

AN FAO EMERGENCY PROGRAMME FOR NORTH AFRICA



# ***ERADICATING THE SCREWORM***



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## FOREWORD

If the New World Screwworm infestation detected in Libya in 1988 had spread into other areas of Africa it would quickly have become a major threat to livestock, wildlife and even human health. The continent would have been faced with livestock losses amounting to thousands of millions of dollars and on-going treatment and control costs of hundreds of millions more. In the Americas, the Screwworm is today primarily a livestock pest but in Africa, where medical facilities are often limited, it could have claimed a great many human victims as well.

In 1990, when FAO created SECNA, the Screwworm Emergency Centre for North Africa, there was no doubt that the presence of the New World Screwworm in Africa represented a crisis of international significance. As with the locust emergency of the mid-1980s, FAO quickly assessed the problem, considered its likely impact, and devised an effective response. SECNA worked to ensure that the most appropriate technology was applied in the field as quickly as possible.

Now, less than two years later, the Screwworm has been eradicated from Libya and Africa has been saved from the devastating impact of a permanent infestation. Even more encouraging, the victory was achieved in far less time than was originally estimated and at far less cost.

In addition, the programme has shown a clear economic return. An independent study assessed the annual regional benefit of eradicating Screwworm as \$480 million at a benefit/cost ratio of 50:1. By any standards this is a result that all those who contributed to the programme can consider with pride.

The Eradication Programme was, above all, a cooperative effort. SECNA worked closely with the Libyan Government, the Mexican-American Commission for Screwworm Eradication, the FAO/International Atomic Energy Agency Joint Division of Nuclear Techniques in Food and Agriculture, the International Fund for Agricultural Development and the United Nations Development Programme.

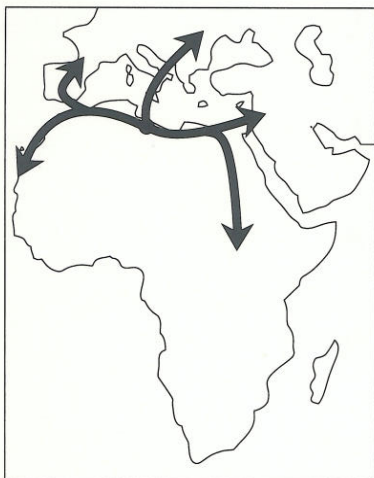
Of equal note, the programme demonstrated once again FAO's ability to promote and coordinate the diverse international support required to ensure an effective operation, bridging the gap between north and south and between differing ideologies. It provides an excellent example of what the United Nations system can achieve.



Edouard Saouma  
Director-General  
Food and Agriculture Organization  
of the United Nations



## THE THREAT



The arrival of New World Screwworm fly in Libya in 1988 represented a grave threat not only to Libya, but also to the African continent as a whole. The Screwworm had already proved itself one of the most devastating livestock pests in the Americas, where it had cost farmers thousands of millions of dollars in lost production and governments hundreds of millions in control and eradication measures. Its introduction to North Africa posed a serious health threat to domestic animals, wild animals, and even humans.

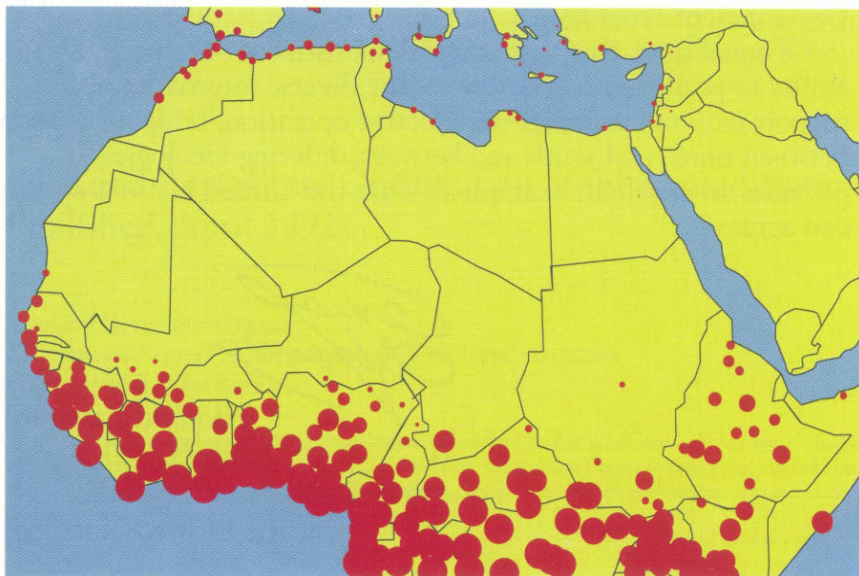
The fly lays eggs in wounds as small as a tick bite or in orifices such as ears or the nose. The eggs hatch into larvae that eat into the living flesh of the host, enlarging the wound. More Screwworm flies – and other parasites – infest the wound and frequently, if left untreated, the victim dies. Fully grown cattle can be killed within ten days.

