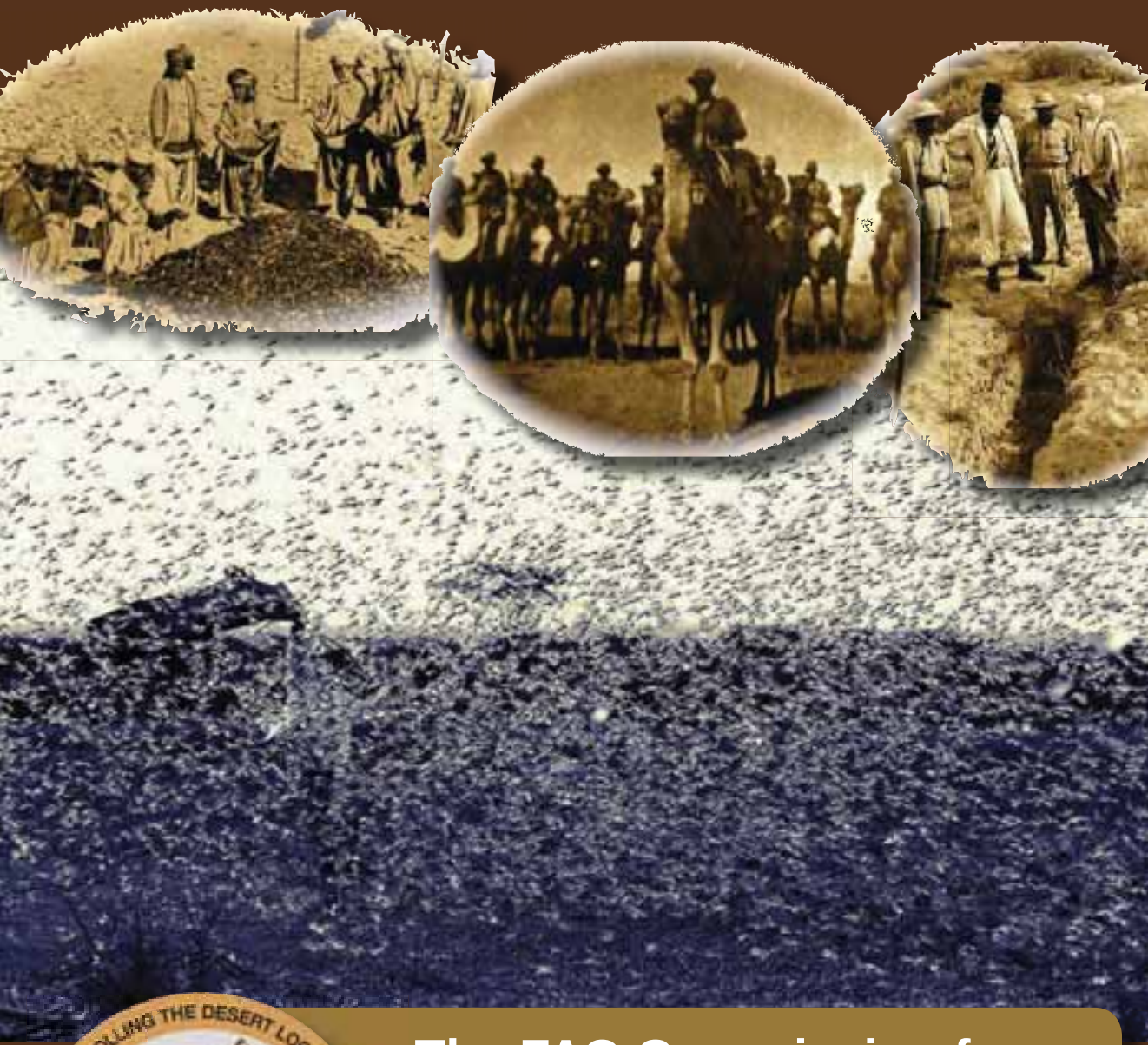
Food and Agriculture Organization
of the United Nations



The FAO Commission for Controlling the Desert Locust in South-West Asia

A celebration of 50 years

COMMISSION FOR CONTROLLING THE DESERT LOCUST IN SOUTH-WEST ASIA
since 1964
SWAC

The FAO Commission for Controlling the Desert Locust in South-West Asia

A celebration of 50 years

Keith Cressman and Clive Elliott

Commission for Controlling the Desert Locust in South-West Asia
Food and Agriculture Organization of the United Nations
Rome, 2014

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Foreword

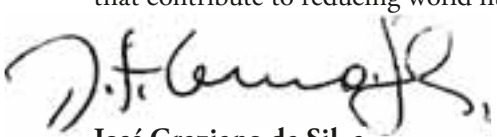
In 1964, the Food and Agriculture Organization of the United Nations (FAO) established the first of three regional locust commissions – the Commission for Controlling the Desert Locust in South-West Asia (SWAC).

Fifty years later, I am pleased to report that SWAC continues to play an important role in Desert Locust early warning and control within Southwest Asia. During the last major upsurge in 1993 technical assistance and capacity building were provided to India and Pakistan that successfully prevented swarms from migrating to other regions. Two years later, Iran and Pakistan requested that the Commission assist in the re-establishment of the annual joint Iran/Pakistan survey in both countries after a 20-year gap.

The Commission acts as a neutral forum, bringing member countries together every two years to discuss common approaches to Desert Locust management and to share expertise and knowledge. It provides useful advice and support for the strengthening of national capacities in the four member countries in their fight against this global pest. Joint activities such as cross-border surveys and meetings, training courses, and technical workshops are organized under the auspices of the Commission despite fluctuations in security and relations within the region.

This book has been prepared to commemorate the 50th anniversary of the Commission for Controlling the Desert Locust in South-West Asia. It presents an overview of the Commission, its member countries and Desert Locust in Southwest Asia.

The strength and resilience of the Commission in the past half-century is a result of the generous contribution of knowledge and expertise by its member countries. I believe that this shared commitment to a common cause will sustain the Commission and its activities in the coming decades. I am proud that FAO is associated with SWAC and I would like to extend my best wishes for another 50 years of successful endeavours within the region that contribute to reducing world hunger.



José Graziano da Silva
FAO Director-General

Preface

Locusts are an age-old problem that has plagued the Earth for thousands of years. A small swarm can wreack havoc and completely destroy a farmer's entire livelihood in a single morning. Swarm invasions and damage on a larger scale can reduce the food security of a country or a region for years to come. It is not uncommon for household heads to go into debt during plagues and their children to be pulled from school to help the family cope with this increased burden. The Desert Locust is considered to be the most dangerous of all migratory pests in the world.

While historical accounts of Desert Locust plagues go back a several hundred years, it was only during the early twentieth century that systematic record keeping began, followed by the establishment of organized monitoring and control programmes in order to combat this ancient enemy. Prior to chemical pesticides and aerial control, plagues would rage out of control for a dozen years or more. More recently, new technologies have improved our ability to monitor habitat conditions and detect the first signs of locust increases so as to respond quickly before plagues develop. Although it is not possible to eradicate Desert Locust nor would this be particularly desirable, we are able to manage locust populations so plagues, when they do occur, are much shorter, smaller, and less intense.

Over the years, the control strategy has shifted from reactive and curative to proactive and preventive. When applied successfully, this has saved crops, protected livelihoods, reduced the volume of pesticide and its impact on the environment, and avoided the need to spend huge sums of money. However, successful preventive control relies on a sufficiently strong national capacity to undertake surveys that contribute to reliable early warning and then to carry out effective control operations. This capacity must be maintained on a continual basis every year, even when the locust situation is calm and there is no imminent threat.

In the mid 1960s, the Food and Agriculture Organization (FAO) of the United Nations established three regional Desert Locust commissions to assist in strengthening national capacities and promote national action in the control of the pest. The Commission for Controlling the Desert Locust in South-West Asia (SWAC) was the first of these commissions to

be established, consisting of four member countries: Afghanistan, India, Iran and Pakistan. It was inaugurated on 15 December 1964.

This book has been prepared in commemoration of the 50th anniversary of the Commission. It starts with the history of the Commission and the various secretaries who have dedicated themselves to serving the member countries. Chapter 2 describes the many activities of the Commission, concentrating on the most current ones. Chapter 3 presents an overview of the national locust programmes in the four member countries. Chapter 4 describes the Desert Locust and its seasonal breeding areas within the region, and includes a summary of the various outbreaks, upsurges and plagues that member countries have faced over the years. Chapter 5 outlines some of the challenges that may lie ahead for the Commission. The book concludes with personal anecdotes from contributors and a collection of historical photos.

The fact that the Commission will reach its 50th Anniversary in 2014 is an achievement in its own right but that the Commission remains a useful and productive forum for advancing the effective management of the Desert Locust threat to agriculture in the region after five decades is something of which the member countries can be proud. In this respect, FAO would like to express its appreciation and deep gratitude to the member countries for their commitment and the knowledge and expertise that they have contributed to have made this possible. The Commission can move forward confidently for the future and the next 50 years.

We are grateful to the member country representatives at the 28th Session of SWAC who recommended that the Commission should finance a commemorative book for the its 50th anniversary. We would like to thank those contributing authors who agreed to share some personal memories about their locust experiences. We would like further to thank several persons who reviewed various portions of the draft manuscript for accuracy and completeness, in particular Mehdi Ghaemian (Iran), J.N. Thakur (India), Azam Khan (Pakistan) and Mirjan Hemat (Afghanistan). Lastly, we are indebted to the assistance provided by Antonietta Drappa for the historical photos, and by Ali Babali Fashki and Reza Najib for translation of background material in Farsi. We hope that you will enjoy our collective efforts.

Keith Cressman
Clive Elliott
15 December 2014

Islamic Republic of Afghanistan

Ministry of Agriculture, Irrigation and Livestock

Afghan Minister's letter for SWAC secretary:

Dear Mr. Secretary:

First please find my congratulations for the respected secretary of SWAC and to member countries for the 50th anniversary session of the SWAC that will be held in Iran (Tehran).

Afghanistan is not in the frontline for desert locust problem, but it is a dangerously plague and a staunch enemie of human and animal food situation.

To overcome this enemy, Regional cooperation is therefore required, because desert locust (DL) will not know borders between countries and can easily cause damages and ruins our agriculture.

To solve this problem, the Food and Agriculture Organization of the United Nations (FAO), set up the South West Asia Commission for desert locust management in 1964 (SWAC). In the first session held in December, 1964 in Teheran, Afghanistan was already a member of this organization which is on its 50th aniversary session in western Iran (Tehran).

I hope that the SWAC has received the information on the status of the DL in Afghanistan that we have sent to you. We hope that SWAC will provide the same service and advice to Afghanistan as India, Pakistan and Iran have received.

Aghanistan's Government will spend its upmost energy to apply all rules from SWAC and hope for more cooperation.

Date:

13, Oct, 2014

signature:

H.E, Haidary

Deputy minister

राधा मोहन सिंह
RADHA MOHAN SINGH

D.O. No. 1318 /AM

कृषि मंत्री
भारत सरकार
MINISTER OF AGRICULTURE
GOVERNMENT OF INDIA

12 SEP 2014

MESSAGE

It is a matter of great pleasure that "South West Asia Commission (SWAC)" of Food and Agriculture Organization (FAO) is going to celebrate its "50th Anniversary" at Tehran (IR Iran) on 15th December, 2014.

Desert Locust is a serious trans-national pest. Effective International Cooperation under the aegis of FAO has led to considerable success in the containment of the ravages of Desert Locust in the region in recent decades. Technical and material assistance provided by FAO during the large-scale locust attacks in 1989 and 1993 created conditions for SWAC to put technology, systems and resources in place to enable India to combat any large-scale locust invasion in the ensuing years. India congratulates SWAC for continuously updating knowledge and information on locust activities in affected countries through Desert Locust Bulletins and Newsletters.

I am fully confident that the book being published to commemorate the 50th anniversary of SWAC will open windows to many success stories and best practices adopted by countries to combat the menace of Desert Locust. The distance travelled by SWAC in the last fifty years will undoubtedly provide encouragement and hope for common action and cooperation among countries to deal with trans-border issues that affect agricultural growth and development.

I wish FAO and SWAC success in their endeavours for growth and sustainability in agriculture in the years to come.

Radha Mohan Singh

(Radha Mohan Singh)

Office : Room No. 120, Krishi Bhawan, New Delhi-110 001 Tel.: 23383370, 23782691 Fax : 23384129

شماره:
تاریخ:
پیوست:

جمهوری اسلامی ایران

وزیر

جهاد کشاورزی

IN THE NAME OF GOD

MESSAGE OF HIS EXCELENCY
MR. MAHMOUD HOJJATI,
MINISTR OF JIHAD-E-AGRICULTURE,
ISLAMIC REPUBLIC OF IRAN

By looking at the history of man's life and knowledge about agriculture and supply of foods, we realize that man has always challenged with locusts, and with the passage of time and increase of man's knowledge from this pest, man has certainly obtained appropriate solutions to control it. Today, with the use of modern lookout and pre-warning equipment and facilities including satellite systems and using the state-of-the-art computer software and hardware technologies and also the best and most efficient controlling methods, we can manage this pest at any time, in which the conditions are suitable.

According to the United Nations' Food and Agriculture Organization (FAO), among different species of locusts, *Schistucerca Gregaria* (Desert Locust), is one of the most dangerous pests for agricultural products. Known as an international pest, it is being managed by FAO throughout the world.

This pest has a worldwide distribution and some regions in southern and southeastern provinces of Iran are apt to the presence of desert locusts. The available records and information show that in 2009, the outbreak and attack of desert locusts happened in southern regions of Iran and this attack lasted for several years. This outbreak was so big that the pest reached central and northern provinces and even Azarbayejan Province and could cause irreparable damages to agricultural crops. Hence, in the same year, due to the importance of the issue, a unit called Office of Locust Control was established in the time Ministry of Agriculture and it was given the responsibility to control locusts in the country.

Once every several years, the outbreak and attack of desert locust continued in Iran, for example, in 1942, the southern coasts of the country were unprecedented attacked by desert locust. This attack continued for 5 years and most of the southern regions of the country like Chabahar, Goatr, Dashtyari and Jask were contaminated.

So, in order to efficiently control the desert locust in different regions of the world, FAO has established regional commissions. These commissions are directed by Desert Locust Central Committee (DLCC). One of these commissions is the Desert

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Locust Central Commission, located in Southwest of Asia (SWAC), that was established in Iran 50 years ago and its secretariat was located in Iran for 12 years. This commission mainly strengthens national capacities in monitoring and controlling Desert Locust and by using updated methods to manage this pest in the world. Nevertheless, we have seen some examples of Desert Locust outbreak in recent years. For example in 2008 and 2014, the outbreak of this pest happened in south and southeast provinces of Iran where it was effectively controlled and managed.

At the end, I would like to express my sincere appreciations to the South-West Asia Commission (SWAC) for Desert Locust control due to their valuable cooperation, contributions and directions with respect to forecasting and controlling locust in our country.

Mahmoud Hojjati,
Minister of Jihad-e-Agriculture
Nov. 2014

Sikandar Hayat Khan Bosan
Federal Minister

No.F.1-5/2014-FM
Government of Pakistan
Ministry of National Food Security and Research
Islamabad
October 23, 2014

MESSAGE

It is my very proud privilege to record my warm and heartiest felicitations on the 50th anniversary of the FAO Commission for Controlling the Desert Locust in South West Asia Commission (SWAC), which is being celebrated on 15th December, 2014 in Tehran, I.R. Iran. It is also a matter of great honour, that Pakistan is one of the pioneer members of SWAC since its establishment. After the locust upsurge in 1962-63, serious need for a platform for keeping close coordination and exchange of information amongst the four member countries of the region under the auspices of FAO was felt. Hence the establishment of SWAC in 1964.

Pakistan is an agricultural country. About 80% people of Pakistan are associated directly or indirectly with agriculture for their livelihood. God has gifted a very fertile land to Pakistan. Our farmers enjoy all seasons and have various ecologies for cultivation of crops of their choice. In Pakistan, there are vast highlands and lofty mountains with an average elevation of 20,000 feet, including world's highest peaks of K-2 and Nanga Parbat. On the other hand, Pakistan has Indus plains and vast deserts of Tharparkar, Cholistan and Kharan. Pakistan possesses world largest canal irrigation systems providing farmers with irrigation facilities to cultivate cotton, wheat, sugarcane, rice and other major crops.

The Department of Plant Protection is an important component of the Ministry of National Food Security and Research which is playing a vital role in controlling different injurious insect pests of orchards and crops. The Department is in possession of a well established locust survey system and control organization, having mandate of locust control in the desert areas of Pakistan, over an expanse of 300,000 sq. kilometers. These deserts have huge potential for the locust breeding and infiltration of locust swarms from India and I.R. Iran. The most sensitive breeding areas are the deserts of Tharparkar in Sindh and Cholistan of Punjab, where our irrigated fields are closer to the eastern border.

B-Block, Room No. 307, Pak Secretariat, Islamabad. Tel. No. 051-9210088, 9211701, Fax: No. 051-9205912

Pakistan is lying on the route of desert locust migration from both the eastern and western borders and due to this very reason there is dire need for strict vigilance on locust swarms from both sides. Perpetual vigilance on indigenous breeding is also carried out in a very well designed manner. In the past, Pakistan have been a victim of number of locust attacks from across eastern and western borders. Due to effective planning and prompt actions by the Department of Plant Protection this menace has been effectively kept under control.

I also want to express my gratitude on the role of SWAC as well as of the FAO, who have provided assistance to the member countries to join hands in their common cause. The technical as well as field technology support of SWAC has helped the member countries including Pakistan to well equip itself in fight against the attacks of desert locust. During the last few years SWAC (FAO) has provided modern locust survey equipments like GPS, eLocust2, RAMSES database and the eLocust2 mapper. It has also organized various National and International training courses and workshops for the locust officers and field staff, as a result of which the locust organizations of member countries of the region are sensitized to eradicate this common menace. I wish the SWAC and FAO a success in their future endeavors.

(SIKANDAR HAYAT KHAN BOSAN)

1. History of the Commission 1964-2014

Locust problems in Southwest Asia have a long history and probably began when crops were first cultivated. Several species of locust occur in the region but the Desert Locust (*Schistocerca gregaria*) is by far the most important. Locusts are mentioned in Sanskrit literature in particular in the epic poem Mahabharata where Karna includes locusts in a "poetically beautiful" speech when he encounters his rival Arjuna on the battlefield. The earliest known Sanskrit text dates to about 400 BCE but the poem is thought to have existed as early as 750 BCE. Equally ancient mention is made in the Iranian Zoroastrian Vendidad where the locust is one of the xrafstra or evil creations of Angra Mainya. Locusts also feature in the tenth chapter of the Book of Exodus in the Bible as the eighth plague of Egypt. This probably dates back to about the fifteenth century BCE. It certainly concerns the Desert Locust, but of course it is outside our Southwest Asia region. Locusts are mentioned in the Al-Araf chapter 7 of the Koran. Locusts are again included as a plague, along with widespread death, lice, frogs and blood. The earliest known Koranic text is said to date to 671 CE.

It is a long leap from these ancient accounts to present times. Records of Desert Locust "outbreaks" were properly kept from about the beginning of the nineteenth century. Cotes (1891) reported eight such "outbreaks" in India from 1812 to 1889, but most likely they would have been described as plagues using our current definitions. A ninth plague occurred in 1896-1897.

"Like a great cloud of locusts, the shafts covered Arjuna's chariot" (Mahabharata, Book 7)

Hem Singh Pruthi (1941) reports "serious invasions" of locusts in India every few years during the 1900s and says that the five-year invasion from 1926 to 1931 was estimated, conservatively, to have caused damage to crops alone of 2 crores of rupees (GBP 1.3 million in 1926, equivalent to USD 109 million at today's prices). Damage was also caused to fodder and pasture resulting in "heavy mortality among cattle, goats and sheep".

As a result of this recurrent problem with Desert Locusts in India, initially each of the princely States and Provinces had a different administrative set up of its own and it was not possible to put up a common front against locusts.

A flamethrower is used to destroy locusts resting in a tree by fire (Rajasthan, 1949)

There was no coordinated policy or a central coordination organisation to destroy marauding locusts, though sporadic attempts were made locally. As a consequence of the 1926-1932 locust plague, the Government of India, under the British Raj at the time, sponsored a scheme of research into the Desert Locust, starting in 1931. This led to greatly improved understanding of the Desert Locust problem and its biology, and in 1939 led to the establishment of a permanent Locust Warning Organization (LWO) with its headquarters in New Delhi and a substation in Karachi. The main function of the LWO was to survey Desert Locust outbreak areas in the desert, warn the States likely to be affected and help them in carrying out control if locusts attacked.

In 1941, a conference of representatives of all States in the desert areas and of the Provinces affected by Desert Locust invasions that came out of those areas was held at the Department of Education, Health and Lands of the

Government of India. It was agreed to set up a Coordinated Anti-Locust Scheme, and this expanded the role of the LWO to include a control capacity for all India by 1942. The contributions of the Provinces and States were grouped into categories A to E according to their proximity to the deserts (outbreak areas) and the amount of cultivation within their borders, with the A States most vulnerable and expected to contribute most. The whole scheme was initially administered by the Imperial Entomologist and, from 1946, by the Plant Protection Adviser and Director, Locust Control.

More details of the development of locust survey and control capacity in India and the other SWAC member countries are given in Chapter 3.

In the Islamic Republic of Iran (I.R. Iran)[1], or Persia as it was known at the time, the first record in modern times of a locust plague was in 1876 in the south of the country but locals and travellers have reported sporadic outbreaks that date back to the 1600s. A series of plagues occurred in the early twentieth century, one of the worst was that of 1926-1932, mirroring the one in India. The Government responded initially by establishing a Department of Agriculture in 1934 with one of its main tasks to carry out locust control. As locust problems continued in 1937, a separate Desert Locust Department was created and the original Department of Agriculture was expanded into a full Ministry of Agriculture in 1941. The Desert Locust Department also had responsibility for Sunn Pest (*Eurygaster integriceps*) control. In 1941, locust infestations were especially huge and destroyed all the cotton crops around Varamin city in Tehran province. The following year, as the plague developed, crops were destroyed in three provinces. Control was mainly mechanical with temporary walls being built in the paths of hopper bands and the hoppers collected by hand. Farmers were also required to collect eggs and were paid for this by the Desert Locust Department.

Apparently the first case of collaboration between countries in the region occurred in 1942 when a delegation from India helped with locust control work in southwest Persia. Over the next two years, Indian help was also provided to Oman and Persia. This was followed by the first conference within the region on Desert Locust, which was held in Tehran in 1945 and involved Iran, India, Saudi Arabia and Egypt. The subject was planning and methodology for emergency Desert Locust control. A second conference

1 For the purpose of this book, the official name of the Islamic Republic of Iran (I.R. Iran) has been shortened to Iran in the text and figures.

took place in 1950 also in Tehran with Pakistan participating having gained its independence.

Meanwhile locust problems continued in Iran with a full-blown plague in 1950. It was reported that egg density in the Bushehr plain in the coastal southwest reached more than 1 000 eggs/m^2. The Food and Agriculture Organization (FAO) of the United Nations, which had been founded in late 1945, became involved for the first time in 1950. FAO established a Technical Advisory Committee (TAC) that met 12 times between 1952 and 1964. The Committee was composed of locust experts from Egypt, France, India, Iran, Pakistan, United Kingdom and United States of America. FAO recommended improvements to Desert Locust control in Southwest Asia and a collaboration agreement was agreed between Iran, India and Pakistan.

©USOM/Iran

Spray aircraft were unloaded from a transport plane in Abadan for immediate use in a Desert Locust control campaign in southwest Iran during the early 1950s

Large-scale control was carried out in Iran in 1951 over more than 1.5 million ha using DDT, BHC and Aldrin. In 1954, Iranian experts also helped with locust control in Saudi Arabia.

FAO established the Desert Locust Control Committee (DLCC) in 1955 and held its first meeting in Rome in April of that year. Delegates attended from India, Iran and Pakistan but there appeared to be no mention of

Southwest Asia during the proceedings with the focus of locust activities at this time being an emergency in the Arabian Peninsula. A second DLCC was held in August 1955 in Syria and this time locust infestations in Iran were mentioned but only in passing. The third meeting of the DLCC was held in Tehran in 1956. During this time, the locust situation in Southwest Asia was calm but Indian and Iranian teams participated in control actions in the Arabian Peninsula and Pakistan provided two aircraft that carried out over 100 hours of aerial locust surveys in Saudi Arabia.

