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8.0-10225
NASA CR
160616

**PHASE II
PROJECT PLAN**

SCREWWORM ERADICATION DATA SYSTEM (SEDS)

FIELD TESTS

(E80-10225) SCREWWORM ERADICATION DATA
SYSTEM, PHASE 2 PROJECT PLAN: FIELD TESTS
(Lockheed Electronics Co.) 15 p
HC A02/MF A01

N80-27774

CSSL 08C

Unclas
00225

G3/43



National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

Revised August 1975

LEC-6473

NR-08-03862

JSC--09825

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1.0 SUMMARY

This document describes proposed field tests of remote sensing systems which may assist in screwworm eradication. (See Annex 1, "The Screwworm Fly and Its Eradication.") The tests will be conducted in Mexico as a joint effort among the National Aeronautics and Space Administration (NASA), the U.S. Department of Agriculture (USDA), the Secretaria de Agricultura (SAG), and the Comisión Nacional del Espacio Exterior (CONEE) of Mexico. Basic sponsorship of this test program is the Mexican-American Commission for the Eradication of Screwworms.

In general, USDA working in a joint evaluation team, will be responsible for determining the effectiveness of the satellite system in providing data of value to the screwworm eradication program. NASA and CONEE will be responsible for observing and reducing satellite data over Mexico, and the Mexican-American Screwworm Commission will be responsible for observing the incidence of screwworm cases in Mexico and for providing timely reports of such infestations to the space agencies.

This is an experimental program requiring constant test and evaluation which may require changes in details of the program plan. Should such changes occur, they will be coordinated with appropriate officials of both countries.

2.0 INTRODUCTION

A project, "Remote Sensing as an Aid to Screwworm Eradication," was established in 1974 and was to be

accomplished in three steps: (1) preliminary development, (2) field test, and (3) operational phase.

The objective for the first year's development work was to verify the feasibility of correlating screwworm fly population changes with radiometric temperature and other weather data as observed by remote sensors aboard satellites operated by the U.S. National Oceanic and Atmospheric Administration (NOAA). Test sites were established in Texas and in Mexico, and ground climatological data that affect the population dynamics of the screwworm fly were collected. Satellite data covering large areas were successfully processed on a routine basis to establish correlation with ground-collected weather information (these data are presented as Annex 2 of this report).

Results from the Phase I effort indicated general reliability of the satellite to measure the near-ground environment with sufficient accuracy to be useful in monitoring screwworm growth provided that an initial population of flies existed in the area. Further, testing of the satellite system indicated that such information could be reliably collected about 50 percent of the time. The balance of the data would be less reliable because of cloud cover or poor satellite coverage of Mexican terrain.

At the same time that research and technical procedures were being studied in the test areas, a sophisticated data analysis system was being developed for operational use in the screwworm eradication program. This system, the Screwworm Eradication Data System (SEDS), has been operational since mid-March 1975, producing information and estimates

of climate conducive to the growth of screwworms or geographic regions where screwworms cannot possibly exist because of environmental factors. At the present time, the products from this system are being produced daily and consist of false-colored maps of Mexico indicating temperatures and soil moisture conditions which affect screwworm populations. Although SEDS has passed through the development phase, the system must be field tested and evaluated before it is used operationally. Some of the mathematical expressions and insect population dynamics models that were entered into the system were preliminary and need evaluation and refinement. This can only be done by observing SEDS products over an extended period of time, supplemented with field reports of screwworm incidence.

3.0 RATIONALE FOR FIELD TESTING

Basically, there are three reasons for project personnel to further study environmental conditions in all of Mexico:

1. to obtain more accurate emissivity values (see discussion below);
2. to conduct field studies of geographic areas where SEDS may appear to be providing inaccurate information;
3. to coordinate with area epidemiologists
 - a. instructing in the use of SEDS products,
 - b. observing their utilization of SEDS information for field use, and
 - c. obtaining feedback of field information for product improvement.

3.1 Emissivity Measurements

The satellite-observed radiometric temperatures over any given place are affected by the type of terrain and by the type and density of vegetative cover. These variations are manifested as surface emissivity values and can affect the color-coded temperature maps by as much as 7° C in some areas of Mexico. Only a preliminary emissivity value for terrain in Mexico is presently in the SEDS computer since project personnel have not made measurements over all of the republic. An accurate emissivity map for the various areas is needed.

Project scientists have developed the techniques for making the measurements and applying them in the computer. They need to visit unique areas to make the physical measurements of bare soils and vegetation when the vegetative cover makes seasonal changes.

It is proposed that project scientists will meet officials of the Mexican government who will accompany them in the field. Two scientists are required for the measurements. Each visit will take approximately a week per area. The instruments to be used include the following.

