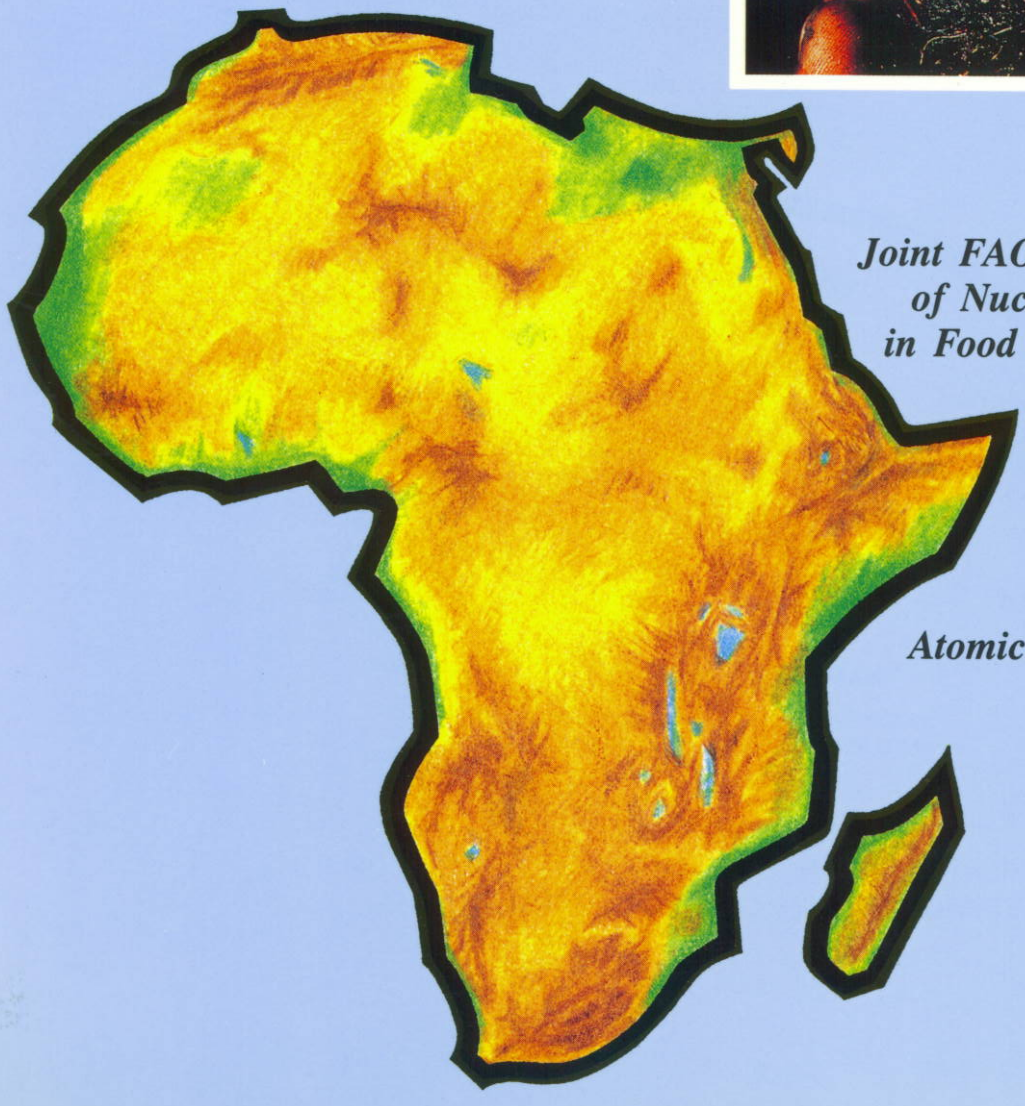
A Programme for the Eradication of the New World Screwworm from North Africa

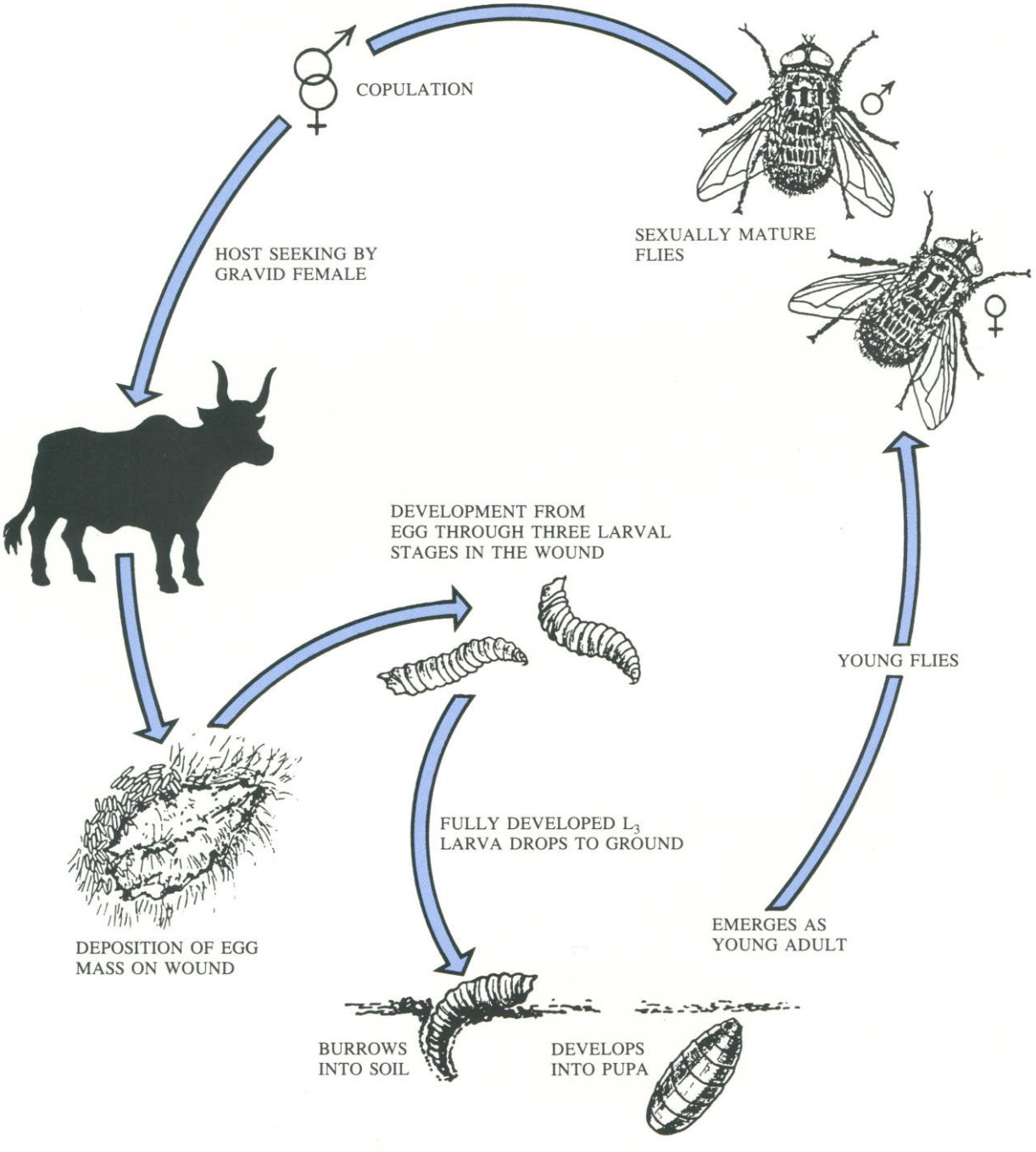
Prepared by a Consultants Group
Vienna, 8–9 January 1990



Joint FAO/IAEA Division
of Nuclear Techniques
in Food and Agriculture

International
Atomic Energy Agency

LIFE CYCLE OF SCREWWORM FLY



A PROGRAMME FOR THE ERADICATION OF THE NEW WORLD SCREWWORM FROM NORTH AFRICA

Prepared by a Consultants Group
Vienna, 8–19 January 1990

JOINT FAO/IAEA DIVISION
OF NUCLEAR TECHNIQUES IN FOOD AND AGRICULTURE
INTERNATIONAL ATOMIC ENERGY AGENCY

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INTRODUCTION

The recent establishment of the New World Screwworm (NWS), *Cochliomyia hominivorax,* in North Africa poses an enormous threat to that continent, as well as the Mediterranean Basin and the Middle East. Because of the urgent need to initiate an eradication programme as soon as possible, three consultants (Annex 1) met in Vienna from 8 to 19 January 1990 to prepare a programme outlining the eradication of the NWS from North Africa. Emphasis was placed on the Sterile Insect Technique (SIT) portion of an eradication programme.

At the time the report was prepared the NWS had been reported only from Libya, therefore the report deals with eradication from that country.

The document will be used by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture as a guide to assist FAO in NWS eradication from North Africa.

CONTENTS

I. EXECUTIVE SUMMARY

The New World Screwworm (NWS), *Cochliomyia hominivorax,* has become established in Libya. Unless eradicated it will spread throughout Africa, the Middle East and southern Europe. The NWS is the most destructive insect pest of livestock in the Americas. Never before has it become established outside of the Americas.

The NWS is a parasite of all warm-blooded animals. The female lays eggs in wounds as small as tick bites. The eggs hatch into larvae (maggots) which eat the living flesh of animals. Unless treated, death of the animal is a common occurrence. Livestock, wildlife and humans are attacked by this destructive pest.

The NWS female can lay up to 400 eggs at a time and a generation can be as short as 3 weeks. Although the insect can only overwinter in a mild climate, it can move far into temperate areas in the summer. The climate in much of Africa, the Middle East and southern Europe is suitable for the NWS to become established.

Although the NWS can fly long distances, the most common method by which it spreads is through the transport of infested animals. Undoubtedly the pest was transported to North Africa in infested animals from the Western Hemisphere.

Livestock owners must inspect their animals at least twice a week and treat all the wounds with an appropriate insecticide to prevent serious sickness or death. The NWS is particularly destructive of wildlife, which cannot be treated. Human infestations are relatively common and may cause death if not treated.

With intensive animal inspection by owners and treatment of all wounds with the appropriate insecticide as a preventive or curative measure, livestock sickness and death can be reduced. These control procedures, however, are labour intensive and expensive, estimated to be at least US $4 per head of livestock per year. With 70 million head of livestock in the five North African countries, the annual cost of control for livestock will total more than US $250 million.

If the NWS is allowed to become established in Africa south of the Sahara losses of wildlife will be extensive. Up to 80% of the newborn mammals may die annually from NWS attack.

The NWS has been eradicated from the USA, Mexico and some Caribbean islands by use of the Sterile Insect Technique (SIT) integrated with surveillance and treatment of wounds, and control of animal movement. Use of SIT requires huge numbers of sexually competitive sterile insects which mate with native insects and prevent production of offspring. Sterile NWS can only be obtained from the one NWS mass rearing facility in the world, located in Tuxtla Gutiérrez, Mexico. Standard technology has been developed and used for 25 years to eradicate NWS in the Americas. Cost/benefit analyses on the eradication programmes in the USA and Mexico have been very positive, in spite of the high cost of the programmes.

The objective of this proposed programme is to eradicate NWS as soon as possible from North Africa. Only eradication will prevent the expected enormous devastation of livestock and wildlife populations, human suffering and death, which will occur in the Hemisphere.

It is now technically feasible to eradicate the NWS from its limited area (about 18 000 km^2) of infestation in Libya. When the NWS spreads, which is inevitable, it will not be possible to eradicate at any cost. The situation can be described as virtually "now or never".

In 1960 the cost of living with the NWS infestation in the USA was estimated at US $100 000 000 per year and by 1980 the cost estimate of a possible reinfestation was US $378 000 000 per year. The few studies elsewhere in the Americas were of similar magnitude in comparison with livestock at risk. Evidence of how seriously livestock owners consider this disease can be indicated by personal contributions and political pressures by livestock producers to have programmes implemented for NWS eradication once the technology became available. Costs to eradicate the pest from the southern USA and Mexico exceeded US $500 million. Cost/benefit analyses of programmes have been universally favourable. In the USA they exceeded 1:10. Strategy in the Americas differed from that planned for North Africa. In the Americas, areas were progressively eradicated and protected by barriers to contain

infestation. Such barriers should only be temporarily required in North Africa. The cost/benefit of completely eradicating a limited area of infestation before it spreads throughout the Hemisphere will be overwhelmingly favourable.

Large losses of newborn fawns in NWS infested areas of the USA were observed. Deer populations rapidly increased after NWS eradication. There are no large migrating herds of wildlife in tropical America. Projected effects on the game herds of Sub-Saharan Africa are alarming.

Recognizing the disastrous potential of spread throughout the Eastern Hemisphere, urgent and considerable Libyan, FAO, IAEA, UNDP and IFAD resources have been committed to this emergency. The strategy is to assist countries infested with NWS and at immediate risk. The objectives are to attempt to prevent its spread and to continuously define the limits of infestation. Intensification of these efforts will be required as integral parts of the eradication programme.

Risks inherent to the programme include the NWS mobility, which could extend its range beyond the possibility of eradication at any time. The nature of sterile insect production includes biological risks, in addition to those caused by human or physical interference. Outbreaks in North America where the NWS has already been eradicated could require diversion of sterile fly plant production to protect the massive investment in previous programmes. The risks in infested North Africa include, most importantly, difficulties in programme execution.

The number and stringency of prerequisites to programme success are also considerable. These include arrangements to obtain a sufficient number of sterile flies from the plant of the Joint Mexico–US Screwworm Eradication Commission in Mexico, donor support on a continuing basis, complete support of North African governments to permit execution of an eradication programme along with their active participation, and the acceptance, by all concerned, that eradication will be successful only with timely and co-ordinated action. Successful eradication will require the establishment of a separate organization devoted solely to the eradication campaign.

Simultaneous upgrading of the existing sterile NWS facility in Mexico for increased production and the creation of an eradication organization with autonomy of resources and operation will be the first steps in the programme. Strengthening NWS control and surveillance activities in Libya also are required. Preparation of sterile fly transport and dispersion aircraft will follow, then increased fly production. A commitment for the production and dispersion of up to 100 million flies per week for an indeterminate period must be foreseen. Budgetary requirements of the programme should be based on quarterly requirements. If all activities are executed without delay and with precision, eradication could be achieved within one year after start of sterile releases.

The budget for a two year programme of operations is estimated at US $80–85 million. This is in addition to contributions by participating North African governments.