FAO Technical Advisory Committee, 1957 (L-R): K. B. Lal, Plant Protection Adviser to Government of India and Director, Locust Control, Ministry of Food and Agriculture, India; Esfandiar Esfandiari, Administrator General of Plant Protection, Ministry of Agriculture, Iran; Habibollah Nasser, Chief, Locust Control Service, Ministry of Agriculture, Iran

After this period of relative calm in Southwest Asia, a plague developed in 1958 with the southern areas of Iran being the most affected, and continued until 1961 affecting the whole region. Control operations against more than 2.5 million ha of infestations were carried out and contributions to the cost of pesticide were provided by the United Kingdom, the United States of America and the Union of Soviet Socialist Republics. In response to the scale of the problem, the 11th session of the FAO Conference in November 1961 in Rome passed Resolution 9/61 recommending the establishment of a regional organisation for the Eastern Region (as the Southwest Asia Region was first known). The seventh session of the DLCC in April 1962 endorsed this recommendation and in October of that year FAO organized a meeting in Tehran of the countries involved, namely Afghanistan, India, Iran and Pakistan. This was designated as a "Special Meeting of the Eastern Desert

Locust Region", which decided that the Eastern Region should be defined in relation to Desert Locust activity rather than geographical features and, therefore, should comprise Afghanistan, India, Iran and Pakistan. The meeting drafted a convention that was finalized at a follow up meeting in early May 1963 for what was in effect the first FAO regional locust commission to be established.

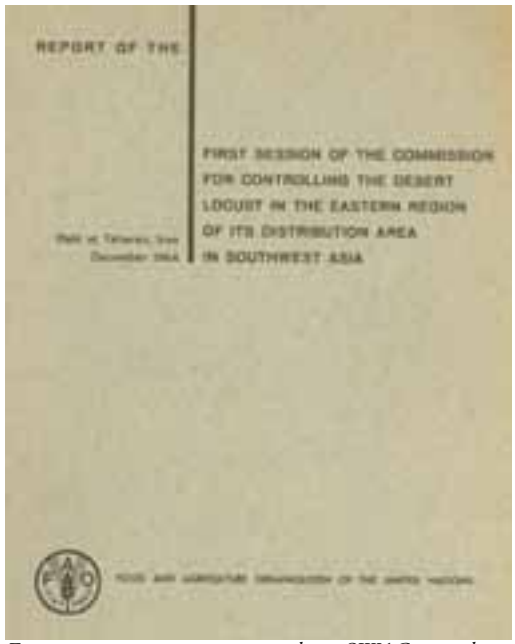
The agreed draft was discussed at the eighth session of the DLCC (May, 1963) that recommended to the FAO Director-General that he take all necessary steps to establish the Commission at the earliest opportunity. The FAO Conference at its 12th session (November, 1963) approved the text of the Agreement and authorised its submission to Member Nations for acceptance. The Governments of Afghanistan, India and Iran deposited the instruments of acceptance of the Agreement with FAO. That of Pakistan was deposited later.

The first FAO Desert Locust Commission was born!

FAO established a regional locust secretariat at Tehran and Mr. S.M. Taqi Ahsan was appointed as FAO Regional Locust Officer and commenced his duties in Tehran in July 1964. Mr. S.S. Pruthi was also appointed as FAO Locust Officer to Afghanistan based in Kabul.

The inaugural meeting of the new commission, which was officially known as the "Commission for Controlling the Desert Locust in the Eastern Region of its Distribution in South-West Asia", was held in Tehran in December 1964. It was attended by delegations from Afghanistan, India, Iran and Pakistan, by FAO staff who provided the Secretariat, and by observers from the United States of America.

The first session of the Commission discussed a number of crucial issues. It agreed that the seat of the Commission should be Tehran. It was also agreed to establish a Trust Fund for the Commission to be paid for by contributions from member countries, with an initial budget of USD 71 450. The lion's share of the budget was met by India and Iran. The United States of America expressed its pleasure at the establishment of the Commission and agreed to provide some assistance. The session established an Executive Committee with the role of planning and coordinating a research programme involving the national research stations. It would meet immediately before the main session. Finally the session agreed on a Programme of Work and Budget for the forthcoming year and agreed to meet next in Rawalpindi, Pakistan.



Four countries were accepted as SWAC members: Afghanistan (14 July 1964), Iran (19 November 1964), India (15 December 1964), and Pakistan (12 July 1965)

The second session of the Commission was again held in Tehran in 1966 after Pakistan withdrew its offer to host the meeting. The meeting routinely reviewed the Desert Locust situation in the region and heard the report of the Executive Committee. One event of interest did occur. The observer at the session from the United States of America complimented the Commission "for the manner in which it has assumed direction of desert locust activities". The Commission had quite correctly taken over some of the functions that had been previously carried out by the American "Regional Insect Control Project" (RICP). The United States of America announced that it had decided to close RICP and to provide assistance for locust control through FAO. The second session was also notable for the detailed appendix that listed all the equipment and pesticides available in each country.

The third session was held in Delhi (1967) and the fourth in Kabul (1968). At the fourth, it was noted that contributions from Iran and Pakistan to the Commission Trust Fund had not been received. The problem of late, or failure to make, payments to the Trust Fund surfaced early. It has continued to this day, although in the last few years member countries have been

The fifth session of the Commission was held in Karachi on 10-13 March 1969 and chaired by Heshamul Huque from Pakistan

making significant efforts to pay off their accumulated arrears. FAO also announced that there was no provision for the post of Locust Officer in Afghanistan beyond July 1968 as it was felt that sufficient progress had been made to develop an Anti-Locust Service there. The Commission disagreed and recommended that the post be continued for a further two years to give Afghanistan time to consolidate its Service, but FAO was unmoved. In December 1964, Mr. Pruthi replaced Mr. Taqi Ahsan as Regional Locust Officer / Secretary to the Commission in Tehran who was transferred to Somalia. At the fifth session (1969), mention is made of the loan of four aircraft by Iran to Pakistan in autumn 1968 for three weeks of survey and control operations, a striking example of international cooperation under the auspices of the Commission.

The sixth session of the Commission (1970), together with the seventh (1971), eighth (1972) and ninth (1973), seem to have passed off smoothly except that the latter was held in Rome for the first time, not in one of the member countries. At this meeting, it was also mentioned that the unpaid arrears to the Trust Fund had now reached USD 74 731 thereby being larger than the annual budget. Resolutions were passed undertaking to rectify this situation. The meeting report describes a joint survey of southwest Iran and western Pakistan with the teams working together. It also mentions a joint Indo-Afghanistan survey of southwest Afghanistan. The Iran/Pakistan survey

became a regular feature of collaboration. The year 1973 was noteworthy for the establishment of a FAO/Denmark Development Cooperation (DANIDA) project on the use of organochlorine pesticides and the effect of these on wildlife and the environment. The project carried out field work in locust areas within India and continued until 1978.

The seventh session of the Commission, held in New Delhi on 15-18 February 1971, was chaired by S.N. Banerjee from India and assisted by the Commission Secretary, S.S. Pruthi

The tenth session (1974) was also held in Rome. At this meeting it was agreed that the Executive Committee (EC) need only be convened when the Desert Locust situation particularly demanded it. This agreement seems to have sounded the death knell of the EC, which was not convened again until 1995. As a result, all the substantive technical issues were discussed in the main session. Another matter was expressed in the recommendations: that the post of Regional Locust Officer, still held by S.S. Pruthi, was vital to the smooth functioning of the Commission and that the post should be continued. This suggests that FAO must have hinted that the post might not be continued.

The 11th, 12th and 13th Sessions in 1975, 1977 and 1978 respectively continued as normal, their venue rotating between the member countries each time. It was mentioned that in addition to the joint surveys between Iran and Pakistan, and between Afghanistan and India, regular meetings between officials to discuss the locust situation were held from 1977 at the India/Pakistan border.

©FAO

The 11th session of the Commission was held in Karachi on 8-12 December 1975

It was also noted that the arrears owed to the Trust Fund had increased by 1978 to USD 93 436, i.e. substantially more than the annual Trust Fund contributions of USD 71 450. Up to 1978, Mr. Pruthi was still in situ as Regional Locust Officer / Secretary to the Commission in Tehran, but in 1979, following the revolution in Iran, he was withdrawn to FAO headquarters in Rome on a temporary basis. At the 13th session (1978), amendments to the Commission's Establishment Agreement were approved that allowed other countries in the region to join the Commission, and countries outside of the region that are members of the United Nations could attend sessions as observers. Both the 14th (1980) and 15th (1983) sessions of the Commission were held in Rome, which was contrary to FAO's declared policy that such meetings be held in the region. Upon the retirement of Mr. Pruthi at the end of 1981, the functions of the Secretary were carried out by FAO staff, starting with George Popov for two years. In response to this situation, the session made a strong recommendation that the post of Regional Locust Officer be re-established and returned to Tehran in order to ensure the smooth running of the Commission. This plea continued to be repeated at every session that followed. At this same meeting, a discussion took place about including other species of locust such as the Moroccan Locust (*Dociostaurus maroccanus*) in the Commission's remit but it was pointed out that the Convention by which the Commission was established specified that it concerned only the Desert Locust.

At the 16th session (1985), the FAO Senior Officer acted as Technical Secretary as Mr. Stanislaw Manikowski, the FAO staff member appointed as Secretary to the Commission, could not attend the meeting. At the 17th session (1988), FAO said that financial constraints precluded the appointment of a new Secretary to the post in Tehran so Mr. Jeremy Roffey, the Senior Locust Forecasting Officer at FAO headquarters, had assumed the Commission Secretary duties in 1986. Another matter discussed at the meeting was that following the stopping of the manufacture of the locust pesticide dieldrin for environmental reasons, countries that still held stocks would be permitted to use them up. At all the recent Commission Sessions, each time a Chairperson and Vice-Chairperson of the Executive Committee (EC) had been elected. However the EC did not meet for 21 years between 1974 and 1994 inclusive. The 18th session (1991) noted that Commission activities were low in between sessions and decided that the EC should start to meet regularly again. Upon Mr. Roffey's retirement in 1993, the new Senior Officer of the Locust Group at FAO headquarters, Mr. Abderrahmane Hafraoui, took over as Commission Secretary.

In the 19th session (1994), the focus was on how to improve coordination between member countries and on the training required to be carried out by FAO for locust survey and control staff. FAO was also requested to purchase many items of equipment including vehicles using funds available from Trust

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The 19th session of the Commission was held in Tehran on 5-9 February 1994 and was chaired by Ahmad Rassipour from Iran

Funds for the region supported by donors and from the Commission's own Trust Fund. The 19th session was also notable for the inclusion in the FAO delegation of a certain Mr. Keith Cressman, Locust Information Officer. From that year, he developed a commitment for the region, which has continued to the present day.

In 1995, the Executive Committee finally convened in its ninth session after a gap of 22 years. At the 21st session of the Commission (1998), the first indications of efforts to modernise communications are noticeable with the introduction of email. Mr. Clive Elliott, FAO Senior Officer, assumed the Commission Secretary duties after Mr. Hafraoui retired at the end of 1997. At the 22nd session (2000), a photograph of the participants is included for the first time, member countries expressed concern that their region was not included in the Desert Locust component of the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) programme and requested FAO to try to identify donors that would be willing to support an extension of EMPRES to Southwest Asia. Important changes were also agreed in the Commission's Establishment Agreement. One of these changes was to shorten the name of the Commission by seven words to the "FAO Commission for Controlling the Desert Locust in South-West Asia" or SWAC. Another was the abolishing of the Commission's Executive Committee. The Secretariat was requested to submit the changes to the

SWAC sessions					
1	1964	Tehran	16	1985	New Delhi
2	1966	Tehran	17	1988	Tehran
3	1967	New Delhi	18	1991	New Delhi
4	1968	Kabul	19	1994	Tehran
5	1969	Karachi	20	1995	Islamabad
6	1970	Tehran	21	1998	New Delhi
7	1971	New Delhi	22	2000	Tehran
8	1972	Tehran	23	2002	Islamabad
9	1973	Rome	24	2005	New Delhi
10	1974	Rome	25	2006	Tehran
11	1975	Karachi	26	2008	Kabul
12	1977	New Delhi	27	2011	Islamabad
13	1978	Tehran	28	2012	New Delhi
14	1980	Rome	29	2014	Tehran
15	1983	Rome			

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The 24th session of the Commission was held in New Delhi on 10-14 January 2005 and was chaired by P.S. Chandurkar from India

FAO Council for approval. The year 2000 was also notable for a beginning being made to paying off the arrears to the Commission's Trust Fund. The arrears had by then reached USD 428 111 of which Iran owed 78 percent.

At the 23rd session (2002), the theme of modernisation was continued with recommendations that frontline countries should be provided with the eLocust system so that locust officers can record field observations electronically and with the geographic information system RAMSES to assist national locust information officers in managing and analysing survey and control data. More details of these new technologies are given in Chapter 2. The session strongly recommended, yet again, the restoration of the Secretary post for the Commission in Tehran but FAO continued to cite a lack of funds for the post. Discussions took place about the need to verify that field officers followed correct practices in their locust survey and control activities. An observer was present from the Australian Plague Locust Commission who explained how a biopesticide (*Metarhizium anisopliae*) was used successfully and routinely in his country for locust control operations in sensitive areas. It was also noted that the FAO Council had approved the proposed changed to the Establishment Agreement.

The 24th session (2005) routinely recommended a number of improvements to locust surveys by the member countries including the annual joint border survey between Iran and Pakistan. The latter survey had become a key activity of the Commission both for intercountry cooperation but also as part of an early warning system for locust outbreaks in the region. FAO

was requested to provide more technical support for eLocust and RAMSES. While the Commission continued to try to put pressure on FAO to re-establish the Secretary post, the current Chairperson (India) was asked to appoint a staff member as Hon. Secretary of the Commission whose job would be to distribute locust information and promote Commission activities. Mr. Cressman assumed the duties of Executive Secretary of the Commission from Mr. Elliott who retired in July 2006. Again the session requested FAO to extend the EMPRES programme to the region. Many of these sentiments were reiterated at the 25th session especially that FAO provide further specialised training.

At the 25th session (2006), expenditure reached an unprecedented level of USD 355 390 against a budget of USD 372 800, a delivery of about 95 percent. Of the funds spent for the Commission, nearly half derived from FAO's Regular Programme budget left over from the 2003-2005 upsurge in the Western and Central regions. The level of expenditure was also helped by Iran's continued gradual paying off of its arrears. Two other events were significant: first, Afghanistan, having participated in Commission sessions for the first time after a long period in 2005, indicated that it wished to engage fully in Commission activities, offered to host the next session in Kabul and would do its best to settle its accumulated arrears to the Trust Fund; and second, Iran opened a new National Desert Locust Station in Karaj, outside Tehran, which delegates were shown. The new centre should improve Iran's organisation of locust control campaigns and response to emergencies.

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After a 40 year gap, Afghanistan hosted the 26th session, which was held in Kabul on 15-17 December 2008

The 26th session was duly held in Kabul in 2008, the first time in 40 years. Afghanistan fulfilled its promise to pay all its accumulated arrears to the Commission's Trust Fund and was applauded by the other participants. The main emphasis of the session was training of locust staff. Each country was requested to identify two competent officers for training as Master Trainers. FAO was requested to arrange a two-week course for them, preferably in Chabahar, Iran and also an interregional workshop for directors and information officers. One new feature of the meeting was a presentation on how to make locust control operations safer both for the people involved and the environment.

SWAC Executive Committee meetings				
	Year	Location	Chair	Vice-Chair
1	1966	Tehran	Pakistan	India
2	1967	New Delhi	India	Pakistan
3	1968	Kabul	Afghanistan	Iran
4	1969	Karachi	Iran	Pakistan
5	1970	Tehran	Pakistan	Afghanistan
6	1971	New Delhi	India	Iran
7	1972	Tehran	Afghanistan	Pakistan
8	1973	Rome	Iran	India
9	1995	Rome	Pakistan	India
10	1995	Islamabad	Pakistan	India
11	1997	Rome	India	Iran
12	1998	New Delhi	India	Iran

At the 27th session (2011), member countries were urged to check that field officers were following the correct methodology for surveys and control, which implies that standards had been allowed to slip. It was also noted that in conditions of insecurity for the joint border survey between Iran and Pakistan, each country should carry out the survey within its territory and then meet at the border for three days to discuss the results. Members were also reminded that Master Trainers should conduct at least two training courses per year for locust staff. FAO was requested to provide the services of the Rome-based Secretary to assist with these "training-of-trainers" workshops. It was agreed to use the Commission's Trust Fund to sponsor the Chairperson and Vice-Chairperson to attend DLCC sessions, starting in 2012.

The 28th session (2012) focused on a decline in quality of the locust reports being produced by India, Iran and Pakistan and urged improvements. Much emphasis was again placed on training to be carried out by FAO. Iran was requested to select a qualified Locust Information Officer for 11 months of intensive training at the FAO Desert Locust Information Service (DLIS) in Rome. This would be followed by an officer from Pakistan and then India. FAO support for Master Trainers and training on contingency planning was also requested. Another important proposal put forward at the session was that contributions to the Commission's Trust Fund, which had remained at USD 71 450 since the first session nearly 50 years ago, should be increased by 30-50 percent. It was noted that the Western Region Locust Commission (CLCPRO) had recently increased its contribution level by 300 percent. Member countries asked the Secretariat to provide documentation in support of an increase in contributions, which delegates would take up with the relevant Ministries and would hope to report back favourably to the next session.

SWAC Executive Secretaries		
1964-1968	S.M. Taqi Ahsan	Tehran
1969-1979	S.S. Pruthi	Tehran
1979-1981	S.S. Pruthi	Rome
1982-1984	George Popov	Rome
1984-1986	Stanislaw Manikowski	Rome
1986-1993	Jeremy Roffey	Rome
1994-1997	Abderrahmane Hafraoui	Rome
1998-2005	Clive Elliott	Rome
2005-	Keith Cressman	Rome

The 28th session also noted that the 29th session was scheduled to be held in 2014 and would mark the 50th Anniversary of the founding of the Commission. Delegates requested the Secretariat to prepare a commemorative book on the history of the Commission and on the Desert Locust problem in the region over the years.

2. Current activities of SWAC

In 1964, the FAO Commission for Controlling the Desert Locust in South-West Asia was established in response to the urgent necessity of preventing losses to agriculture in certain countries caused by the Desert Locust. As per the establishment agreement, the Commission shall promote national action with respect to the control of Desert Locust in Southwest Asia, specifically to:

- plan and implement joint action for the survey and control of the Desert Locust in the region and to arrange means whereby adequate resources are available;
- assist and promote national, regional and international survey and control efforts;
- determine, in consultation with member countries, the nature and extent of assistance needed for implementing the national programme;
- assist at the request of member countries in situations that exceed that national capacity of a member country;
- maintain strategic locations of control equipment and pesticides;
- ensure all member countries are provided with the current locust situation and relevant research results;
- assist national research organizations and coordinate research in the region;
- collaborate on locust survey, control and research within the region.

Member countries are obliged: to exchange locust information regularly with countries and the FAO Desert Locust Information Service (DLIS); to carry out all possible means to prevent plagues, which includes maintaining a permanent locust information/reporting and control service, holding reserves of pesticides and equipment, encouraging and supporting training and research, implementing a common preventive control strategy, facilitating the storage of Commission equipment and pesticides, providing the Commission with any information it may request to carry out its functions effectively; and to keep the Secretary informed of action taken to fulfil the previously mentioned obligations.

The Commission helps to strengthen national capacities to carry out the aforementioned activities by supporting, for example, joint surveys and border meetings, training, workshops, contingency planning, safe locust control, new technologies, updated equipment, translation of technical material into local languages and the transmission of field data via satellite.

The Commission emphasises intraregional cooperation and collaboration by encouraging countries to work together in facing their common enemy, the Desert Locust. SWAC also works closely with the FAO Commission for Controlling the Desert Locust in the Central Region (CRC).

Iran/Pakistan joint survey

A joint survey is a special survey carried out together by two locust-affected countries to assess the current situation regarding habitat conditions and locust infestations in areas that may not be adequately covered by national surveys but are considered potentially important for Desert Locust. A joint survey is often carried out where a seasonal breeding habitat straddles both sides of a common border. There are number of relevant examples within the Desert Locust recession area such as Egypt/Sudan, Sudan/Eritrea, Yemen/Saudi Arabia and Mauritania/Morocco during the winter; Morocco/Algeria, Algeria/Libya and Iran/Pakistan during the spring; and Mali/Niger, Chad/Sudan and India/Pakistan during the summer. Often these areas may not be monitored on a regular basis owing to security concerns and sensitivity issues associated with international frontiers.

The 9th session of the FAO Desert Locust Control Committee (Rome, 1964) welcomed the proposal to establish special joint surveys in several countries, including Afghanistan, Iran and Pakistan. Under the auspices of the United Nations Special Fund Desert Locust Project, joint surveys were conducted from 1965 to 1970 in southwest Afghanistan by Indo-Afghan teams and in southern Iran and adjacent areas of southwest Pakistan by Iran-Pakistan teams. From 1971, these surveys were carried out under the aegis of SWAC and financed from its Trust Fund. The surveys were stopped in 1978.

At the 19th session of SWAC (Tehran, 1994), representatives of Iran and Pakistan recommended that the joint survey be re-established and requested the Commission to take the necessary steps to organize a joint survey in 1995. Since that time, joint surveys have been carried out on an annual basis in April. Initially, FAO provided technical assistance to reinstate

the survey and assure that it was carried out in a professional manner by well-trained staff. At times, the FAO Senior Locust Forecasting Officer would also participate in the survey to provide on-the-job training. The Commission provides funds for daily subsistence allowances and general operating expenses. Locust officers from other countries are sometimes invited to participate in a portion of the joint survey.

The joint survey is carried out for 30-35 days in April because that is the most important month for locust activity in the spring breeding areas of southeast Iran and southwest Pakistan. Each country provides one team consisting of a team leader, a locust officer and a maintenance/environmental officer. Both teams meet on the Iran/Pakistan border at Mirjaveh, Iran and

A month-long survey is undertaken jointly by a single Iran/Pakistan team in spring breeding habitats on both sides of the common border

Taftan, Pakistan. The joint team then surveys the Pakistan side for two weeks, followed by Iran for the last two weeks. At the end of the survey, the joint team prepares a single report of its findings and conclusions that is distributed to member countries and made available on the Internet. The host country provides drivers, four-wheel drive vehicles, accommodation and security. During the joint survey, the team travels up to 20 000 km and makes several hundred stops to collect ecological, rainfall and locust data. The joint survey can be gruelling as the areas are very remote with little infrastructure and the team works non-stop for a month.

Annual joint surveys are conducted in the spring breeding areas of southeast Iran and southwest Pakistan. Monthly joint border meetings are held during the summer on the Indo-Pakistan border

The Desert Locust joint survey in the spring breeding areas of Iran and Pakistan is the only joint survey that is carried out on a regular basis in the Desert Locust recession area. It is a good example of implementing a survey to assess a large remote area in a short amount of time by using standardized methods to collect and report locust and environmental data. The findings of the survey are used for planning purposes in the coming months not only in the two countries in which the survey is undertaken but also for preparing the summer campaign in India and Pakistan as well as in other neighbouring countries that could potentially be threatened by the Desert Locust. The joint survey illustrates the type of cooperation that can be achieved between locust-affected countries under the auspices of FAO, in particular SWAC. It is considered a model for other countries.

India/Pakistan joint border meeting

As it is not possible to undertake a similar joint survey along both sides of the Indo-Pakistan border during the summer, alternative mechanisms were established to ensure that both countries remained aware of the locust situation and activities in the summer breeding areas. In 1977, both countries began to meet on a regular basis at the India/Pakistan border to discuss the Desert Locust situation and ongoing field operations such as surveys and control.

From 1991 to 2003, the Commission funded special border surveys in India and Pakistan during the summer period. The locust officers in the respective country, rather than jointly as in the Iran/Pakistan joint survey, undertook the surveys. In 2002, the 23rd session of SWAC (Islamabad) reaffirmed that joint cross-border surveys were not possible and recommended that efforts should be made by India and Pakistan to re-establish the monthly border meetings during the summer locust season. Since 2004, monthly meetings have been held on a regular basis between June and October or November, paid from the national budgets of both countries as a means of sustaining this activity on a national basis.

Report of the third India/Pakistan joint border meeting (September, 2014)

The monthly meeting is organized on the Indo-Pakistan border at Zero Point, west of Barmer, Rajasthan and east of Chor, Tharparkar. Three to four officers from each country normally attend the meeting: a locust director, a locust information officer and one or two locust field officers. Each country takes turns in hosting the meeting on its respective side of the

border. Arrangements are made in advance and protocols are followed for crossing the border under the authority of the Border Security Force of India and the Pakistani Rangers. The meeting is held in the morning and lasts a few hours. Fortnightly bulletins, FAO bulletins and maps showing survey locations, locust infestations, green vegetation and rainfall in each country are exchanged and discussed. Both countries review the current situation and expected developments in the coming month, based on information provided by FAO DLIS in Rome and ongoing field operations.

The reports of each monthly meeting are available on the Internet.

