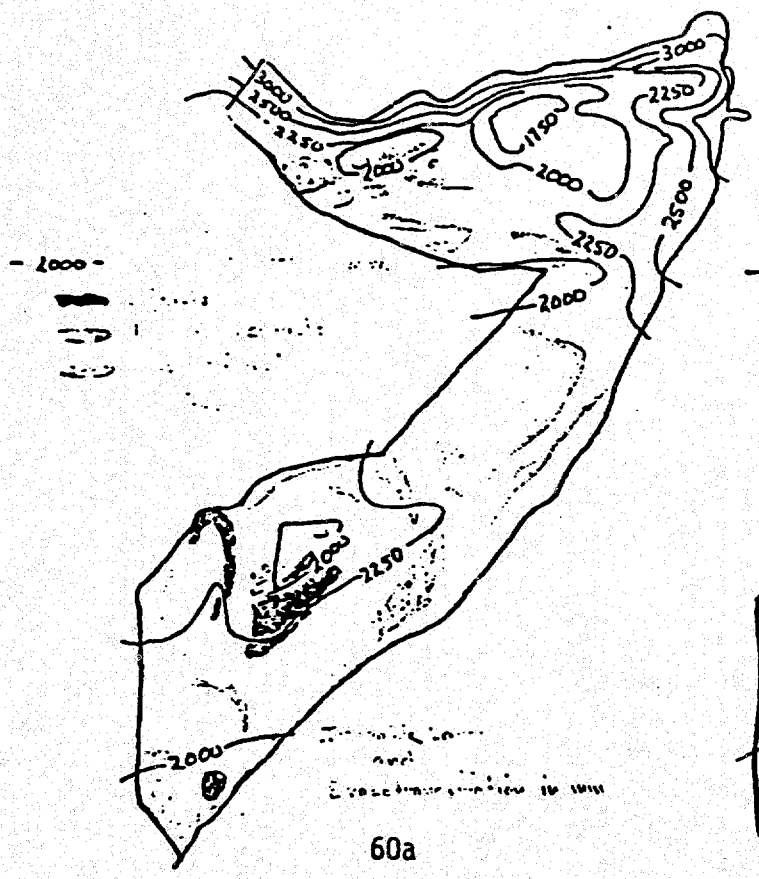
Figure 59



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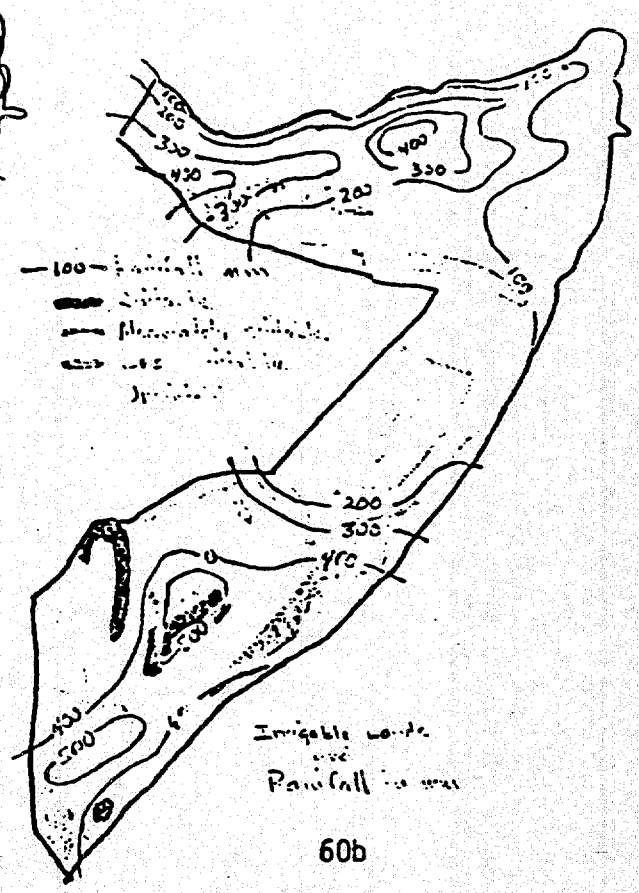

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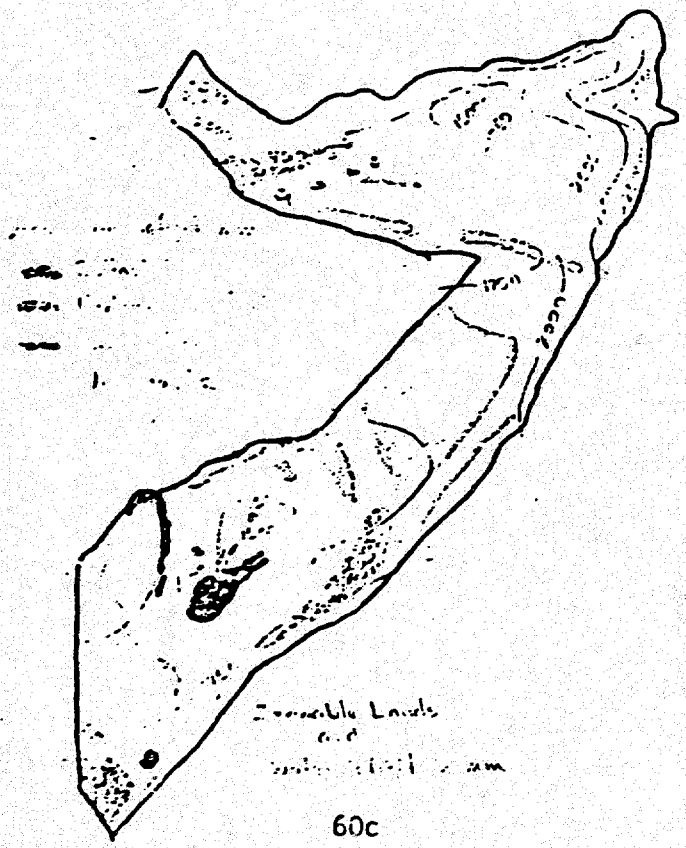

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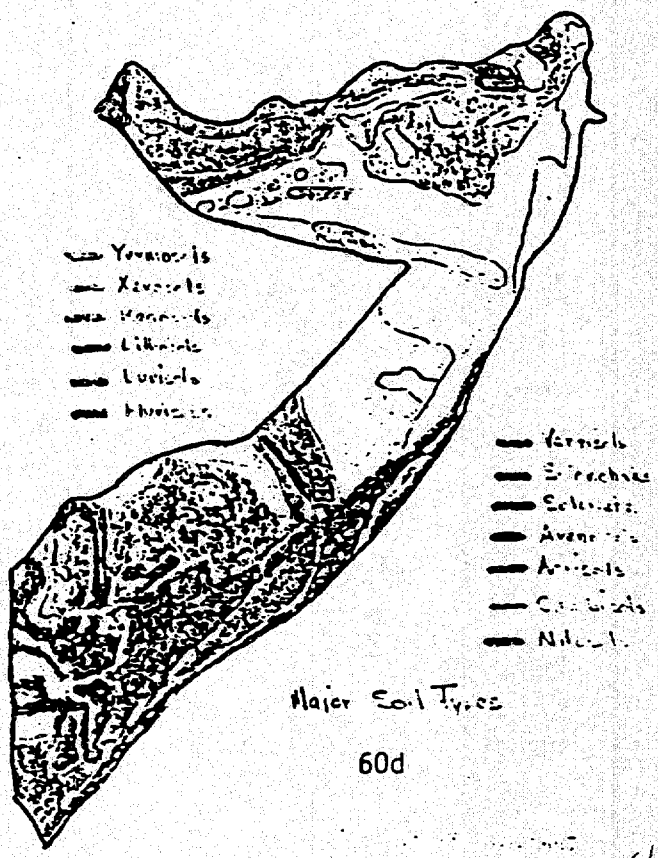


60d

TOPOGRAPHICAL MAP

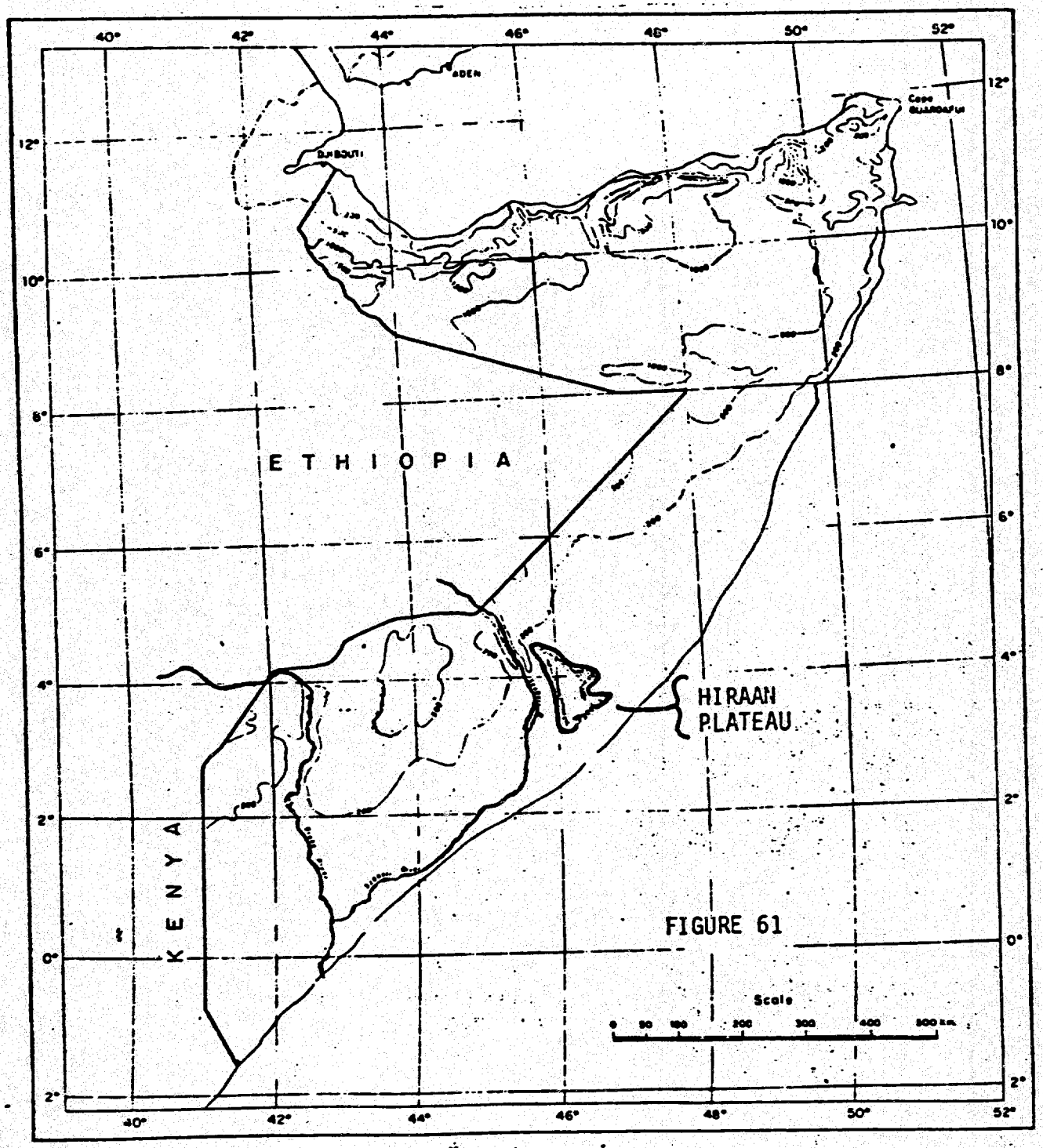


FIGURE 61

and 55b, shows that there is very little grass steppe, between 30 to 50 percent of the cover is grass plus shrub steppe, less than 20 percent is in the form of dwarf shrub steppe, less than 20 percent is in the form of open shrub steppe and most of the area has less than 20 percent in dense shrub steppe. As shown by Figure 59b, the livestock density of the area is relatively low compared to areas immediately south, but has a similar density to areas immediately north.

Animal density in the area does not fluctuate as much as in the Haud. The average wet season density is approximately 8,500 units per 10,000 square kilometers and approximately 5,700 units per 10,000 square kilometers in the dry season. Thus, the dry season represents 67 percent of the wet season population, slightly more than the Haud's 64 percent. While percentages between the two regions are not vastly different, the absolute magnitude of the Haud is much greater. This may relate to the greater number of temporary watering points in the Haud which, upon drying, cause movement of animals, (Fig. 57b--57c, p. 46, showing total watering points and number of permanent watering points). In addition, (Figs. 5-7, p. 22 & 61, p55) the average rainfall in the Hiraan Plateau area is approximately 50 percent greater than the Haud.

III: The Shebelli Flood Plain

The Shebelli River is the southern boundary of the zone. The flood plain is many kilometers wide and has great potential, but has been severely overused. Soils are generally deep and grey-brown clays, (Fig. 60d, p. 51, showing soil types). The grass cover is limited to scattered bunch grasses, such as Sporobolus, with annuals interspersed in season. The shrub and tree cover is restricted to Acacia spp. and Dichrostachys and has been substantially reduced by overstocking.

In areas where sluggish drainage causes an increase of salinity, halophytic species such as Sueda become more important. These increase the carrying capacity of the land where they are allowed to persist. Erosion by wind and water is prevalent in this region, being characterized by severe wind piling around trees and bushes and by a scouring and guttering of the surface.

Wet season stocking rates range from 5 animal units per square kilometers to 28 animal units. In the dry season, the animals shift south from the more arid northern portions to give densities of 13 to more than 28 (Figs. 56c&56d, p. 43). As depicted in Figure 56d, the dry season animal density is about 90 percent of the wet season. This correlates with the number of permanent or dry season watering points which are about 84 percent of the total watering points for the area.

The average forage production varies from 10--15 tons per square kilometers in the arid northern portions, (Fig. 54a, p. 41) to about 20--45 tons per square kilometers in the southern portions. From these values, the computed average animal density should be about 4 to 6 animal units at an intake of 2.6 tons AU. For those areas with 10--15 tons forage production, and from 8 to 18 animal units, at the same intake, for areas producing from 20--45 tons of forage.

If the animals are surviving on 1.6 tons dry material per animal

unit, then the calculated density could be 6 to 9 animal units in areas of 10-15 tons forage production, and range from 12 to 28 for areas of higher forage production.

From Figures 56c and 56d, it is seen that stocking rates are ranging from 5 to 28 animal units in the wet season and from 5 to over 28 in the dry season. It is evident that the area is carrying too many animals in both wet and dry season and therefore, one can expect deterioration of the environment to continue.

IV. Central Coastal Plains

These coastal plains run along the coastline and form a band, approximately 700 kilometers long by 25 km in width. The band extends from Itala in the south to Negro Bay in the north. These plains are easily distinguished on satellite imagery (Fig.62,p.58) and are separated from the central higher elevated plains by the band of active sand dunes (Figure 63). The plain is derived from former Pliocene coastal dunes, which have been stablized. Major soil types, as shown in Figures 58d and 60d, are Solonchaks, Arenosols, and Yermosol. Soils can be basically described as grayish coarse sands over limestone.

The central coastal plains are essentially treeless grass fields. The grass component is extremely rich and consists of such species as Heteropogon contortus, Enneapagon, Cenchrus, Ergrostis superba, Eragrostis spp. and Aristida. Even where heavily grazed near permanent waters, such as near Obbia, the grass cover does not appear to have altered floristically, although basal cover and vigor have been reduced by overstocking. As noted from Figure 54b, up to 40 percent of the vegetative cover is grass steppe, 11 to 40 percent cover is in the form of grass plus shrub steppe with less than 10 percent composed of dwarf shrub steppe; dense shrub steppe, and open shrub steppe values generally fall below 20 percent. (Figures 54c, 54b, 55a, and 55b, pp.41-41)

Estimated forage production (Figure 54a) in the upper third of the area is between 30-45 tons per square kilometer, decreasing to a range of 20--30 tons for the middle third, and from 15--20 tons for the lower third.

When viewing wet and dry season, stocking estimates (Fig.56c-56d page 43), it will be noted that livestock densities are greater in the lower third where forage is presumed poorest. This may relate to the greater number of watering points in this area which are outside of settlements, as shown by Figure 57c. Note from Figure 59b that the greatest percentage shift from wet to dry season correlates reasonably well with the greatest reduction in available water.

By comparing Figures 56d and with Figure 54a, one can assume the upper third of the area and the middle third are under utilized, but the lower third is overgrazed for Somali stocking. For production rather than subsistance, the entire area is probably overgrazed, thus leading to continued deterioration. Because the area is one of active dune formation (see Figure 62), extreme care should be taken in management.

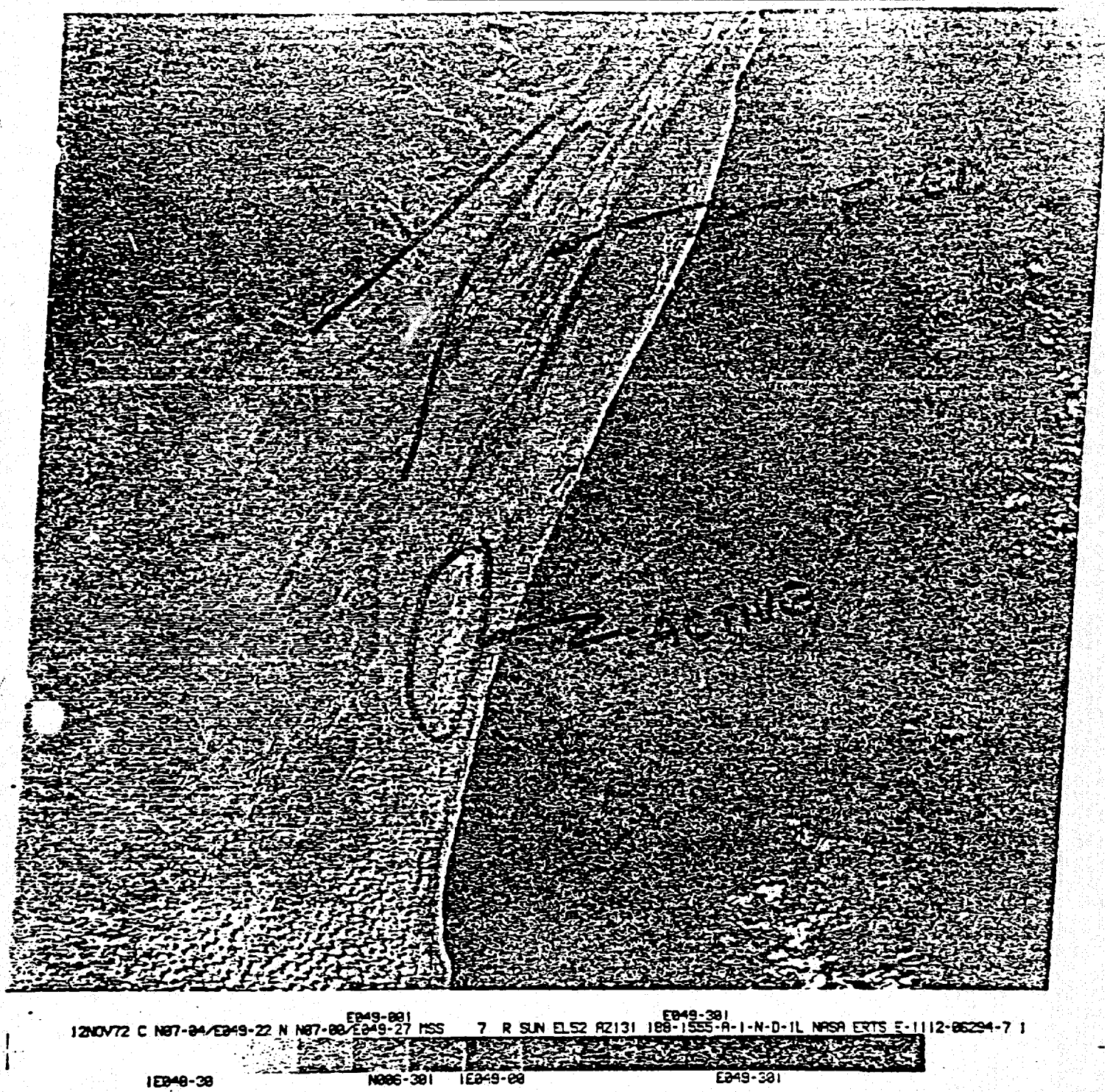


FIGURE 62

This satellite photo of Nov. 1972, shows a portion of the coast from Negro Bay in the north to roughly Addan in the south. Of interest in the photo are the fixed Pliocece dunes (see overlay) and the active dunes. The dots in the lower left of the photo and running up the coast are clouds The active dunes are Barchans.

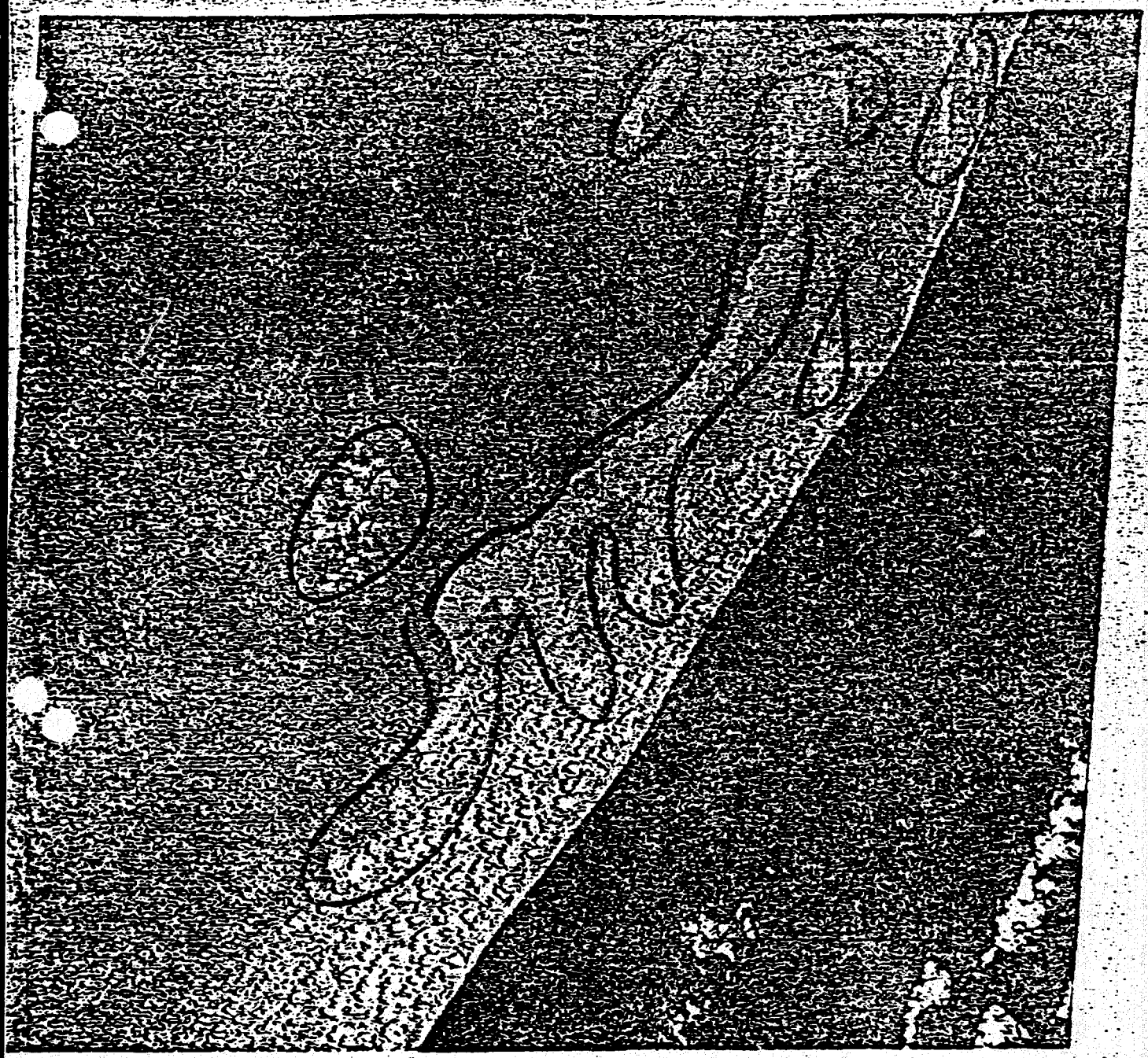


FIGURE 63

This satellite photo of Sept. 72, shows roughly the coastline between 3 degrees and 5 degrees North. Obbia is slightly north of the top of the photo. The overlay shows extensive areas of active dunes. The total area represented as sand is approximately 660 square kilometers. This represents a loss of about 7300 stock units or the equivalent of about 200 families. Calculations are based on the estimated carrying capacity of the surrounding area, i.e., 11 AU/Km2.

V. Central Inland Elevated Plains

In the central part of the zone is a vast tract of orange and pink toned sands overlying limestone at variable depth (Figure 58d). These plains rise in a series of benches from the coastal plains and finally merge with the Haud in the west. Ridges up to 50 meters in height are common, often serving as the edges of successive benches. Behind these benches, the orange and pink toned sands extend in broad undulations. The valleys between bench systems are up to 5 km across. In these successive valleys, outcropping sheet limestone is frequent often extending without break for hundreds of meters. Shallow sands over limestone occur freely. The vegetation is variable in height, density and foliar cover throughout this region.

Deep, light colored wind-blown sands supporting a stunted vegetation occur as a feature of some inter-bench areas, seemingly replacing the repetitive sand/sheet limestone sequence which is the most common land form unit. In the poorest sections with deep find sands, Acacia ehrenbergia, A. edgewrothi and A. reficiens sub sp. miera occur over scattered Aristida and Dactyloctenium.

The shallow soils which lay over limestone carry Acacia horrida, Acacia spp, Commiphora and very sparse Bossia over Aristida, and Cenchrus. In many instances, the shrub height does not exceed 1 m and the foliar cover is less than 5 percent.

Where the soil is deeper, the sands assume a reddish orange appearance and support a much denser grass cover of Aristida, Cenchrus and Panicum beneath the Acacia spp. which may also include A. Tortilis and A. senegal. The central grassy tract is an extremely fragile environment, which would be susceptible to overuse. Disturbance of the shrub and grass cover would almost certainly result in the formation of dunes which would grow rapidly. Average forage production per square kilometer is estimated between 6 and 20 tons.

Principal vegetative cover is shrub plus grass steppe (10--40 percent) and open shrub steppe (10--30 percent) as noted from Figures 54bto 55b. From Figure 54a, the estimated average tons of forage production per square kilometer ranges from 6--20 tons. This translates into a carrying capacity of 2 to 10 livestock units per square kilometer at a consumption rate of 2.6 tons per livestock unit. At consumption rates of 1.6 tons, the stocking rate could increase from 4 to 12 animal units per square kilometer.

After reviewing Figure 56c, it will be noted that wet season stocking rates are from 5 to 13 animal units per square kilometer and dry season rates are 3 to 7 animal units per square kilometer. Thus it would appear that the area is currently overstocked and degradation is expected. It will be noted that animal density shifts during wet and dry seasons, as depicted in Figure 59b, have a high correlation to the number of permanent water points and water points outside settlements, as seen in Figures 57b & 57c.

1. Italia to Kismayo

--Vegetative types: Maritime and sub-maritime

From approximatley 2° 30' N at Italia to 1° S, along the coast, vegetative types occur which are classified as maritime and sub-maritime.

The vegetation consists of communities which grow in the immediate vicinity of the sea, and of communities which develop in an inland strip sometimes several km broad. The latter, which represent the sub-maritime vegetation, are so closely related to the former that these two kinds of community must be studied toegther. The maritime vegetation consists chiefly of the communities of the sea bottom near the shore edge, of the coastal cliffs, of mangrove swamps and of the sandy shores. The sub-maritime vegetation is formed of the cenoses of the fixed dunes and of the salt and mud flats.

The vegetation of the sea bottom near the shore is inadequately known, but together with sea weeds Thalassia Hemprichii, occasionally with Cymodocea ciliata.

The coastal cliffs are not well represented along this portion of the Indian Ocean. A cenosis with Suaeda fruticosa exists in the promontory of Nimu, south of Mogadiscio. The vegetation of the calcareous coastal cliffs of Agarre include Senecio bellioides, Portulaca Ciferrii, Sporobolus spicatus, Aerva lanata var. rotundifolia, Atriplex halimus, etc. Where the rock is more disintegrated Sporobolus spicatus, Blepharis edulis are abundant. They are accompanied by Cyperus chordorrhizus, Tephrosia vicioides, etc.

The mangrove swamps are present along the coast between Mogadiscio and Merca, and in several sites south of the equator. They ascend the rivers 20-30 km inland. The vegetation of the mangrove swamps of the southern coasts was studied by Paoli, Benguinot, Senni and Ciferri. The commonest species is Avicennia marina, which is distributed along all the mangrove swamps of the semi-arid zone. Between Mogadiscio and Merca Rhizephora mucronata and Ceriops somalensis are also present, while south of the equator in the mangrove swamps the above-mentioned three species and Bruguiera gymnorrhiza and Sonneratia alba also occur. A species which is frequent in these communities south of the equator is Xylocarpus obovatus. Other plants, in the mangrove swamps and present in the transition zone to the dry soils farther back, are Flagellaria guineensis, Vitex negundo, Sideroxylon diospyroides, Pluchea Dioscoridis, Fimbristylis ferruginea, Sporobolus setulosis, Arthrocnemum indicum, Suaeda fruticosa, etc.

Sandy shores predominate along the coast where they present three fundamental habitats: the sands at the water's edge; the flat sandy shelves farther back; and the moving sand dunes. These three habitats sometimes form a continuous series going inland from the sea, but often one of the latter two is lacking. However, one of the two is generally present between the sands at the water's edge and the sub-maritime habitats. The vegetation of the sandy shores was studied by Ciferri near Merca, Mogadiscio, Brava and between Ciumbo and Kisimayo. Other information is given by Chiovenda

and Paoli.