The consultants prepared a brief statement on some of the points for NWS eradication from North Africa which they felt were of particular importance. These included programme management, method of transporting sterile flies from Mexico to North Africa and the "Regional Pilot Biological Control Programme for the New World Screwworm in North Africa" which has been approved by IFAD/UNDP. These comments and a specific recommendation on the pilot test are attached as Annex 2.

II. PROGRAMME

A. PROBLEM

In 1988 both veterinary and medical authorities reported the presence of the New World Screwworm (NWS), *Cochliomyia hominivorax* in Libya. Subsequent investigations confirmed that it had become established, the first time outside its home range in the tropical and sub-tropical Americas.

The NWS is considered the most important insect pest of livestock in the Western Hemisphere, causing economic losses of hundreds of millions of dollars annually. Losses result not only from loss of productivity due to sickness and death, but also from the labour and insecticide costs of continuously inspecting for and treating wounds. This pest also attacks humans, pets and wildlife.

The larval stage of the NWS is an obligate parasite of living flesh of warm-blooded animals. Gravid female flies are attracted to wounds, even those as small as tick bites. Eggs are laid in and on the edges of these wounds. The eggs hatch and the larvae feed on the living tissue. Wounds enlarge and infections occur. Death is frequent. The life cycle is completed in about 3 weeks under optimum conditions.

Animals must be individually inspected at least twice weekly and all wounds treated with an appropriate insecticide to prevent or cure NWS infestations.

Favourable climate, vegetation and an abundance of hosts (livestock and wild animals) assure that the NWS will continue to spread throughout North Africa and invade Africa south of the Sahel, the Middle East and southern Europe. Spread will be primarily by movement of infested animals. Costs of control and losses to livestock owners will be extensive and may exceed US $1000 million per year.

Based on data from the Americas, the cost of insecticides plus labour to inspect and treat animals will total at least US $4 per head per year in Libya and other North African countries. Thus Libya, with more than 7 million head of livestock, will be faced with costs exceeding US $28 million per year. In addition, livestock losses from reduced weight gain and other reduced productivity, death, quarantine restrictions, etc., will be significant.

Extensive changes in the livestock management practices will be required to reduce losses.

Of urgent concern is the impact that the NWS will have on wildlife in Africa, south of the Sahel. The presence of large herds of wildlife, all giving birth to young at the same time, will result in enormous NWS infestation rates. The mortality rate in these newborn animals may approach 80%, based on data from deer herds in south Texas. The potential impact on wildlife in Africa is a grave concern to wildlife conservationists throughout the world.

Unless a successful NWS eradication programme is implemented, this pest will spread throughout Africa, the Middle East and southern Europe. Costs of control and losses of livestock and wildlife will be of major consequence. Human infestations will be common until people adopt preventive practices. The quantity of insecticides required for NWS control will be enormous.

B. BACKGROUND

The NWS has a high reproductive rate. Each female lays several batches of eggs of up to 400 eggs each. A generation can be as short as 3 weeks under ideal climatic conditions.

The immature stage of the NWS is an obligate parasite of living animals. The female fly lays eggs in wounds of any warm-blooded animal, including humans. The eggs hatch and the larvae eat the living flesh. If not treated with an appropriate insecticide to kill the larvae, they will feed for 5 to 6 days with a great expansion of the wound. They then drop to the ground, burrow into the soil, pupate and emerge as adults 5–6 days later. In a few days the females of this new generation will lay eggs in wounds.

These flesh eating worms cause enormous damage to livestock and wildlife and also can be a serious human health problem.

Based on data from the Americas, the cost of controlling the screwworm is estimated at US $4 per head of livestock per year. The effects of the NWS on wildlife in Africa will be extensive as curative treatments are not possible on wildlife.

The NWS has been eradicated from the USA, Mexico, and several Caribbean islands using a combination of the Sterile Insect Technique (SIT) and intensive animal inspection, wound treatment, animal movement control and quarantine.

The SIT requires the release of huge numbers of factory reared, sexually sterile insects. Sexual sterility is induced by exposing the late pupal stage to gamma radiation. When these sterile insects mate with wild insects, no progeny are produced. By maintaining over several generations a ratio of 10 to 20 sterile insects for each wild insect, eradication is achieved in a relatively short period of time.

The economics of the NWS eradication programmes in the New World have been very positive, in spite of the very high cost. Cost/benefit ratios in the USA exceeded 1:10. It is anticipated that cost/benefit ratios in this range would be obtained for an eradication programme of the NWS from Libya.

Unless the NWS is eradicated in the immediate future from Libya, it will spread to neighbouring countries, Africa south of the Sahara, as well as the Mediterranean Basin and the Middle East. The losses will be staggering.

UN organizations have mobilized significant resources to initiate activities in Libya and other North African countries to combat the NWS. The Libyan Government has made available more than US $7 million towards this effort. FAO has made available some US $2 million which have been used for insecticides, equipment, expert services, training courses, scientific visits, etc., to assist in the eradication programme. UNDP and IFAD have made significant funds available for various programme activities. The IAEA has made a modest financial contribution and made available members of its staff to assist in the programme.

Additional background information is in Annex 3.

C. OBJECTIVES

The development objective is to eradicate the NWS from its current rather small area of infestation in Libya. The eradication of this pest will eliminate extensive control costs and losses to Libyan livestock and more importantly eliminate the danger that the pest will spread throughout Africa, the Middle East and southern Europe. **The immediate objective is** to provide equipment, supplies, personnel and training required to implement a successful NWS eradication programme in North Africa. The eradication campaign will be conducted in Libya where the NWS has become established in an area of about 18 000 km^2 as of January 1990. Other areas of Libya and other countries in North Africa at risk from invasion by the NWS will be involved in intensive surveillance, wound treatment, livestock movement control, and quarantine activities to prevent the spread of pest from its present confined area in Libya. The eradication programme will involve the integration of the release of sterile NWS flies, intensive animal movement control, quarantine, and surveillance and animal wound treatment. A successful eradication programme will thus prevent Africa and neighbouring regions from the devastation caused by the NWS to domestic livestock, wildlife and humans.

Of particular importance will be the elimination of this threat to the livestock of the small farmer throughout Africa who will not have the resources to effectively treat infected animals. Many of these small farmers rely on livestock for their livelihood which will be jeopardized when the NWS spreads throughout Africa.

The entire human population of the region will benefit from the programme by not suffering a reduction in the quantity of meat and dairy products available.

The training which will take place during the eradication campaign will greatly benefit national capabilities to handle emergency eradication programmes in the future.

D. ACTIVITIES

In order to achieve the ultimate objective of NWS eradication from North Africa, certain activities must be planned and executed. These activities are described in considerable detail in Annex 4.

The activities necessary include both administrative and technical aspects. The activities described for the North African programme are based on a history of more than 20 years of successful NWS eradication programmes in the Americas. While some adaptation may be required, the basic administrative and technical programme elements are considered to be standard operating procedures.

The initial planning, establishing an effective and efficient organization to conduct the eradication programme and arranging for administrative procedures which permit the required flexibility in programme activities will, to a large extent, determine the success or failure of the programme. Considering that the NWS eradication programme is an emergency, the organization to be established and the administrative procedures to be used by that organization will, of necessity, be somewhat different than the usual bilateral and multilateral funded project to assist developing countries.

Of prime importance in a successful NWS eradication campaign in North Africa will be the arrangement of contracts for major parts of the programme. If possible, the entire eradication programme should be contracted. Contracting, however, will not decrease the responsibilities of the FAO to oversee the effective performance of the contractors nor will it relieve FAO, other UN organizations, the donors, and Libya of being ultimately responsible for the NWS eradication from Libya.

Ongoing programme activities in Libya must be intensified as soon as possible. These include surveillance, identification and wound treatment of livestock throughout the country and particularly within the known infested area and the immediately adjacent areas. Every effort must be made to involve livestock owners in this activity.

The control of animal movement within Libya and an effective quarantine must be intensified. Animal movement control and quarantine constitute the primary method of preventing spread of the NWS. Therefore, this programme activity must receive very high priority.

The present information campaign in Libya and adjacent countries must be strenghtened in order to alert the general public, animal owners and government officials, of the necessity for surveillance, identification and wound treatment activities, control of animal movement and quarantine, and the initiation of the eradication programme utilizing sterile NWS.

The only NWS mass rearing facility in the world is in Tuxtla Gutiérrez, Mexico. The present production capability of this facility is not sufficient to handle the current needs of the programme in Mexico and Central America as well as the one in Libya. Therefore, the facility must be upgraded as soon as possible so that sterile NWS flies can be made available for the Libyan NWS eradication programme. The transport of the sterile NWS from Mexico to North Africa can be done either by shipping bulk sterile pupae or by shipping pre-boxed sterile pupae. The latter is preferred. In either case, charter aircraft will be required for this activity. The receipt and handling of the sterile pupae in Libya will require extensive preparation. Climate controlled facilities must be available and individuals must be trained in procedures to ensure that the sterile flies are handled in a manner which will not reduce their effectiveness once they are released in the infested area.

The release of sterile flies will require several aircraft flying from before sunrise until mid-morning when temperatures will become too high for the release of sterile flies. Arrangements for these release aircraft, training of pilots and monitoring of the releases all require extensive initial planning and training.

Quality control tests on all shipments of sterile flies from Mexico are mandatory in order to ensure that effective sterile flies are released in Libya.

Emergency programmes such as NWS eradication from Libya require a rapid, accurate and extensive flow of technical information. A system utilizing computer technology should be developed for this information management system.

Requirements for on-the-job training will be extensive and must be initiated several months prior to the time that significant numbers of sterile flies are to be released in Libya.

A small research and development unit must be established several months before the actual eradication programme is initiated. This unit must be responsive to programme needs and problems.

The activities listed below are described in considerable detail in Annex 4.

(1) Prepare eradication plan.
(2) Establish organization to conduct eradication programme.
(3) Arrange for contracts.
(4) Continue and improve the intensive surveillance, identification and wound treatment activities initiated during the already ongoing surveillance and control projects (FAO and UNDP).
(5) Intensify effective control of animal movement and quarantine.
(6) Intensify information campaign.
(7) Production of sterile NWS flies.
(8) Transport of sterile NWS from Mexico to North Africa, receiving and handling.
(9) Release of sterile flies.
(10) Quality control of sterile flies.
(11) Technical evaluation.
(12) Administrative evaluation.
(13) Technical information management system.
(14) Training.
(15) Research and development.

E. PREREQUISITES

The NWS eradication programme from Libya is an emergency action programme. Therefore, it is essential that all organizations involved in the programme clearly understand their duties and responsibilities for a successful programme. An emergency programme is very different from the more usual multilateral or bilateral type of agricultural development projects. Flexibility must be maximum and bureaucracy a minimum. An emergency programme in which the outcome is of such vital importance to a region, such as the NWS eradication from Libya, will only be successful when all participants adjust their usual rules and regulations to meet programme requirements.

Nearly all of the prerequisites are non-technical since the technology for NWS eradication has been used for more than 20 years in the New World.

Detailed prerequisites are identified in Annex 5 for national governments, organizations, management, and funding.

F. PROGRAMME COMPONENTS

The components of the programme are:

(1) the contributions of the African countries which are infested or at risk of being infested; and
(2) the donors' contributions.

The contributions of the North African countries are in general those items identified in the prerequisites (Annex 5, Sections 9 and 10). In addition, the governments will provide office space, other facilities required for the programme, and personnel as required. Equipment and supplies previously received from donor organizations for use in the screwworm programme will be made available for the eradication programme.

The donors' contribution, estimated at about US $80–85 million for a two year programme, includes personnel, equipment, supplies, sub-contracts, etc. These items are summarized in Annex 6.

G. WORK PLAN

A detailed work plan will be one of the first tasks required of the programme managers. The work plan will require frequent adjustment as the programme progresses. An outline of the work plan, following the list of activities identified above, is in Annex 7.

H. OPERATIONAL/INSTITUTIONAL ARRANGEMENTS

The character of an emergency action programme, such as the eradication of the NWS from North Africa, requires institutional arrangements and operational procedures which are different from the usual ones used by United Nations or bilateral aid organizations. Flexibility in all aspects of operations must be built into the arrangements.

1. Organization

A separate organization established specifically for eradication of the NWS screwworm from North Africa is required. This organization, while temporary in nature, must be immediately established with complete authority to conduct the campaign. The organization must have no other responsibilities than the NWS eradication campaign. As of January 1990 the NWS infestation in North Africa is reported to occur only in Libya. Thus the major programme will be conducted in Libya. However, the adjacent countries at risk will be directly involved by continuing and expanding activities of surveillance, wound treatment, animal movement control, data collection and information.

The organization must have the flexibility to employ and discharge personnel, purchase supplies and equipment, and have the complete support of the national governments, donors, and UN organizations involved in the programme. The organization must be a legal entity so that it can receive and disburse funds, make contractual arrangements, etc. Personnel can be seconded to the NWS eradication organization from the existing government organizations on a temporary basis and foreign consultants/experts/managers can be employed for the programme.

2. Management Plan

The management of the NWS eradication programme should be patterned after proven plans used in other eradication campaigns.

The responsibility for the NWS eradication in North Africa will be with the North Africa NWS Eradication Commission. This Commission will be made up of representatives of donors, UN organizations and national governments. The Commission will have a technical advisory committee from which it will receive technical evaluations of programme progress and technical recommendations for future activities. The Commission will approve activities and budgets for the eradication programme. The Commission will employ a programme director (expatriate) and a deputy director (national) to manage day to day activities of the NWS eradication programme. There will be 4 units reporting to the programme director:

(a) Administration will consist of contracting, purchasing, personnel and finance.
(b) Data management will deal with technical and financial data, including receipt of data, analysis and distribution.
(c) Operations (in the known infested country) will deal with obtaining sterile flies, transport of these from Mexico to North Africa, handling the flies on receipt in North Africa, release of the sterile flies in the infected area, quality control, data collection, evaluation of the eradication progress, and research and development. The organization will have technical supervision of required surveillance, wound treatment, sample identification, animal movement control, general treatment activities and public information executed by the governments of infested countries.

(d) Operations in countries at risk of NWS invasion will involve the technical supervision of surveillance, animal treatment, insect identification, animal movement control, data collection and public information.

See Annex 8 for a suggested organization chart.

3. Contracting

To have the greatest probability of a successful NWS eradication programme in North Africa FAO should contract the entire campaign to a private company. The only alternative which offers reasonable probability for success is that FAO establish a separate unit with great flexibility to supervise and co-ordinate several sub-contracts.

The advantages of FAO contracting the programme to a private company include that there will then be a single organization responsible and accountable for the programme. A private company will have greater flexibility to make arrangements with national governments, private organizations and private individuals for timely procurement of essential programme components to achieve the goals of the programme and will have much greater flexibility than any government or UN management system.

