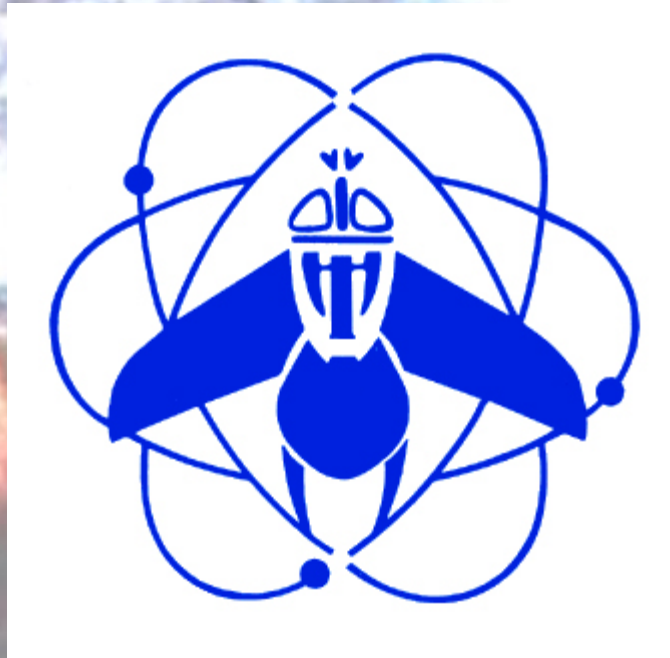


Eradication of the New World Screw Worm *Cochliomyia hominivorax*



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What is a screw worm? A fly that initiates primary obligate myiasis

Myiasis: the invasion of live vertebrates by fly larvae (maggots)

primary = first attack on host, **obligate** = must feed on live hosts

New World Screw Worm (Primary Screw worm)

Class: **Insecta**

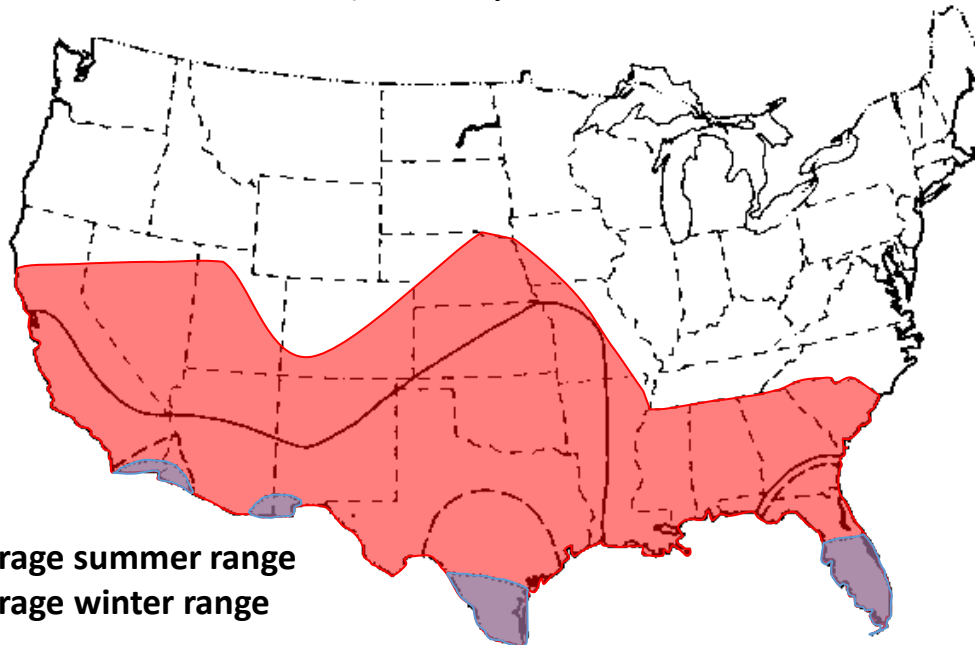
Order: **Diptera** (True flies)

