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**THE SCREWORM AS A PEST IN THE CARIBBEAN AND
PLANS FOR ITS ERADICATION FROM JAMAICA AND THE
OTHER INFESTED ISLANDS USING THE STERILE INSECT TECHNIQUE (SIT)**

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ABSTRACT

The New World Screwworm (NWS), *Cochliomyia hominivorax* (Coquerel) has been shown to be of widespread occurrence and distribution in the majority of countries in the Caribbean Region. Its occurrence is without regard to seasonal variations, type of ecological community and altitude. This pest currently presents a serious problem for these countries making for significant economic losses to the livestock industry in addition to posing potential public health risks.

A programme for the eradication of this insect pest has been initiated in Jamaica. Annual losses due to NWS infestation in this particular country are estimated to range from US\$5.5 B 7.7 million. The eradication of this pest should serve to eliminate the current losses while greatly contributing improvement of the expansion of the Jamaican livestock industry. It is expected that a successful Jamaican programme will serve as a model for future programmes in the other Caribbean countries namely, Cuba, Haiti and the Dominican Republic which have also been confirmed as being NWS infested.

Eventually the entire Caribbean should be screwworm free with the exception of Trinidad and Tobago which will have to be eradicated in association with South America. This paper will discuss the current status of the NWS eradication efforts in Jamaica and the rest of the Caribbean.

INTRODUCTION

The screwworm, *Cochliomyia hominivorax* (coquerel), was eradicated from the Caribbean island of Curacao in 1964 (Baumhover et al, 1955) with that programme being considered a test of the SIT principle. In 1959, the pest was eradicated from Florida and with the concept fully established as a sound and novel entomological principle (Baumhover 1966). In 1962, a similar programme was initiated in the Southeastern United States with a barrier established along the Mexican-US Border (Bushland 1975). In 1975, the pest was eradicated from the island of Puerto Rico, the US and the British Virgin Islands (Williams et al 1977). By 1981, the pest was totally eradicated from the United States and from all of Mexico in 1986.

It has since been eradicated from Belize, Guatemala, Honduras, El Salvador and Nicaragua. The eventual goal of the programme is to eradicate the pest from Costa Rica and Panama down to the Darien Gap where a sterile fly barrier will be maintained.

In the Caribbean Jamaica, Hispaniola, Cuba, Trinidad & Tobago are the only countries infested. Despite this fact, no comprehensive eradication plans have ever been made for these countries. However, based on the great success of the programme elsewhere and recent interest shown by various international organizations and governments in countries which are infested, the situation is changing rapidly. Currently, the country which is most prepared for an eradication programme is Jamaica where government officials have long shown an interest.

For example, in 1959, a group of Jamaican livestock owners visited with officials associated with the Florida eradication programme. Since this date serious consideration has been given and several attempts made by Jamaica to implement an eradication programme but without success. Real progress was made in 1997 based principally on efforts of the Jamaica Veterinary Services Division (VSD) when cooperation was established with the International Atomic Energy Agency (IAEA), Food and Agriculture Organization (FAO) and Animal and Plant Health Information Service of the United States Department of Agriculture (APHIS/APHIS/ARS) with respect to the preparation for an eradication programme. Preliminary organizational activities for this programme have been started with the expectation that the first sterile fly releases will be made in January, 1999 to initiate what is projected to be a 3-year eradication campaign.

With respect to the rest of the Caribbean, the FAO currently has a project in Cuba which is aimed at a determination of the extent of the problem and its economic impact.

Concurrently, the IAEA is developing a "thematic" plan for the entire Caribbean and South America.

Cuba

This is the largest New World Screwworm (NWS) infested country in the Caribbean with a landmass of approximately 114,525 km² and a human population of 10,870,000. (Table 1). An eradication programme for Cuba will require about 150 million sterile flies per week for two (2) years, a full year to organize the programme, two (2) years for actual eradication and about one (1) year for verification of results. It is possible that the country could also be eradicated in two sections which would take longer but fewer sterile flies at one time. The cost of eradication would likely to be in the region of US\$54 million (Table 2), with the costs somewhat higher if the 2-phased approach were to be selected. A one step approach would add cost based on the need for more emergence chamber space for flies. On the other hand, it would reduce the time needed for the eradication as well as eliminating the need for quarantine and a buffer zone. The cost-benefits from eradication have not yet been determined for Cuba but this work is currently being undertaken through the sponsorship of the FAO. The current data collected have indicated that the NWS is a serious problem in the country and that the insect is widely distributed throughout and affects all warm blooded species while being active at all seasons of the year

Table 1. Comparison of Size (Miles²/km²) and Human Population of Caribbean Countries Where the Screwworm is or was Endemic.