Training

In order to ensure that national locust field staff are well trained to carry out survey and control operations, and to collect and transmit high quality field data, FAO has adopted a training-of-trainers (ToT) approach that is implemented in every region, consisting of nationally-designated Master Trainers who provide training to national staff. The Commission plays an important role in making sure that Master Trainers in Southwest Asia are well trained and kept up to date so that they can conduct well-structured and effective training courses in their own country for locust staff and other trainers on safe and effective survey and control, and on how to train others.

In 1991, the Commission organized a regional training workshop in Jodhpur, India that was a precursor to the ToT approach. Subsequently, FAO spent ten years in developing a Desert Locust Master Trainer Kit, consisting of a manual with detailed session plans, ready-to-use visual aids, comprehensive guidance on how to carry out effective training and equipment. The approach adopted is that of hands-on participatory learning. This method requires active involvement of trainees throughout the course and has been shown to be far more effective than training based purely on lecturing. The kit provides top-level source material and equipment for Master Trainers to train locust field staff and other National Trainers in their own country. It was distributed in 2003 to SWAC member countries. The Commission in collaboration with the FAO Commission for Controlling the Desert Locust in the Central Region (CRC) organizes interregional workshops for training Master Trainers in the Southwest Asia and the Central Regions.

Since 2008, DLIS has organized an annual interregional workshop for the nationally-designated locust information officers in each country on the latest

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The Commission organized the first regional workshop on Desert Locust survey and ULV control in Jodhpur on 2-14 December 1991, supervised by P.M. Symmons

developments in new technologies and tools such as eLocust3, RAMSESv4 GIS and remote sensing. The overall objective of each workshop is to create and sustain links between national information officers in the recession area. In this respect, the workshop is a forum for participants to share their experiences and for DLIS and participants to suggest improvements in locust reporting and early warning. It is also an opportunity for locust information officers to refresh their knowledge in using the various tools for data management and analysis. The Commission supports this activity by covering the cost of the participants from Southwest Asia.

The Commission also supports member countries in training their field staff in locust survey, reporting and control by providing funds for one or two national workshops each year that are conducted by their Master Trainer. This assistance is meant to supplement national efforts on a limited basis as member countries generally fund their own training activities. In this way, the Commission promotes a national training effort that is sustainable in each country.

Contingency planning

Effective early response to locust infestations and their management relies on having well-established and tested contingency and action plans in place in front line and invasion countries before a locust emergency or crisis develops. Delegates at the 28th session of SWAC (New Delhi, 2012) felt that

eLocust3

a systematic approach be taken in introducing and developing contingency plans in the region. Member countries drafted initial contingency plans for locust outbreaks at a subsequent regional workshop that form the basis of more detailed action plans to be developed in the near future. The Commission continues to play an important role by facilitating the preparation of contingency plans and providing feedback and advice to member countries.

New technologies

The Commission provides limited support in the investigation and adoption of new technologies such as remote sensing and the use of geographic information systems for data management and spatial analysis. From this support, several tools such as eLocust2Mapper, eLocust3 and the RAMSESv4 GIS have been developed that are commonly used by national locust information officers from West Africa to Southwest Asia. These tools have helped countries to improve the quality of their field data, which in turn has led to better monitoring and early warning.

Data transmission

Locust field officers in front line countries affected by the Desert Locust use a handheld device called eLocust2 to record field data and transmit it in real time by satellite to their national locust centre or headquarters during survey and control operations. The eLocust2 system was established in 2006 and has been upgraded in 2014 to eLocust3, which uses a rugged 10-inch tablet with a built-in camera, GPS and wireless antenna connection and includes an expanded database for recording additional field observations, references

in three languages, survey and control equipment user manuals and satellite-derived maps showing green vegetation. Simply put, the eLocust system has revolutionized early warning and early response to locust outbreaks. For the first time, information officers, forecasters and decision-makers received data from field teams in a matter of minutes. The data are used for assessing the current situation, forecasting its developments and planning survey and control operations. It is the foundation of the global early warning system operated by FAO and the basis for providing international assistance.

The cost of the eLocust data transmission by satellite and the monthly subscriptions is paid from the Trust Fund of the Commission. In this way, sustainability can be assured and there will be no service interruption. The Commission also provides users with updated training and technical support.

Safer control operations

Since the late 1980s, dangerous organochlorine pesticides such as dieldrin were replaced with safer organophosphate compounds like malathion. These insecticides are fast-acting, relatively non-persistent, but quite broad spectrum compounds. After more than a decade of research, a specific biopesticide for locust control was developed and commercialized. This biopesticide is an alternative to chemical pesticides and kills locusts with a naturally occurring fungus that causes disease in the insect. Biopesticides are ideal for areas where chemical pesticides should not be sprayed such as in national parks

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Using eLocust3 at an interregional Desert Locust information officer workshop (Morocco, 2014)

and organic farms, close to water bodies and near populated, grazing and beehive areas. Biopesticides are safer and do not harm the environment, including people, wildlife and flora. The Commission actively encourages member countries to adopt the use of biopesticides and include it as a valuable complement to existing chemical pesticides.

Equipment procurement

As the annual budget of the Commission is relatively small, a limited amount of funds is earmarked for the procurement of equipment such as laptops and other office equipment or field equipment such as sprayer spare parts. This assistance is meant to supplement national efforts and is not meant for the procurement of vehicles, sprayers or pesticides.

Local languages

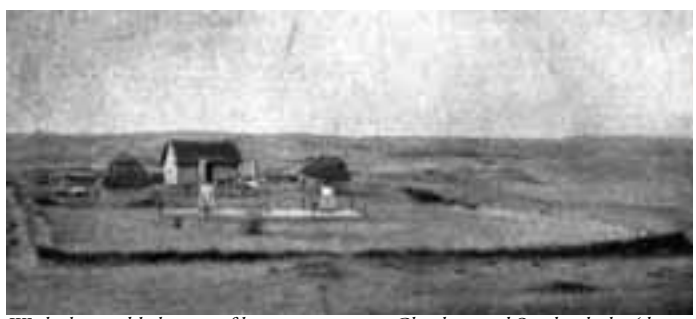
FAO produces a number of very important publications such as guidelines, standard operating procedures and training manuals but it does not have the capacity to produce these in local languages. Therefore, the Commission is supporting national efforts in translating this material into the common local languages such as Farsi, Urdu and Hindi so that the publications can be disseminated widely and reach a larger audience, including more field staff.

3. National locust control programmes

Each of the four member countries of the Commission have a well-established national locust control programme within the Ministry of Agriculture of their Government. The programme is centrally organized at the federal level in India and Pakistan while it is decentralized in Iran, involving both the federal and provincial levels. The programme in Afghanistan is also responsible for managing other locusts and grasshoppers because it is not a front line Desert Locust country.

India

During the devastating plague of 1926-1932, it became evident that there was a need to have a centralized system of monitoring and control to meet the serious locust threat. Accordingly, a Central Locust Bureau was established in 1930 that became the permanent centralized Locust Warning Organization (LWO) in 1939 with its headquarters in New Delhi and a substation in Karachi. In 1932, a research station was opened on the Mekran coast at Pasni and an outpost was established at Sonmiani in the Lasbela area west of Karachi. Several more research stations and outposts were established in the following years in Baluchistan, Sind and Rajasthan. Initially, the LWO was responsible for surveying locust habitats, issuing warnings to the States and assisting them in control operations. By 1942, a centralized control wing was added to LWO, under the supervision of Dr. Hem Singh Pruthi, the Plant Protection Advisor and Director of Locust Control. The LWO took



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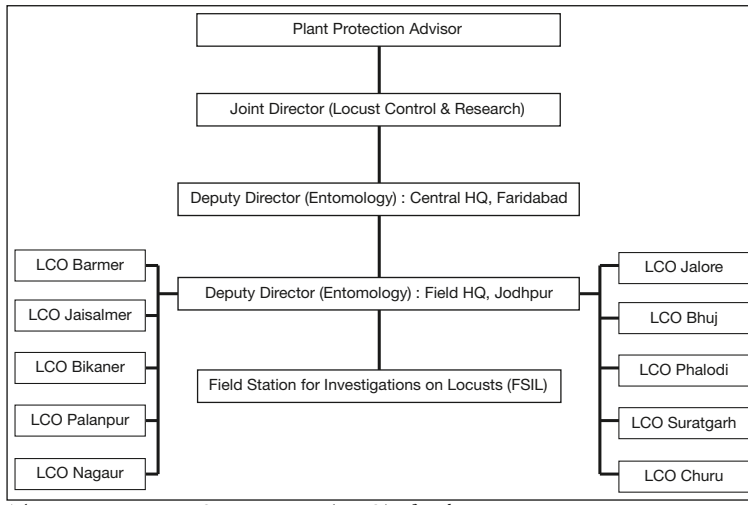
With the establishment of locust outposts at Chachro and Sardarshahr (shown here) in 1934, and later on at Nokh in 1935, regular intensive surveys were conducted up to a radius of 5 to 10 miles around each outpost

The Field Station for Investigations on Locusts (FSIL), Bikaner (circa 1970)

over responsibility from the local governments for controlling Desert Locust in the scheduled desert areas in the states of Rajasthan and Gujarat. During the 1940-1946 plague, Indian teams not only carried out substantial control in their own country but also assisted in operations in Iran and Oman. In 1946, LWO was merged with the newly established Directorate of Plant Protection, Quarantine and Storage (PPQS) in the Ministry of Agriculture, Department of Agriculture and Cooperation. The Plant Protection Adviser to the Government of India is the head of the Directorate.

A separate and specific facility was established in March 1957 in Rajasthan for conducting Desert Locust research on a sustainable basis. The Field Station for Investigations on Locusts (FSIL) was housed in a seven-room building on 2.2 ha in the outskirts of Bikaner. The station consisted of a small library, museum, well-equipped laboratories, rearing room, offices, store, garages and staff quarters. Gardens for growing plant material and a small meteorological station occupied part of the premises. The station was responsible for conducting research on various aspects of the biology, ecology and behaviour of locusts and grasshoppers, evaluating chemical and biological pesticides for locust control in the laboratory and the field, and studying new techniques of monitoring and control. It has produced more than 150 papers in various scientific research journals.

The LWO comes under the Locust Control & Research Scheme that is implemented from Directorate Headquarters at Faridabad (Haryana) under National Capital Region (NCR), Delhi that is under the Supervision of the



The Locust Warning Organization (LWO) of India

Joint Director (Ento). LWO has its field headquarters at Jodhpur, Rajasthan. LWO is responsible for monitoring and controlling the Desert Locust within a vast desert area of some 200 000 km^2 of which 87 percent is in Rajasthan and the remainder is in Gujarat and parts of Haryana state. Since its inception, dozens of LWO field staff undertake surveys every week throughout the year. The LWO has a network of wireless stations for transmitting locust information. Since 2006, field officers have been using eLocust to record survey and control observations and transmit them to the Field Headquarters in Jodhpur where data are downloaded, processed, compiled and assessed prior to on-forwarding to the Directorate Headquarters in Faridabad and FAO DLIS in Rome. Fortnightly locust situation bulletins are produced that contain a summary and forecast of the Desert Locust situation in the country.

Originally, field staff were located in 23 locust outposts under the supervision of five Circle Offices but, after restructuring during 2005-2006, the outposts and Circle Offices were merged into ten Circle Offices located in Barmer, Bikaner, Churu, Nagaur, Jaisalmer, Jalore, Phalodi and Suratgarh in Rajasthan, and Bhuj and Palanpur in the State of Gujarat. These circle offices are headed by Assistant Directors and Plant Protection Officers. At present, the total sanctioned staff strength is 255, comprising technical, mechanical and ministerial staff.

Iran

In 1934, the Department of Agriculture (Edare Falahati) was established in response to the devastating 1926-1932 Desert Locust plague that had recently ended in the country. Locals believed that plagues occurred regularly every 10-12 years and lasted for three to five years. One of the main tasks of the department was to undertake Desert Locust control. As locust activity started to pick up again, a separate Desert Locust Department was established in 1937 while the Department of Agriculture expanded into today's Ministry of Agriculture in 1941, referred to as the Ministry of Jihad-e-Agriculture since 2001. For the first two years, technical officers in the Desert Locust Department were busy controlling Desert Locust and Sunn Pest (*Eurygaster integriceps*). In 1939, the department assumed responsibilities for controlling all plant pests and later became known as the Plant Protection Organization (PPO).

In September 1945, in the midst of another devastating plague, the first conference to be organized in Iran on Desert Locust brought representatives together from India, Pakistan, Saudi Arabia, Egypt and Iran to discuss how to collaborate in reducing the large numbers of swarms and bring the plague under control. A second conference was organized to follow up activities five years later.

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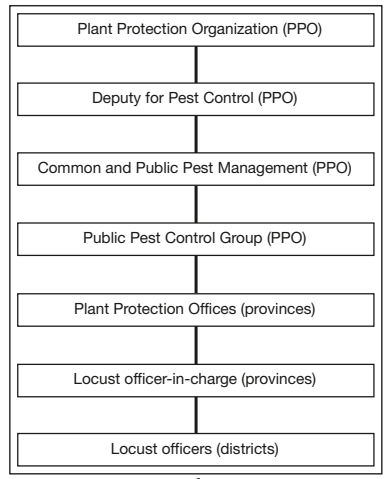
Inauguration of the National Desert Locust Station in Karaj, Iran during the 25th session of the Commission (November, 2006)



Desert Locust control in Iran

Following the short-lived 1968 plague, a Desert Locust advisory group was established in the PPO, consisting of the PPO Director and agriculture research experts who were charged with organizing survey and control campaigns during plagues. Starting in 1972, FAO organized several month-long international Desert Locust training courses to strengthen the ability of locust-affected countries to manage locusts better. A number of countries such as Pakistan, India, Turkey, Algeria, Morocco, Lebanon, Syria, Jordan and Iran participated in the first training session held in Tehran.

Today, the PPO in Tehran oversees locust activities in the country while the various provinces are responsible for survey and control operations. In May 2005, the Government established a National Desert Locust Station in Karaj, outside of Tehran. The station maintains a stockpile of vehicles, sprayers, GPS, survey and camping equipment to be used primarily during Desert Locust emergencies. As these resources are on standby, they can be deployed quickly to other parts of the country when there are Desert Locust outbreaks and invasions, for example, in 2008 and 2014. The Government continues to renew equipment once it has been used in campaigns. Two additional stations are being established for Desert Locust outbreaks in the southeast (Jiroft, South Kerman) and Moroccan Locust outbreaks in the north (Gorgan, Golestan).

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The primary function of the aerial wing of the Plant Protection Department in Karachi is locust control

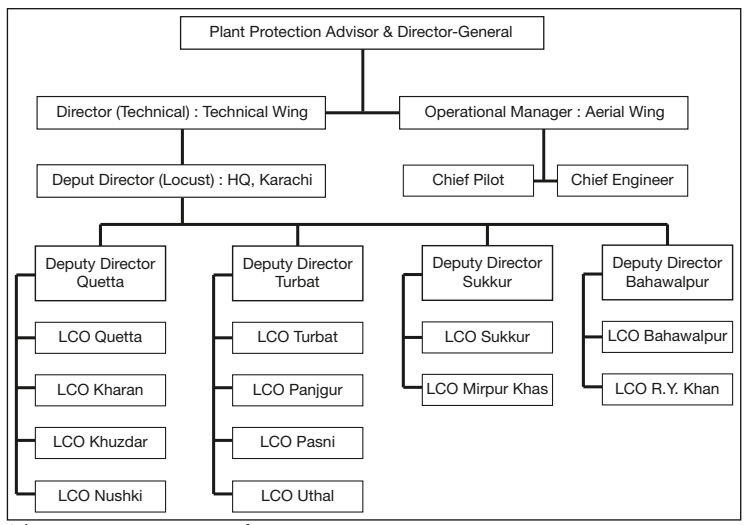
Pakistan

In 1951, the Government formed a National Locust Committee in response to a serious locust plague that was in progress at that time. Two years later, a permanent anti-locust unit, including an aerial control section, was established. The aerial unit assisted in control operations in the remote Nafud Desert of Saudi Arabia in 1955-1956, followed by control operations in Oman and Kuwait. In 1961-1962, the Government created a Shock Force that was instrumental in bringing the 1949-1963 plague to an end in the region. In the same year, today's Locust Division was formalized at the Federal level.

The centralized Locust Division is under the auspices of the Plant Protection Advisor and Director-General of the Plant Protection Department, and consists of an Aerial Wing and a Technical Wing. The Aerial Wing currently works as an emergency response agency. Although its primary function is that of locust control, it has been utilized for spraying crops and orchards at the request of provincial authorities during locust recession periods. In 1951, the Aerial Wing started with one Piper Cub aircraft. Nearly ten years later, five Beaver aircraft were added, followed by eight Cessna and seven Fletcher aircraft. This brought the total fleet to 21 aircraft. Well-equipped engineering laboratories and maintenance workshops were established in a separate hanger at the Karachi airport. Unfortunately, the fleet has dwindled during the past few decades and only three spray-worthy aircraft are presently on standby in the Karachi and Lahore hangers. The Aerial Wing also maintains six landing strips in the country.

Permanent Desert Locust outposts in Pakistan and India

The headquarters of the Technical Wing is located in Karachi where a Technical Director and Deputy Director oversee field offices in Quetta, Turbat, Sukkur and Bahawalpur, each with a Deputy Director who manages 12 permanent outposts in Quetta, Kharan, Khuzdar, Nushki, Turbat, Panjgur, Pasni, Uthal, Sukkur, Mirpurkhas, Bahawalpur and Rahimyar Khan. In all, there are some 113 technical and other staff who are responsible for



The Locust Division in Pakistan

undertaking survey and ground control operations in the spring breeding areas in Baluchistan, western Pakistan and in the summer breeding areas along the Indo-Pakistan border in Cholistan, Nara and Tharparkar deserts.

Afghanistan

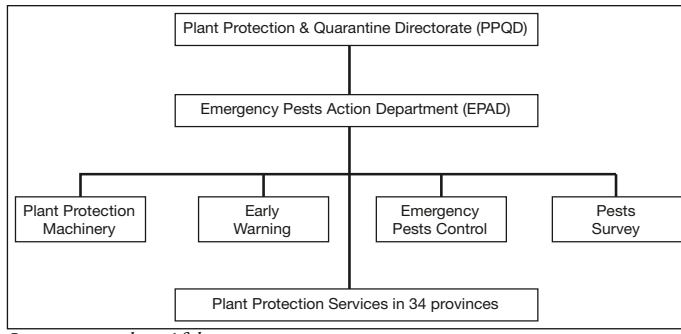
In response to a major attack by Desert Locust in 1953, the Government established the Public Department for Locust Control in the following year. The department was promoted to today's Plant Protection and Quarantine Directorate (PPQD) in 1961 after the Ministry of Agriculture, Irrigation and Livestock (MAIL) was formed. The locust control section within PPQD is responsible for several species of locusts (Moroccan, Italian and Desert Locust) as well as grasshoppers. The last significant Desert Locust invasion

©FAO

PPQD, Kabul

was at the end of the 1949-1963 plague and the Union of Soviet Socialist Republics dispatched an expedition of planes, helicopters and vehicles for combating the swarms. Since then, survey and control efforts have focussed on the other locust species in the country. Nevertheless, Desert Locust stations were set up with the help of FAO in Herat, Kandahar and at PPQD in Kabul, and equipped with communication systems and other resources to be used in case of emergencies. In this way, timely information regarding Desert Locust could be passed to the Government and neighbouring countries,

and control teams could respond to invasions quicker. Unfortunately, these stations were looted and destroyed during the civil war. Ground surveys and control operations are difficult to carry out because of safety concerns in locust habitats.



Locust control in Afghanistan

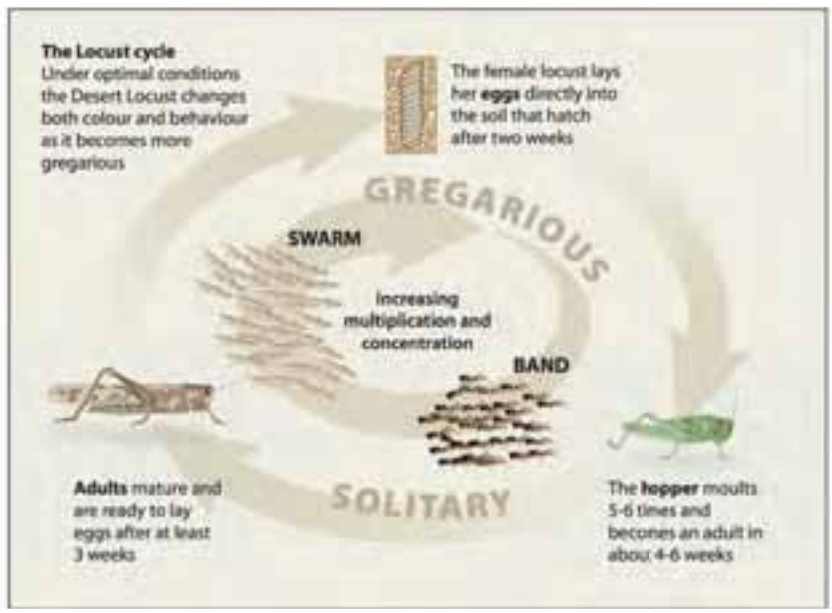
Since 2009, SWAC has been assisting the country in rebuilding a basic capacity for responding to Desert Locust invasions through staff training and the development of a national contingency plan. Iranian locust experts have provided some of this training to their colleagues in Afghanistan. Since 2011, the country has been participating in an interregional multifunded FAO programme to improve national and regional locust management in Caucasus and Central Asia.

4. The Desert Locust

The Desert Locust is considered to be the most dangerous of the 20 or so species of locusts that inhabit the earth. Locusts are a special type of grasshopper that can change their behaviour and appearance, switching from a solitary lifestyle as camouflaged individuals in the desert to forming dense gregarious groups of brightly coloured hoppers and adults.

Lifecycle

A Desert Locust typically lives for about three months when temperatures are warm, roughly 25-40°C, and there is good rainfall, usually about 25 mm in a month. When temperatures are lower or conditions are less favourable, locusts can live up to six months, for example during the winter and early spring in western Pakistan, as it takes them longer to mature. The female will only lay eggs in moist sandy soil usually 5-10 cm below the surface. She first probes the soil to make sure it is suitable. The eggs are laid in batches called egg pods. The eggs are the size of rice grains and are arranged in the pod like a miniature hand of bananas. The pod is usually about 3-4 cm in

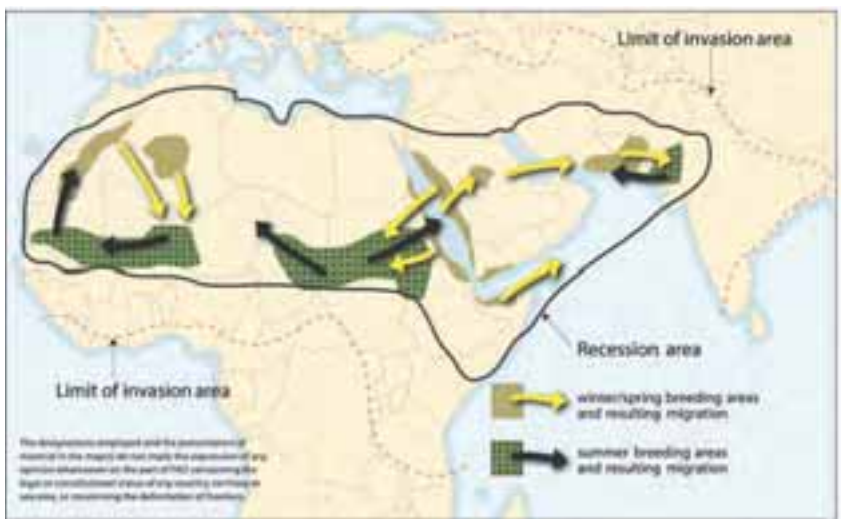


length. Solitarious females typically lay about 90-160 eggs in a pod while a gregarious female will lay only about 80 eggs. Gregarious females from swarms will usually lay egg pods in dense groups, up to 500 per square metre. Females can lay up to three egg pods in their lifetime. The time in between laying each pod is about ten days.

The eggs hatch after about two weeks and the young wingless nymphs (hoppers) develop for the next six to eight weeks through a series of 5-6 moults, each time shedding their skins and increasing in size. During the final moult (fledging), the hopper becomes an adult with wings. Not all eggs hatch and not all hoppers reach adulthood because of natural mortality. Under normal conditions, one gregarious female can produce up to 16-20 viable locusts in a single generation. In other words, the number of locusts can increase about 400 times in six months after two generations of breeding.

Migration

Once hoppers fledge into adults, they cannot fly immediately as the wings and body need a few days to harden. During this time, the fledgling will make very short test flights of several metres or more. Under optimal conditions, it takes at least three weeks before the immature adult is mature and ready to lay eggs. Immature adults are considered to be the most dangerous stage because they can consume large quantities of vegetation and can fly long distances.