Family: **Calliphoridae** (Blowflies, bottle flies)

Subfamily: **Chrysomyinae**

Genus: ***Cochliomyia*** (4 species)

Species: ***hominivorax*** (Primary screw worm)



■ Average summer range
■ Average winter range



▨ eradicated
■ *Cochliomyia hominivorax*

The Adult Fly

Adult *C. homnivorax* - (powerful flier upto 180mi)

bluish to bluish green,

3 prominent longitudinal black lines on pronotum

reddish brown eyes,

8-10mm long

In general very similar in appearance to other blow flies



Cochliomyia hominivorax

The Larva - "The Screw"

Pale white colors tapered cylinders upto 17mm long (2/3 inch) ("Wood Screw shaped")

Breathing spiracles at the wide end

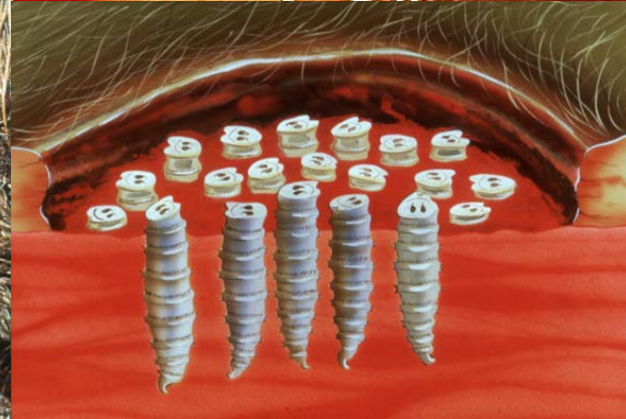
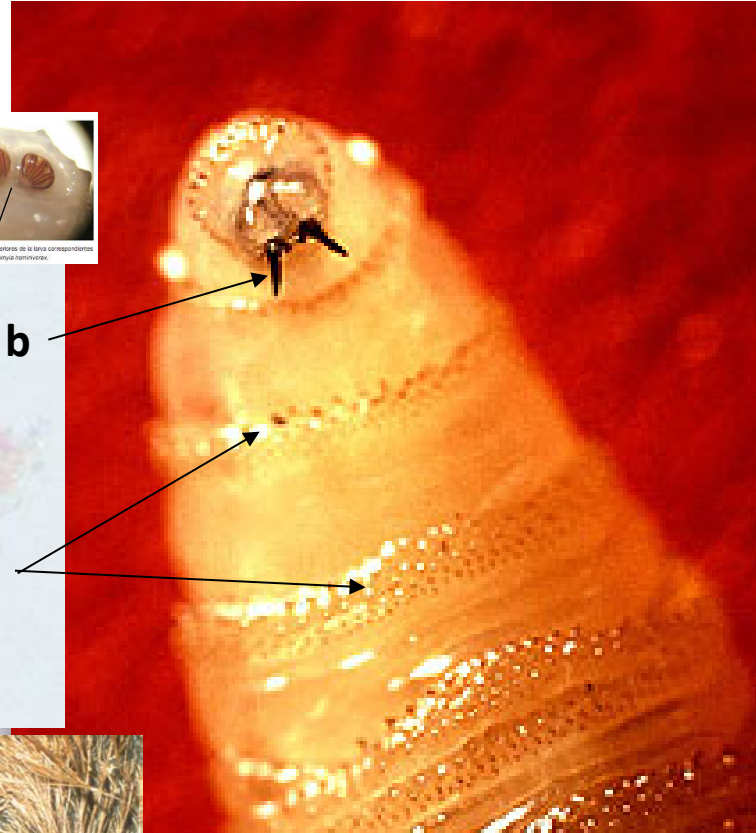
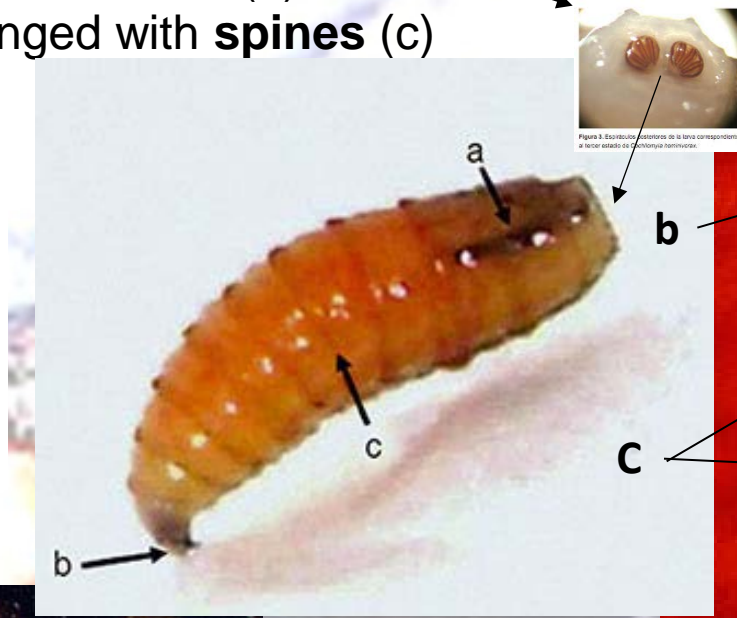
Mouth hooks at the narrow end (b)

