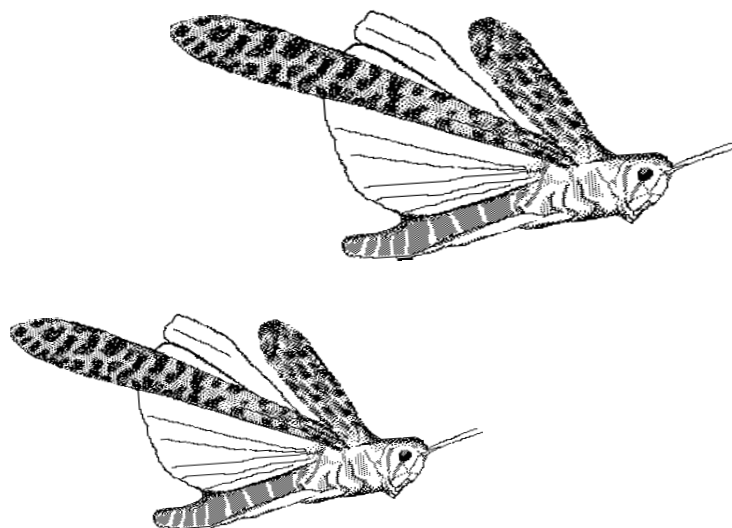


A Joint Survey of the Winter Breeding Areas of the Desert Locust on the Red Sea Coast of Sudan

8 - 13 March 1999



FOOD AND AGRICULTURE ORGANIZATION
OF THE UNITED NATIONS

Rome, 1999



**A Joint Survey of the
Winter Breeding Areas of the
Desert Locust on the
Red Sea Coast of Sudan**

8 - 13 March 1999

**K. Cressman
A.O. Abobakr
M. Al-Alawi
A.M. Al-Khider
R. Khalil
A. Khan
G.A. Mahmoud
K. Sulyman**

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1999

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or its authorities, or concerning the delimitation of its frontiers or boundaries.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, Information Division, Food and Agriculture Organization of the United Nations, Viale delle Terme di Caracalla, 00100 Rome, Italy.

© **FAO 1999**

CONTENTS

Introduction	7
Survey Methodology	7
Survey Route	8
Habitat descriptions and conditions	8
Southern Red Sea Plains: Suakin - Tokar	8
Central Red Sea Plains: Suakin - Port Sudan	10
Northern Red Sea Plains: Port Sudan - Oseif	11
Northern subcoastal area: Sufiya - Wadi Diib	12
Survey Results and Discussion	13
Organizational Matters	14
Planning	14
Timing	14
Usefulness	14
Recommendations	15
Acknowledgments	15
Annex 1. Participants	18
Annex 2. Rainfall during the winter of 1998/99	19
Annex 3. Coordinates of Populated Places	20
Annex 4. Habitat description: Tokar to Karora	21
Annex 5. Itinerary	22
Annex 6. Results of survey	23
Annex 7. Photos	30

A joint survey of the winter breeding areas of the Desert Locust on the Red Sea coast of Sudan (8-13 March 1999)

K. Cressman, A.O. Abobakr, M. Al-Alawi, A.M. Al-Khider, R. Khalil, A. Khan, G.A. Mahmoud, K. Sulyman ¹

A joint survey was organized by the FAO Commission for Controlling the Desert Locust in the Central Region to visit breeding areas on the Red Sea coastal plains of Sudan in order to assess the Desert Locust situation and exchange technical viewpoints. An eight member team consisting of locust officers from Egypt, Oman, Saudi Arabia, Sudan, Yemen and FAO surveyed 1,300 km from Tokar Delta to the Egyptian border and adjacent subcoastal areas in five days. No Desert Locusts were found and conditions were unsuitable for breeding. This was due to a failure of the winter rains this year. Consequently, no significant developments are expected during the remainder of the spring. The survey highlighted the usefulness of familiarizing locust officers from neighbouring countries with breeding areas to understand better the locust situation and strengthen collaboration amongst affected countries. Given the current difficulties of making joint cross-border surveys within the Central Region, simultaneous surveys made by each country in their own territory may be more appropriate for monitoring the border areas of Sudan/Eritrea, Saudi Arabia/Yemen, and Yemen/Oman.

Introduction

Desert Locusts breed in desert areas where favourable conditions exist, irrespective of national frontiers. Sometimes locusts may be present and breeding on both sides of a common border between two countries. From an ecological viewpoint, such areas can be considered to be homogeneous but from a practical standpoint, they may be difficult to survey for security, political or other reasons. Furthermore, communication problems may prevent each country from knowing the situation in the other.

In order to encourage better collaboration between locust affected countries and to alleviate the difficulties of surveying border areas, FAO organizes joint border surveys by a team composed of locust officers from both of the concerned countries. The areas surveyed are often not checked during normal surveys carried out by the country. So far, this has been successfully implemented in the Eastern Region of the distribution area of the Desert Locust where a joint survey has been carried out in the spring breeding areas of Baluchistan in eastern Iran and western Pakistan every April since 1995. FAO hopes that similar surveys can be carried out in the Central and Western Regions as required and when they are feasible.