1. PRT-5 (precision radiation thermometer) thermal radiometer (24" x 24" x 8") weighing approximately 40 lbs.
2. Digital voltmeter (18" x 8" x 4") weighing approximately 8 lbs.
3. An emissivity box consisting of a truncated pyramid weighing 10 lbs.
4. A stable 110-volt, 50-watt power source (should batteries fail).

Although all areas to be visited have not been selected, the following areas are expected to be of great value to the project:

1. Mountains in the state of Guerrero, near the city of Chilpancingo
2. Córdoba, Veracruz
3. Monterrey and Saltillo areas in the states of Nuevo León and Coahuila, respectively
4. State of Durango, northwest of the city of Durango
5. West of Chihuahua, in the state of Chihuahua

3.2 Field Studies

During the application phase of SEDS, it will be necessary to obtain field information on the number of screwworm cases to test validity of this system and to refine it further. Currently, screwworm data are obtained from the United States along the Mexican-U.S. border in the form of weekly reported screwworm cases. These data are correlated with SEDS predictions on screwworm growth. Because southern Mexico presents a more varied topography and ecology than is encompassed in the southern United States, the need arises for collecting ground truth data from areas in Mexico as well. The project is particularly interested in zones which may show little or no correlation between SEDS predictions and actual screwworm cases. These inaccuracies may be due to any of the following reasons.

- Since SEDS has a limited ground data resolution, small areas may exist with high screwworm growth potential that are not resolved and shown in the

prediction products (e.g., deep canyons in semi-arid and arid areas or extremely rugged terrain).

- Animal husbandry practices and host populations are two of the major factors in screwworm epidemiology, and these two may influence the correlation between data on actual screwworm cases and SEDS predictions.
- Areas with unusual weather may present problems of interpretation or data gathering, as in the case of cloud-blanketed zones.
- Wrong emissivity value in SEDS may provide erroneous temperatures.

The project scientists visiting Mexico will understand SEDS and know its capabilities, potentials, and limitations; this knowledge will provide them with the technical skill to study the problem area. Because the project staff represents several diverse fields of training (ecology, veterinary medicine, botany, physics, entomology, meteorology), the particular project specialist required to visit Mexico would be determined by the nature of the problem. These visits will involve talks with personnel working in the screwworm eradication program (epidemiologists, supervisors, inspectors) to obtain basic data about the screwworm incidence in the area in question and such information as host density, animal husbandry practices, or other unusual conditions. Visits with Mexican personnel in other fields of science may be required in the area studied. Consultation may be needed from botanists, meteorologists, soil experts, or other specialists.

Project personnel will always make the field trips in company of designated Mexican government officials.

The equipment expected to be required for the environmental measurements includes (1) soil moisture sensors and meters, (2) thermometers, (3) hygrothermographs, (4) psychrometers, (5) rain gauges, and (6) solar radiometers.

It is proposed that items 1 and 6 will be carried into and out of Mexico. The other items are already in Mexico at the Screwworm Commission office in Tampico. The project scientists will make about six visits of 1 to 2 weeks' duration at a time, with all Mexican agencies involved kept informed about their activities.

3.3 Coordination with Area Epidemiologists - Training and Feedback

SEDS produces new products unfamiliar to the area epidemiologists. Epidemiologists must be furnished an explanation of each product and how it may be utilized in screwworm eradication. In addition, each area has unique ecological and geographic characteristics. It is important to see how SEDS performs under various field conditions. This type of information will be used in directing product improvements.

Personal visits are needed to provide project personnel with insight into the unique topography of the various screwworm control areas. In addition, area epidemiologists need to understand first-hand the details of the SEDS products, how they were produced, and the basic reliability of the system. This can be done only through personal iteration.

One or two scientists connected with the project will visit area epidemiologists for a period of a few days. The only equipment required may be a slide or film projector for displaying products. About four visits are planned for each area.

3.4 Requirements for Field Reporting by the Mexican-American Screwworm Commission

The Screwworm Commission is responsible for the routine gathering of reports on the number of screwworm cases in many areas of Mexico. In addition, certain meteorological data such as the amount of rainfall and general temperature conditions (freezing, extremely hot, dry, or humid) will be expected from field inspectors and area supervisors. It is expected that these reports gathered weekly would be forwarded expeditiously to the Joint Evaluation Team (JET) (see paragraph 4.0) so that they may be compared with SEDS and so that the system may be improved. The Commission may also make whatever special studies it may require to evaluate the efficiency of SEDS as related to the overall eradication effort and will make the results of these studies available to JET.

4.0 PROJECT MANAGEMENT

A joint Mexico/U.S. group known as the JET will be formed to evaluate SEDS performance. The JET will be headed by representatives of the Mexican-American Screwworm Commission and will have a technical staff as appropriate. These could be representatives from NASA, CONEE, the Agricultural Research Service (ARS), NOAA, the Mexican Meteorological Service, and/or others.

