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PLAN PROPOSED STRATEGY TO ERADICATE THE NEW WORLD SCREWWORM FROM THE CARIBBEAN

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New World Screwworm (NWS) is a parasite that causes cutaneous myiasis, a disease of economic and commercial importance in all warm blooded animals, including human beings. This condition is characterized by malodours, reddish brown fluid produced in the wound which usually drains and may stain the hair or flees around or below the wound, sometimes resulting in fever, and may culminate in the death of young animals and humans.

Most of the Caribbean countries are NWS – free. Although some noteworthy progress has been made in its control or eradication in some island countries, such as: Cuba, Dominican Republic, Haiti, Jamaica, and Trinidad & Tobago, they continue to the suffer from this pest, and this represents a biological risk to both the NWS – free Caribbean region and continental mainland countries.

This report outlines a plan of action for the eradication of NWS in the Caribbean region which may be implemented by national governments in close technical collaboration with national and international agencies such as the FAO, the Mexican – US Commission, the IAEA and the USDA.

El Gusano Barrenador del Ganado (GBG) causa una enfermedad parasitaria de importancia comercial y económica. Denominada miasis cutánea en los animales de sangre caliente incluyendo el hombre, estas se distinguen por la producción de exudados rojizos malolientes que manchan la periferia y/o parte inferior de la herida. En ocasiones provocan fiebre y la muerte de los animales recién nacidos.

La mayoría de los países del Caribe están libres del GBG. A pesar de los esfuerzos hechos por Cuba, República Dominicana, Haití, Jamaica, Trinidad y Tobago, para conseguir su control y erradicación, estos continúan padeciendo de la enfermedad y representan un riesgo biológico para los países del Caribe y continentales que se encuentran libres de esta plaga.

Este documento describe un plan para lograr la erradicación del GBG en el Caribe el cual podría ser implementada por los gobiernos nacionales, en estrecha colaboración técnica con agencias nacionales e internacionales tales como la FAO, la Comisión México – Americana, la IAEA y el USDA.

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BACKGROUND

The **New World Screwworm (NWS),** *Cochliomyia hominivorax,* is one of the most damaging insect parasites of livestock in the tropical and sub-tropical Americas, causing economic losses of hundreds of millions of dollars annually. Losses result not only from the direct reduction of productivity due to sickness and death, but also from the labour and insecticide costs incurred through continuously inspecting for and treating vulnerable wounds in some countries, these flesh-eating maggots are also a serious human health problem.

The larval stage is an obligate parasite of warm-blooded animals. Gravid female flies are attracted to wounds, even those as small as a tick bite. Eggs are deposited on the borders of these wounds. After 12 hr incubation period the larvae emerge from these eggs and enter the wounds where they feed on the live body tissues and fluids. The wounds are thus enlarged and secondary infections may occur. Without treatment, death may occur in one to two weeks. The NWS has a high reproductive rate; each female lays several batches of up to 400 eggs each. A generation can be as short as 3 weeks under optimum condition (3). In the Caribbean, NWS prevails throughout the year, but is especially abundant in the wet periods. All animals are affected. The most vulnerable wounds are the navel of neonates, accidental scratches and lesions, tick bites and branding abrasions.

The Livestock in the region

Livestock production in the Caribbean is based predominantly on small farmers raising in small numbers a variety of species of animals. These animals are mainly for family consumption and draught power, with some for sale. However, there is also an industrial commercial sector which is totally market-oriented that supports tourist-activities and this sector is growing very rapidly as the economic situation is making a remarkable improvement. Therefore, the Caribbean animal production is developing in a complex and dynamic environment.

Livestock populations in the involved countries are shown hereunder.

NWS susceptible population (x 1,000)

Country	Cattle	Horses	Swine	Sheep	Goats	Humans
Cuba	4,650	620	2,400	310	140	11,168
Dominican R.	1,904	329	539	105	163	8,364
Haiti	1,300	490	800	138	1,618	8,087
Jamaica	400	4	180	1.5	440	2,560
Trinidad and Tobago	34	1	28	12	59	1,289
Others	600	29	309	188.5	230	6,278
Total	8,888	1,473	4,256	755	2,650	37,746

(Source, FAO, Statistics Data Base, 1999 (FAOSTAT)

Recent trade changes on the continent have increased animal movement in many directions, depending on market prices of animals and their products. With the exemption of Cuba, all the countries in the Caribbean basin have extensive open international commerce.