Desert Locust adults are not strong fliers. They become airborne easily enough and can stay airborne for hours but cannot fly against the wind. As a result they always fly downwind. Individual solitarious adults fly during the early evening hours and may fly up to several hours per night whereas swarms fly during the day from shortly after sunrise to shortly before sunset. In this way, swarms can cover a much greater distance, usually some 100-150 km in a day. They can fly as high as about 2 000 m above the ground on warm days and will fly nearly continuously when over the sea. Immature adults usually migrate further than mature adults because they tend to fly at a substantially higher altitude.

Desert Locust swarm

In the past, spectacular migrations have occurred during upsurge and plague periods. For example, immature swarms crossed the Atlantic Ocean from West Africa to the Caribbean in October 1988, covering a distance of 5 000 km in ten days. Swarms migrated from West Africa to the British Isles in 1955. Crossing the Red Sea from northeast Africa to the Arabian Peninsula or vice versa, the Arabian Sea from the Horn of Africa to the Indo-Pakistan border, the Gulf of Aden from Yemen to Kenya, northern Africa from Sudan to Morocco and the Sahel from Guinea to Ethiopia, all occur from time to time.

Gregarization

For centuries, it was thought the Desert Locust was actually two different species. In 1921, Dr. Boris Uvarov, a Russian entomologist, discovered that it was actually a single species that has two different phases: solitarious

©FAO

Solitarious (L) and gregarious (R) adults copulating

and gregarious with *transiens* phases in between. In most years, locusts are normally found in low densities as solitarious individuals. As locust numbers increase in response to suitable environmental conditions or successful reproduction, they concentrate together, form groups and become gregarious. This often occurs at the end of a breeding season when vegetation dries out and the locusts are forced to concentrate in those few areas that remain green. Convergent winds can also help to concentrate adults. As locusts become concentrated, they come into increasing contact with each other and this triggers a hormonal response that encourages gregarization. Their colour changes from green in solitarious hoppers to black and then black and yellow in gregarious hoppers. Solitarious adults are a dusty brown or light gray while immature gregarious adults are pink and mature gregarious adults are yellow. Once locusts become gregarious, each individual locust behaves as part of a group, marching and flying in the same direction, and their maturation becomes synchronized. The process of gregarization may take several generations of breeding before solitarious locusts are considered to be fully gregarious. This is also true for reversion to the solitarious state.

©Texas A&M

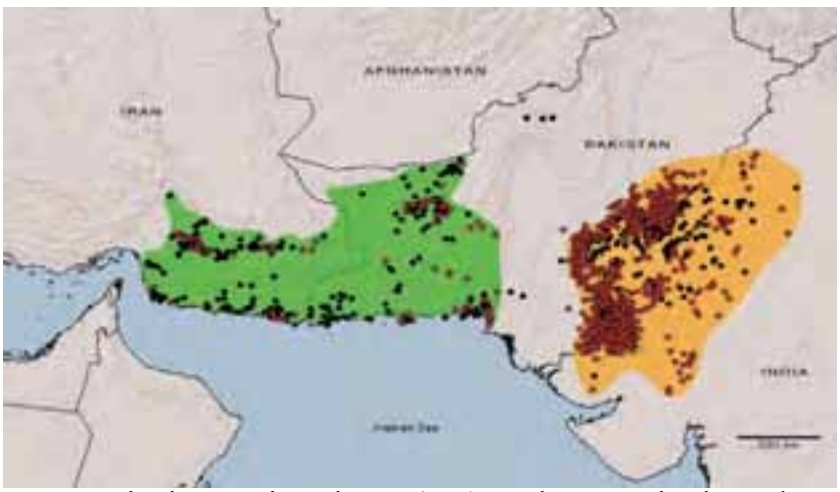
Solitarious (L) and gregarious (R) hoppers

Behaviour

The daily behaviour of a locust is influenced by its surrounding habitat. Just after sunrise during the early morning hours, locusts will face the sun and bask in it. Once a hopper has warmed up, it will march on bare soil or climb into the vegetation where it will remain during most of the day until late afternoon when it once again returns to the ground to bask. Near dusk, it will return to the vegetation where it spends the night. After morning basking, solitarious adults usually return to the vegetation for the day. On the other hand, gregarious adults form swarms that take off a few hours after sunrise and continue flying until just before sunset when they land and feed. Sometimes under extremely hot conditions, swarms may settle at midday before flying again in the afternoon.

Desert Locust in SWAC

Southwest Asia represents the eastern extent of Desert Locust distribution which stretches from Mauritania in the west to India in the east and encompasses the deserts of North Africa, the Near East and Southwest Asia. In Southwest Asia, Desert Locust can be found in a vast area that lies between 20-40N/44-90E. This area contains high mountains and plateaus separated by desert basins and arid/semi-arid plateaus and lowlands. The



Desert Locust breeding occurs during the spring (green) in southeast Iran and southwest Pakistan, and during the summer (orange) along both sides of the Indo-Pakistan border where solitary hoppers (black) and hopper bands (red) are often reported

climate in the western portion is a modified Mediterranean type while the eastern part is influenced by the southwest monsoon. Within this area, Desert Locust can breed and migrate. There are two main Desert Locust breeding areas and periods in Southwest Asia. Every year, locusts are normally present in southeast Iran and southwest Pakistan during the spring and along the Indo-Pakistan border during the summer. In the past, there have been rare occasions in which swarms invaded Afghanistan, Nepal, Bangladesh and Central Asia during plagues.

Spring breeding

The spring breeding area stretches from southwest Iran to southwest Pakistan (25-36N/45-67E). This area is characterized by rugged mountain ranges that surround a central plateau. Within this area, the coastal plains and inland valleys are the most important places for breeding during the spring.

In northern Iran, the Alborz Mountains extend from Azerbaijan and Armenia in the northwest, along the southern end of the Caspian Sea, to Turkmenistan and Afghanistan in the east. The high and narrow mountains

The topography of Iran is characterized by mountain ranges surrounding a central plateau

separate the Iranian plateau from the Caspian Sea, varying from 60 to 130 km in width with elevations up to nearly 5 700 m. In southwest Iran, the Zagros Mountains form the largest mountain range with elevations of more than 4 400 m. The mountains are divided into many parallel subranges that are aligned northwest to southeast and vary in width from 10 to 250 km. They stretch from Turkey and Iraq in the northwest and west, and span the entire length of the western and southwestern Iranian plateau until the Strait of Hormuz in the southeast. The Iranian plateau located between these two mountain ranges, extends for about 2 000 km and has an average elevation of about 900 m. It contains two salt deserts, the Dasht-e Kavir (Great Salt Desert) in the north and the Dasht-e Lut (Emptiness Desert) in the southeast. Dasht-e Kavir, about 900 m ASL, is nearly 800 km long and 320 km wide with a total surface area of about 77 600 km^2. It consists of large salt pans interspersed with marshes. Temperatures can reach 50°C in the summer. Rain usually falls in the winter. Dasht-e Lut, about 350 m ASL, is 480 km long and 320 km wide with an area of about 51 800 km^2. The eastern part is a low plateau covered with salt flats while the centre consists of parallel ridges and the southeast has vast expanses of sand (ergs). Dasht-e Lut is considered to be one of the world's hottest and driest places because the mountain ranges are too high for rain clouds to reach this region. The land surface has been measured at temperatures as high as 70°C while air temperatures are cooler. Rains occasionally fall during the spring when water briefly flows down from the Kerman Mountains but soon dries up. Except for a few scattered oases, both deserts are uninhabited.

Locusts may be found in the above areas during plagues but, in recession periods, locust presence and breeding are generally limited to a much smaller area of southeast Iran and southwest Pakistan. This area consists of the coastal plains and adjacent interior areas of the Mekran, stretching from the Strait of Hormuz in the west nearly to Karachi in the east, and from the Arabian Sea in the south to the Afghanistan border in the north (2500-2930N/5700-6700E). Breeding rarely occurs in the inland basins (Dasht-i-Margo) and salt pans (Hamun-i-Helmand) of the Khash and Registan deserts in southern Afghanistan.

In southeast Iran, narrow coastal plains stretch along the Persian Gulf from Bandar Abbas to the Strait of Hormuz between Minab and Jask, and along the Gulf of Oman from Jask to Zaribad, Chabahar and the Pakistani border at Gwatar Bay. The plains are up to 30 km wide near Zaribad where there are low sand dunes up to 80 km wide along the Dashtiari (Bahu Kalat)

River near the Pakistan border. Upstream and inland to the northeast of Chabahar are the Vashnum Plains. The Bashagerd Mountains of the Mekran are aligned north-south along the coast from Bandar Abbas to Jask where sand dunes are prevalent, then become west-east along the Gulf of Oman coast. Three primary wadis flow from the mountains onto the coast between Zaribad and Jask. The Bashagerd separates the coastal plains from the Jaz Murian Basin (Hamun-i Jaz Murian), a sandy inland depression more than 400 km long and about 150 km wide with a seasonal lake (hamun) in the centre, surrounded by mountain ranges exceeding 2 000 m. Two principal seasonal rivers flow into the basin, the Bampur River from the east and the Halil Rud from the west. In wetter years, smaller wadis drain into the basin from the north and south. The barren salt pan in the centre is about 300 m ASL at its lowest point. There are three main valleys east of Jaz Murian that are aligned northwest-southeast and separated by rocky barren treeless inner ranges of the Mekran: Zaboli, Suran and Saravan. The average elevation of the valleys is at least 1 000 m. The area to the north between Khash and Zahedan is mainly an elevated mountainous and rocky plateau with a few small arid plains and valleys, and dominated by the volcanic cone of Kuh-i-Taftan (3 941 m). Large, dry and barren high plains open up near Mirjaveh and the Pakistan border, continuing east in Pakistan across northern Baluchistan.

The spring breeding areas of southeast Iran and southwest Pakistan are characterized by coastal plains and inland basins separated by mountain ranges

In southwest Pakistan, the topography is similar to and continuous with that in adjacent areas of Iran. The Iranian and Pakistan Mekran form a single geographical area extending from the Strait of Hormuz in the west to the Indus Valley in the east. In Pakistan, the narrow coastal plains are backed by the dry and barren coastal and central ranges of the Mekran, consisting of several parallel ridges aligned west to east and terminating in the eastern end at the Kirthar range of the north-south oriented Suleiman Mountains. In between the parallel ranges, there is a succession of long valleys and basins that rise in elevation progressively from south to north: Turbat, Rakhshan and Kharan. Water flows in these valleys before finding a breach through the Mekran ranges to reach the coast. In the Turbat Valley, water drains from the east in the Kech and from the west in the Nihing, meeting at Turbat to flow southwest through the Dasht Valley to the sea. The central Mekran ranges are separated from the coastal range by the wide Dasht Valley, which in its lower reaches broadens onto the Dashtiari plains on both sides of the Iran/Pakistan border. A smaller wadi, Shadi Kaur, breaches the coastal Mekran range near Pasni while the larger Hingol River reaches the sea east of Ormara. Kulanch Valley, a subcoastal valley less than 8 km wide, is located about 35 km inland northwest of Pasni and runs roughly west to east for about 50 km. On the coast sand dunes are prominent near Gwadar, Pasni and in the east near Lasbela and the Porali River. The Rakhshan Valley, where Panjgur is located, continues west where it meets the Saravan, Suran and Zaboli valleys in Iran. Water north of the Rakhshan Valley and the central Mekran range flows northwards into a series of landlocked basins of various sizes. The largest of these, Kharan Basin (or Great Sandy Desert), extends from the Iran border in the west to Kharan in the east, consisting of the barren salt pan Hamun-i-Mashkel and shifting sand dunes. The altitudes of the basin slope from about 1 000 m in the north to 250 m in the south. The Siahan Range that separates Kharan Basin to the south from the Rakhshan Valley is 175 km long with elevations up to 2 000 m while the Ras Koh Mountains with elevations up to 3 000 m separate the basin in the northeast from the Nushki plains. A vast barren plain of sand and gravel stretches north of the basin from Iran in the west to Nushki in the east, bounded in the north by the Chagai Hills, about 95 km wide, that run along the Afghanistan border for about 175 km with elevations to 3 000 m.

In the spring breeding areas, locust habitats belong to two geographically distinct areas, the coast and the valleys of the interior. Breeding corresponds with the seasonal rains that usually fall from about February to May owing to

eastward-moving disturbances. The prevailing winds are from the northwest. The Mekran coast receives less than 125 mm of rain a year. In the inland valleys of southeast Iran, melting snow from the surrounding mountains can water the plains and basins. Prior to February, temperatures are generally too cold and after May, ecological conditions dry out rapidly in the high temperatures and absence of rains.

Breeding usually commences in coastal Mekran where temperatures become warmer about two months earlier than interior areas. In most years, locust adults first appear in coastal areas in about February and lay eggs shortly thereafter that usually hatch in April or May. From about April onwards, an increasing number of locust adults appear in the interior valleys and lay eggs that hatch in May or June. Fledging usually comes to an end on the coast in May or June, and in July in the interior where sometimes it may continue into August. During average years of rainfall and temperature, there is normally only sufficient time for one generation of breeding to occur in the spring breeding areas. In most years, the spring breeding areas become clear of locusts by July and it is rare to find infestations from August to January.

In Afghanistan, breeding does not generally occur during recessions. However, if swarms arrive from adjacent areas of Baluchistan in Iran and Pakistan and lay eggs, the first hopper bands are likely to appear in April or May, and fledging usually ends in June or July.

Occasionally, adults and swarms arriving from summer breeding areas may overwinter in Baluchistan or mature and lay eggs from December or January on the coast and from about February or March in the interior. Hatching and band formation can start in February in coastal areas and in March or April in the interior.

Summer breeding

Summer breeding in the region occurs on the desert plains along both sides of the Indo-Pakistan border. This area encompasses the Thar Desert, some 200 000 km^2 of arid plains and sand dunes that extend from the Indus River in the west (Pakistan) to the Aravalli Range in the east (India), and from the Rann of Kutch in the south to the Sutlej River and the Punjab Plain in the north (24-30N/69-75E). There are a number of small salt water lakes or ponds that are formed by rainwater percolating down the sand and held by impervious clay that lies under the sand, or in areas where the water table

Summer breeding occurs on the Thar Desert plains on both sides of the Indo-Pakistan border

is high. The Indira Gandhi Canal (Rajasthan Canal) is the major irrigation scheme of the desert. The summer breeding area also includes the Lasbela area west of Karachi.

In Pakistan, the Thar Desert is variously known as the Tharparkar Desert in the southeast, Cholistan Desert in the north and the Nara Desert in between. In India, it may be referred to as the Great Indian Desert or as the Rajasthan Desert.

The Tharparkar Desert is located in Sindh with an area of 22 000 km^2. It is the only fertile desert in the world, consisting of sandy plains and low dunes up to about 50 m in height. There is a noticeably sharp delineation between the irrigated Indus Valley and the desert. There are no fresh water sources in the desert but there are two perennial springs, Anchlesar and Sardhro, as well as seasonal wadis, Bhatuynai and Gordhro that flow during the monsoon season. There are low hills up to 300 m ASL on the southern edge bordering the Rann of Kutch. Usually less than 180 mm of rain falls every year, generally between mid-June and September.

The Nara Desert is located in Sindh, lying between 26-28N/68-70E with an area of about 23 000 km^2, and comprising the districts of Sanghar, Khairpur

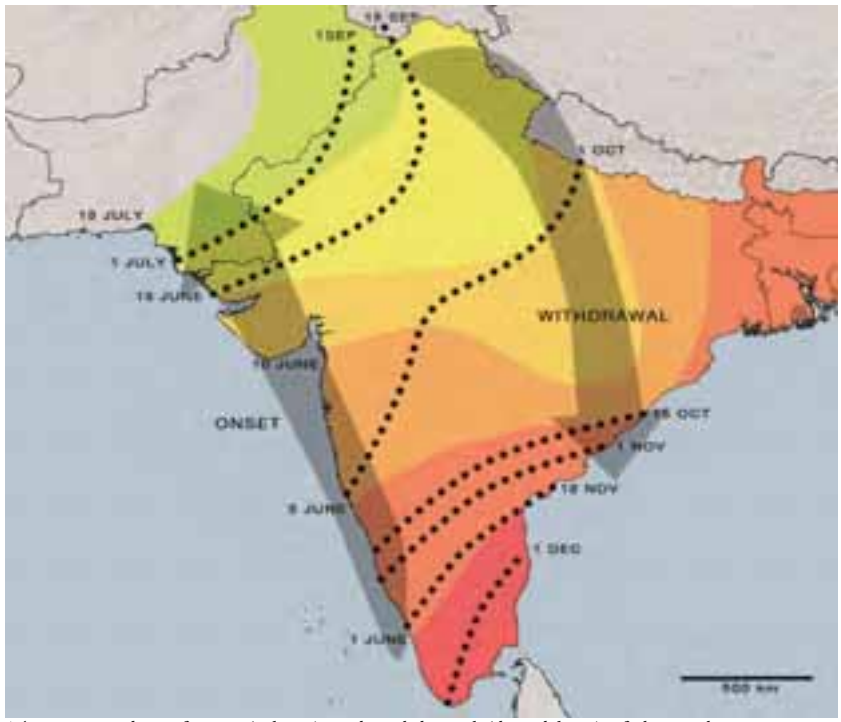
and Sukkur. Altitude ranges from 50 to 155 m ASL. The topography is marked by sandy hills and dunes, vast low-lying areas (Patt) and small brackish lakes. The mean annual rainfall varies from 100 to 250 mm per year, mainly falling from mid-July to the end of August.

The Cholistan Desert covers an area of 26 300 km^2 in the northern portion of the summer breeding area near Bahawalpur. It is bounded by the Indus River in the west, the Sutlej River in the north, the India border in the east and the Nara Desert in the south. It is characterized by sand dunes up to 150 m in height and sandy plains. The mean annual rainfall varies from 75 to 250 mm usually falling during the monsoon from July to September, which allows desert grazing for 4-8 months from July to February.

The Rajasthan Desert lies between the Aravalli Range in the east and the Pakistan border in the west. The Luni River is 495 km long and drains the western slopes of the Aravalli, emptying into the Rann of Kutch wetlands in the southwest. The Indira Gandhi Canal is 649 km long, starting just below the Sutlej River in Punjab State and runs parallel to the Pakistan border, terminating near Jaisalmer. Extensive irrigation and agricultural activities associated with the canal are causing changes to the environment that may affect Desert Locust by creating new areas for survival and reproduction. Rainfall declines from northeast to southwest. The mean annual rainfall varies from less than 100-300 mm usually falling during the monsoon from late June to September.

The Rann of Kutch is a salt marsh located in the western tip of Gujarat covering an area of about 25 000 km^2, divided into two parts: the Great Rann of Kutch and the Little Rann of Kutch. It is periodically flooded.

During the summer, locusts are present nearly every year along both sides of the Indo-Pakistan border as these areas receive seasonal rains associated with the southwest monsoon that arrives in Gujarat, followed by Rajasthan and Pakistan. Convection in the moist monsoon winds from the Arabian Sea associated with monsoon depressions moving westwards over north or central India bring heavy rains and are the main source of rain in the desert areas. In normal years, monsoon rains commence in Gujarat by mid-June, reach Rajasthan in early July and the deserts in Pakistan by mid-July. About 2-3 months later, the rains decline and recede towards the south and southeast, usually having left Rajasthan Desert by the end of September.



The average date of onset (colours) and withdrawal (dotted lines) of the southwest monsoon over India and Pakistan

The summer is the only time of year in which rains fall along both sides of the Indo-Pakistan border. It may not necessarily rain every day and there can be dry spells or monsoon breaks that may last up to three weeks. Nevertheless, when it does rain, it can be heavy and torrential, causing local flooding in some areas. The frequency and persistence of monsoon depressions and breaks determine the duration and amount of rain in a given monsoon season. During the summer, the Inter-Tropical Convergence Zone (ITCZ) lies along the southern side of the Himalaya Mountains and a weak low pressure system is present over western Pakistan until about October when it fades away.

Normally, only one generation of breeding occurs along both sides of the Indo-Pakistan border during the summer with laying in July and August, and hatching from July to September. Fledgling usually starts in September and can continue in October. If the monsoon rains commence, for example, two weeks earlier and continue into October, then there can be sufficient time for two generations of breeding to take place between June and November.

In this case, second-generation hoppers can appear in the second half of September or in October and fledge from late October to early December. Two generations of breeding can lead to a rapid increase in locust numbers and swarm formation.

Since 2005, there has been an increased frequency of pre-monsoon rains falling in parts of the Indo-Pakistan border area during April and May. If sufficient pre-monsoon rains fall, ecological conditions can become favourable for breeding some two months earlier than normal that would also allow two generations of summer breeding.

Autumn-winter breeding

On rare occasions, adults and swarms spread westward from summer breeding areas along the Indo-Pakistan border and breed in the interior of Baluchistan, Pakistan. Sometimes breeding can also occur on the Mekran coast in Pakistan and Iran with hoppers hatching in December or January and fledging in March.

Migration

When there is prolonged summer breeding along the Indo-Pakistan border with hatching until November, two generations of breeding can produce swarms that will move west to the spring breeding areas and sometimes continuing to the Central Region. Westward emigrations can begin in September or October while they can occasionally be delayed until November. During westward migrations, adult groups or swarms appear between September and December in the interior and along the coast of Baluchistan, Pakistan and spread to adjacent areas of southern Iran. The movements are associated with easterly and northeasterly winds and short-lived high pressure over northern Iran that can occur from October to December. Occasionally, swarms have continued to Oman (September 1961, October 1950 and 1952, November 1949 and 1952, December 1949), Qatar (October 1950) and Kuwait (October 1952) usually during periods of warm southeasterly winds that blow over the Persian Gulf ahead of eastward-moving depressions. In October-November 1952, swarms reached Yemen and crossed the Gulf of Aden to Somalia. Adults that reach coastal areas of the Mekran can mature and breed in the winter and early spring.

Desert Locust migration routes in Southwest Asia from spring-bred populations in April-June (black) and summer-bred populations in September-November (red)

In years of exceptional summer breeding, monsoon swarms may move from the source areas eastwards over northern India, spreading to eastern Rajasthan and western Uttar Pradesh (September 1952 and 1960, November 1952 and 1961, December 1950) and Madhya Pradesh (1960). The movements are associated with light westerly winds in the absence of monsoon depressions. Swarms may also move south to Gujarat and the Rann of Kutch on northeasterly and northerly winds blowing ahead of a westward-moving monsoon depression (September 1961, October 1952, November 1950) and occasionally reach Mumbai (November 1950) and Kerala (1954).

If swarms are produced from early breeding in southern Iran, then they may move west to Iraq (April 1962) or to Kuwait and southern Iraq (April-May 1951). Apart from this, there do not appear to be any recorded cases of swarms leaving the region from May to August. Instead, locusts produced during the spring from breeding in Baluchistan of Pakistan and Iran generally move east to the summer breeding areas along the Indo-Pakistan border from about May onwards. Locusts usually first appear in the summer breeding areas from May or June and continue as successive waves during July. The eastward movements to the summer breeding areas are associated with northwesterly winds blowing over the Persian Gulf, westerly or southwesterly monsoon winds, or the upper northwesterly winds blowing above the southwest monsoon.

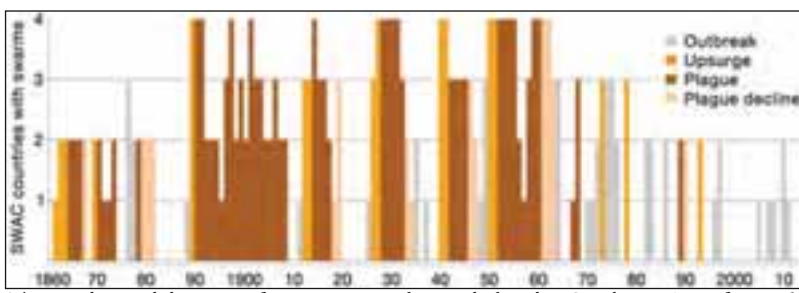
Invasions

Occasionally, swarms from the Central Region may invade Southwest Asia countries. Swarms originating from summer breeding areas of Northeast Africa and Arabia may reach southwest Iran (November 1960, December 1958 and 1967) during the autumn and move further east into Baluchistan on westerly winds in the wake of eastward-moving disturbances. During the spring, locusts originating from winter or early spring breeding in Northeast Africa and Arabia can arrive in Baluchistan from the west or southwest (March 1952, 1958 and 1959) or from Oman (April 1950). The swarms will usually breed in the coastal areas or move inland. If little rain has fallen in the spring breeding areas, then the locusts are likely to move through the area on their way to the summer breeding areas along the Indo-Pakistan border.