In 1960, the cost of the Screwworm infestation in the United States of America was estimated at \$100 million a year. Clearing Mexico and the southern United States of the pest took more than 20 years and cost nearly \$700 million.

The fly's mobility makes containment extremely difficult. Adult flies have travelled up to 200 km and, where conditions are favourable, the size and range of the population can expand rapidly. Carried by infested animals, the primary cause of the infestation spreading, Screwworm can travel across continents.

The Screwworm presence in Libya, therefore, was a concern of international significance: unless quickly eradicated, it would inevitably spread. Studies carried out by the Commonwealth Scientific and Industrial Research Organisation of Australia (CSIRO) showed the Screwworm could easily migrate around the North- and West African coasts and down the Nile valley. Computer models predicted the establishment of permanent infestations throughout Africa and Southern Europe. From this base it would then reach into the Middle East and Asia. Such an

CSIRO computer projection of permanent New World Screwworm colonies.







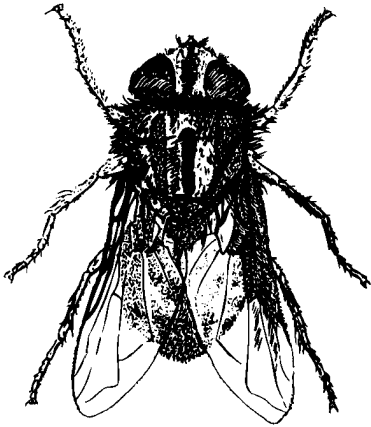
Screwworm larvae eat into an animal's flesh, enlarging the wound and attracting flies to lay more eggs. If left untreated, the animal may eventually die.

infestation would be virtually impossible to eradicate and the countries affected would be saddled with the on-going expense of treatment and control programmes, which would sap national reserves and drain funds from much-needed development programmes. In the North African region alone, treatment and protection could have cost as much as \$360 million a year – an investment that would merely deal with the symptoms and do nothing to remove the cause.

In addition to the economic impact, a continent-wide infestation would pose a major human health risk. In remote areas, where people are unfamiliar with the Screwworm and medical facilities are limited, humans would fall easy victims – particularly children, the sick and the aged. The poor and the hungry would be ravaged by a new pestilence. Within the first year of the Libyan infestation a number of human cases were reported, mainly affecting hospital patients.

The health risk for animals would extend to Africa's wildlife, reducing natural populations and exacerbating the threat to already endangered species. Studies in southern Texas showed that up to 80 percent of newborn fawns were killed in areas where the infestation was severe. The large, migrating herds of ungulates – East Africa's wildebeest for example – would prove ideal hosts, with large outbreaks likely during the calving season when the screwworm would lay eggs in fresh umbilical wounds. Whereas domestic livestock are regularly inspected and fairly easily protected, the difficulties of controlling and treating an infestation among wild animals would be insurmountable and the Screwworm would quickly establish a permanent "breeding pool" from which it could re-infest domestic herds.

## THE PEST



Indirect evidence of New World Screwworm presence in the Americas dates back to the early 1500's when prisoners captured by Hernando Cortez fell victim to "*el gusano de muerto*" (the worm of death) which infested wounds left by branding. The first scientific description, however, was not made until 1858. Once again prisoners were the victims. An investigation of the alarming death rate among prisoners at the penal colony on Devil's Island in French Guiana revealed that a major cause was infestation by a worm that seemed to eat the convicts' living flesh. The Screwworm would lay eggs in a prisoner's nostrils. When the larvae hatched they would bore their way into the nasal sinus.

Samples of the larvae were collected and the flies were hatched for study. In February 1858 Dr Charles Coquerel, a French naval surgeon and noted entomologist, published his findings in the *Annales de la Société Entomologique de France*. He declared the fly a new species and named it *Lucilia hominivorax* (shiny blowfly that eats man).

To farmers in the region, however, the pest became known simply as the Screwworm – a term which was used for both the Screwworm and *Cochliomyia macellaria*, a related species. This caused some confusion, which hampered efforts to deal with Screwworm infestations. Methods that should have worked were ineffective against the true Screwworm. No one, however, could explain why so little progress was being made. Then, in the 1930s, E.C. Cushing and W.S. Patton confirmed that the true Screwworm differed from *C. macellaria* – and would require different control and eradication techniques. They named it *Cochliomyia americana* (of the Americas), but it was eventually matched with Coquerel's description and given the scientific name accepted today, *Cochliomyia hominivorax* (Coquerel).

The adult flies are a deep greenish-blue, with three dark stripes on their thorax (back), and bright red eyes, slightly wider apart on the female than on the male. The Screwworm passes through several stages during its life-cycle: egg, larva, pupa, and fly. Under normal conditions this cycle lasts about three weeks. In hot weather it may be slightly shortened and in cool weather it may stretch to as long as 90 days.