Economic significance of NWS myiasis

Based on data collected through surveys and on economic studies carried out recently, estimated annual losses due to NWS in Cuba (8) were US$33,6 million (1999), and in Jamaica (7) (1998) from US$ 5,5 to 7,7 million. It is estimated that the minimum annual cost (12) of maintaining livestock in the affected countries is US$5.0 animal. If we take this value in theoretical economic basis then losses in the remaining infested countries may estimated as follows: Haiti US$21,7 million, Dominican Republic US$15,2 million and Trinidad & Tobago US$0,67 million. The total infested countries face costs exceeding US$ 75 million

yearly for treatment and prevention alone. In addition, productivity losses, deaths and costs of imposing quarantine restrictions are significant. In contrasts annual savings in the Caribbean NWS-free countries is US$6,7 million.

The total Caribbean land surface is 234,700 km^2 and the affected countries represent 203,460 km^2, which are 87 percent of the total. The human population in 1999 was 37,7 million; when 23 percent of the labour force was employed in the agriculture sector, which continues to be one of the main bases of the area's economy. Twenty two percent of the land is used for pasture and it supports a livestock population of over 18 million.

Zoonotic aspects

The NWS myiasis is an important zoonosis. The NWS scientific name, *Ch. hominivorax* (eater of man) shows that the first cases were diagnosed in man. The most common infestation sites in humans are the nose, ears and other exposed orifices. Failure to treat such cases may result in death the last human death due to NWS in the USA was in 1976. Deaths in humans were recorded in Jamaica during 1983 and during the eradication campaign in El Salvador, it was shown that humans were one of the most affected species.

There is evidence that the NWS fly can be carried by winds, as it was recorded in 1977 by the infestation of the Virgin Islands (11). However, the most common way that the NWS is introduced into an area is through the transportation of infested animals or humans. The presence of NWS in the Caribbean represents a continuous threat of reinvasion to the newly eradicated and non-endemic areas in the region, such as mainland Americas. Indeed, even countries in other parts of the world are vulnerable to be affected, as it has been demonstrated by the recent outbreak in Libya (1).

NWS myiasis situation in the Caribbean

The NWS is endemic in the Southern part of Panama and is widespread in all 13 countries of South America. The current status in the countries of the Caribbean region is summarized below:

Cuba: NWS presence was officially reported in 1995, with the Food and Agriculture Organization of the United Nations (FAO) technical assistance. Cuba has implemented a national control programme and has designed an eradication programme which is estimated to cost US$62,5 million with a four year duration. From 1995 to July 2000, a total of 34,094 cases were reported. The species more affected are cattle, swine, sheep, goats, horses, dogs and humans (4).

Dominican Republic: NWS cases occur in all parts of the country and without seasonal variation; most neglected wounds and untreated navels of newborn animals soon become infested. Human cases are a common occurrence. In 1999, the governments of Jamaica, Haiti, Dominican Republic and FAO began a regional technical assistant project on the control and eradication of the NWS. When this study is concluded, a donors meeting will be held to promote the eradication campaign funding.

Haiti: The disease is endemic with a high incidence throughout the country. It causes considerable losses in domestic livestock and it affects people of all ages. Presently, the FAO project is operational and will conclude in 2001. This is expected to be followed by a joint eradication programme with the Dominican Republic.

Jamaica: Until 1997, there was a heavy NWS infestation, with 100 percent of untreated wounds becoming infested, showing no seasonal variation. On July 1998, the Government of Jamaica began a NWS eradication programme supported by a United States Department of Agriculture (USDA) loan and the cooperation of international agencies, in particular, the International Atomic Energy Agency (IAEA) and the FAO. The estimated cost is US$ 9 million and will require 3 years for completion (7). From November 1998 to July 2000, a total of 4,912 cases were reported. Weekly treatment of the island with sterile NWS flies began on August 1999 with about 16 million flies per week. When the number of reported cases continued at a high level, the number of sterile NWS flies was increased to 32 million per week in July 2000.