Body segments are ringed with **spines** (c)

Unique to

C. homnivorax :

Dark pigmentation
of dorsal tracheal
trunk in posterior
segments (a)



Lifecycle

21+ days (depending on temperature, moisture and soil type.)

Sexually mature 48hrs after ecdysing.

Males aggressively seek out and mate with females.

Females mate once only

Adults fly for 10-14 days
Capable of traveling large distances

Oviposition begins 6 days after ecdysing.
Females lay an average of 4 batches of 200-500 eggs on edge of wound

Pupate in soil for 7days-2months depending on temperature

cannot survive sustained temperatures below 46°F (8 °C)

Eggs hatch in 12-21hrs and enter wound to feed

Mature larvae (~17mm) leave the wound and burrow into the soil

Larvae feed on living tissue for 5-7 days



Pathology

All open wounds, as small as a tick bite, can be targeted.

All warm-blooded vertebrates are susceptible to attack.

New wounds contain larvae of a **single age**.

Older wounds may contain larvae of **various ages** and of **other species** of flies.

The **necrotic tissues** of the wound produce a stinking, reddish brown **fluid** as they leak blood and serum.

Attracting further gravid females and **other facultative myiasis producing species** (e.g. *C. macellaria* the secondary screw worm)

Thus the wound can become greatly enlarged due to **multiple infestations** and, unless treated, usually result in death of the host.



Eradication Time Line

1930's **Knipling** developed his Sterile Insect Technique (SIT)

He theorized that screwworm, could be controlled by

- 1) inundating wild populations with sterile males.**
- 2) Fertile females mate only once - if mate is sterile their eggs do not hatch.**
- 3) Reproduction would drop with each generation, eventually reaching zero if sterile flies continued to be introduced.**

1936 **Bushland** developed an **in vivo technique for mass rearing** on an artificial diet, thus saving live animals which were the only way to produce screwworms for experiments, an inhumane and costly practice.