The primary disadvantage of a contractual arrangement for the entire NWS eradication programme is that the initial cost may be somewhat higher than if the programme is managed by FAO or national organizations. However, the increased chances of eradication, including its acceleration, will more than offset any initial cost differential. The contract must be made with a reputable concern with a proven record of successful programmes.

If, for whatever reason, it is not possible for FAO to contract the entire programme to a private company, then operational parts of the programme must be sub-contracted by FAO in order to have a reasonable chance of success. Specifically, the air transport of sterile flies from Mexico to North Africa and the aerial release of these sterile flies within the eradication zone must be contracted. The contract must be written so that if the sterile flies are not delivered on time and in good condition, or that releases are not made on schedule according to the release plan, the contractor will be penalized. Supervision of these and all other activities will be provided by the organization managing the eradication programme. The preferred structure is that one organization contract for the entire programme, and if necessary, sub-contract sterile fly and other activities.

I. RISKS

A number of factors could cause major delays or prevent achieving the goal of NWS eradication from North Africa. Many of these are based on previous eradication programmes. Examples of risks are:

- Cannot obtain agreed-on number of sterile NWS flies.
- Infested area expands and sufficient numbers of sterile NWS flies cannot be obtained.
- A new infestation occurs from imported infested animals.
- Donors delay providing sufficient funds to meet programme needs.
- Government does not fulfil its prerequisite pledges to meet requirements of the NWS eradication programmes.
- Cultural practices prevent meeting emergency requirements of the programme.
- Government changes policy which results in NWS eradication programme becoming lower priority.
- Natural disasters.
- Political unrest.

J. EXPECTED RESULTS

The immediate result of eradication of NWS from North Africa will be the elimination of economic losses and human suffering incurred in the area of infestation. Even more important is the elimination of the threat of economic losses and human suffering in areas at risk to infestation (i.e. the remainder of Africa, southern Europe, the Middle East, and southern Asia).

Resources devoted to the eradication campaign will indirectly benefit other sectors of the agricultural economy. Trained staff and the institutional framework will be in place to reinforce other pest prevention programmes and be prepared for future pest introductions. The programme also will serve as a model for future emergencies.

K. PROJECT REPORTING, REVIEWS AND EVALUATION

1. Reports

The NWS eradication programme in North Africa is an emergency programme requiring great flexibility, rapid and continuous exchange of technical and financial data, and immediate solutions to technical, financial and policy problems; therefore an efficient reporting system must be implemented to facilitate exchange of information. Reports must be accurate, timely and specific. Reports will be submitted to the North Africa NWS Eradication Commission and other involved organizations, donors and individuals. The reports will be as follows:

(a) Weekly technical reports on progress of the eradication campaign prepared by Operations for the Programme Director.
(b) Monthly technical reports prepared by the two Operations Units for the Programme Director which will summarize the weekly technical reports and expand them to include major policy issues requiring attention.
(c) Monthly financial reports prepared by the Administration for the Programme Director.
(d) Quarterly technical reports prepared by the Programme Director for the North Africa NWS Eradication Commission.
(e) Quarterly financial reports prepared by the Programme Director for the North Africa NWS Eradication Commission.
(f) Quarterly technical reports prepared by the Technical Advisory Committee for the North Africa NWS Eradication Commission.
(g) The North Africa NWS Eradication Commission may request special reports on particular topics from the Programme Director.
(h) Annual summary reports prepared by the Programme Director for the North Africa NWS Eradication Commission and the general public.
(i) A final report prepared by the North Africa NWS Eradication Commission for Commission members and interested parties at the end of the programme.

2. Reviews

(a) The Technical Advisory Committee will review the programme on a quarterly basis.
(b) The Commission or any of the donors may request a special review of the programme at any time. Additional funds will be made available by the donors for these reviews.
(c) Should the NWS infestation rapidly spread or be found in other African countries, where significant realocation or increase in resources is required, the Commission will immediately convene an emergency meeting to discuss the problem. Should too few sterile NWS flies or other resources be available to initiate eradication of the expanded or new infestation, a decision must be made whether to terminate the entire programme or to reallocate resources most effectively.

3. Evaluation

(a) The programme will be evaluated on an annual basis by evaluators appointed by the donors.
(b) The national governments involved in the programme may appoint individuals to evaluate the programme on an annual basis.

L. ESTIMATED BUDGET SUMMARY (US $1000)

An estimated budget for two years of the programme is shown below. The estimates are as accurate as could be made in January 1990. Refinement of the figures must await such factors as how much of the programme will be contracted, whether the infested area within Libya expands significantly before the programme begins and whether the availablility of sterile flies from Mexico can be provided as anticipated.

Item	Year 1	Year 2	Total
Personnel	2 500	3 500	6 000
Equipment	2 500	1 500	4 000
Supplies	400	600	1 000
Facilities	200	100	300
General operating expenses	400	600	1 000
Upgrade rearing facility	2 500	0	2 500
Purchase of sterile flies	9 000	13 000	22 000
Transport of sterile flies	14 000	16 000	30 000
Dispersal of sterile flies	2 500	3 500	6 000
Travel	200	300	500
Reports, misc.	100	100	200
Sub-total	34 300	39 200	73 500
Contingency	1 500	1 500	3 000
Sub-total	35 800	40 700	76 500
Overhead[a]	2 000	3 000	5 000
TOTAL	37 800	43 700	81 500

[a] Will be negotiated with donors.

III. ANNEXES

Annex 1

CONSULTANTS

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Annex 2

COMMENTS, CONCLUSIONS AND RECOMMENDATIONS OF CONSULTANTS

The group of consultants, having written the Plan for Eradication of NWS from North Africa, noted that:

(1) The only NWS rearing facility in the world is in Mexico, and it has the capability to provide sufficient sterile flies to eradicate the NWS from the infested area in Libya as known in January 1990, in addition to some expected NWS spread. Construction of a new plant would take an unacceptable amount of time to be in production. The NWS would have spread in the Eastern Hemisphere to the extent that sterile fly requirements for eradication would exceed the new plant's capacity.

(2) The only objective of the programme is to eradicate NWS before it spreads to the extent that eradication will not be feasible at any cost. Thus, action should be taken as soon as possible.

(3) The Governments of Libya and neighbouring countries at immediate risk must, under the proposed programme, continue to commit considerable human and material resources to improve the probability of programme success.

(4) Donor support is requested for the programme and proper programme execution will increase probability and acceleration of eradication which will be a great savings to donors and participating countries.

The group concluded that:

(A) Except for sterile fly provision, one organization with operational autonomy whose only objective is to eradicate NWS as soon as possible should be funded by donors. This will be accomplished most effectively by contracting the programme operation with one outside organization, which would sub-contract for specialized activities as necessary. With considerable resource support of participating countries, this organization will be responsible for timely provision of programme resources and executing all programme activities including shipment of sterile flies from Mexico through dispersion in North Africa, in addition to supervising and evaluating all participating country associated activities. This organization should be supervised by an International Commission comprised of representatives of the governments of participating countries, the FAO and the donor countries and agencies.

(B) In order to reduce delays and prevent possible failures, the least possible complexity in operations should be programme policy. Therefore, it is strongly recommended that flies already boxed and as nearly ready to be dispersed as possible be transported by dedicated aircraft from Mexico to North Africa.

(C) A "Regional Pilot Biological Control Programme for the New World Screwworm in North Africa" has been approved by IFAD/UNDP. The programme includes provisions for amplification of surveillance, animal movement control and quarantine, and information programmes which are compatible with the initiation of a full-scale eradication programme. The project also includes a Sterile Insect Technique (SIT) component using four million sterile flies weekly over a portion of the infested zone in North Africa for up to 20 weeks. The SIT portion of the IFAD/UNDP Regional Pilot Programme should be incorporated as the initial donor support for the full-scale eradication programme, preceded by and parallel with the other activities that the consultants believe are necessary to enhance probability of programme success (see attached recommendation).

Recommendation on the SIT Part of the IFAD/UNDP NWS Pilot Test by the Consultants Group Responsible for Preparing the North African NWS Eradication Programme — 18 January 1990

The objective of the NWS programme in North Africa is to eradicate the NWS from the region as rapidly as possible while the insect pest is confined to a relatively small area and eradication is feasible.

The "Regional Pilot Biological Control Programme for the NWS in North Africa" is a portion of the regional IFAD/UNDP funded NWS project. This must not be a separate project or a separate phase, but integrated into the overall NWS eradication programme. The IFAD/UNDP funds should be considered the first donor contribution to the North African NWS eradication programme.

The IFAD/UNDP project logically states that the full-scale eradication campaign is to follow immediately after the pilot test. As described in the full-scale eradication plan, the timing of preparations required for the programme dictates that the operation of the SIT be parallel with and subsequent to other activities.

Advanced donor commitments, including an assurance of up to 100 million sterile NWS per week from Mexico, must be available before activities using sterile NWS are initiated in North Africa. The pilot test will be used primarily to initiate the SIT part of the NWS activities as the validity of the technique is tried and proven. The control of NWS resulting from the first phase (pilot) must be maintained by immediate subsequent sterile fly dispersion. Otherwise the pilot test will be wasted and require repetition at the risk of discontinuity of action with spread of infestation.

The first use of sterile flies available for shipment to North Africa should be utilized to adapt systems for transport, handling in North Africa, and release in North Africa. The second use of sterile flies in North Africa should be to establish a barrier to slow the expansion of the infested area within Libya. This barrier probably should be established along the Libya–Tunisia border.

A pilot test conducted as a prerequisite to funding and implementing a full eradication programme will result in unacceptable delays. The NWS will spread beyond its present relatively small area and infest an area which then may be too large to handle with the available sterile flies from the Mexico facility.

The first steps in establishing the programme to eradicate the NWS from North Africa must be to establish a separate organization to conduct the NWS eradication programme in North Africa, parallel with preparation of the sterile fly plant for increased production. This will involve employing a management team and developing a management system. Continuity of activities implemented in the pilot project by the North Africa team is required. Certain adaptations to the procedures outlined in the pilot project are described in the eradication plan, which will require supplementary activity and resources.

Libya must guarantee free access to all areas where the screwworm can reproduce within the country, as well as the other prerequisites identified in the programme to eradicate the NWS from North Africa.

The NWS eradication technology to be used in North Africa has been successfully used for more than 20 years in the Americas and is therefore routine. Implementation of the programme requires only the adaptation of currently available methods to North African conditions, establishing an organization to operate the programme, the availability of sufficient resources, and the authority from the North African governments to effectively and efficiently implement the eradication programme.

Annex 3

BACKGROUND

1. New World Screwworm (NWS)

For the first time, the NWS has become established outside of its home range of the sub-tropical and tropical areas of the Americas. This poses a great threat to livestock and wildlife in Africa, the Middle East and southern Europe.

The larval stage of the NWS is an obligate parasite of living flesh of warm-blooded animals. Gravid female flies are attracted to wound sites, even those as small as tick bites. As many as 400 eggs are laid in batches on the edges of these wounds. These eggs hatch into small larvae in about 12 hours and invade the wound. With their hook-like mouth parts larvae rasp the living tissue and feed on the resulting secretions, growing quickly. The wound is enlarged and deepened as a result, attracting more female flies which in turn lay more eggs. Multiple infestations, often complicated by secondary infections of wounds, lead to sickness and frequently death of the host animal.

Worms feed from the wound for an average of one week before the mature larvae, approximately 1.5 cm in length, drop to the ground to burrow into the soil and pupate. The length of this pupal stage of the life cycle in the ground is temperature-dependent. During ideal conditions it can be as brief as seven days and during cool weather can exceed one month. Neither pupae nor other stages of the parasite survive freezing weather — a feature that determines its geographical distribution during the winter. Very hot dry weather reduces NWS populations.

Emerging flies quickly mature. Males mate several times, commencing 24 hours after emergence. The female mates about two days after emergence and four days later she is ready to lay her first batch of eggs. Several batches may be laid at 3 day intervals. Females may travel long distances in search of wounds—up to 200 km have been recorded with marked sterile flies. Distances travelled depend on the local availability of hosts, mates and vegetation upon which adult flies feed. Adult flies are rarely seen. It is the larva ('worm' or maggot) that causes the damage and is easily seen by the livestock keeper.

2. Effects on Livestock

Where the NWS occurred in the southern USA and northern Mexico its presence dictated animal husbandry practices. In areas where NWS was seasonal in incidence, ranch management (calving, branding, shearing, castration, dehorning) was scheduled to avoid infestation. With the advent of modern insecticides, prophylactic and curative treatment was possible. However, the costs of continuous surveillance of all animals for wounds and the treatment of wounds was expensive.

Livestock producers with sufficient resources employed cowboys to ride the range to find and treat wounds. Small or part-time livestock raisers who were not able to continuously examine and treat their animals were forced out of business.

Livestock mortality and morbidity could be reduced but not without considerable expense and effort. Perhaps the best evidence of the effects of NWS on livestock owners was the funds they contributed to start the eradication programme (US $3 million) and the pressure the livestock industry placed on the Governments of the USA and Mexico to eradicate the NWS.

3. Effects on Humans

Human infestation with this dangerous parasite has occurred in Libya. This is expected as hundreds of human cases have been documented throughout the Americas. The scientific name, *Cochliomyia hominivorax* (eater of man) shows that the first cases were diagnosed in man.

Failure to treat cases may result in death. In the NWS infested Americas people are aware of the parasite and take precautions. The most dangerous infestation sites are the nose and ears and other exposed body cavities.

4. Effects on Wildlife

All mammalian wildlife are susceptible to NWS attacks. Observations on susceptibility of Africa's wildlife to NWS attacks have been made on captive animals in the USA and Mexico. Most American observations have been made on wild deer herds, which suffer significantly from the parasite. One biologist in south Texas stated that in years where infestation was severe in the area he surveyed, up to 80% of newborn fawns were killed by screwworm. After eradication, the deer population increased rapidly in the southern USA.

Game ranching was not practical in the USA when routine NWS preventive treatment was required. After NWS eradication, game ranching has become an important and growing industry in the southern USA.

5. Eradication from the USA and Mexico

Eradication of NWS from the southern USA and Mexico was achieved in a period exceeding 20 years at a cost of more than US $500 000 000. The eradication programme required the use of the Sterile Insect Technique (SIT), the first and most ambitious use to date of this technique.

The programme also required continuous surveillance, preventive and curative insecticide wound treatment, and animal movement control. These measures entailed a large degree of active livestock owner participation and veterinary activities.

Only one functioning NWS rearing plant now exists. It belongs to the Joint Mexico-US Screwworm Eradication Commission, located in southern Mexico. It is a large facility employing several hundred people and operates 24 hours a day, seven days a week. The plant must continuously produce sterile NWS flies to maintain a barrier in Central America against reinvasion of Mexico and the USA which are now free of the pest.