Trinidad and Tobago: NWS is endemic and cases are found throughout the year with slightly higher numbers in the drier months from December to May. Wounds left untreated usually become infested. No information is available on incidence on humans. However, in December 1998, a human case was introduced and diagnosed in the UK from a lady who travelled from Port Spain (5). The vicinity of the islands to Venezuela may complicate NWS control and eradication due to possible migration of NWS flies.

Others: The countries and territories naturally free of NWS are: Antigua & Barbuda, Bahamas, Barbados, Cayman Islands, Dominica, Grenada, Guadeloupe, Martinique, Montserrat, Netherland Antilles (Aruba, Bonaire), Saint Kitts & Nevis, Saint Lucia, Saint Vincent & Grenadines, and Turks & Caicos Islands.

NWS Eradication

NWS can be eliminated using an environmentally-friendly technology known as the **Sterile Insect Technique** (SIT) complemented by intensive control, epidemiological surveillance and quarantine measures. SIT involves weekly aerial release of sexually-sterilized laboratory reared flies over infested areas in a ratio of 10 to 20 sterile insects to each wild insect. Mating between wild females and sterile males produces no offsprings thus interrupting the life cycle and progressively reducing the wild population to the point of eradication (9).

The severity of the constraint the NWS imposes on national economies and human health has justified its elimination using SIT from Curacao (1954, 1976), South-eastern USA (1959),US Virgin Islands (1972), British Virgin Islands (1972), Puerto Rico (1975), Southwest USA (1981), Mexico (1991), Libya (1992), Guatemala (1994), Belize (1994), El Salvador (1995), Honduras (1996), Nicaragua (1998) , Costa Rica (1999) (10, 13, 14). It is expected that by 2000 it will be eradicated from the Northern part of Panama and that a sterile fly barrier will be established over the Darien Gap using 40-50 million flies/week, which will protect the NWS-free territories North of Panama from future infestations.

The Sterile Fly Production

The NWS programmes demand large numbers of NWS sexually sterilized flies; these numbers are determined by the various local epidemiological situations. Presently, there is only one factory that can produce sterilized NWS flies. It is located in the State of Chiapas, Mexico and has a production capacity of 500 million NWS flies per week. Current production is 140 million pupae/week of which 98 million are sent to Panama, 39 million to Jamaica and 3 million are released around the factory forming a protective grid in case of accidental escape of fertile flies (6). Once the Darien Gap barrier becomes operational, the Mexican plant will only operate at 10 percent of total capacity.

Based on the future needs of the Panama barrier, it is planned to build a new NWS production plant in Panama with a maximum production capacity of 210 million pupae per week (2). Construction will take 3 years and the cost is estimated at US$100 million. The design of this plant will depart from that of previous plants in Florida, Texas and Mexico in that it will consist of three independent modules, each capable of producing 50 million flies/week. The advantage of this new modular plant will be to have the capability to increase or decrease the level of fly production in a more expeditious manner; and to rear different NWS strains, if needed. Having this plant next to the biological barrier will reduce operational costs of transportation and the possibility of fertile flies escaping from the plant into the zones where NWS has been eradicated. However, funding problems are being faced for the construction of this new facility.

Veterinary Services

The veterinary services of the five countries involved are in different stages of development and will require additional inputs. The essential veterinary infrastructure to support an efficient NWS eradication programme is as follows: i) Adequate distribution of human and material resources; ii) effective and efficient diagnostic services; iii) disease surveillance and reporting system; iv) availability of reliable transportation and communication systems; v) control over animal movement and quarantine; vi) animal health legislation; vii) funds for disease control programmes; viii) good relations among public and private

sectors; ix) accessibility to international airports; and x). infrastructure for the establishment of NWS distribution centres.

THE PLAN

The purpose of this plan is to coordinate efforts being made by the countries involved in the NWS eradication programmes on mainland America with those of other Screwworm affected countries in order to eliminate this pest and to protect the NWS-free countries in the Caribbean Region. By redirecting existing resources and experience from Central America, once eradication has been achieved from this area, to the island countries maximum efficiency will be maintained at a minimum cost.