**Dr. Edward F. Knipling (seated),
and Dr. Raymond C. Bushland**

Eradication Time Line

late 1930s,

By this time the elements in place for a solution to the screwworm problem were

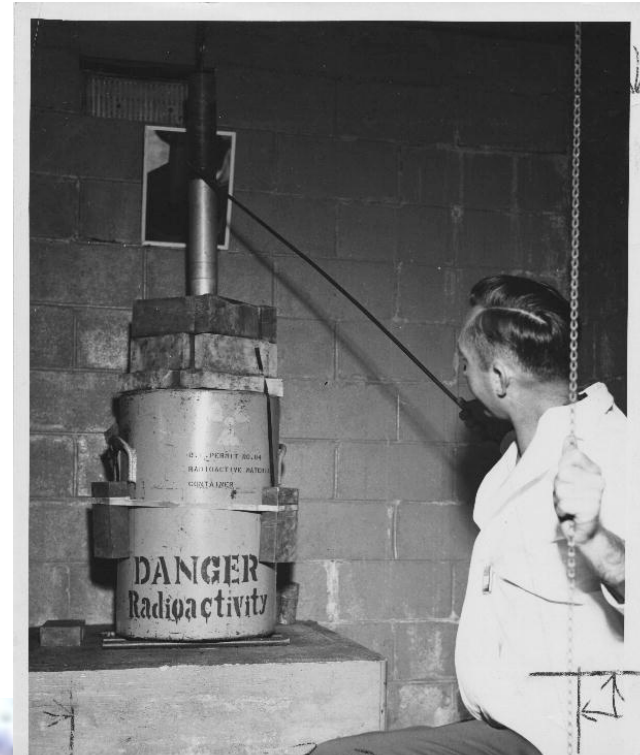
- 1) Knowledge that the screwworm was a separate species, with a dependence on live hosts,
- 2) Bushland's technique for raising large numbers of flies,
- 3) Knipling's understanding of the species' mating patterns, and theory for controlling the pest by the mass release of sterile males.

Unsolved Problem: how to sterilize mass quantities of screwworm flies

Not solved until 1950

1950

Knipling and Bushland solved the problem of mass sterilization using cobalt-60 gamma ray equipment from Oak Ridge National Laboratory to sterilize masses of screwworm flies.



Eradication Time Line

First Complete Eradication

first successful field trial

1954-1955 Curaçao Island Experiment:
40 miles off the coast of Venezuela.

1954 (Aug) Large scale sterile fly releases
(10s of 1000s)

**Within 2 months no fertile eggs
were found**

1955 (Jan) Screwworms had been eradicated
from Curaçao.

Effective eradication- achieved in 10 weeks!



Eradication Time Line

Southeast US 1956-1959

NSW cost SE \$20,000,000.00/yr

1956-1957 Florida livestock producers, petitioned the State of Florida to set up a full-scale screwworm eradication program.

1957 a test in a 2,000sq mile area east of Orlando produced **~70% eradication**

1957-1958 A **severe winter** forced overwintering screwworms further south than usual and increased releases (upto 800 sterile males/ sq mile) made possible the establishment of a **barrier zone across central Florida early in 1958.**

1959 by the end of 1959 the barrier had been pushed to the Mississippi River.

**Screwworms disappeared from the Southeast
One year ahead of schedule!**

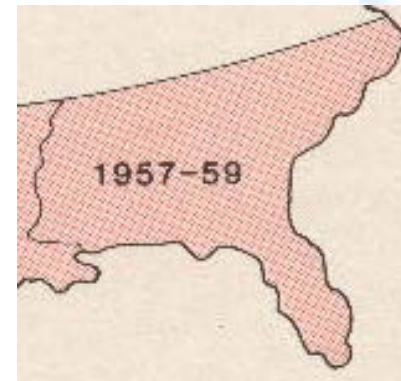
The Southeast was **kept screwworm free** by

- **livestock inspection** and **quarantine**, 24hrs/day as of May 1958
- **targeted fly releases** in areas accidentally reinfested by livestock from other areas.



**Sebring FL Rearing Facility 1958-1966
produced 50 million sterile males/ week**

EXTERIOR VIEW OF FLY REARING PLANT AFTER COMPLETION OF CONSTRUCTION



Work at the Sebring Plant Photos by O. G. Babcock. ca. 1960. National Agricultural Library.