The vegetation of the sands nearest the water is the poorest because of the direct influence of the sea (tidal inflow and heavy seas of the summer monsoon). It consists of specimens isolated or grouped into small colonies of Ipomeea pes-caprae, the commonest species, Atriplex facinosa, Sporobolus spicatus, Dactyloctaenium radulans, and other less common species. The flat sandy shelves (usually not more than 8 m) above the sea level, quite flat or slightly sloping seawards. The sands are usually semi-fixed, but moving sands are not infrequent. The vegetation is formed either of discontinuous and spaced colonies or, where the substratum is fixed, of dense communities. The most characteristic and abundant species is Cyperus chordorrhizus which is distributed all along the coast. In several communities it represents 80-95% of the specimens. The moving sand dunes form one, two or sometimes more ridges parallel to the coast. They attain the height of 10-30 m above the basic floor and of 15-40 m above sea level. These dunes are subjected to two opposite seasonal movements, the winter (NE) and summer (SW) monsoons. The vegetation present in the lower part of the dunds consists mainly of Scaevola Plumieri, which is the characteristic and dominant species. At the base and in the lower part of the dunes it is accompanied by Calotropis procera, Sporobolus sp., Blepharis edulis, Eragrostis ciliaris var. arabica, etc. The last specimens on the flanks of the dunes belong to Scaevola Plumieri. Another interesting plant of the moving sand dunes is Hypnaene pyrifera, which grows between the dune ridges in the area of Giumbo and El Sai (Paoli)

The moving sand dunes pass gradually into the fixed ones which represent the substratum of the sub-maritime vegetation. The fixed sand dunes form a ridge parallel to the coast, which varies in breadth, from some hundreds of meters to 20-25 km. This ridge consists of a few or several rows of dunes and does not exceed 150 m in height. Inland it passes gradually into the alluvial deposits covered by the xerophilous open woodland. In the transitional zone between the moving and the fixed dunes the vegetation is similar to that of the semi-fixed flat shelves or the moving dunes with Cyperus chordorrhizus, Scaevola Plumieri, and Blepharis edulis. The vegetation of the fixed sand dunes is rich and varied. It consists of shrubs, undershrubs, herbs and grasses, with occasional widely spaced trees. Together with some species of Acacia (A. Bussei var. benedirensis, A. nilotica var. adstringens, A. senegal var. pseudoglaucophylla, A. planifrons, A. cheilanthifolia) we find Cordyla africana, Anisotes involucratus, Aerva tomentosa, Commiphora Paoli, C. benadirensis, Grewia spp., Uvaria denhardtiana, Jasminum tomentosum var. somalense, Solanum Pampaninii, etc. In the southern areas of the semi-arid zones and above all in the depressions between the dunes and on the inland edge of the dune ridge, together with the above-mentioned species, are found Adansonia digitata, Mimusops densiflora var. Paoli, Siderozylon diospyroides, Vitex negundo, etc. Inland the vegetation of the fixed dunes is more and more similar to that of the xerophilous open woodland to which it is closely related.

Another aspect of the sub-maritime vegetation is that of the salt and mud flats. They occur chiefly in southern areas of the Somali coasts. Ciferri mentions a nearly pure population of Arthrocnemum glaucum. At its edges ceno-ses with Sporobolus spicatus and S. minutus occur. Paoli mentions Centema Stefaninii, Astrochlaena lachnosperma,

Sporobolus setulosus, etc. in the salt and mud flats north of Kisimayu. Where water stagnates Nymphaea stellata and Phyllanthus reticulatus are indicated.

Vegetative Cover/Forage Production and Utilization

II. Italia to Mogadiscio

Principal cover is a mixture of grass steppe up to 40 percent (Figure 54c). Open shrub steppe and dense shrub steppe range from 11 percent to 30 percent. Forage production averages from 15 tons per square kilometer to 45 tons per square kilometer.

Carrying capacity at the lower range of forage production would be about 5 AU/km^2 at a consumption rate of 2.6 tons dry matter per AU. At the higher rate of forage production one might expect the carrying capacity to be 18 AU/km^2 at the consumption rate of 2.6 tons/AU. Using 1.6 tons dry matter per AU, the carrying capacity ranges from 9 AU/km^2 to 28 AU/km^2/

Dry season stocking rates for the area range between 3 and 7. Wet season rates range between 10 and 13 AU/km^2.

It would appear from the data that the carrying capacity of this area is within limits during the wet season. Careful inspection of Figures 54a 55d and 59b indicate that the northern portion has the lower forage production, but the higher animal densities. This may relate to the availability of water. The percent shift wet season to dry is slightly higher in the lower portion of the area (see Figures 56 & 57).

III. Mogadiscio to Kismayo

The predominant vegetation covers are grass steppe and grass plus shrub steppe. Forage production ranges between 20 and 30 tons per square kilometer to Kismayo. From Kismayo south it increases to 45 and 75 tons per square kilometer.

In the range of 20 to 30 tons of forage per square kilometer, carrying capacities would range between 8 and 12 AU/km^2 at consumption rates of 2.6 tons/AU. At consumption rates of 1.6 tons per livestock unit, the carrying capacity could be 13-19 AU/km^2.

From Figures 56c and 56d, it will be noted that wet season density for the ranges from 17 to 22 AU/km^2, and dry season density ranges from 13 to 17 AU/km^2. It is obvious from these data that the area is heavily overstocked.

INTERRIVER ZONE

This is the area of greatest potential conflict between settled agriculturalists and nomads (see Figures 56a, 56 c-d). It is the area of highest rainfall (see Figures 6, 21 - 32), hence forage production (Figure 54a). It is also the area containing the best soils for irrigated agriculture (see Figures 60a - d).

Principal major soil types (see Figure 60d) are Solonetz, Regosols, Vertisols, and Nitosols; however, the smaller areas of Fluvisols represent some of better potential for irrigation.

Vegetative Types

On the alluvial plains of the Wabi Shebelli and Juba rivers the grasses are represented by species of the genera Aristida, Cenchrus, Chloris, Cynodon, Dactyloctenium, Digitaria, Eragrostis, Panicum, Sporobolus, and Tetrapogon with a predominance of the rhizomatose species. Several herbs, but far less frequent in occurrence, are associated with the grasses. They chiefly belong to the families of Cyperaceae, Leguminosae, (Crotalaria, Tephrosia, Clitoria, Indigofera, Vigna), Acanthaceae, Labia-

tae, Pedaliaceae, Commelinaceae, etc. The commonest bushes are Thespesia danis, Combretum spp., and Solanum spp. (S. arundo, etc.). In some places, such as Iscio (scindle), woody vegetation is represented by scattered small trees of Terminalia praecox which branch from the base in contact with the ground and form big dome-shaped bushes. In these areas we find the native cultivated patches (Somali: shamba) which chiefly consist of annual crops. Where these patches are given up, small thickets of Acacia seyal var. fistula, Dichrostachys glomerata or Combretum spp. soon cover the ground.

The typical riverine vegetation consists more or less of wide strips of luxuriant vegetation along the banks. Behind these strips vegetation, although less luxuriant, clearly shows signs of the presence of underground water. The greatest riverine forests occur along the Juba river south of Salagle, where after a long course between rocky banks it flows into the alluvional plains. The strips of riverine forest are generally some dozen meters wide, but when the river forms some meanderings the forest often covers all the space between any two. The riverine forest, in the lower reaches, has a great luxuriance and density, and some trees exceed even 20 m. in height. However, the height of the majority of tall trees is about 12-15 m. Beneath them trees of all heights occur, so that the vegetation does not show a clear stratification. A great profusion of big bushes and shrubs covers the ground, where the trees are less dense. The climbers are particularly abundant.

A similar type of vegetation occurs along the Wabi Shebelli. The riverine forest is narrower and has not the luxuriance of the vegetation of the Juba river. In some places the riverine vegetation consists of the same species as the adjacent xerophilous open woodland, which becomes denser and is associated with species of Ficus (F. populifolia, F. sycomorus, etc.). In other sites it is richer, denser, and taller, but several of the hygrophilous species of the riverine forest of the Juba river are lacking. Behind the riverine vegetation we sometimes find a strip of wooded grassland, but it is always narrow and the trees are chiefly represented by acacias. Only in the lower reaches of the river does the wooded grassland attain great luxuriance.

The most characteristic or commonest trees of the riverine forest of the rivers are Mimusops degan, Piptadenia Erlangeri, Ficus Scassellatii F. zambesiaca, F. populifolia, F. sycomorus, Garcinia Ferrandii, Afzelia quanzensis, Tamarindus indica, Teclea Alexandrae, Trichilia jubensis, Hypseloderma jubensis, Acacia stenocarpa, Phoenix reclinata var. somalensis and Hyphaene benadirensis among the tall trees (over 10 m high); and Antidesma venosum, Hunteria africana, Haplocoelum Scassellatii, Chiarinia Jubae-fluvii, Polysphaeria jubensis, Cecchia somalensis, Bridelia microphylla, Zizyphys mauritania, and Ximenia americana among the small trees (4-10 m high). The big bushes and shrubs are represented by Allophilus rubifolius, Grewia tembensis, Uvaria denhardtiana, Oncoba spinosa and Sterculia Pivae. Several climbers are present, and we may mention Landolphia comorensis var. florida, Salacia somelensis, Chasmanthera dependens, Cissus spp., Merremia spp., Canavalia gladiata, Ipomoea rubens and Rhynchosia flavissima.

Behind this curtain of forest, where the phreatic flow swiftly becomes scanty, is a wood which represents a transitional vegetation between the riverine forest and the xerophilous open woodland. In this

wood several species of Acacia predominate; the commonest are Acacia seyal var. fistula, Acacia Stefaninii and Acacia Stuhlmannii. Other trees, such as Adansonia digitata, Kigelia aethiopica, Delonix elata, Albizzia anthelmintica, Excoecaria venenfera, etc., grow among the stratum of big bushes and shrubs, in which species of grasses such as Panicum Petiveri and P. maximum occur also.

Where the phreatic flow extends far from the river, behind the forest exists a strip of grassland, chiefly a wooded grassland, sometimes some km broad. There the grasses are represented by tall species of Andropogoneae, Panicum, Paspalum, Pennisetum, etc., while the commonest trees are Adansonia digitata, Dobera Macalusoi, Acacia seyal, A. planifrons, etc. If the soil conditions are moister the Acacias become scanty and are replaced by Terminalia bispinosa, T. spinosa, Combretum copaliferum, C. usaramense. In sites where the water becomes more and more abundant, the trees are chiefly represented by Adansonia digitata, Dobera Macalusoi, and Diospyros Cornii.

In several areas along the Juba river, instead of the above-described forest, there is a riverine wood of dum palm (Hyphaene benadirensis) which occurs in the upper reaches of the river. There the dum palm is accompanied by an assemblage of small trees and shrubs, chiefly Acacias, climbers (Cissus spp., etc.) and succulents (Aloe, Sanseviera). In some sites Hyphaene benadirensis becomes widespaced and forms a vegetation similar to a palm-stand grassland.

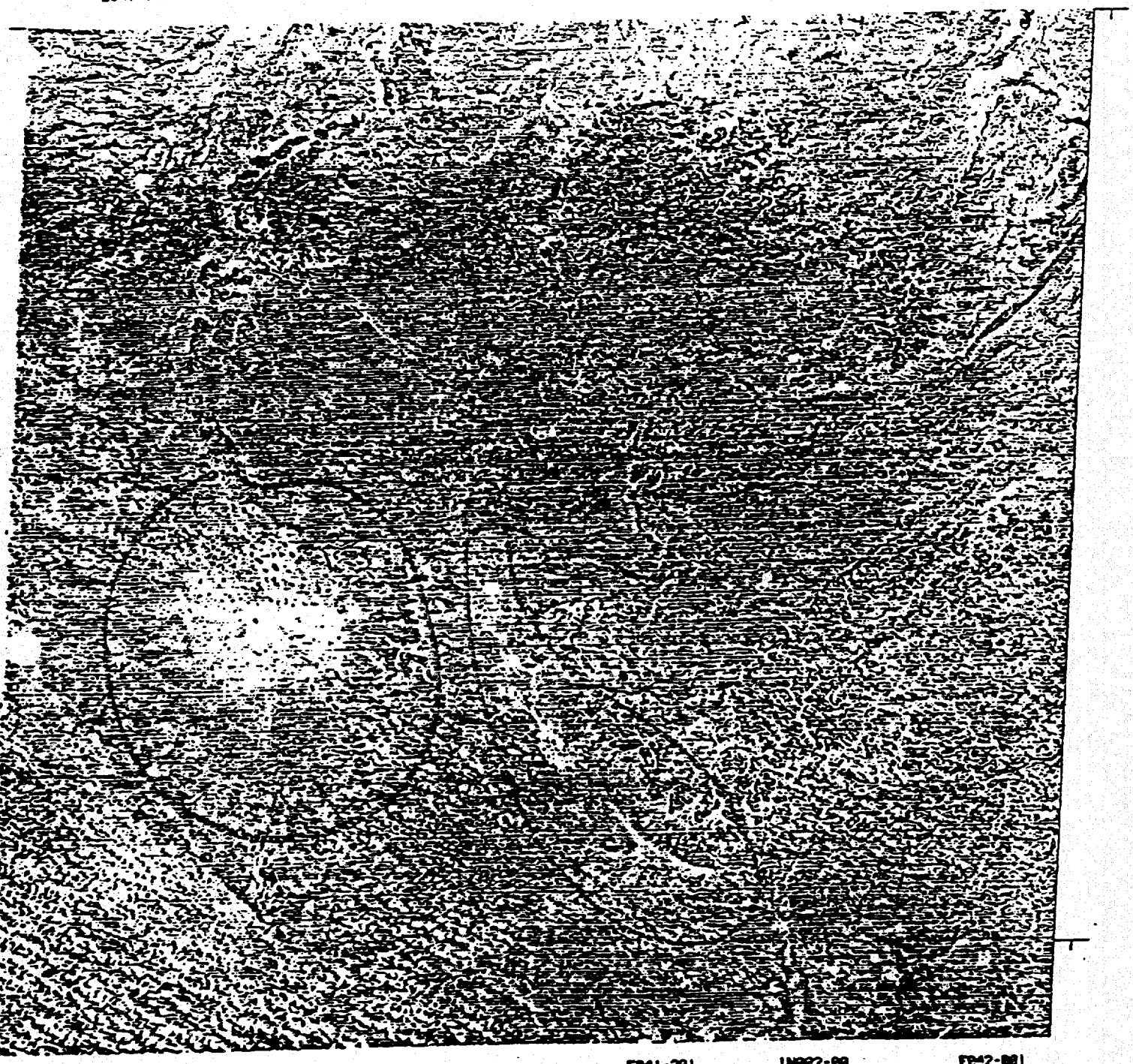
In some parts along the Juba river, the riverine forest is interrupted by stretches where the banks are covered by open grassy communities of either Panicum pyramidale, or Saccharum aegyptiacum, or Sorghum vulgare var. Drummondii. These communities are very probably due to antropic influence, the forest having been destroyed in favor of cultivation, which was later given up owing to the presence of the tsetse fly Glossina pallidipes.

In the lower portions of the Wabi Shebelli, the river loses itself in a long strip of swamps about 80 km long and 40 km wide separated from the sea by a ridge of dunes. All this vast area is covered with a dense vegetation which chiefly consists of tall grasses. The commonest species of grass are Sorghum virgatum, S. purpureo-sericeum, Andropogon pertusus, A. radicans, Digitaria somalensis, Panicum muticum, P. haplocladum, P. Crus-pavonis, P. deustum, P. pseudo-infestum, P. maximum, Cenchrus aequiglumus, Sporobolus senegalensis, S. robustus, etc. Other species occurring there are some giant species of Cyperaceae (Cyperus Zollingheri, C. maculatus and C. immensus). Ciferri mentions communities of Typha australis at the edges of the deep water. Communities with this species are largely represented in all the region of Ballad. Communities with Digitaria somalensis and Cynodon brachyatus as dominants, occur where the water is less abundant.

Vegetative Cover/Forage Production and Utilization

Turning to Figure 54a , it will be noted that forage production increases from north to south. It averages 15-20 tons per square kilometer along the lower Shebelli.

From Table 2,p37, estimates of carrying capacities can be made for the northern interriver area and are as follows: At forage consumption rates of 2.6 tons/AU, the area would support 6 to 8 AU/km^2. It is evident upon inspecting Figures 56c and 56d , that the data show the area to be greatly overstocked. At forage consumption rates of 1.6 tons/AU, the



This satellite photo of March '75 demonstrates the extent of over grazing around water supply points. Approximately 300 square kilometers have been extensively over grazed as shown by the over-lay. The area shown is near Lolabussi, on the Somali/Kenya border

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the area is "understocked."

For the lower portions of the zone, forage production is estimated between 45 and 125 tons/km^2. At the lower level of forage production, the carrying capacity at 2.6 tons/AU would be 18AU/km^2. Wet season stocking densities, Figure 56c, are 17-22 AU/km^2. The area appears to be within carrying capacity, and may not be fully stocked. For production purposes, these figures may be invalid.

CONCLUSIONS

Large portions of Somalia are over stocked. Eventhough this is the case, herd sizes appear to be no more than necessary to meet the subsistance requirement of the average nomadic family. Thus removing any appreciable number of animals to bring the density within the carrying capacity will have disruptive influences on families. Opening unused areas for dry season grazing will aid in reducing pressures on existing lands. Care must be exercised in the opening of wells and the timing of animal movement. If herds reach the forage areas prior to the seeding stages, the consumption of the plants and the seeds will reduce the following year's production. This has been shown to be a serious problem in other areas, e.g., Kenya's range programs.

AREA DENSITIES OF RURAL SETTLEMENTS

On the average, the number of households in rural settlements is approximately 1,225 per 10,000 km^2. There is however a large regional dispersion. Density is the highest in the interriver areas (0°-4°N, 41-45°E) at 2,230 per 10,000 km^2 which reflects the predomintly settled agriculturalists. Density is lowest in the Central Rangelands and Northern Rangelands areas. The northwestern areas show an average density of approximately 1,500 households per 10,000 km^2.

Northwest area

There are approximately 325 rural settlements with an average of 76 households or approximately 24,500 settled rural households. Of these settlements, approximately half are considered small, i.e. 6-24 households per village. Approximately one third could be considered settlements of medium size, i.e. 30-125 households per village. The remaining one sixth comprises the larger village group, with a range of 130-580 households.

While the numerical average is approximately 20 villages and 1500 households per 10,000 km^2, the dispersion is wide. Density is highest in the agricultural areas near Borama, Gabile, and Hargesia, 115 villages with approximately 1,700 settled households per 10,000 km^2. Areas around Las Anod and Las Koreh vary from 60 households to about 360.

Northeastern Area

Approximately 72 rural settlements are found in this area.

Settled Population* per 10,000 km^2

Area	Villages	Size Average	Households
Northwest	19	76	1500
Northeast	8	45	340
Central	7	36	250
Interriver	53	37	2230
Somalia average	27	46	1225

*Excluded are regional and district capitals and Hiran, Middle and Lower Shebelli

While the numerical average is 45 households each, again there is a high dispersion. Approximately 27 villages could be classified as sm for the area, as the average number o households is 6 for this group. Medi villages average 35 households, and there are approximately 33 of these. What could be considered as large for the area are the 12 villages averagin 160 household each. This latter grou is somewhat skewed because the Alula district has 5 villages with an avera of 240 households per village.

On an area average, the density per 10,000 km^2 is about 8 settlements and 340 households. The dispersion is wide. Around Alula-Basaso, the density is highest - 1400 households per 10,000 km^2. The lowest density occurs in the areas of Eil (except for resettlement) Bender, Baila, Garoe, and Gardo districts, with a range of 10 to 30 households per 10,000 km^2.

Central Area

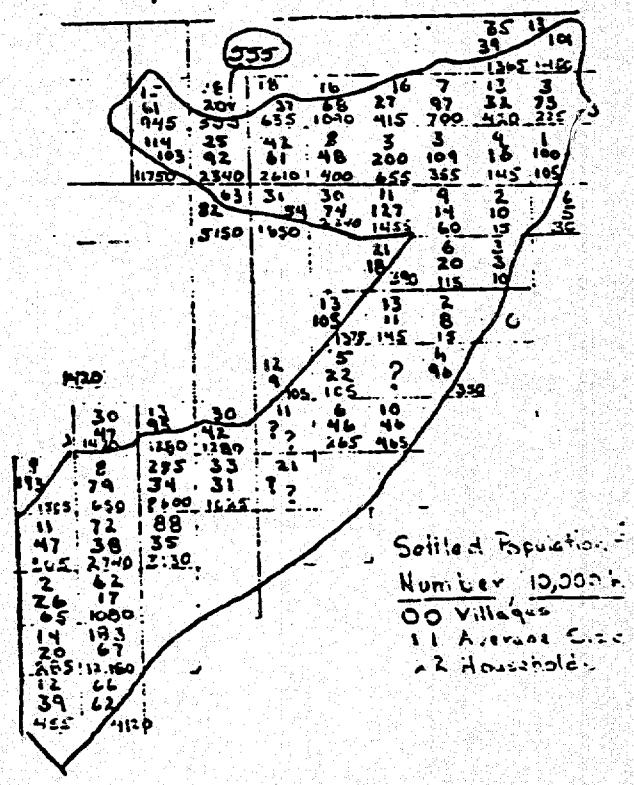
The central area contains approximately 7 rural settlements of about 36 households as an average. This corresponds to roughly 250 households. The dispersion from the average is wide. Villages of less than 20 households account for approximately 40 of the total. There are 18 villages with households ranging from 12 to 60 units, and the larger villages, 12 in number have households ranging from 80 to 200.

The average density is 7 villages and 250 households per 10,000 km^2. The range varies from about 1400 households at the densist areas (Galcaio, Dusa Mareb) to approximately 16 households per 10,000 km^2 between Giriban and Obbia.

Interriver Area

Of the approximately 1100 villages in this area 80 percent are considered small, having an average of 22 households each. Villages classified as medium or large account for the remainder — 20 percent. There are approximately 70 villages with an average household number of 117 (range 75-150) and approximately 65 rural villages with an average of 300 households (range 200-470).

The average density of the interriver area is 53 villages and about 2200 households per 10,000 km^2. The highest density of rural settlements is in the areas surrounding and between Afmadou and Giamama -- 12,200 households and 185 villages. Next, the area around Baidoa and north to Oddur with about 9000 settled households and 250 villages per 10,000 km^2. The area along the Kenya border contains the lowest density, with a range of 3-14 villages and 70-300 households respectively per 10,000 km^2.



Analysis of Benefits and Disbenefits of Major Development Inputs

The following comparative analysis of selected project inputs is arranged to highlight major positive and negative aspects in key areas of impact, i.e., Human Health, Environment, Animal Health, Economic, Agriculture, and Social Organization. Following each comparison is an opinion weighing the effects.

DEVELOPMENT INPUTS
By Area of Impact

I. Fertilizer

Human Health

Anticipated Benefits: Potential increased overall human health from improved nutritional intake and diet balance occurring to greater variety of crops raised, increased yield and availability of crops and livestock output; decreased morbidity and mortality and increased life expectancy. Improved general health will provide for an increased availability of medical services which would otherwise be needed to cope with diseases associated with malnutrition.

Potential Disbenefits: Increased human population based on increased birth rate and lifespan and decreased death rate producing an increased need for many basic social services. Potential nitrite poisoning from contamination of ground waters because of concentration or excessive use and misuse of fertilizers. Potential eye, respiratory, and skin irritation from mishandling fertilizers.

Opinion: Potential positive effects far outweigh disbenefits which can be minimized through education and appropriate safeguards.

Environment

Anticipated Benefits: Potential reduction or reversal of deteriorating nutrient quality of soil. Potential reduction or reversal of deteriorating soil structure with positive effects in water retentive capacities. Increased soil structure will help reduce erosion, improve the production and carrying capacity of existing lands and thereby reduce expansion onto nomadic grazing areas, other lands, and wildlife areas. Improve output of woodlots or their potential thereby acting to reduce soil movement and increased wood output.

Potential Disbenefits: Potential contamination of ground and surface waters leading to deterioration of existing dependent biota. Serious potential for masking continuing erosive soil loss through initial gain in yield thereby creating disincentive for immediate soil conservation measures. Increased potential for erosion and air pollution from road construction and transport necessary to farm inputs and outputs accruing to increased yield. Increased chance of soil erosion by water and wind as currently non-productive land is brought under tillage through the use of fertilizer.

Opinion: The gains in the environment, given consideration and control of disbenefits far outweigh any reasons against fertilizer usage.

Animal Health

Anticipated Benefits: Potential for increased herd nutrition from improved pasture and forage; increased production of crop residues and decrease in potential to overgraze, thereby reducing potential for intrusion of less palatable species which occur as range lands deteriorate.

Potential Disbenefits: Potential for nitrite poisoning from uptake of excessive nitrogen by certain grasses. Potential for nitrite poisoning from excessive concentration in stock water.

Opinion: The gains in animal health far outweigh the disbenefits which can be controlled or eliminated by education and monitoring of waters.

Economic

Anticipated Benefits: Potential for greater personal income and increased GNP through import reduction and expansion, producing a better balance of trade. Potential for risk reduction from the greater diversity of crops which can be raised through the use of fertilizer. Potential development of commerce and infrastructure which would produce jobs thus reducing dependency for employment on existing non-income generating government structures. Potential for development of positive commercial infrastructure within small farmer association accruing to increased disposable income.

Potential Disbenefits: Increased demand on existing governmental structures for social services in remote areas. Increased cost of fertilizers necessary to sophistication of farming. Increased risk of failure if improved seeds are used during fertilizer shortage. Increased cost for proper storage facilities and methods needed because of increased yields. Increased dependence on transportation systems for farm input and outputs. Increased need for credit and maintenance of cash flow balance. With increased usage, there may be an accompanying disparity between small farmers and larger farmers, as larger farmers would have a greater facility to adopt capital intensive technology. This could create a rural elite and accompanying social fragmentation. Increased risk as fertilizer is currently an input supplied by foreign sources. Total reliance on fertilizer rather than in combination with other soil additives in addition, such as lime, may increase cost. Increased cost for soil preparation to realize full benefit of fertilizer.

Opinion: Considering all above aspects of both benefit and

disbenefit, the gains outweigh risks. Certain risks should be considered by the central government, i.e., dependence upon foreign sources of so necessary a technological input, and any developing disparity among farmers creating a rural elite. Area research should be conducted on yield increases from fertilizer as well as soil additives.

Agricultural

Anticipated Benefits: Potential increase in output, soil fertility, soil structure, water retention, and tillage character. Increased yield per ha will help reduce critical shortage of draught animals.

Opinion: From an agricultural standpoint using the correct fertilizer in proper amounts has only positive aspects.

Social Organization

Anticipated Benefits: Increased potential social interaction and cooperation as productivity exceeds subsistance level. Increased potential for evolvement of sophisticated infrastructure and increased responsibility awareness accruing to handling fertilizer credits and marketing of farm inputs and outputs. Increase in social infrastructure and self-reliance as well as social benefits from availability of consumer items accruing to increased disposable income. Positive creation of social structures through division of labor and increased availability of social technology. Potential positive effect on women as increased disposable income allows for development of labor saving services thereby allowing women time to develop positive social organizations. Potential for establishment of social organizations with large overlap in service output affecting areas other than those directly related to individual programs.

Potential Disbenefits: Increased reliance on currently scarce technically competent person nel, increased need for training, potential reduction in farm labor force during training, potential for displacement of persons by adoption of more capital intensive technology leading to disruption of social organization or increased drain on social structure. Potential negative aspects from competition for leadership positions from a social-psychological aspect. Need for ongoing training to integrate younger persons into power structure. Stress and potential social disruption accruing to shift from subsidized fertilizer program to full cost program. Potential for initial high failure rate and accompanying stress and social disruption during initial phase of learning curve for operating fertilizer cooperatives.

Opinion: Positive aspects and potential benefits substantially outweigh negative aspects. Nonetheless the potential for some negative disruptions in the current social structures through the introduction of technology must be carefully considered. Reduction of the negative

aspects can best be achieved through infusion of adequate extension in both use of fertilizer and guidance in cooperative establishment.

II. Pesticides

Human Health

Anticipated Benefits: Potential increased productivity and production of food and fiber because of decreased pest loss. Potential increase in average nutritional intake and accompanying overall improvement in human health accruing to increased production. Improved general health will provide for an increased availability of medical services which would otherwise be needed to cope with diseases of malnutrition. Decrease in morbidity and mortality including infant mortality and accompanying increase in life expectancy. Potential reduction in human external parasite problems.

Potential Disbenefits: Lack of experience in use, storage, or preparation of pesticides is a real danger to personal and public health resulting in adverse affects from direct occupational or non-occupational exposure to pesticides or residues in food, air and water. Increased resistance in pest population, resurgance in non-target pest populations leading to decreased production and accompanying food intake. Increased resistance in disease vectors resulting in increased potential of disease in human population through direct infection or increased potential of zoonoses.

Opinion: Long term benefits from the judicious use of pesticides outweigh short term disbenefits such as acute human intoxication from mishandling during initial phase of learning curve. Adequate training in the use of pesticides is a must. The apparent lack of sufficient numbers of trained advisors represents a potential human health problem. The need for monitoring must also be considered.

Environment

Anticipated Benefits: Potential reduction of certain diseases in wildlife population e.g., trypanosomiases. Potential for large scale reversal in deteriorating range and wildlife areas from encroachment of disadvantageous woody flora through use of herbicides.

Potential Disbenefits: Potential for pesticide residues in air, water, and soil to produce adverse affects on exposed non-target fauna and flora. Potential disruption or loss of wildlife habitat because of ability to expand agricultural activities into otherwise economically non-productive areas. Potential population shifts with chance of disrupting entire dependent biota.

Opinion: Effects of uncontrolled pesticide usage from a nonfarm environmental standpoint probably have more negative aspects than potential benefits. This is especially true if there is inadequate education prior to widescale use. For example,

sources in government indicate that poorly controlled pesticide usage by state farms has created some adverse affects on the surrounding environment.

Agricultural

Anticipated Benefits: Potential increase in overall agricultural production and productivity from reduced pest pressure and improved health of draught animals and farm workers. Potential increase in available land for agriculture by removal of physical and disease barriers.

Potential Disbenefits: Potential increased resistance in target pests with potential increase in secondary pest resurgance created by induced shift in insect population pressures and disruption of natural controls.

Opinion: Without adequate education in pesticide use and pest control which is likely to occur in the initial stages, primarily from a shortage in competently trained technicians and extension agents, the rate of misuse and inefficient usage will probably be high. Consequently, the gains from pesticides, with the exception of large control measures for emergency outbreaks, are estimated to be low. Therefore, it is recommended that restrictions be placed on the use of pesticides until: 1) there is assurance of sufficient number of adequately trained extension personnel with the capacity to convey information on past management methods in addition to chemical controls; 2) central government has established crude economic thresholds for most major pests; 3) village and rural farm communities contain sufficient numbers of well trained crop protection personnel to cover the general pest control needs of the area; 4) there is an accurate data base on pesticide loading within areas with accurate updating by chemical category; 5) the central government has established a functioning monitoring system for: (a) pesticides in crop residues going to either human or animal use, and (b) waters to protect fisheries and wildlife.

Economic

Anticipated Benefits: Potential increased overall labor productivity from improved general health. Potential positive impacts on individual income and GNP from increased production and productivity. Potential increase in crop and livestock production from increase in available land.

Potential Disbenefits: Potential displacement of persons involved in labor intensive activities such as weeding if herbicides are used. Potential increase in incremental added cost of production as insects become resistant to less expensive pesticides. Potential dependency or increasing need for more sophisticated materials, equipment, and training thereby increasing overall cost of production. Potential for increased human health costs, both direct and work loss from intoxication accruing to in-

creased toxicity of more sophisticated pesticides.

Opinion: With inadequate education and regulation of pesticide use, which is likely to occur during the initial stages of many projects, the diseconomies in the early phase will probably outweigh benefits. Agriculture will however need this form of technology especially with improved seeds to produce the expected yields. Since, however, it is likely to be some time before ample supplies of improved seeds are available, there is not the pressing need for immediate use of many pesticides. Nonetheless the economic gains from the judicious and well regulated use of pesticides when other inputs are available will certainly justify the cost of this technology. The responsibilities, however, must be recognized and accepted.