COUNTRY	SQ. MILES	SQ. KM	POPULATION
CUBA	44,205	114,525	10,870,000
HAITI	10,710	27,750	6,764,000
DOMINICAN REPUBLIC	18,700	48,440	7,471,000
JAMAICA	4,410	11,425	2,469,000
PUERTO RICO	3,640	8,960	3,580,000
TRINIDAD & TOBAGO	1,980	5,130	1,265,000

Table 2. Estimated Cost of Eradicating NWS from Cuba.

Item	Estimated Cost
Sterile Flies (estimated at 1,700/million for 2 years)	26,000,000
Chilled Fly Chambers for Fly Emergence	3,000,000
Information Campaign	4,000,000
Quarantine Campaign	3,000,000
Administration	3,000,000
Dispersal Centre Operation	12,000,000
Miscellaneous Costs	4,000,000
Field Operations	7,000,000
TOTAL	54,000,000

Hispaniola

Hispaniola which comprises both Haiti and the Dominican Republic is considered an infested area. Both countries occupy equivalent landmass of 10,710 km² each and with human populations of 6,764,000 (Haiti) and 7,471,000 (Dominican Republic) (Table 1). The population of both countries is fast growing with an expected increase of 1.5 million within the next 10 years. The best estimates of NWS damage at this time (FAO) is US\$16.0 million and US\$10.0 million annually in the Dominican Republic and Haiti respectively. In both countries there is currently no organized effort to control the pest although NWS is well known by local people. The problem is believed to be either ignored or neglected by the local authorities. It is suspected that the greatest losses to the livestock industry and the biggest human health problem resulting from NWS infestation anywhere may well be found in these two countries once the relevant impact studies are conducted.

Despite the current situation these two countries may well be the most important ones for eradication to take place at this time in the region. It is being suggested that the best approach to the implementation of an eradication programme for them is a combined programme which utilizes a single distribution centre for both.

The estimated requirements for such a programme is about 95 million sterile flies weekly at a total cost of US\$36,000,000 million. (Table 3). The time frame would be similar to that for Cuba.

Table 3. Estimated Cost of Eradicating the NWS from Hispaniola.

Item	Estimated Cost
Sterile Flies (estimated at 1,700/million for 2 years)	17,000,000
Chilled Fly Chambers for Fly Emergence	1,000,000
Information Campaign	2,000,000
Quarantine Campaign	1,000,000
Administration	1,500,000
Dispersal Centre Operation	9,050,000
Miscellaneous Costs	1,000,000
Field Operations	3,000,000
TOTAL	35,550,000

South America and Trinidad and Tobago

The landmass associated with the NWS in South America is very large. The literature contains numerous reports of infestations in Columbia, Venezuela, Suriname, Guyana, French Guiana, Ecuador and Paraguay. There are reports of human infestations in Uruguay, Peru and Bolivia. The temperatures in the southern regions of Argentina and Chile, as well as, high elevations of the Andes Mountains are notably too cold for the survival of the NWS. The situation is similar for parts of the Brazilian and Guiana highlands. An estimate of the areas of South America which is continuously NWS infested is placed at 50% with another 30% of the land area invaded each year but only to be eliminated by cold weather at the end of the warm season. This is only an estimate of the situation and data need to be collected in all of the countries in order to determine the true situation.

The Twin Island state of Trinidad and Tobago is also NWS infested. Given their geographical location with and almost contiguous border with South America an eradication effort at this time would best be considered in association with this area rather than as a part of the Caribbean. This may well be so unless new information pointing to the contrary becomes available.