In late spring and early summer, locust swarms originating from breeding during the spring in the interior of the Arabian Peninsula may move east during May through southern Iran and western Pakistan to reach the Indo-Pakistan border area with the onset of the monsoon rains (May-July 1949 and 1954, June and July 1961, July 1968). Swarms can also arrive along the Indo-Pakistan border during July on the southwesterly winds associated with the monsoon from breeding areas in the Yemen interior, after moving south to the Gulf of Aden coast, and from the Horn Africa (1993, 2007).

A history of outbreaks, upsurges and plagues

In areas where good rains have fallen and green vegetation is present, locusts can increase on a local scale as a result of concentration, multiplication and gregarization. If such infestations are not controlled, hopper bands and



The number and duration of Desert Locust plagues declined in Southwest Asia after 1963. Thereafter, mainly outbreaks and a few upsurges occurred.

swarms can form and an outbreak develops. Most outbreaks occur locally within a relatively small area of some 10 000 km^2 (e.g. 200 km by 50 km). Sometimes the initial generation of breeding goes undetected. A local outbreak may not become apparent until a second generation of breeding occurs unless, for example, an outbreak develops as a result of a swarm invasion and subsequent breeding. If further rains fall, a very large increase in locust numbers and contemporaneous outbreaks can arise, followed by the production of two or more successive generations of transient-to-gregarious breeding in complimentary seasonal breeding areas. This is referred to as an upsurge. A period of one or more years of widespread and heavy infestations, the majority of which occur as bands or swarms, is called a plague. A major plague exists when two or more regions area affected simultaneously.

SWAC countries		
Outbreaks	**Upsurges**	**Plagues**
1935	1925-1926	1812-1821
1949	1940-1941	1843-1844
1956	1949-1950	1863-1867
1964	1973-1974	1869-1873
1982	1978	1876-1881
1983	1993	1889-1898
1986		1900-1907
1997		1912-1920
2005		1926-1932
2008		1940-1946
2010		1949-1963
2011		1967-1969
		1988-1989

Prior to the early twentieth century, there were a number of locust plagues in Southwest Asia, some lasting as long as a decade. Incalculable damage and destruction to crops often occurred during these periods. For example, damage caused to crops in India during the 1926-1932 plague was about 20 million rupees, equivalent to about USD 125 million today.

During plagues, locust swarms often migrate further north and east than usual, spreading into Afghanistan and throughout India to Bengal and Assam in the east and Madras in the south, and occasionally invading countries on the southern edge of the former Soviet Union as well as Nepal and Bangladesh.

Outbreaks

Historically, a number of small outbreaks have developed during the spring along the Mekran coastal plains, in subcoastal areas such as the Dasht and Kulanch valleys and in interior areas such as the Jaz Murian Basin and the Kharan Valley. Outbreaks have also occurred during the summer along both sides of the Indo-Pakistan border.

Outbreaks in Southwest Asia are more common in the summer breeding areas (orange) than in the spring (green)

A few examples of outbreaks from the 1930s to the 1980s are described while a more complete picture is provided of outbreaks from the mid 1990s onwards. It may appear that the frequency of outbreaks has increased in the latter period but this can be misleading and inaccurate. Instead, the ability to monitor rainfall and ecological conditions using remote sensing in addition to improvements in data recording, transmission, reporting and analysis using tools such as eLocust and geographic information systems have allowed FAO and locust-affected countries to detect and respond to

outbreaks earlier and more effectively than in the past. Not all outbreaks develop into upsurges and plagues. Often a combination of control efforts and a failure of rains halt the further increase and gregarization of locust populations, bringing the outbreak to an end.

1935

Good rains fell along the Mekran coast and in the interior of the spring breeding areas of Pakistan and Iran during April and May. Solitarious hoppers were present in coastal areas from March to May, and fledging occurred after the first week of April. The immature adults migrated inland, matured and laid eggs that hatched, giving rise to hopper bands in three areas between May and July.

1949

Locust densities increased in Rajasthan from 300 to 7 400 adults/km^2 between May and July. Good rains fell in late May and early June. The adults matured and laid eggs in areas of sandy dunes. The resulting hoppers were initially solitarious but moved into cultivated areas where they formed groups. Fledging began in late July and the immature adults were pink and mostly gregarious.

1956

Low numbers of solitarious adults appeared in the summer breeding areas along both sides of the Indo-Pakistan border in late June. Good rains also fell at the end of June. By mid-August, large numbers of hoppers were present in the Sri Ganganagar district of Rajasthan. Late instar hoppers were becoming gregarious and fledged into *transiens* adults. It was suggested that the parental adults had become concentrated by convergent winds in the area of rainfall and matured while the subsequent hoppers become crowded, resulting in partial phase transformation.

1964

In mid-June, a swarmlet was reported in Barmer district, Rajasthan. During July, groups of solitarious adults were present in Khipro, Pakistan. These infestations are likely to have been supplemented by a substantial influx of adults from spring breeding areas in southeast Iran and southwest Pakistan throughout July. Widespread monsoon rains in July and August allowed breeding to occur until October, causing overlapping generations and a substantial increase in locust numbers. In the Barmer area, first-generation adults that fledged in late July matured and a second generation of breeding

occurred with hatching in early September. Elsewhere, an increasing number of hopper bands was reported in September and adults that escaped control operations formed several swarms totalling some 10-20 km^2 during October. By the end of the month, swarms were moving westwards and appearing in coastal and interior areas of Baluchistan, Pakistan. Some of these locusts may have continued to Iran and Oman in November and December. There were no further reports of swarms in the region through the winter and the following spring.

1982

There were widespread winter-spring rains in southern Iran and southwest Pakistan. Extensive flooding in Iran hampered survey operations until early June when hopper groups and bands were found within about 270 km^2 near Chabahar and 20 km^2 near Iranshahr. Aerial and ground control operations treated 36 100 ha. In September, a light infestation developed on the coast west of Chabahar and 200 ha were treated. In Pakistan, some 77 000 ha were treated by ground and air in the Kharan and Gwadar areas. In August, three small swarms were treated in the Lasbela area in August and small adult concentrations were treated in Tharparkar during September.

1983

Good rains fell in the spring breeding areas of Baluchistan, Pakistan in February and April with breeding commencing in February, causing considerable numbers of adults to be produced that reached the summer breeding areas from late April onwards. Adults arriving from eastern Arabia may have supplemented this movement. Pre-monsoon rains fell in April, late May and late June. Breeding commenced in May. Widespread heavy monsoon rains fell along both sides of the Indo-Pakistan border from July to September. Solitary adult densities continued to increase, reaching more than 20 000/km^2. On 30 July, a mature swarm arrived in Lasbela and three more swarms arrived and laid in early August with hatching during the second half of the month. From late August onwards, mature swarms started to form and widespread laying occurred during September. This resulted in a third generation of breeding, giving rise to hopper bands and, from mid-October onwards, a new generation of swarms. By mid-November, intensive ground and aerial control operations had ended and no swarms were reported except for a small swarm in the UAE that may have escaped from the Indo-Pakistan area. During the campaign, India used 120 325 kg of dust and 22 625 litres of pesticide while 43 000 kg of dust and 124 000 litres of pesticide were consumed in Pakistan.

The Mekran coast of southeast Iran and southwest Pakistan

1986

Widespread and heavy rains fell in Rajasthan during the second half of July and into August. Breeding commenced in late July and became more extensive during August. Ground and aerial control operations treated hopper infestations and three small swarms for a total of 20 300 ha between August and October. Locust activity declined thereafter.

1997

At least one small mature swarm arrived in Tharparkar, Pakistan in early July that may have come from spring breeding areas in Baluchistan or perhaps from the Central Region. Several more small mature swarms and groups arrived from the west during the second half of July and locust numbers increased in Rajasthan, India. By then, heavy rains had fallen in many areas and conditions were exceptionally favourable for breeding. All the swarms laid eggs that hatched and gave rise to hundreds of small hoppers bands along the Indo-Pakistan border. During August, hopper bands were present and swarms began to form and mature rapidly in Pakistan. At the end of the month, four mature swarms arrived in Rajasthan. A second generation of breeding occurred, causing hopper bands to form in both countries in September and October. New swarms formed in early October in Pakistan. During the campaign, control operations treated 46 000 ha in Pakistan and nearly 22 000 ha in India. By November, the situation had become calm.

2005

Good monsoon rains fell along the Indo-Pakistan border during the summer. In July, solitarious adults were scattered along both sides of the border between Jodhpur and the Indus Valley. Most of the locusts were concentrated in Cholistan along a 300 km stretch of the Indian border southeast of Rahimyar Khan and Bahawalpur. Laying occurred in July, hatching and gregarization took place in August and swarms started to form in September at two places on the border about 150-210 km west of Bikaner. A second generation of breeding took place within a much more limited area of about 115 km by 70 km (8 000 km^2) that extended from the Indira Gandhi Canal to just over the border in Pakistan. Hatching and band formation occurred in October and new groups and swarms formed in mid-November. Based on survey and control data, about 1.5 percent of this area may have been infested. After mid-November, ecological conditions dried out and a few groups and swarms that were not controlled moved back and forth across the border. Some groups and small swarms also moved east towards New Delhi while others moved south, nearly reaching Jaisalmer. Although there were no reports of swarms reaching the Indus Valley in Pakistan, some adults appeared in the spring breeding areas in Baluchistan, western Pakistan in mid-December. Control operations ended in Pakistan and India in early December after treating 13 922 ha and 5 269 ha respectively.

2008

Scattered adults that had been present since the summer on the southeast coast of Iran bred on a small scale after rains fell in November 2007. A second generation occurred in early 2008 when unusually heavy rains fell over most of the spring breeding areas in southeast Iran and western Pakistan. In some places, more than five times the long-term average fell. This was compounded by the arrival of a few low-density mature swarms in southeast Iran from eastern Arabia from 20 February to early March. The swarms dispersed and laid eggs that hatched on the coast and in the interior during March and April, and hoppers formed small groups and bands. Control operations treated nearly 35 000 ha from February to June, causing locust numbers to decline by July.

2010

Scattered mature adults appeared in late June in Cholistan, Pakistan. As a result of good monsoon rains, two generations of breeding occurred between July and November, causing locust numbers suddenly to increase in early October as second-generation eggs hatched. The outbreak was confined to

The Jaz Murian Basin in the interior of southeast Iran

Ghotki district, Pakistan and Jaisalmer and Bikaner districts of Rajasthan, India. During October, hopper and adult groups, bands and swarms formed on both sides of the border. Control operations commenced in September and continued through November, treating 14 204 ha in Pakistan and 4 700 ha in India. No locusts were seen after December.

2011

Low numbers of immature and mature adults were present in a few coastal and interior areas of Baluchistan, Pakistan. During April, small-scale breeding occurred in the interior of southeast Iran and in Baluchistan, Pakistan. Groups of solitarious and *transiens* hoppers and adults as well as a few hopper bands formed in May in northern Baluchistan. During June, a small swarm appeared in southeast Iran while hoppers and adults continued to form groups in northern Baluchistan. Locust numbers had declined by early July as a result of control operations in Iran (6 703 ha) and Pakistan (8 771 ha) and because of limited movements to the summer breeding areas along the Indo-Pakistan border.

Upsurges

Southwest Asia has faced six Desert Locust upsurges between 1925 and 2014. Most of the upsurges involved both the spring and summer breeding areas while only a few affected one or the other seasonal area. Many of the upsurges developed as a result of large numbers of adults and swarms arriving into the region from the west and southwest, in other words an extension of an upsurge already in progress in the Central Region. A brief synopsis of each upsurge is presented.

1925-1926

Breeding is thought to have occurred along the Mekran coast in Pakistan during winter 1925-1926 with new adults appearing in February and March, and probably moving inland to breed in the interior. During March and April, large numbers of hoppers were seen on the coast of Pakistan. In June, significant hatching occurred and swarms were reported until July. In Iran, swarms appeared in the south where breeding is thought to have taken place during the spring. In July, swarms appeared from the west and invaded the summer breeding areas in Lasbela, Tharparkar and Rajasthan. Laying occurred during July and August, followed by hopper infestations in August and September, and swarm formation in September and October. Good monsoon rains allowed extensive laying by the last of the invading swarms and rapidly maturing local populations in September and October, causing widespread hatching in October and swarm formation in November. Although swarms spread south to the Rann of Kutch, west to Iran and northwest to Punjab and Afghanistan, a large portion of the monsoon swarms remained within the Indo-Pakistan area throughout winter 1926-1927 and a plague developed.

1940-1941

An upsurge developed in the region during the summer of 1940. In July, large numbers of *transiens* adults appeared in the summer breeding areas of India and Pakistan, probably originating from Iran and/or Arabia. Many of the adults concentrated and formed swarms upon arrival. As a result of abundant rainfall, two successive monsoon-generations were produced between July and November, giving rise to swarms that moved west into Iran and Afghanistan by the end of 1940. In 1941, breeding occurred during the spring in Iran, Pakistan and Afghanistan, causing swarms to form in May that invaded Rajasthan from mid-June and into July, resulting in widespread infestations over most of eastern Pakistan and western India. The upsurge later developed into a plague that continued until 1946 (see Plagues section). During the upsurge, India sent some of its teams to assist in control operations in Iran.

1949-1950

Adult groups and swarmlets formed in southeast Iran and southwest Pakistan in winter 1947-1948. Following good rains in March, some hopper bands formed in May but control operations prevented formation of swarms. Good rains fell in June and gregarizing hoppers developed in July and August in southwest and southern Pakistan and western Rajasthan. Again swarm

formation was prevented by control but large populations of scattered adults remained in these areas until mid-October. In 1949, spring breeding occurred from March to June during which at least one swarmlet appeared in April from the west and locust numbers and densities increased. The formation of swarms was prevented by control. From May onwards, locust numbers increased in the summer breeding areas along both sides of the Indo-Pakistan border and *transiens* adults were present in July. It appears that considerable numbers moved into the summer areas from the spring breeding areas of Pakistan and Iran as well as from Oman. The monsoon during the summer of 1949 was lengthy and allowed two generations of breeding in rapid succession, causing large numbers of swarms to form by December. Laying began in June, hoppers gregarized in July and fledging began at the end of the month, adult groups and swarms formed in early September and laid eggs, serious hopper infestations developed in October and November and fledging and swarm formation occurred in late November and December.

1973-1974

An upsurge developed in 1972 in the Arabian Peninsula and eventually spread to Southwest Asia. Locusts that were present along both sides of the Indo-Pakistan border at the beginning of summer 1973 probably originated from three different sources: (a) low numbers of adults that remained in Rajasthan and adjacent areas of Pakistan after breeding in summer 1972, (b) adults arriving in April and May 1973 from breeding that occurred along the Red Sea coastal plains between November 1972 and March 1973, and (c) adults arriving in July and August 1973 from Iran and Afghanistan where widespread low-density breeding occurred between April and July. The adults began laying after heavy rains in early July and the subsequent hoppers started to fledge in mid-August. Laying is thought to have occurred on a considerably larger scale than detected by ground surveys as immature and mature swarms were reported along the border in late September. Breeding conditions remained favourable in western Rajasthan after heavy rains in mid-August, allowing the swarms to lay eggs that hatched and caused numerous hopper bands to form from mid-October. Successive laying over two months resulted in the formation of some 3 000 hopper bands within an infested area of about 20 000 km^2. Despite intensive ground and aerial control operations, numerous swarms formed in November. The main features of this upsurge were: (a) multiple sources of initial populations, (b) very low densities of hoppers and adults reported at the early stage of the outbreak, (c) most of the first generation

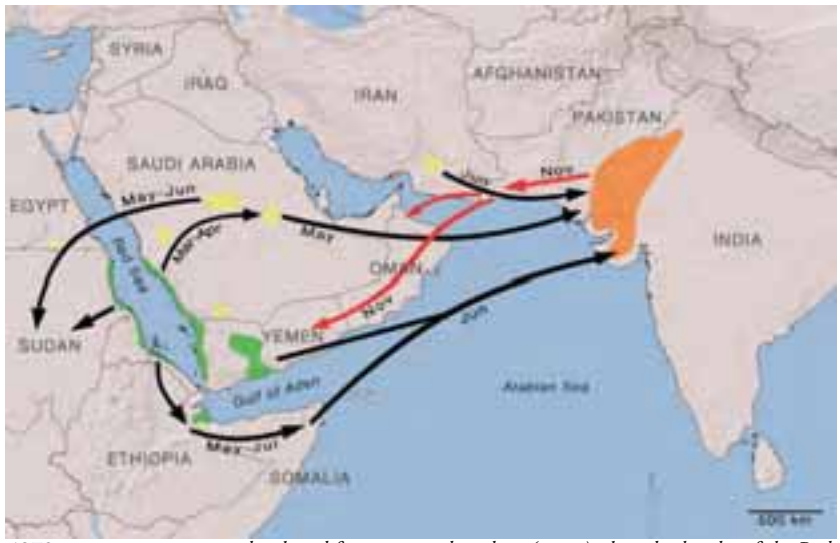
1973 upsurge: locusts arrived from May to August into Indo-Pakistan where summer breeding (orange) occurred from July to November, giving rise to hopper bands and swarms

of breeding along the Indo-Pakistan border was undetected, (d) heavy rains in mid-August allowed two months of breeding, (e) first-generation adults concentrated close to the areas that received rain in mid-August and formed groups, and (f) very successful second-generation breeding produced numerous hopper bands and swarms, some of which persisted as swarms to breed again in spring 1974.

1978

Summer breeding along both sides of the Indo-Pakistan border in 1977 was on a smaller scale than in the previous six years. An upsurge developed in the Central Region during the second half of 1977 and spread to Southwest Asia the following year. Small-scale breeding occurred in the spring breeding areas in spring 1978. Control operations were carried out against hopper and adult infestations near Jiroft, Iran. On 7-8 June, several immature swarms from the Horn of Africa invaded the region, arriving in the Rann of Kutch, India and then moving to Rajasthan, Tharparkar, Nara and Cholistan where they matured rapidly and laid eggs in areas that received good rains in mid-June. Several swarmlets from southeast Iran or perhaps Arabia appeared on the Lasbela coast in Pakistan during the third week of June and subsequently moved to the Indo-Pakistan area. The most significant breeding during summer 1978 occurred in India and Pakistan where hatching started on 25 June with fledging on 19 July. It was noted

that there were two waves of mature swarms, one in June and another in August. This was probably accounted for by rapid maturation associated with widespread and heavy rains as well as warm temperatures in July so that first-generation swarms were mature and ready to lay eggs by the second week of August. Consequently, a second generation of breeding occurred within an estimated area of 30 000 km^2 in India and 17 000 km^2 in Pakistan with hatching in the last week of August and fledging after mid-September. New swarms began to form and appear during the last week of September in both countries, many of which moved west and southwest into Pakistan.



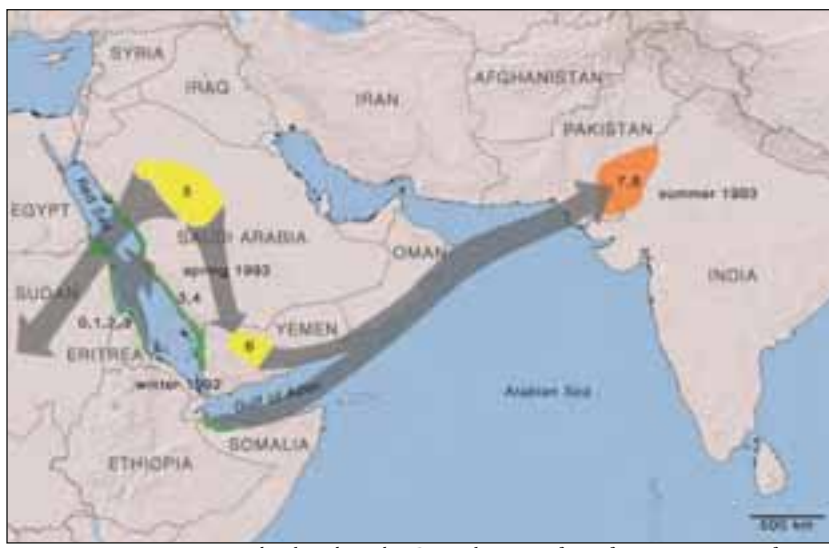
1978 upsurge: an upsurge developed from winter breeding (green) along both sides of the Red, which spread (black arrows) to spring (yellow) and summer (orange) breeding areas. Escapees from Southwest Asia returned (red arrows) to the Central Region by the end of the year. The dates indicate the month in which migration occurred.

Most of the infestations in India were concentrated in Jaisalmer and Barmer districts while those in Pakistan were in Tharparkar. By the beginning of November, the intensive control campaigns in India and Pakistan had ended. Ground and aerial control operations in India used 742 000 kg of bait and 58 000 litres of pesticide while those in Pakistan used 126 000 kg of bait and 358 000 litres of pesticide. The Pakistan campaign was the largest ever undertaken in one season in a single country. Thereafter, small groups that escaped control operations moved west along the Mekran coast and in interior valleys during November and some adults reached southeast Iran.

A small immature swarm was reported in mid-December on the Iranian coast near Bandar-e Lengheh and Chabahar. Some adults overwintered in Rajasthan and the situation returned to calm.

1993

An important Desert Locust upsurge developed in coastal areas around the Red Sea during winter 1992-1993. Winter-bred swarms moved to the interior of Saudi Arabia where one generation of breeding occurred and a portion of the resulting swarms moved south to the interior of Yemen and laid eggs. Despite control operations, numerous swarms were produced which migrated northeast across Oman, reaching Pakistan and northwest India in early July. The swarms first arrived in India on 5 July when a 10 km^2 mature swarm was seen at Sam in Jaisalmer district and in Pakistan on 11 July when mature swarms were seen in Tharparkar Desert. There was an earlier unconfirmed swarm in Tharparkar on 25 June. Although ground and aerial control operations were quickly mounted in both countries, this could not stop laying from occurring on a large scale over a wide area because of extremely favourable ecological conditions. This was further compounded by the arrival of additional swarms during July that laid eggs. In India, breeding was reported from the districts of Jalore, Barmer, Jaisalmer,



1993 upsurge: an upsurge developed in the Central Region from four generations of winter breeding (green) along both sides of the Red Sea, followed by spring breeding (yellow) in the Arabian Peninsula. Swarms from Yemen and Somalia invaded Indo-Pakistan where two generations of breeding (orange) occurred during the summer. The numbers indicate generations.

Jodhpur, Bikaner and Ganganagar in Rajasthan and in the Tharparkar, Nara and Cholistan deserts of Pakistan. Hatching commenced in Jaisalmer district on 14 July and approximately one week later in the adjacent areas of Pakistan. Hopper bands escaping control efforts in India and Pakistan formed new-generation swarms from mid August to the end of September and, in India, spread to Banaskantha district of northern Gujarat and Ajmer, Nagaur and Sikar districts of northeast Rajasthan and, to a lesser extent, to Udaipur, Chittorgarh, Pali, Churu and Jaipur districts of eastern Rajasthan and Mandasur district of Madhya Pradesh. Those swarms that were uncontrolled rapidly matured and laid in Rajasthan, mainly in Jodhpur and Bikaner districts and, to a lesser extent, in Nagaur, Sikar and Churu districts. Newly emerging hoppers were reported in those areas in late September and during October. However, this generation of breeding appears to have been on a much smaller scale than the first generation. Intensive ground and aerial control operations with assistance provided by the international donor community and FAO continued against all infestations, which eventually led to a dramatic decline in the populations to the extent that control operations ceased in early November in both countries. Thereafter, only small numbers of locusts emigrated from the summer breeding areas to the Mekran coast of southwest Pakistan and southeast Iran until early December. During the campaign, India treated 311 199 ha by air and ground operations and Pakistan treated a total of 316 979 ha.

Plagues

Southwest Asia has faced five plagues since the 1920s. Plagues prior to the 1960s were more frequent and lasted longer than those after 1960. All of the earlier plagues developed from upsurges in the region.

1926-1932

A plague occurred from an upsurge that developed in the summer of 1926. Monsoon swarms that had overwintered in Pakistan and India began to mature in February 1927. Swarms in southern Iran spread north into Turkmenistan. Laying began in February and continued to early May with hoppers fledging from late April to the end of July. Breeding occurred over a wide area from Iran and southern Afghanistan to Uttar Pradesh, India. From May onwards, spring swarms that formed in Iran, Afghanistan, Pakistan and India moved to the Indo-Pakistan summer breeding areas. In July, some swarms continued eastwards to Bihar, India. Substantial laying occurred in Cholistan, Tharparkar and Rajasthan from July to September,

giving rise to hopper infestations throughout October. Monsoon swarms began to form in September and moved west to southern Iran during October and November. By mid-December both India and Pakistan were clear of swarms. In 1930, the plague reached its peak. In the following year, the weather was exceptionally cold in Iran, which delayed spring breeding and restricted it to mainly coastal areas. Spring breeding also occurred in southern Afghanistan and was widespread in Pakistan, giving rise to numerous swarms that moved to the Indo-Pakistan summer areas where widespread breeding occurred until October. Summer-bred swarms moved west from September to November with a few remaining in Pakistan until February 1932. Drought restricted breeding during spring 1932 and only a few swarms were produced that moved to the Indo-Pakistan area and central India. Limited breeding occurred and one immature swarm was reported in November. Despite good rains in spring 1933, very little breeding occurred in coastal areas of Iran and Pakistan from March to June and no swarms were produced. During the summer, limited breeding gave rise to a few swarmlets in the Indo-Pakistan area. Thereafter, the situation remained calm and the plague had come to an end in the region. It was estimated that damage to crops alone amounted to some 2 crores of rupees (GBP 1.3 million in 1926, equivalent to USD 109 million at today's prices).