Social Organization

Anticipated Benefits: Potential increased social interaction and cooperation as productivity exceeds subsistance level. Potential increase positive evolvement of social structures and communications with other areas and levels of government leading to increased technical and social awareness. Increased awareness of environmental dynamics and value thereof as related to crop production. Increase in social infrastructure and self reliance as well as social benefits from availability of consumer items accruing to increased disposable income. Positive creation of social structure through division of labor and increased availability of social technology. Potential positive effect on women as increased disposable income allows for development of labor saving services - allowing women time to develop positive social organizations. Potential for establishment of social organizations with large overlap in service output affecting areas other than those directly related to projects.

Potential Disbenefits: Increased reliance on currently scarce technically competent personnel, increased need for training, potential reduction in farm labor force during training, potential for full cost program. Potential for initial high failure rate and accompanying stress and social disruption during initial phase of learning curve for operating pesticide cooperative.

Opinion: Adoption of 20th century technology is not without risk. Nonetheless, with proper training and guidance, the net effect on social structures and people is positive.

III. Improved Seed

Human Health

Anticipated Benefits: Potential increase in average nutritional intake and overall quality of health from improved availability and variety of food and foodstuffs. With improved general health, the otherwise needed medical services can be utilized for other pressing problems. Decreased morbidity and mortality and increased

life expenctancy from improved nutritional balance.

Potential Disbenefits: Increased requirement for many basic services because of increased population and longer life span. Potential for increased use of farm chemicals needed to support seeds.

Opinion: Benefits far outweigh costs from human health standpoint. Improved seed will, however, only reach potential if accompanied by other forms of technology such as fertilizer/or pesticides - refer to discussion on each.

Environment

Anticipated Benefits: Potential for reducing poor farming practices of utilizing poor ground or steeper slopes because of increased yield potential on better lands. Also this would lead to a decrease in erosion. Decrease dependence on pesticide through use of pest and disease resistant seed varieties. Potential reduction in air pollution from burning stubble accruing to certain short stemmed grains. Potential , for reclaiming overgrazed areas.

Potential Disbenefits: Potential increase in air pollution from increased use of transporation needed to move farm inputs and outputs. Potential increased erosion arising from the need for more roads.

Opinion: Benefits substantially outweigh environmental costs, especially for disease and pest resistant varieties.

Animal Health

Anticipated Benefits: Potential increased herd nutrition from increased availability of feed and fodder, leading to improved herd health and greater animal output. Increased health leading to reduced dependence on higher cost medical inputs.

Potential Disbenefits: Potential decrease in crop byproduct in certain short stem grains.

Opinion: Benefits outweigh costs, care must be taken to assure use and control over other technological inputs necessary to the use of improved seed. Increased herd health through use of improved seed in areas otherwise incapable of supporting animals, where such seed can work is a major benefit.

Economic

Anticipated Benefits: Potential for increased personal income and GNP from increased yield. Reduced pest loss and expenditure for imported technology (pesticide). Potential risk reduction from greater availability and variety of resistant seed and ability to diversify. Potential ability to increase number of crops during season through use of shorter growing time accruing to improved seed.

Potential Disbenefits: Increased reliance on capital intensive technological inputs to obtain maximum gain from improved seed. Higher risk of failure if these inputs become scarce. Increased cost for storage as yields exceed local demand and increased dependence upon external sources for inputs and transportation. Increased dependence on seed

multiplication with attendant cost.

Opinion: Benefits far outweigh the costs as long as other technical inputs are assured.

IV. Water

Human Health

Anticipated Benefits: Potential reduction in diseases associated with poor sanitation and lack of higher quality water for consumption, and for greater variety of crops. Ability to expand production base and thereby reduce risk of food shortage from localized crop failures. Potential for increasing nutritional intake with accompanying improvement in nutritional balance. Potential for better forage utlization in nomadic areas and for reduction of risks accruing to droughts. Potential for greater protein intake accruing to increased animal production.

Potential Disbenefits: Potential spread of water borne disease or soil borne disease. Potential for adverse effects accruing to high mineral contents in certain ground water sources. Potential adverse effects from pump failure.

Opinion: Properly designed, sited, and maintained water sources are needed to assure further development. Development must be commensurate with the host country's absorption capacities in health education extension at the village level.

Environment

Anticipated Benefits: The exceeded capacity can be extended and some degredation reversed through careful provision of water. Potential for increased production on existing agriculture thereby reducing need to expand into otherwise undesirable areas, fragile areas, and areas utilized by nomads and wildlife. Potential to reclaim badly damaged soils thereby reducing need to clear more lands with attendant loss of fuel wood potential. Reduction in soil salinity buildup through better planning accompanying normalized supply. Potential reduction in silt loss as better systems are utilized commensurate with higher water costs. Land use planning becomes reality, based on adequate water delivery systems and constantcy of supply.

Potential Disbenefit: Potential for extending or providing vehicle for various disease vectors affecting both man and animal. Large projects have potential to modify existing environment by extensive diversion of water. Potential for causing severe overgrazing in range areas if not properly planned and monitored. Potential for causing salinity problems in soils through improper use and planning. Potential for extending land use into fragile areas which without proper planning and management may be degraded and later be abandoned.

Opinion: Water has the greatest potential for both beneficial and disruptive influences. Development must be in concert with the absorptive capacity of the service and regulatory agencies needed to assure management.

Animal Health

Anticipated Benefits: There is a direct relation between animal health, production, and water quality and quantity. There are forage areas which are underutilized because animals cannot treck between these areas and available water. With increased availability of water, forage utilization efficiency will increase leading to better animal health and thereby less demand on currently scarce veterinary services.

Potential Disbenefits: Potential for overgrazing range thereby reducing overall herd health. Water not analyzed for mineral content, may contain toxic elements. Land use plans based on specified carrying capacities per watering point must consider that animals on higher mineral content water have reduced grazing radii.

Opinion: Development of water for animal use is not without risk. Adequate monitoring of range stocking rates and capacity to reduce such rates will be needed. Development must be accomplished in concert with host government absorptive capacities for both services and regulation.

Economic

Anticipated Benefits: Provision of water will allow both agricultural and stock raising enterprises to expand in a productive manner. This expansion can be either through bringing new lands into production, or increasing production of existing lands. Increasing production on existing lands will mean a reduced need to clear land. This will save both the energy to clear and also the loss in fuel wood. Water will reduce uncertainty and with it short term decision-making. With better planning, long term economic forecasting, and savings to other sectors will be possible. The greater diversity of crops available will further reduce risk, thus raise skill in medium and long-term planning. Potential for greater personal income increases as well as GNP, leading to stability and better balance of trade.

Potential Disbenefits: Improper planning through availability of water may lead to displacement of other enterprises whose opportunity costs must be considered. For example, controlled irrigation and flood control may substantially reduce present nomadic grazing areas. Poor coordination between water development and social services, especially health, may cause an excessive drain on the latter. Water as a vehicle upon which certain diseases are borne may substantially reduce the productive capacity of the people, with an accompanying reduction in yield and increase in overall cost. Increased requirement for many basic services because of increased population and longer life span. Potential for increased use of pesticides.

Opinion: Considering all aspects, water development has favorable positive aspects. Drawbacks will be development inexcess of host government absorptive capacities.

Agricultural

Anticipated Benefits: Potential

to increase cropped area at rate in excess of need to bring new land into production. Potential for increasing yield of existing land and for increasing variety of crops. Potential to reclaim certain areas currently losing production from salt build-up. Increased yields per area will reduce need for currently scarce technology and extension personnel. Potential for increased livestock output.

Potential Disbenefits: One must consider livestock production as a necessary part of agriculture. Care must be exercised to carefully balance costs and benefits, including opportunity costs accruing to livestock enterprises, of removing water from rivers for irrigation. Potential areas for irrigated agriculture, or rainfed agriculture where domestic water is provided, equate well with traditional grazing areas. Water of excessive mineral content may eventually lead to loss in production. Poor water management or planning can reduce yields, defeating the purposes of water development. Increased reliance on currently scarce technically competent personnel, increased need for training, potential reduction in farm labor force during training.

Opinion: From an agricultural stand point, water is necessary for further development. Proper planning and management should mitigate many of the problems. Because of the potential competition and conflicts arising from the use of this scarce resource, donors must not develop beyond the absorptive capacity of the host governmental agencies.

Social Organization:
Anticipated Benefits: Potential to induce soil movement and change. Potential increased social interaction and cooperation as productivity exceeds subsistance level. Potential increase positive evolvement of social structures and communications with other areas and levels of government leading to increased technical and social awareness. Increased awareness of environmental dynamics and value thereof as related to crop production. Increase in social infrastructure and self reliance as well as social benefits from availability of consumter items accruing to increased disposable income. Positive creation of social structure through division of labor and increased availability of social technology. Potential positive effect on women as increased disposable income allows for development of labor saving services - allowing women time to develop positive social organizations. Potential for establishment of social organizations with large overlap in service output.

Potential Disbenefits: Increased potential conflict betweeen nomadic and settled agricultural peoples, thereby undermining government objectives. Potential for initial high failure rate and accompanying stress and social disruption during initial phase of learning curve. Potential displacement of persons by adoption of more capital intensive technology leading to disruption of social organization or increased drain on social structure. Potential negative aspects from competition for leadership positions. Increased potential

for social and psychological stress accruing to failure in adoption of new technologies, and extended or over extended credit. Possible disruption in current group social dynamic during phase change. Potential for misuse of power or concentration of power by few technically competent leaders. Need for ongoing training to integrate younger persons into power structure.

ALTERNATIVE TO THE PROPOSED OVERALL DEVELOPMENT ACTIONS

A. No Action

This alternative has no advantage. Development must be undertaken by the government if Somalia is to avoid continued environmental degradation and the resulting increase in the hazards of famine. Development under a no action mode would continue from increasing population pressures, but in an uncontrolled way and without correction of the attendant undesirable effects for which the project was established.

B. Postponing of Action

This alternative has no compelling advantages. There is some consideration for waiting until the absorption rate of the requisite agencies is sufficient. Nonetheless, the programs can function with expatriate help within the existing manpower limits. More problems may result if, for example, the government does not continue its efforts to unify the nomads into a cohesive range management program. Certainly the longer the program is postponed, the greater the losses from the current misuse of resources.

C. Postponing segments of the Program

As discussed elsewhere in this report and in the various project proposals, there is a high degree of dependence upon competent technical personnel. Some segments of the program should be scaled back in initial phases or postponed until adequate technical personnel are available. Other interphasing segments will by their limited availability, dictate later introduction. Principal segments to be scaled back or postponed pending further analysis are:

1. Pesticides.
   Until sufficient monitoring systems are established and technical manpower exists to assure proper introduction of this technology, its introduction should be scaled back.

2. Tsetse fly.
   Control and resulting opening of the area to agricultural and livestock pursuits should be postponed until land use management is assured.

3. Exotic poultry and livestock.
   Until sufficient technical manpower and support exist, introduction of the exotic animals should be limited to only those areas having sufficient markets, management, feed production, and animal health backup.

4. Provision of watering points for nomadic stock.
   Limited data exist on the performance of the northern rangelands' grazing reserves. A more thorough analysis of the nomadic response to range reserve utilization, cooperative legal structure, and livestock marketing feasibilities is recommended before providing water.

5. Irrigation.
   From preliminary data, it would appear that proposed irrigation projects will utilize in excess of 60 percent of normal seasonal river flow. Although further analyses need to be conducted to either confirm or disprove this, the potential adverse effects are, for example: a) overbank spillage between Belet Ven and Audegle will be reduced or eliminated--overbank spillage now supplies approximately 100 million M^3 of water to approximately 4100 square kilometers of land. This land produces between 200,000 and 300,000 tons of forage annually--or support for approximately 100,000 animal units, b) Irrigation use per planned projects will affect vegetation in the lower Shebelli swamps. Some 2400 square kilometers will be affected to some

degree, affecting forage production for approximately another 100,000 animal units.

6. Land use planning.
Opening new lands for irrigated and rainfed agriculture could ultimately affect another 17,000 square kilometers--for which land use plans must be provided. Alternate fuel supplies must also be considered. In addition, some of the new agricultural areas will conflict with traditional grazing areas.

PROBABLE ADVERSE ENVIRONMENTAL IMPACTS WHICH CANNOT BE AVOIDED

A. Adverse Effects

1. Air.
Increasing agricultural production will inevitably be accompanied by an unqualified but modest increase in air pollution. Many of the practices to be introduced by the projects such as soil and water conservation, use fertilizers, range management and animal health improvements, will tend to reduce this. Consequently, the overall level of pollution increase should be minimal and principally confined to growing and harvest season activities.

2. Water pollution.
Increased use of fertilizer and pesticides, as production increases, will ultimately produce some adverse affects on the nonagricultural environment. The extent of such effects will depend on the rate of adopting mitigation measures. Certainly the soil conservation practices will mitigate the major effects by reducing the severe erosion. If the soil does not move, many of the materials placed in or on it will also not move appreciably into water sources. The major pollutant, silt, will be substantially reduced through proper soil conservation measures.

3. Wildlife.
As agriculture increases, there may be an accompanying intensification in the competition between agriculture and wildlife. Certainly pesticides will have some effect on wildlife. This can be mitigated by: a) instilling a knowledge of the value of wildlife, b) assuring adequate coordination and research communication between affected parties, and d) establishing a national monitoring system for pesticides and other potentially toxic chemicals.

4. Human health.
Introduction of pesticides to an unsophisticated population without proper control will result in occupational and nonoccupational poisoning or contamination. Even under better conditions of advanced agriculture, some acute and chronic intoxication will occur. This can and must be minimized principally through education and control. Both are included within the design of various projects but need strengthening.

5. International concerns.
Since most of Somalia's rivers flow into international bodies of water, outflow from these rivers during production intensification will have some negative effects. This aspect of intensified agriculture will require an understanding among cobasin users and the establishment of agreements and

monitoring systems. While not included within any specific proposal, the concept of a national monitoring system has been introduced at the ministerial level. Development of such a system, however, must be advocated by both the donor community and the government.

B. Effects of Recommended Actions On Project Costs and Economic Evaluation

Recommended actions in some instances, have been partially addressed within various proposals. Unfortunately, a lack of coordination and knowledge exists among the donor community which hampers effective solutions. Some recommendations may increase the internal costing of individual projects. The overall cost of not considering the consequences of long-term effects may outweigh the short-term internal project cost. Other recommendations, such as a national monitoring system, have cost reduction effects.

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

If it is granted that the most productive long-term effect is to promote the cultural and economic development of small farmers and livestock owners through increased production, then there is no apparent conflict between short and long-term uses.

There will be some temporary environmental degradation due to noise, dust, etc. during the process of construction of roads, range demarcation lines, water points, soil and water conservation projects, or farm facilities. With adequate planning, this degradation, for the most part, will be local and short-term. Continued use of rural roads will be accompanied by dust and, if not properly designed and constructed, erosion and potential for harboring shistosomiasis in low areas.

Once the facilities are open to their final use, construction disturbances will end and the long-term benefits to human and animal health will continue for the useful life of the particular activity or facility.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The varied projects are principally concerned with resource management of essentially renewable natural resources in areas currently undergoing progressive environmental degradation. Large scale water holding, drainage, and irrigation systems and large scale brush land clearing are proposed. As a consequence, alterations of natural patterns will occur. These alterations can be mitigated by the inclusion of reserves which exist in many project proposals. Careful environmental and social planning must preceed development. With respect to USAID projects, there are currently no major or serious irreversible or irretrievable commitments.

Effects of pesticides when properly applied, including other farm chemicals, on the natural systems would persist, but not permanently.

With respect to road construction, proper controls during construction for erosion and water channeling would preclude continued ill effects. Initia soil movement, dust, and erosion would be greatly reduced as vegetation covers raw cuts or fills. Continuing use and maintenance would produce some localized dust and erosion, especially on non-paved roads.

NOMADIC TRIBAL LIFE

Summary

I. The amount of available water is the determining factor in how they live.

II. The land is harsh, arid, rocky in terrain. Desert scrub is the main foriage.

III. Tribal life revolves around the need of the herd. Camels are the animals of survival. Their milk is the mainstay of the dry season diet. Families are separated for months because of herding duties.

IV. Camel husbandry is especially difficult. The animal is fractious, breeds irregularly, has a long gestation period and is susceptable to ticks. The incidence of ticks forces frequent, long distant moves.

V. Human birth rate is low. Infant mortality high. Lifespan averages forty years. Medical and health facilities are unknown, death rate is high.

VI. A cultural bias against agriculturalists exists.

VII. Somali government plans by use of general mandatory education to encourage detribalization and resettlement. It must break down psycho/social resistance to sedentary agriculture.

(See Kurtanwaare)

The Nomad is a fierce and hauty dweller in the harsh terrain of the Somali desert. The amount of available water is the determining factor in how these nomads live. Lava rubble, volcanic ridges, and shallow craters, interspersed by gravel patches and salt flats as well as sand dunes make up the region's drab environment. Desert scrub predominates and the temperature is torrid, the air chalky. The camel is the focus of survival. Although the nomads maintain herds of smaller animals such as goats, sheep and cattle, it is the camel around which their existence depends.

Raising camels permits survival in this arid land but camel husbandry is no easy matter. Fluidity as a lifestyle is displayed in response to the requirements of their stock. The main camp is mobile for camel ecology precludes fixed housing. Family members are dispersed for much of the year and often widely separated. Youths of the family spend months away from home with the grazing stock. Economic demands limit the time the family will spend at any one camp. Droughts, stock raids, disease as other misfortunes, often drive the family to seek its survival with kinship groups.

In meeting these requirements the human community incurs heavy costs in time and energy. Resulting in little social activity which occurs independent of the needs of the camels. Settlement patterns, division of labor, and community organization all reflect the demanding nature of camel herding as a subsistance method of life.

The Tribe

An important index of the camel to the tribe is the association of the animals to the main camps throughout the year. These are mobile living units each with more than seventy persons and seventeen tents. This is the tribe's nuclei -- political and ritual. Much of the year finds the camps occupied by older married persons and younger children. Residents are usually related through kinship and marriage ties. During the dry season, the bulk of goats and sheep are driven to satellite camps by youths. Often these camps are two hundred miles distant. Camels are kept close to the main camp for their milk is the mainstay of the dry season diet.

Woman's Role

The women dress in brightly patterned garments which are wrapped around the waist, drawn up over the breasts and then tied at the neck. Frequently another dark piece of cloth is wrapped around the shoulders. Their costumes are brightened by aluminum beads, anklets and earrings. Their hair is worn in many fine braids. Their heads are adorned by triangular fillets of aluminum. Colored beads are strung on thongs and it is clear that they have made the most of the meager supply of feminine adornment available to them. Women play a major role in the frequent times the tribes must move. They pack up and move as often as twelve times a year. The women dismantle the tents. They then load all household goods on the back of one camel. Often small children and nursing mothers may ride. Members of the camp usually depart as a group, but will shortly breakup into smaller units. Women are not allowed to milk the camels or assist in the herding, watering or breeding process. They may load the camel or lead it, but to be otherwise involved creates a fear of the stock becoming sterile. They do milk cows and goats. They perform the duties of the home, cooking, carrying water vast distances, making clothing and child rearing. Young girls will often walk seven to ten miles a day leading camels loaded with water. They walk barefoot over hot gravel. When the woman marries she becomes part of her husband's clan. She brings the intricately woven water basket, usually made by her mother. Her children become a resource of her husband's labor force. Interfamily obligations and ties are strengthened and created.

The House

The clans live in round highly portable houses. These are formed by a framework of strong saplings over which are tied hides, pieces of cloth and a skirt of sisal. A curtain covers the entrance. There is a male and a female side of the house. The furnishings are meager. This is practical in a society where all household goods must fit on the back of one camel, during their frequent moves.

There is a fire circle, a few cooking pots, some hides and water containers made of braided asparagus roots. The men and women do not eat together, the males being served first. Their beds are woven sticks with a few hides. They use milk gourds and giraffe hide water buckets. Often they have ceremonial gourds decorated with cowrie shells. Circular outlines of manyattas, divided like giant pie-like sections for each family scatter their human imprint on the desert.

Men wear shorts or sarongs, wrapped head coverings, and brightly colored stone or bead necklaces. Married men carry walking sticks.

Tiling the soil is considered ritually polluting. The nomad considers the sedentary farmer unmanly. An all-over aridity makes cultivation all but impossible. Cattle husbandry, the most efficient method of animal subsistence is only limitedly successful here.

The nomads also subsist by a small amount of trade. Most traders trek through the desert with their camels well loaded. Using barter, the nomad can secure maise, meal, tea, coffee beans, and sugar. They consider it sacrilegious to sell camels and their products to outsiders. Recent years of drought have forced tribesmen into this practice.

Camel Herding

The camel, an unruly and fractious beast is not only a source of food but valued for its brute strength. The nomad will exploit the beast's ability to travel long distances heavily burdened. Only in this way can otherwise uninhabitable dry plains be crossed. It can go as long as three months without water if there is water in the foliage. Camel herding requires more manpower than any other type. Camel husbandry has many disadvantages.

There are breeding problems because camels mature slowly. They do not bear young until their third to fifth year. There is a long gestation period of twelve months. Breeding patterns are irregular. Inexperienced males must have human assistance to copulate. Lactation stretches birth intervals from twelv to forty months. Healthy females may bear no more than eight offspring in a lifetime of 20 years.

Added to the herder's problems are mating patterns. When the rains fail, as they frequently do for several months, the bulls will not rut and the birthrate is low. Their eating habits also cause range manag ment problems. Except in lush range land camels avoid pastures of previous days because of their droppings. They prefer to move about and sample scattered shrubs and grasses. The herd has a highly scattered grazing formation in contrast to cattle that graze in a compact herd. This habit makes them easy prey for predators and requires constant watch by the herds men.

Camel habits force their owners to work hard. A nomadic cattle settlement may remain stationary for a period of months. However, the camel herds must move an average of once a month for ecological reasons

The most important is the tick

Rhipicephalus pulchellus, which carries a disease leathal to camels. The dung levels of the corrals build and the ticks infest the excreta. They live part of their life cycle beneath the ground so mere removal of the dung does not eliminate them. When the dung level reaches a certain height the family is forced to move. The tick factor is responsible for longer moves which increase the workload.

The anatomy of the camel forces frequent movement during the rainy season. Its flat, padded feet have little traction on slippery corral surfaces. Muddy enclosures so disturb the camels that they will attempt to break out unless they are promptly moved. Eating water soaked plants during the rainy season makes the animals ill and drinking surface water bloats them. Another reason for frequent moves.

The nomad is badly overworked. Members of a family often must spend up to 16 hours a day on herding duties. They are usually short-handed. Their survival relies on additions of rich cow's milk and meat. Camel milk is thin and salty. It requires an astute herdsman to deploy these diverse herds in a complex and critically harsh environment.

The herding is even more difficult because of the camel's reluctance to return to camp. It has no homing instinct or intuition. Continuous prodding and searching for lost animals requires even more labor at day's end. The female will often secrete a new calf in the bush and hours may be spent in discovery.

Strong men and the elders join the herdboys at sunset to assist in the difficult and sometimes dangerous job of getting the camels back to camp.

Defense of the camp is often difficult because young men spend many months isolated with the herds. Family ties are difficult to maintain. Custom declares that a young man may not marry until his mother is past childbearing age.

Watering Ritual

There is a distinct watering pattern. Herds of camels, goats and sheep will be milling about in the vicinity of the wells waiting for a signal to move up to the troughs. There is a waiting etiquette; one might call it a protocol of cooperation. Each herd has its turn and the sequence is known by the herders. Small animals appear to have precedence but camel herds need repeated trips to the trough. There is a social belief in oneness and unity which is reflected by behavior at the wells. The temperature is torrid, the air dusty. At the well one man is knee-deep in brownish water. With a hide bucket in hand, he dips and pours water into an adobe trough. He often sings in rhythm with his motion. In a larger well a man is in the water and hands up a full bucket as he receives an empty one. The scooping of water as the buckets pass between three men to the trough continue as they sing. At the largest of the wells the government provides a cemented cover to prevent erosion and evaporation. Camels are usually watered at the largest of the wells.

The nomad has lived for centuries in this inhospitable environment. He survives droughts and intertribal warfare, works hard long hours, and endures family separation. There is little gaiety in his life and rarely a surplus of anything. There is a high infant mortality rate and a high death rate where the lifespan is forty. Life is dependent on the herd and all social and economic needs

THE NOMADIC LIVESTOCK REQUIREMENT

SUMMARY

I. For subsistance, approximately 6 livestock units are needed for each human adult equivalent.

II. At 6 LU/adult equivalent assuming a carring capacity in the Central Range of 12-15 ha/LU, the range is seriously over-stocked.

III. Although overstocked, it appears that families are already at subsistance. Thus destocking is not the answer as there appear to be no excess animals to sell.

IV. The Central and Northern Rangeland Projects will be unable to reverse the current deterioration for some time, therefore:

V. The government needs to initiate more programs to provide an alternate life style for nomads.

VI. Irrigation plans to contain overbank spillage from the main rivers will reduce nomadic grazing areas.

VII. Water draw-off in the upper Shebelli may reduce the grazing areas on the lower reaches of the Shebelli.

Nomads are generally of lighter build and less active than agriculturalists. Their food requirement is therefore less. Darling and Farvar estimate the nomads'average dietary intake to be about 1,800 calories per day. If the average family consists of about eight individuals, half of whom are children under 14, then family unit is equivalent to 6.5 adults.

Most of the diet of the nomad will be milk, since that is the only food regularly available. The daily subsistance need will dictate herd size and makeup. In many areas, the principal animal will be the camel.

Lewis (50) and Drake-Brockman (22) indicate that two camels in milk will support one adult on a 100 percent milk diet plus their own foals. Torry (81) indicates that camels breed irregularly, and Darling and Farrar (20) indicate that "every second year female camels provide 5 to 9 pints per day..." Milk contains about 2 percent milk fat, as an average, when produced under Somalia's range conditions. This will provide about 500 calories per liter. Lewis (50) indicates that pastoral nomads will consume from 5 pints to 2 gallons of milk per day. May's work (57) however shows that if the diet is nearly all milk, both the sugars and proteins are used for calories because of the marked absense of supplementry energy foods. Since this diet is also deficient in essential vitamins, the body often cannot fully utilize what little protein exists. For this reason, the annual average effective caloric intake is estimated at 1,800 per day. Using these data, and extrapolating an example from Brown (11), one may estimate the size of a herd needed to maintain the "typical" family.

From the estimate of 1800 calories per adult, the theoretical minimum need of the family on a 100 percent milk diet would be 11,700 calories per day. This would require 23.4 liters (500 calories per liter) or the production of about 5 to 9 camels. Using data from Lewis (50) and Drake-Brockman (22), this same production would require 13 camels.

For the following example, the average of 9 camels is selected. As stated above the camel breeds irregularly or every two years at best, and produces for about 12 months. Under these conditions the nomadic family would need to maintain 18 breeding females, 9 for each

alternating year. Brown (11) indicates that most nomadic herds are composed of 60 percent breeding females as compared to a rancher's 20 percent. If this is the case then the herd size is more realistically 30. This however does not allow for a 15 percent annual loss rate. Accordingly, the herd size is raised to 35 animals. Assuming serious drought every seven years, losses of 50 percent are not unreasonable. To compensate for this eventuality, the nomad would carry extra animals. Thus it is not unreasonable for the number of camels to range upwards to 40.

The above scenario assumed a diet of 100 percent milk. If the nomad and his family utilize the 15 percent annual herd loss, slaughtering animals prior to their death or using small stock, the milk requirement can be reduced, and with it the number of required animals.

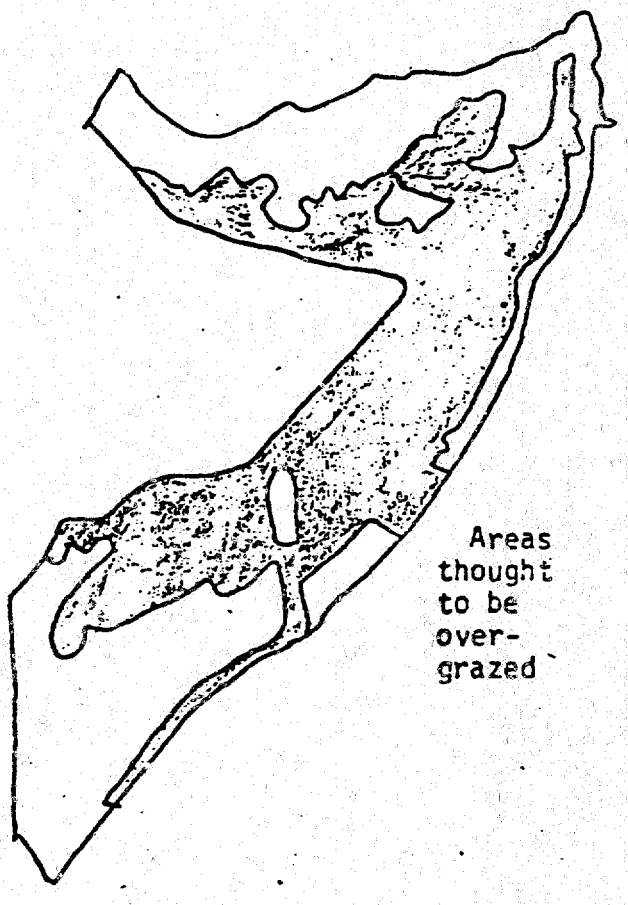
On a 15 percent meat 85 percent milk diet, 1.1 kilograms of meat and 20 liters of milk are consumed daily. The herd can therefore be reduced to 85 percent of that needed for the 100 percent milk diet or to 34 camels.

Since camels are not the only animals in a typical herd, a further extrapolation of data may provide the average herd makeup.

Using Hunt's (34) data, there are two typical herd compositions: the herd with a higher cattle count and herds with relatively few cattle intermixed. The ratio for camels, cattle, sheep, and goats is expressed in livestock units. Higher cattle intermixtures typically show 1.6 : 1.3 : 0.17 : 0.53. For areas with few cattle, the ratio is as follows: 3.0 : 0.05 : 0.25 : 0.13.

If cattle are introduced into the herd, their milk capacity must be considered. Milk output is estimated at 2 liters per day for their shortened lactation (6 months) under arid range conditions. The milk requirement per human adult equivalent on the 85 percent milk diet is about 3 liters per day or the output of 1½ cattle in lactation. To assure a continuous milk supply throughout the year, under a scenario similar to that for camels, it would require a minimum of 6 cattle per human adult equivalent.

Using these derived figures one can then estimate the herd makeup, assuming milk only from camels and cattle.



Low Cattle Complement

	Camels	Cattle	Sheep	Goats	Total
LU	41	1	4	2	47
Head	34	1	50	25	108

Higher Cattle Complement (camels reduced accordingly to maintain 11,700 calories)

	Camels	Cattle	Sheep	Goats	Total
LU	23	18	2.5	7.5	51
Head	19	18	31	95	163

As a cross check, data from the IBRD document for the Central Rangelands Project were averaged. Herd composition suing these data is as follows: 2:1.15 : 0.64 : 1.15. From this composition the following obtains using 34 camels as a base.

	Camels	Cattle	Sheep	Goats	Total
LU	26	16	0.32	15	57
Head	22	16	4	187	229

Torry ( ) found that among the Gabra of northern Kenya, the average family owned 25 camels, 9 cattle, and 125 goats and sheep or 49 LU. He states that such holdings are unimpressive by Somali standards.