In view of the success of the Iran/Pakistan joint survey, it is one of the goals of the FAO Commission for Controlling the Desert Locust in the Central Region to encourage joint surveys between member countries, particularly in winter breeding areas of the Desert Locust along the Red Sea coast. Accordingly, a survey was undertaken on the coastal plains of Sudan on 8-12 March 1999. Although the survey team could not on this occasion cross the border into adjacent areas of south-eastern Egypt, the purpose of the survey was: (a) to assess the current habitat conditions and the Desert Locust situation on the Sudanese coastal plains, (b) to familiarize participants with traditional winter breeding areas, and (c) to show how a joint survey consisting of a multi-national team can be organized.

Survey Methodology

The eight man survey team was composed of one experienced Locust Survey Officer from Egypt, Oman, Saudi Arabia and Yemen, three officers from Sudan, and one locust survey and forecasting expert from FAO Headquarters (Annex 1). Two four-wheeled drive stationwagons and two four-wheeled drive support pickups were used. The support vehicles carried camping equipment, food, water, fuel and spare parts. The support team consisted of four driv-

1. see Annex 1 for the affiliation and addresses of the authors. The survey was funded by the FAO Commission for Controlling the Desert Locust in the Central Region.

ers, one cook, and one assistant. One of the pickups was equipped with a VHF radio for communication with fixed PPD radio bases in north-eastern Sudan. The two stationwagons were rented from a local company in Khartoum and Port Sudan who also supplied two drivers.

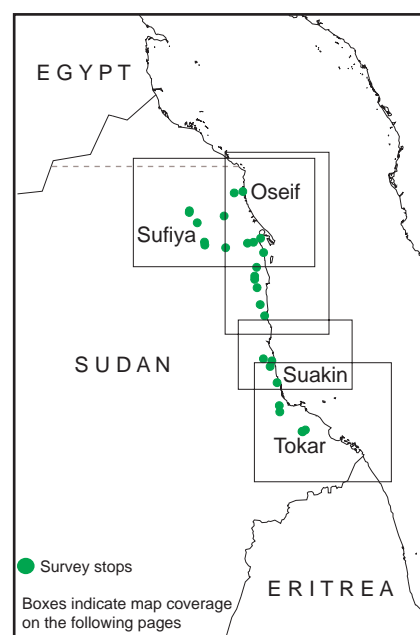
The standard survey methodology as recommended in the *FAO Desert Locust Guidelines* was employed but modified slightly to account for the extremely dry conditions. At each survey stop, the team members inspected the surrounding vegetation for locusts. The condition and density of the vegetation as well as soil moisture were noted, the coordinates of the stop were determined using several hand-held GPS units, and the name of the location was read from 1:250,000 scale paper and linen maps. Although some of the maps were nearly 70 years old, they were still in good condition and remained remarkably accurate and useful in the field. Farmers, locals, truck drivers and nomads were questioned along the way about locusts and rainfall. All of the results and observations were recorded on the latest version of the *FAO Desert Locust Survey and Control Form*. The time spent collecting this information at each stop varied from 10-20 minutes. Habitat conditions were also noted in between stops.

Surveys started about 30 minutes after sunrise (5:45 AM) and continued until just before sunset (5:30 PM) with a meal break mid-morning and sometimes mid-afternoon. The day's results and observations were entered into a laptop computer and were discussed during the evening.

Survey Route

The team assembled in Khartoum and then flew to Port Sudan where the vehicles and drivers were waiting. A local house in Suakin used by the PPD Locust Unit for their annual winter campaign on the Red Sea coastal plains was the base for the survey team. From here, the southern and central coasts were surveyed. During surveys on the northern plains and subcoastal areas, the team camped in the villages of Oseif and Sufiya.

A survey itinerary was agreed upon by the team members the evening before the survey began (Annex 5). The route was based on the current conditions, supplemented by the experience and knowledge of the Sudanese officers as to where locusts commonly occur and breed. It was designed to cover as much of the coastal and subcoastal areas as possible in the allotted time period of five days. The first day was spent surveying the coastal plains between Suakin and Tokar, including Tokar Delta. The coastal plains between Suakin and Port Sudan were surveyed during the second day. Both nights were spent in Suakin. During the next three days, the team surveyed the coastal plains from Port Sudan to Oseif (day 3), the subcoastal wadis between Oseif and Sufiya, including Wadi Diib (day 4), and the subcoastal areas between Sufiya and Dungunab (day 5), returning to Suakin at the end of the fifth day. A total of 1,300 km were surveyed.