6. Economic Effects of NWS Infestation in the Western Hemisphere

With the exception of the USA and Mexico, and a few other countries, losses to the livestock economy due to NWS elsewhere in the Americas have not been studied or documented. Because there are no official programmes in these countries, prevention and treatment are considered the reponsibility of the individual livestock owner.

A résumé of estimates of NWS caused economic losses follows (in US dollar costs at the time of estimate):

Texas (1935)	10 000 000	
South-eastern USA (1960)	20 000 000	
South-western USA (1960)	80 000 000	
Texas (1976) outbreak	283–375 000 000	(includes costs to consumers)
Mexico (1984) (savings/area west of barrier)	130 000 000	
Central America (1982) and Panama	40 000 000	
Jamaica (1977)	3 000 000	
USA (1980) reinfestation estimate	378 000 000	
Surinam (1983)	300 000	
Trinidad and Tobago (1983)	1 020 000	
Guyana (1983)	4 330 000	

NWS eradication programmes in the Americas have been considered cost effective. An economic analysis was done in 1987 of the NWS eradication programmes in the southeast and southwest USA. The resulting cost/benefit ratio was 1:11.5. A variety of previous studies using different presumptions and methods had c/b ratios which exceeded 1:10, figures universally considered very acceptable. As more sophisticated methods were used with discount rates and other factors considered, c/b ratios were changed. In a 1985 Mexico study designed to project benefits of programme extension into Central America, the c/b ratio ranged from 1:2 to 1:4.5. In this study consumer benefits were not included nor were any benefits to the producers and consumers of the USA, resulting from the programme which provided continued freedom from the NWS.

7. Anticipated Economic Effects of NWS in North Africa

The only logical strategy in North Africa is to eradicate the present limited area of infestation as soon as possible. If not done the NWS will spread beyond technical feasibility to eradicate at any cost. The immense projected losses to the producers and consumers of countries where it will spread must be compared to the cost of this proposed programme. If the programme is successful, savings will be overwhelming.

The costs of screwworm control are continuous and recurrent in infested areas. They include not only the cost of sickness (medication, treatment, loss of weight, extra feed, fertility, and other products such as milk, skins, etc.) and death, but the continuous costs of wound prevention, surveillance and preventive and curative treatment of all wounds. Animal movement control measures and costs of export losses to the national economies have never been considered.

A few studies of the costs of living with NWS in Mexico and the Caribbean led to wide variations of estimates. Different categories of costs were used and important factors excluded because they were incalculable.

Every animal must be individually examined at least twice a week. Insecticides must be preventively and curatively employed in order to prevent losses. Labour consistently ranks high in NWS control costs.

Based on a conservative US $4/head/year of livestock, comprised of three dollars a year for labour, and US $1/head for insecticide, an estimate which includes none of the production losses due to morbidity or mortality, Libya, with more than 7 million head of livestock, would have recurrent costs of nearly US $30 million a year.

When NWS spreads throughout North Africa, with its estimated 70 million head of livestock, estimated control costs will be US $280 million/year. The great bulk of animals in Libya, Egypt, Tunisia, Algeria and Morocco are in areas at continuous risk — where the combination of climate, water, grass and livestock provide good conditions for NWS.

A recent expert analysis substantiates the most alarming impression of previous observers about the potential for NWS spread in Africa. The Nile Valley in Egypt and Sahelian countries through which it passes offers excellent conditions for NWS spread and establishment.

When the NWS arrives in Sub-Saharan Africa and the Middle East it will cause immense losses to livestock producers in countries where animal production is the most important activity of the majority of people. The foreign exchange costs of insecticides to adequately control it will additionally contribute to the burden on national economies.

The human populations will not be familiar with the parasite and suffering will be considerable. Not only sickness but deaths can be expected since human populations are frequently far from any medical services.

The otherwise endangered wildlife of these areas will have another threat, perhaps the only additional factor needed to provide conditions for accelerated extinction. Tropical Latin America does not have the large migrating herds of ungulates with seasonal breeding similar to those found in parts of Sub-Saharan Africa. Thus, there is no parallel scenario to compare with the game rich regions of Africa. Explosive outbreaks may be caused by, among other factors, the simultaneous availability of

umbilical wounds of newborn animals. National economies and people reliant on wildlife for livelihood or income will suffer.

The human/animal misery and losses in Africa will at least equal those in tropical America.

There is also little reason to believe that Mediterranean and adjacent Europe would be immune to NWS effects. If NWS becomes endemic on the African shore of the Mediterranean, periodic European introductions by the large-scale commerce and transportation across the sea can be expected. If these are in springtime or summer, explosive reproduction would occur, spreading far into temperate areas as they did in the Americas.

NWS could very well find microclimates in which it will overwinter, as have other diseases previously considered tropical such as African Horse Sickness. Each year NWS populations would build up, spread northward to cause livestock and wildlife losses until wintertime stopped the life cycle. The continuous costs of surveillance and treatment would be required, additional to animal movement control and quarantines. Only control, not eradication, would be possible unless a sterile fly facility were constructed.

The Middle East imports many millions of live animals annually from Africa. The most significant cause of long-range movement of NWS is by commercial transport of infested animals. Even if prohibition were placed on live animals from Africa, NWS infestation will arrive in the area by uncontrollable illegal animal movement, imports of infested pets, or gradual migration of fertile flies.

8. Action taken by FAO, UNDP, IAEA, IFAD

Recognizing the disastrous potential for spread of the Americas' most dangerous livestock insect, urgent and considerable FAO efforts and resources have been devoted to the emergency. A brief résumé of these activities follows:

At the invitation of the Libyan Government an expert FAO mission confirmed the presence of NWS in April 1989 and worked with government officials to develop a control programme. In addition to a Technical Co-operation Project (TCP), a UNDP–Government cost sharing NWS project was approved. During May 1989, FAO missions also visited Tunisia, Algeria and Egypt and concluded that there was no evidence that infestation had yet spread to these countries and worked with these countries to establish surveillance and prevention programmes. TCP projects for this purpose were approved. Additionally, in 1989 similar missions visited Niger and Chad with resultant TCP projects.

Permanent Representatives to FAO of countries at immediate risk from NWS attended a meeting in Rome in April 1989 immediately following confirmation of the presence of NWS in North Africa. An FAO proposal for including myiasis caused by NWS in the list of international notifiable diseases was approved by the General Session of the International Office of Epizootics in Paris in May 1989. The disease will be included in the international reporting systems, occurrence data published in the FAO/WHO/OIE Animal Health Yearbook and special recommendations for export/import of animals will be included in the OIE International Zoosanitary Code.

On 5–6 June 1989, FAO held a Preparatory Meeting on the Formulation of a Regional Strategy for Control/Eradication of the NWS in North Africa. This meeting was attended by NWS experts from the USA and Mexico, senior veterinary officers of Libya and the countries at most immediate risk of infestation. The meeting resulted in recommendations for infested countries and for those at risk, for importation requirements from screwworm infested countries and outlined the FAO Screwworm Action Programme.

Priority has been given to the infested area of Libya where UNDP and TCP funds complement more than US $7 million the Government has committed to NWS control. Four FAO consultants from Mexico have so far lent their services to this programme. Consultants were provided for projects in other countries at most risk, as they were for the regional project.

The IAEA, in co-operation with FAO, through the Joint FAO/IAEA Division, undertook an expert mission to the Tripoli area from 2 to 13 July 1989. The terms of reference included preparatory investigation into the potential use of the sterile insect technique for control and eradication.

In close co-operation with the Mexican Government, a study tour for selected specialists from North Africa was organized in order to acquaint them with experience in NWS control and eradication in Mexico.

Under the Regional TCP, FAO, assisted by UNDP, held a Libyan Government hosted training course during the last week of July 1989. Invited participants included nationally selected candidates from Algeria, Chad, Egypt, Libya, Morocco, Niger, Sudan and Tunisia.

In addition to those from Libya, lecturers were drawn from the Joint FAO/IAEA Division, the British Museum (Natural History) and the Joint Mexico–US Screwworm Eradication Commission. Comprehensive training was offered on all aspects of NWS identification, biology and on the surveillance, prevention and control of the disease including animal treatment and quarantine measures.

An important input for this livestock owner oriented programme is the provision of individual insecticide preventive and curative wound treatment sachets combined with larval sampling vials for immediate identification of the parasite by the country's veterinary service. Components for 1.75 million treatment/sampling kits have been provided to the infested area and those at risk.

Information activities are necessary to elicit livestock owner co-operation for treatment and surveillance. In support of the NWS prevention and surveillance and control programmes, FAO has prepared a series of information materials. Slide sets showing the severe effects of NWS infestation are being duplicated for appropriate distribution. These will be accompanied by explanatory brochures.

Also in production, after having been field tested in North Africa, are a series of posters and information cards supporting programme objectives. Themes include reporting and sampling, treatment and avoiding the purchase or movement of wounded and infested animals.

A Manual on the Control of NWS has been written and will be published in English, French and Arabic. Two letters have been sent to the Chief Veterinary Officers of countries world-wide informing on the NWS situation. The second letter included an identification key for NWS for use until the manual is printed. An article on the pest will appear in the World Animal Review.

The Entomology Department of the British Museum (Natural History) has agreed to be the FAO reference centre for NWS.

An NWS Information Newsletter is being sent to countries most concerned with the North African infestation.

The IAEA is supporting the NWS Programme in North Africa. Included is:

- arranging for tests in Fargo, North Dakota, USA, to study the sexual compatibility between the Mexican mass-reared and the North African strains of the NWS,
- making available the facilities and staff of the IAEA laboratory at Seibersdorf, Austria,
- supporting research, including trial shipments of sterile NWS pupae from Mexico to study the effect of shipment on fly quality,
- providing modest equipment, supplies, training, etc., to the programme in Libya through an IAEA technical assistance project, and
- making available staff to assist the programme planning and implementation, both in Rome and Libya.

FAO has requested the Government of the USA, in agreement with the Government of Mexico, to arrange to make available the quantity of sterile flies which will be required to eradicate screwworm from the infested area.

In October 1989, a follow-up meeting was held with the Permanent Representatives to FAO of the countries at immediate risk from NWS. It was agreed that the highest priority is to keep infestation limited to an area from which it would be technically feasible to eradicate using sterile NWS flies from the world's only production facility in southern Mexico.

IFAD has responded favourably and rapidly to requests from Libya and several countries at risk for assistance in the NWS emergency in North Africa. In co-operation with UNDP it will provide funds for initiation of sterile fly dispersion, provision of animal movement control and treatment, and support public information activities for the programme.

Representatives of Libya and those of neighbouring countries supported NWS eradication during the 25th Session of the FAO Conference, November 1989 in Rome.

At the invitation of UNDP Libya, a joint UNDP/FAO/IAEA sub-regional NWS meeting was held in December 1989. All agencies participating, as well as the Government of Libya, supported eradication.

The FAO strategy is to assist NWS infested and immediate risk countries to control the parasite where it exists, prevent its spread by animal movement control and treatment, and to define the limits of infestation by surveillance programmes. If successful, NWS will be confined to an area from which it is still feasible to eradicate. These efforts by countries must not only continue but be strengthened throughout the eradication programme.

Annex 4

ACTIVITIES

1. Eradication Plan

A plan will be prepared for the eradication of the NWS from North Africa. This plan will detail the problem of the NWS in North Africa, background information, objective of the eradication programme, activities required to conduct the eradication programme, and prerequisites to be fulfilled by organizations and governments responsible for and involved with the eradication programme. In addition the eradication plan will include a work plan of the entire project. The necessary operational and institutional arrangements for effective implementation of this emergency programme will be described. Of particular importance will be the identification of very serious problems which could jeopardize the success of the eradication programme. If the prerequisites are fully met, then the risk of failure will be greatly reduced. Estimates of resource requirements for the first year of the eradication programme will be prepared as accurately as possible. It may be necessary to operate the programme on quarterly budgets, rather than the more usual annual or total programme budget.

2. Establish Organization to Conduct Eradication Programme

At a very early stage and prior to the initiation of the major eradication programme, an organization to operate the eradication programme must be formed and accepted by national governments, UN organizations and donors. To meet the needs of this emergency eradication programme, the organization must be independent, highly flexible, a separate legal entity permitting it to employ and discharge personnel, contract, purchase, etc., and have a high level of technical knowledge and efficiency. The organization will have total responsibility for the NWS eradication programme and will have no other responsibilities. The Director of the organization to eradicate the NWS will report to the North Africa NWS Eradication Commission (which will be comprised of participating countries, UN organizations and donor countries and agencies).

3. Contracts

One organization with operational autonomy whose only function is to eradicate NWS as soon as possible should be contracted to implement the entire programme (with the exception of the provision of sterile flies in Mexico).

This organization should be responsible for the timely provision of resources needed by the programme, for the operation of all programme activities under its direct control and the technical supervision and evaluation of those activities under government control. Penalties for failure to deliver and disperse good quality insects and other programme activities under its control should be incorporated in the contract.

This contracted organization may sub-contract for specific activities such as sterile fly tranport (packaging if necessary) and dispersion.

The organization would have direct operational liaison with the Joint Mexico–US Screwworm Eradication Commission regarding all aspects of sterile fly provision.

4. Intensified NWS Surveillance, Treatment and Identification

National project directors will assign staff whose primary responsibility is for surveillance, identification and preventive flock and area NWS treatment. They will co-ordinate the public information programmes and report this information as indicated in "Activities". Special training of involved staff in the reading, marking and reporting of geographic co-ordinates of cases will be required. Emphasis of activities in epidemiologically determined areas of risk will be required.

An essential activity before, during and subsequent to NWS eradication is intensifying and expanding already initiated surveillance and identification of the parasite. This is required within the infested area, throughout the remainder of the infested country, and for neighbouring countries at risk.

To eradicate a pest from a continent it is obvious that the limits of infestation must be continuously known. The intensity of infestation within known infested areas must be continuously measured to assess programme progress. A regular submission of larval samples from areas considered at risk will assure prompt detection of spread. Negative samples are an indication of the level of surveillance, and will be used to certify the areas are free of NWS.

Veterinary services are not staffed sufficiently for surveillance of all wounds that occur on all animals. Therefore, as proved to be the most sensitive and efficient method of surveillance in the Americas, in both developed and developing programme areas the distribution of NWS sampling/treatment kits to farmers concurrent with grass root information campaigns should be employed. A system of livestock owner notification of officials able to make a rapid diagnosis is required. Veterinary service attention to infested areas by sterile fly dispersion and whole flock treatment is expected to be appreciated by livestock owners.