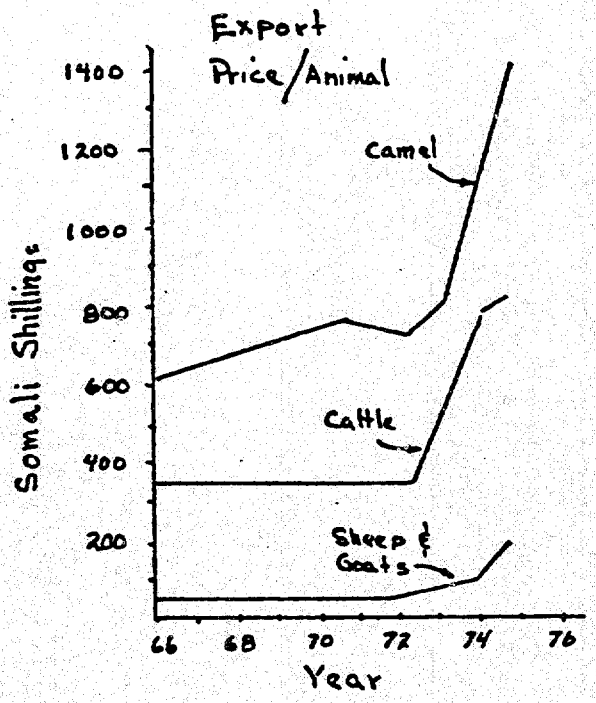
Thus through these crude estimates, it appears that an average family owns approximately 47 to 57 livestock units. This approximates 8 livestock units per human adult equivalent.

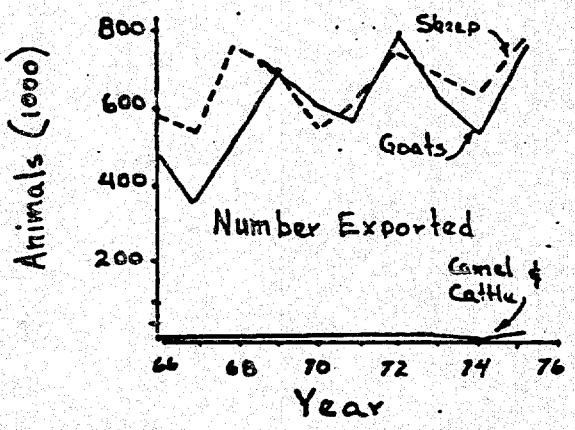
If one considers only subsistance needs, the holding could be reduced to meet only the dietary requirement, which is about 36 livestock units or about 6 LU per human adult equivalent. This latter figure agrees with the 5.7 LU equivalent which is derived from the 1975 Somali census data.

As overgrazing increases, the productivity per animal unit is expected to decrease. Consequently more animals are needed to produce the same supply. The result is an uncontrolled spiral.

In typical rangeland conditions, only a limited number of humans can survive by nomadism. If 36 livestock units are needed for a typical family and the carrying capacity of the range is 10 hectares per livestock unit (LU), each family must have 360 hectares. As the range deteriorates to a carrying capacity of 12 ha per livestock unit, then 432 ha are needed. With a carrying capacity of 15 ha/LU, 570 ha per family are needed. The Bank document estimates that there are about 408,000 nomads in the Central Rangeland Project area. Based on family sizes of 8, about 51,000 families exist in this area of 149,000 sq. km. which provides 292 ha/family unit. Brown (11) and Gwynne (66) indicate that 12 to 15 ha are needed per LU, and IBRD concurrs. Thus 292 ha per family means a maximum of 19-24 LU can be kept per family, or about ½ of that needed.

Inequities in holdings occur. There are often a few wealthy families with much larger herds, and a few people without enough animals to survive. Intertribal warfare and stock disease have both been controlled, resulting in sharply increasing populations of humans and animals. In addition the market price in the Arab states for animals has almost tripled since 1972 giving impetus to the problem. The need to find a solution is clear and urgent. If no solution is found the rangeland will cease to be a productive asset and become a costly liability. Where the cause of overgrazing is excessive human population measures to reduce the number of nomadic people on the land must be found.





With respect to the price of animals on the export market, it is noted that oil prices have greatly influenced them. While the absolute price of large stock has increased substantially, small stock numbers and prices have grown even more. The number of cattle and camels exported since 1966 has not increased appreciably. Sheep and goat numbers and prices over this same period have increased as follows: average number exported inceased 50 %, price increased 400%.

Since the reproductive turnover is much higher in small stock, it will be important to watch these trends. Where range lands begin to deteriorate, there is a tendency to shift to small stock which have a better survival capacity. Under these conditions, with the influence of higher market prices one would expect to see a spiral of increasing small stock and accompanying deterioration of the range. Herd mixes in the central rangelands project are seen to follow this process, and are, in fact encouraged to do so.

The above figures also indicate that the nomads are turning toward a market economy. The limited sales of large stock (the milk producing portion of the herd) may indicate a steady-state in the number of these animals for subsistance needs. With proper management, the project can exploit this trend.

Only when large herds in excess of subsistence requirements exist will destocking result in the needed improvement. Where the average herd is less than that needed for subsistence, general resistance to destocking can be expected, and a proportionate reduction in stock herds will force people to live at below subsistence level. The man with a minimum herd in an area where a few rich men own most of the stock cannot reduce his holding and survive. The livestock baron can equally be expected to resist being told to dispose of two thirds of his stock. These varying factors will mean that differing remedial measures must be suggested in different situations.

In addition to local customs associated with livestock numbers, the outsider must be aware of basic religious differences between the Islamic faith and the Christian dogma. This is seen in the apparent disparity in livestock holdings, as well as the general socio-economic philosophy of the people.

Where Christian dogma preaches equality, hence large welfare systems, the Islamic faith assumes that adults are capable of self sustenance. Under the Islamic teachings all persons (mal upon reaching adulthood have equal capacities to deal with the world. Failure of an individual for whatever reason is "the will of Allah." As an example, the purchase of livestock from drought stricken nomads by wealth but pious Muslim livestock owners for more than a week's supply of grain is accepted as a fair trade. Both partie have received the best of the bargain under the situation. There is no animosity and society does not chastize the wealthy stockman for having an "unfair advantage," nor does it rush t the aid of the other. The family of the drought stricken individual will supply the aid providing it is available.

Under these circumstances, there is not the feeling by the "have-nots" to bring down the "haves." The government, being of the same mental set is placed in an awkward situation. The donors coming from countries with essentially Christian backgrounds must be aware of these social constraints which impinge upon range management.

Remedy may be found in agricultural or fishing resettlement schemes.

Conclusion:

Solutions must be based on biological understanding of the situation. Dependence on milk is at the root of this problem. A reduction in the dependence on the milk diet is worthy of consideration. This, however, requires a drastic change in eating habits and taste. The most obvious food to substitute for milk is grain. A cut in milk dependency and the number of stock required would also reduce the demand on available water supplies. The amount of water drunk by the nomad himself in relation to that of his herd is negligible. Assuming half the milk ration is replaced by grain, then half the number of breeding females are required, and the land requirement per family is halved. The proceeds from one or two livestock units could provide a 50 percent grain diet for the whole family for one year.

The problem with this approach lies with transportation and storage of sufficient grain needed by a nomadic family. Currently there is no infrastructure to assure the nomad this exchange of animal for a continuum of grain. The animal will produce, each day, a portion of the nomad's food, transport itself, provide transport for the nomad's belongings, convert to meat, and have a value that will rise or fall with inflation and money systems. While grain may have a few of these attributes, it cannot equal the animal.

Until Somalia becomes self-sufficient in grains, the value of these commodities will be set by external factors. The nomad under these circumstances is no longer master of his own fate, but becomes tied to the inflationary systems external to his world.

PROBLEMS OF PASTORAL AREAS

Overstocking is related to the basic biological needs of pastoral man. In order to free the pastoralist from his dependence on milk it is necessary to change his diet. Another imperative to effecting change is to encourage the sale of livestock while substituting a more economically feasible food instead. It is relevant to consider these changes in the light of an applied biological analysis.

The problem is convincing these traditional people to convert livestock to cash. This will have a desired effect of reducing herd size and introducing a cash economy with a resulting change in diet. We are addressing the issues of cultural diet bias and a dramatic change to using this money to buy gain. Not only must we ask a primitive society to give up a lifestyle where their animals constitute wealth, per se, but they must use the grain as a primary food source. Most important a nondependence on milk will lead to herd size reduction and therefore herds will not abuse the carrying capacity of the land.

The pastoralist has used his herd for a primary food source. It also supplies dung for heating, and hides for sale, clothing and tentmaking. What can the Somali government do to ensure that once the nomad has sold his animal he will use the money to buy grain, and that the grain will be acceptable.

Pratt and Gwynne suggest that enforced government sales are not the answer. It would not be too difficult to organize compulsary sales and to force the buying of grain with the money. However, it would be virtually impossible to ensure that the grain was eaten. Another problem is the lack of massive abatoirs. Forced sales which would deprive the people of milk would create havoc in the present system of processing as they now exist. There would be a problem of how to set quotas. There would be an unprecedented influx of cash to stock owners. How would the government prevent the nomad from either dissipating it or buying stock from other areas? Furthermore, the need is not to depopulate the range but to bring stocking rate and carrying capacity into balance.

If compulsion is discounted, the problem remains on how to break through the people's natural resistance to change. We are looking toward government extension services and education as primary sources. The Somali nomad is a fiercely independent, proud man who has maintained his herds and it will require a great determination on the part of the population to accept change.

Even if the people accepted these changes; in theory, and did agree to sell livestock, to what use would the accrued money be put? The Hamites, of Islamic faith already demonstrate a use for money. But the question is emphasized: What worldly goods does a nomad really need?

Were we discussing the more sedentary pastoralist, he might be persuaded to roof his abode in tin rather than grass or hide. He might be persuaded to buy consumer goods. But is this so very desirable? It is imperative that the first step in establishing a cash economy is to convince the nomad of the value of money. To show him that money has a valid use and that his country's interests require a cash-economy be established.

Such a valid outlet would exist in the improvement and development of land. Conceivably this is the only valid outlet at present. The present occupiers cannot become potential investors unless they have security of tenure over the land. At present this is not the case. Most occupiers have only a nebulous traditional right of occupancy. Increasingly pastoralists are becoming aware of the disparity between their situation and that of their agricultural neighbors. Many agriculturalists already have land titles. Pastoralists are already suggesting that they also should have land titles. see Range Law Appendix

Individual land ownership has no tradition in pastoralism, nor does it follow that traditional communal use implies communal or individual ownership. Communal use of land in Africa is different from the European concept of communal use of land. This is a serious difference and requires a different approach. The tribal lands are sacrosanct, to the tribe. They often allow others entry but the land belongs to the tribe. In many societies separate clans, or other sociological groupings have separate territorial rights. The groupings vary in their sociological basis, but all the concerned groups exercise discretion over who may graze in their territory.

The existence of such natural groups suggests a basis upon which to build. The principles of adjudication and registration of customary rights need present no problem as it has been applied extensively in agricultural areas. The incentive of land title almost guarantees group cooperation. On the other hand, the issuance of land title, per se, accomplishes little. More importantly, forms of group organization must be worked out so that the group will effectively manage its land. There will be a need for elected individuals who can operate the affairs of the group. An environment must be created through the medium of a society or a corporate body that will encourage the entrepeneur but still accommodate the traditionalist. Social change will take place and favor economic development.

The ecological concerns are great. It is necessary to ensure that the units will be a size appropriate to the economic potential of the land so that once legal title is established, there will be opportunity and incentive to invest in development of the land. The group will require sufficient water within its own area. Livestock will need to be sold to acquire the capital. Downpayments and later repayments on a developmental loan must carry low interest rates. Improved bull semen may be purchased and dips for tick control will improve the herd. It is felt that as a cash-economy develops the rest will follow.

One method of government control will be clauses contingent upon development in loans. Stocking rates and range management techniques must be monitored. The group itself can be brought to responsibility if they have land when mismanagement occurs.

In such an approach the type of corporate structure is most important. The people are being introduced to a radical adaptation in lifestyle.

Freehold titles will not be universally appropriate in all cases. An alternative incentive is the prospect of water development. New water

supplies are almost always welcome in new areas of rangeland. Proper management and maintenance of new water supplies is important. Past governments have tended to install new water supplies as a service to the population. However, no adequate long-term effect on the ecology was measured. There was little management of livestock sales. With the establishment of corporate bodies the people could themselves make agreements with the government. Free water, if that water is used as the incentive for livestock sales, is no more a solution to the problem of overgrazing than is the issue of free food in time of famine.

The objective is commercial ranching. These methods do not seek to make the change overnight. Typical figures for East Africa ranch development requires a capital investment of approximately Shs 100 per hectare. Moreover, the direct substitution of commercial ranching for pastoralism would displace large numbers of people.

Commercial ranches do not require a population density of three per square kilometer. Surplus people would become a nuisance and a burden on the land. The introduction of small, individual ranches is not the solution. They would only succeed on the very best rangeland. If the total population were to be so accommodated, the units would be so small and the development costs so high that the pastoralists would find themselves with a gigantic debt. This debt could not hope to be offset from the produce of the ranches concerned. Small individual ranches can only operate efficiently if each unit is enclosed by a perimeter fence. In the large group operations, as previously described, movements can be controlled by herding as they were in the past.

There appears to be no reason why extensive group operations should endanger existing wildlife populations. Wild animals in these pastoral areas rely upon the tolerance of the nomads for their survival. Wildlife is now appearing as a competitor, not only for grazing, but for the land title itself. These forms of group development may prove to be a way of preserving wildlife. In this way, wildlife and cropping can become ecologically sound, the preservation of endangered species and a tourist attraction. Considering the potential revenues of controlled wildlife management and the attraction of future tourist currency, this should be a powerful incentive for future wildlife conservation.

Intensive pre-development surveys are clearly needed to meet the individual needs of different areas. Heed must be taken of the potential and present condition of the land. Human and livestock populations as analyzed at the level of the family unit, as well as water resources and wildlife. In each case, a balance must be sought between ecological, sociological and economic factors.

Surveys do not always produce solutions. Because of human overpopulation, range development programs will offer no solution unless they are incorporated into an overall plan which is designed to absorb the surplus population by means of agriculture or irrigation schemes or fisheries.

LAND USE TRADITIONAL LAND TENURE

The Somali government is pledged to a program of detribalization and resettlement of nomadic herdsmen. According to Pratt and Gwynne, the Somali people are not a tribe, but rather comprise a confederacy of tribes similar to the Masai. Generally, pastoral peoples have common rights within their own tribal boundaries. These rights include grazing, water supplies, and salt licks. There are, however, a number of restrictions and not a few anomalies. Masai and Somali districts are divided into sections within which families tend to remain in certain areas, or follow a set pattern of migrations. In parts of Somalia, traditional family grazing areas are now recognized as well as ownership of water rights. Several of these anomalies can be untangled by first establishing the status of the concerned tribes. Social order plays an important part in territorial rights. Where the social orders are considered to be lower, territorial rights are less well defined.

Contrasting grass and cattle ownership is often a complicated matter largely dictated by social custom. Cattle are individually owned and are considered measurable wealth. In one sense, cattle are considered "land", since the number of cattle constitutes the pastoralists wealth and security. The more cattle he has, the more land he uses. Nominally, all men have equal opportunities to increase their stock-wealth and there is no limit to its accumulation.

Clearly, individual ownership of land dichotomizes basic concepts of pastoralism. On the other hand cultivation, trading and schools and community developments require a more sedentary way of life and hence complicate traditional land-use systems as well as lifestyles. A social system of interests of individuals in conflict with interests of neighbors for exclusive rights of settlement in certain areas can be anticipated.

Cultivation, by its very nature confers users rights. This is so, even where rights to grazing, forests, salt licks and hunting remain communal. Casual cultivation is slightly different because it confers only transitory rights. However, in underpopulated areas the cultivator may retain rights over the land for a year after his departure. In areas where population pressure requires whole sectors of society to become cultivators, rights over these areas can become perpetual. Somali concept of ownership differs from European traditions. Although in one sense, the land can belong to an individual, it may also belong to the clan. The rationale for this is that the land was inherited from his ancestors and all clansmen are believed to be descended from a common ancestor. Thus, all land becomes, in effect, community land upon which the entire clan may depend for support. Since this concept of community clan ownership prevails, there can be no question of sale, lease, rental, or capital value.

It is the duty of tribal authority to see that local land customs are observed. Each individual is to receive a fair share and individual allocations must not damage the rights of the group as a whole. When all the land that is available has been allocated, the only way to absorb extra population is to diminish the size of plots on inheritance. At this stage, the land may become salable. Often permanent cultivation leads to permanent use and the enclosure of grazing areas.

The improvement of land tenure systems are vital to the state, as well as the individual. Land ten-

ure and reform is a priority in Somalia as fragmented communal ownership of land become main obstacles to progress. It is felt that the exact form of tenure is not in itself important as long as it ensures that over a period of time the land will be held by those best capable of working it. The security given must be sufficient to encourage users to develop the land to its fullest potential, a concept in concert with Islamic dogma.

Land tenure reform has many benefits. Governments are able to take advantage of the opportunity for land planning. They can make provision for stock routes, marketing and processing facilities, roads and other amenities. They can plan for resettlement, forests and wildlife and for the introduction of reductions in the sizes of holdings. In relation to the individual, the feeling of responsibility and security towards the land is frequently reflected in greater physical effort. In rational land-use, security of tenure often stops land litigation, frees funds for investment, allows for longer-term development. Bush control is a much needed result of better land management as are programs of livestock breeding and the reduction of animal diseases.

Freedom from problems of traditional inheritance increase the value of land and enhance the creditworthiness of the owner. There should be a system of control over the transfer of land interest, in order to avoid chronic indebtedness or uneconomic fragmentation or aggregation of holdings. Also, care must be exercised so that land is only transferred to those most capable of developing its optimum usefulness.

Land reform programs take time to implement. Rapid survey methods can be applied to the range area. This is especially helpful when large group areas are adjudicated instead of small holdings. Retraining of survey and adjunct staff will be necessary. New legislation is usually required in range areas. Originally, land legislation, in East Africa, was designed to accommodate agricultural rather than pastoral development. A review of the new Range Law indicates that this design has shifted.

In significant wildlife areas, a wildlife biologist should participate in an ecological survey. Ecological land units would be described in terms of their significance to wildlife, as well as to pastoralism. An aerial census of wildlife populations would be practical along with that of domestic herds. The result would be a map, showing the distribution of wildlife habitats within an ecological land unit.

EXISTING FACILITIES

Mapping of existing facilties is an integral need and should include: roads, water supplies, livestock marketing facilities, veterinary centers, medical centers, schools, government institutions, market centers, airports, and other systems of communication.

If the survey is designed for individual development units the subdivisions should be shown on a final map. It will be necessary to seek a compromise between existing sociological division, the potential and present condition of the land, the human and livestock populations and the economic feasibility of water development. Livestock carrying capacity must be figured for each ecological land unit or range type. Forecasting and economic projections within the total carrying capacity of each developmental unit must be calculated. In certain cases where it is not possible to gather hard data, the assessment of carrying capacity must be made subjectively.

Priority should be given to the establishment of study plots which will allow long-term productivity to be assessed in quantitative terms.

As mentioned in the section on vegetation, a potential conflict exists between sedentary farming and nomadic use of the interriverine area. Figures 56a and 60 depict the zones for the greatest potential crop production. The "75 day growing zone" as depicted in Figure 56a accounts for an area of about 62,730 km^2. When this area is combined with the other areas depicted as suitable for irrigation (see composite map of figure 59d) a total of 92,300 km^2 results.

Assuming that this area will eventually be utilized for agriculture, the displacement of approximately 1,107,600 AU could occur, using current numbers. As noted in other discussions, the data indicate that the interriverine area is not theoretically overstocked using Somali standards. Whether or not the remainder of the interriverine area could absorb the displaced animals is unclear.

Not included in the above figure are the additional existing and proposed irrgation projects which fall outside of the analyzed area. These are all on the Juba and account for another 7,000 km^2. In addition, there will be 16,575 km^2 dedicated to dam catchment, national parks, forest reserves, and wildlife reserves, for a total of an additional 26,376 km^2.

Assuming an average livestock density of 12 AU/km^2 the 26,376 km represents 316,500 AU. The total potential displacement, then, is 1,424,100 AU. Based on calculations in the section on vegetation, this could represent about 42,000 families which must be shifted into agriculture.

Although the above treatment is overly simplistic, it does demonstrate that development must proceed with caution. It must be recognized that with a well-developed mixed farming system utilizing fallow pastures, crop residues, and concentrates, it is possible that the interriverine area might support fully as many animals. Thus, each hectare devoted to agriculture may not displace the animal units which formerly utilized the area. The outcome will depend upon the increased productivity of the land through an integration of crop and livestock enterprises in a complimentary relationship.

This latter scenario assumes a sophisticated and well coordinated effort. Part of this effort will depend on the capacity of agricultural extension to effectively and continuously analyze pesticide residue levels in crop by-products which are utilized as livestock feed. This is critical for at least two reasons: a) Somalies are milk drinkers and many of the halogenated or chlorinated hydrocarbons are lipid soluble, thus concentrating in the milk; b) animals or their meat products destined for export may be rejected because of an over tolerance, thus causing a serious negative economic effect in the cost benefit analyses of the program goals.

In addition, not all crop regimes provide a by-product or crop residue whi can be effectively and economically utilized as livestock feeds. The tenden to force this mix may cause the planting of crops which are not in the best interests of the agriculturalists.

The potential renewable fuel wood resource of the interriverine area is conservatively estimated to be one cubic meter (1m3) per hectare. This is based on the current plant density and on comparable estimates by IBRD for the Sahelian zone.

The renewable yeild in fuel wood, 1m3, represents approximately 13,750,000 BTU's or the amount needed per capita per year. Using an oil equivalent of 20,600 BTU's per pound, 1m3 of wood represents about 100 gallons of oil.

Present prices of kerosene are about 2 Somali Shillings per liter, or roughly 8 Shillings per gallon. At the current income of $120 per year, the fuel wood in each hectare when lost to crops will cost approximately one persons wages. Thus the farm programs must cost the loss of fuel wood into the gross returns of the particular crop mix.

As oil prices increase, and presumably oil becomes more scarce, fuel wood supplies are also diminishing. The dependency on external scarce resources will increase placing Somalia in a potentially serious situation.

For the above reasons, development projects should be considered from an energy balance standpoint, as well as other feasibilities.

SURVEY AND RESEARCH APPROACHES

Intensive surveys are a necessary part of range development. Good data can provide information on safe and economic implementation. The livestock carrying capacity of the land must be ascertained even in areas of gross overgrazing.

In its most simple form, a range survey might consist of a description of the site condition. However, a more intensive type of research is suggested for optimum decision-making information. Information is required on range potential and conditions. Water resources and population and the distribution of people and livestock are necessary. Maps are often the best way of summarizing survey results. Needed with strong emphasis are separate catenories covering: ecological land units, water resources, vegetation and range condition, sociological units and population data, disease distribution and wildlife habitats. Infrastructure of existing facilities and services must be studied.

It is most important to try to achieve integration within the survey itself. It should require soils experts, sociologists, ecologists, and all those concerned with the physical description of the environment to work as a team. This is best achieved by presenting the data in the form of ecological land units.

Ecological Land Units:

1. Uniform in climate, landform and soil.
2. Characteristic vegetation type.
3. Notation of ways man and animals change the vegetation.
4. Show variants or uniformity.

Ecological maps of land units represent a statement of ecological potential. It tells of the immutable factors of the environment that determine the optimum pattern of land use, its gross productivity and hence the level of capitalization and the feasible size of developmental units.

Climate soil interactions are the most important environmental factor in East Africa. Rainfall, in particular is most dramatically important. Complex climatic zones should be determined initially. These zones can then be subdivided by landform and soil to give the desired ecological land units.

Weather monitoring stations are usually few and far between. Climatic zones can be delineated accurately only if sufficient data are known of the local ecology for vegetation to be used as an indicator of climate. Climatic zones are equated to the presence of key communities or species.

Key species will be the rarer components of vegetation where the present vegetation type is removed from site potential. In determining unit boundaries, full use should be made of aerial photographs. Stereoscopic photo interpretation often gives an accurate first approximation of ecological land units even before an area is visited. Aerial photographs are also of very great use in mapping existing facilities and the distribution of population, and in determining sites for new water supplies.

WATER RESOURCES

Water resources may require a separate map. However, in general range surveys it may be possible to include these data on the ecological map. Ecological land units are defined in terms of landform. Landform itself is defined by reference to geology and surface relief, generalization can usually be made for each land unit or groups of units on prospects of ground water and surface water development. The ecological land units provide a paradigm for planning resistivity tests, test - drilling and surface catchments.

An intensive survey should divide a large area into individual development units. Each should be self sufficient in water. Water exploration is likely to be a lengthy and detailed operation. The requirement for manpower will likely exceed the primary ecological survey. Planning of water-spreading schemes could involve river gauging, topographical survey and soil sampling.

VEGETATION AND RANGE CONDITION

The subject for a companion map to that of ecological land units should be vegetation and range conditions. Field data for both maps should be collected concurrently. However, the objective should be to prepare one map that provides a permanent record of site potential and land description. Erosion that has permanently impaired the productivity of the land could be included on the former map. Lesser degrees of erosion or other damage are best included in a map that shows present vegetation types.

SOCIOLOGICAL AND POPULATION DATA

Sociological and population data are only relevant to mapping if the sociological units have specific territorial boundaries. These boundaries can then be drawn and data entered on human and livestock populations. Their essential distribution according to dry season and wet season grazing areas can be shown. Existing water supplies, where known, would correlate with transitory migrations where there are no settled units. Population data are gathered by counting, with the aid of aerial counts. Aerial counts are of little use in heavily wooded areas.

DEVELOPMENT UNITS

Where development units are intended, more specific data are needed on population. It is necessary to know the number of families, their composition, their diet, composition of the herds by size, species, age and sex. Diseases of man and animal must be known. Deaths in livestock, sales and income from pastoral and nonpastoral pursuits will effect economic projections. Information on social organizations and attitudes to change must be explored. A good working relationship with the population is the only way to gather social/psychological data.

DISEASE DISTRIBUTION WILDLIFE

Disease distribution and wildlife in some areas may not warrant special study. However, some of the most difficult human and livestock diseases are transmitted by insects. They are facilitated in their spread, by wild animals which may carry either the disease or the vector.

Recent data on disease relationships between livestock and wildlife in Ethiopia, however illustrate the reverse. Dr. J.P. Blanc, former Provencial veterinarian in Hararghe and now with the Ethiopian Department of Fish and Game, investigated this problem. In August of 1976, he sampled wildlife serologically for various diseases and found no reactors. Animals sampled included wart hog, antelope, and gazelle. Animals were tested for Rinderpest, brucellosis, foot and mouth, and other bacterial and rickettsial/viral diseases. In November 1976, there was a Rinderpest outbreak in Afar cattle. Subsequent serology on wildlife during January-February 1977 showed 40% of wildlife as reactors to Rinderpest. Posts on these animals showed low levels of endo and ecto parasites. The cattle had high levels of endo and ecto parasites.

Summary Schistosomiasis

"With the creation of each new irrigation ditch in tropical regions, schistosomiasis may infect more people." Kenneth S. Warren

I. Schistosomiasis is considered the greatest unconquered parasitic disease in humans and animals in tropical countries.

II. The ecological chain between man as victim and vector, and specific species of snails as intermediate hosts is known; man has no immunity.

III. Host snails exist only in fresh water.

IV. Sanitation in sewage treatment is necessary. Human defecation and urination in irrigation and watering places is the major way the disease is transmitted.

V. The treatment is severe and can lead to death by cardiac failure.

VI. Breaking the biological chain between man and snail has been tried.

VII. Fatalities from high worm carrying capacities in man are likely. The disease is debilitating, lowers work productivity and is difficult to treat. In its final stages it leads to kidney, heart and liver failure.

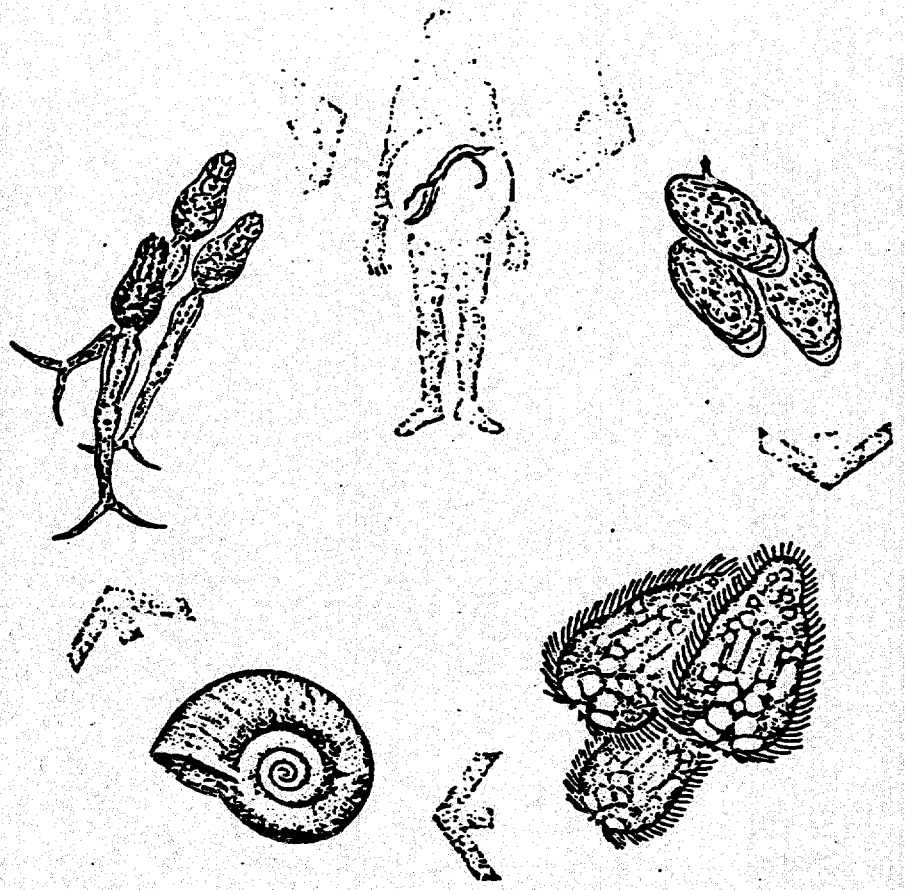
VIII. The severity of the disease and numbers of persons infected must be determined. In a society reaching for high productivity and increased GNP of the labor force, the erradication of this disease can play a major role in the increase of productivity and longevity.

Life Cycle of Schistosoma mansoni

Schistosomiasis can only occur with the appropriate interaction of water, snails, and man. When S. mansoni eggs, which are carried in human feces or urine, enter fresh water, they hatch into ciliated miracidia within minutes, then find and penetrate the proper snail species. There, each miracidium produces more than 100,000 cercariae (larvae), which often crowd out the snail's internal organs, killing it. After a month, the cercariae begin to leave the snail. Upon contact with a person in water, a cercarcia bores into the body in three minutes and metamorphoses into a schistosomule (young worm). The young worms then migrate via the circulatory system to the lungs, where they undergo some development, then pass to the liver, where they mature and mate - the female entering the cleft in the male's body and remaining there for life. The couple then migrate to the intestines, where they produce about 300 eggs per day during their entire lifespan, which may last up to thirty years. More than half the eggs remain in the intestines and the liver, but the rest are expelled in the feces, renewing the cycle.