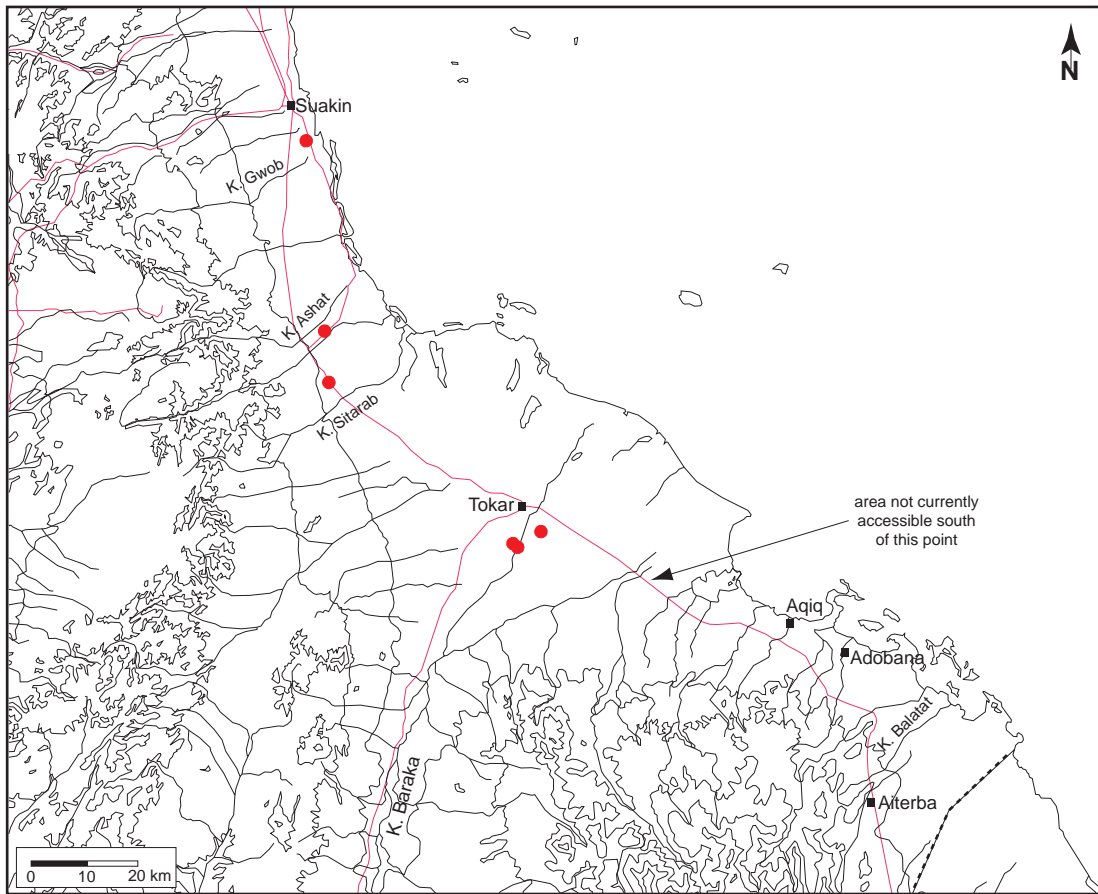


Habitat descriptions and conditions

For the sake of this report, the Red Sea coastal plains have been divided into three sectors: southern, central and northern. The northern subcoastal area represents a separate sector. Coordinates of populated places are listed in Annex 3 and survey photos are in Annex 7. Survey stops are indicated on the maps by circles and inhabited places by squares.

Southern Red Sea Plains: Suakin - Tokar

The southern coastal plains of the Red Sea extend from Suakin to the Eritrean border. Since 1997, the portion south of Tokar has been closed. Therefore, the team could not survey south of Tokar Delta. Suakin is a small village



of wooden huts and cement block buildings on the shore of the Red Sea. The old abandoned town built from coral lies on a small island connected to the shore. Flat sandy coastal plains extend south of Suakin for just over 100 km until the Tokar Delta. The width of these plains vary from about 10-20 km. Behind the plains are the Red Sea Hills which are rocky and barren, reaching a maximum altitude of 1740 m west of Tokar and 2440 m south of Tokar. In between the hills are rocky canyons or khors. Neither the hills nor the khors away from the coast are suitable habitats for Desert Locust, so the team concentrated on surveying the coastal plains themselves. The plains are traversed by three large and poorly defined khors: from north to south, these are Khors Gwob, Ashat, and Sitarab. Khor Gwob is about two km wide and stretches for about 15 km before it meets the Red Sea Hills. Khor Ashat is probably the largest of three, about 20 km by 3 km; Khor Sitarab is about 20 km by 2 km. After K. Sitarab, there is about a 30 km stretch of flat plains occasionally interrupted by low sandy dunes before Tokar Delta.