Male Screwworm flies are sexually aggressive and can mate several times during their lifespan. The female usually mates only once. From this encounter she will produce several batches of eggs at three to four day intervals – on average, four batches of up to 400 eggs each. She lays the eggs at the edge of a wound in multiple, shingled rows. After about twelve hours, the eggs hatch and the larvae eat their way down into the wound. Using hook-like "teeth" to tear at the animal's flesh the larvae create a straw-coloured tissue fluid on which they feed. Breathing tubes in the posterior allow them to work their way deep into the wound. Unlike other parasites which can survive on carrion or faeces, Screwworm larvae *must* feed on the tissue fluids of a *living* animal



– one of the reasons they have proved such a destructive pest.

The larvae feed for five to seven days, enlarging the wound and thereby making it more attractive to other Screwworm flies which deposit more eggs. Unless the animal is treated it will likely die. Charles G. Scruggs, in his book *The Peaceful Atom and the Deadly Fly*, describes the death of a young deer from a Screwworm infestation. Five days after the first larvae hatched "the wound in his head was now several inches deep. Screwworms now numbered in the thousands. The writhing, tearing pests had made a round wound three inches across. Underneath the skin the wound bulged wider." The next day the animal died.

The Screwworm larvae grow through three distinct phases, then drop to the ground and burrow into the soil to pupate. The larva cuticle (skin) hardens into a red-brown casing – a puparium – and the insect then develops into a fly. This pupal stage normally lasts about one week but can take up to two months in cool weather.

Within two days of emerging from the puparium, the fly is sexually mature and ready to mate. The cycle then begins again.

Within two days of emerging from the pupal state, the adult flies are sexually mature. Males can mate several times, females usually only once.

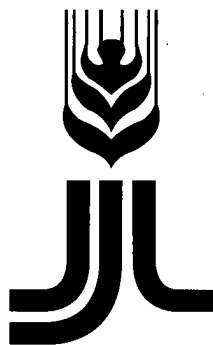
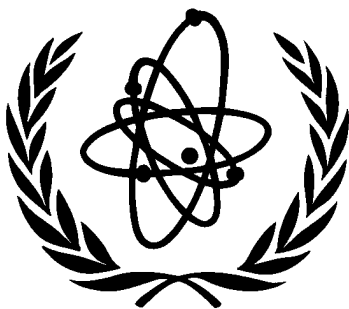
From one mating, the female fly usually produces four batches, of up to 400 eggs each, which she lays at the edge of a wound.

After five days the larvae drop to the ground and burrow into the soil. They form a hard pupal casing and develop into adult flies.

After about 12 hours, the larvae hatch then eat into the wound, tearing at the flesh to produce a fluid on which they feed.



## THE RESPONSE



The New World Screwworm most probably made its way to Libya through the importation of infested animals from South America. It is uncertain when the Screwworm arrived, but the first specimens were found in March 1988 at Habda, near Tripoli. By the end of the year, numerous animal infestations had been found, along with a number of human cases. Samples collected in November and December were sent for analysis to the British Natural History Museum and the Commonwealth Agriculture Bureau Institute of Entomology. On 31 January 1989, the Institute confirmed the samples were *Cochliomyia hominivorax* and notified FAO of the Screwworm presence in Libya. FAO passed the information on to concerned agencies, including the International Atomic Energy Agency (IAEA), and informed other countries in the region of the threat from Screwworm.

An FAO mission, sent to Libya in mid-April, reported that some 2000-3000 cases had been detected during the previous 12 months in a 200km-long coastal strip centred on Tripoli and extending approximately 80 km inland. By the end of April, following the recommendations made by the mission, a project under the FAO Technical Cooperation Programme (TCP) was approved for emergency assistance to Libya. A Screwworm Task Force was formed and work began on designing a programme to eradicate the Screwworm from Libya. This programme would be based on the Sterile Insect Technique (SIT). Millions of Screwworms, sterilised by irradiation, would be released to mate with wild flies and produce eggs that don't hatch, thereby breaking the reproductive cycle.

The Libyan authorities had already drawn-up a preliminary plan and begun concentrating animal surveillance activities on Screwworm detection and the treatment of wounds. Recognising the immensity of the work involved in eradicating the Screwworm – particularly the production and dispersal of the sterile flies – they requested assistance from the United Nations system.

On 28 April, the Director-General of FAO notified all member countries in North Africa, the Middle East and southern Europe of the new infestation. During May, missions were sent to neighbouring North African countries – Algeria, Egypt, Tunisia. A Screwworm expert, the General Sub-director of the Mexican-American Commission to Eradicate Screwworm (MACES), was contracted as a consultant to FAO. The FAO/IAEA Joint Division began planning the research necessary to apply SIT in Libya.

In order to begin sterile fly releases as quickly as possible, FAO proposed purchasing flies from MACES rather than building a new production facility in Libya. The MACES production plant in Mexico would merely need to step-up production – a relatively quick and simple operation. FAO opened negotiations for the purchase and transport of the MACES-produced sterile flies.

At the beginning of June 1989, FAO held a meeting to begin





In May 1990, FAO invited donors to support a programme for the eradication of the Libyan infestation. Eventually a consortium of more than 20 nations and agencies provided funds for the operation.

formulating a regional Screwworm eradication strategy and examine draft programme proposals, including a \$2 million research and SIT Pilot Test project. In the same month, three additional TCP projects were approved: a programme for regional technical support and training, covering Algeria, Chad, Egypt, Libya, Niger, Sudan and Tunisia, plus national projects for Tunisia and Algeria. A further project, funded by Libya and the United Nations Development Programme (UNDP) and to be executed by FAO, was established.