Each country will fortify its surveillance and sample identification programme. Weekly reports of submitted samples, their identification, host and precise location of origin will be submitted promptly from each country to the International Programme Director. The Programme Director and other officials will be notified immediately of any positive NWS case outside known infested areas (or countries previously believed to be NWS free). Animal movement control restrictions for a radius of 50 km around positive NWS cases will be declared.

Access of programme personnel to all geographic areas of participating countries will be officially provided. Countries will commit themselves to official surveillance programmes for a minimum of two years subsequent to apparent eradication of NWS from North Africa.

Individual sampling/treatment kits each have an insecticide packet (with instruction for its use) for the preventive and curative treatment of animal wounds. Public information campaigns will promote the use of these for individual wound treatment in areas infested and considered to be at risk of infestation.

Within the limits of available resources preventive whole flock/herd treatment will be executed in areas around NWS infested herds and those considered to be at most risk of infestation (i.e. near the infested area, at lambing or shearing time, etc.).

5. Intensified Animal Movement Control/Quarantine

Experience in Mexico and the United States has shown that rigid control of livestock movement from NWS infested areas is a vital part of any eradication and control programme in order to prevent spread to NWS free areas. The basic requirements of a movement control and quarantine programme consist of an information campaign to encourage inspection and treatment of wounds of all animals prior to movement out of the infested area, and not to move any animal suspected of being infested with NWS. Checkpoints should be established at strategic locations on the edge of endemic areas for inspection of animals, treatment of wounds, preventive spraying or dipping of livestock. It is also important that country border control points are established to facilitate inspection of animals moving across country boundaries.

The programme would support the setting up of about 40, mostly mobile, livestock control and quarantine stations which are incremental to existing facilities. There would be 10 stations in Libya and 5 each in Algeria, Chad, Egypt, Niger, Sudan and Tunisia.

Unless enforcement of animal movement prohibition during certain periods can be assured, participating governments will provide 24 hours/day operation of animal movement control points.

Each station would consist of an animal-holding ground and inspection corral with loading ramp, lighting, a station vehicle and insecticidal spraying equipment.

All participating countries will require official origin inspection and preventive treatment from NWS infested countries and reinspection and preventive treatment at destination.

Animals originating from or transiting NWS infested or suspect areas will receive official individual animal inspection, whole flock preventive treatment (insecticide dipping or spraying) and individual treatment of all detectable wounds.

Wounded animals with myiasis (infested) will be retained at the holding ground and infested wounds treated daily for three days before allowing their release from quarantine. Samples of larvae will be obtained for immediate identification. All permanent and mobile animal movement control stations will report weekly to national authorities on their activities. Monthly résumés will be sent to the International Programme Director.

The Programme Director will be notified immediately of all positive and suspicious NWS cases. Positive identification should be made the same day, and the International Programme Director notified of the results. In the event of new outbreaks, mobile control stations may be directed to be moved, along with supporting resources, within and between countries, at the discretion of the Programme Director.

6. Information Campaign for the Entire Eradication Campaign

There should be a Chief of the Public Information Unit plus additional assistants and draftsman. The number will be determined by the funds available and the area to be covered (Libya would require 4 assistants for example, two for the infested area, one for the Bengazi area and one for the fringe desert and the oases).

Radio and TV interviews as well as short features should be scheduled on a regular basis. Data should be made available to the media. Lectures at schools, meetings, animal shows, etc., should be included in the work plan.

In the first stages of the information campaign, the public will be informed about the NWS destruction of livestock, how to detect it, collect samples, treat wounds and avoid movement of infested animals. In the follow-up stage, the public will be briefed on the Sterile Insect Technique. They should be advised that the sterile flies are not harmful, not to damage traps and sentinel sheep pens, and to report any suspicious wounds, particularly in pets. The third part of the information campaign will concentrate on the state of the infestation and the progress achieved within the eradication programme.

Movie, slide, video projector, photographs and captions and a vehicle should be made available to each senior staff.

The Chief of Public Information must establish close liaison with media officials, agricultural organizations, and programme managers.

The ratio of samples received from owners and those directly taken by inspectors must be continuously studied. If the majority of the samples originate from inspectors, or if they are mostly during the later (third instar) stage of the larva, the information campaign has failed. The campaign must encourage animal owners to submit samples. Additional publicity within the area from which the samples are needed should be carried out. The same applies to areas where people complain about sterile fly dispersal.

7. Production of Sterile Screwworms

Sterile NWS are available only from the Joint Mexico–US Screwworm Eradication Commission. Their rearing facility is located in Tuxtla Gutiérrez, Mexico. The North African programme will obtain the sterile NWS from the Commission. The strain of NWS will be the standard strain used in Central America. Data have demonstrated that this strain is sexually compatible with the strain in Libya. Rearing will be done by standard procedures of the Commission, which involves obtaining eggs from egging cages, incubating the eggs on the starter diet in the initiation room, transferring the young larvae to the finishing diet, harvesting the mature larvae, providing for suitable substrate for pupation, allowing the pupae to mature, and sterilizing the pupae 48 hours before adult emergence with gamma radiation using caesium 137 sources. The radiation dosage used is 7.5 krad. After the NWS pupae have

been sterilized, they are transported to the local airport where they are packaged in fly release boxes (about 1500 pupae per box), placed in climate controlled rooms where the adult flies emerge, and loaded onto aircraft which fly to the release area and release the sterile flies.

The sterile insects destined for North Africa will be transported from the rearing facility after radiation sterilization and packaged for immediate shipment to North Africa. The two options available for shipping the sterile insects to North Africa are:

(a) Sterile pupae will be packaged in the release boxes in Mexico and shipped by charter aircraft to North Africa.
(b) Sterile pupae will be packaged in bulk in Mexico and shipped to North Africa by charter aircraft where the pupae will be packaged into the release boxes.

The determining factor on which method to use will rely primarily on quality of the fly arriving in North Africa, as well as logistics and costs associated with each method. Both shipping methods are described.

The release of sterile adult NWS as a component of the eradication effort in North Africa will require the production and delivery of 40 to 100 million sterile flies weekly. Accordingly, production at the rearing facility of the Joint Mexico–US Screwworm Eradication Commission will have to be expanded beyond the existing sterile fly needs of the Commission. Presently, the Commission produces 100 million sterile flies weekly but the number is expected to increase when budgetary constraints are eased.

Currently, the larval rearing process at the rearing facility is undergoing a conversion from a hydroponic- to a gel-based diet. By the time North Africa is ready to receive Commission flies, the conversion to gel will likely be complete or nearly complete. The rearing facility in its present condition, however, does not have sufficient capacity to rear NWS with gel even at the projected levels for the Commission. In order to meet the demand for sterile flies for North Africa, the facility will require an upgrading of equipment and more space beyond the needs of the Commission in addition to the expected increases of such basic resources as diet products, personnel, water and electricity, and other expendable rearing related supplies. Once these needs are met, the facility would need 4 to 6 weeks in order to raise weekly production to meet the needs of North Africa.

The most critical limitations to the production of NWS for North Africa are space and environmental control equipment for the initial stages of larval development (hereafter, the initiation rooms). In order to make additional space available for the projected needs of the Commission, the facility managers are considering temporary expansion into areas currently not in use that are adjacent to the existing initiation rooms. This move will require the installation of additional air handling duct work and will result in additional load on an already strained environmental control system. To meet sterile fly demands for North Africa, new initiation rooms will have to be constructed and environmental control equipment purchased. An increase in refrigeration and steam generating capacity is being contemplated in order to meet the added temperature and humidity demands of all rearing areas of the facility.

The production quota at the Mexico rearing facility should be inflated slightly to compensate for expected daily production fluctuations and the logistics of delivery. In order to deliver the weekly quota that is expected to be made in 2 to 3 shipments to North Africa, the Joint Mexico–US Screwworm Eradication Commission (which delivers sterile flies every 4 hours for packaging) may find it necessary, particularly when delivery reaches 100 million weekly, to raise weekly production above the quota so that enough flies will be available for each shipment. For example, if the Commission and North Africa each require 100 million, a combined quota of 230 million may be necessary in order to deliver 100 million flies to North Africa in three shipments.

8. Transport of Sterile NWS Flies from the Production Plant at Tuxtla Gutiérrez, Mexico, to North Africa

(a) The sterile NWS flies are perishable and require strict adherence to temperatures, packaging, shipping, storage, handling and time criteria. This is necessary in order to deliver high quality effective sterile flies to the infested zone. The procedures must be followed strictly on each shipment throughout the eradication programme. A failure in any one shipment is expected to delay conclusion of the eradication by at least several weeks. Quality control samples must be evaluated in Mexico and North Africa in order to identify immediately when there are problems in the transport. Corrective measures should be taken immediately when problems are identified in order to avoid problems with subsequent shipments.

(b) There should be at least two shipments of sterile NWS flies each week with three to four day separation. This will place sterile flies in the infested zone that are at various ages and maximizes the likelihood of mating with the native screwworm flies.

(c) The size of the infested zone at the end of 1989 was about 18 000 km^2. The entire zone is located within Libya with Tripoli near the centre. The western limit of infestation is within 60 km from the border with Tunisia. The size of the infested zone will probably increase, or the concentration of insects dispersed in the infested zone may need to be increased.
Up to 100 million sterile NWS flies per week can be provided by the Joint Mexico–US Screwworm Eradication Commission. This is sufficient to meet the current requirements of the eradication programme in North Africa.

(d) *General Requirements for Packaging and Transport*

— Procurement or lease of up to four refrigerated 40 foot (12.2 m) insulated trailers and diesel truck tractors with sleepers for transport of insects from the production plant of Tuxtla Gutiérrez, Mexico, to the airport in Mexico for departure on the charter aircraft.
— Procurement of 3 575 000 (includes 10% for damages) fly release cartons, partitions and food cups, which is a one year supply. At least a 90 day delivery time should be anticipated.
— Procurement of 46 250 kg of honey or sugar, and up to 50 000 kg of cotton (No. 2 linters) or 1250 kg of gel Carrogeenan for packaged adult fly diet.
— Manufacture of 1980 baskets (35 × 60 × 80 cm) made of light weight, but rigid, galvanized or aluminum wire. Each basket is capable of containing 48 fly release cartons. The baskets need to be stackable, allow for adequate air circulation around the fly release cartons and easy removal, and be sturdy enough for storage and transport. If the NWS sterile flies are packaged in North Africa then 660 baskets are required. It is estimated that each fully loaded basket will weigh 14.5 kg.
— Two carton forming machines will be required for packaging. The Joint Mexico–US Screwworm Eradication Commission has 2–3 machines that may be available.
— Procurement or lease of a 24–30 passenger bus for transport of personnel at the packaging centre (Mexico or North Africa).
— Manufacture of 25 rigid screen bottom trays (3.8 cm × 46 cm × 60 cm) for pupae storage that will be used in North Africa with bulk pupae shipment or in Mexico with packaged fly shipment.
— Procurement of four 40 ft (12.2 m) refrigerated insulated trailers for emergence and transport of sterile NWS flies in North Africa as well as two truck tractors to move the trailers.
— Office supplies and space for the office, packaging, and quality control should be secured at the site in North Africa where the sterile NWS flies are received.

(e) *Packaging and Loading the Sterile NWS Flies in Mexico and Transport to North Africa (Option 1)*

— Fifteen Mexican packagers, one fork-lift operator, and two loaders under the direction of a supervisor and an assistant supervisor should be employed for packaging of the sterile NWS

flies in fly release cartons and loading of the trailer or aircraft. The trailers will be used to transport the packaged insects to the airplane, in the event that the airplane is located at a different location than the packaging centre. The transit time could be as much as 24 hours for ground transport of the insects to an international airport with a runway long enough to accommodate a large aircraft. Each trailer can transport up to 9375 fly release cartons (15 million sterile flies). One truck driver (chauffeur) plus travel allowances will be required for each 10 hour trip in one day. If the airplane and packaging centre are at different locations, then two extra labourers and a fork-lift operator will be required at the site of the airplane.

- Fly release cartons from each four hour group of irradiated pupae will be sampled by the quality control technicians.
- Records of temperatures inside the trailer and the cabin of the airplane will be made hourly during transport and reported to quality control personnel.
- The transport of the sterile NWS flies will be at 24–28°C where emergence of adult flies may begin within 24 hours after packaging and occur en route. If necessary the emergence of the insects can be retarded during transport by maintaining lower temperatures at 8–10°C.

— Packaging Procedures

- The gel adult diet is prepared and placed in the food cups the day or shift prior to packaging. Two people are required.
- One person is needed to load the cartons into the carton-forming machine. One machine will be required to package 25–30 million flies per day.
- Formed fly release cartons are placed on a moving belt (ca. 9 m). One person with a premeasured cup places 1600 pupae in each carton. Another person brings pupae from the storage room.
- Two people hand-form and place the paper partitions in the cartons.
- Two people place the food cups in the cartons.
- Four people close the cartons as they reach the end of the moving belt and stack them in wire baskets.
- Two people move the baskets to the storage room or transport trailer.

(f) *Transport of Bulk NWS Pupae from Mexico to North Africa (Option 2)*

- Pupae are collected after irradiation, placed in screen bottom trays, and stored at 8–10°C.
- Shipment of pupae in airtight plastic bags placed in insulated ice chests with artificial ice is satisfactory for 24–72 hours of storage.
- Methods of shipment include placing 400 000 pupae in a 60 L cooler (46 × 92 × 44 cm, 45 kg). An alternative is to use larger insulated boxes with wheels (1.53 × 1.22 × 1.07 m). Each box fully loaded (5.5 million pupae) weighs ca. 418 kg. Artificial ice would add to the weight. Boxes can be transported with fans connected to a duct system to introduce 8–10°C air. The aircraft should have a heating and air-conditioning system to accommodate this requirement. The fans would be connected into the airplane's electrical system. The air is blown through the bottom of the boxes, filtered through the pupae, and exhausted out the top. This system could be used in place of artificial ice and the total weight would be approximately the same.
- The boxes of pupae will be transported from the rearing facility to the airport and loaded and secured in the aircraft for immediate departure. Two people and a fork-lift will be required at the rearing facility in Mexico, the airport in Mexico and the airport in North Africa.
- Upon arrival in North Africa, the boxes of pupae are immediately transferred to a refrigerated trailer (8–10°C). The pupae are transported to the packaging centre where they are placed in screen bottom trays and stored at 8–10°C. Empty transport boxes are returned to Mexico on the return flight.