Jamaica

Jamaica lies in the Caribbean Sea 145 km south of the southern most extremity of Cuba. The greatest length of the island is 235 km and with its greatest width being 82 km. The topography consists mainly of coastal plains

around the island separated by a central mountain range running from the east and with hills and a limestone plateau occupying the central and western areas of the interior. The land area is 11,422 km². The island has a tropical climate which is modified by the influence of the sea, the trade winds and to a lesser extent, by land and sea breezes. There are four (4) seasons distinguished mainly by the differences in rainfall but conditions are not uniform over the island and vary considerably according to altitude and location.

Usually, the major rainy season starts in August and reaches a peak in May. However, periods of heavy rainfall and drought may occur at any time during the year. The lowest temperature occurs in January or February the peak temperature usually occurs in July or August. In coastal areas, the average daily temperature ranges from about 23 - 28 °C. However, the temperature often rises to about 30°C during the afternoon and may fall as low as 18°C. in the early mornings during the cool season.

Screwworm infestation is widespread in Jamaica and without regards to seasonal variations, altitude or ecological conditions. All types of livestock operations are affected irrespective of size and management practice. Trang (1998 unpublished study) estimated that the annual benefits from eradication would be between US\$5.5 and 7.7 million. Benefits were defined as losses avoided due to (1) mortality and (2) additional expenses for labour associated with surveillance, prevention and treatment of infested wounds, and (3) loss in productivity of infested animals. Assuming an eradication cost of US\$9.0 million, she calculated net savings after 3 years as ranging from US\$4.2 million to US\$13.5 million. It was further estimated net benefits to be between US\$25 and 43 million after 10 years.

Active infestations are likely to occur in any season but appear to be related to the wetter periods. However, this pattern is modified by traditional production schemes for calving, branding etc. In most instances wounds are treated by the owner and not reported to veterinarians. Snow et al (1976) reported that peak occurrence was in October during the major rainy season, and that there was a smaller peak in February, several months before the minor rainy season. They reported 210 cases in their paper as cattle, 151; swine 20; sheep 11; goats 23 and horses 5.

Cattle were by far the principal economic host, followed by swine and goats. They reported dogs were more likely to be the single most important host of the screwworm in Jamaica. Private veterinarians have reported to the senior author that from 15-30% of clinically treated dogs were for screwworm infestation. Dogs are most heavily infested during the mating seasons when they stray from home for days at a time and become wounded while fighting.

Unlike cattle, dogs are rarely treated until after infestation. Rawlins and Sang (1984) reported pigs as the most important host in Jamaica and that screwworm occurred in all parishes. Table 4 presents data taken from this paper where they reported that infestation was the most prevalent in the umbilicus of neonates, bites and barbed wire cuts. Tick bites, castration wounds and branding scars were of lesser significance.

TABLE 4: NWS Infestations of Five-Types of Wounds Seen in NWS Infestation in Jamaica in 1981.

Animals	Branding Scars	Accidental Cuts	Tick Bites	Neonate Umbilicus	Castration Wounds
Beef Cattle	7	43	10	54	7
Dairy Cattle	1	27	2	19	8
Pigs	1	4	3	15	24
Goats	2	5	2	18	5
Sheep	0	0	1	2	0
Horses	0	5	1	1	1
Dogs	5	3	2	0	6
Donkeys and Mules	2	1	1	-	0
Cats	0	1	0	0	1

The occurrence of screwworm infestation in Jamaica is as such that potentially all wounds occurring at any time of the year can be infested. It is estimated that 80% or more of all untreated wounds are likely to become infested. Most producers have become so accustomed to living with the screwworm that they take prophylactic actions without considering the cost involved.

The livestock operations range from large scale to medium size commercial and smaller backyard and "down-the-road" type operations. Cattle production comprises the largest and most important component of livestock industry in Jamaica with approximately (350,000 heads) and with beef (67%), dairy (15%) and dual purpose and draft animals the other (18%). Currently Jamaica is not self-efficient in beef production but hopes to attain this goal within the next 10 years. The other livestock of importance include goats (440,000), pigs (210,000), equines (33,000), and sheep (4,000). Most of these animals, particularly goats are found in small-type operations of fewer than 5 animals. However, all operations regardless of size have some methods of controlling screwworm infestation.