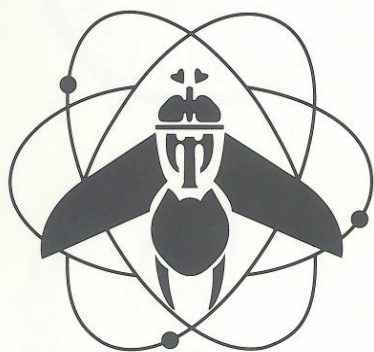
The International Fund for Agricultural Development (IFAD), which had also been asked for assistance by a number of North African countries, joined the Screwworm Task Force in July. Taking into account FAO's earlier proposal, IFAD began developing a \$1 million Pilot Biological Control programme. This was later superseded by the joint FAO/IFAD/Libyan government Pilot Project, signed in May 1990 (with additional funding support provided by African Development Bank and UNDP).

From October 1989, FAO began distributing kits for treating wounds and collecting larvae samples. Nearly two million kits, containing 5 gram sachets of coumaphos larvacide powder, were distributed throughout North Africa, plus an additional 8.5 tonnes of coumaphos in 1 kilogram boxes. The larvacide kills the Screwworm larvae and prevents re-infestation.

Three FAO consultants, recruited from the Mexican American Commission, were appointed to assist the Libyan Veterinary Service and moved to Tripoli in June 1989. A training workshop for 30 North African veterinarians was held in Libya in July.

Work on the main eradication project continued. In April 1990, the Joint FAO/IAEA Division published a report which became the basis for FAO's Eradication Programme. On 18 May 1990, the first Donors' Consultation was held at FAO Headquarters in Rome and less than a month later, the Director-General established SECNA, the Screwworm Emergency Centre for North Africa, to coordinate the various international efforts. Working closely with the Libyan veterinary authorities, SECNA was to implement the Eradication Programme, based on SIT.

## THE STERILE INSECT TECHNIQUE



The Sterile Insect Technique, developed by American entomologists Edward F. Knipling and Raymond C. Bushland, represents one of the greatest breakthroughs in pest control this century. The method is simple: large numbers of sterile insects are released in the wild, where they mate with fertile insects to produce infertile eggs.

The work which led to the development of SIT began in the 1930s, when eradicating the Screwworm seemed impossible. Knipling describes the programme just after he joined the United States Department of Agriculture (USDA) in 1934: "We were trying to protect and cure animals *after* they were attacked... Since it was impossible to find and treat all infested livestock, not to mention wild animals, I couldn't see any hope of ever controlling Screwworm." He was convinced there must be a more effective way of dealing with the problem.

During field work, Knipling observed the relatively low number of Screwworm flies in nature compared to other blowflies. In 1937, he began working with Bushland – who had developed an artificial medium for raising larvae. This allowed him to study the behaviour of the flies being raised in captivity. He observed that two to three days after emerging from their pupal state, the flies went into a two-day mating frenzy. After that, the males were still interested but the females rejected them. He concluded that the females mated only once, while the males remained sexually active. Combining these two observations he developed the idea that if the number of wild Screwworm flies was statistically low enough and sterile insects could be raised and distributed to outnumber the wild population, then the eggs laid by the females would not hatch and the population would eventually die out. Bushland began working on methods for mass-rearing the flies and Knipling on ways to sterilise them, but in 1939 they were transferred to separate laboratories, then the Second World War halted their Screwworm research.

Screwworms are mass-reared at a specially-designed plant in Tuxtla Gutierrez, Mexico: the larvae are raised on an artificial food medium; during the pupal stage they are loaded into the irradiation system (left) and sterilised with a dose of Caesium<sup>137</sup> generated from Husman irradiators (centre) and then packed into dispersal boxes (right).



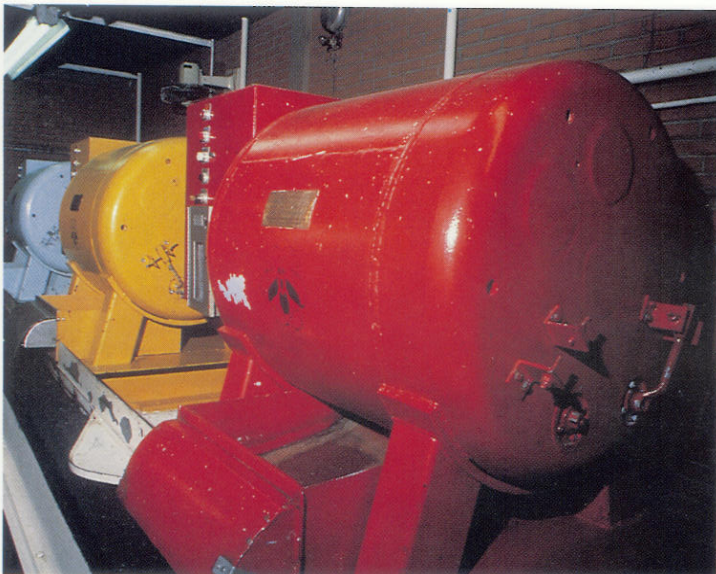


In 1947 a new Livestock Insect Laboratory was opened in Kerrville, Texas, and Bushland continued his work, mainly attempting to find a chemical that would induce sterility. In 1950, Arthur W. Lindquist told Knipling about an article by Nobel laureate H. J. Muller warning of the possible effects of nuclear fall-out. Muller cited experiments he had previously conducted in which he caused mutation and *sterility* in fruit flies by exposing them to high doses of x-rays.