— The pupae should be packaged as soon as possible after arrival. Aircraft arrival time in North Africa should be scheduled near sunrise. This will permit a normal work day for packaging. Gelled diet could be prepared in Mexico and transported with each shipment of pupae.
— Packaging procedures are the same as described above. The baskets of fly release cartons are placed in emergence rooms or refrigerated trailers at 24–27°C.

Emergence will occur within 48 hours. When emergence reaches 80% the storage temperature is lowered to 10°C. The dispersal flights should be scheduled to depart as soon as possible after the 80% emergence is achieved. If part of the sterile fly shipment is to be dispersed a day later, it should be stored at 8–10°C for an additional 24 hours after arrival, then raised to 24–27°C. If necessary, sterile flies may be stored at 10–12°C for up to 3 days without significant mortality or reduction in quality; such delays, however, should be avoided. Sterile flies should be dispersed within 2 days of arrival.

9. Sterile Fly Dispersal

(a) The infested zone is 18 000 km^2 in Libya. This zone extends from ca. 60 km east of the border with Tunisia east about 225 km and extends inland from the Mediterranean coast approximately 80 km.

(b) The international airport at Tripoli is located in the infested zone. It provides the best location to receive the sterile fly shipments from Mexico, and for staging the sterile fly dispersal over the infested zone.

(c) The infested zone should be delineated by co-ordinates of latitude and longitude. Aerial navigation charts of the infested zone at the 1:500 000 scale will be required. The infested zone, delineated by the co-ordinates, will be covered by numbered parallel flight lines 1.5 km apart (called a "grid"). The flight lanes are drawn to minimize deadhead (the distance necessary for the airplane to travel between the airport and the beginning of the assigned fly dispersal lines, and between the end of the assigned fly dispersal lines and the airport). The infested zone may be covered by two or more grids, each with an identification code for reporting purposes, such as A, B, C, etc. The flight lines within each grid will be identified by numbers. All of the flight lines with the even numbers will be flown the same week. All of the flight lines with the odd numbers will be flown the following week. In this manner the flight lines flown each week will have 3 km separation and will be shifted 1.5 km on alternate weeks.

(d) Each dispersal flight will have flight lines assigned and drawn on a 1:500 000 scale aerial navigational chart. Flights are assigned flight lines separated by 6 km. The entire grid is covered in this manner the first half of the week. The remainder of the flight lines (even or odd) are covered the second half of the week. In this way the grids receive fresh flies twice each week. Attached to this chart will be a data form on which the flight lines assigned are recorded. The data form includes the assigned grid codes and line numbers, and longitude and latitude co-ordinates of the ends of the flight lines if a computerized navigational system such as OMEGA or satellite is used. The data form will specify the statute miles to be flown on the flight lines and the miles of deadhead to be flown. The rate of dispersal of fly release cartons is indicated. The names of the airplane crew members, the airplane matriculation number and person who prepared the *flight plan* are also recorded. The pilot is given the aerial navigation chart and the data form which serve as the flight plan. The pilot calculates the estimated time en route (ETE). A copy of the data form is kept at the departure airport as a record of the flight.

(e) The sterile NWS flies are transported to the airplanes in the refrigerated trailers. The airplanes are parked in an area that is accessible to the trailer.

(f) The airplanes used for sterile fly dispersal must be dedicated to the programme and should not be used to transport chemicals that may be toxic to the insects. The parking and loading area for the airplanes should not have any toxic chemicals stored within 500 m, or any ground contamina-

tion by such chemicals in the immediate area. The transport vehicles must not be used to store or transport such chemicals.

(g) The dispersal airplanes should be equipped with a cargo door for ease of loading the fly release cartons. Sufficient seats must be in the airplane equipped with safety belts that will accommodate all crew members. The dispersal crew member must have access to the cabin of the airplane during flight in order to disperse the fly release cartons.

(h) Fly release cartons are dispersed from the airplane through a fabricated aluminum chute with an opening measuring approximately 15 × 19 cm, and long enough to carry the cartons from the cabin to the exterior of the aircraft. A curved extension is used on the exterior end of the chute to create a "Venturi Effect" which draws the carton through the chute, and causes it to be pulled apart as it exits. Each chute is tested to assure 100% opening of the fly release cartons which should open gently, not explode, and not hit part of the airplane where the flies may be killed or injured.

The chute installed through a hole in the airplane should not interfere with the control cables of the airplane.

A dispersing machine with a variable speed belt or plunger set to achieve the desired rate may be used to feed the fly release cartons into the chute. The dispersal crew members keep the belt or magazine for the plunger filled with boxes. The alternative is for the dispersal crew members to feed the fly release cartons into the chute at the prescribed rate by hand.

A watch with a second hand in order to time the dispersal rate will be used. Hand feeding the chute is not recommended because the dispersal rate may be erratic while cartons are retrieved from the cabin of the airplane.

The pilot will advise the dispersal crew member of the number of fly release cartons per minute to achieve the assigned rate. Corrections will be made for prevailing wind conditions since the rate is cartons per kilometre of ground travelled.

The dispersal crew member will save one unopened fly release carton from each flight, or one from each 1000 cartons dispersed. These will be given to the quality control technician immediately after returning from each flight.

(i) Airplane navigational equipment includes operational true airspeed indicators, gyro compasses, altimeters, OMNI directional indicators, and dual VOR and VHF radios. Flights are conducted under daylight Visual Flight Rules (VFR) and dead recognizing navigation at 1500–3000 feet (450–900 m) above the ground. Take-off and landing may be made under instrument weather conditions. Dispersal from above a cloud cover is permitted when navigation equipment is adequate to assure accurate line of flight and it is not possible to fly below the clouds. Additional navigational equipment such as Distance Measuring Equipment (DME), VLF OMEGA System, and Global Satellite Navigation System should be used to assist in accuracy of flight and fly dispersal. The Loron C Navigation System should *not* be relied upon as a navigation aid in the North Africa region. Dispersal flights should be flown as accurately as possible with no more than a 2 km deviation from the assigned flight lines.

Dispersal flights are ideally conducted at 175–200 km/hour average ground speed. However, fly dispersal has been satisfactory up to a maximum of 250 km/hour. The deadhead may be flown at an average ground speed above 250 km/hour depending on the capability of the airplane. The airplane may be a single engine or multiengine type. It should have a minimum service ceiling of 10 000 feet (~3300 m) above MSL.

(j) The pilot should have a minimum of 500 hours as command-pilot flying time in the type of aircraft used for fly dispersal. The pilot should have a commercial pilot's licence with an instrument rating.

(k) During times of the year when temperatures reach or exceed 25°C, flights are programmed to depart at sunrise or as early in the day as possible in order to load and disperse the sterile flies

during the cooler part of the day. Airplanes are loaded expediently (maximum one hour). The dispersal crew members load the fly release cartons on the airplane with the assistance of one or more ground personnel. The pilot does "preflight" on the airplane prior to loading. Flight plans are filed and clearances obtained with the authorities while the airplane is being loaded. The airplane departs immediately after fly release cartons are loaded, since a delay may cause a reduction in fly quality. The airplane cabin ventilation system must be open in order to keep the sterile flies cool during the flight.

(l) Departure time and cabin temperature are recorded on the flight plan data form. A thermometer with a probe located in the cabin where the fly release cartons are loaded records the inside cabin temperature. Cabin temperatures and altitude are recorded hourly during the flight.

(m) If the flight pattern is not completed as programmed owing to weather conditions, mechanical problems, restrictions, or other factors, these are recorded by the pilot on the flight plan data form. The portion of the pattern not flown as assigned and the alternate pattern should be marked on the navigation chart. The areas not flown will be scheduled on a subsequent flight if possible.

(n) No airplane landing should be made during the programmed flight except for an emergency. Each landing and departure are recorded on the flight plan data form including the location and reason for unscheduled landings. The time of the termination of each flight is also recorded. The flight plan data form becomes the permanent record of each flight.

(o) If an airplane makes two or three dispersal flights in one day, it should be refuelled, and reloaded expediently (maximum one hour). The loading procedure is the same as with the first flight of the day.

(p) The fly release cartons are transported to the airport prior to scheduled flights and stored at 10–12°C until the airplanes are ready to be loaded. After the last flight of the day the trailer is used to tranport the wire baskets that contained the fly release boxes to the packaging centre, or they are loaded on the next aircraft returning to Mexico.

(q) An air-conditioned office (3–5 m^2) in a building or travel trailer should be established at the airport. The office is used by the dispersing chief and the pilots. Records of flights are maintained. Telephone and/or radio communication is needed.

(r) Personnel consist of a dispersing chief, assistant dispersing chief, and at least one ground worker for each airplane. There should be at least one dispersal crew member for each airplane. Extra ground workers and dispersal crew members are employed to cover absences. The dispersal crew members and the ground workers will be under the supervision of the dispersing chief, except if the dispersal crew members are employed by the aviation company or organization providing the dispersing aiplanes. It is assumed that the aviation company or organization providing the airplanes will provide the pilots and all maintenance support for the airplanes.

(s) Zones of higher NWS incidence are treated with additional sterile flies (referred to as *special treatments*). A special grid pattern may be drawn to overlay the regular grid. The special grid may encompass a microzone of higher and persistent NWS infestation. Special grids are flown in the same manner as regular grid patterns with rates of 1000 to 2000 sterile flies per km^2. The special grid treatment continues weekly until the microzone of infestation disappears. This is determined by the lack of detection of animals newly infected with NWS.

Isolated cases of NWS in the infested zone should be treated with 100 000–500 000 sterile flies per week. These sterile flies are dispersed weekly within a 3 km radius of the location of the reported case for six to eight weeks from the collection date. This type of special treatment is referred to as a *"Hot Spot"* with the objective of increasing the concentration of sterile flies in the immediate vicinity of known screwworm infected animals where larvae may have exited the wound and pupated. The increased concentration of sterile flies will improve the probability that the flies emerging from those pupae will encounter and copulate with sterile flies. Additional sterile flies are also dispersed over habitats for screwworm, concentrations of animals or potential routes of screwworm fly migration, referred to as *strategic releases.*

Ground dispersal of sterile flies may be used to treat isolated locations, quarantine stations where NWS infected animals have been detected, animal concentration points, premises where known NWS infected animals have been detected, or isolated microzones which cannot be treated by aerial dispersal. The number of sterile flies distributed at a location will depend on the size of the area and animal density to be treated.

Special treatments are supplemental to flies dispersed on the regular grid patterns. The regular grid dispersal should normally receive priority.

(t) Occasions when the airplanes are unable to fly on a scheduled day owing to unfavourable meteorologic conditions, mechanical problems with the airplane, failure of clearance by the authorities, or other factors, the sterile flies should be stored at 10–12°C. The flights are scheduled for the following day. If aerial dispersal is not possible within 72 hours the sterile flies should be distributed by ground, which is accomplished by placing the fly release cartons in air-conditioned vans. The vans should have a driver and a person to disperse the flies. Dispersal should be done as early in the day as possible when the ambient temperatures are relatively low, and into the zone that would have been covered by aerial dispersal. Distribution is limited by time, availability of personnel and vehicles, and accessibility to the zone; it is employed only as a last resort when aerial dispersal is not possible. Mortality of the adult sterile flies may be expected after 72 hours in storage.

(u) The eradication of screwworms is possible only when quality sterile flies are routinely and accurately distributed in a timely manner over the infested zone. The execution of this phase of the programme is vital to successful elimination of this costly animal and human pest.

10. Quality Control of Sterile Flies

(a) A quality control laboratory (4.5–6 m^2) should be located at the packaging centre. The laboratory will be air-conditioned for creature comfort. There should be a work bench (1/2 m × 6 m) for placement of two microscopes, flourescent lights, etc.

(b) The quality control staff should consist of a supervisor and two technicians. They should be experienced in conducting biological laboratory functions.

(c) Two boxes will be fabricated from wood with solid sides measuring 40 cm on each side. The inside of the box will be painted in black. The top of the box will remain open with a 1.3 cm lip around it on the inside. This will be used to conduct flight agility tests. A release carton with the adult flies will be placed in the black box and opened. After about 15 minutes any dead flies found in the release carton are counted and removed. This gives a percent mortality. Then the box is covered with plastic and injected with Co_2 to inactivate any live flies that had not flown out. The adult flies that are in the box are removed from the box and counted. The count is recorded. This gives a percent of flyable flies. Any visible abnormalities such as broken wings or legs, mutations, etc., are recorded. The release carton is taken to the laboratory where the number of empty pupae cases are separated from those from which the flies did not emerge. This will give the percent of emergence. All of the data are recorded in a ledger or on a computer.

(d) The quality control personnel will monitor the emergence of the flies after the packaging is complete. When approximately 80% of the flies have emerged the temperature will be lowered in the emergence room to 10–15°C.

(e) Two fly release cartons out of the 1250 in each shipment are removed for conducting the test described in (c) above. In addition 100 adult flies are placed in each of two fly cages without food. The fly cages are incubated in the emergence room. When 50 percent of the flies have died the amount of time is recorded. This is the longevity test.

11. Technical Evaluation

All components of the operation, from fly rearing to dispersal and case reporting, will be closely monitored. Reports containing data that detail the effectiveness of each component will be sub-

mitted regularly. Where data indicate problems or failures, corrective action will be taken immediately with follow-up.

Components that require regular assessment include the following:

(a) *Insect Quality Control*

Pupal weights, emergence rates, flight agility, and adult sterility assessed post-irradiation in Mexico and as applicable in North Africa.

(b) *Delivery*

Dates and times of departure and arrival of sterile fly shipments, numbers of flies per shipment, and a record of temperature during shipment.

(c) *Dispersal*

Dates of release, age of flies at release, number of flies released, grids covered, and results of fly trapping on the ground.

(d) *Infestations and Egg Sterility*

Numbers and locations of positive and negative cases collected in surveillance operations, and numbers and rates of sterility of egg masses collected from sentinel animals.

(e) *Animal Treatment*

Numbers and locations of insecticide packet distribution and numbers and location of animals treated.

(f) *Animal Movement*

Record of animal movement into and out of the area of infestation.

(g) *Information*

Record of literature distributed, radio spots, and meetings. Reports of lack of co-operation of animal owners and other involved parties.

12. Administrative Evaluation

Continuous evaluations will be required for both the financial and management aspects of the programme. Of particular importance will be financial summaries on a monthly basis for use by the Commission, Programme Director, Unit Heads and donors. Financial management will require a computerized system with continuous inputs from the administrative unit and with the information continuously available to those responsible for expending the funds as well as those responsible for providing the funds. The evaluation of the management system will likewise be continuous with quarterly reports provided to the Commission. These reviews will be internal but supplemented by external consultants as required by the Commission.