Schistosomiasis

"Schistosomiasis is now considered to be the greatest unconquered parasitic disease afflicting humans and animals in the tropics and subtropics. The schistosomiasis is a minute, forktailed worm larvae which bores its way through the skin. These are freshwater organisms which develop into worms called schistosomes, or blood flukes. The adult worms are an inch-long and live in the blood vessels of the intestines and urinary tract.



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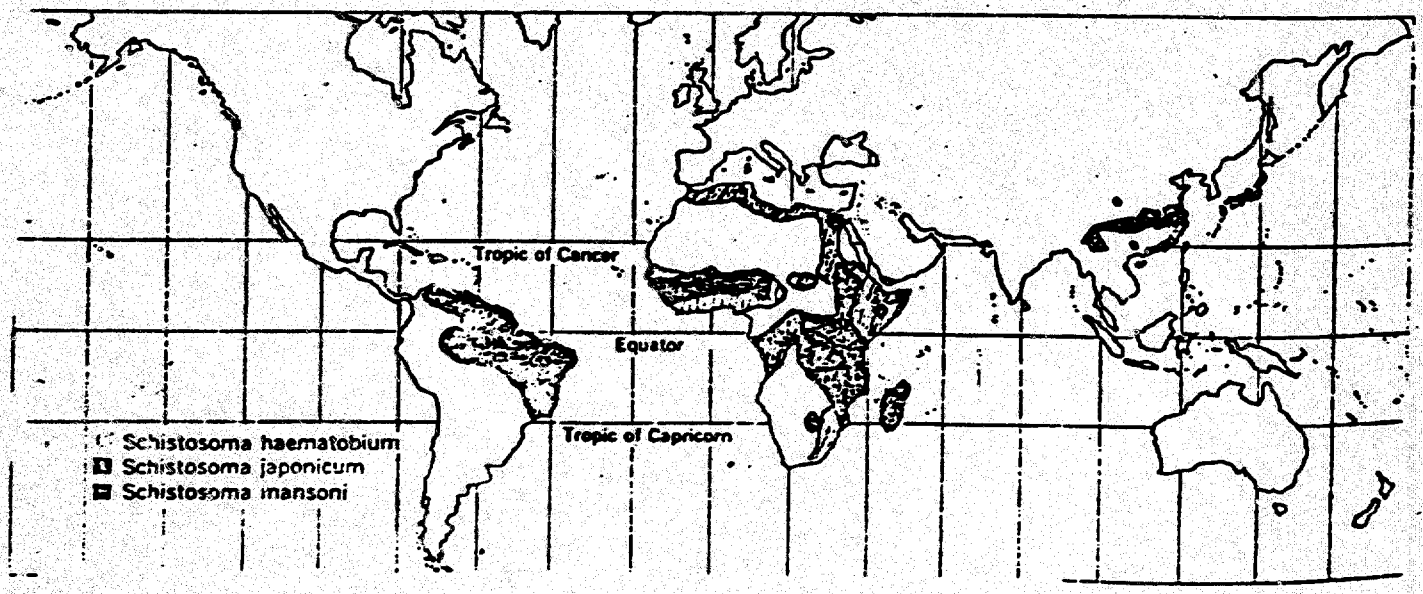


The major species occurring in Africa are S. haemotobium and S. mansoni. Schistosomes are a class of parasitic flatworm called trematodes, all of which have life cycles involving snails as intermediate hosts. The adult worms that live in the intestines and urinary bladder of man produce large numbers of eggs. Most of the eggs work out of the blood vessels and through the tissues of the intestines or bladder. They leave the body in the feces or urine. The eggs begin to hatch almost immediately upon entering fresh water. The tiny ciliated miracidia begin to swim rapidly about. They must find and penetrate a snail of the proper species. They develop at an enormous rate after going through three different developmental stages.

A month or so later, snails with S. mansoni or S. haematobium infections begin to shed thousands of tiny, forktailed cercariae or second stage larvae. These move about in the water by wriggling their tails. When coming into contact with humans, the S. mansoni bore into the body in about three minutes. The tail is left behind, and in penetrating the head of the cercaria changes profoundly from a freshwater animal to one which can exist in the salty environment of the blood.

Susceptible snail species determine the geographic distribution of the schistosome species. The life cycle cannot continue in areas where such snails are not found.

Infected humans carry different worm burdens. This depends largely on their degree of contact with water and the number of penetrations and maturations of cercariae. Once in the body, these organisms live for five to ten years and some as long as thirty. Nevertheless, the majority of people in endemic areas have relatively low worm loads. Only people having a high worm load will develop fatal disease.

What is the ecological relation between man and the snail as hosts in relation to schistosome infections? The numbers of eggs excreted by man and the site of the deposition are important factors. Some infected persons excrete only 100 eggs per day. Others more than 500,000 eggs per day. Feces deposited on land will do no harm unless washed into a stream by heavy rains. The most advantageous life cycle is the passing of feces directly into a water environment rich in vegetation. This is an excellent habitat for snail breeding.

Children swimming in streams frequently defecate or urinate in the water. This is also a practice of women washing clothes or men working in the fields. In Muslim countries, like Somalia, there is a religious necessity for ablutions after defecation and before prayer. This is a significant factor in the spread of infection.

The entire problem could be solved by use of latrines. However, even when sanitary facilities, such as those planned for Kurtanwaarre, are built people refuse to use them.

Only a small proportion of people with schistosomiasis have infections heavy enough to result in overt disease. Few deaths are directly attributable to the infection. There is controversy about the effect of the disease on people. In the case of low worm loads, there is little effect other than lassitude and bloody urine. However, high worm loads have revealed potentially fatal infections. Fever may last for several weeks

with skin irritation, diarrhea, cough, headache and chills. In the later stages of severe infection the person may vomit up to a quart of blood.

Large numbers of eggs may remain in the body. These cause extensive formation of fibrous tissue, which impedes the flow of blood through the liver or of urine through the bladder. There is a marked increase in blood pressure as the veins along the upper stomach or the esophagus may become dilated and burst, causing the patient to bleed to death.

In the latter case, urine flow from the kidneys to the bladder may be blocked by fibrosis of the ureteurs resulting in urinary back pressure and enlargement and destruction of the kidneys. Increased incidence of bladder cancer is also found.

Less commonly, the lungs and central nervous system may be harmed. Severe lung damage occurs after blood to the liver has been obstructed. The heart has to work harder to continue pumping blood under these adverse circumstances and hence may fail.

There is no evidence of immunity in man. Hence no attempts have been made to develop a vaccine. Tartar emetic is the staple treatment. As a therapy it is administered intraveneously every other day for a month. It causes vomiting, severe cough and cardiac damage, which may result in sudden death. One of the best new drugs has been implicated as a cancer producing substance.

In essence, what is the ecological balance that maintains the chain between snails and humans? Methods tried have been larvae-eating guppies, carnivorous water plants and non-susceptible snail species. Another approach would be to prevent infection in snails. This requires mass treatment of infected peoples or adequate sanitation facilities. Infected snails can actually be cured by drugs. The major means of controlling the disease has been the use of moluscicides to kill the snails. This analogizes to a wide spread use of insecticides with all the dangers of overkill and other pollution of water and fish populations.

A system of biological control of snails has been noted. It requires the use of predators such as larger snails, fish, turtles and ducks or bacteria, viruses and other worm larvae. None has proved effective on a large scale.

In summation, the present-day symbol of schistosomiasis remains the great high dam at Aswan. It will irrigate millions of square miles of land and will cause untold cases of new infections with the blood fluke.

WATER DEVELOPMENT AND SCHISTOSOMIASIS (Bilharzia)

Schistosomiasis is endemic in Somalia. That it should be otherwise would be surprising. Available evidence from other areas of Africa indicates that man made water supply projects are a major factor in the transmission of the disease.

In some cases attempts have been made to provide alternative water supplies in resettlement areas. Contamination of the environment through domestic and occupational activities by new settlement and resettlement populations has resulted in new and increased patterns of transmission in many places. It is evident that any attempts to control the spread of transmission or to reduce its intensity must depend upon integrated control measures, including sanitary engineering health education, and the provision of clean water supplies for domestic and recreational purposes. The principal element is to minimize contacts between man and potentially dangerous waters.

In considering the overall problem of schistosomiasis in relation to man made transmission, it is vital to remember that the definitive host, man, is the true vector of the parasite. By contaminating the aquatic environment he acquires the infection from the snail intermediate hosts. Human ecology must, therefore, receive appropriate attention in any considered measures for control of transmission.

Control may have the objective of limiting the spread of infection, reducing morbidity, or reducing transmission, and control of transmission implies the reduction of schistosomiasis to a level of prevalence where it is no longer a public health problem.

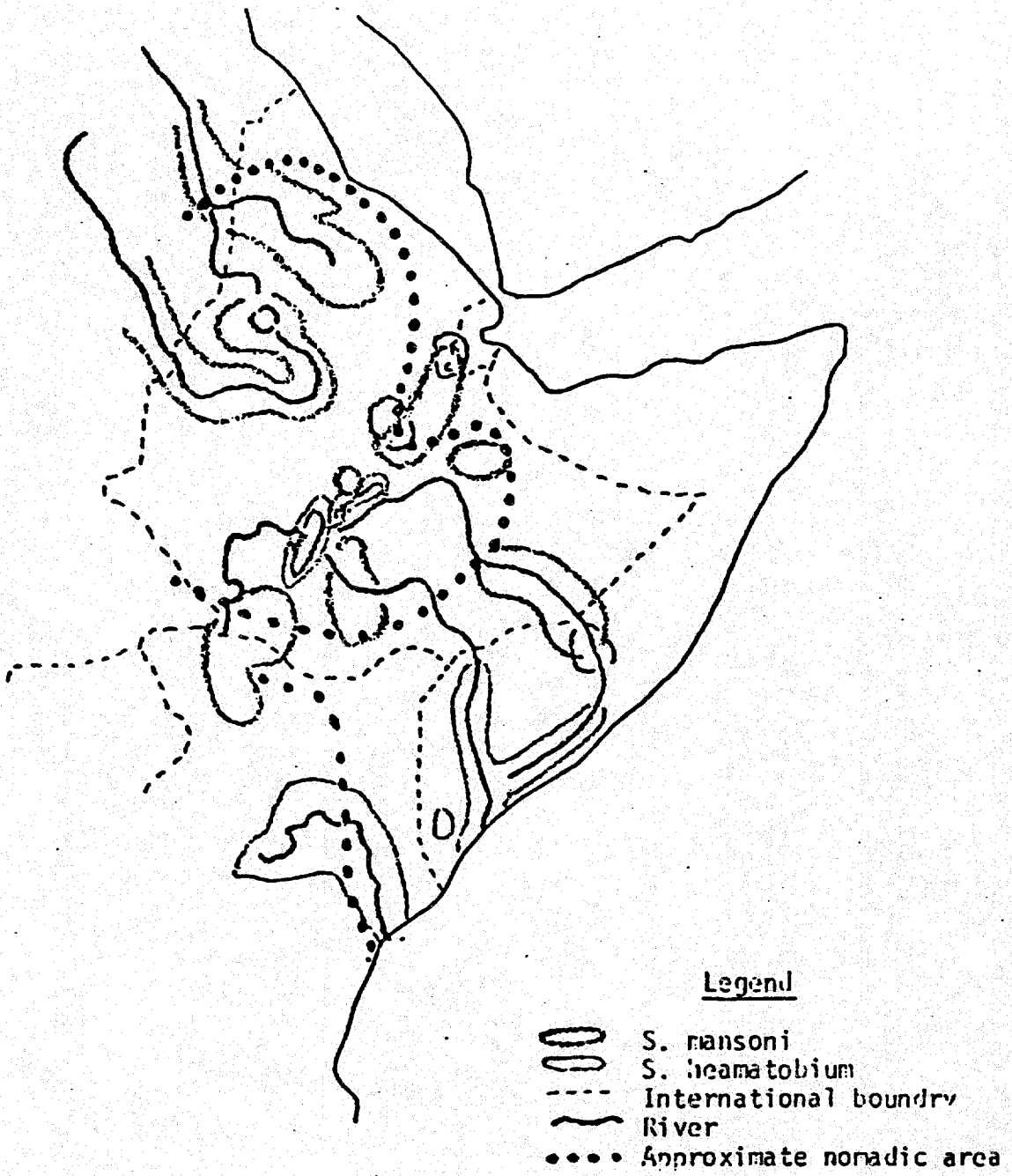
Regretably, however, general progress in control of schistosomiasis has been rather slow. This is mainly attributable to the failure to realize its public health importance and other related factors earlier, and therefore to accord it appropriate priority in the development of water systems, and development programs in general.

Urinary schistosomiasis, Schistosoma haematobium is endemic in the settled areas of the middle and lower Shebelli and lower Juba. Its intermediate host is Bulinus abyssinicus. In addition, a few cases of S. mansoni have been reported, but accerding to WHO are suspected to have been acquired elsewhere. The presence of S. mansoni, and its intermediate host Biomphalaria spp. is found in the upper Shebelli and Juba drainage basins (see composit map next page).

As noted(map) S. mansoni exist within both river basins - but it predominantly located upstream in Ethiopia. S. haematobium is the predominate form in Somalia, as noted from the same map.

Since nomads will range extensive distances, as indicated by the map they can become reinfected and bring the disease back to Somalia. One would expect the infection rates among nomads to be relatively low. Nevertheless, they do represent a transport mechanism for both snails - in water containers - and the cercariae. This is just another example demonstrating the need for regional multidisciplinary analysis rather than current single country approaches.

Figure 65, a composite of surveys within Somalia between 1969 and 1977, shows the prevalance of schistosomiasis and rates. It will be noted from examination of the figure that villages located on the east bank of



This figure is a composite of several maps. It is intended to illustrate that the movements of the nomadic peoples have the potential to act as a transport mechanism. In addition, note that the rivers up-stream contain S. mansoni, adding another variable to the problem.

FIGURE 64

SCHISTOSOMIASIS
Infection Rates
Somalia - Lower Shebelli River
1969-77

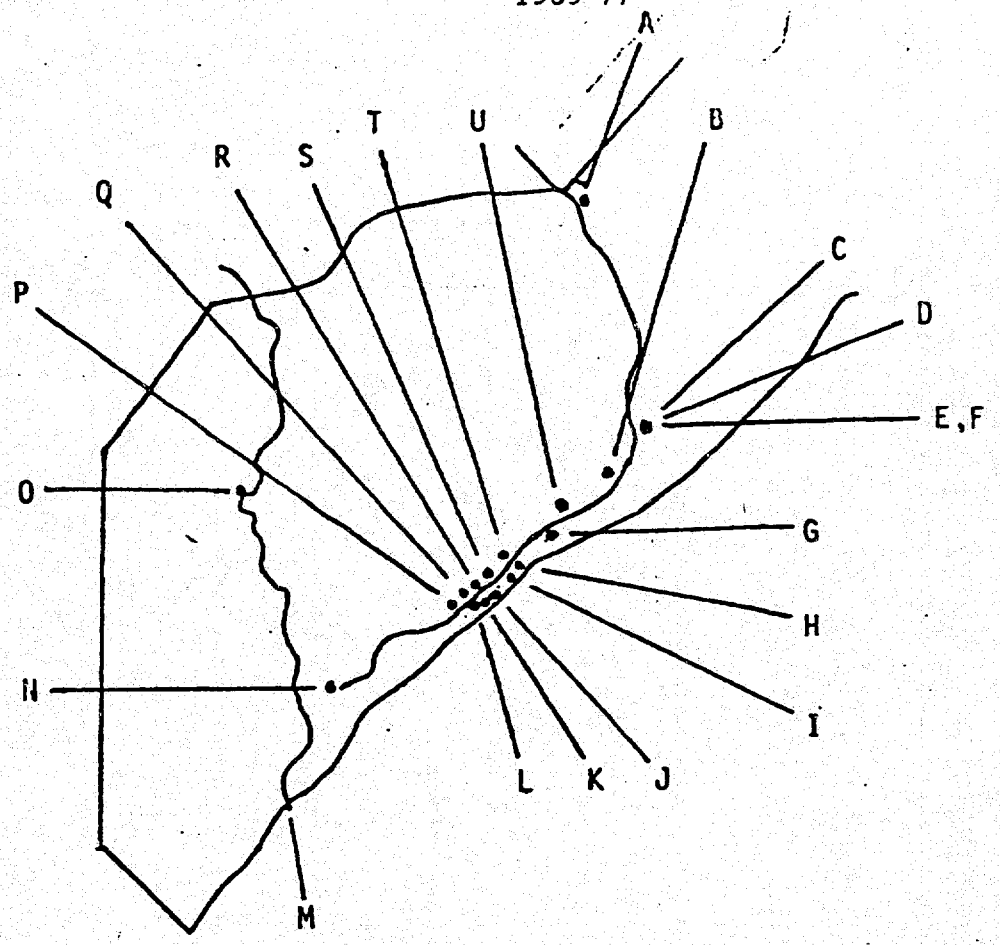


FIGURE 65

Location	Year surveyed	Percent infection	Number sampled
A. Belet Uen	1972	24.2	153
B. Balad	1969	27.0	411
C. Jowhar Villages	1972	83.0	467
D. Jowhar Exp. Stn.	1972	84.0	56
E. Jowhar	1969	58.0	312
F. Jowhar	1972	72.0	1472
G. Genale	1969	76.0	119
H. Haduuman	1977	45.9	2456
I. Farxaano	1977	38.3	2121
J. Cabdi Cali	1977	62.2	1527
K. Jeerow	1977	68.3	2315
L. Fuurogley	1977	55.9	770
M. Kismayo	1972	79.0	108
N. Gelib	1972	84.0	108
O. Bardere	1972	38.0	218
P. Creel Werego	1977	27.7	636
Q. Donburale	1977	51.5	1208
R. Maanyo Farax	1977	53.7	1463
S. Qoryooley	1977	37.6	4306
T. Gaywarow	1977	35.6	2141
U. Afqoi	1969	58.0	148

the Shebelli, in the Qoryooley District show infection rates from 38% to 68%, overall 53%. On the west bank, village infection rates ranged from 28% to 54%, overall average 41%. The difference is attributable to a few bais factors.

People in Ceel Werego (west bank infection rates of 28%) have been motivated to stay out of any natural water bodies. Villages generally on the west bank are near irrigation canals that are closed and dry for several months of the year. This is not the case on the east bank - partly due to levee construction on the west bank and the river meanders in the east bank area.

A survey by the MOH in the lower Juba and Shebelli areas show that when water lillies and other aquatic plants are removed on a continuing basis, the snail populations are low to nonexistant.

Eventhough areas adjacent to water systems may be free of snails, water bodies and depressions in the ground may become contaminated and provide focci when canal and river overflows occur. One MOH report (see Appendix A) cites depressions along a road created during road construction as a hazard. The report concludes that although there were no water lillies or other aquatic plants in these depressions, the potential for their establishment was high. As a recommendation, the report suggests that the benefits from low cost labor intensive aquatic vegetation clearing schemes would be great. It further suggests the filling depressions by labor intensive methods. Both of these cases seem to be candidates for the Food for Work type of programs.

MOH schistosomiasis teams while conducting surveys in villages and discussing the problems with local health authorities and village leaders thereby imparting much needed information. The results of such discussions are evidenced by villages such as Ceel Werego.

While the incidence of schistosomiasis appears to be slowly falling, the recent resettlement program has introduced a new population, hence a new variable.

Socio-economic levels must be raised considerably in many endemic areas before improvements in sanitation will be accepted and considered desirable. Vigorous efforts, e.g. AID's program in Kurtunwaarre should continue to be made to provide improved sanitary facilities in association with active health education programs and alternative safe water supplies in order to minimize contact with contaminated waters.

CONTROL

It has frequently been stated that the snail is the weakest link in the schistosome life cycle, the most vulnerable to attack, and, therefore, snail control is the best way of stopping transmission.

A combination of methods directed against different links in the disease cycle is most likely to achieve a threshold level below which transmission will cease. The composition of any control program will necessarily vary in the emphasis placed upon one or more different approaches according to local conditions, the goal of the control effect, available resources, and a feasible strategy. The different methods of control include: (1) mass therapy of the human definitive host, (2) health education and environmental sanitation, (3) control of contact with water, and (4) control of the molluscan intermediate host.

Under the current constraints, method 1 is not a viable solution because of cost and ease of reinfection. Methods 2 and 3 have merit

over the long run, but depend upon developing capabilities within the infant health delivery systems. Construction of proper wells is dependent upon building infrastructure and technical capability in the requisite agencies. The fourth method - control of the intermediate host, can while other structures are developed, bring fairly rapid short term results.

Control implies that the program will be unending, with inevitable recurrent expenditure. In contrast, expenditure on eradication will represent capital investment without such recurring costs. Eradication, however, is not considered to be a feasible goal in relation to available measures and their application in most endemic conditions at this time.

Control costs can be minimized through labor intensive self help programs and the extension of health information.

It is conceivable that focally, the application of combined measures involving available molluscicides and health education extension can play an important role in the current situation. Somalia is now conducting studies under guidance of WHO experts, in the use of slow release organotin mollusicides.

These new mollusciciding techniques will probably result in successful snail control..

Nonetheless, considering old and new formulations of molluscicides and their prolonged usage, long-term evaluation of the action and fate of molluscicides in relation to the biota and assessments of any cumulative effects must be made. The possible development of snail resistance to molluscicides should also be investigated.

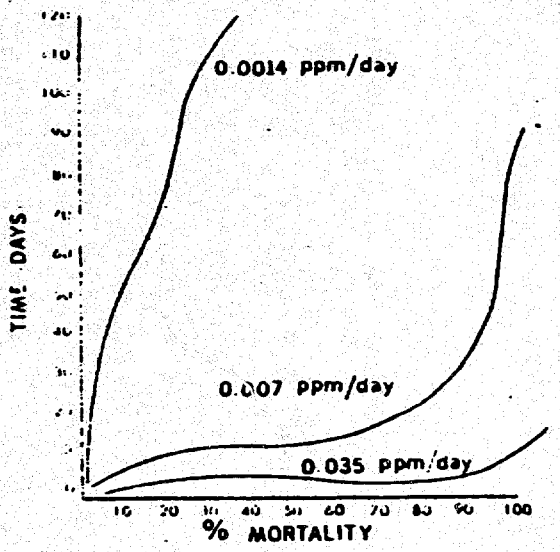
While excellent results have been obtained in certain campaigns, assessment of the different approaches has frequently been poor because of variances in data between donors, the number of donors over time and change in political structures. This leads to a lack of sound epidemiological data and has resulted in much wasted effort.

Additionally while research in schistosomiasis has received enormous impetus from fast progressing technology, there is far too great a gap between the laboratory development of new molluscicides and their considered application in the field. Improvements in methods of control cannot be expected unless operational research is carried into field application and the gap between laboratory and practical implementation closed.

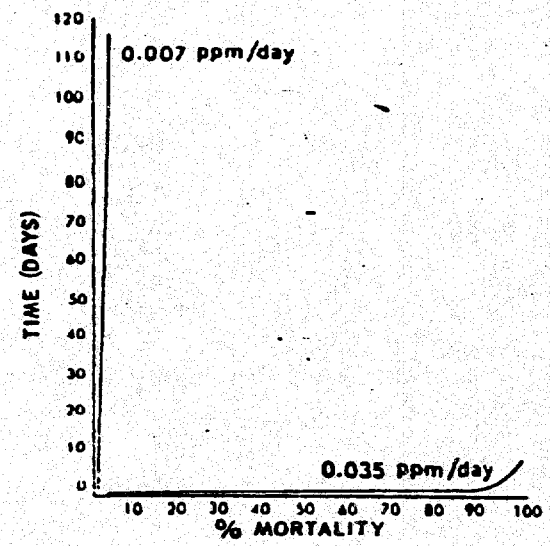
Because of the prevelance of the disease and the country's socioeconomic position, AID's development programs cannot be isolated from snail control and the use of molluscicides. Development projects such as the cofinanced Bay Region will ultimately produce population shifts toward a more water intensive economy and infact, are designed to do just that. While AID may not be directly connected with the purchase and use of molluscicides, it does have some responsibility as a precursor to development and should, as an interested party, advise the GOS. As mentioned above, WHO and the Somali government are proposing to use bis (tri-n-butyltin) oxide and tin flourides in snail control. These materials are formulated as slow release rubber impregnated compounds. Available data show these materials to be relatively non toxic to other aquatic organisms when compared to older materials.

Figures 66 show some results of chronic low level exposure up to 120

days. Appendix B contains excerpts from two papers on organotin compounds. Nonetheless, E.P.A. should be querried about these compounds and available data within. E.P.A. should be reviewed to assure that no long termed adverse effects are forthcoming to non target aquatic organisms, humans, and their livestock.



Mortality curves for *Biomphalaria glabrata* exposed to three dosages of TBTO.



Mortality curves for *Lepistes reticulatus* exposed to three dosages of TBTO.

FIGURE 66

These graphs show the differential effects of tributyl tin oxide with chronic exposures of 0.007 parts per million per day on two species of aquatic animals. Note that at 100 days the snail mortality is near 100% but that of the fish is less than 5%.

WATER, DEVELOPMENT, AND MALARIA

Discussions with MOH staff, other technical staff, and other donors, confirm that malaria follows water development. This is equally true for construction of remote watering points in the arid central and northern rangelands, as this provides a habitat for the mosquito. The MOH, to mitigate the effects, has been stocking all watering points with mosquito-larva eating fish. The reduction in Anophalese larva under this procedure has been dramatic. Nonetheless, where improperly designed watering points occur and where sufficient leakage exists to pool water outside the main container, the mosquito continues to survive. To be effective, fish must be able to reach the mosquito larva. One must also keep in mind that to survive, a predator must not kill all the prey.

In semi-permanent water points, where drying during the year is likely, fish must be restocked. This also applies to cases of mechanical pump failure because of the accompanying drying of the container.

Whether or not fish can survive for long periods and reproduce in some of the highly mineralized waters remains unclear. This must be clarified. Additionally, it is not uncommon for isolated water bodies to become contaminated with Bulinus abyssinicus - the bilharzia snail. Certain molluscicides are also effective against mosquito larvae (Mosquito News, 29:38-41). The government may decide to use slow release molluscicides to control both mosquito larvae and snails. With this possibility in mind, it would behoove USAID to investigate the feasibility of this use as an adjunct to Phase I of the water development program. The action of molluscicides in a confined environment such as steel and concrete water tanks, may bear little resemblence to actions in open environments. Additionally, the results of humans and livestock using water containing various levels of these toxicants should be considered.

DEVELOPMENT OF WATER AS A PRECURSOR TO INTENSIVE AGRICULTURE

Separately through development of domestic water sources, or jointly as a cofinancer of projects involving irrigation, the result of AID projects will be a tendency to move toward more intensive agriculture.

This tendency will be accelerated by provisions of research and extension - but water is a major precursor. Accompanying the move to more intensive systems and consequent need to economically justify higher water costs will be the hazards associated with agricultural chemicals as well as their presence in return waters and the atmosphere. Thus AID's development programs, although presently not containing provisions for chemical inputs, must consider the responsibility of "but for". This responsibility seems consistent with court decisions that may provide precedent by holding that a disjointed incremental approach is accountable (California Supreme Court decision).

As a consequence, development programs must be evaluated from an integrated approach - preferably on a regional/multicountry basis described by drainage basins rather than international boundaries.

Water development in the range will ultimately lead to the desire for more intensive systems, not only on the range, but the support infrastructure. Whether or not the provision of water on the range will increase or decrease the wet/dry season migration is unclear. Ultimately

if projections are correct, there will be more animals per unit area. Ultimately there will also be more rainfed and irrigated crop land in the inter-riverine areas - the traditional areas for livestock during the intense dry seasons encountered two years in five. It is planned that increased offtake of animals will stabilize the situation and yield economic benefits. Nonetheless, no comprehensive feasibility study has been undertaken in the livestock industry nor its relationship to the rangelands projects. Increased off-take will ultimately lead to an increased animal products subsector, with accompanying demands on yet further resources. As mentioned above, road construction may influence, to some degree, schistosomiasis.

Until a feasibility study is undertaken for livestock projects, which includes a costing of such items as filling depressions during road construction, conflicts between livestock and settled agriculture, the cost of assuring adequate anciallry infrastructure and support for the increased output, as well as other externalities, the economic returns for various inputs can not be accurately determined.

Although discussed below, provision of domestic water in rainfed areas may lead to substantial population shifts and intensified production techniques. MOH presently uses DDT to control mosquitos, and according to ministery officials, with good results - apparently, there is little evidence of a building resistance. Nonetheless, as agricultural production intensifies, other materials will be used in the immediate area. The overspray from the agricultural sector will accelerate the buildup of resistance to a degree dependent upon the mosquito population and use.

Perhaps the most glaring example of overspray and mosquito resistance is found in California's Central Valley. A small focci of resistance started near Fresno County, California perhaps 2½ decades ago. This area spread gradually at first then spread rapidly. Today the mosquito of California's Central Valley is virtually resistant to all forms of available materials.

Somalia agriculture will probably never approach the intensity of that found in the Central Valley, nonetheless, as the agricultural use of materials increases, some overspray will occur and with it the increased risk of increasing the rate of resistance.

Where irrigation systems tend to extend the availability of water past the normal wet season, there may be an accompanying increase in malaria. This statement is qualified because if the infiltration of standing water does not exceed 4 to 7 days (the time necessary for adult formation) the danger is substantially reduced. Other mosquitos, however, can reproduce in moist soil. These are vectors of other diseases.

The disease of trypanosomiasis affects the health of both man and livestock. Currently its principal vector, the tse tse fly (Glossina sp.), exists in both river basins. Considerable effort is being expended in the design of methods and programs to eventually eradicate the fly, hence the disease.

First, the term "eradication" must be understood, and with it the complexities of achievement. Eradication, technically means total elimination of the species from the area. This is a most difficult task, e.g., eradication of the screw worm from Texas.

Early indications of the screw worm program were promising. Recent evaluations, however, indicate a resurgance. This resurgance is in part due to the proximity to Mexico where controls are lax and the ease of recontamination.