Inspecting ground beef and blood for growing media



"Removing Eggs from Oviposition Vat"

Inspecting larval rearing trays



Pupa inspection



boxes ready for release



Irradiation Room



Filling boxes with irradiated Pupa



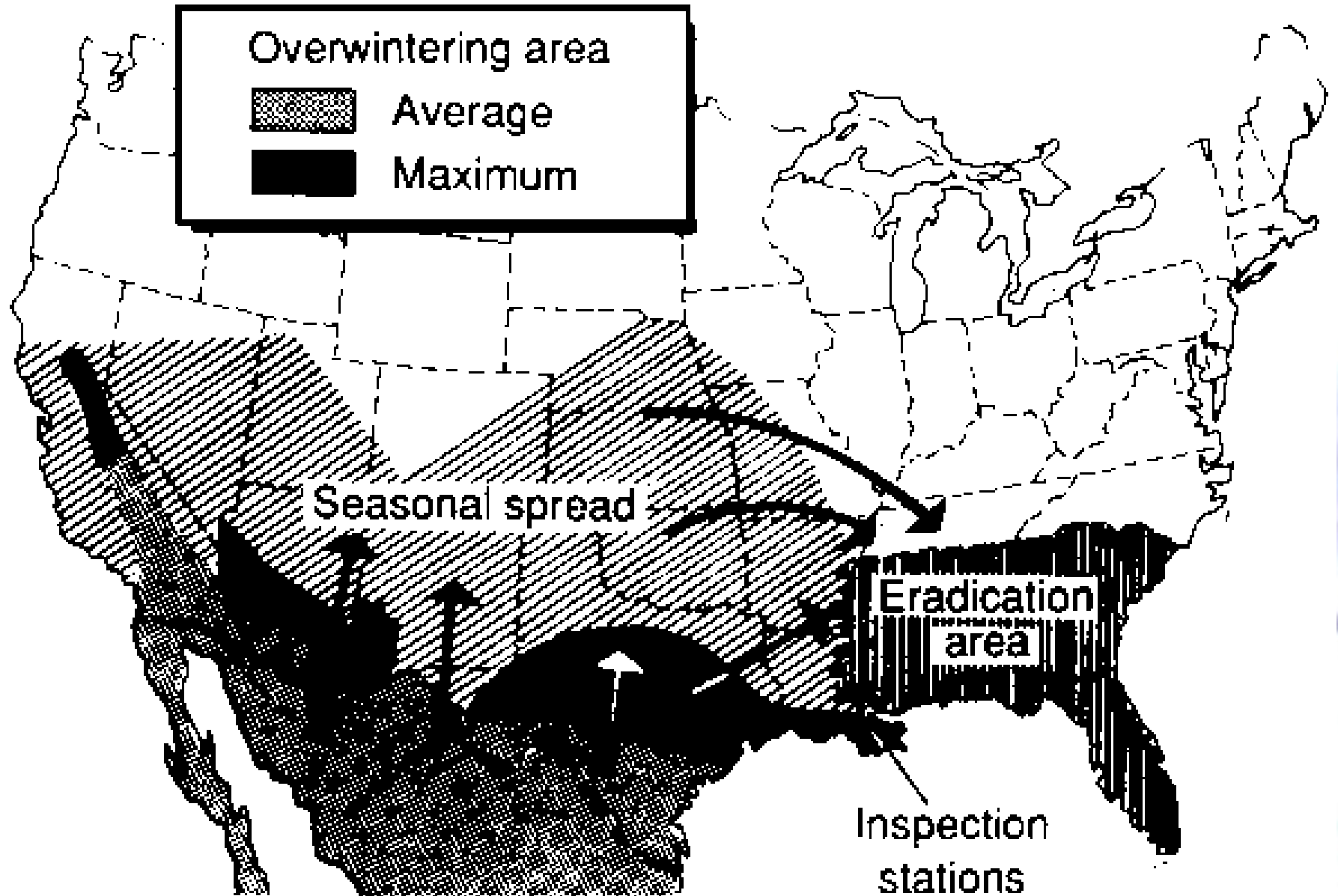
A box of flies

Releasing Sterile flies



Eradication Time Line

Screwworm situation in January 1961



Eradication Time Line

Eradication in the Southwest 1958-1969

1958 (Sept) with success in Florida livestock producers in the Southwest began to press for an eradication program.