Objectives

The **immediate objective** is to eradicate NWS from the Caribbean region, and at the same time, to develop improved techniques for disease diagnosis, control and prevention for the benefit of other countries.

The **mid term objectives** are to eliminate the risk of spread to other NWS –free territories, improve animal production and to increase the income of livestock producers of Cuba, Dominican Republic, Haiti, Jamaica, Trinidad and Tobago.

The **development objectives** are to improve international trade, to contribute to the well being of wildlife, and the consolidation of eradication campaigns on mainland America.

Justification

Unless a successful NWS eradication programme in the Caribbean is implemented, the costs of controlling the disease and the losses to livestock will continue, as will the threat of human infestation and the danger of further spread into the neighbouring countries and to cleared areas of North and Central America. Should this occur the losses will be staggering.

Since the 80s, due to the negative impact of NWS on the Sub – Regional economy, the Caribbean Governments have on several occasions requested FAO and other international organizations for support to eliminate this parasite. The eradication of NWS from the five infested Caribbean countries, using modern and environmentally friendly biotechnology, is estimated to cost US$140 million. Most of this investment would be recovered after the second year of the eradication.

The economics of eradication programmes in the Americas and in North Africa have been very positive, in spite of the high investment cost. Cost/Benefit ratios for previous operations have been calculated as follows: Mexico 1:4, Libya 1:50 and USA 1:10. It is anticipated that similar Cost/Benefit ratios will be obtained from the eradication of the NWS in the Caribbean.

Strategy

A common strategy for NWS eradication includes establishment of a sub - regional and national reference laboratories, strengthening veterinary services in individual countries, creation of strategic alliances among private and public sectors, developing effective NWS surveillance and reporting systems, reduction in the number of attractive wounds in the affected areas, implementing its prophylactic and treatment as the primary method to reduce disease incidence to low levels, and implementing control methods for individual outbreaks as appropriate.

Efforts will be concentrated on Jamaica, Cuba and the island of Hispaniola (Dominican Republic – Haiti) where eradication is technically-feasible and economically-justified. The sea will act as a barrier to prevent reinvasion though the migration of fertile flies. Activities will be planned and executed, based on the success of the FAO Eradication Programme in North Africa, and on more than 20 years of experience gained through the programmes successfully undertaken in the Americas; while some adaptation of the

technical elements are considered to be standard operating procedure. The Caribbean eradication campaign, using the SIT, will be methodically applied across the entire four involved countries.

Trinidad and Tobago are not included in the beginning of the programme due to their proximity to the endemic countries of South America, and the associated real risk of reinvasion. However, once control/eradication activities are underway in the rest of the Caribbean infested countries and in the coastal areas of Venezuela, they should then be actively involved in the eradication process. The countries within the Caribbean basin and adjacent regions which are considered to be at risk from invasion by the NWS will at the same time be encouraged and, where necessary, assisted, to strengthen intensive surveillance, wound treatment, livestock movement control, and quarantine activities to prevent the spread of the disease from infested countries.

The estimated number of sterile insects required per week based on releasing 3000 sterile flies/square mile, and using the Chilled Fly System (CFS) as proven effective in the CA campaigns, is as follows: Jamaica 15, Haiti 35, Dominican Republic 60 and Cuba 130, for a total of 240 million flies/week. However, it will not be necessary to use this amount simultaneously as has been the case in some mainland programmes.

The production capacity of the Mexican plant is sufficient to handle the needs of the programme in Mexico and Central America as well as the anticipated needs for that in the Caribbean. The transport of sterile NWS from Mexico to the operation sites will be by the bulk aerial transport of chilled sterile pupae. This technique greatly reduces handling costs.

The receipt and handling of sterile pupae will require extensive preparation. Climate controlled facilities must be available and personnel must be trained in procedures to ensure that the sterile flies are handled in a manner which will not reduce their effectiveness once released in the infested areas.

The dispersal of sterile flies requires various specially-equipped aircraft. The time for dispersal is restricted to the hours from just before sunrise until mid-morning, after which temperatures becomes too high for the guaranteed survival of the newly released sterile flies. Quality control testing of all shipments of sterile insects dispatched from the production plant is mandatory to ensure that effective sterile flies are released.