1940-1946

A plague developed and spread as a result of the upsurge in 1940. Large swarms were reported in Iran, some reaching Azerbaijan province in the northwest where schools were closed and students helped to collect and control infestations by mechanical means. The Government paid farmers and locals for collecting Desert Locust eggs. In India, aircraft were used in 1944, probably for the first time, for locating hopper bands and swarms. The plague reached its peak during the same year and began to decline in 1946. In Southwest Asia, the plague ended because the spring-generation swarms that appeared in the summer breeding areas in 1946 continued to move east to eastern Madhya Pradesh where it was unsuitable for breeding and survival. The swarms did not return and disappeared without breeding. A similar phenomenon occurred again in 1955. During the campaign, India sent specialized locust teams to assist in control operations in Iran and Arabia.

1949-1963

While some of the monsoon swarms remained in the Indo-Pakistan area where an upsurge had developed and bred during spring 1950, others migrated westwards in late 1949, invading the Central Region and reaching

Oman, Yemen and the Horn of Africa. Some of the monsoon swarms that invaded Iran bred in January 1950 along the coast, with subsequent fledging in April. The numerous spring-generation swarms that formed in Iran and Pakistan between May and July moved east to the Indo-Pakistan border and laid, causing a large number of summer-generation swarms to form in September and October. These swarms moved westwards in October to Iran and the Central Region. The plague lasted some 13 years and was the longest continuous major plague of the twentieth century. It was particularly strong in Southwest Asia between 1958 and 1962. In late 1961, swarms invaded western Afghanistan and eastern Iran. In March 1962, swarms reached Turkmenistan in southern Union of Soviet Socialist Republics, the first time since 1930. During the last three years of the plague, Iranian teams treated more than 2.5 million ha in their country. The plague declined gradually, first in the Western Region in 1960, followed by the Central Region and finally in Southwest Asia in the first half of 1963 despite widespread and protracted breeding during the previous summer in which two to three generations of breeding occurred but only relatively few swarms were produced. The introduction of a more effective method of aerial spraying of hopper populations may have contributed to this failure. Aircraft belonging to the Aerial Unit of the Directorate of Plant Protection, Quarantine and Storage in India treated nearly 200 000 ha in 1959-1963. In addition to controlling its own locusts, the Government of India sent self-contained teams with vehicles and control equipment to the Arabian Peninsula every year between 1955 and 1962.

1967-1969

A short-lived plague developed in the Central Region in 1967 as a result of a cyclone and the exceptional rainfall it produced, and spread to Southwest Asia. Swarms from southeastern Arabia invaded southwest Iran in December 1967 and January 1968 and spread to southwest Pakistan. Good rains fell in both countries during February and adults concentrated and bred on the Mekran coast in March and further inland in April. Hatching started in March and by April there were groups and bands. Fledgling began in April and adult groups and swarms formed during May and June. In July and August, swarms from the spring breeding areas as well as a few from winter breeding areas along both sides of the Red Sea reached the summer breeding areas along the Indo-Pakistan border. The swarms laid upon arrival and hatching began in late July and continued during August. The hoppers failed to survive to the adult stage mainly owing to the failure of the monsoon rains but also as a result of control operations. At the request

A plague developed in the Central Region (green) in late 1966. A portion of the swarms migrated to Southwest Asia and bred during the spring (yellow), giving rise to swarms that moved to Indo-Pakistan where summer breeding (orange) failed due to poor monsoon rains.

of Pakistan, Iran sent four aircraft to assist in survey and control operations in the spring and summer breeding areas during the campaign.

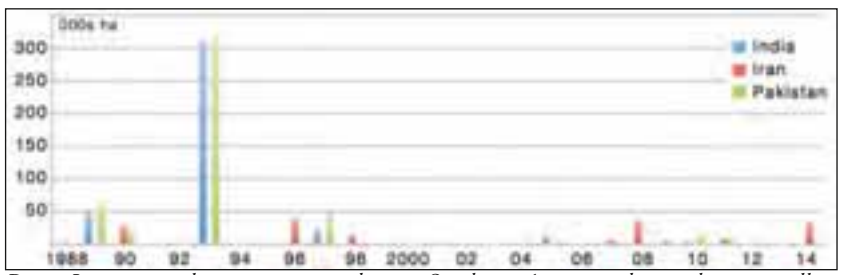
1988-1990

Compared with other regions, Southwest Asia was not significantly affected by the plague of 1987-1990. In October 1988, swarms originating in Sudan moved to Saudi Arabia and some of these continued northeast through Iraq, reaching southwest Iran in early November and Iranian teams treated 3 150 ha. The situation remained calm during spring 1989. Scattered adults first started to appear in the summer breeding areas in Cholistan, Nara and Rajasthan in July and in Tharparkar in August. In late August, swarms appeared in Cholistan and laid. The situation worsened in September as swarms moved into Tharparkar, Nara and Rajasthan and laid. Hatching occurred and hopper bands formed in late August and continued in Rajasthan until October. By early October, numerous immature swarms and high densities of adults were reported from Nara and Tharparkar. The situation improved dramatically by early November and control operations ended by mid-month in Pakistan after having sprayed 65 700 ha since August. India finished control operations by the end of November after treating a total of 49 516 ha. In Iran, solitary adults appeared on the coast near Chabahar in November. Breeding occurred in the spring breeding areas following

widespread heavy rains in February 1990, giving rise to hopper bands and groups of hoppers and adults in April. By June, numerous immature groups and swarms had formed. Control operations continued until June in Iran, treating nearly 30 000 ha, and July in Pakistan. In late July, swarm laying occurred in Tharparkar and widespread breeding was in progress in Rajasthan because of unusually heavy rains. Aerial and ground control operations were undertaken during August and September against hopper bands and immature adult groups in Tharparkar and Nara, treating 22 500 ha. Breeding continued in Rajasthan until October and limited control was undertaken against hoppers, adults and a small swarm that formed. By the end of November, the situation improved.

Control Campaigns

In the past, poison baiting was commonly used against Desert Locust in the Region from the late 1800s to World War II. In addition, farmers used traditional mechanical methods against hopper bands such as beating, burying in trenches and burning roosting locusts at night. Scaring away locusts from farms is not a solution though sometimes it was resorted to for saving valuable crops. From the 1940s onwards, persistent organochlorine pesticides such as DDT, BHC and dieldrin, later recognised as dangerous, were used extensively in Desert Locust control. Dusting was used for the first time in India in 1949 and, thereafter, poison baiting declined. Manually operated hand dusters were used to treat small populations while power-operated machines mounted on vehicles were used against larger infestations. If dusters were not available, then dust was shaken out of thin cotton cloth or jute bags. In some cases, leftover dust was collected and reused. Ground and aerial sprayers were first used in India in 1951 and, thereafter, spraying was used on an increasingly large scale. In 1962,



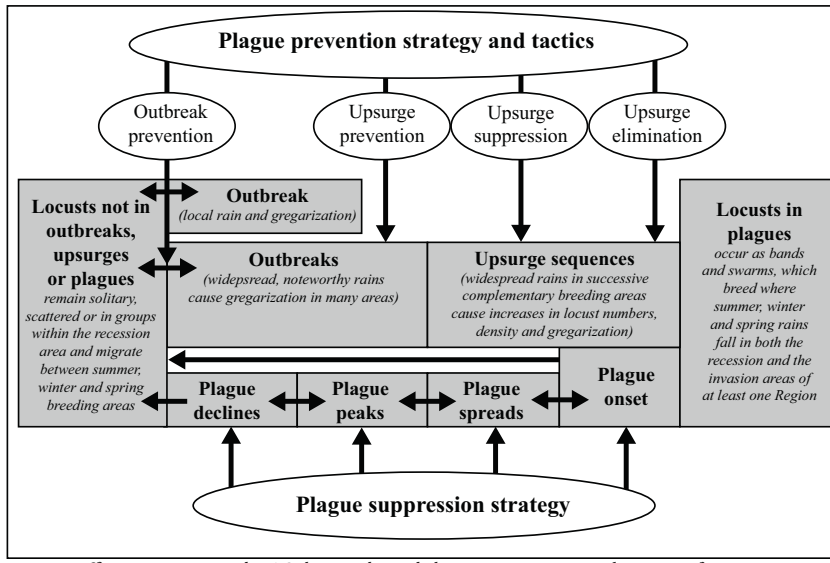
Desert Locust control operations carried out in Southwest Asia treated more than one million ha between 1988 and 2014

air-to-air swarm control began in India as a way to overcome the limited amount of time available to spray settled swarms in the morning before they take off. Eventually organochlorine pesticides were banned because of their toxicity and persistence in the environment. By the late 1980s, they had been progressively phased out and gradually replaced by generally less-harmful organophosphate insecticides.

Between World War II and the early 1960s, several large-scale control campaigns were carried out in the region. In 1951, more than 1.5 million ha were treated in Iran. India, Iran and Pakistan organized and carried out smaller campaigns during the past 50 years that often lasted for several months or more. By far the largest control campaign in recent times was that of 1993 following the upsurge that developed in the Central Region in 1992. During the campaign, aerial and ground control operations in Pakistan used 151 000 litres of pesticide and 74 900 kg of dust to treat 316 979 ha consisting of 60 245 hopper bands and 497 swarms within an area of nearly 19 000 km^2. In India, ground teams treated 77 456 ha while aerial operations treated 233 743 ha, consuming 103 860 litres of pesticide and 640 315 kg of dust. Both countries mobilized substantial quantities of human and material resources for the control campaign that lasted almost four months.

Preventive control

If good rains fall and ecological conditions become favourable for breeding, then locust numbers normally increase. In Southwest Asia, this occurs mainly during the spring, often in the Jaz Murian Basin of Iran and in the Kharan Valley in Pakistan, and during the summer along both sides of the Indo-Pakistan border. Once vegetation starts to dry out, locusts may concentrate and the resulting groups may require treatment. If timely and effective control operations are conducted, then a further increase in locust numbers can be halted, hopper bands and swarms do not form and infestations decline, cultivations are not threatened and emigration to other countries is either prevented or seriously reduced. Therefore, it is of paramount importance that countries maintain regular monitoring and readiness for early intervention as part of the preventive control strategy. Experience has shown that only a centrally coordinated effort can guarantee efficiency and sustainability of these activities. The fact that many of the outbreaks that have occurred did not worsen and develop into upsurges and, similarly, not all upsurges have led to plagues is testimony to the benefits of a well-coordinated and



Locust-affect countries and FAO have adopted the preventive control strategy for Desert Locust management

implemented preventive control programme. In the Western Region, the cost of controlling the 2003-2005 major upsurge was estimated to be equivalent to 170 years of preventive control. Subsequently, countries within the region agreed to increase their annual contributions to the FAO Commission for Controlling the Desert Locust in the Western Region (CLCPRO) by three-fold. Although studies have not been undertaken yet in Southwest Asia, a similar conclusion is almost inevitable.

5. Future challenges for SWAC

Desert Locust early warning and preventive control continue to present a number of significant challenges to SWAC and its member countries. Although recent advances in communications and technologies have led to improvements in national locust programmes, particularly regarding survey, reporting and control, substantial efforts will be required to avoid complacency and a lack of preparedness to monitor the situation and take action in a timely and effective manner.

In order to reduce the frequency, duration and intensity of upsurges and plagues and their devastating consequences on livelihoods and national food security, member countries need to maintain a fully functioning national locust unit that actively monitors current conditions and is ready to respond quickly to increased activity or an invasion. This unit should consist of a centralized command authority at the Federal level with well-trained staff and well-equipped survey and control teams. Decentralizing locust survey and control resources and operations to the provinces has been shown consistently to be an ineffective and inefficient means of managing Desert Locust that can easily and quickly move from province to province, outpacing local responses. Therefore, it is critical that survey and control teams, vehicles and drivers, sprayers, pesticide and field equipment can be mobilized and shifted at a moment's notice anywhere throughout the country. This is more easily done within a centrally organized locust unit. The Commission can provide advice to countries regarding the structure or restructuring of their national locust programmes.

National locust staff must be well trained and kept abreast of methodologies and latest techniques through continuous training programmes on a regular basis. One of the main roles of the Commission is to ensure that each member country has at least one or more well-trained and updated Master Trainer who can provide the necessary training to the national staff. Incentives and encouragement supplemented by high-level political will are necessary to limit the turnover of staff so as to reduce the burden for further training. Supervisors should maintain regular and close contact with field staff. Locust Heads should seek the advice of their national locust information officer regarding current ecological conditions, survey and control operations and expected developments in order to manage teams and resources effectively.

Here, the Commission should continue to play an important role in sensitizing Locust Heads and training national locust information officers with the help of DLIS.

Each survey and control team needs to be equipped with the eLocust system for collecting and reporting important data that is used for planning and carrying out field operations as well as being the basis for early warning and preventive control. In order to achieve this, sufficient resources are required for procurement of the equipment and training of the users. The Commission should continue to pay for the transmission costs of eLocust data. Investments are required in new cost-saving technologies that can be adopted and incorporated into national locust programmes.

Member country governments must continue to fund adequately their national locust programme on a regular and reliable basis. Sufficient funds are required to maintain and renew resources used in locust survey and control operations, including the upgrading of vehicles and sprayers, to provide regular training to all staff, to sustain locust offices and bases and staffing levels and to have contingencies in place for responding to emergencies. Governments should also continue to meet their financial obligations to the Trust Funds both of the Commission and of the FAO Desert Locust Control Committee. The Commission plays an important advocacy role by raising awareness of the need for proper and regular funding through discussions with the relevant stakeholders at the national, regional and international levels.

One of the more difficult challenges faced by the Commission is that of insecurity and sensitivities in the region. In recent years, security has deteriorated in parts of the spring breeding areas to the point that it has disrupted the annual Iran/Pakistan Joint Survey. A single team composed of nationals from both countries has not been able to survey jointly important locust habitats in Baluchistan, Pakistan because of safety concerns. Member countries will need to adopt new measures of working together in monitoring and controlling infestations in insecure areas and along sensitive borders.

SWAC organizes a number of specialized workshops and training courses, for example, workshops on contingency planning and training courses for Master Trainers. In order for member countries to derive the greatest benefit from such Commission-funded activities, it is critical that the appropriate individuals are designated to attend each event. This is also important when

selecting delegates to represent the country at Commission and DLCC sessions as well as in other international meetings pertaining to Desert Locust. The Commission should vet the nominations of such participants to ensure maximum benefit.

There is tremendous potential that already exists within the member countries of SWAC. Every country has knowledge and expertise that it can contribute to its neighbours. In the past, for example, Indian locust officers used to assist in surveys carried out in Afghanistan. New ways should be found within the Commission to expand the availability of this expertise so that all countries in the region may benefit and extend it to locust-affected countries in other regions.

In order for SWAC to continue to carry out its current level of activities, to address additional topics related to Desert Locust management and to develop new initiatives for the benefit of member countries, a dedicated commitment will need to continue in financing the Commission from member contributions. It remains important that annual contributions are paid on time and that arrears are kept to a minimum. Given the continual increase in the cost of living and the desire for the Commission to do more for its member countries, it will be necessary to consider increasing the annual contributions that have not been updated in 50 years.

The biennual sessions of the Commission will continue to be an important forum for discussing openly and frankly all of the issues concerning Desert Locust management in the region amongst member countries and FAO. Recommendations should focus on strengthening national capacities on a sustainable basis in a collaborative manner within a regional framework.

The combined expertise and commitment of member countries within the collaborative framework of SWAC will certainly improve the management of Desert Locust in the region that, in turn, will contribute to increased food production, a reduction in world hunger, alleviating rural poverty and increasing resilience. The Commission with its member countries has the potential to be a showcase for other regions.

6. Anecdotes and tales from the past

My knapsack - Its memory lives on

Shirzad Behzadi (Iran)

My knapsack
My knapsack, good memories!
It was made of desert and smelled like soil
Good memories

Wet from sweat!
Nights full of flirting stars

And with the voice of that man who used to say:

Sing in the name of the rose within the deserts of the night (Kadkani)
Kissing the bare body of an accident
Good Memories

My knapsack!
Falling down into locusts
Hurtling on mice motion
With a proliferation of earthworms
Was dropped and nothing else

Becoming a bread stew for worms

Good memories!
My knapsack
Whatever it was or was not
It came to be full of green grass

Wet Sweat!
It was made of desert and smelled like soil

I also passed from there

Shirzad Behzadi (Iran)

There I saw a camel that was drinking blood from the sun spring and milk from a cameleer girl's breasts
There I saw loneliness growing in a mosque
There I saw children stealing a rosary from a holy man for treating their pains
There I saw a woman who was putting her dried goat breasts into the hot desert mouth
There I saw a man who was binding his look to a dusty horizon
There I saw the soil in the hands of the wind
There I saw a river wishing for a water bed fellow
There I saw a caravan transporting death from east to west
There I saw a date garden dying in a tragic silence
Finally I saw the whole life so alone and crawling on the desert surface.

Baluchistan, Iran and Pakistan
Joint Survey 1996

On the participation of the CRC Executive Secretary in SWAC Sessions and events

Munir Butrous (Sudan)

I was fortunate to represent the FAO Commission for Controlling the Desert Locust in the Central Region (CRC) in several SWAC sessions. It was realized that it is important for the CRC Executive Secretary to participate in these sessions, bearing in mind that the Commission in the Central Region had provided support to SWAC as the following:

- Accepting trainees from SWAC member countries in the Desert Locust international training courses undertaken in the Central Region;
- One candidate from India participated in 2001-2002 Desert Locust Management Diploma Course at the University of Khartoum;
- Provided SWAC countries with publications such as the Standard Operating Procedures (SOPs) on ground survey, radios, ground control and aerial survey and control and sprayers testing report as well as a poster for radio operators;
- Training of Trainers (ToT) manual kit produced and sent to SWAC countries.

Therefore, I participated in the 25th Session of SWAC that was held in Tehran (2006), the 26th Session in Kabul (2008) and the 27th Session in Islamabad (2011).

This practice was followed in order to give an overview of the activities and achievements of the CRC. In turn, the Executive Secretary of SWAC participates in the CRC sessions, presenting SWAC activties and, in his capacity as Senior Locust Forecasting Officer, giving an excellent overview of the Desert Locust situation at the regional and global levels.

At this juncture, I would like to express my sincere appreciation to the SWAC Executive Secretary and the four member countries, bearing in mind that their sessions are organized in a critical and sensitive atmosphere.

My experience was that the member countries are very cooperative with the Executive Secretary in achieving the biennial activities and plans to combat successfully the Desert Locust. The main activity that I fully admire was the joint-border survey between Iran and Pakistan where the survey is undertaken for one month in important Desert Locust spring breeding areas that otherwise are not surveyed by the individual country. At each session, the participants discuss the various recommendations made by the joint survey team to improve future surveys and, accordingly, a number of recommendations are made on those aspects.

Also, there is a monthly joint border meeting held between India and Pakistan during the summer in which they discuss action plans and arrangements for Desert Locust preventive management.

In May 2010, SWAC organized and conducted jointly with CRC an inter-regional ToT workshop to train national Desert Locust Master Trainers on Desert Locust survey and control operations in Ramsar, Iran. The objective was to create national master trainers in the region who would shoulder the national training programme in the four countries without any external technical assistance and to ensure a sustainable training programme in each country.

Dawn to dusk, a comfortable journey in Desert Locust control and research

Dr. Harish Chandra (India)

Just after obtaining my post-graduate M.Sc. Degree in Zoology-Entomology in 1960 from the Government Agricultural College in Kanpur, Uttar Pradesh, I was given a job of Plant Protection Assistant at the Department of Agriculture in Uttar Pradesh. It was then a locust plague period that commenced in 1959 and continued until 1961. Besides Rajasthan, swarms were reported from other parts of the country, including Lalitpur in Uttar Pradesh.

The Plant Protection wing of the Directorate of Agriculture constituted a team of its technical officers, in which I was one of its members, in order to arrest the movements of swarms. The team was ordered to run to Lalitpur urgently with pesticides and equipment loaded in trucks to fight the locust swarms. Therefore, the team accompanied the trucks to reach the swarm-affected areas and organize control operations immediately. The swarms and swarmlets were chased to locate their roosting sites and dusted with 10% BHC using hand operated dusters in the night. The area was cleared with locust swarms within a fortnight. The participation of local inhabitants in controlling the locust swarms was commendable.

The Directorate of Plant Protection, Quarantine and Storage in the Ministry of Agriculture advertised the post of Locust Technical Officer in 1961 for which I made an application. Perhaps, my locust control experience in Lalitpur was the grounds for my selection. After having been selected, I was ordered by the Plant Protection Adviser to the Government of India to report for duty at the locust substation in Jodhpur, Rajasthan. Accordingly, I reported where Mr. K.R. Bhatia, Deputy Locust Entomologist was the office manager. He directed me to report at the Circle Office in Jaisalmer.

Jaisalmer is in the western part of Rajasthan and lies in the Desert Locust outbreak area of India. It is part of the scheduled desert area for the purpose of locust management. It comes under arid zone and consists of flat and sand hills of all shapes and sizes, rising up to 150 feet high. The valleys in between the sand dunes are covered with bushes and tufts of large grasses. The inhabitants of the villages do not do cultivation. They earn their livelihood by herding cows, goats, sheep and camels. They however take certain plants after rainfall. There were no roads then. The villagers mostly

lived in thatched houses called Jhopa. Their mode of transport then was either camelback or camel cart. Some of the Government departments had four-wheel drive vehicles. There were no means of communication except that of wireless sets installed at the Anti-Dacoit (armed bandits) Force Camps and Army/BSF Camps on the Indo-Pakistan border. There was scarcity of water. People used to collect rainwater to drink in the water tanks, called Tanka, dug by them.

Jaisalmer then had no railhead to reach. One had to go up to Pokaran by train and then continue to Jaisalmer by bus. When I reported for duty at the Circle Office in Jaisalmer, the Assistant Locust Entomologist in charge of the office briefed me about the topography and vegetation of the Circle and also explained the life history and behaviour of the Desert Locust and the grasshopper species found in the Circle.

This was a challenging job. I therefore put all my energies to make Jaisalmer Circle free of locust swarms. I had to run from dawn to dusk in a vehicle mounted with a wireless set locating and chasing locust swarms so I could inform the officers camping at strategic points with their pesticide and equipment about the details of the swarms such as their size and colour and the latitude/longitude location of their roosting sites. In this way, the teams could reach the spot and arrange their control during the night. The hoppers and fledglings were easier to control. Sometimes the locust officers faced awkward situations when the tribals did not allow them to kill the fledglings because they were their food. They used to collect the fledglings to store them for their future consumption.

The Directorate of Plant Protection, Quarantine and Storage, after concluding the locust control campaign in Jaisalmer Circle, posted me to Sikar, which was a Zonal Office and fell within Bikaner Circle. The vegetation and terrain were different than Jaisalmer and it had better developed roads and means of transport. The inhabitants, besides taming animals, grew rain-dependent agricultural crops and also with well water whenever possible. In order to save their crop areas from locusts, the farmers were very quick to transmit the information about swarm movements, egg laying, hopper emergence and the movements of hopper bands to the locust officers for the purpose to take steps to organize control. The farmers did not wait for the locust officer to come to control the locust but opted to carry out the control themselves. They adopted all the methods known to them such as driving away the swarm from their fields by trouncing around and also to kill the

settled swarms by setting fire or dusting with BHC. To avoid the entry of hopper bands into their fields, they made trenches at vulnerable points and drove the hoppers into them by beating with bush and then covering the fallen hoppers in the trenches with soil.

I remember that I once happened to meet Dr. S. Pradhan, an eminent entomologist who was Head of the Division of Entomology at the Indian Agriculture Research Institute in New Delhi. He enquired if I do research on acridids. I replied that "Sir I do not have lab facilities and therefore, there is no scope for me to do research". He told that nature itself is a big laboratory. Therefore, whenever you are in the field, you keep your eyes and mind open, and record what is happening in nature. This is research. I followed his teachings throughout my service career and made significant contributions to the field of entomology.