Knipling stated that Texas and the other southwestern states would never be free from screwworms until Mexico was also free of the pest.

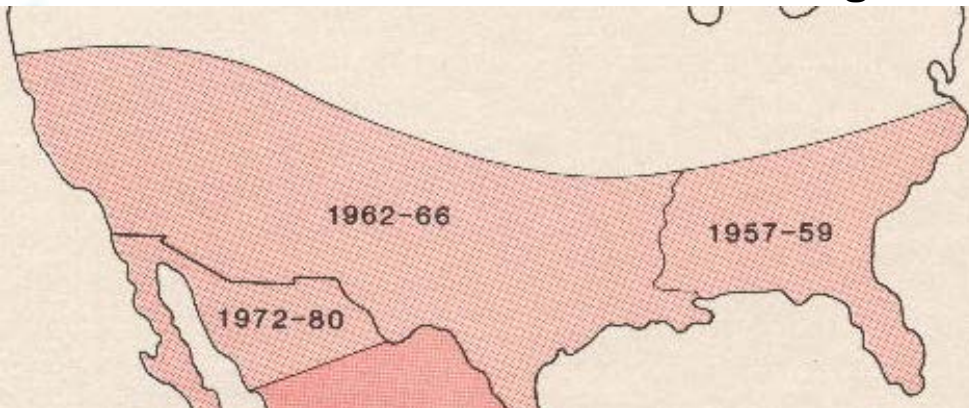
1962 **Eradication began in the southwest.**

Ranchers alone raised over \$3.0 million for the construction of sterile fly-production facilities at.

The plant near Mission, Texas was producing >50 million sterile flies/wk by July 1962

1966 The eradication barrier was pushed to the **US-Mexican border.**

USDA declared the **U.S. free of indigenous screwworms** as early as **July 1966.**