To prevent and cure infestations, animals must be individually inspected at least twice weekly and all skin abrasions and wounds treated with an appropriate insecticide.

Major activities of the programme

The duration of the programme will be approximately 8 years. The campaign may be divided into three phases and the major activities of the three phases are summarised as follows:

Preparation – phase 1: To strengthen veterinary services reporting and diagnosis laboratory capabilities in each country; to establish the obligatory reporting of NWS cases to the International Office of Epizooties (OIE); to determine animal movement patterns and develop better systems for animal health control at national borders and to carry out epidemiological surveillance on NWS; to improve public awareness on the importance of NWS and to encourage active involvement of the private sector in the planning and implementation of eradication programmes; to increase NWS sterile insect capabilities after the identification of the most suitable flies strains; to train personnel in control and eradication methodologies.

NWS Control – phase 2: To step up communication and treatment campaigns and to encourage active participation of the private sector and farmers in the campaigns; to progressively reduce the case presentation and defining control zones; to strengthen control of the movement of animals from infected areas or countries and to carry out investigation of each outbreak.

Eradication and consolidation - phase 3: To reinforce all control activities; to introduce SIT; to monitor the biological quality of sterile flies; to train the personnel on SIT procedures, to establish solid intensive surveillance zones to prevent the entry of NWS from endemic countries. The three phases will be supported with a strong public communication campaign highlighting each of the main activities.

Definitions

Diagnosis: It is the process of identifying and determining those areas infested with NWS in any of its forms: eggs masses, larva, pupae or adult.

Eradication zone: Those territorial regions were the programme initiates and intensifies its control and eradication activities in order to totally eliminate the presence of the parasite.

Intensive surveillance zone: Those territorial regions where the programme performs all of the necessary actions to preserve the zone free of NWS. This will occur three months after the last reported screwworm cases in a given sector, sub-region, or region.

Free zone: that territorial portion, based on epidemiological studies, that has had no self-sustaining NWS populations for at least six months and can be officially declared free of screwworms.

Prerequisites

The following assumptions are made in drafting the proposals for extending the present activities to the Caribbean:

- That adequate funds will be available as required.
- That adequate sterile insects of desired quality will be available from the Mexican or Panamanian plants.
- That the governments involved will fully support the NWS eradication campaign and that there will be no changes in their policy.
- That the infested areas in the Caribbean will be treated once the current operations in Central America have achieved their objectives.
- That all NWS-free countries will maintain strong inspection and quarantine services to prevent the introduction of infested animals from other endemic areas.

Chronology of events for a 2008 NWS elimination from the Caribbean

DATE	PRODUCT	RESPONSIBLES
Continuing	Intensive epidemiological surveillance in the NWS – free countries in Americas mainland and Caribbean countries, including obligatory report to OIE, in case of NWS outbreak occurrence.	Animal health directors in each country, OIE, FAO, IAEA.
12 / 2000	Eradication completed in Panama, including installation of the Darien Gap (50 million flies/week) barrier	Government of Panama, USDA, OIE
06 / 2001	The character of this project requires institutional arrangements as the creation of the "Caribbean Commission for NWS Eradication" (CC), among Ministries of Agriculture of Cuba, Dominican Republic, Jamaica, Haiti and Trinidad & Tobago, with assistance of FAO, IAEA, OIE and NWS-free countries. Beginning on September 2000.	Ministries of agriculture in each country (Animal health directors), FAO, IAEA, OIE, NWS-free countries.
07 / 2001	Conclusion of NWS control project in Dominican Republic and Haiti.	Animal Health Directors, FAO, IAEA