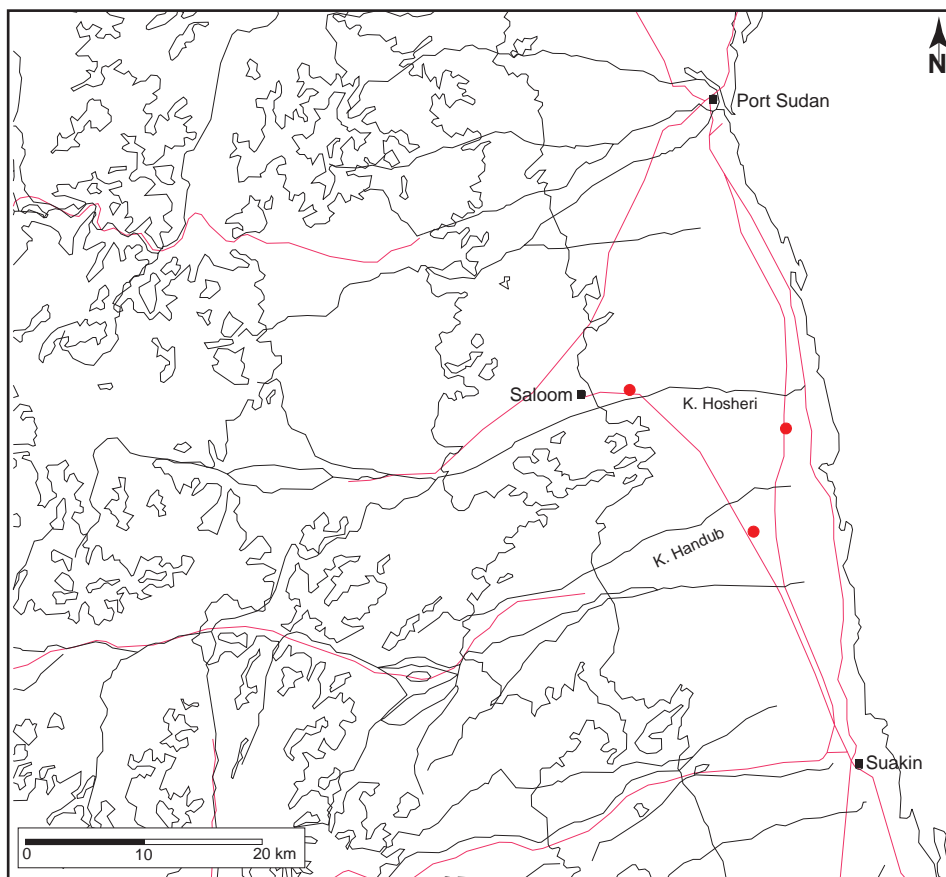
The vegetation in the khors consists of several of the main plant species preferred by Desert Locust: *Tribulus* sp., *Dipterygium glaucum* and *Heliotropium kotschyi*. Acacia trees dominate the flat plains between the khors. The habitat near the seashore is not suitable for Desert Locusts because it consists of hard and saline plains with little vegetation except for saltbrush (*Zygophyllum* sp.). Therefore, the khors themselves as they empty onto the plains are probably the most likely area where locusts may be present and breeding in years of normal rainfall. This may extend to sandy areas on the plains outside of the khors in years of above-normal rainfall.

Tokar Delta represents a habitat that is quite different from the khors and coastal plains to the north. Here, about 250,000 ha of primarily millet and sorghum, and to a lesser extent cotton, okra and other vegetables, are cultivated. The delta consists of fine silty soils that are nurtured by floods arising from rain falling in the Red Sea Hills and Eritrean highlands that flow down Khor Baraka to Tokar. The delta is demarcated into 79 rectangular blocks, each subdivided into numerous 67 ha sized plots. Each block has a unique name. Roughly in the centre of the delta is the town of Tokar which consists of wide streets lined with cement and mud buildings oriented on a north-south axis to account for the prevailing winds and minimize the accumulation of blowing sand. Crops and weeds in the delta often remain green longer than the natural vegetation on the coastal plains to the north and south. This can provide shelter and suitable breeding conditions for Desert Locusts.

To complete the habitat description of the southern plains south of Tokar Delta to the Eritrean border, observations from a previous survey by the lead author are presented in Annex 4.

During this survey, only small patches of drying *Tribulus* sp. were seen in K. Ashat and to a lesser extent in K. Gwob. In Tokar Delta, most of the millet and sorghum had been harvested and only scattered patches of cotton and okra remained. In all areas, the soil was dry and not suitable for breeding. The last rains fell on 26 October in Tokar. Prior to that, Khor Baraka was said to have flooded sometime in July and August 1998.