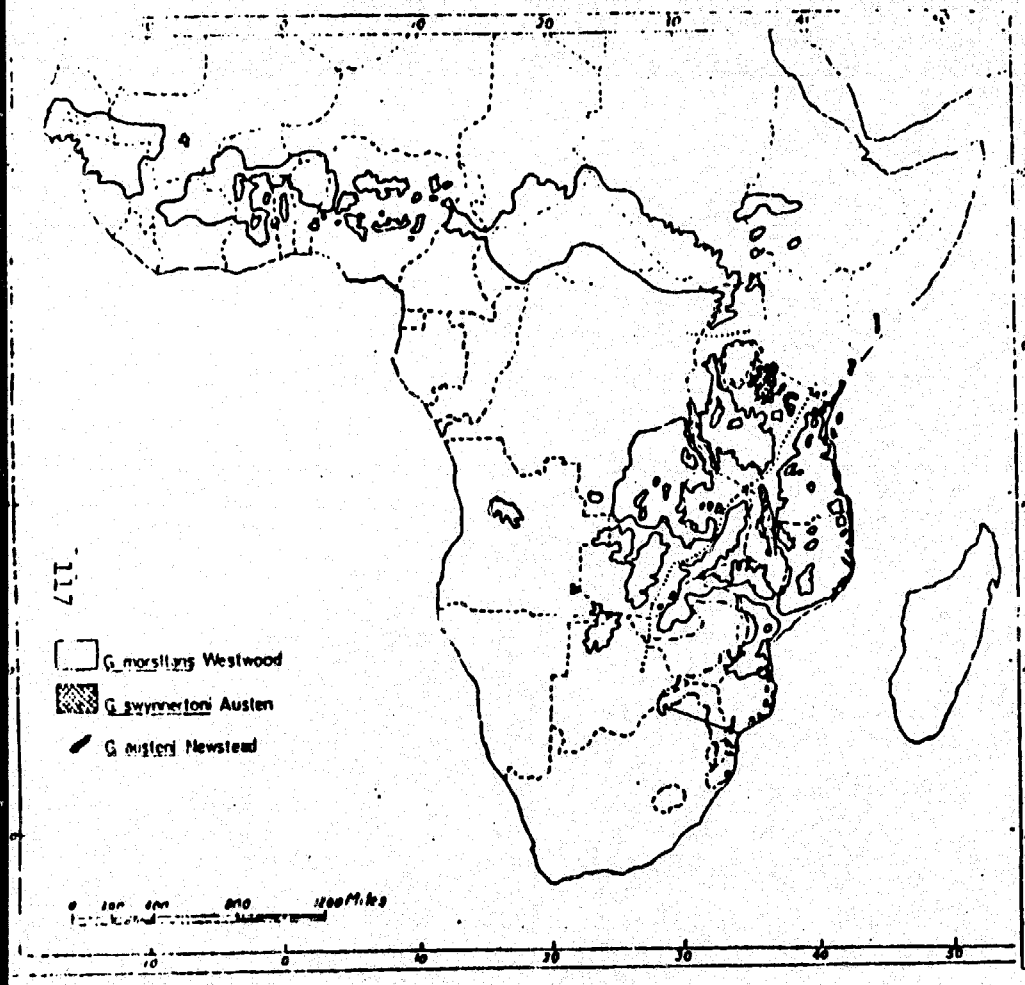
Nonetheless, it is contemplated that eradication will be successful because of the isolated areas. The program envisions the use of sterile male releases, selective use of farm chemicals, and some habitat modification. To conduct such a program will require a thorough analysis of the existing biota and will require the establishment of a monitoring system.

Since the tsetse is not the only vector of the disease complete eradication of the disease may not be possible. The Tabanid sp. can transfer the disease mechanically by bitting an infected host, then a disease free host. The incidence of this type of transmision is not thought to be frequent. Nonetheless, with frequent movement of animals, reinfection can occur and these animals can bring the disease to the area.

Unlike screw worm fly, the tsetse does not ovaposit in the host. It is this factor which provides the key to possible eradication.

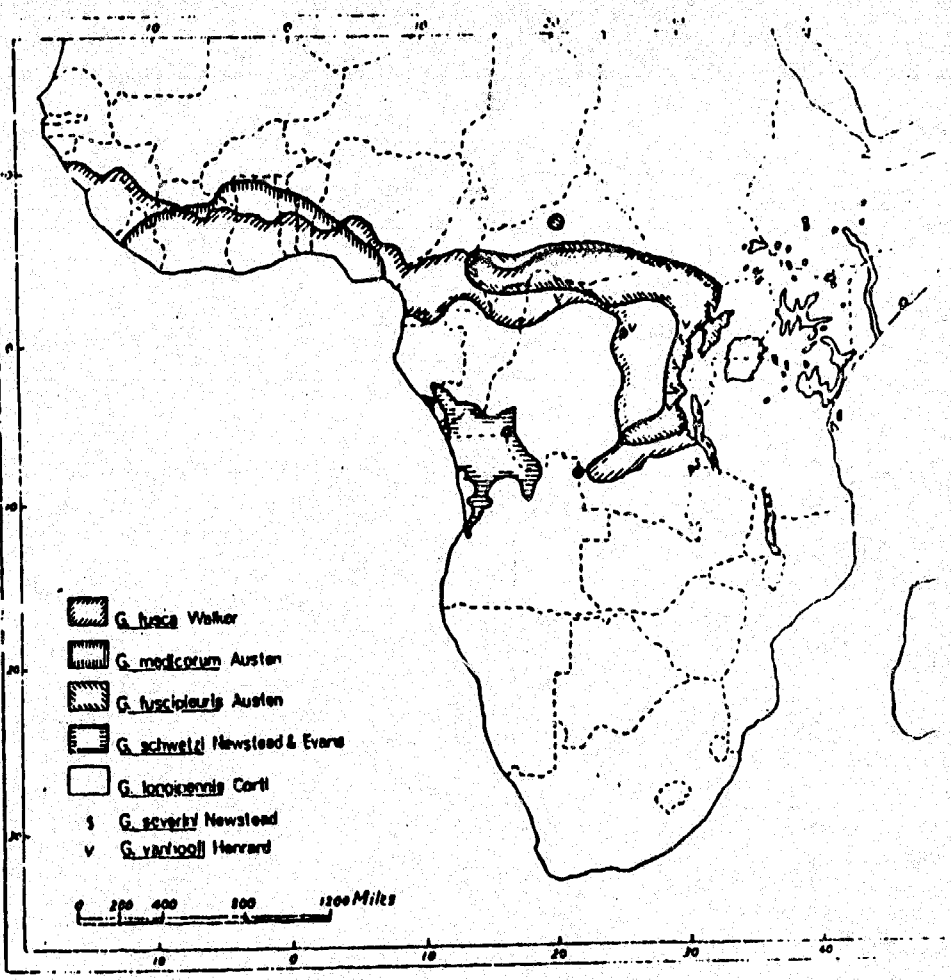
From the environmental perspective, the extent of pesticides used and their types in the proximity of the rivers remains an unknown. Consideration must be accorded to the transport systems of the rivers. In addition, land use plans for the areas must be developed to assure proper use and avoid degradation similar to the surrounding areas.

An analysis of the disease and survey program is found in the Appendix C.



Morsitans Group. *Glossina morsitans*, *G. swynnertoni* and *G. austeni*. The historical limit of tsetse in southern Africa is shown and also the type locality of *G. morsitans* Westwood. Dotted lines separate *G. morsitans orientalis* Vanderplank in eastern Tanzania, Mozambique and Rhodesia from *G. morsitans morsitans* as currently recognised and between the latter and *G. morsitans submorsitans* Newstead.

FIGURE 67



Fusca Group. The forest edge species and *Glossina longipennis*

FIGURE 68

Wind, Water, Currents, Fish and Fisheries

There are four main seasons in Somalia. The two monsoon winds and the two lulls between.

The monsoons are created by high and low pressure areas resulting from unequal heating and cooling off of large areas. Water has a high heat capacity, i.e. requires a considerable amount of heat to increase its temperature. Land has a low heat capacity such that the same amount of insolation will bring about a greater increase in the temperature of the land than an equivalent area of ocean. Conversely, the same amount of heat loss will result in a much greater drop in temperature on land than over the ocean. Hence, the land becomes hotter in summer and cooler in winter. Since warmer areas tend to become areas of ascending air and therefore of low pressure, and cooler areas tend to become areas of descending air and of high pressure, the land will develop high pressure areas in winter and low pressure in summer.

The southwest monsoon is created by heated air rising over the Asia subcontinent in the summer (see Figure 1) which causes an inflow of air. This inflow in turn drives the surface currents as noted in Figure 69 . The northeast monsoon is created from the winter pattern where the cooling land mass creates a high pressure area in northern Asia and causes an outflow of air that drives the surface currents to the southwest (see Figure 69a, p. 120)

Because of these wind shifts and the wind shear against the surface of the ocean, the currents of the Indian Ocean shift in summer and winter.

The Somali current (see Figure 69) during the summer southwest monsoon flows up coast and diverges near the tip of the Horn (see Figure 70). This divergence creates a void which is filled by water that moves in from below - i.e. an upwelling. Waters are affected to a depth of 100 to 200 meters and are brought to the surface. These upwellings are easily identified and tracked through thermal sensitive satellite photographs as the water from this depth is considerably cooler than the surrounding water mass. In addition to the divergence, the wind being parallel to the shore, produces an Ekman spiral which pushes water away from the shore. Thus this resulting shoreline water deficit will also be met by an upwelling. The upwelling brings nutrients which attract plantonic organisms, hence higher trophic levels until fish are attracted. This factor is demonstrated by Figure 70, and 71, showing higher concentrations of Disolved O_2, Phosphate phosphorous, Nitrate/nitrogen, and silicate silicon during the May-October phase of the year. This phase correlates well with the southwest monsoon which generally lasts from June through September. Turning again to Figures 70 and 71, it will be noted that during the period of the northeast monsoon, December through March, the higher concentration of nutrients have disappeared. Transport of water in the Equitorial Counter Current (Figure 73) is thought to amount to approximately 40 million tons of water per second. The current splits around Madigascar, the southern portion, eventually rounding the southern portion of the continent to become the Benguela Current, transporting 16 million tons per second. The northern portion follows the east coast northward to become the Somali Current. As the water nears the

FIGURE 69a
Surface currents driven by the Northeast Monsoon

FIGURE 69b
Surface currents driven by the Southwest Monsoon

tip of the Horn, but past the upwelling, warm highly saline water from the Red Sea pours out through the Gulf of Aden and spreads into the Indian Ocean at a depth of 800 meters.

In the winter with the northeast monsoon, the wind and surface currents are reversed - the Ekman spiral in this instance piles up water along the coast which must sink through force of gravity. This sinking may cancel out the upwelling. These occurrences account for the seasonality of fishing experienced by shore fishermen. Fishing, by traditional boats in the Gulf of Aden is limited to about 140 days a year as the southwest monsoon has a particularly disruptive effect and fishing is frequently prevented by the north east monsoon (see Figures 1, and 2). Along the eastern coast, north of Eil, the fishing season extends from September through April. Fishing is partly curtailed by the onset of the northeast monsoon. There are about 140 fishing days a year for traditional boats. From Eil to Brava the season is about 160 days a year as the surface winds of the monsoon is less disruptive. Similarly, from Brava south to the border, there are about 180 fishing days a year. Production figures and catch data vary from point to point, by species, and often lack coordinates. While reasonably good data are thought to exist, they are not compiled in a useful way. Much information was gathered by Russian trawlers, and with the withdrawal of Russia, are no longer available.

Data are available for 1974-75 in a compiled form. These data relate to north coastal regions and east coastal regions.

The catch from the north coast is estimated to be about 4,400 tons and from the east coast is estimated to be about 3,500 tons. This estimated product is appreciably lower than that quoted in studies by Moal in 1969-70 who estimated the catch to be 10,000-14,000 tons a year. While earlier estimates may have erred slightly on the high side, current available data indicates that there has been an appreciable fall in production. A number of reasons may have contributed to this decline, such as a failure to maintain equipment or replace gear. Problems associated with the transition from free marketing to a system based on co-operatives have also influenced incentives.

Data on species composition is not good. The survey work of the Russian research vessel Zheleznyakov gives an indication of the species found off the north coast. The estimated composition of the north coast catch in 1974-75 was:

tuna	-	45%
shark	-	15%
pelagic fish	-	20%
(mainly mackerel with some sardine)		
other fish	-	20%
(particularly sailfish, marlin, grunts, and snappers)		

The tuna catch in the east part of the Gulf of Aden may rise to 90% of the total catch.

On the east coast, however, the catch of shark predominated, accounting for 70% of production. Other prominent species were tuna, mackerel, jacks, kingfish and a variety of bottom fish.

Of total Somalia production in 1974-75 it is estimated that shark accounted for over 40% of the catch and tuna for 25%. The increase in tuna undoubtedly reflects the build up of an industrial fishery at that time. These data also take into account some decline in the traditional markets for sun dried fish products and difficulties in marketing.

In 1974-75 there were about 6,000 active fishermen of whom about 1,000 were part time, and about 1,500 fishing boats in use.

Table 1

Fishing Boats by Area

Area	Motorised	Non-Motorised		
		Huris	Bedens	Jahasa
East Coast				
Southern Border				65
Chisimaio	13	75		
Brava	28	275	18	
Mogadiscio	20		10	
Obbi				
Eil-Guardafui		31	80	
North Coast				
Alula-Bosaso	100	780		
Berbera-Zeila	13	65		
Totals	154	1226	98	65

The annual production by the artisinal sector was estimated at about 8,000 tons, plus an additional 3,000 tons caught by trawlers owned by Somalfish. Of the artisinal production it was estimated that 1,300 tons of a variety of species were sold fresh in Somalia; 1,700 tons of tuna canned and exported; 400 tons of tuna and mackerel were canned and sold in Somalia; 4,000 tons, mainly shark, were processed into salt dried, salt smoked and dried forms for export; the remainder is estimated as waste.

In the last three years most of the canneries have been closed for a variety of factors. Among the primary factors are lack of maintenance, high cost of operation, and without Soviet trawlers, a lack of sufficient supplies.

Somalfish produces almost exclusively for export. Production has fallen due to problems in the new co-operative organizations and to the collapse of traditional markets for salt-dried fish. The domestic marketing is traditionally poor because of ample meat supplies, and a lack of adequate transport and refrigeration.

There are over 20 fishing settlements along the Somalia coast (Fig.72,p.126)Three of these centers, Berbera on the north coast Mogadiscio in the center and Chisimaio in the south, are deep water ports which fishing vessels of more than 50m. could enter. None of these ports have facilities for handling fish.

Several centers, including Las Koreh, Alula, the old port at Berbera, Bosaso, Merca, and Brava have jetties which are adequate for berthing small motorized vessels. Except at Las Koreh, and Alula, these jetties are not used by fishermen. There is a preference to use beaches to haul up boats. Factors involved are that beaches are more conveniently situated near their homes, the fishing grounds or the selling and fish drying points.

The recent resettlement camps included fishing villages. From inspection, it is evident that more planning is needed for any future settlement. Some of the constraints in existing villages are: 1) processing facilities are often great distances from landing areas; 2) mooring facilities are non-existant; 3) there is a lack of water for processing; 4) only dried or salted products are possible as there is no refrigeration or rapid transportation; 5) cooperative set prices do not encourage aggressive or progressive entrepreneurs); 6) there is a lack of maintenance of equipment (not only Russian equipment is run down, English, German,

American, etc. equipment is in disrepair); and 7) people more than likely remain in these camps - not because fishing is wonderful, but the World Food Program feeds them. An intensive review and training effort is needed.

Prospects for developing a domestic market for fresh fish are dim. Communication links are poor to nonexistant. Fuel costs are high and delivery uncertain. Canneries are in severe disrepair, often with inefficient energy consumptive systems. Domestic urban markets are few and likely to remain so. Unlike livestock, which remains fresh while awaiting slaughter, fresh fish however needs constant care from the moment they are caught. It is often several hours before fish are landed. Without refrigeration in the Somalia climate, degredation rapidly progresses. Catch may lie in the sun for several hours. It is uncommon to see fish cleaned. Several more hours may transpire before the fish is offered to the public. Public acceptance under these conditions is low. Fish markets also may be several kilometers from major urban markets, and usually without refrigeration. Preference is for meat. A change to fish will require presentation of a superior product at lower prices. Such is not now the case.

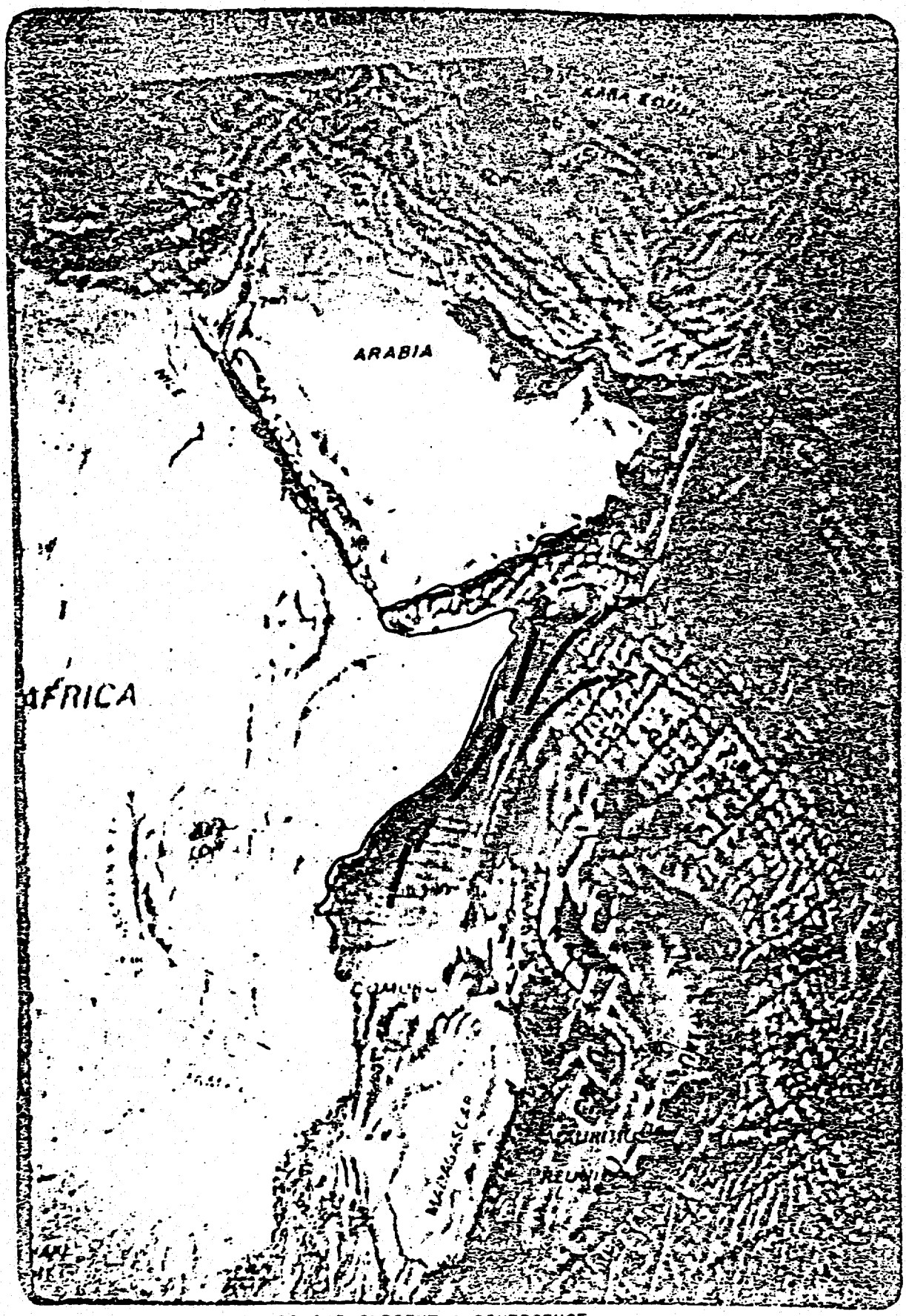
Type of Boats Most Commonly Found

Huris: 10-18 feet long, wholly or partially dugout construction except in Chisimaio and Mogadiscio where boats called huris (or dhows) are 18-20 feet and of rib and plank construction, or more recently of fibre glass.

Bedens are 18-25 feet long with a pointed stern and a rib frame covered with boards tied together with twine.

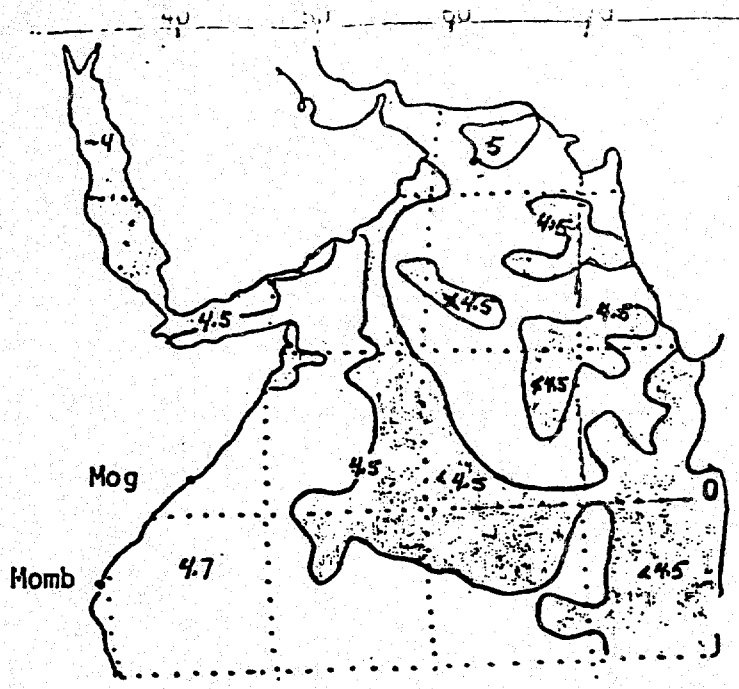
Jahasas are 20-30 feet long, rather broad and shallow, of rib/plank construction and propelled by a big lateen snail.

The motorized boats vary a great deal in size, building material and H.P., but are all quite small, of 20-30 feet.



SOMALI CURRENT & DIVERGENCE

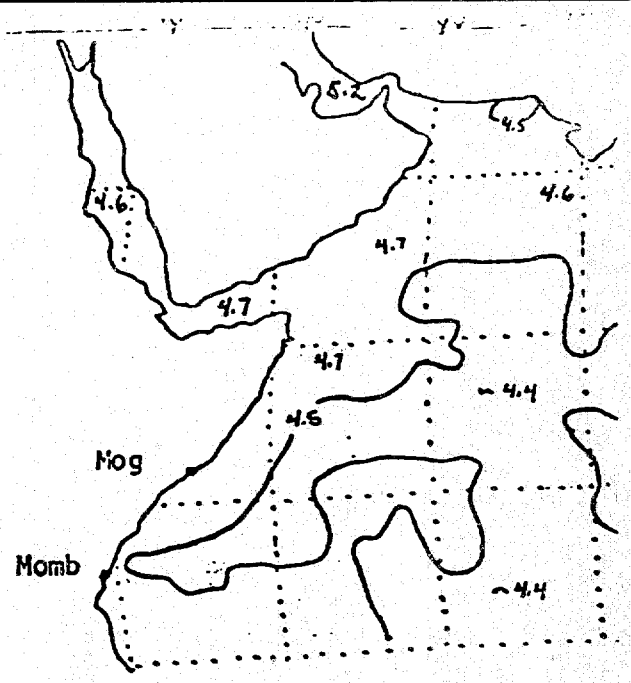
FIGURE 69c



Disolved Oxygen
mm/liter

MAY TO OCT.

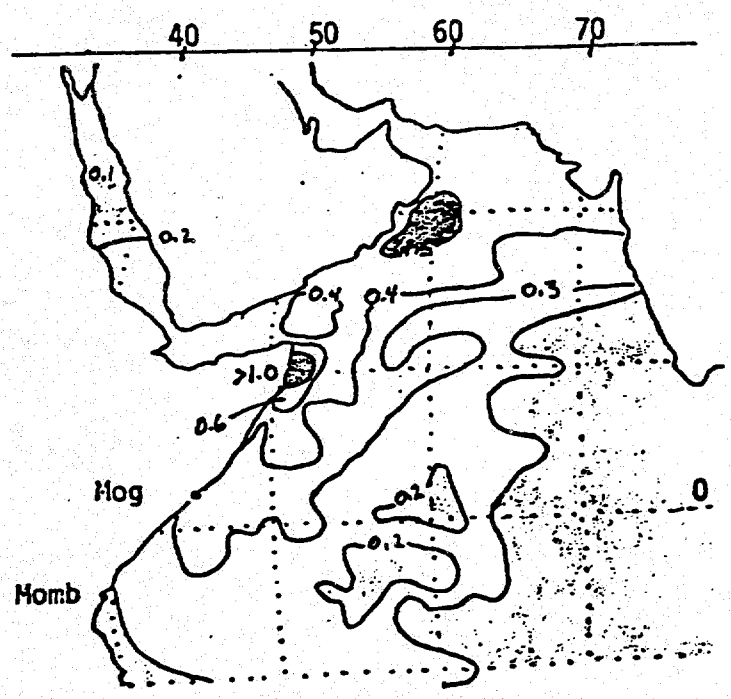
FIGURE 70a



Disolved Oxygen
mm/liter

NOV. TO APRIL

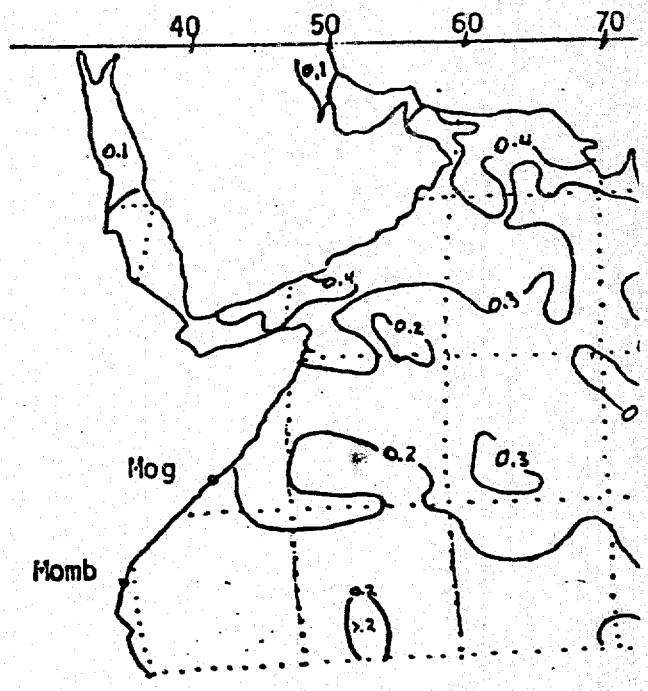
FIGURE 70b



Phosphate phosphrous
microgram-atoms/liter

MAY TO OCT.

FIGURE 70c

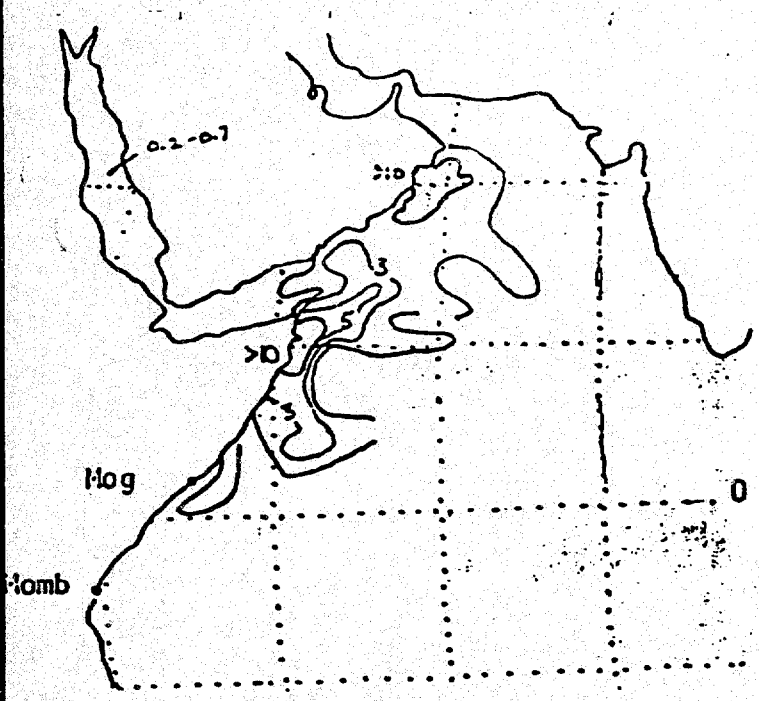


Phosphate phosphrous
microgram-atoms/liter

NOV. TO APRIL

FIGURE 70d

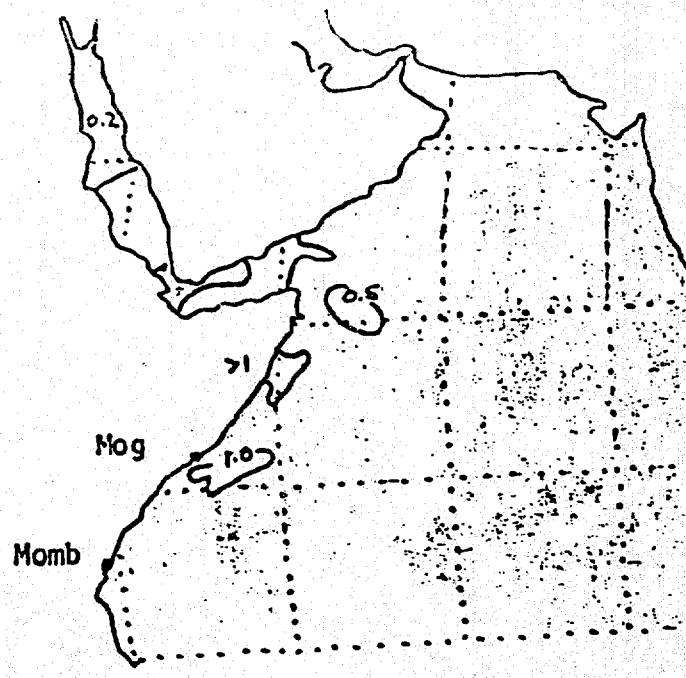
FIGURE 70



Nitrate nitrogen
microgram-atoms/liter

MAY TO OCT.