No wild animals capable of supporting infestations such as the white-tailed deer, rabbits, opossum or peccaries are present in Jamaica. The only likely candidates are a few wild pigs in the eastern region of the island and the mongoose, an animal introduced in the last century to destroy rats and snakes in the sugar plantations. It has not been determined if the mongoose serves as a reservoir host for NWS.

Reports of human myiasis have been made by both public and hospital officials who considered this a minor problem. However, anecdotal information suggests that NWS myiasis in human is a significant problem on the island. It should be noted that a major problem in terms of determining true prevalent rate is that of reporting non or underreporting of cases. The cases reported are for the most part have been observed in children, the senile, the mentally retarded and individuals not receiving adequate medical attention or those experiencing substandard levels of personal hygiene. Usually, infestations are found in the legs, toes, facial sores and nasal cavities.

The Eradication Programme

The plan is to eradicate the NWS from Jamaica by the use of the Sterile Insect Technique (SIT) which involves the sequential aerial dispersion of adequate numbers of radiation-sterilized NWS over the entire island. An estimated twenty million pupae per week will be obtained from the Mexican-US Screwworm Commission in Mexico. These pupae will be flown weekly to emergence facilities in Jamaica. Once emerged, these pupae will be subjected to aerial release 4 days of each week. An estimated 15 million sterile flies are expected to emerge from the 20 million pupae each week thereby making for a 1,200 sterile flies sq./km aerial release over the entire country.

It is estimated that this eradication programme will require three (3) years for completion. This includes (6) months for the programme organization, two (2) years of sterile fly releases and another (6) months for free-status verification. The cost of the programme will be approximately US\$9.0 million dollars (Table 5).

Table 5. Estimated Cost of Eradicating the NWS from Jamaica.

Item	Estimated Cost
Sterile Flies (estimated at 1,700/million for 2 years)	3,536,000
Chilled Fly Chambers for Fly Emergence	500,000
Information Campaign	800,000
Quarantine Campaign	50,000
Administration	1,214,000
Dispersal Centre Operation	1,500,000
Miscellaneous Costs	300,000
Field Operations	1,100,000
TOTAL	9,000,000

Most of these funds will be used for the purchasing of flies and aerial release component of the programme. The necessary funds for implementation has been secured through budgetary allocations by the Jamaican Government and with financial assistance from the International Atomic Energy Agency (IAEA). Additional support will be that given through a "cess" on slaughter cattle agreed to by the local livestock association. Technical and "in kind" assistance will also be provided by the USDA/ARS and the US-Mexican Screwworm Eradication Commission.

To facilitate the economic and effective use of the SIT and to ensure an early positive impact, implementation will be supported by ground-based activities aimed at reducing the local wild fly population. Intensive animal inspection measures and wound treatment regimes will be initiated in collaboration with local livestock owners. These activities will involve the regular inspection of all domestic animals throughout the island and will include prophylactic and curative treatment with selected insecticides. Larvae found in wounds will be collected, recorded, preserved and identified. The data obtained will be used as the basis for estimating the density and distribution of the screwworm and for monitoring the progress being made towards final eradication.

Finally, to prevent the spread of infestation, all livestock movement will be effectively controlled through the strengthening of quarantine and other existing regulatory measures. Similarly, all animals will be inspected and treated prior to leaving the country and with strict import entry for all animals with respect to screwworm free-status. Animals with infested wounds or with abrasions susceptible to infestation will be quarantined and treated. At some point in the future, following a successful Jamaican programme similar eradication programmes will be planned and be implemented for the other Caribbean islands with the Jamaican programme serving as the model.

In summary, the available information suggests that NWS myiasis is well recognized and acknowledged to be economically devastating to the livestock sub-sector of the Caribbean Region. Despite this fact, in most of these countries competing national priorities for scarce budgetary allocations may suggest that such eradication programmes may not be seen as being expedient. However, based on unknown experience the immediate and long-term returns from an NWS free-status will more than offset the cost of any eradication programme. More importantly, the eradication of NWS have repeatedly been shown to contribute greatly to the alleviation of rural poverty and the promotion of an orderly development of integrated crop and livestock production systems in those countries which have undertaken such a programme

A successful Jamaican eradication programme would not only serve as a model for future eradication efforts in the other countries of the Caribbean but should also serve as an important barrier against re-infestation of already free areas of both the Caribbean and mainland America.

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