Bushland borrowed time on a hospital x-ray machine and found the solution he had been looking for. Irradiation sterilised adult flies and older pupae but did not kill them or significantly diminish their drive and capacity to mate with fertile females. Gamma rays produced from Cobalt<sup>60</sup> soon replaced x-rays as the irradiation source (today Caesium<sup>137</sup> is used).

The first two field tests were conducted during 1951-53 on Sanibel Island, 5km off the Florida coast. The technique successfully eradicated the local Screwworm population, although flies migrated from the mainland to re-infest the island. Despite these results, the technique was still regarded by many scientists as fanciful. So when an agricultural officer from Curaçao – 40km off the coast of Venezuela – made enquiries about Screwworm control, Knipling persuaded the Governor of the island to use it for a third field test. Following preliminary trials, the eradication programme began on 1 August 1954, with the release of 160 sterile males per square kilometre per week. After ten weeks, only two egg masses were found – both sterile. The programme was a success and SIT was proved.

The technique was used by the USDA to clear the United States and has since been used by the Mexican-American Commission for the Eradication of Screwworm to eradicate the pest from Mexico (declared in 1991). The Commission's on-going project is expected to free the remainder of Central America, as far as Panama, by 1996.





## THE ERADICATION PROGRAMME



When SECNA was established in June 1990, an extensive and diverse series of activities had already been initiated: animal surveillance and treatment in Libya, research relating to the use of sterile flies from Mexico, and training of veterinary staff from the North African region. SECNA became the coordinator of all these activities, channelling the efforts of the various agencies and institutions to ensure quick, effective action.

As a preliminary to the SIT operation, the compatibility of the mass-produced sterile flies with the wild flies in Libya needed confirmation. The sterile flies were produced from a strain called OW-87, collected in Orange Walk, Belize, in 1987. In October 1989 Screwworm samples from Libya were taken to the USDA Agricultural Research Service laboratory in Fargo, North Dakota and a series of tests was conducted. The central question was whether the sterile males would mate with the wild females. Male NWS are sexually aggressive – they will even attempt to mount a small pebble if it is thrown past them – but for mating to occur, the chemistry must, literally, be right. The flies "smell" through sensors in their feet, and chemicals secreted on the body of the female tell the male fly he has found an appropriate mate. Fortunately, the tests conducted at the Fargo laboratory proved positive.

The next step was to ensure that the flies could be shipped to Libya and dispersed in a healthy condition. In the Mexican-American Eradication programme, Screwworm flies were usually dispersed within 58 hours of irradiation, the key factor being the timing of the emergence of adult flies from the pupal state. If released too early, the flies may be damaged or emerge deformed; if released too late, the emerged flies may have already begun mating with each other, decreasing the potential effectiveness and sexual aggressiveness of the males. Fortunately, the emergence schedule can be controlled by manipulating the temperature at





which the pupae are stored. If it drops too low or rises too high, however, the pupae may die.

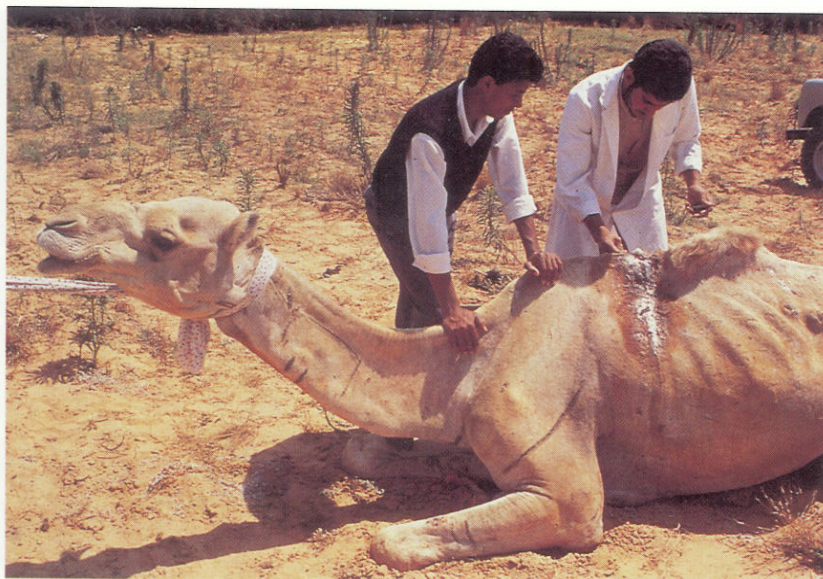
Air cargo companies were contacted and transport requirements developed for the variety of shipping options. The chosen contractor would have to meet specific operational criteria, including a minimum delay in delivery and the maintenance of a strict temperature regime in the cargo hold.