Central Red Sea Plains: Suakin - Port Sudan

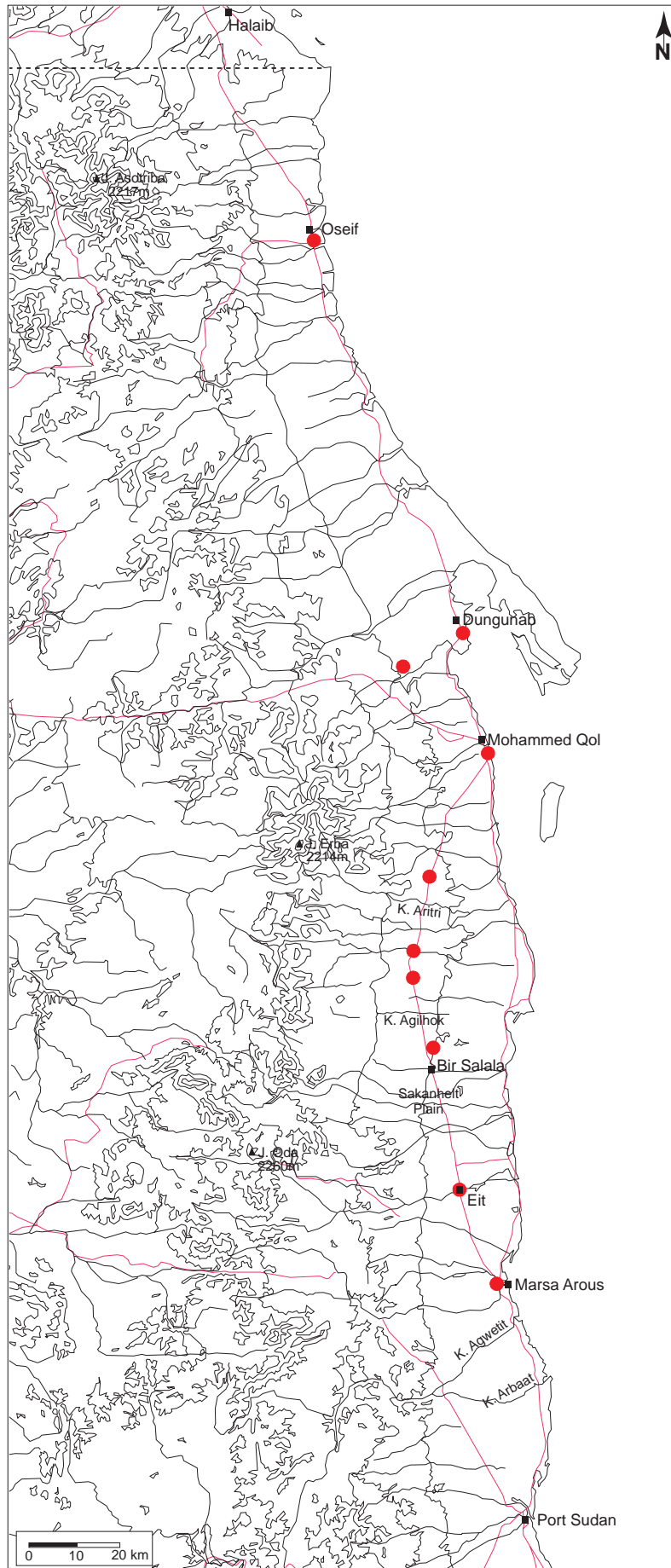


The central plains extend from Suakin to Port Sudan. This area differs from the southern plains since very few large khors traverse the area. It consists almost entirely of flat sandy plain that is about 50 km in length and up to 20 or 30 km in width. Similar to the southern plains, the central plains are saline and unsuitable for locusts close to the shore. Small plots of rainfed millet and sorghum crops are scattered throughout the area. There are three primary cropping areas: from south to north, these are Handub, Hoshi, and Saloom. The latter is set at the back of the coastal plains at the base of the Red Sea Hills and consists of irrigated plots. The highest point in this part of the hills is Jebel Akreribay (1680 m) west of Saloom. The plain is traversed by a pipeline, the Khartoum-Port Sudan railway, and the Port Sudan airport is located about 15 km south-west of Port Sudan.

During years of normal rainfall, the vegetation consists mainly of green *Panicum* sp. and other annuals, interrupted by plots of millet and sorghum. During years of above-average rainfall, both the natural vegetation and the crops are greener and more dense. On the contrary, few crops are present and annual vegetation may be completely dry or absent during years of below-average rain.

During this survey, annual vegetation was dry and very little millet and sorghum were seen or appears to have been sown as a result of the lack of rainfall in recent months. During the winter, moderate rains fell in Suakin on 27 December 1998 and light rains fell on 8 January. Port Sudan also reported light rainfall on or about 8 January.

Northern Red Sea Plains: Port Sudan - Oseif



The northern plains stretch for about 300 km from Port Sudan to the Egyptian border south of Halaib. The width of the plains range from about 10-30 km and contain patches of gravel, soft and hard sand, interrupted by several khors, sand dunes, and sets of low hills. Several large inlets from the sea are present near Port Sudan and north of Mohammed Qol. There are no large towns on this part of the coast but there are a few very small fishing villages (Mohammed Qol, Dungunab, Oseif) and wells (Eit, Bir Salala). The highest points in the Red Sea Hills are J. Oda (2260 m) west of Bir Salala, J. Asotriba (2217 m) west of Oseif, and J. Erba (2214 m) west of Mohammed Qol.