The Mexican-American Commission for the Eradication of the Screwworm will be in full charge of the screwworm eradication effort and the overall conduct of Phase II activities in Mexico. It will receive reports regularly from the group coordinators and will be fully informed of all project activities relating to the conduct of this experiment.

4.1 Project Structure - Phase II

Environmental data will be obtained over Mexico by remote sensing from satellites (primarily infrared data from the NOAA meteorological satellites). These data will be processed utilizing SEDS and will then be analyzed by scientists in Mexico City and Houston to infer where meteorological conditions are the most favorable for screwworm propagation. This information will then be cross-checked with field data being acquired throughout Mexico. Thus, the feasibility of the predictions can be evaluated and the technology modified. The general data flow is shown in figure 1. To facilitate the independent analysis of the system, data products, reports, and other materials will be supplied to representatives of the ARS/USDA on request.

4.2 Logistic Support

The Mexican-American Commission for the Eradication of the Screwworm and CONEE will use their best efforts to arrange for logistic and administrative support for U.S. project scientists visiting Mexico. It will make the necessary arrangements for a Mexican government official to accompany project scientists while in Mexico. In addition, it will make the necessary arrangements for temporary entry

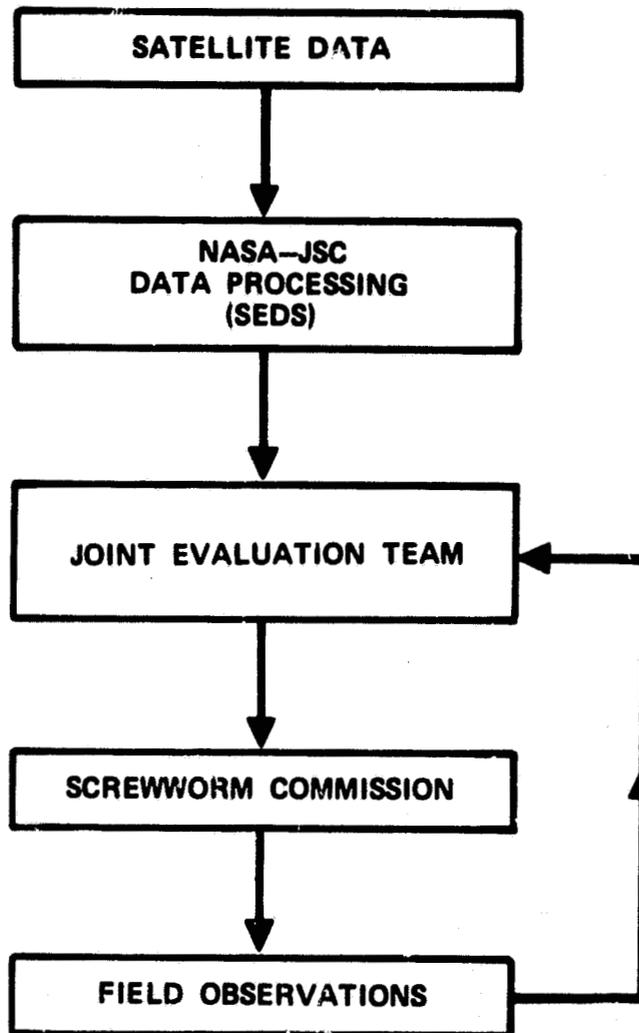


Figure 1.— General data flow. Key staff is the joint government evaluation team. In addition to evaluating the original data products produced by SEDS, the staff will also evaluate results of field observations and determine accuracy of SEDS.

of scientific personnel and customs clearance for equipment. The USDA and NASA will assist Mexican personnel in clearance procedures when visiting or working in the United States.

4.3 Scheduling and Project Review

To assist the principal officials of the governments concerned in the functions of planning, controlling, and reviewing project activities, a master schedule will be maintained showing the major activities of Phase II.

The JET will review and evaluate project progress and report results to the participating agencies and to the commissioners of the Mexican-American Commission for the Eradication of the Screworm on a regular basis.

4.4 Funding

It is understood that the ability of U.S. and Mexican government agencies to carry out this experiment is subject to the availability of appropriated funds.

In carrying out this cooperative effort, USDA, NASA, and the participating Mexican agencies will each fund their respective responsibilities.

NASA anticipates termination of all SEDS activities on July 1, 1976, since technology development associated with screwworms should be complete by that time. If other program participants desire to carry on this project, NASA will assist in training and technical discussions prior to that date.

4.5 Contractors

NASA has retained LEC and Aeronutronics Ford as support contractors. These companies are responsible for providing scientific or multidisciplinary technologies to support the U.S. portions of the remote sensing project. The manager of these support groups is responsible for the coordination and administration of the contractor personnel working for him, insuring that these contractor personnel comply precisely with NASA policies. Contractor personnel working in Mexico are responsible administratively to the managers of either LEC or Aeronutronics Ford. They will be responsible to the Mexican-American Screwworm Commission for policy and technical direction while in Mexico.