13. Technical Information Management System

To obtain the information identified in Section 11 above (Technical Evaluation) it will be necesary to establish a system of handling technical information rapidly and accurately. If possible this should be a computer-based system. The system must be designed so that data are available on a daily basis to the programme management. The data will be summarized and made available in printed form on a weekly basis. It is essential that all units within the programme have continuous and immediate access to technical data. In addition, the weekly reports must be made available to the Commission, donors, UN organizations and other interested parties.

14. Training

Training courses will be designed for the personnel listed below:

(a) *Pilots and Dispersers*

Duration: 1 day
Location: anywhere

The officer in charge of the implementation is the Aviation Adviser. He should teach what regular and special grids are, hot spots, frequency of releases, what types of forms are used and how to complete them and instruct how to feed and control carton release machines. Dispersers must be instructed to keep cartons for quality control personnel to be used for post-flight tests. This course should be held a week before actual releases.

(b) *Research Personnel*

Quality Control Personnel:

Duration: 1 week
Location: Libya
Staff in charge: Entomology Adviser

The course will teach how to conduct pre-and post-flight agility tests, provide information on emergence and malformations, completion of report forms and filing and record keeping. This course should be held at least one week before actual dispersal.

Biological Technicians:

Duration: 1 week
Location: Libya
Staff in charge: Entomology Adviser

The course will include identification, female fly dissection technique, handling of attractants (chemical and liver), handling of fly traps, sheep and sheep pens, completion of report forms and filing and record-keeping. This course should be held as soon as possible to begin actual work and have a record of pre-dispersal NWS populations that can be used to measure the effect of sterile fly dispersal.

(c) *Packaging Personnel*

Duration: 1 week
Location: Mexico
Staff in charge: Joint Mexico–US Screwworm Eradication Commission

Two supervisory staff members responsible for packaging the pupae should be sent to Mexico to be trained. Their training should include fly food mixing, maintenance and operation of the carton forming machine, measuring of pupae, filling of baskets, racks, plane and truck loading, temperature ranges for pupae and flies, completion of forms and record-keeping. The alternative is to have an expert consultant conduct the training in North Africa.

Note: This training is not necessary if the NWS pupae are packaged in Mexico.

(d) *Public Information Personnel*

Duration: 1 week
Location: Libya
Staff in charge: Public Information Expert

The proper way to conduct public information activities and what information must be released to the public at each programme's stage will be taught. It shall include public speaking and draft-

ing of news releases for radio, TV and press. Furthermore, training will be provided on projector/generator use, setting up exhibitions, school and public meetings, animal shows and markets, and how to use report forms.

Training courses will be held in any country interested, provided the conditions are adequate.

15. Research and Development

Research and development requirements for the rearing and irradiating phase of the operation will be assumed by the Methods Development Section of the Joint Mexico–US Screwworm Eradication Commission and the Agricultural Research Service, United States Department of Agriculture. These activities are ongoing and include quality control during rearing (flies and diet ingredients), monitoring sterility of irradiated flies, and testing and implementing improved rearing methods.

Although the technology for successful NWS eradication is available today, future research activities and new thrusts directed toward a new set of conditions are indicated to accelerate success of an eradication programme in North Africa.

Results of recent mating compatibility studies involving the Libyan NWS strain and the current NWS production strain indicate that the strains are compatible and fully competitive. Together with the immediate continuation of genetic characterization of NWS population from North Africa research will also focus on NWS attraction for mating assembly and oviposition with the aim of improving surveillance techniques and developing additional technologies for NWS population suppression.

As the NWS has only recently become established in Libya, research on field ecology, population dynamics, and population genetics is particularly important. The Joint IAEA/FAO Division will be reponsible for assembling a team of appropriate scientists to study the equally important short-term aspects which are:

(a) Quality control studies to determine the most appropriate packaging, transportation and short-term pre-release storage conditions (e.g. packaged adults vs. bulk pupae).
(b) Studies to determine the relationship between NWS activity and environmental/meteorological conditions and the physical factors and socio-economic practices that determine NWS population dynamics and the annual cycle of infestation.
(c) Field and laboratory experiments to determine more specifically the details of the NWS life-cycle.
(d) Designing and putting into practice fail-safe procedures.
(e) Ready access to research findings will prove beneficial to the operation in North Africa. Therefore, the research and development team should stay in close contact with scientists of the Joint Mexico–US Screwworm Eradication Commission, the Agricultural Research Service and the Animal and Plant Health Service of the United States Department of Agriculture and the Secretariat of Agriculture and Water Resources of Mexico.

Annex 5

PREREQUISITES

Prior to the implementation of a campaign to eradicate the NWS from North Africa, there are a number of prerequisites which must be fulfilled. These prerequisites are almost entirely non-technical, since the technology for eradication of the NWS from North Africa has been successfully used for more than 25 years in the USA, Mexico and in some Caribbean islands. These prerequisites are based on the experience of these successful NWS eradication campaigns as well as on other emergency eradication campaigns.

1. FAO

FAO, which has accepted the leadership role in the programme to eradicate the NWS from North Africa, will be sufficiently flexible for this emergency programme to be conducted efficiently and effectively. This will require waiving many of the usual rules and regulations governing FAO project operations. FAO will assume the attitude that the only objective is NWS eradication and that if this can best be done, for example, by contracting the entire programme to an outside organization, then FAO in co-operation should arrange for this.

2. IAEA

The IAEA will support and co-operate with the FAO in the NWS eradication programme.

3. Sexual Compatibility of the North Africa NWS Strain and the Mexican Mass Reared NWS

Tests have confirmed that the NWS strain reared in the Tuxtla Gutiérrez, Mexico, mass rearing facility are sexually compatible with the NWS strain in Libya.

4. Method of Air Transport of Sterile NWS from Tuxtla Gutiérrez to Tripoli, Libya

A method of shipping large numbers of sterile NWS from the mass rearing facility in Tuxtla Gutiérrez to Tripoli, Libya, will be available and have been evaluated prior to the initiation of the eradication programme. The shipping method used will ensure high quality sterile flies arriving in Libya. The loss in quality cannot exceed 10% as measured by the standard quality control tests which are routinely conducted in Mexico.

5. Infested Area

The known infested area at the time the eradication programme is implemented will not exceed an area or areas from which it is technically feasible to eradicate NWS with the number of sterile NWS flies made available for the programme, or other resources required for their effective dispersion.

6. USA

The US Government will grant legal authority for the Joint Mexico–US Screwworm Eradication Commission to provide sterile screwworm flies (up to 100 million per week) for the NWS eradication campaign in North Africa. This authority will be for the life of the eradication campaign in North Africa.

The USA will continue to permit US personnel to provide technical and administrative assistance for the eradication programme in North Africa.

The USA will grant waivers for procurement of specialized materials and equipment from US sources which cannot be readily procured in other countries to be used in Libya for the North Africa emergency NWS eradication campaign.

The USA must continue to permit US citizens to train North African personnel in NWS eradication technology. The majority of this training will take place in Mexico and other Latin-American countries; however, training within the USA may be required in individual cases. These cases will be handled on an individual basis.

Permission by the US Government for US citizens to work in Libya would be of great advantage to the NWS eradication campaign. Current restriction of US citizens working in Libya should be waived for the NWS eradication programme.

7. Mexico

The Mexican Government will grant local authority for the Mexico–US Commission to provide sterile flies (up to 100 million per week) for the North African programme.

The Mexican Government will continue to permit training of personnel from Libya and other North African countries.

The Mexican Government will continue to permit their citizens to work in Libya and other North African countries.

8. Joint Mexico–US Screwworm Eradication Commission

The Commission will agree to provide up to 100 million sterile flies per week for use in North Africa. In addition, they will provide samples of all equipment necessary for handling, packaging, shipping, storing and releasing sterile flies. Detailed engineering drawings may be required of certain speciality equipment items.

The Commission will accept that the North Africa NWS eradication programme is an emergency and that a constant supply of the required number of high quality sterile flies is mandatory for the success of the campaign. Thus, the Commission will agree that the supply of sterile flies to the North Africa campaign will be a very high priority. A minimum weekly number or minimum percent of total available sterile flies will be negotiated. Additional resources will be required to adapt the production facilities to provide the additional sterile flies for North Africa.

9. NWS Infested Countries

As of January 1990, Libya is the only country outside of the Americas that is infested with the NWS. However, countries adjacent to Libya may become infested at any time, thus this prerequisite applies not only to Libya but also to these adjacent North African countries.

The governments will:

(a) assure the continuous provision of sufficient qualified personnel on a 24 hour day, seven day week basis to assure the successful execution of all aspects of the programme.

(b) intensify their control programmes including animal movement control, prophylactic and curative insecticide treatment, and country wide NWS surveillance during the full period of the programme. Infested countries and countries at risk will continue official surveillance programmes for two years subsequent to apparent NWS eradication.

(c) provide continuous access to programme personnel of all control activities, including particularly distribution data on NWS and other myiasis incidence.

(d) assure the continuous availability of all equipment and facilities including maintenance and supply designated for the programme, in addition to whatever spare parts and other resources are required to assure successful execution.

(e) provide continuous (24 hour) world-wide communication facilities, including telefax and telephone to project personnel.

(f) provide all legal, customs, military and any other government clearances required.
(g) provide full-time counterparts with no other professional or official duties.
(h) provide multiple entry visas to all programme personnel.
(i) provide detailed maps of areas in which the programme will operate.
(j) allow programme personnel complete access by ground and air to all areas of actual and potential NWS infestation within the country.
(k) ensure that all animal owners have the knowledge and are encouraged to participate in the eradication programme through animal inspection, wound treatment and most importantly the collection of worm samples from animal wounds.
(l) assure the use of print, radio and TV for NWS programme information.

10. Participating Countries at Immediate Risk

In participating countries not infested with NWS the governments will fulfil the following obligations listed in Section 9 (Infested Countries): (b), (c), (d), (f), (g), (h), (i), (j), (k), (l). They will also arrange prior commitments that immediately upon confirmation of NWS in their country, (a) and (e) of Section 9 will be provided to the programme.

11. Organizational Structure

A new organization will be established to conduct the NWS eradication campaign. This organization will have flexible rules regarding employment, procurement, contracting, etc., which is commensurate with an emergency action programme. The programme managers will have great leeway in taking action to conduct the programme efficiently and effectively and to solve unexpected problems. The staff for the entire eradication programme will be a combination of those directly employed by the organization and those seconded full time to the programme by government organizations under the technical supervision of the organization. The new organization will be a legal entity.

12. Management System

The management system employed to operate the new organization will have an International Director with wide latitude and responsibility for implementing the programme. The Director is responsible to and will report to the North Africa NWS Commission which will be responsible for the eradication programme. This Commission will consist of representatives from UN Organizations, donors and participating national governments. This Commission will meet quarterly or as necessary and receive reports from the Programme Director, approve budgets and activities for the following quarters, and solve policy issues which may be impeding the progress of the programme.

The Director will be assisted by a Deputy Director. Reporting to the Director will be the Heads of the various units (such as surveillance, quarantine, sterile fly shipment and release, programme evaluation, administration, etc.).

13. Contracting

Very serious consideration will be given to contracting the entire programme to an outside organization. If for some reason this is not possible, then the significant operational parts of the programme will be sub-contracted in order to increase efficiency.

14. Funding

Sufficient funding for one year of activity will be available before initiating the programme and pledges will be available for the second year. At the beginning of the first year activities will start at

the required level and as systems, techniques, procedures, management skills, organizational structure, etc., are developed and people employed and trained, activities will accelerate as soon as feasible. Sterile fly dispersal will begin with a limited number of flies per week. A continuous technical evaluation will be made, and when the operation is satisfactory, the quantity of sterile flies and resources will be increased and the size of the infested zone covered will be increased as rapidly as possible. This will be in increments as additional quantities of sterile flies are made available up to the quantity needed to cover the entire infested and other relevant areas. Full-scale eradication should be in place 3 to 5 months after programme implementation.

Annex 6

DONORS' CONTRIBUTION

The donor contribution is estimated at US $80 000 000 and will cover:

1. Technical Assistance

		m/m
(a)	Chief Technical Adviser (Regional)	24
(b)	Entomologist (Regional)	24
(c)	Animal Health Officer (Veterinarian) (Regional)	24
(d)	Aviation Adviser (Regional)	24
(e)	Laboratory Specialist (Libya)	24
(f)	Packing Specialist (Libya)	24
(g)	Administrative Officer (Libya)	24
(h)	Information Officer (Regional)	24
(i)	Consultants (unidentified)	60

2. Administrative Support

(a) Two trilingual (A/E/F) secretaries
(b) Four bilingual (A/E) typists
(c) Two administrative assistants
(d) Eight drivers

3. National Personnel for Sterile Fly Dispersal

(a) One packaging supervisor
(b) Thirty packagers
(c) Six biotechnicians
(d) Two loaders
(e) Two lorry drivers
(f) Two bus drivers
(g) One dispersal officer
(h) Four information assistants

4. Sub-contracts

(a) Sterile fly provision
(b) All management of the programme including sterile fly transport and dispersal

5. Training Activities

(a) In-service training at all levels during the implementation of the programme
- — Quality control
- — Biotechnicians
- — Control of livestock movement and quarantine
- — Packing and fly release, including equipment
- — Maintenance
- — Information
- — Surveillance

(b) Regional seminar on surveillance and control for two participants from each country of the region at risk.

(c) Study tour to Mexico for two participants each from Egypt, Libya, Tunisia and Algeria.

6. Non-Expendable Equipment

(a) Vehicles

— Fifty-nine (59) 4-WD to be distributed:

— Twenty-one (21) for surveillance, treatment and identification for:

Algeria (5); Chad (2); Egypt (5); Niger (2); Sudan (2) and Tunisia (5).

— Thirty (30) for quarantine and movement control for:

Algeria (5); Chad (5); Egypt (5); Niger (5); Sudan (5) and Tunisia (5).

— Eight (8) for Programme staff.

— A Liaison car type 505 Peugeot SW.

— Two (2) truck tractors and four (4) refrigerated trailers for the transport of flies.

— One (1) bus for personnel transport.

(b) Sixty-one (61) portable spray rigs with spare parts to be distributed:

— Forty (40) for intensified animal movement control and quarantine activities to be distributed to:

Algeria (5); Chad (5); Egypt (5); Libya (10); Niger (5); Sudan (5) and Tunisia (5).

— Twenty-one (21) for intensified surveillance, treatment and identification activities to be distributed to:

Algeria (5); Chad (2); Egypt (5); Niger (2); Sudan (2) and Tunisia (5).

(c) Twenty-one (21) dissecting microscopes for the intensified surveillance, treatment, and identification activity for:

Algeria (5); Chad (2); Egypt (5); Niger (2); Sudan (2) and Tunisia (5).