While technical demands had to be the first priority, cost-effectiveness could not be overlooked. A 14-hour direct charter flight from the MACES production plant to Tripoli was the favoured option, but for small shipments – less than 25 million pupae – it was too expensive. The early shipments were taken by truck to Mexico City airport, by scheduled flight to Frankfurt, then by charter to Tripoli (40 hours).

In addition to contracting a transport company, SECNA needed to arrange for the dispersal of the flies over the infested area in Libya. Light aircraft would have to be fitted with a chute to drop the boxes at a controlled rate along fixed flight lines. A charter company in Libya won this contract.

By mid-1990, winning financial support for the programme had become the key issue. In addition to cooperating with FAO on the Pilot Project, IFAD had joined FAO in lobbying donors for support. At the first Pledging Conference, held at the IFAD's Rome Headquarters in July, the two organizations' efforts bore fruit – donors pledged nearly \$30 million to the Eradication Programme. This was in addition to FAO's own contribution, money IFAD had raised for the Pilot Project and funds donors had already committed directly to national governments in North Africa.

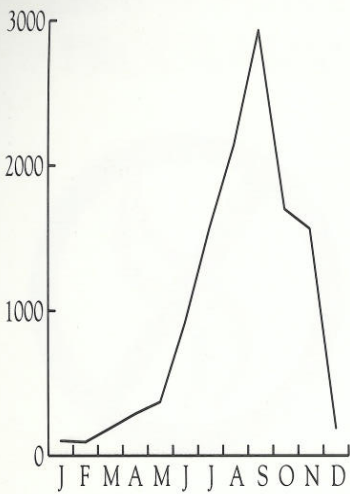
With all these elements falling into place, SECNA began working to turn the proposed Eradication Programme into a reality. Preceding the main programme, the Pilot Test Project would build up the Field Programme infrastructure and act as a trial run of the transport and dispersal operation.



Quarantine, spraying animals with preventative larvacide and treating wounds were the first line defences against Screwworm. At quarantine stations (left) details of animal movement were recorded. Surveillance teams inspected up to 4 million animals per month. They sprayed herds where Screwworm wounds were detected (centre) and treated any wounded animals (right).



## SEASONAL GROWTH



Myiasis cases (1990): graph reflects population growth during summer

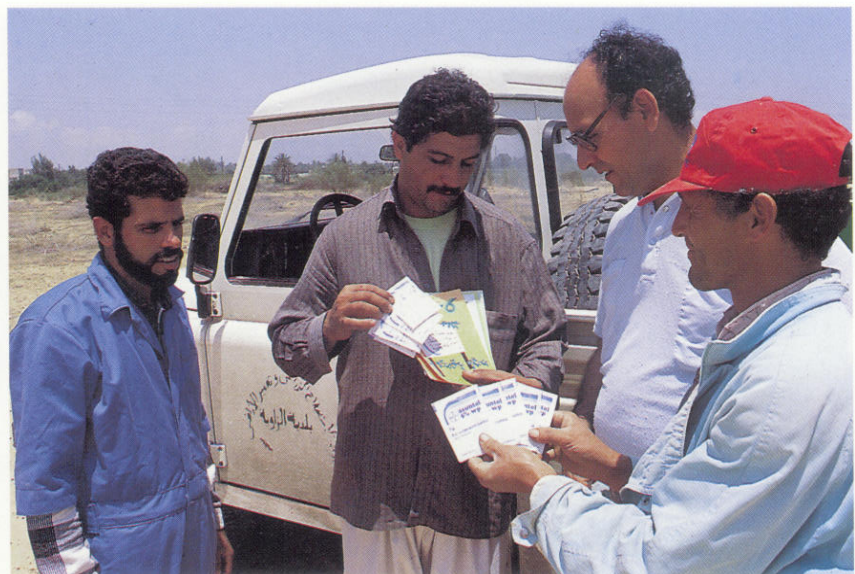
Three priorities dominated the Pilot Project: expanding surveillance and quarantine activities; building up the Field Programme facilities; and testing the fly dispersal operation over a trial grid in the northwest corner of the infested area.

Following the detection of the Screwworm, the Libyan Veterinary Service stepped-up animal surveillance activities, as did the veterinary services in neighbouring countries. At this stage, when the SIT operation was still only at the planning stage, surveillance, treatment of wounds and spraying animals were the first line defence against the Screwworm. Later, they remained an integral part of the eradication campaign. SIT relies on sterile flies substantially out-numbering wild flies. Controlling the population through surveillance and treatment laid important groundwork for its effective implementation.