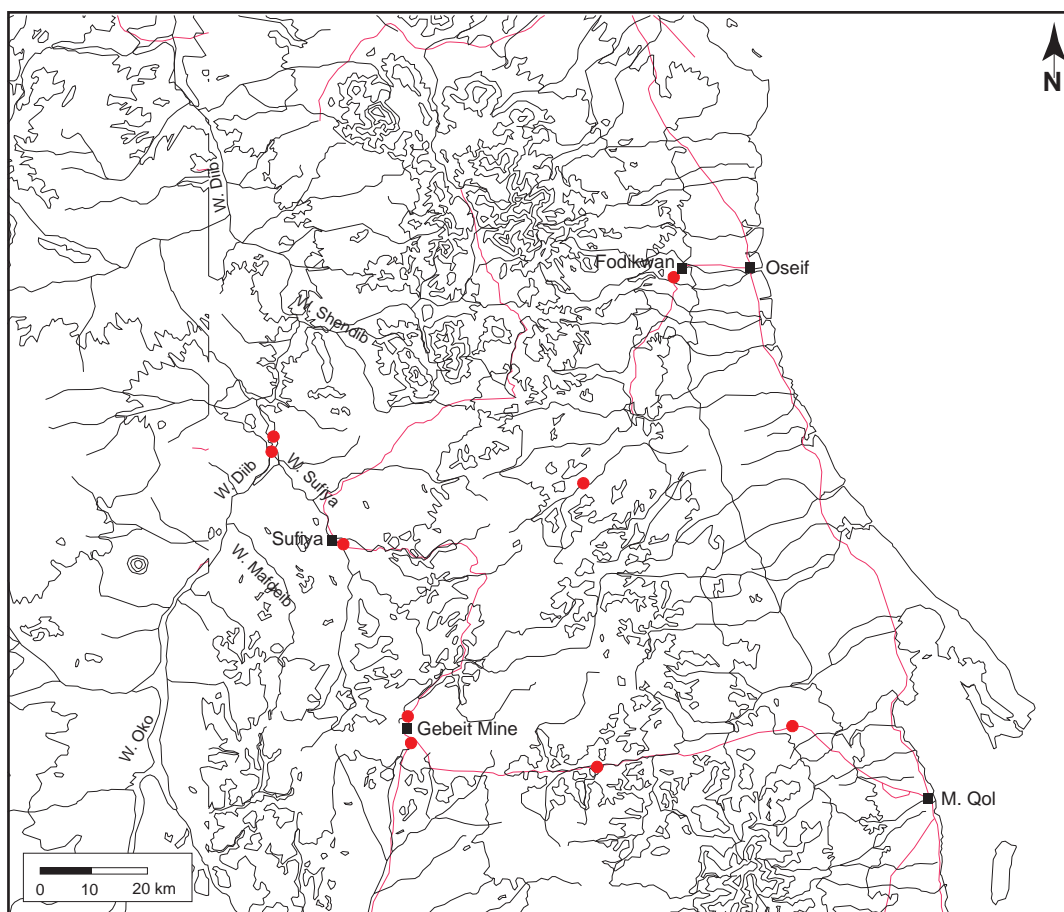
On the northern edge of Port Sudan, hard saline plains devoid of vegetation stretch northwards along the coast for about 20 km. Inland from this are thick mesquite groves and further inland at the base of the Red Sea Hills are sandy areas of difficult access. The northern side of this area is interrupted by many small and insignificant wadis. The first major khor that intersects this plain is Khor Arbaat. Here, suitable locust habitats consisting primarily of *Panicum* sp. are found towards the foothills rather than towards the sea. Moving northwards, this is followed by a hard plain of packed sand until Khor Agweilit, similar to Arbaat but smaller, and then followed by a second hard plain devoid of vegetation which leads to the saline plains and small dunes at Marsa Arous. North of Marsa Arous, a large flat plain of about 15 km by 15 km opens up, consisting of small patches of sand and annual vegetation, and several low conical hills. On the northern side of this plain is a set of low dunes, followed by Eit well in a sandy khor. After Eit, there is a large open plain criss-crossed by alternating stretches of hard and soft sand and patches of gravel. After crossing an area of low undulating gravel hills separated by tiny sandy wadis, the coast opens up into the Sakanhelt Plains, an

area about 25 km long by 15 km wide, containing mostly *Panicum* sp. On the northern edge of the plains are low sandy dunes which dissolve into a sandy khor at Bir Salala, followed by the narrow and short Khor Agilhok where low density *Panicum* sp. bushes are present. After this, there is a rocky hilly area traversed by the sandy Khor Aritri which contains a good expanse of *Panicum* sp. This is followed by a large sandy plain with very little vegetation that gently descends to the coast at Mohammed Qol. Hard packed saline plains with very little vegetation, interrupted by numerous inlets (the largest being Dungunab Bay) and flat-topped hills, extend close to the seashore from Mohammed Qol to Oseif. Apart from one small area of *Panicum* sp. north of Dungunab and another one west of Oseif, this is not a particularly suitable area for Desert Locust. However, further inland towards the Red Sea Hills between Mohammed Qol and Dungunab are large expanses of low rolling sand dunes with *Panicum* sp. in the depressions. This is an area of difficult access but very good for Desert Locust when rains fall.

If rain occurs along the northern coast, there are several relative distinct areas that would be suitable for locust breeding. However, it seems that rains fall much less often here than on the plains that extend south of Port Sudan.