09 / 2001	Finalisation of the NWS eradication preparatory phase in Cuba, with NWS eradication from the Juventud Island	Government of Cuba, IAEA, FAO, Mexican American Commission
10 / 2001	Finalization of a detailed activities work plan by CC managers, including eradication plan, establishment organization to conduct the eradication, etc, begins on July 2001.	CC, FAO,IAEA,OIE
01 / 2002	Conclusion of four-month period for donor's contacts to NWS eradication programme financial support allocation, beginning on July 2001.	CC, countries of NWS – free countries, FAO, IAEA, USDA, EU
07 / 2002	Jamaica eradication is achieved after 3 years activities (July 1999)	Government of Jamaica, IAEA, Mexican American Commission, FAO.
02 / 2004	Complete NWS eradication programme in Cuba after two years of not interruption release of NWS sterile flies; released in a number of 130 million insects/week, beginning in February 2002.	CC, Mexican American Commission, FAO, IAEA,
02 / 2004	Conclusion of the preparatory and control phases in the Hispaniola, beginning in July 2002.	CC, FAO, IAEA, OIE
03 / 2006	NWS elimination from the Hispaniola Island after completing two years of release of flies of 95 millions NWS sterile flies per week, beginning in March 2004.	CC, Mexican-American Commission, FAO, IAEA, OIE
03/ 2006	Results of the entomological studies done in Trinidad & Tobago and Venezuelan coast, on NWS flies migration patterns, starting in March 2005.	CC, FAO, OIE, USDA (APHIS-ARS), Mexican-American Commission
04 / 2008	Achievement of NWS eradication in Trinidad & Tobago on the condition that the full technical justification for eradication is consolidated with avoiding infestation from Venezuela begins in April 2006.	CC, FAO, OIE, USDA (APHIS-ARS), Mexican-American Commission
11 / 2008	Achievement of NWS eradication in the Caribbean region and declare the región officially free of the pest.	CC, FAO, OIE, USDA (APHIS-ARS), Mexican-American Commission

The above estimation on sterile flies requirements were done in the assumption that the Mexican plant maintains its production level up 140 millions pupae/ week or when Panama plan becomes operational with 210 million pupae produced weekly.

Organizational structure

The suggested organizational structure of the campaign is as follows:

The *Caribbean Commission for NWS Eradication* (CC), formed with the ministries of agriculture of Cuba, Dominican Republic, Haiti, Jamaica, Trinidad and Tobago. This will be the maximum authority of the programme and due to screwworm eradication procedures may meet two times during the year.

The *Sub – Commission for NWS Eradication*, integrated by one high level officer from each of the five countries and will follow on a day to day basis all the executive and normative decisions taken by the commissioners.

The *Advisory Committee*, consist of one representative of major donors and international agencies such as FAO, OIE, Mexican - American Commission, IAEA and others. Its function will be to provide technical and managerial advice to the CC. It will be chaired by one of the institutions representative elected every two years.

The *Regional Coordination Unit*, will be led by a FAO expert under trust fund modality and he/she will be the regional coordinator of the programme. Will be supported by personnel provided by interested donors, countries participating or international agencies. For logistical purposes, this unit may will be located in Santo Domingo, DR.

The *Sub - Regional Reference Laboratory*, will support both the RCU and national eradication programmes. Its physical base will be define later.

The *Directors of National Programmes for NWS Eradication* will have the technical and managerial responsibility for campaign implementation and day to day operations, and will be provided by the respective governments with this single task as well as the rest of the personnel dedicated to the programme.

It is contemplated that the services of several shorts – term consultants will be required on an ad hoc basis and horizontal international cooperation will be promoted.

Financing

The eradication project ideally should have an early assurance that the funds required are available to allow completion. However, particularly in the case of the Caribbean, operations can be programmed on an island-by-island basis, as they have the advantage of being isolated and presenting less risk from the natural migration of NWS flies. The Dominican Republic and Haiti will be considered together since these two countries share the same island.

The CC will be the executive body to identify and obtain the necessary funds for national eradication programme operation. Separate allocations of funds will be made to cover the cost such as travel expenses for directors of eradication programmes to attend coordination and technical meetings, and travel expenses for trainees to attend international courses.

Adding to the above economical assistance from multilateral and bilateral aid agencies will be contacted for both RCU and national programmes. USA and the European Union are already committed to support NWS programmes and others related with animal health in the Caribbean.

It is expected that complementary projects for national eradication programmes will be financed by international agencies or Non-Governmental Organizations. This project may be operated independently but close links among these projects and the RCU will be established.

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