The surveillance work consumed by far the most staff hours. By the time the SECNA Field Programme was in place – August 1990 – approximately 50 teams were making regular inspections. This operation was expanded to nearly one hundred teams, consisting of a veterinary officer, an assistant and a driver. Every month at the peak of the operation – during the Eradication Phase – the surveillance unit was carrying out roughly three million inspections and treating nearly 20 000 animal wounds. In total, more than 50 million inspections were recorded.

Each surveillance team visited all the herds in its inspection area once every three weeks. The veterinary officers examined the animals, collecting larvae samples from myiasis cases (wounds infested with fly eggs or larvae) and treating all wounds with coumaphos powder to kill the larvae and prevent re-infestation. The samples collected were sent back to the laboratory for analysis – to determine if they were New World Screwworm or other larvae. Each confirmed Screwworm infestation was recorded as one positive myiasis case, although it would probably represent the presence of several hundred larvae. At the peak of the

Explaining the risks of Screwworm infestation and treatment procedures to farmers (left) showed them the benefits of helping the veterinary inspectors. During inspections, larvae samples were collected from wounds and then sent to SECNA's Field HQ for examination (centre). Traps were set in the field (right) to catch fertile flies and check the dispersion of the sterile flies.





infestation, 2 932 Screwworm myiasis cases were detected in just one month – during September 1990.

Throughout the programme, communication activities played a vital supportive role. Much of the success of the surveillance operation was due to active participation by livestock owners. Radio announcements and television programmes were broadcast; leaflets and posters explaining the threat of New World Screwworm were distributed through schools and community groups. Farmers were encouraged to check their livestock for Screwworm infestation and report any wounded animals to local veterinary officers.

Farmers were also told why quarantine stations were necessary. During the Pilot Phase, 13 stations were established throughout the infested zone, checking animal movement, spraying all livestock, and treating animal wounds. By the end of 1991, nearly one million animals had been inspected at quarantine points.

As the SIT operation drew closer, communication activities were stepped-up to ensure as wide an audience as possible was informed why low-flying aeroplanes would be dropping cardboard boxes full of flies over large sections of the country – and, more particularly, over people's own land. The communication activities were so effective that people in the street kept asking SECNA staff when the flies were coming.

To cater for the dispersal activities and the increased collection of samples under the expanded surveillance operation, SECNA Field Programme resources were upgraded. The laboratory was improved and air-conditioned trailers were purchased for the storage of pupae. Fly traps were set in the field to monitor both the wild population and the post-dispersal activities of the sterile flies. A programme of quality control tests was designed to check the health and performance of the sterile flies.

The dispersal operation was timed to take advantage of the natural population decline during winter months. As

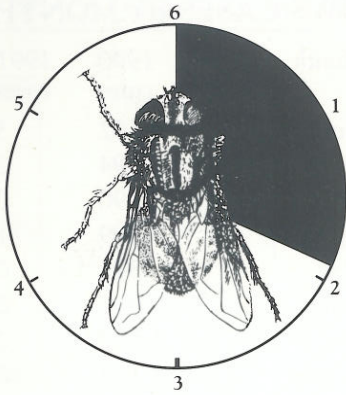
### NWS CASES BY MONTH

Month	1990 cases	1991 cases
January	102	3
February	94	2
March	190	0
April	289	1
May	371	0
June	917	0
July	1 570	0
August	2 145	0
September	2 932	0
October	1 701	0
November	1 566	0
December	191	0
<b>Total</b>	<b>12 068</b>	<b>6</b>

Each case = laboratory-confirmed infestation of 1 animal







temperatures cool, the pupal phase grows longer and each generation of Screwworm remains longer in the ground. As the preceding generation dies off, they are not replaced as quickly as during warm weather. Slowly the active population declines, although a large number of Screwworms are waiting, literally in cold storage. As temperatures rise during the spring, these Screwworms begin emerging and new pupae develop more quickly, so several generations of flies become active in a relatively short time.

By conducting the Pilot Project during the winter and starting the main phase at the beginning of spring, SECNA could take advantage of the low numbers, maximize the ratio of sterile to fertile flies, and hope to halt the new cycle of population growth before it could take hold. While the dispersal of sterile flies during the Pilot Phase was not sufficient for eradication purposes, it did help to suppress the population in the trial area, where the infestation had been severe during the summer.

On 14 December 1990, the first Pilot Project shipment – 3.5 million sterile pupae – left the production plant at Tuxtla Gutierrez. It arrived in Tripoli on 16 December. The flies emerged during storage at the distribution centre and then were dispersed by Twin-Otter aircraft over an area of some 7 000km<sup>2</sup> on 18 and 19 December. Just as for all subsequent shipments, a series of quality control tests were carried out. The emergence rate (the percentage of pupae that successfully matured into adult flies) was measured 72 hours after irradiation. Fly agility was measured by a test release from a special enclosure. Survival with and without food and water was recorded. The latter, the baseline for how much time the flies had to get out into the field and find food and water for themselves, determined how much flexibility could be allowed in the dispersal schedule. The health and performance of the flies had not suffered from the Trans-Atlantic flight: trapping revealed effective dispersal. This pattern held for the eight,

At the height of the sterile insect release campaign, 40 million sterile Screwworms were shipped from Mexico to Libya each week. After unloading at Tripoli airport (left), they were stored in refrigerated trailers until ready for dispersal then packed into light aircraft (centre). The boxes, designed to open during their fall, were released over a total area of some 40 000 km<sup>2</sup>. Public information activities explained the reason for dropping boxes and encouraged people to release flies from any unopened box (right).