During the survey, only dry *Panicum* sp. bushes were seen north of Marsa Arous, on the Sakanhelt Plains, in K. Agilhok and K. Aritri, north of Dungunab, and west of Oseif. Light rains reportedly fell north of Oseif earlier this year. No other rains fell which meant that it was unusually dry this year.

Northern subcoastal area: Sufiya - Wadi Diib



The habitat commonly referred to as subcoastal consists of the Red Sea Hills, the khors and small valleys and plains in between the hills and the Wadi Oko/Diib complex on the western side of the hills. These areas are distinctly separate from the coastal plains. The hills extend for about 85 km in an east-west direction. They are rocky and devoid of vegetation. In between the hills are numerous narrow khors that look remarkably similar to each other. Some of these are rocky while others are sandy. Vegetation in the khors is sparse and consists mainly of perennials such as *Acacias* and *Calotropis procera* bushes. In two areas east of Gebeit Mine towards Mohammad Qol, there are

open plains containing some sparse *Panicum* sp. Unless unusually high rainfall occurs, this area probably cannot support or generate large numbers of locusts.

On the western side of the Red Sea Hills is a large wadi complex known as Wadi Oko in the south and Wadi Diib in the north. The western side of the hills drain into Wadi Oko/Diib through many moderate-sized westward flowing sandy wadis (such as Mafdeib, Sufiya, Shendib). Wadi Oko/Diib itself flows north to the coastal plains at Halaib. If rains fall in or near this area, very good breeding conditions can develop. Rains often occur here in September or October before those on the Red Sea coast which can allow one generation of breeding after the summer breeding in the interior of Sudan and before the winter breeding on the Red Sea coast. Rains also tend to end sooner in this area than on the coast.

There are no large towns or villages in the Red Sea Hills or Wadi Diib. The few inhabitants in this area are mainly concentrated at the abandoned mines at Gebeit, the few huts at Sufiya, and the small village of Tomala which is about 140 km to the south at the beginning of Wadi Oko. Port Sudan is about 10 hours away by vehicle.

In years when there is rain, large expanses of *Panicum* sp., *Dipterygium glaucum*, *Heliotropium kotschyi* and *Tribulus* sp. develop. The local inhabitants and nomads will also sow millet and sorghum in the wadis. During dry periods, only perennial plants such as *Calotropis procera* and *Acacia* remain.

During the survey, the khors between Oseif and Sufiya were found to be dry and rocky, unsuitable for Desert Locust. Khor Sufiya leading to Wadi Diib was also very dry as was Wadi Diib. The small plains east of Gebeit were also dry. No rain has fallen in the Wadi Diib and Sufiya area for two years. The last rain that fell at Gebeit Mine was in October 1998. This explains why it was unusually dry along the entire survey route.

Survey Results and Discussion

Not a single Desert Locust was seen during the survey (Annex 6). Farmers and locals interviewed along the survey route indicated that they, too, had not seen any locusts this year. This is not surprising considering the unusually dry conditions as a result of the failure of the seasonal rains on the Red Sea coastal plains this winter (Annex 2). A few areas received at most only one light rain shower in the past six months while most areas did not receive any rain and some of these for the second year in a row. The lack of rainfall has had a significant impact on the natural vegetation along the coastal plains and in subcoastal areas. In most areas, annual vegetation is completely dry. South of Suakin there were a few small patches of drying *Tribulus* sp. associated with the khors that drain from the Red Sea Hills onto the coastal plains. On the northern coastal plains, there were several large areas of completely dry *Panicum* sp. In subcoastal areas of the north, annual vegetation was absent and only perennials such as *Calitropis* bushes and *Acacias* were present, both of which do not play a significant role in locust breeding or survival. No crops were sown this year in Wadi Diib or nearby wadis. In Tokar Delta, most of the millet and sorghum crops were harvested by early March. The remaining cotton and okra crops were thin compared to wetter years. Similarly, very little millet or sorghum was seen in areas normally cultivated between Suakin and Port Sudan.

The failure of the rains means that it is very unlikely that locust breeding occurred during the past six months on the Red Sea coastal plains or in subcoastal areas. The lack of locusts seen during the survey indicates that there are very few, if any, locusts present on the coastal plains and further supports the notion that breeding did not occur this year. At most a few isolated adults may be present and even these may have a difficult time surviving under such dry conditions. Although adults are not expected to arrive from other areas, even if they did, they would most likely overfly the area and continue across the Red Sea. It should be emphasized that such a movement is not expected in the coming months. Considering that the possibility of further rain falling during the remainder of the spring is extremely low and given the seasonal increase in daily temperatures that is expected, the current dry conditions will become even drier and less favourable for locusts. Therefore, the locust situation on the Red Sea coastal plains of Sudan is expected to remain calm for the remainder of winter/spring breeding period and no significant activity nor threat to neighbouring countries or regions is anticipated.