(d) Two (2) word processors for the project secretariat HQS and one (1) portable for field missions.

(e) One (1) photocopier.

(f) Office and laboratory furniture.

(g) Twelve (12) air-conditioners for the office and laboratory.

(h) Telex and telefax facilities.

(i) Three (3) computers for the project data processing.

(j) Sixty-eight (68) portable generators (5 kWA, 220 V, 50 cycles) to be distributed as follows:

— for the intensified movement, control, and quarantine:

Algeria (5); Chad (5); Egypt (5); Libya (10); Niger (5); Sudan (5) and Tunisia (5).

— for the information campaign:

Algeria (4); Chad (4); Egypt (4); Libya (4); Niger (4); Sudan (4) and Tunisia (4).

(k) Forty (40) mobile handling facilities for the same activity and distribution as per (j).

(l) Twenty-eight (28) videotapes.

(m) Twenty-eight (28) transparency projectors. (l) and (m) shall be distributed as follows: Algeria (4), Chad (4), Egypt (4), Libya (4), Niger (4), Sudan (4) and Tunisia (4).

7. Expendable Equipment

(a) *Insecticide*

— Coumaphos 50% wettable powder (boxes 1 kg). Eight thousand five hundred (8500) kg distributed as follows:

— Four thousand five hundred (4500) kg for the intensified surveillance, treatment and identification activity to be distributed as follows:

Algeria (1000 kg); Chad (500 kg); Egypt (1000 kg); Niger (500 kg); Sudan (500 kg) and Tunisia (1000 kg).

— Four thousand (4000 kg) for the intensified animal movement control and quarantine activity to be distributed to:

Algeria (500 kg); Chad (500 kg); Egypt (500 kg); Libya (1000 kg); Niger (500 kg); Sudan (500 kg) and Tunisia (500 kg).

— Coumaphos 5% (sachets of 5 gr).

— One million five hundred thousand (1 500 000) sachets for the intensified surveillance, treatment and identification activity, distributed to:

Algeria (300 000); Chad (200 000); Egypt (300 000); Niger (200 000); Sudan (200 000) and Tunisia (300 000).

(b) *Office Supplies*

— For documents produced by the programme.
— Photocopier.
— Data processing supplies (diskettes, paper, printing releases, etc.).
— All stationery supplies.

(c) *Documentation*

— Books.
— Technical and scientific journals.

(d) *Information*

— Videocassettes (32).
— Slides, etc.

8. Miscellaneous

(a) *Maintenance of equipment*

— Vehicles: spare parts and operating costs.
— Communications: telex, telephone, fax.
— Maintenance of buildings and office equipment.

(b) *Reports*

Preparation, translation into A/E/F of the final report of the programme.

(c) *Sundry*

Preparation, translation (A/E or F) of technical documents, training manuals and audiovisual aids.

Annex 7

OUTLINE OF WORK PLAN

		Year 1	Year 2
1.	**Surveillance, Control and ID**		
	Strengthening of actions already undertaken by FAO/UNDP in North Africa by:		
	(a) Continued surveillance	Continuous	
	(b) Treatment of wounds	Continuous	
	(c) Livestock dipping and/or spraying	Continuous	
2.	**Control of Animal Movement and Quarantine**		
	(a) Strengthen actions as per 1.	Continuous	
	(b) Establish new methods for livestock movement control	Continuous	
	(c) Establish new quarantine posts	Continuous	
3.	**Information Campaign**		
	(a) Obtain public support on preventive treatment, animal movement control collections and reports	Continuous	
	(b) Inform the farmers about: — Dispersal of sterile flies — Flies innocuous to humans, animals and plants — No tampering with fly traps and sheep pens	Continuous	
4.	**Establishment of Organization to Conduct Eradication Programme (contract)**	Month 1	
5.	**Eradication Programme**		
	(a) Agreement among donors, Joint Mexico–US Commission and countries involved for the provision of necessary sterile flies to the programme from Mexico	Month 1–2	
	(b) Strengthening of the Tuxtla Gutiérrez rearing facility capabilities in order to produce enough extra sterile flies for North Africa	Month 1–6	
	(c) Adapt system to transport sterile flies from Mexico to North Africa	Month 1–2	
	(d) Epidemiological survey for accurate delimitation of infested areas in Libya	Month 1–2	
	(e) Training of pilot, dispersers, packers, and other personnel	Month 1–2	
	(f) Dispersal of sterile flies	4th Month Continuous	

	Year 1	Year 2
6. Quality Control of Sterile Flies		
(a) In Mexico		
— Emergence and sterility		
— Mortality		
— Malformations	4th Month	
— Flight agility	Continuous	
(b) In North Africa		
as per (a) except sterility	Continuous	
7. Technical Evaluation		
Every two months evaluate progress by results of quality control, fly trapping, egg mass sterility, numbers of positive and negative cases, animal movement and treatment, etc.	6th Month Every 2 months	
8. Administrative Evaluation		
Monthly balance of project expenses and other audit controls as requested by donors and the operating organization	Monthly Continuous	
9. Technical Information Management System		
(a) Gathering data and filing of technical reports	1st Month Continuous	
(b) Distribution of information to donors, interested agencies and countries	2nd Month Weekly	
(c) New outbreaks	Instantly	
10. Contracting		
Contracting of organization responsible for operation of eradication programme including aerial services for sterile fly transport from Mexico to North Africa and dispersal in Libya	2nd Month, daily	
11. Recruitment of Project Personnel		
(a) Chief Technical Adviser (Regional)	1st Month, 2 years	
(b) Entomological Adviser (Regional)	1st Month, 2 years	
(c) Veterinary Officer (Libya)	1st Month, 2 years	
(d) Entomologist (Libya)	1st Month, 2 years	
(e) Laboratory Specialist (Libya)	1st Month, 2 years	
(f) Packaging Specialist (Libya)	1st Month, 2 years	
(g) Administrative Officer (Libya)	1st Month, 2 years	
(h) Administrative Officer	1st Month, 2 years	
(i) Information Officer	1st Month, 2 years	
(j) Administrative support: (8 secretaries, 8 drivers, 2 administrative assistants)	1st Month, 2 years	

		Year 1	Year 2
(k)	Consultants (60 man-months unidentified)	As necessary	
(l)	Tripartite Review Mission	As necessary	
(m)	Evaluation Missions (2)	As necessary	
(n)	National Personnel (packing supervisor 1; packagers 30; biotechnicians 6; loaders 10; truck drivers 6; bus drivers 2; dispersal chief 2; dispersers 12	1 Month	Continuous

12. Training

(a)	In-service training for quality control, biotechnicians, animal movement control and quarantine, surveillance, packing and information personnel	Continuous	
(b)	1 regional technical seminar (15 days) with 2 participants per country at risk	First year	
(c)	1 study tour to Mexico with 2 participants per country at risk (1 week)	First year	

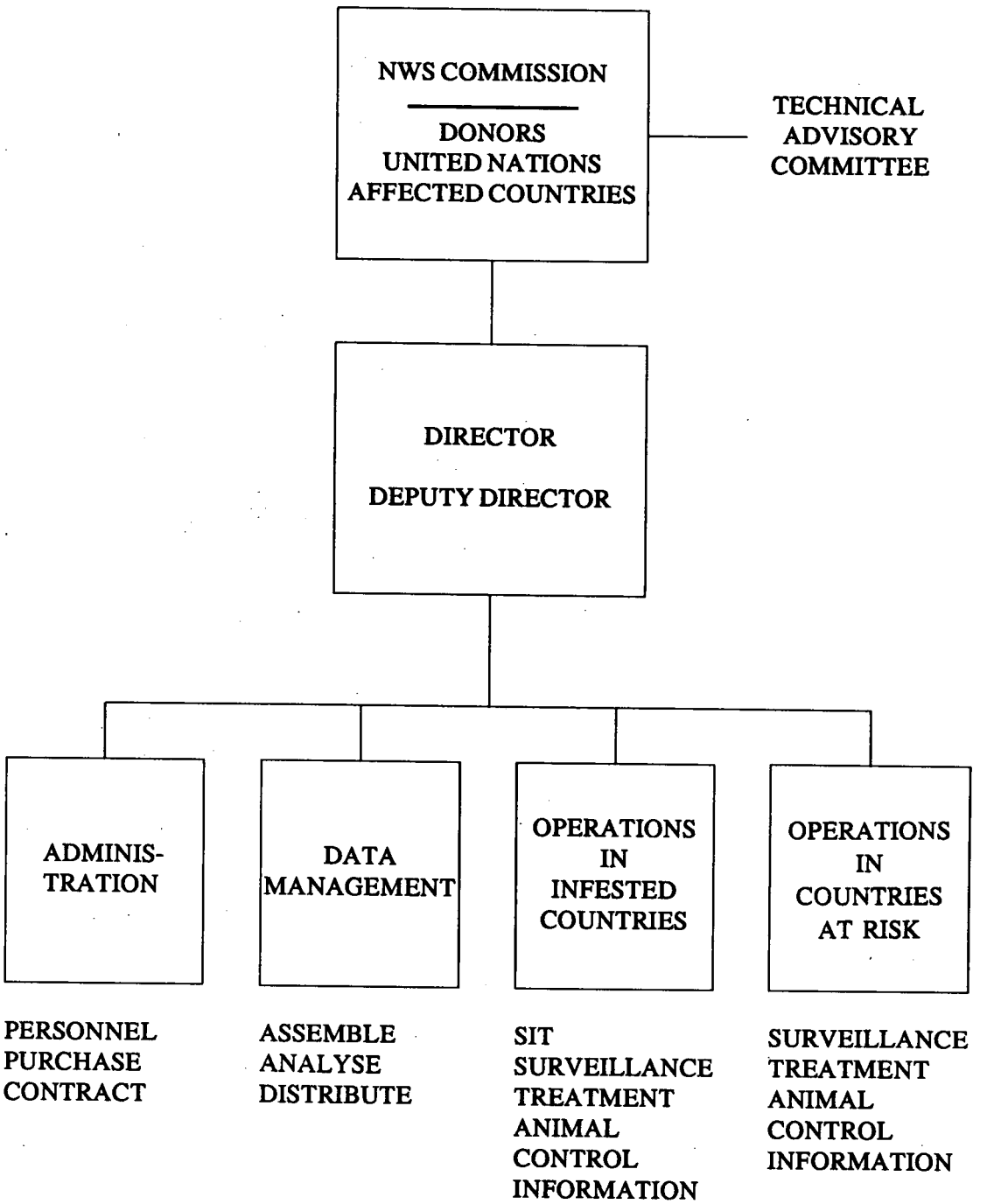
13. Research and Development

(a)	Adapt programme techniques to the North African eradication programme	Continuous	
(b)	Adapt transport system for use between Mexico and North Africa	1 Month	Continuous
(c)	Conduct R&D as required to solve programme problems	Continuous	

Annex 8

SUGGESTED ORGANIZATION CHART

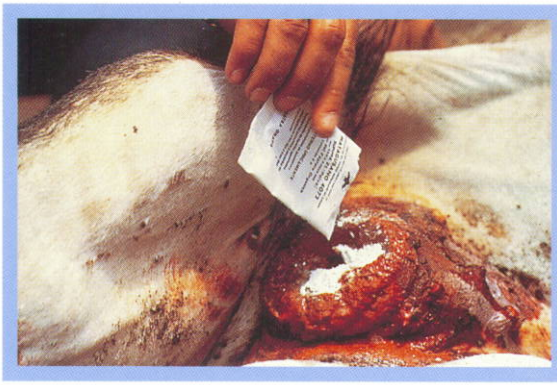
NWS ERADICATION FROM NORTH AFRICA



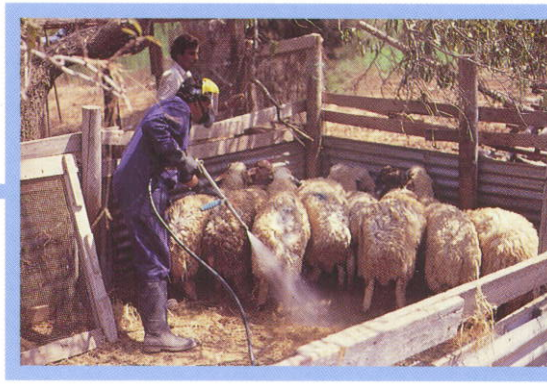
PROBLEM SOLVING

Animal inspection

Use of tracer animal

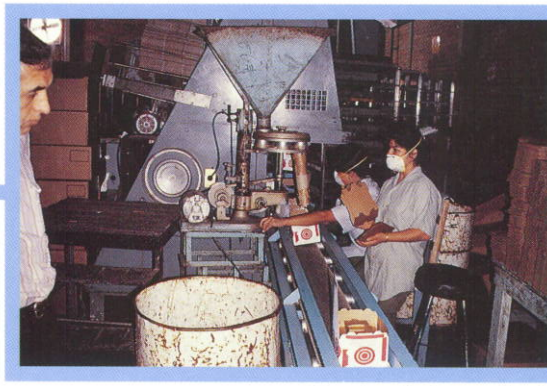


Wound treatment

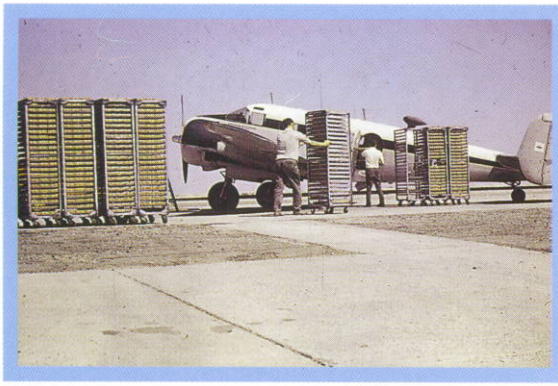


Animal spraying with insecticides

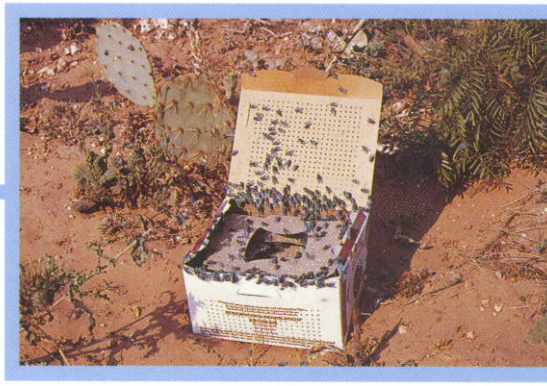
Mass-production of flies



Post-irradiation packaging



Preparation for aerial release of sterile flies



Release box with sterile flies

DAMAGE CAUSED BY SCREWWORM