I met D.R. Bhatia, a locust entomologist in charge of the Field Station for Investigations of Locusts (FSIL) in the field during the locust control season in 1963. He asked me if I was interested to join him at the station, as it was a better place for me to work. After obtaining my consent, he managed my transfer to his station. The function of the FSIL was to study the biology, ecology and behaviour of the locusts and arid zone grasshoppers under various ecological conditions and their natural enemies. The station also standardized dose rates of the various pesticides used against the eggs, hoppers and adults of Desert Locust and other species of acridids.

The Directorate of Plant Protection, Quarantine and Storage deputed three of its officers, including myself, to Tehran to attend the 6th FAO training course on Desert Locust control from 19 February to 10 March 1966. It was a nice opportunity for us to know all about locusts. After completing this training, I was posted as Plant Protection Officer to the Central Plant Protection Station in Karnataka. From this station, I was sent to Agatti Island, one of the islands in the Laccadive chain off the coast of Kerala, to study the cause of the outbreak of Bombay Locust during 1967. I sailed from Cochin to Agatti Island by ship. It is interesting to mention that every one on board vomited but I did not. I conducted the investigations on Bombay Locust, submitted my report to the Government, and published an article in the Plant Protection Bulletin.

I was then shifted back to the Locust Warning Organization for the joint locust survey of the south-western part of Afghanistan in 1969. Mr. S. Singh,

FAO Locust Officer, received the Indian team and the survey programme was chalked out with mutual discussions. The survey routes and places of the night camps were decided. Accordingly, the Indo-Afghan locust survey team along with Mr. Singh proceeded for survey in vehicles with survey equipment, food and tents.

I was elevated to the post of Deputy Locust Entomologist (Research) in 1971 and posted at FSIL under Dr. M.V. Venkatesh. I was again included in the team of locust officers consisting of two members for the joint locust survey of southwest Afghanistan organized by FAO. This time, observations on the feeding capacity of lizards on insects were recorded and the results were published.

I worked at FSIL until 1997 as Assistant Director (Entomology), Deputy Director (Entomology), and Joint Director (Entomology). I also attended a training course on ground and aerial spraying at Les Barges, Switzerland in 1983 organized under SWAC.

Throughout my service career, I worked on locusts and grasshoppers, and collected observations on their activities and natural enemies. During the course of this service of 37 years, my most important contribution was to develop an ultra low-volume power take-off sprayer for the replacement of the exhaust nozzle sprayer. I also utilized my skills in managing and supervising aerial application of insecticides on locust swarms by Beaver and other light aircraft. From dawn to dusk, my career in locust was enjoyable and has given 55 research papers to acridology for which I am satisfied.

Driving in the desert

Keith Cressman (FAO)

Drivers are essential to Desert Locust surveys. A good driver can make the world of difference to a productive and enjoyable survey. An inexperienced driver can cause hours to be wasted stuck in the sand, sweat covered arms coated with sand digging out the wheels, denuding the landscape by ripping up the few bushes that exist to place under the tires to get some traction, and other assorted tricks of the trade. Oddly enough, metal sand ladders are nearly always missing from the *Essential Items To Take In The Desert* checklist. On the other hand, a good, experienced off-road driver will cross sand dunes with ease as if it was a tarmac parking lot. Drivers are always

curious characters. Most of them are oldish, extremely nice with some odd peculiarities mixed with often rather questionable desert driving skills. One driver I had kept falling asleep at the wheel. Another nearly got us killed as he was forced off the one lane road in northern Baluchistan of Pakistan by a speeding bus. We suddenly found ourselves bumping across the desert at 120 kph before jolting to halt in a ditch with a punctured oil tank, hours and hours from any village or garage. Drivers are also very clever. This one plugged the oil tank hole with a combination of a bar of soap mixed with cotton threads that held for six hours to the next village 200 km away.

By far the funniest driver we had was a Baluchi Iranian. A short fellow, difficult to say his age, but with two wives, three houses and seven children, one of whom was a doctor and I saw a second child at least two decades younger. This particular driver was quite shy, but one day as we were listening to the soundtrack from the movie Pulp Fiction on a pirated cassette bought in a Pakistani bazaar, he hopped into the back of the pickup and started dancing there in the middle of the desert. And the funny thing was that this guy was good. He really had rhythm and style. He repeated his star performance a few more times in subsequent days when everyone was least expecting it. Each time it made everyone roll over in the dust laughing and made it easier to deal with the extreme heat and fatigue that followed us every day during the month-long survey in the spring breeding areas of Iran and Pakistan. Fortunately, he did not display his dancing skills when driving.

So most people are born really not to drive. This is why there are particular individuals whose job is to drive, so called drivers. And there are other persons called Team Leaders whose job is something other than to drive. We were fortunate to experience and confirm this first hand in the beautiful and remote Kharan Valley in northern Baluchistan, Pakistan. We were staying at the guesthouse of the Government's Road Department (incidentally, this must be a very small department in Baluchistan given its lack of roads). Our guesthouse was across the street from the District Commissioner's rest house. There are many rest facilities in Pakistan. We were taking our meals in the DC's house (acronyms are an important mainstay in the country). After lunch, the Team Leader decided to drive us the long distance of 300 metres back to our guesthouse, although as survey officers we were accustomed to walking many times that distance during a single survey stop in the desert. He went around the back of the DC's house to fetch the four-wheel drive vehicle. After more than five minutes without him appearing we began to get worried. Had he succumbed to heat stroke, fallen ill from the meal or

maybe attacked by a stray dog? All we could hear was the car's engine and the gears constantly shifting. So we peered around the corner and watched in amazement as our fearless Team Leader was in the midst of manoeuvring a 30-point turn, inching forward and backward in a space large enough for ten vehicles. It was difficult to know how to react to this cultural situation. Should someone go rescue him and the vehicle, or should we just wait it out? Time was passing. We certainly did not want to embarrass him but we were also hoping to arrive at our guesthouse before sundown. Patience persevered and eventually he showed up at the front door with the vehicle. We hopped in for an anticipated long drive to our guesthouse. We were not disappointed. It took him several more minutes to find first gear, eventually settling for third, then the gate appeared, wide enough for two vehicles that he had to squeeze through without leaving the side mirrors behind, then the 200 meters to traverse, which involved crossing a deserted street. Who in their right mind would be out driving in the middle of the day in 45°C heat? He never found the other gears except for first, so we lurched and jumped and hopped as the engine whined in complaint towards our destination. The final stop was achieved by popping the clutch and we jerked to a halt and started rolling backwards on the unlevel ground. We quickly opened the doors and piled out into the afternoon dust and heat, thanking the Powers to Be that we had made it in one piece and in the same day. His final words were a soft admission that he's not used to driving very much. As he lurched away, we could not help wondering if he made it back to the DC's house by nightfall.

SWAC tales

Hans Dobson (UK)

I was running a series of training courses in the Thar Desert to get control teams up to speed rapidly during a Desert Locust upsurge in the 1990s. Every two days a new venue and after that another perilous drive along single-track tarmac roads to the next venue. The preferred technique for dealing with the occasional vehicle coming the other way was to barrel along towards them and at the last minute when death seemed imminent, for both drivers to wrench the steering wheel over to the left so that both vehicles shot off the road in opposite directions into the steeply cambered sand and passed each other by a whisker. The wheel would then be wrenched back to the right so that the vehicle slewed around and back onto the tarmac in a cloud of dust still travelling at 100 kph. Every night was an ordeal sharing a small hotel

room with the driver. He was a perfectly nice chap but a keen smoker and would be puffing away in the dark at all times of night. Both of us would be smelling like ash trays by the morning.

One trainee on that mission in an unnamed location was always a little sleepy during training. He was cheerful enough but clearly with no interest in the training course whatsoever. At times like these you choose your battles and I knew I had no chance of motivating him, and he was not disrupting the course at all, so my strategy was to let sleeping dogs lie. During one refreshment break he roused himself for a friendly chat with me, during which he ate a small pellet of brown material and washed it down with a sip of tea. I asked him what it was. Some sort of dried dates perhaps? He generously offered me a similar pellet that I chewed with interest and then sipped my tea. As I did that somebody shouted, "STOP...", and came running over, "DON'T SWALLOW IT!". But it was too late. After half an hour, the dynamism of my delivery seemed to be flagging. Nozzles, droplet spectra, aircraft height... who cared? I began to feel sleepy and I asked what it was I had eaten. The trainees looked at me as though I was an idiot. I ended the course early and retired to my bedroom for an afternoon of wonderful sleep and psychedelic dreams.

Rats are a common sight in some parts of India. On being ushered into a restaurant in Rajasthan, there was a rat as big as a medium sized cat sitting on the back of the bench seat in the corner, which sauntered reluctantly off to the kitchens when the waiter shooed it away. In the office of the Deputy Director of the Locust Warning, we were having interesting discussions on survey and control when I couldn't help notice a sort of criss-cross pattern of lines on the carpet. I was just wondering what they were when a rat scuttled along one of the lines, under the directors desk and off into a hole in the corner. I pointed and was about to say something but the Director didn't bat an eyelid. I was tormented all night by a rat in Jodhpur. Just as I was drifting off to sleep after a long day in the field, I could hear scratching and scrabbling down on the floor. I turned the light on but saw nothing so turned the light off and was nearly asleep again, when the scratching and scrabbling started again. I searched the room, found nothing, except that where a low down air conditioner had been there was a gaping hole to the outside. Something had got in, but there appeared to be nothing in the room. I turned the light off again and waited for the sounds to start. When they did, I realized they were coming from my rucksack and remembered I had a half packet of biscuits in there. I reached for the bag and a large rat

ran up my arm and over my head, down onto the floor and out of the air conditioner hole. Enough is enough I said to myself. I got the hotel towel and a roll of electrical tape and taped the towel to the wall over the hole. Surely that would stop it. Just drifting off again and I could hear more scratching and scrabbling, this time coming from the blocked off hole so I turned the light on. A rat was trying to push its way into the room between the towel and the wall and had got half its body through. I rushed over to it and gave it an almighty kick that must have broken its neck since it hung lifeless from the edge of the towel. By this time it was about 4:00 in the morning and although jubilant that I had killed the rat I was also furious that the hotel had allowed it to steal a night's sleep from me. I grabbed the rat by its tail, marched down the corridor to reception, and rang the bell. When a sleepy night porter got up from his bed behind the counter I dropped the rat on the registration book and told him that the huge hole in my hotel wall had better be fixed or I was leaving. They did seal off the hole the next day, but the oddest bit was that they did it with glass, a sort of rat window. All the next night I imagined rats peering hungrily through the glass looking for biscuits.

Keith Cressman and I were due to give a training course in Jaisalmer on survey and control in 1996. We had a flight booked from Delhi to Jodhpur in the afternoon but had a series of meetings in the morning, culminating in a meeting with the PPA in Faridabad. He made us most welcome and we warned him immediately of our deadline to leave for the airport in half an hour. "Oh don't worry about that" he said. "My driver will get you there in plenty of time". We thanked him graciously and commenced discussions. After 25 minutes we were glancing at our watches but he was in full flow about how serious the locust problems are in India and what a good job FAO was doing in assisting the country and its people. He then moved on at a leisurely pace to his absolute commitment to put whatever resources were required behind the national capacity for locust management and how marvellous it would be if FAO could advise on exactly what was needed. By this time we were ten minutes behind our tight schedule and politely told him. He pressed a buzzer under his table, carried on his ambitious musings and a further ten minutes later, tea arrived. After another 20 minutes we managed to get away from his warm handshakes and promises of eternal friendship. As instructed, his driver stepped on it. Hooting his horn weaving through the heavy traffic, pedestrians and cows on the road it was a white-knuckle ride. He was good, but not good enough. By the time we arrived at the airport, they had given my ticket away to someone on the waiting

list. We protested, we asked to see the manager; we showed our UN Laissez Passers, told them how important our work was for India and begged for one more ticket. We even call the PPA who tried to intervene. All to no avail. All other passengers had boarded. Keith and I discussed whether he should travel ahead but we decided on balance that we should both go on an overnight train or bus to Jodhpur so that we could at least do some more planning for the course which was due to start the next day, so he handed back his boarding pass and it was snapped up eagerly by the next person on the long waiting list and they were rushed through security. We were just about to leave the desk when the manager came running across to us waving a boarding card saying "I have a cancellation so you can both fly but go quickly, the plane is about to leave"! A cruel blow, but we did not realize quite how cruel. We queued at the railway station, only to find that the last train had departed so we made the long taxi trek through traffic to the bus station where we were able to get two tickets on the next bus to Jodhpur in four hours. It was a long night. Lorries travel during the hours of darkness and, although it was a road with two lanes, the lorries travel very slowly and the bus had to overtake all the time, timing its overtaking manoeuvres to avoid the oncoming traffic of other buses and lorries. There was no air conditioning on the bus so the windows were wide open in the heat, and the lorries belched out huge clouds of black smoke. By the time we arrived in Jodhpur 12 hours later, our white shirts were grey all over and the shirt collars were black. The LWO staff met us and we were hustled into a local hotel for an hour of clean up and rest before five-hour journey by vehicle to Jaisalmer where we arrived after nearly 24 hours after departing from the Delhi airport. Of course as true professionals we appeared fresh as a rose, delivered a fantastic day's training albeit one day late.

Afghanistan has had its troubles for centuries with different external powers trying to exert their influence on the country's proud people, and usually failing. But one constant enemy has been the scourge of farmers in the north of the country, the Moroccan Locust. FAO had a locust control project in Mazari Sharif run by a young Australian called Rob Nugent. He was locally famous for buying an electric guitar and amplifier across the border in Uzbekistan and treating the bemused population living within a radius of half a kilometre to very bad renditions of Jimmy Hendrix and Led Zeppelin songs at full volume. There was not much variety of food, even in Uzbekistan, unless you like pickled cabbage, so when Rob managed to get hold of a tin of crab meat we were delighted. We got some lovely Afghan flat bread and stuffed them with pickled cabbage and crab meat, then wolfed

them down. They were so delicious except for an aftertaste that was slightly metallic and bitter. The aftertaste got worse. Could it be the seafood was not right? I grabbed the can and examined the worn label closely and my worst fears were confirmed. The sell-by date was four years ago! We didn't sleep well that night, expecting the worst, but saw in a beautiful Afghan sunrise from the house rooftop with no ill effects.

Desert nights

Mehdi Ghaemian (Iran)

I was on joint survey, looking for Desert Locust during one spring in southeast Iran. We had a route along the south coast to Jask from Chabahar. We were supposed to return to Chabahar but on our way we found a wadi filled by water and it was impossible to cross and continue to Chabahar. The best solution was to stay, wait for the level of water to go down the next day, and then cross the river. Fortunately we had some camping equipment with us except for tents. We had a desert bed and sleeping bags so we slept under the open sky. Before falling asleep, we had nice chat with the team together. It was after midnight when I suddenly woke up. I did not know exactly what time it was and really do not know for what reason I woke up but I think it was because of the star light! When I awoke, for few seconds I did not remember where I was. I just faced lots of shiny light in a black background. It seemed to me that the sky came down on to my face. I felt that the distance between the sky and myself was just my nose! At first I was frightened but when I looked around and found where I was, I had an amazing feeling. For sure, I will never forget that night.

I participated in the Desert Locust joint survey in the spring breeding areas of southeast Iran and southwest Pakistan for three years in 1996, 1997 and 1998. The 1996 survey was the most important one for me as I learned a lot from the FAO Locust Forecasting Officer who participated in the survey. In 1997, the joint survey was interesting as both team leaders had to manage everything for the first time without FAO. I must admit that the 1998 joint survey was the most terrible one for me because I had lots of problems, starting with the drivers, then I got a toothache and had to have my tooth pulled out in Iranshahr and finally I got malaria.

I have some good and bad memories from each of these joint surveys that I will never forget. In 1997, we were undertaking the Pakistan portion of the survey and we had to stop for a night by a river that became flooded by

sudden rains. Near our camp, there was a very small guesthouse with only one room in which Pakistan's Team Leader, Mr. Zafarullah Khan Tariq, preferred to have an overnight there. When we reached the place and I saw the guesthouse, I asked Mr. Zafarullah to let me stay outside. I remember telling him that I was worried about the roof and not sure if it would persist until morning! He kindly accepted my opinion and asked his colleagues to prepare a bed for me in the guesthouse yard under some trees. The other reason that I preferred to say outside was that good memory of sleeping under the stars in 1995. Anyway, I was well prepared for an outdoor stay and had my mosquito net. So I unpacked it and I spent nearly two hours to fix the net on the trees and around the wooden bed. It was my first time using a mosquito net and the nylon rope that I used to fix the net managed to cut my hands. Anyway, the mosquito net was finally fixed and I went inside, content for a beautiful sleep under the stars. But then it started to sprinkle. I did not pay much attention to it at the beginning but as the rain became a strong shower, I had to leave my accommodation and retreat to the guesthouse with the dubious roof. Inside, it was full of people and there was no place for me. Moreover, I was sure that the heavy rain would ruin the guesthouse, so I went into a vehicle. After ten minutes, other team members came to the car and all of us had to spend the night in our vehicles. Up to now, I do not remember such a heavy rainfall. Even our vehicle was shaking in the rain! In the next morning we heard that four local people were dead in the flood. We were lucky that the position of the guesthouse was on top of a hill.

A thirsty desert

Azam Khan (Pakistan)

It was a hot summer season in August 1993. Pakistan was under a serious attack of the Desert Locust in its eastern border areas of the Cholistan and Tharparkar deserts. I was posted at Peshawar and called by the Department to participate in the locust survey and control operations in the Rahimyar Khan sector of the Cholistan Desert. I along with my team established a base camp in a rural health centre at Manthar, a town near to the Indo-Pakistan border on the eastern side of Rahimyar Khan. Our team had a schedule to start early in the morning and to return in the evening after the whole day of tiring survey and control work in the deep desert. During those days, illegal immigration from the India side through the unknown desert routes was common.

One day (I cannot remember the date), I along with my team was on survey near the Indo-Pakistan border. It was 12:00 noon and the temperature in desert was at the peak, about 55°C. We were tired and were in search of a shady place to have a rest for a while. Meanwhile we saw a Kacha Kota (a room built of mud) in the foot of the lofty sand dunes near the border having no door. I told the driver to turn the vehicle towards the Kota to have some rest and also to drink water. I was in the front and the first to enter in the Kota, but there was such a serious bad smell in the Kota that all of us ran back. It was very surprising and I told the team that we must check the Kota inside to know the real situation. I wrapped my face and nose tight with the towel and entered inside to see the fact. I was astonished and frightened to see that there was laying a dead body of a man along with a child of about 12 years old. Both the dead bodies were completely rusted and hundreds of thousands of maggots were moving insides the bodies. All the team members were very seriously shocked and came out without staying there any more. While coming out, we came across another vexatious scene. We saw a woman lying inverted in the trench, which was dug around the Kacha Kota for security purposes. The body of the woman had become dried and the hairs were open. Those were really very heart piercing scenes. A film rolled in my mind that how crucial would be the moments when the child would be in agony due to extreme thirst and the parents could do nothing. The woman with extreme thirst would come out of the Kota to cry out for help, but no one was there to listen to her and to give them a few drops of water, and she herself fell into the trench. I do remember that tragic scene even now.

Locust memories in Pakistan

Zafar Ali Khan (Pakistan)

In 1981 I was transferred from Peshawar to Sukkur in Sindh province where I was responsible for locust survey and control. Sukkur includes the Nara Desert, which is the most dangerous and inaccessible part of the summer breeding habitat, consisting of heavy sand dunes, and this is where I had to perform my duties. After my arrival, the Department arranged a training course at the Head Office in Karachi for all field staff in December 1982 that was extremely helpful for me in locust management. Then there was the locust invasion of 1983 in the summer breeding area where I undertook my first control operation, which was successful despite the limited resources that were available.

During the 1983 campaign, there were terrorist activities in Sukkur. An aerial spray camp was established in the remote desert area in Ghotki, close to the Indian border. One night the terrorists came and set fire to the base. Luckily, the aircraft was saved. On complaint to the local administration, they informed us that they could not do anything for our safety and it is better to ask the local lords (Sardar) to provide security from the local tribes. So we went to the local tribes and requested help, and an aerial strip for the aircraft and shelter for the staff of locust campaign were provided in the desert area under their domain.

One day as we were flying to Sukkur after inspecting the strip at the aerial base, our small aircraft sunk down sharply over the Indus River and the engine stopped. The pilot suddenly pushed a few buttons and the engine roared back to life. Upon inquiry, the pilot informed us that the fuel was finished in the main tank and that is why the aircraft sunk. So he quickly switched to the auxiliary tank, and luckily the engine started again in the air and we landed safely at the Sukkur airport.

During a control campaign ten years later in 1993, there was heavy locust attack first in the spring breeding areas of Baluchistan and then in the summer breeding areas. I was asked to supervise operations in the Khipro and Tharparkar deserts in the southeast where hundreds of swarms and thousands of hopper bands were controlled. The army provided logistical support and it was not so easy to work with them. A media group from Karachi was escorted to the desert and shown the locust activities and control operations. During the return journey, their vehicle went off road in the desert somewhere and the group finally arrived in Karachi very late at midnight. With this experience, they understood the terrible working conditions and appreciated our diligent efforts in controlling Desert Locust infestations in such remote and difficult areas. This was reflected in the article that they wrote on the successful efforts of the Department. The FAO also appreciated our work in a letter that was sent from FAO HQ.

In 1995, I was nominated as Pakistan Team Leader for the Iran/Pakistan joint survey that was being revitalized after a 15-year gap. The Pakistani team had to enter southeast Iran from the nearest point of Mand in Turbat District of Baluchistan, adjacent to Pishin in Iran so we could meet the Iranian team in Chabahar on the coast. Then we would all make a survey together. After a full day of hectic travel covering more than 1 100 km from Quetta, we arrived in Mand. The local authorities informed us that there

was no immigration facility available and they suggested obtaining a local pass for crossing the border to Pishin. These passes are issued to the local people to meet their relatives in Iran. After getting the passes, we were able to cross the border along with our two vehicles. After the Iranian border authorities checked us briefly, we met our Iranian counterparts who were waiting for us and drove us to Chabahar.

As this was the first joint survey in years, there were no standard operating procedures for the teams. Mr. Keith Cressman, the FAO Locust Information and Forecasting Officer from Rome accompanied the joint team and together with us chalked out the methodology and the route along the coast and through the interior to reach Zahedan, the last destination in Iran. After completing the two-week survey in Iran, the joint team with Mr. Cressman had to survey the adjacent area in Baluchistan, Pakistan. Everyone proceeded from Zahedan to the Iran/Pakistan border, reaching Mirjaveh border post early in the morning. But the Iranian immigration authorities denied the exit of the Pakistani team because they had not entered there but 500 km to the south at Pishin and did not have proper entry stamps in their passport. So they were told to go to Pishin and leave Iran from there. Clearly this was not possible, so after a long discussion from morning to afternoon, during which the border closed for several hours, they informed the Pakistani team that they could leave Iran and enter Taftan, Pakistan but only at their own risk. So the Pakistani team took the risk and left Iran through the desert and entered Pakistan by some unofficial entry point. After the necessary checking, verifications and formalities by the Pakistani border authorities, the teams were allowed entry into Pakistan but not the Government of Iran vehicles used by the team because some proper entry and customs documentation and authorizations to travel to Quetta were missing. Finally after more long debates with officials in Quetta, the vehicles were allowed to enter Pakistan and the joint survey could continue. It had taken more than 12 hours to travel less than one kilometre and cross the border. We were exhausted with no more patience. We learned the lesson that it was much easier, although not so simple, for people to cross the border but extremely complicated for Government vehicles to do the same. This was adjusted in future joint surveys as well as only using the single official Mirjaveh/Taftan crossing.

While in the Head Office in Karachi, the Locust Division was upgraded and modern technologies in locust survey and control were introduced with the assistance and guidance of FAO. As a result, locust survey and control

is not so hard like it used to be three decades ago. This is thanks to FAO, especially Mr. Clive Elliott and Keith Cressman, for their dedicated efforts and for organizing regular meetings, seminars, and workshops in upgrading the locust survey and control system in our region.

Some funny ideas on Desert Locust

Anil Sharma (India)

The Desert Locust has caused too much concern among the affected peoples for its timely control. Now these people do not know its life cycle or the way it is controlled but in enthusiasm they advance their theory to locate the swarm and how to control it. Sometimes the people confuse it with other insects and give wrong information to get some insecticide for use against parasitic insects on their livestock. I recall some funny incidents and hope you shall also enjoy these.