Mission, Texas Plant 1962-1981

Produced up to 200 million sterile males/week
Released 96 trillion by 1975



Eradication Time Line

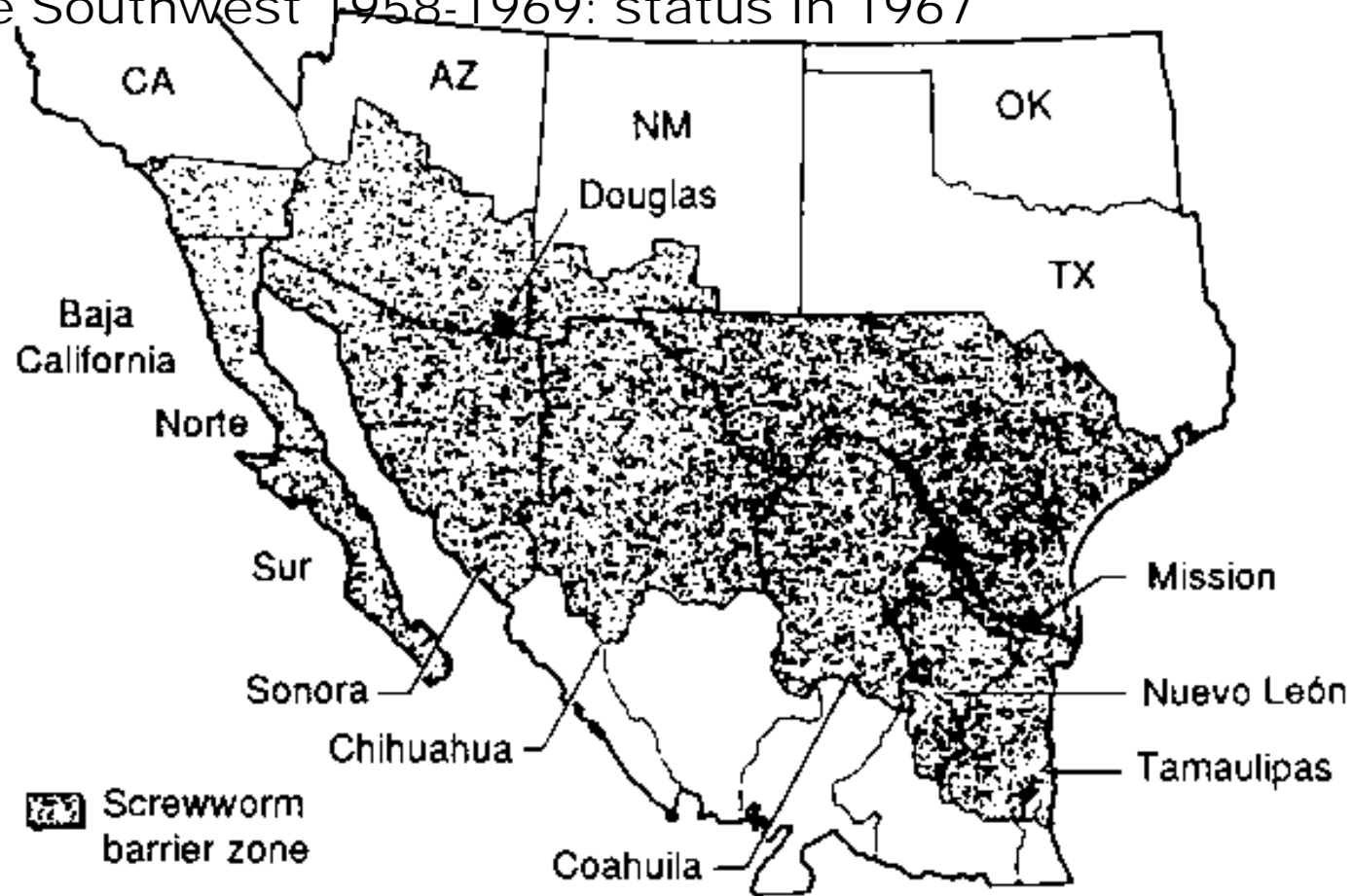
Eradication in the Southwest 1958-1969: status in 1967

Barrier zone at the United States-Mexico border in 1967

~2000 miles long x 300-500 miles wide

requires 125 million sterile males/wk

cost: \$5,000,000/yr
(in 1967 \$US)
~ 1/20th of losses with no barrier



Although the barrier zone was large and difficult to maintain, screwworm damage in 1967 was **less** than it had been 5 years previously.

In 1962, at the beginning of the program, **Texas** alone had reported **1000s cases/wk**
In 1967, Texas **835** cases. **Arizona 23** cases, **California 14**,
and **New Mexico** recorded **none**.

Eradication Time Line

1970s Setbacks

1971 **Heavy rainfall** and **warm temperatures** late summer and fall followed by the **mild winter** of 1971-1972, allowed the screwworm population to **move farther north** and **survive the winter**.

Heavy screwworm activity in northern Mexico resulted in a large influx of screwworm flies migrating across the U. S. border and overwhelming eradication efforts in the Southwest.

1972 A **severe screwworm outbreak** in the United States – the worst since 1966
All SW states reported screwworm-infested livestock.

Texas alone confirmed 90,000 cases, after reporting 444 in 1971.

The **Screwworm Eradication Program Agreement** between the **United States** and **Mexico** was signed **August 28, 1972**,

Establishing a joint **Mexico-United States Screwworm Eradication Commission**.

Eradication Time Line

Mexico-United States Screwworm Eradication Joint Agreement 1972

The agreement called for screwworm eradication in a much larger portion of Mexico than previously planned

It moved the barrier zone from the **United States-Mexican border**, (~2000 miles long), to the narrowest point (140 miles) in Mexico—the **Isthmus of Tehuantepec** at the **93rd meridian**.