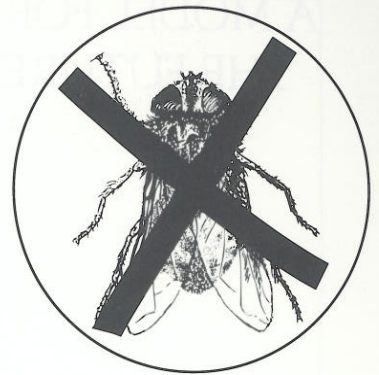


weekly shipments that followed. A total of 49 million flies had been dispersed when the last Pilot Phase release was made on 14 February.

The success of the Pilot Phase allowed an early start of the Eradication Programme. Shipments of sterile flies began on 1 February – before the end of the Pilot Project. Dispersal was increased to 28 million flies per week, delivered in two shipments. On 3 May, when direct charters began, the level was raised to 40 million per week. It had originally been envisaged that, during the summer, dispersal would reach 100 million flies per week. This proved unnecessary. Having acted quickly, SECNA reaped the benefits. In January 1991 only three myiasis cases were detected, compared to 102 the previous year; in February, only two (compared to 94); and in March no cases were found (compared to 190). One myiasis case and one wild fly were found during April, but the wild population had been unable to get a foothold. The saturation of the infested zone with sterile flies had done the trick and by May no further cases were reported. The countdown had begun: if six months passed without any cases, SIT could be suspended.

With the dispersal operation running smoothly, the emphasis returned to surveillance and quarantine activities. It was critical to ensure no isolated pocket of infestation had escaped detection. Surveillance was expanded into remote areas. Still no Screwworms were found. On 16 October, SECNA ended the SIT operation, confident that no Screwworms remained in Libya.

As a precautionary measure, surveillance and quarantine operations were maintained during the first half of 1992. Even with this provision, SECNA's Eradication Programme was completed in less than half the time anticipated and at less than half the cost originally estimated.



## A MODEL FOR THE FUTURE

In dealing with the Screwworm infestation, FAO was able to draw on knowledge and experience from many sources, particularly the Mexican-American Commission for Eradicating Screwworm. A number of Commission staff were seconded to SECNA, as were staff from the FAO/IAEA Joint Division on Nuclear Techniques in Food and Agriculture, and FAO staff with field experience in Libya. The ability to build such a skilled team was crucial: the staff knew what action was needed and how it should be undertaken.

In addition, SECNA's ability to win the cooperation of the governments, agencies and donors who supported the programme was an excellent example of the United Nations system working at its best. The commitment of the Libyan government was crucial. A total of 400 staff were assigned to work on all aspects of the programme: the government's support was worth more than \$25 million. International donors contributed almost \$35 million to the Eradication Programme, and more than \$15 million to other related activities in the region. Without this support, the cost of purchasing, transporting and dispersing sterile flies could not have been met.

Within FAO, the conferring of emergency status on the programme was essential to enable SECNA to put its plan quickly into action. The backing that the Director-General gave to SECNA set the approach to the project. There was a clear mandate and a well-defined programme for achieving it.

In the field, the support of farmers and livestock owners was encouraged by the extensive communication programme, a vital preliminary to such an intensive and large-scale operation.

While every international emergency has its own requirements, some features that contributed to the success of the North African Screwworm programme may provide useful precedents:

- rapid recognition of the problem, and determination of its extent;
- early development of a sound technical programme of action;
- establishment of a single executive unit with the necessary funds and authority to implement the programme;
- clear delineation of the relative responsibilities of the different agencies involved;
- implementation of an extensive communication campaign to ensure that people in the affected region are fully informed on the programme;
- keeping donors well informed. Funding is the bottom line and without donor support no programme can survive. SECNA took great pains to ensure donors were well-informed about programme needs and achievements and to encourage their participation in the management process.



# **SUPPORTING GOVERNMENTS AND INSTITUTIONS**

## **GOVERNMENTS**

AUSTRALIA  
AUSTRIA  
BELGIUM  
FINLAND  
FRANCE  
GERMANY  
IRELAND  
ITALY  
LIBYA  
LUXEMBOURG  
NETHERLANDS  
SWEDEN  
SPAIN  
UNITED KINGDOM  
UNITED STATES OF AMERICA

## **INSTITUTIONS**

AFRICAN DEVELOPMENT BANK  
EUROPEAN ECONOMIC COMMUNITY  
INTERNATIONAL FUND FOR AGRICULTURAL DEVELOPMENT  
ISLAMIC DEVELOPMENT BANK  
OPEC FUND FOR INTERNATIONAL DEVELOPMENT  
UNITED NATIONS DEVELOPMENT PROGRAMME  
WORLDWIDE FUND FOR NATURE