Once I got information from the Border Security Force Headquarters in the morning that a locust swarm had been sighted on a particular Border Post the previous day. I left for the Post immediately in the Government vehicle and by evening reached the said Post. After reaching there I was told that the swarm has flown away. Not disheartened by this development I met the Post-in-Charge and requested him that I would like to meet the persons who had seen the locust to which he readily agreed. After gathering all persons I explained to them about Desert Locust and requested them to give me the details regarding the swarm. They started telling me the directions from which it came and its stay on the Post. One person told that the locust attacked the persons eating their dinner and were hovering over kitchen utensils. I got suspicious and asked one person to tell me exact size and behaviour of the insect that he has seen. He started to describe it as a slender bodied, quick to fly small insect to which I queried "a helicopter" and he nodded in affirmative. So our search for the locust swarm ended then and there as the information given was wrong and since the persons at the Post had not seen the locust they thought it to be locust but in reality they were Dragon Flies.

When in 1993 yellow swarms started coming into the Jaisalmer area I attended a meeting with the District Administration for Desert Locust control on what assistance can be provided at the District level. In this meeting one of the Senior Officers who probably has not seen the locust or knew its life

cycle told me "How locust can come to India when we have fencing on the border?" I politely answered that locust is an insect and knows no barrier.

On another occasion during my discussion with the District Administration I was told by one of the Senior Officers "How old is your Department?" I replied that it was established in 1939. He told me in plain language, "When your department is so much old and you are having this problem of control why not ask the Government to erect a wall so that these locust will never come." Humility prevented me from smiling. I replied politely that locust knows neither barriers nor boundaries and can fly 1-2 km high in the sky.

Once again during one of the locust seasons we got information from the District Administration about locust infestations in a particular area. I knew that this area is a populated one and there is no chance of locust settling there. However we left for the area and enquired from the local residents whether they have seen any locust. Every person we contacted there replied that they have not seen any locust and told us that this is a populated area and locusts do not settle in populated areas. In this way we reached the residence of the person who gave this information on locust to the District Administration. He had gone to the office; hence, we asked his family members about the locust. They have not seen any locust and one of the members told that it was helicopter. I immediately knew the real insect and submitted the report as being false as the insect thought to be locusts were in reality Dragon Flies (again!). Later I met the person and asked him why he gave false information. He told that he wanted to test whether the Department is functioning. I told him that we are going to write for recovery of the charges incurred on deputing a team of officers to verify the infestation report and he should now face the consequences of giving false information. He apologized profusely and promised not to repeat such things in future.

Once during locust season we received a warning about a locust swarm incursion from the west and our Senior Officer was talking to the Senior District Administration Officers of different districts via video conferencing. That year we were experiencing heavy downpour in those districts and we were too much worried about locust infestations in view of the warning. Our officer who was not an entomology expert told during discussion that we should be very careful about locust infestations as locusts can lay eggs even if it is raining and they can lay eggs under water.

Once an officer gave an interview to a correspondent of a newspaper and the news published was this: The wings of a locust become glued to each other during winter; hence, it cannot fly and unable to reproduce due to this reason.

When I first joined LWO in 1988 I was perusing old technical files to learn more about locust and its reporting and control. Here I saw a remark "What are the dosages of BHC 10% required to MURDER different stages of locust?"

My first experience in locust control operations: Adventurous life and funny moments

Dr. J.N. Thakur (India)

It was August 2006 and I was working as Deputy Director (Entomology) in the Integrated Pest Management (IPM) Division of the Directorate of Plant Protection, Quarantine & Storage, Ministry of Agriculture, Department of Agriculture and Cooperation, Government of India. It was about 5:30 in the afternoon on 10 August 2006 when I received an Office Order from our Plant Protection Adviser (PPA) with information that I am one of the members of a locust team deployed for survey and control operations in the Zanskar Valley of Jammu and Kashmir State. The team must leave for the destination by the next day morning due to a locust emergency.

The said order made me a little perplexed because of having no field experience in locust control, and not having much pocket allowance as there was no time left for a bank withdrawal. Also, J&K State was a terrorist hit state at that time and we had to carry out the control operations in a very remote area at high altitude (12 000-16 000 feet above sea level) in a cold and dry zone. I met with my PPA and asked him to send someone else in my place, but he did not agree, reminding me that I am from the hilly state and must be familiar with the hardships in the hill region.

Anyhow, our team of six persons proceeded the next day to our destination. Before visiting the Zanskar Valley, the team had a meeting with the Principal Secretary of Agriculture and the Director of Agriculture of the concerned State (J&K) at Srinagar State headquarters to review the control potential available with the State Government and decide the future course of action. On 12 August, the team was airlifted by State Government helicopter to Kargil District Headquarters. There, the team had meetings with the District

Administration Authority including the Collector and Sub Divisional Magistrate. They provided us with vehicles, made arrangements for pesticide, and advised their field functionaries at the actual sites of control operation to provide the desired assistance to the central team that was on its way.

On the next day, we proceeded by road from Kargil to Zanskar Valley, the actual site of the pest outbreak. We reached Padam, Tehsil HQ at about 9 PM after covering a distance of about 200 km all day. The road was quite unsafe and passed through some very hard areas. We did not see any inhabitants for miles and miles. We were able to get something to eat and water to drink but only with great difficulties. When we reached Padam where our stay arrangement had been made, we saw locusts settled on the ground all around us. It was difficult to walk on the road with so many resting locusts. On close examination, it was found that the insect was the Migratory Locust not Desert Locust.

On 14 August, different control teams were formed in association with the State agriculture officers. The control operations continued for one week, up to 21 August, in the Zanskar Valley at various localities. In total about 5 300 ha were scanned by the survey teams out of which 220 ha were found heavily infested with locust and treated with pesticide. The locusts were present in nearly all the fields along the survey route. Infestations were found everywhere, including farms, roads, pastures, barren lands, hilly terrain, along the sides of water bodies, near boundary walls of residential houses, and so on. The number of migratory locusts in these areas was countless. It was quite a sight. About 90% of the standing crop was found damaged. Although the crop was almost completely destroyed, control operations were carried out to prevent the next generation. No predatory birds and other fauna were observed in the surveyed area in the valley, which may be one of the reasons for the outbreak.

At the direction of the higher authority, I along with two other locust experts was advised to move to Chanthang Valley in District Leh of J&K State to observe the situation there. We moved on 18 August and reached Nyomo Tehsil HQ of Chanthang Valley on the 20th. The locust situation was nearly similar to Zanskar Valley. Infestations were present all along both sides of the Indus River for nearly 250 km as well as in pastures. Migratory Locusts were also reported across the Indo-China border in the Demchok area. Control operations were undertaken for four days.

There were some funny moments during this locust control operation. I remember that the farmers in the villages of Demchok, Skakjung, Kuyol and Rongo did not allow the spraying of pesticides and requested the control team with folded hands not to kill the pest. Their plea was that these pests are also like our children; it is their right to develop in the environment suited for them. The matter was brought to the notice of local administration authority. The Sub-Divisional Magistrate visited the sites and tried to convince the farmers about the impact of pests on their crops and livelihoods, but these farmers remained adamant. Later on, they called their religious leader who also favoured them and control operations had to be stopped. Asked about how to save the standing crops from insect damage, they replied that they will make some spiritual acts that will prevent the incidence of pests. The inhabitants of these valleys are mostly Buddhists and as per their statements killing of any organism is against their religion. Similar cases came to our notice during the control operations in Zanskar Valley.

Of course there were adventurous moments, too. In fact, the entire locust control operation was one big adventure for me because it was my first experience of working in such a hard area where the roads were very risky and dangerous to life. For miles together no local inhabitants were seen. Only army people were there at certain places that helped us to locate the way from one village to another. No communication system was there, except wireless sets with the army persons. We could not communicate to our family members during these operations as no mobiles worked in these areas. If some faults arose in the vehicle, no one was there to repair them and we would have had to wait for some other vehicle in order to leave the area. We could not walk very fast due to the high altitude. Some of the team members were hospitalized and two persons were airlifted immediately back to their home as there was no improvement in their health.

Finally, on 25 August with the permission of local administrative authority, we started our return journey. On reaching Srinagar two days later, we could contact our Plant Protection Adviser, and informed him of our return journey. Our PPA enquired whether we had written permission from the District Collector of Leh or from the SDM of Nyomo, which we were not having. We were directed to go back and bring the certificate from concerned authority that the control operation was over and a further stay of the central control team was not required. This made us quite perplexed as we were running short of pocket money and going back meant we would have to spend three to five extra days there. We were completely exhausted and were about to

lose our temper. On that night we could not sleep and spent a long restless night. In the morning, we approached the higher authority at the Ministry level, explaining our woes and assuring if the need arises, we are ready to go a second time after visiting our family and arranging the pocket money. In this way, we were allowed to return to our homes.

7. Contributor biographies

Shirzad Behzadi was born in 1956 in Masjid Sulaiman, Iran. After he obtained a degree from Shiraz University in Agriculture Engineering (Plant Protection) in 1984, he started working in Boushehr as a Plant Protection Expert. He has also been involved in locust operations including the Iran/Pakistan joint survey. He is currently the Technical and Executive Manager of Shahinshar agriculture management in Esfahan.

Munir Butrous was born in 1949 in Omdurman, Sudan. He joined the Plant Protection Directorate (PPD) as a plant protection officer. in 1972 From 1974 to 1976, he worked in the Pesticide Chemical Lab, Agricultural Research Corporation in Wad Medani. After obtaining a Ph.D. degree in Agricultural Science (Agricultural Pesticides) in 1981 from Wye College, University of London, United Kingdom, he returned to the lab. In 1985, he was transferred to PPD HQ and was promoted in 1988 to Deputy Head of the Locust Control Section. In 1996, he became a National Professional Officer in the FAO EMPRES/Central Region programme in Sudan. In 2001, he was appointed as Executive Secretary of the FAO Commission for Controlling the Desert Locust in the Central Region in Cairo. He retired in 2011.

Harish Chandra was born in 1939 in Uttar Pradesh, India. In 1960, he obtained a M.Sc. degree in Zoology (Entomology) from Government Agricultural College, Kanpur (Agra University). After working for a year in the State Department of Agriculture in Uttar Pradesh, he joined the Directorate of Plant Protection, Quarantine & Storage (PPQS), Ministry of Agriculture where he held various positions as Locust Technical Officer, Plant Protection Officer, Assistant Director (Entomology), Deputy Director (Entomology), and Joint Director (Entomology). From 1971 until his retirement in 1997, he worked at the Field Station for Investigations on Locusts (FSIL). After he

retired, he obtained a Ph.D. from Shri Ganga Singh University in Bikaner in 2009. He has published numerous research papers and has received several distinguished awards.

Keith Cressman was born in 1959 in California. In 1981-1983, he was a Peace Corps Volunteer in Tunisia. He obtained M.Sc. degrees in International Agriculture Development and Plant Protection from the University of California, Davis in 1987. He then joined FAO as an Associate Professional Officer and was posted to the Locust Section in the Plant Protection Department in Khartoum, Sudan during the locust plague of 1988-1989. Since then, he has worked in the Desert Locust Information Service (DLIS) at FAO HQ, first as Locust Information and Forecasting Officer and now as Senior Locust Forecasting Officer.

Hans Dobson was born in 1959 in Bristol, United Kingdom. He worked for two years with Voluntary Service Overseas running a school farm and teaching agriculture in Zambia, followed by stints as an outdoor pursuits instructor on the shores of Lake Tanganyika and in Penrith, United Kingdom. In 1984, he obtained a M.Sc. degree in Agricultural Engineering at Silsoe College, Cranfield Institute of Technology. Since 1985, he has been working as an IPM Specialist at the Natural Resources Institute (NRI) in the United Kingdom, with secondments to the Department for International Development, FAO's Emergency Centre for Locust Operations in Rome, and to Imperial College London at Silwood Park.

Clive Elliott was born in 1945 in Tanzania. He studied zoology at Oxford University for a BA (Hons) and further at Cape Town University, South Africa for a Ph.D. He joined FAO in 1975 working on the bird pest problem which is often called the "avian locust", the Red-billed Quelea, in Chad. In 1978 he transferred to East Africa, first in Tanzania, then Kenya working on the same problem, often controlling pest concentrations with aircraft including those of

the Desert Locust Control Organization for Eastern Africa. In 1989, he transferred to FAO HQ and joined the Locust Group in 1995 as a Senior Officer. He became in-charge of the Locust Group in 2004 just as a major locust upsurge took hold. He retired in July 2006 after 31 years at FAO. He continues to carry out the occasional consultancy in locusts or bird pests.

Mehdi Ghaemian was born in 1966 in Rasht, Iran. In 1993, he joined the Plant Protection Organization as Locust Survey Officer and became Locust Information Officer in 1998. He obtained a M.Sc. degree in Pest Management (Applied Entomology) from Imperial College, United Kingdom under a FAO fellowship in 2002. Upon his return to Iran, he was promoted to Head of Locust and Grasshopper Control and, six years later, to Deputy Head of Common and Public Pest Management. He is currently the Head of Common and Public Pest Management. In addition, he has developed several important software applications used by locust-affected countries.

Azam Khan was born in 1958 in Tajori village, Pakistan. He graduated from the University of Karachi with a M.Sc. degree in Zoology, specializing in Entomology. Since 1984, he has worked in different institutes such as the Pakistan Agricultural Research Council (PARC) and the Commonwealth Institute of Biological Control (CIBC), and the Department of Plant Protection, Ministry of Agriculture. Presently, he is the Deputy Director (HQ) and works as Locust Head in Karachi. He is also a Master Trainer.

Zafar Ali Khan was born in 1949 in Peshawar, Pakistan. He obtained a M.Sc. degree in Zoology (Entomology) from the University of Peshawar in 1975. He began his career as a Junior Entomologist at the Commonwealth Institute of Biological Control (CIBC) in 1977. He joined the Department of Plant Protection, Ministry of Agriculture where he was an Entomologist for two years, followed by Deputy Director and Technical Director. He was Locust Head in Karachi from 1997 until his retirement in 2010.

Anil Sharma was born in 1953 in India. He obtained a M.Sc. degree in Zoology. He joined the Locust Warning Organization (LWO) in 1988 and supervised numerous control campaigns in the Jaisalmer area over a 25-year span until his retirement in 2013. He was also the Master Trainer for LWO.

J.N. Thakur was born in August 1955 in Village Bhumtir, Kullu H.P., India. He obtained his Ph.D. in Life Sciences with a specialization in Entomology from H.P. University, Summer Hill Shimla, Himachal Pradesh, India. He first joined Government service in 1981 as Assistant Plant Protection Officer (Ento.) in the Directorate of Plant Protection, Quarantine & Storage (PPQS), Ministry of Agriculture, Government of India through the Union Public Service Commission (UPSC). Subsequently, he worked as Plant Protection Officer (Ento.), Assistant Director (Ento.) and Deputy Director (Ento.). During his service tenure, he worked on biological control, integrated pest management, plant quarantine and locusts. He has published numerous scientific research papers in reputed journals. He is presently Joint Director (Ento.) and is responsible for the national locust programme in India.

8. A collection of historical photos

First high-level locust meeting between India and Pakistan in 1948

During the 1950s and 1960s, farmers killed hopper bands by burying them in trenches

Desert Locust surveys were undertaken in Rajasthan by camel during the 1950s

Dusters were used to control Desert Locust infestations in Rajasthan during the 1950s

A jeep with power duster spraying eggfields during the 1950s in Rajasthan where Desert Locust bred

Spray aircraft were unloaded from a transport plane in Abadan for immediate use in a Desert Locust control campaign in southwest Iran during the early 1950s

Ground control of Desert Locust infestations in Iran using poison bait during the early 1950s

A village boy looks up at the sound of a spray plane as it flies overhead during a Desert Locust control campaign in Pakistan in 1955

Loading water from a river to be transported by camel to a camp in the desert where it is used to dilute pesticide to be used in aerial control operations against Desert Locust infestations in Pakistan during 1955

©USOM/Pakistan

Entomologists checking Desert Locust control results in Pakistan in 1955

©USOM/Pakistan

Village children examine dead locusts at the scene of locust spraying operations in Pakistan during 1955

©USOM/Morocco

FAO Technical Advisory Committee on Desert Locust Control, Tangier, Morocco in June 1957. Left to right: K.B. Lal (Plant Protection Advisor and Director of Locust Control, India), Esfandiar Esfandiari (Administrator General of Plant Protection, Iran), Habibollah Nasser (Chief, Locust Control Service, Iran)

Aircraft used for aerial control operations during the 1960s in India

Ground control operations were commonly carried out in Rajasthan using vehicle-mounted Exhaust Nozzle Sprayers during the 1960s

CJ7 jeeps were used from the 1960s to the 1980s for locust surveys in Pakistan

©FAO

A field demonstration at the third Desert Locust training course in Karachi, 15 July to 23 August 1963

©FSIL/India

A Desert Locust swarm in Rajasthan in 1961

©PPD/Pakistan

Locust survey using camels in Cholistan during 1963

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An international training course in Karachi on radio communications in 1963

©PPD/Pakistan

Controlling Desert Locust hopper bands in Pakistan by digging trenches during 1962-1963

©PPD/Pakistan

Results of hopper band control operations in Pakistan during 1962-1963

Locust control operations in Baluchistan using a vehicle-mounted Exhaust Nozzle Sprayer during 1962-1963

Locusts on a doorstep in Pakistan during 1962-1963

Locusts for sale in Pakistan during 1962-1963

The Field Station for Investigations on Locusts in Bikaner, India in 1965

Class of the sixth Desert Locust training course in Tehran during 1966

Checking soil moisture during a locust survey in Iran in 1966

The 4th Session of the Executive Committee of the Commission was held in Karachi on 5-7 March 1969

Desert Locust survey in Iran during 1966

The 5th Session of the Commission was held in Karachi on 10-13 March 1969 and chaired by Heshamul Huque from Pakistan

The 7th Session of the Commission was held in New Delhi on 15-18 February 1971

The 7th Session of the Commission, held in New Delhi on 15-18 February 1971, was chaired by S.N. Banerjee from India and assisted by the Commission Secretary, S.S. Pruthi

A locust meeting in Iran during March 1972

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Examining the results of control operations carried out in the Kharan Valley of northern Baluchistan, Pakistan in March 1974

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UNDP/FAO training course in aerial survey and spraying techniques for locust control held in Karachi during March-April 1975

©FAO

The 11th Session of the Commission was held in Karachi on 8-12 December 1975

The 11th Session of the Commission was chaired by Farid Uddin Ahmed from Pakistan, assisted by the Commission Secretary, S.S. Pruthi

Desert Locust control operations on the coast in southwest Iran near Bushehr using bait in 1989

Participants at the regional workshop on Desert Locust survey and ULV control in Jodhpur on 2-14 December 1991

©FAO

The four trainers at the regional workshop on Desert Locust survey and ULV control in Jodhpur were (L-R) Max de Montaigne, Hans Dobson, Harold van der Valk, and Keith Cressman

©FAO

The 19th Session of the Commission was held in Tehran on 5-9 February 1994 and was chaired by Ahmad Rassipour from Iran

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The annual Desert Locust joint survey in the spring breeding areas of Iran and Pakistan was re-established in 1995

The month-long survey is undertaken jointly by a single Iran/ Pakistan team in spring breeding habitats on both sides of the common border

The 1995 joint survey team on the border at Mirjaveh, Iran and Taftan, Pakistan with locust officers from Iran, Pakistan and FAO

Desert Locust control operations in Iran near Iranshahr in Sistan-Baluchistan province in 1996

©PPO/Iran

Desert Locust control operations using a vehicle-mounted Exhaust Nozzle Sprayer near Saravan in Sistan-Baluchistan province of Iran in 1996

©FAO

The 1996 Desert Locust joint survey team in the spring breeding areas of Iran and Pakistan

©LWO/India

A national training course was conducted in Jaisalmer, India during September 1996

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SWAC organized a national training course in Mirpur Khas, Pakistan in July 2000 to train locust officers in survey and control techniques

©FAO

The 24th session of the Commission was held on 10-14 January 2005 in New Delhi

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Participants at the 24th session of the Commission in New Delhi on 10-14 January 2005

The Commission organized a regional training course on the advanced use of eLocust2, RAMSES and remote sensing imagery for Locust Information Officers from India, Iran and Pakistan that was held at LWO Field Headquarters in Jodhpur, India on 12-16 June 2006

Regional training in Jodhpur, India during June 2006

The Desert Locust Information Officer training course in Jodhpur consisted of numerous demonstrations and practical exercises

After a 40 year gap, Afghanistan hosted the 26th Session in Kabul in December 2008

SWAC/CRC interregional workshop to train Desert Locust Master Trainers held in Ramsar, Iran on 8-13 May 2010

The 24th session of the Commission was held in New Delhi on 5-7 December 2012

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A regional workshop on contingency planning was held in Tehran on 13-15 October 2013

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Locust Information Officers from frontline countries in the three regions gathered at a RAMSES/eLocust3 workshop held in Agadir, Morocco on 19-23 May 2014

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A national Training-of-Trainers workshop was held in Jodhpur from 27 October to 1 November 2014 to identify new potential Master Trainers in India

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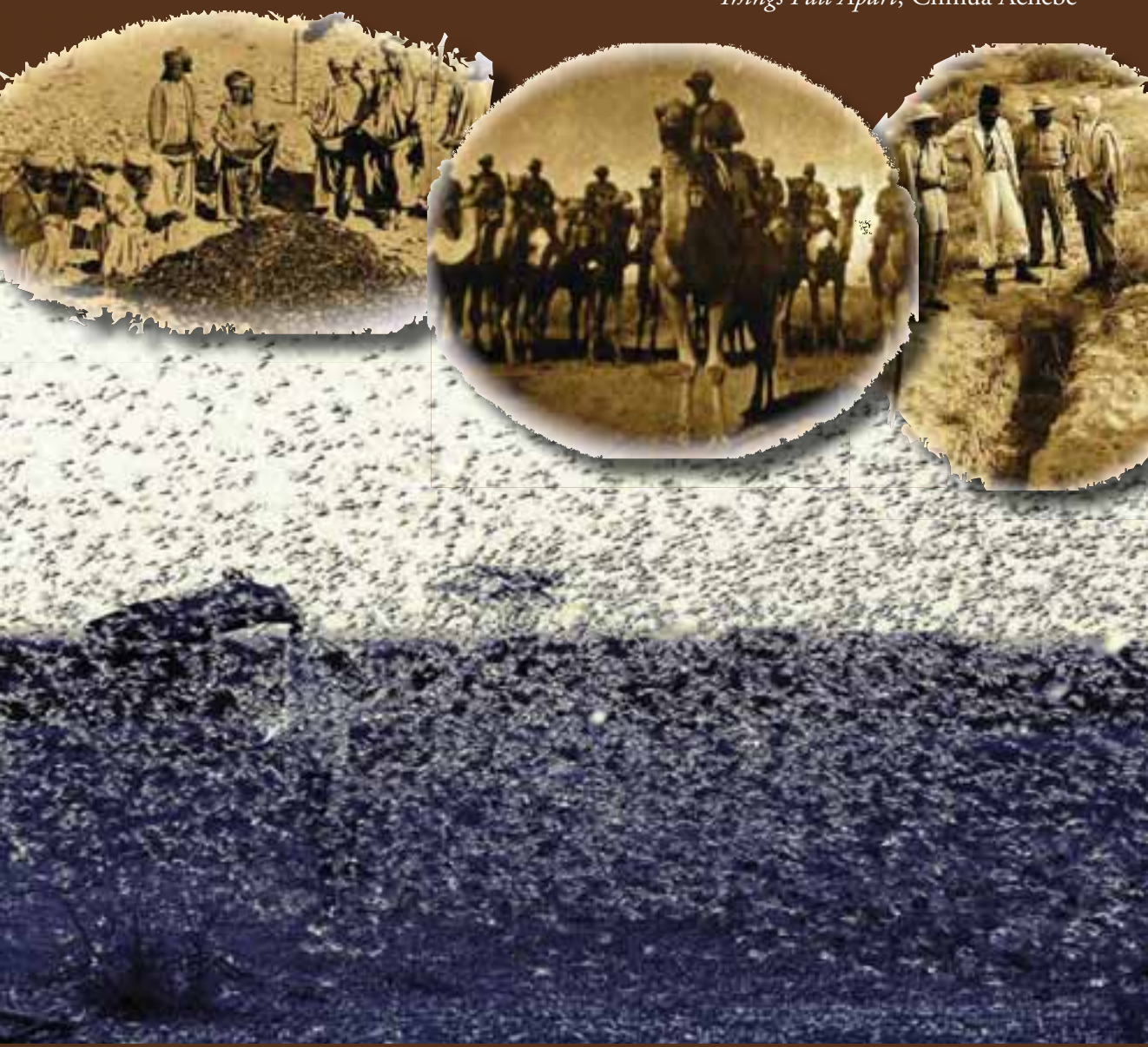
"And at last the locusts did descend. They settled on every tree and on every blade of grass; they settled on the roofs and covered the bare ground. Mighty tree branches broke away under them, and the whole country became the brown-earth color of the vast, hungry swarm."

Things Fall Apart, Chinua Achebe



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