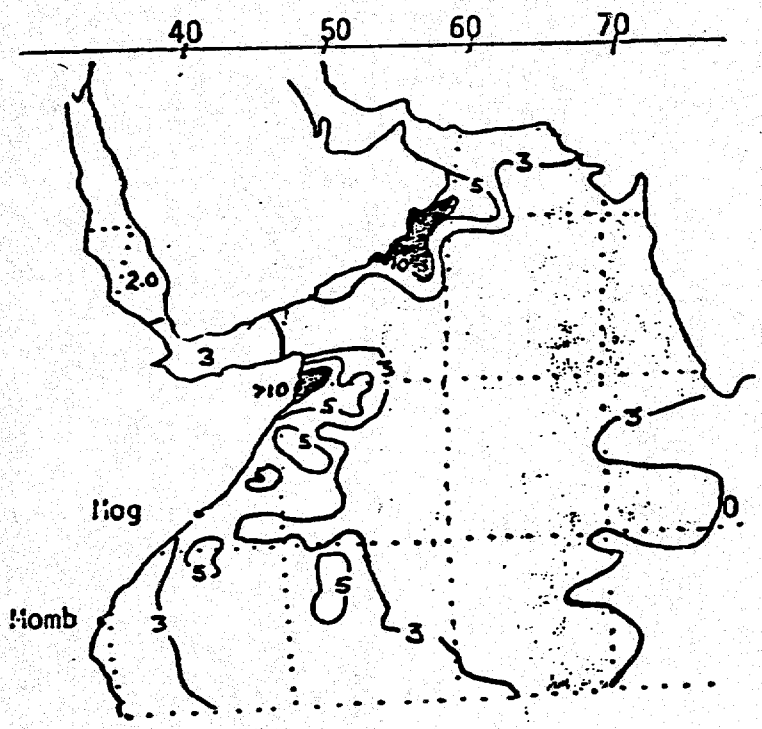
FIGURE 71a



Nitrate nitrogen
microgram-atoms/liter

NOV. TO APRIL

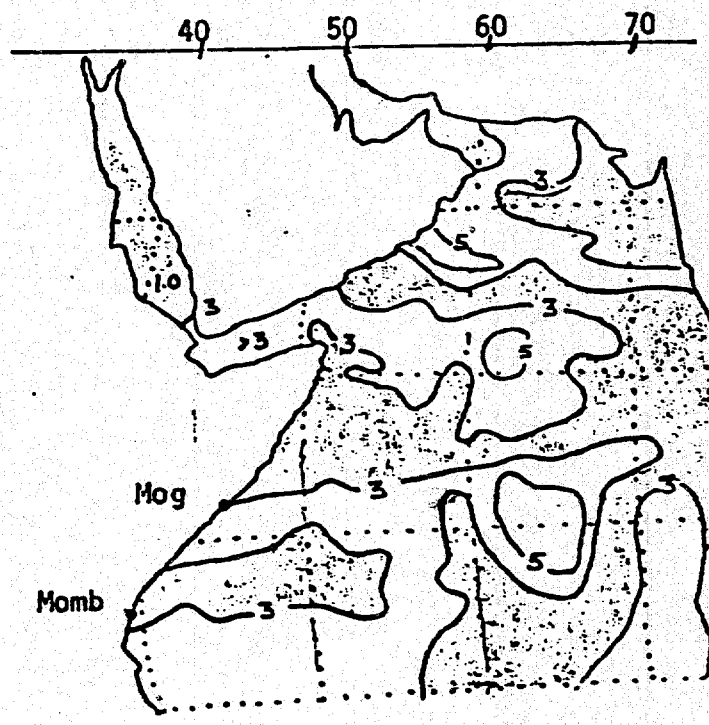
FIGURE 71b



Silicate silicon
microgram-atoms/liter

MAY TO OCT.

FIGURE 71c



Silicate silicon
microgram-atoms/liter

NOV. TO APRIL

FIGURE 71d

FIGURE 71

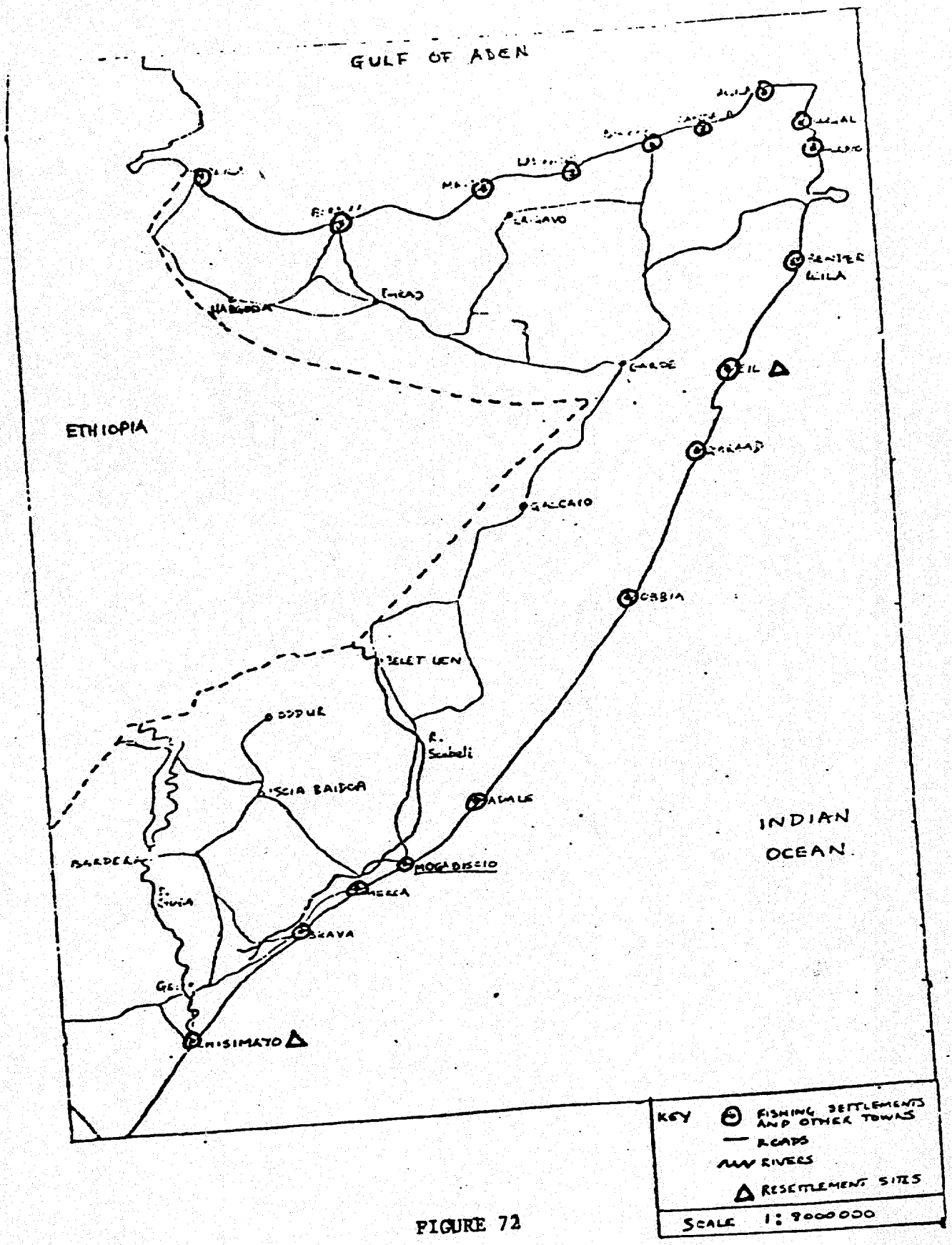

GULF OF ADEN
ETHIOPIA
INDIAN OCEAN
R. Scebeli
MOGADISCIO
KEY
FISHING SETTLEMENTS AND OTHER TOWNS
ROADS
RIVERS
RESETTLEMENT SITES
SCALE 1:9000000

FIGURE 72

FIGURE 73

This figure depicts the major currents of the Indian Ocean. These currents are: a. Somali, b. Monsoon Drift, c. South Equitorial, d. Agulhas, e. Mozambique.

SHEBELLI

Irrigation projects existing and proposed on the Shebelli, as indicated by Hunting Technical Services Interriverine Agricultural Study, 1977, see Table 3 , are used to calculate water use totals. Water use data for irrigation are derived from several sources and are estimated to be 2750 M^3/ha/season (an average of 2.2 acre feet per crop/per season - there are 3 seasons) see Table 4 . Actual use would vary according to season and dry versus wet year. - Average consumption in the first growing season (April to July) represents about 21% of the total demand. The second growing season (August to December) requires about 69% of the total demand, and the third season (January to March) is limited and thus the remaining 10%. The yearly average of 2750 M^3 (2.2 acre feet), varies from the average demand as follows: The first growing season average demand is 2250 M^3 or 1.8 acre feet. The second growing season demand averages 3625 M^3 or 2.9 acre feet. The third season requires about 4500 M^3 or 3.6 acre feet, but substantially fewer hectares are under crop.

The total area of projected and present projects which could potentially be subjected to irrigation on the Shebelli amounts to approximately 156,586 ha. Assuming this to be the case, and further assuming water needs of 2750 M^3/ha/season, as an average, overall demand would represent about 431 million M^3 per season, or approximately 1.3 billion M^3 per year.

Average annual inflow at Belet Uen amounts to about 1.70 billion M^3. Thus if the above calculations are reasonably accurate, about 76% of the river's water may to to irrigation. This figure may be reduced by some portion of the 80,000 ha of integrated development between Afgoi and Audegle, which may not be in total irrigation.

The need for a more thorough review is warranted. If the above assumptions are correct, there may be insufficient flow to assure success of projects on the lower reaches of the Shebelli. The need to increase irrigation efficiency will be first seen in capturing water lost in the form of overbank spillage and flood flow. Reference to Table 5 will show that there are significant water losses in critical months between Belet Uen and Balad. If these losses were reduced, more water could be kept in the river channel and used for irrigation of land downstreams. A study of the aerial photographs and observations made on flights along the channel between Belet Uen and Bulo Burti indicated that spillage was not localized, and hence control works would probably not be practical, although the possibility should be studied further.

In the section between Belet Uen and Bulo Burti there are water losses in most months. These are highest when the river stage is high and overbank spillage takes place. The small gains, which more than offset evaporation losses in January, can be attributed only to an inflow of groundwater, probably from wadi beds and bank storage; whereas the higher but still small-gains in March are the result of surface run-off.

From Bulo Burti to Mahaddei Uen losses occur throughout the year except in June, mainly onto the left bank within a stretch of about 20 kilometers in the vicinity of Gialalassi. The increase in flow during June is probably the result of a return to the river of some of the overbank spillage that

occurred in the previous month. The channel losses from January to April appear to be offset slightly by subsurface inflow, provided no overbank spillage takes place, as sometimes happens in April.

Between Mahaddei Uen and Balad conditions are different. Construction of the Johar project included embankments to control spillage and that these embankments are now ineffective because of improper maintenance. The losses in this stretch are high and occur every month, the highest occuring in May and from August to November, when the river stage is high and overbank spillage takes place. The spillage is aggravated by a weir at Johar which was constructed to raise the water level and allow water to flow by gravity to a sugar plantation. Embankments that were constructed upstream from the weir are damaged through lack of maintenance and are now totally ineffective. Spillage is principally in an area just north of the Johar dam and again mostly onto the left bank into a large depression between the left bank of the river and the dunes.

South of Johar water is again lost due to overbank spillage. Preliminary investigation indicates that this loss takes place along a stretch of up to 30 kilometers of the river bank. It is unlikely that such a length of embankment could be justified, but a detailed investigation may show that, during the critical December period, losses are confined to a much shorter stretch, the embankment of which might be entirely feasible.

The channel from Balad to Afgoi is unique in that it is capable of carrying, without overbank spillage, all the water that enters at Balad. Consequently, the losses are relatively low.

From Afgoi to Audegle the flows show that there is normally a slight increase between these two stations in the period January to July, except in May, when overbank spillage occurs. This is not the result of rainfall and surface runoff, and must be ascribed to subsurface flow. No measurements of water passing the control gates at Falcheiro have been made, hence the natural losses and the water used by controlled and inundation irrigation downstream of Audegle are not known. Water will pass into the swamps below Falcheiro when the stage is high and when irrigation requirements are only a fraction of the flow. In the period January to early April and in June and July, very little water, if any, will pass.

Although some of this water is useful for inundation irrigation and forage production, most of it is lost through evaporation and infiltration into the coastal dunes. If much of this water could be diverted to the right bank of the river to flood the broad plain south and west of Mahaddei Uen, much greater productivity could be expected.

A more detailed analysis is found in the 1967 FAO report entitled Agricultural and Water Surveys, Somalia, Vol. I.

Some overbank spillage, as noted above, provides forage for nomad livestock. To the extent that the spillage is utilized by irrigated agriculture, there will be some reduction in available forage. Further analysis is needed.

Data on phreatophyte water usage from Arizona, indicates that 3 acre feet are consumed annually by this type of vegetation. This amounts to

(Text continues on p. 135)

TABLE 3

PROPOSED AND EXISTING IRRIGATION PROJECTS
SHEBELLI AND JUBA RIVERS

	Project	Approximate Area in Hectares
1	Livestock Fattening Scheme-Belet Uen (Tate and Lyle)	Unknown
2	Belet Uen Crash Programme Farm	800
3	Elo Geibo Onstream Storage (ref. HTS/MMP 1969)	21,300
4	Duduble Flood Relief Channel (ref. MMP 1975)	
5	Duduble Offstream Storage Reservoir (ref. MMP 1977)	4,000
6	Experimental Rice Farm, Johar (Agric. Research Inst.)	100
7	Experimental Sugar Farm, Bueri, Johar	100
8	Johar Sugar Estate net potential	8,300
9	Reclamation and Drainage Study, Johar Sugar Estate (ref. MMP/HTS, 1975)	
10	Johar Crash Programme Farm	230
11	Johar Offstream Storage Reservoir (ref. HTS/MMP, 1969 and MMP 1973)	11,000
12	FAO Livestock Fattening Project (near Balad)	14,500
13	Balad Controlled Irrigation Project (ref. HTS/MMP 1969)	1,000 in 1977 10,000 proposed
14	Balad Irrigated Feedlot (MLFR)	400
15	Warmahan Fodder Farm MLFR/Mogadishu Municipal Auth.)	3,800
16	Agricultural Research Institue	
16A	Afgoi	400
16B	Bonka, Baidoa	Unknown
16C	Alessandra, Gelib	Unknown
16D	Ionte	Unknown
17	ITOP Tomato Farm, Afgoi	Unknown
18	21st October Farm Dairy (ref. HTS, 1976)	600
19	Mogadishu Poultry Farm (kilometres 7 and 13)	
20	Afgoi Seed Multiplication Centre	200
21	Afgoi-Mordile Controlled Irrigation Project (Libsoma, ref. FAO, 1975) proposed 3600 gross	1,500 in 1977 3,000 net
22	Afgoi Prison Farm	200
23	Integrated Development Planning Pilot Project Afgoi-Audegle (ref. HTS, 1976)	80,000
24	Genale - Bulo Mereta Rehabilitation Study (initial feasibility study)	70,000 master plan 5,000
25	Genale Grapefruit Seedling Multiplication Centre (EDF)	70
26	Genale Pilot Rice Farm (Min. Agric.)	400
27	Genale FAO Rice Scheme	5,000
28	Genale Crash Programme Farm	650 gross 340 net
29	Shelambot Crash Programme Farm	1,690 gross 560 net
30	Bulo Mererta Grapefruit Farm (EDF, ref. CITACO, 1974)	1,845 gross 1,386 net
31	Kurtun Waarey Settlement Scheme (Settlement Dev. Ag.; ref. CITACO, 1976)	1,500 in 1977
31A	Toposurvey Area	proposed
31B	Area Proposed in CITACO, 1976	18,000 net
32	Shebelli Swamp Wildlife Reserve (ref. ABEL and KILLE, 1976)	20,000

Proposed and Existing Irrigation Projects (Continued)

Project		Approximate Area in Hectares
33	Sablaale Settlement Scheme (Settlement Dev. Ag.; ref - CITACO, 1976)	1,000 in 1977 proposed
33A	Toposurvey Area	18,000 net
33B	Area Proposed in CITACO, 1976	500 gross 440 net (1977)
34	Awai Rice Scheme (Crash Programme)	3,000 proposed
35	Shebelli Floodplain Wildlife Reserve (ref ABEL & KILLE, 1976)	16,000
36	Luuq - Dolow (Irrigation District No. 1; ref, TECHNITAL, 1975)	33,670 geo. area 19,250 gross 16,400 net
37	Bardera National Park (ref - TECHNITAL, 1975)	550,000
38	Bardera Dam and Reservoir (ref. TECHNITAL, 1975)	57,000
39	Goluen Banana Farm (National Banana Board)	250
40	Baardhere - Saakow (Irrigation District No. 2 ref. TECHNITAL, 1975)	132,490 geo. area 57,000 gross 47,350 net
41	Saakow Dam and Reservoir (ref. TECHNITAL, 1975)	4,500
42	Downstream Saakow (Irrigation District No. 3, ref. TECHNITAL, 1975; SELCHOZPROMEXPORT, 1965)	75,625 geo. area 32,900 gross 26,600 net
43	Dujuma Settlement Scheme (Settlement Dev. Ag.)	29,000
	Toposurvey Area	30,500
44	Juba Wildlife Reserve (ref. ABEL and KILLE, 1976)	20,463 geo. area
45	Downstream of Dujuma (Irrigation District No. 4 ref. TECHNITAL, 1975; SELCHOZPROMEXPORT, 1965)	13,070 gross 11,000 net
46	Dujuma National Park (ref. TECHNITAL, 1975)	380,000
47	Trans - Juba Livestock Project (IBRD)	
47A	Grazing Ranch I	80,000
47B	Grazing Ranch II	80,000
47C	Irrigated Fodder Farm	1,200
48	Dufalach - Afmadow (Irrigation District No. 5 ref. TECHNITAL, 1975)	22,918 geo. area 9,165 gross 7,800 net
49	Lach Dehre National Park (ref. TECHNITAL, 1975)	175,000
50	Descek Uamo (Irrigation District No. 11) ref. TECHNITAL, 1975)	18,740 geo area 11,800 gross 10,000 net
51	Descek Uamo National Park (ref. ABEL and KILLE, 1975)	40,000
52	Kismayu Livestock Holding Ground (Livestock Dev. Agency; ref. HTS, 1976)	20,000 40,000 proposed
53	Forest Reserve (ref. ABEL and KILLE, 1976)	285,000
54	Gelib Livestock Holding Ground (Min. Liv. For. Range/ European Dev. Fund)	21,500
55	Gelib Multipurpose Cattle Ranch	1,500
56	Fanole - Gelib (Irrigation District No. 6, ref. TECHNITAL, 1975; SELCHOZPROMEXPORT, 1965)	34,000 geo. area 28,700 gross 26,400 net
57	Touta Island (Irrigation District No. 7 ref. TECHNITAL, 1975; SELCHOZPROMEXPORT, 1965)	15,700 15,700 gross 13,300 net
58	Lower Juba Sugar Project (ref. Booker McConnell, 1976)	23,900 total
58A	Phase I	15,300
58B	Phase II	8,600

Proposed and Existing Irrigation Projects (Continued)

	Project	Approximate Area in Hectares
59	Kalanji Banana Farm (National Banana Board/LIBSOMA)	250 pilot project 1,000 proposed
60	Gelib State Farms (Irrigation District No. 10 ref. TECHNITAL, 1975 SELCHOZPROMEXPORT, 1965)	13,734 geo. area 12,300 gross 10,300 net
61	Bender Salama Crash Programme Farm	250
62	Baardhere - Ionte (Irrigation District No. 8 ref. TECHNITAL, 1975; SELCHOPROMEXPORT, 1965)	37,900 geo. area 37,900 gross 32,200 net
63	Moganbo Irrigation Project (ref. TAMS/FINTEC, 1977)	7,000
64	Jamaame (Irrigation District No. 9 ref. TECHNITAL, 1975 SELCHOZPROMEXPORT, 1965)	28,436 geo. area 26,810 gross 20,050 net
65	Torda Irrigation Project (ref. COCKS, 1977)	2,400
66	Forest Reserve (ref. ABEL and KILLE, 1976)	140,000
67	Baidoa Cattle Project (ref. HTS 1976)	4,000
68	Bay Region Agricultural Development Project (ref. FAO, 1977)	

TABLE 4

ESTIMATED IRRIGATION REQUIREMENTS FOR PROPOSED CROPPING

Crops	1st Cropping Season Apr-July			2nd Cropping Season Aug-Dec			3rd Cropping Season Jan-Mar		
	Acre Ft/H2O	Total Acres Planted	Total Water Acre/Ft.	Acre Ft/H2O	Total Acres Planted	Total Water Acre/Ft.	Acre Ft/H2O	Total Acres Planted	Total Water Acre/Ft.
Animal Feeds	2	87,300	174,600	3	87,300	261,900	0	0	0
Hay	1½	39,175	58,762	2	25,625	51,250	0	0	0
Grain	1½	16,200	24,300	2	16,200	32,400	0	0	0
Silage	0	0	0	3	54,500	163,500	0	0	0
Cotton	2	17,000	34,000	3	17,000	51,000	4	17,000	68,000
Sugar Cane	0	0	0	6	46,500	279,000	0	0	0
Rice	1½	15,000	22,500	2	15,000	30,000	3	15,000	45,000
Rubber and Inter-Crop	0	0	0	3	40,875	122,625	0	0	0
Castor Beans	2	12,000	24,000	3	12,000	36,000	4	12,000	48,000
Bananas	1½	5,000	7,500	2	5,000	10,000	3	5,000	15,000
Other Fruits-Nuts	0	0	0	1½	9,975	14,962	0	0	0
Sesame	1½	4,000	6,000	2	4,000	8,000	0	0	0
Beans	0	0	0	1½	3,500	5,250	0	0	0
Peanuts	2	1,000	2,000	3	1,000	3,000	4	1,000	4,000
Coconuts and Inter-Crop	1½	2,400	3,600	0	0	0	0	0	0
Corn	1½	400	600	2	400	800	0	0	0
Other Vegetables	0	0	0	2	700	1,400	0	0	0
Tobacco	1½	300	450	2	300	600	0	0	0
Tomatoes	1½	225	337	3	225	675	0	0	0
Root Crops	0	0	0	2	59,900	119,800	0	0	0
Misc.		200,000	358,649		400,000	1,192,162		50,000	186,000
Total									

For Delivery in 60 Days C.M.S. Required
85.4 + 17.1 = 102.5

For Dry Years C.M.S. Doubles 205.0

For Delivery in 90 Days C.M.S. Required
189.2 + 37.8 = 229.0

For Dry Years C.M.S. 50% More 343.5

For Delivery in 120 Days C.M.S. Required
21.5 + 4.3 = 25.8

TABLE 5

SHEBELLE RIVER

MEDIAN MONTHLY TOTAL FLOW

PASSING GAUGING STATIONS

Hectare Meters -
(thousands)

Station	J	F	M	A	M	J	J	A	S	O	N	D
Belet Uen	2.8	2.3	2.1	5.2	17.7	6.1	4.5	25.1	38.8	34.5	23.2	8.6
Bulo Burti	2.9	2.3	2.6	4.6	16.8	5.2	3.6	19.5	34.0	32.2	22.9	8.1
Mahaddei Uen	3.0	1.8	2.0	4.4	16.6	6.1	4.9	19.1	33.0	31.4	20.5	7.9
Balad	2.2	1.4	1.2	3.8	14.7	5.4	3.9	16.3	23.6	24.2	16.8	7.6
Afgoi	1.4	.5	.7	2.4	15.1	5.2	3.2	17.5	23.8	24.3	18.3	7.5
Audegle	1.9	1.1	1.2	3.5	14.3	5.6	3.7	14.0	20.2	20.7	16.3	7.6

3750 M^3 per ha. Irrigation usage per season of all existing and proposed projects, i.e., 1.6 billion M^3, would equate to approximately that amount needed by 420,000 ha. of phreatophytic vegetation along the Shebelli. The majority of such vegetation would be found in the Shebelli swamp south of Genale. This vegetation is utilized for forage to some extent. Loss of water would translate into higher competition for alternate grazing areas. The reader should review Figures 54a, 56c and 56d showing current forage production and stocking densities in both wet and dry season. It will be noted after such comparison that the livestock industry is heavily dependent upon this area.

Again, a more thorough analysis of the overall water usage and diversion is warranted.

The interriverine area is, according to WHO and MOH, hyperendemic throughout the year with malaria. As farm chemicals wash from projects into the Shebelli, some will ultimately be deposited in the Shebelli Swamp which acts as both a sink to the river and as a breeding ground for the Anopheles mosquito. The concentration of materials within the breeding area will ultimately create a condition favoring increased resistance. This in turn will require greater concentrations and amounts of insecticide to control mosquitos. As agriculture intensifies in this area - both rainfed and irrigated, the economic importance of a disease free workforce will increase.

JUBA

Pursuant to the Hunting Technical Services report, the area for existing and proposed irrigation projects sums to approximately ½ million ha. This represents approximately 1.4 billion M^3 of water or about 26% of the annual 5.2 billion M^3 flow recorded at Lugh Ganana for one season.

Water flows of the Juba both during high and low flow seasonal periods are greater than those in the Shebelli, therefore more total development can be instituted along this river. However, because of the relatively small area of the flood plain and soil problems, the total area of irrigable land is approximately equal to that for which irrigation water is available, with the flow unregulated. If the flow were to be regulated there would be considerably more water available than could be utilized on land adjoining the Juba River.

Though the Juba River has more than twice as much water as the Shebelli, it is similar to the Shebelli in the torrential nature of its flow. The flow patterns are similar, with high flows of short duration occurring in April and May, and high flows of longer duration occuring from August to December. Peaks are irregular in magnitude and the highest flows may occur in either period. The irregular nature of the flow is well illustrated in Figure 74 .

In the section from Lugh Ganana to Bardera, the losses in May and in the period August to November coincide with high river flows. They must be a result of overbank spillage, much of which probably infiltrates the ground as bank storage to re-appear in the river at a later time. The gains in June and July and from December to March, in the lower flow periods, represent a contribution from groundwater, some of which will be bank storage returning to the river. In each period the gains decrease progressively as the bank storage is

depleted and as the groundwater head decreases. The sharp increase in gains in April is probably caused by run-off as a result of the April rains. The effect of run-off caused by rains in October and November is overshadowed by the high flows and the channel losses in that period.

From Bardera to Kaitoi the flow pattern is more complicated because of changes in the terrain over which the river flows. From Bardera to Saco it flows over limestone, and it is to be expected that the groundwater gains; whereas from Saco to Dijuma the river crosses the drift-covered basement and changes would reflect the combined effect of evaporation losses and of gains from local run-off. The remaining reach, from Dijuma to Kaitoi, is over the flood plain, and it is to be expected that losses here are caused by infiltration and overbank spillage. The changes in flow shown in Table 5 indicated substantial gains in the periods May to June and September to December, corresponding to periods of high river flow and high rainfall. They also correspond to the main losses upstream but lag behind by about one month, at least in the latter period. They are probably caused by a re-entry of flood water that infiltrated the ground higher upstream and by local run-off. During periods of low flow the only gains are in January and March. Throughout the rest of the low flow period they are more than offset by infiltration losses.

From Kaitoi to Giamama, steady losses resulting from infiltration, evaporation and use take place throughout the year. They increase sharply in October and continue at a high level in November, when the river stage is highest and overbank spillage takes place. This condition probably prevails until the ocean is reached.

The main area of irrigable land lies downstream of Fanole, extending south for a distance of about 105 kilometers to the vicinity of Ionte, approximately 15 kilometers from the mouth of the river and 25 kilometers from Kismayu. It occurs on both banks of the river but preponderantly on the left bank in the northern half of the area and with a slight preponderance on the right bank in the southern half.

According to FAO, the total area of irrigable land appears to be about 165,000 hectares. Even so, the land is not all Class I, as is the case with all land proposed for development along the Shebelle. The latest available figures, produced by the U.S.S.R. team and based on soil studies of this project, classify the land as follows:

Class I	-	59,400 hectares
Class II	-	45,200 hectares
Class III	-	42,900 hectares
Class IV	-	17,500 hectares

The U.S.S.R. team has also examined a second major area upstream of Dijuma as a result of the soil surveys and findings of this project, and preliminary estimates have indicated a total of over 100,000 hectares being suitable for irrigation.

Comparing these figures and those compiled by Hunting (Table) for proposed projects, indicates that a review is in order - It is possible that various donor projects when summed, may exceed the water capacity of the river and allow for reasonable outflow.

A highly detailed analysis of the Juba and its potential if found in the Russian report entitled The Giuba River Scheme, 1965.

Since the Juba, unlike the Shebelli empties into the Indian Ocean, it is expected that toxicants and nutrients from projects will also be transported in run-off. The extent of contamination will depend on how well irrigation is managed and the use of farm chemicals.

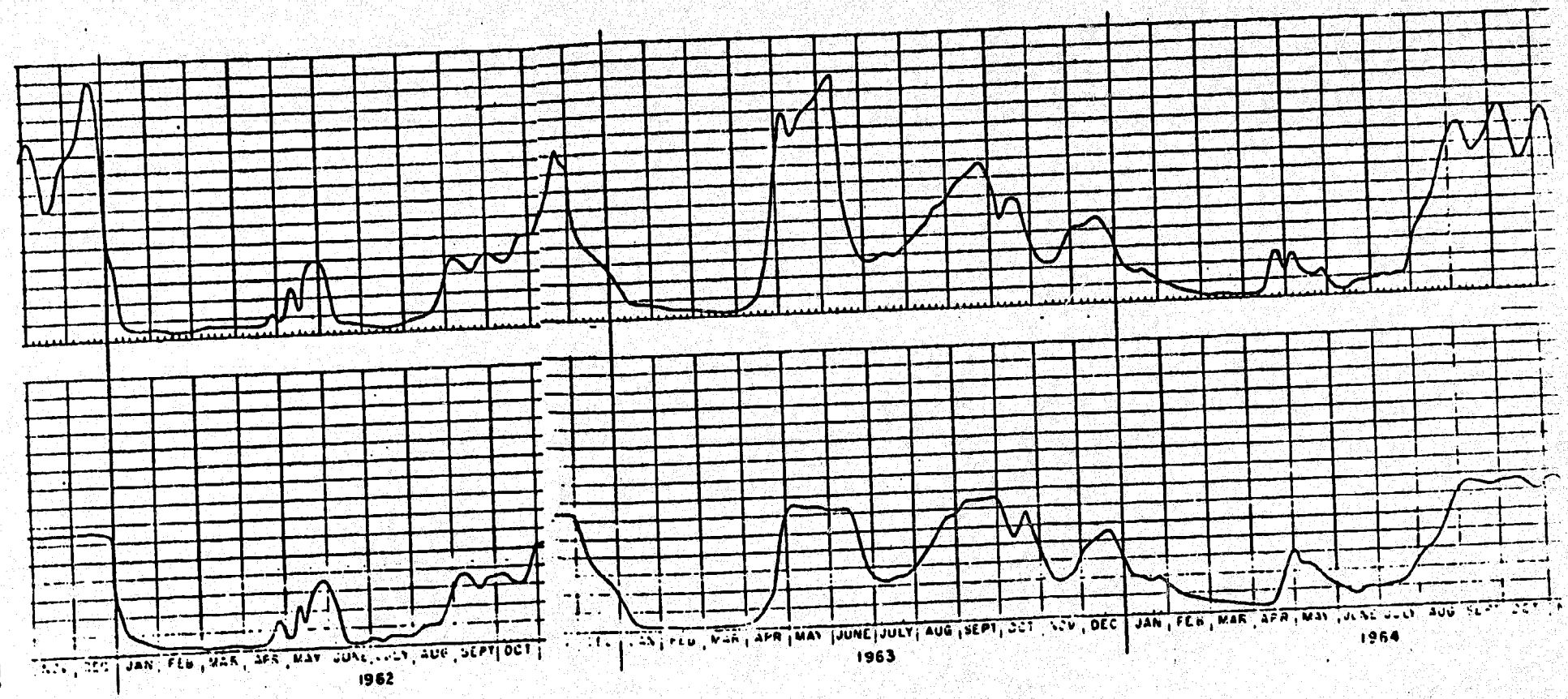
Peak run-off is expected to occur in May, August-September, and from mid October through early December. (Fig.74 page 139,-- hydrographs for the Juba.) Materials from the first cropping season (April-July) would be expected to be found in run-off occurring in May. It is expected that the first season represents about 30 percent of the total effort of the combined three cropping seasons.