1974, work began on a **new facility** near Tuxtla Gutierrez, Chiapas, Mexico

1976 New plant opened
producing 500 million sterile flies/wk

NEW GOAL: MEXICO



EVENTUAL COST REDUCTION TO
1.8 MILLION PER YEAR

Eradication Time Line

1980, **Northern Mexico free of self-sustaining screwworms**

1982 (Feb) Mexican government officially declared the **north Mexican states** of Sonora, Baja California Norte, and Baja California Sur **free of screwworms**
Texas reported zero cases of infestation.

Only a handful of imported cases have been reported in the US since 1982

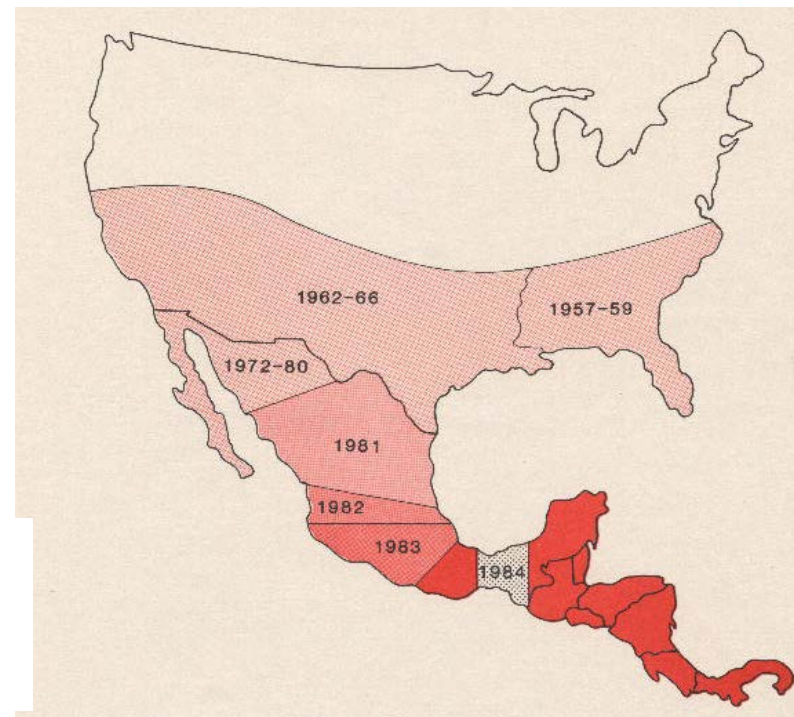
1984 a **permanent barrier zone** at the **Isthmus of Tehuantepec** was achieved,
1986 **no outbreaks** were reported north of the barrier zone.

1986, the **Mexico-United States Commission** extended the eradication program to the adjoining **Central American states.**

1993 **Mexico completely free of NWS**

It was clear by the mid-1980s that an eradication plan extending to the **Darien Gap, Panama** and east to the **Columbian border** was necessary.

1991 Projected cost of maintaining the barrier at Isthmus of Tehuantepec = US \$235.2 million/yr
cf. at **Darien Gap = US\$181.8 million/yr**



Eradication Time Line

Screwworm Eradication in Central America

Country	Program Initiated	Screwworm Eradicated
Mexico	1972	1993
Guatemala	1987	1994
Belize	1989	1994
El Salvador	1991	1995
Honduras	1991	1996
Nicaragua	1992	1999
Costa Rica	1995	Oct, 4, 2000
Aruba	Mar 2004	2005
Panama	2003	2006?
Jamaica	1999? 2007 (SIT failures)	(05/21/2012) ~\$15m/yr for govt eradication program 2012/ 2013
Cuba		

1971-1974, U.S. and British Virgin Islands.
1971-1976 Puerto Rico

Questions?



Stop Screwworms. Selections from the Screwworm Eradication Collection, Special Collections, National Agricultural Library. Agricultural Research Service, U.S. Department of Agriculture.

Jamaican Government website. <http://nsep.gov.jm/index.html>



<http://nsep.gov.jm/index.html>