Rainfall along the Red Sea coasts from September to April greatly influences the success of winter breeding and its impact on the summer breeding that follows. In most years, low numbers of adults are scattered along both sides

of the Red Sea and enough rain falls to allow these to breed at least once. If the rains continue, a second generation of breeding can occur, resulting in a greater build up in locust numbers. In years when the rains fail, such as in this year, the few locusts present on the coastal plains usually disperse and die without breeding. As a result, populations do not increase; instead, the total number of locusts falls to an extremely low level. This has a dramatic impact on the scale of the summer breeding. If only very low numbers of locusts are present at the end of the winter/spring breeding period, then the number of locusts that move to summer breeding areas and lay once the seasonal rains begin will be very low. In other words, the initial or source populations for summer breeding are so low that it will take several generations of breeding before populations increase to a level that is threatening. Such an increase would require good rainfall to occur successively over several months which is unusual in arid areas. Therefore, the scale of summer breeding this year in the Central and Western Regions is expected to be very low as a result of the general failure of the rains this winter along the Red Sea coasts. This will only contribute to the continuation of the current Desert Locust recession.

Organizational Matters

Planning

Although participating countries were informed, there was some confusion as to the purpose and intent of the survey, whether it was for training, assessing the locust situation, or as an exchange visit. The amount of time available for planning the survey, specifically to assemble a multi-national survey team, arrange transportation and visas of the participants, disburse funds, and prepare vehicles was extremely short. Because of a severe shortage of PPD/Locust Unit vehicles that are currently in good working condition, two Land Cruiser stationwagons with drivers had to be rented for this survey. It was felt that this was not the best solution because the hired vehicles were old and the drivers were not experienced in driving in the difficult off-road conditions typical of a locust survey. This resulted in a serious breakdown 14 hours north of Port Sudan in which one vehicle was abandoned and the driver had to remain in an isolated khor for more than a day and a night. Despite such difficulties, the survey was well organized by the Plant Protection Department of Sudan. The accomodation and meals were more than adequate. Good maps and GPS units were made available.

Timing

March is generally too late for making surveys along the Red Sea coast since this is the end of the rains and conditions are often dry by this time. Given the unusually dry conditions this year, five days was almost the right amount of time. A few more days would have allowed for a more intensive survey in Wadi Oko/Diib which was desirable. Obviously the duration of any survey is a function of the amount of rain that has fallen, the general state of the habitat and the quantity of locusts that are present. In so-called normal years, it was felt that at least ten days would be required to adequately survey Red Sea coastal and subcoastal areas in Sudan. Ten days were originally planned allowing more areas to be checked and more samples to be taken. This was less critical this year but would have been important in years when breeding conditions are good and locusts are present. Lastly, more time is required for internal travel, either by air or ground.

Usefulness

Despite the short time and dry conditions, the survey was extremely useful for several different reasons. It allowed those participants from other countries who had not previously visited the Red Sea coast to become familiar with the habitats and imagine the possibilities for locust populations to develop. It allowed for an exchange of technical expertise and experiences in terms of surveying, data collection, reporting, and use of radios, maps and GPS, and as a means of strengthening cooperation and collaboration amongst affected countries. It was an opportunity to see how assessment surveys can be organized that involve a multi-national team. Lastly, the current locust situation could be evaluated and these results used for planning monitoring activities in the participating countries in the coming months.

Recommendations

The PPD/Locust Unit must have enough vehicles in good working condition that can be used for field surveys including future joint surveys. Funds should be made available well in advance to allow minor repairs of vehicles and the purchase of spare parts. Similarly, PPD/Locust Unit drivers should be used who know the survey areas and have experience in difficult off-road driving. The comfort of vehicles is of less importance than their reliability.

If a similar joint survey is made in the future but the team cannot cross the border, a short survey should be organized in the adjacent area of Egypt, that is in the Halaib - Shalatein area. This would complete the assessment of the Sudanese-Egyptian Red Sea coastal plains and would allow an opportunity to see potential breeding areas. It is estimated that such a survey would take about three days to complete.

Exchange visits similar to the survey that was undertaken should be organized in other countries along the Red Sea coast to allow survey officers to understand better the breeding areas and further strengthen collaboration between countries. Surveys should occur during periods when locusts are most likely to be present (i.e. in January in Saudi Arabia and Yemen). One survey officer from each country along the Red Sea should participate.

The general idea of joint cross-border surveys, such as the one between Iran and Pakistan, is that the locust situation along common borders is comprehensively monitored. An alternative, less official, method relies on discrete arrangements between the national locust units of the two countries to organize surveys on their own side of the border at the same time and communicate the results. This method has been used in the past to monitor the Sudanese-Egyptian border area along the Red Sea coast and it has been effective until now. Given the current difficulties of making joint cross-border surveys within the Central Region, simultaneous surveys made by the relevant countries may be more appropriate for monitoring the border areas of Sudan/Eritrea, Saudi Arabia/Yemen, and Yemen/Oman.

Acknowledgments

The authors would like to express their sincere gratitude to the FAO Central Region Commission and to FAO Headquarters for organizing and funding this survey. A special word of appreciation is due to the FAO Representation in Khartoum, the Government of Sudan and, in particular, the PPD/Locust Unit for their time and efforts in ensuring that this was a successful survey.