Waters from the Juba entering the Indian Ocean in May are expected to be influenced by the Somali Current, which at this time of year will be moving north east along the coast (see Figure 69). In June the force of the southwest monsoon would give impetus to the current's velocity. Some interpolation from temperature gradients of the surface waters may provide an idea of spread and velocity during this period. From Figures 76, showing May surface temperature, one notes that 27°C isoline strikes the shore near the Juba's mouth. By June this line has reached the tip of the Horn (figure76b). By July, the midpoint of the southwest monsoon, the 27°C isoline has reached the mouth of the Gulf of Oman.

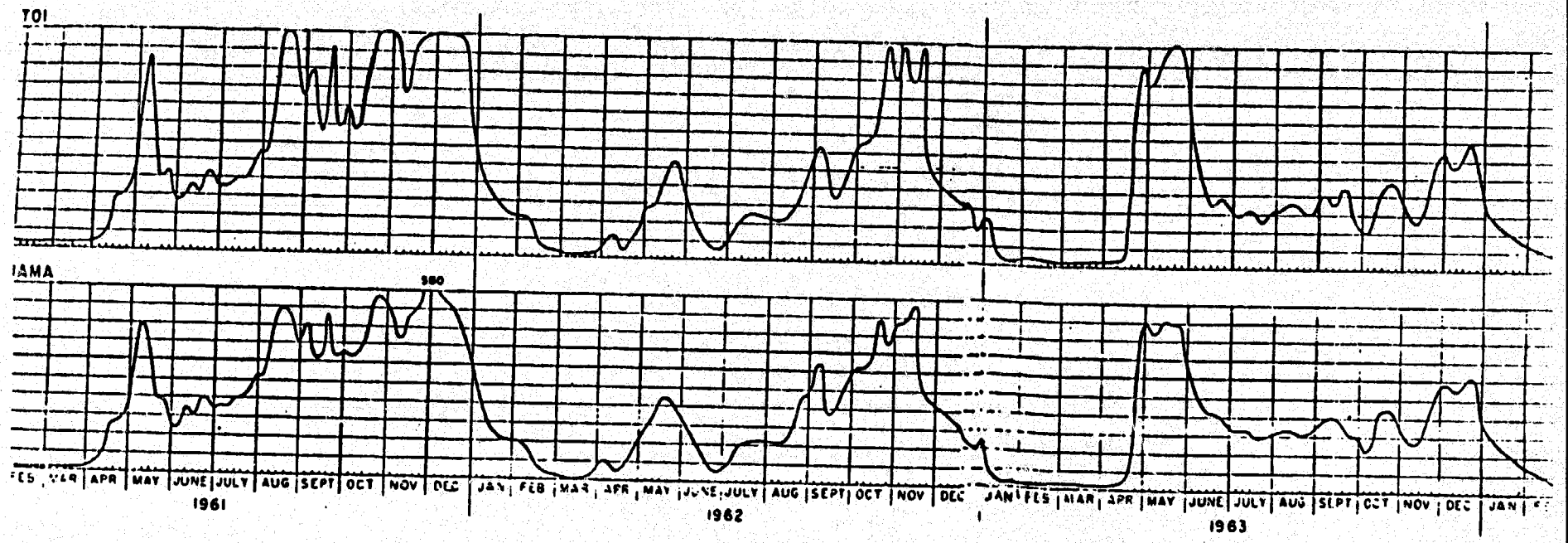
The reader's attention is now directed to Figures 70a, 70c, 71a, and 71c showing the nutrient levels for the period may to October. These higher levels represent the upwelling from the combined effects of the diverging current at this point and the action of the Eckman spiral. These higher nutrient levels will attract and allow trophic level succession to occur. The other major upwelling within the effect of the Somali Current is noted from the same Figures, and occurs off the Arabian peninsula. Both these points represent the better fishing areas of this portion of the Indian Ocean.

When the Somali Current is affected by the northeast monsoon during November through April, the northern part of the Indian Ocean experiences a complete reversal of currents. Figure 69 illustrates this reversal and indicates that a west to east equitorial counter current is developed. The effect of this counter current can be interpolated to some degree from Figs. 77c,77d,p. 134 -- showing surface temperatures of the Indian Ocean for November and December. It will be noticed from Figure69 that the northward moving Somali Current and the southward driven monsoon surface currents converge near the mouth of the Juba.

The second cropping season (August through December) coincides with both the high outflow (Figure 74) and the development of the west to east equitorial counter current. This counter current intersects some fishing grounds as indicated by Figure 78, p.142.



SHEBELLI HYDROGRAPH



JUBA HYDROGRAPH 1961-1965

FIGURE 74

TABLE 6

JUBA RIVER

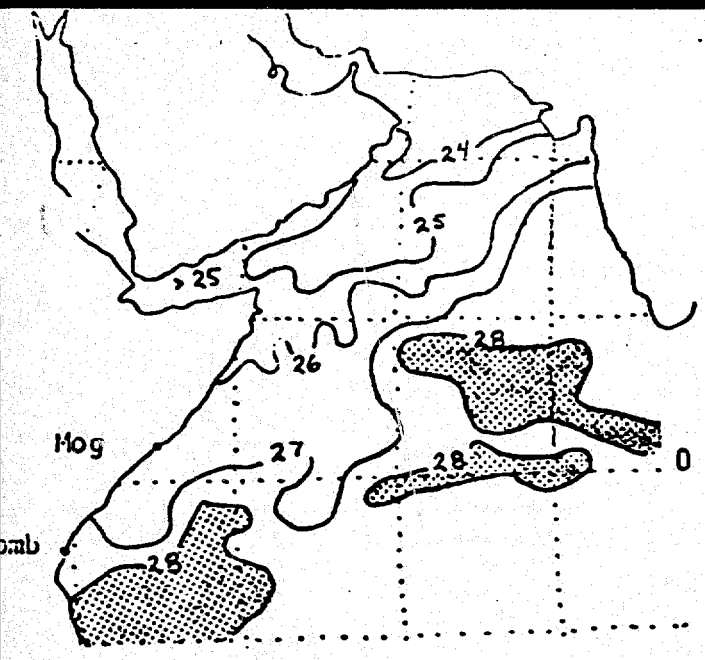
MEDIAN MONTHLY TOTAL FLOW*

PASSING GAUGING STATIONS

Hectare Meters
(thousands)

Station	J	F	M	A	M	J	J	A	S	O	N	D
Lugh Ganana	6.0	3.1	2.6	11.8	55.5	26.9	39.2	73.3	75.8	119.4	80.7	32.1
Bardera	7.5	4.7	4.3	16.6	51.6	34.9	41.8	66.1	82.1	104.1	76.5	34.7
Kaitoi	12.4	3.8	3.2	16.1	54.6	40.4	47.8	68.3	70.4	120.3	94.5	41.8
Gianama	10.3	2.4	1.3	13.6	53.5	39.2	46.2	60.4	68.0	89.4	84.9	39.6

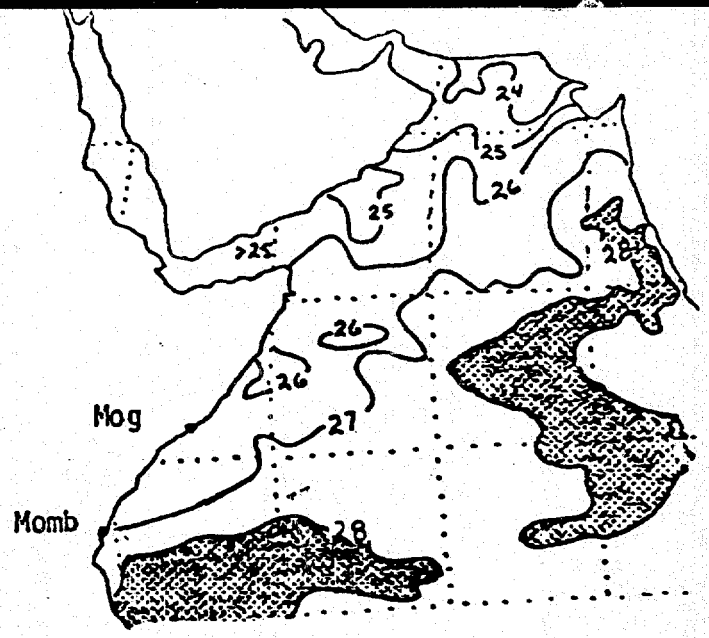
* The median is based on the thirteen year period 1952 to 1964 inclusive.



Sea Surface Temp. Deg. Cent.

JANUARY

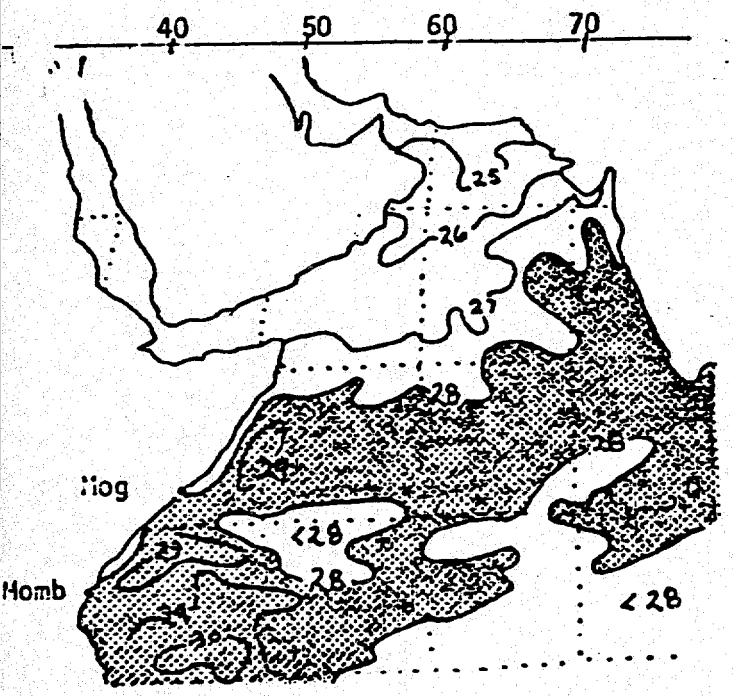
FIGURE 75a



Sea Surface Temp. Deg. Cent.

FEBRUARY

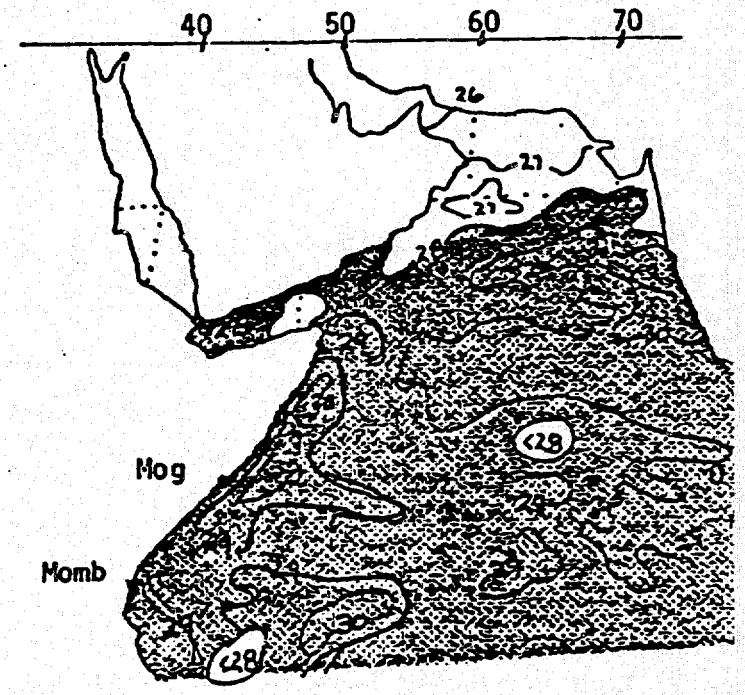
FIGURE 75b



Sea Surface Temp. Deg. Cent

MARCH

FIGURE 75c

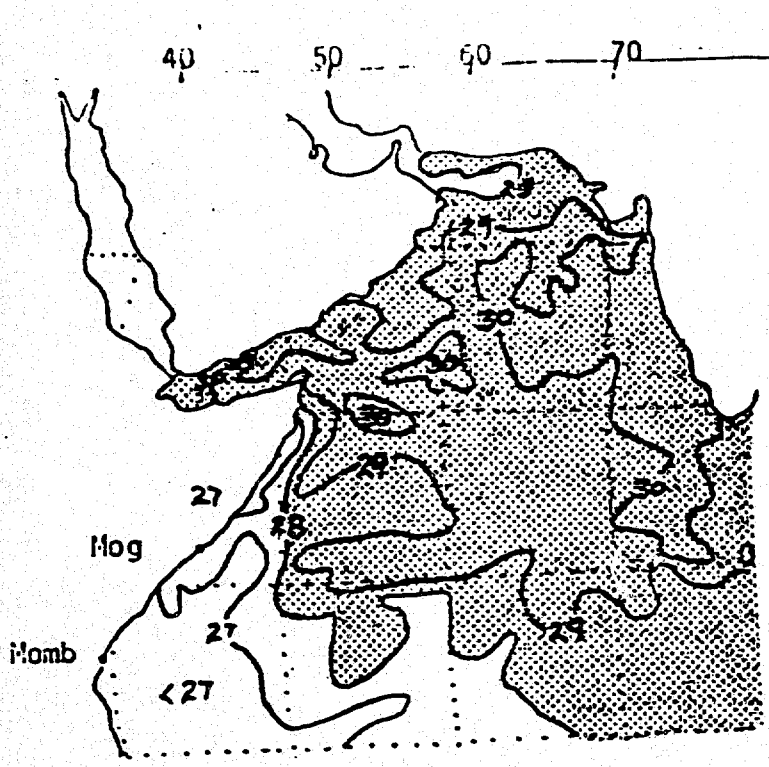


Sea Surface Temp. Deg. Cent.

APRIL

FIGURE 75d

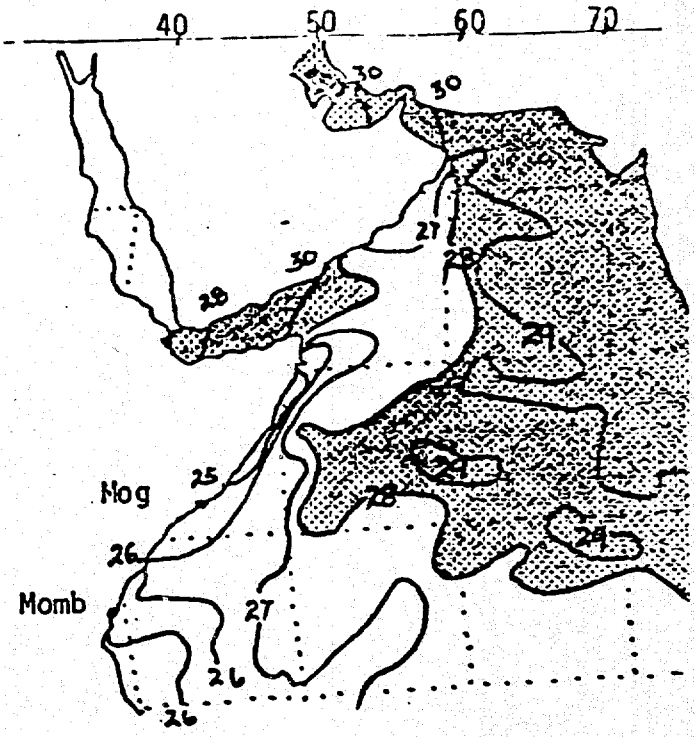
FIGURE 75



Sea Surface Temp. Deg. Cent.

MAY

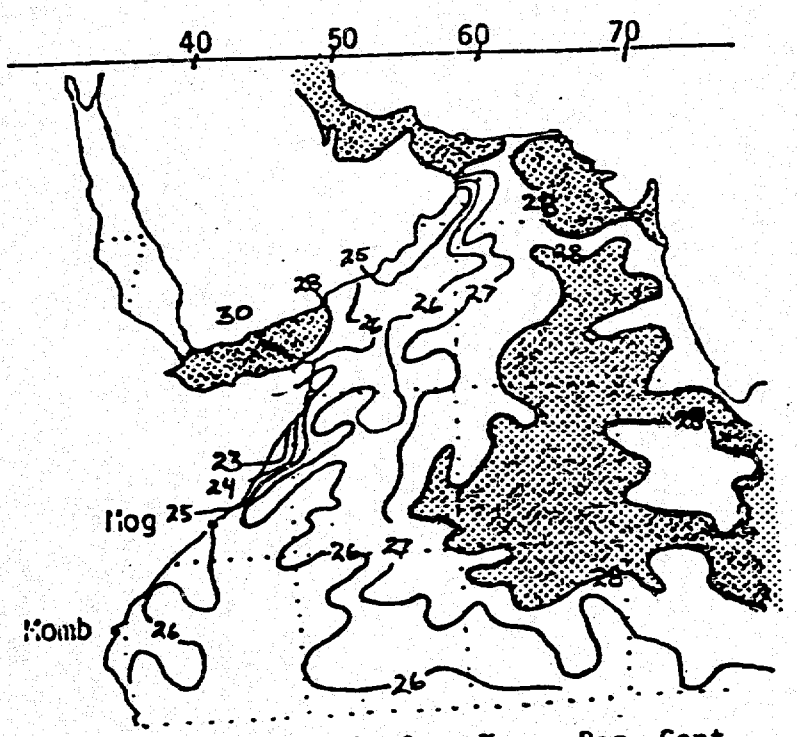
FIGURE 76a



Sea Surface Temp. Deg. Cent.

JUNE

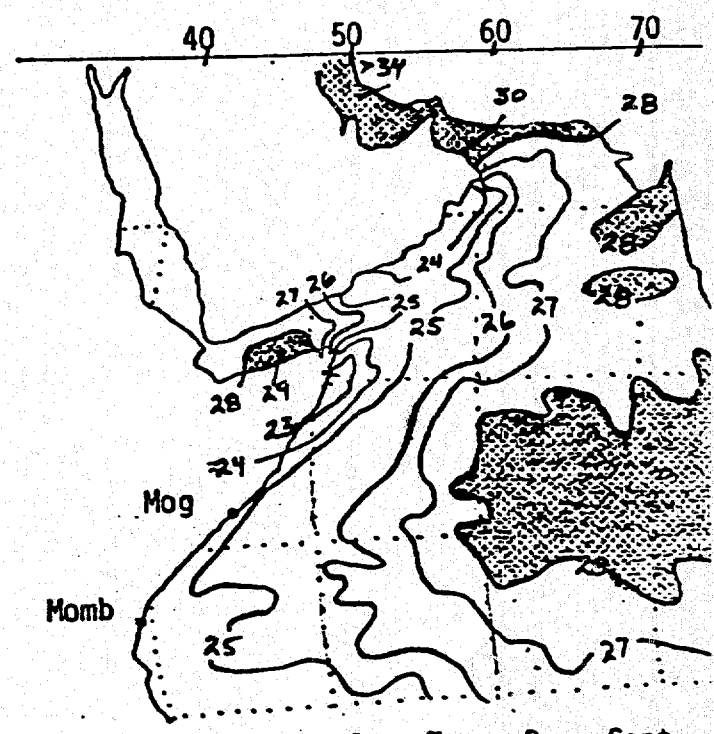
FIGURE 76b



Sea Surface Temp. Deg. Cent.

JULY

FIGURE 76c

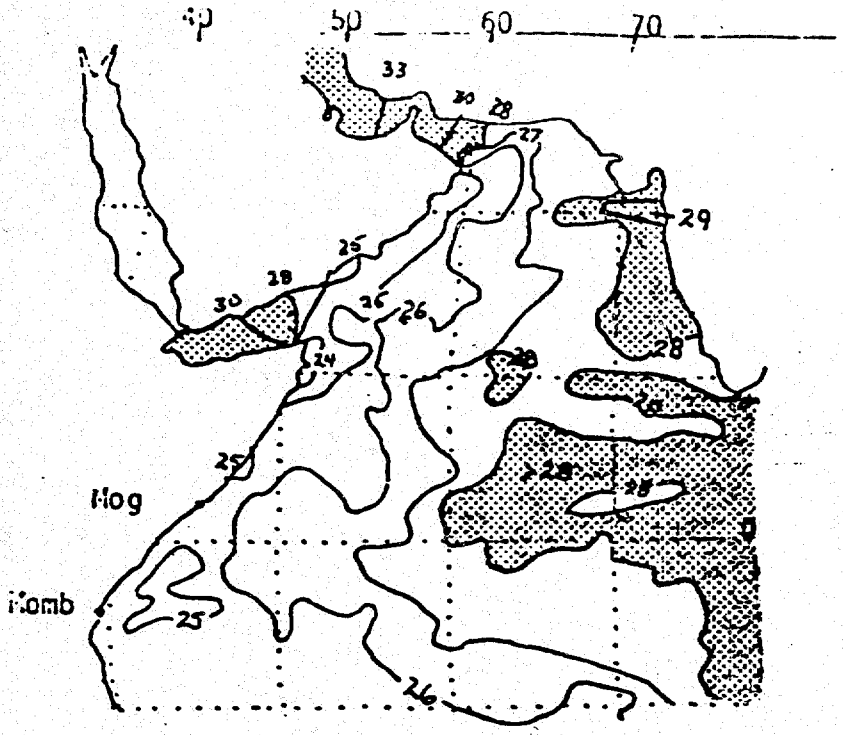


Sea Surface Temp. Deg. Cent.

AUGUST

FIGURE 76d

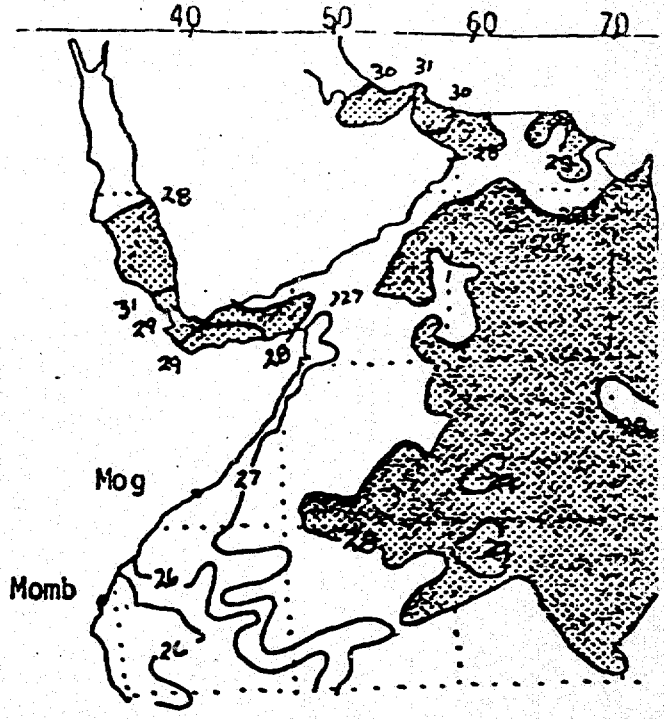
FIGURE 76



Sea Surface Temp. Deg. Cent

SEPTEMBER

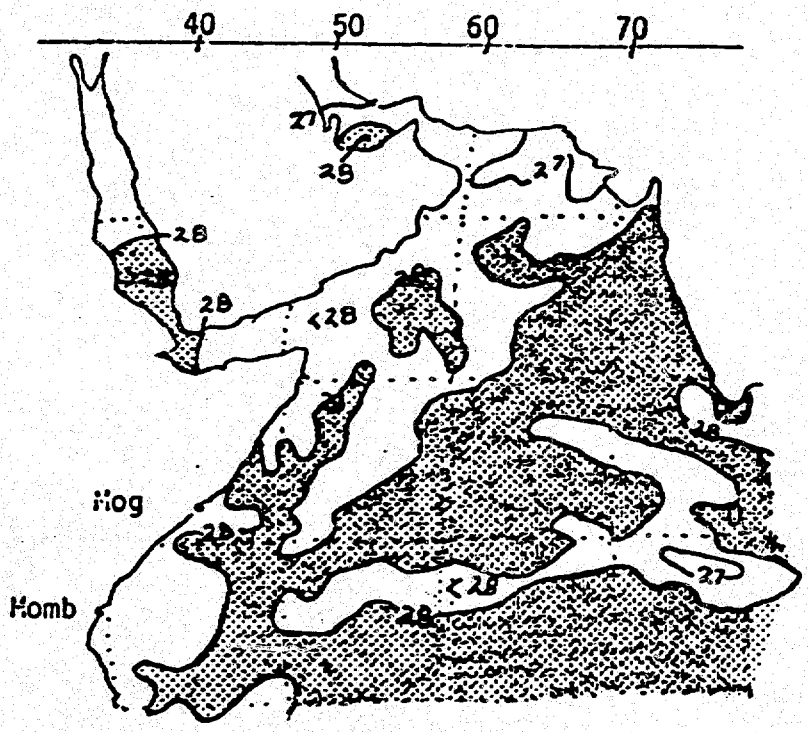
FIGURE 77a



Sea Surface Temp. Deg. Cent.

OCTOBER

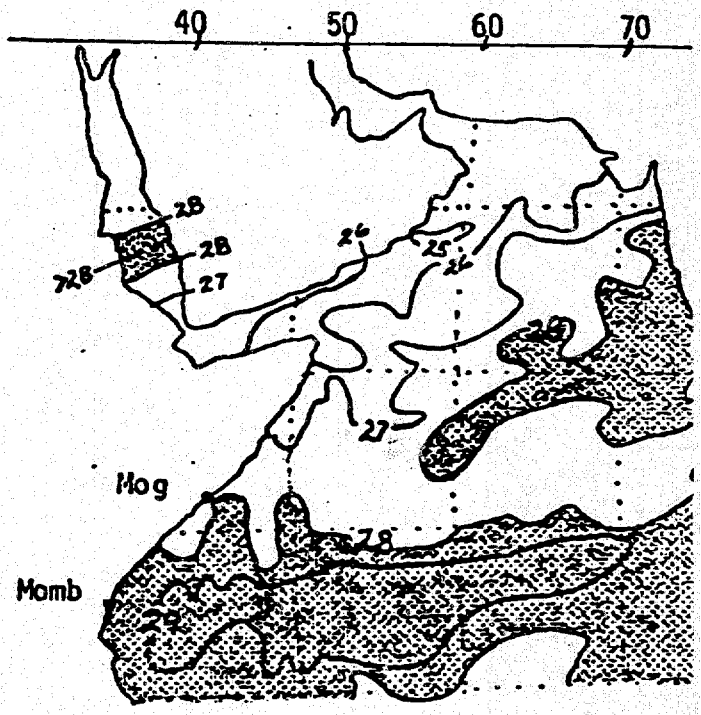
FIGURE 77b



Sea Surface Temp. Deg. Cent.

NOVEMBER

FIGURE 77c

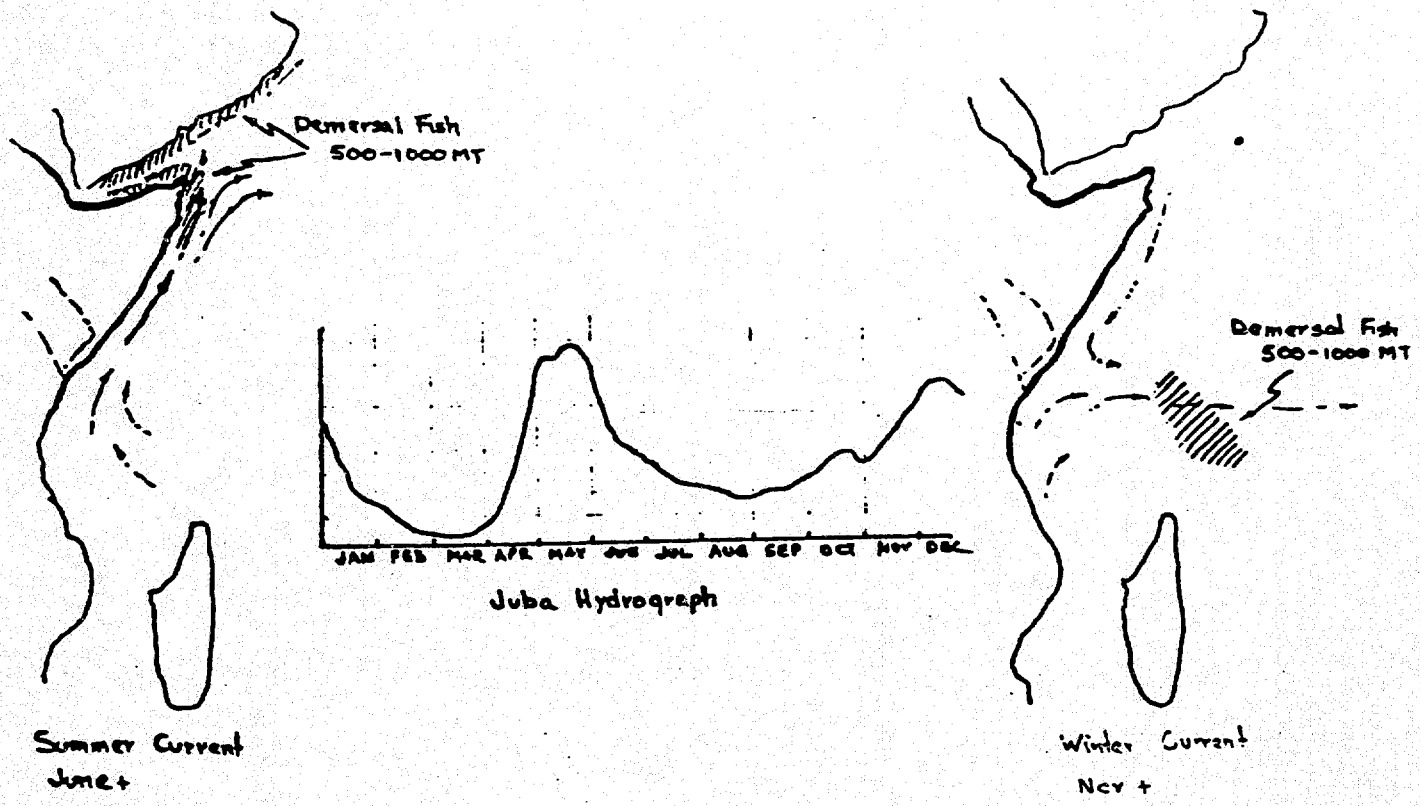


Sea Surface Temp. Deg. Cent.

DECEMBER

FIGURE 77d

FIGURE 77



This figure illustrates the potential effects of the combination of natural and manmade events. In the upper left, the figure depicts the Summer condition. The Somali Current is flowing parallel to the coast in a north-easterly direction. The current is fairly narrowly defined and thus has the potential to transport materials for some distance. The maximum outflow from the Juba coincides well with the maximum current flow, as seen from the hydrograph (center). From inspection of the Summer Current, it will be noted that it diverges at the tip of the Horn. This causes an upwelling which supplies nutrients to produce a concentration of the lower trophic level and thus the fish. The filter feeding organisms can concentrate minute levels of certain toxicants. In addition, certain sections of the trophic level are aquatic arthropods, the marine version of the terrestrial arthropod--insects. These animals are highly sensitive to most pesticides, much more so than insects. During the Winter the monsoon winds cause a reversal of the currents as depicted by the figure on the upper right. The condition creates a counter current, the convergergency of which has the potential to transport river effluent into another fishing area. The formation of the counter current coincides well with the maximum out-flow of the Juba during the second cropping season, as noted fron the hydrograph.

FIGURE 78

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