13. Interpretation of sterile fly recapture

STEP VII OF PROCESS IN FLOW CHART IN APPENDIX 2

13.1 BACKGROUND

Application of the SIT against fruit flies was first attempted at least 45 years ago (**Table 13.1**). These early programmes demonstrated the potential for significant population reductions up to and including eradication.

A chronology of all significant field trials and operational programmes up to 1992 was compiled by Klassen *et al.* (1994). This list includes multiple species of tephritid fruit flies.

The first organized attempt at documenting and evaluating data from tephritid eradication programmes using SIT, evolved during the 1981 San Jose/Santa Clara, California, USA, Medfly Project. Trap catch figures were entered manually on drawn grid maps as total flies per square mile. From 1984–1987, data for each trap was displayed electronically on a grid printout representing the release area. Flies retrieved per trap indicated the actual numbers counted by the identification section.

R. H. Cunningham indicated a need for a more timely reporting tool to capture sterile fly distribution. A model report was developed to display distribution of fly numbers

TABLE 13.1
Early recorded tephritid fruit fly programmes or pilot test applying the SIT (from Robinson and Hooper 1989).

Country	Fruit Fly	Area (km^2)	Sterile Flies Released	Timeframe	Sterile flies per ha per week	Population Reduction	Comments
USA – Hawaii	Medfly (*C. capitata*)	31 km^2	187 mil.	Ca. 1 year (end July 1960)	116	90 %	Pilot test
Marianas/Rota	Melon fly (*B. cucurbitae*)	85 km^2	257 mil.	11 months (Sept. 1962–July 1963)	720	Eradication	First successful eradication of an insect species other than screwworm with SIT approach
Nicaragua	Medfly	48 km^2	40 mil.	9 months (Sept. 1968–May 1969)	278	90.1 egg 91.1 larvae	2 km wide buffer around release area sprayed
Costa Rica	Medfly	2.5 km^2 48 km^2	2 mil./wk 48 mil.	1964 1968–1969	8,000 Not available	90 %	Promising results; compared with two controls
USA – California	Medfly	258 km^2	500 mil.	1975 (7 months)	646	Eradication	Ground applications of bait sprays were applied with unsuccessful control
Tunisia – Porto/Farina	Medfly	6 km^2	250 mil.	1972 (9 months, March –Nov.)	11,000	97 %	Equally effective as chemical control plot comparison

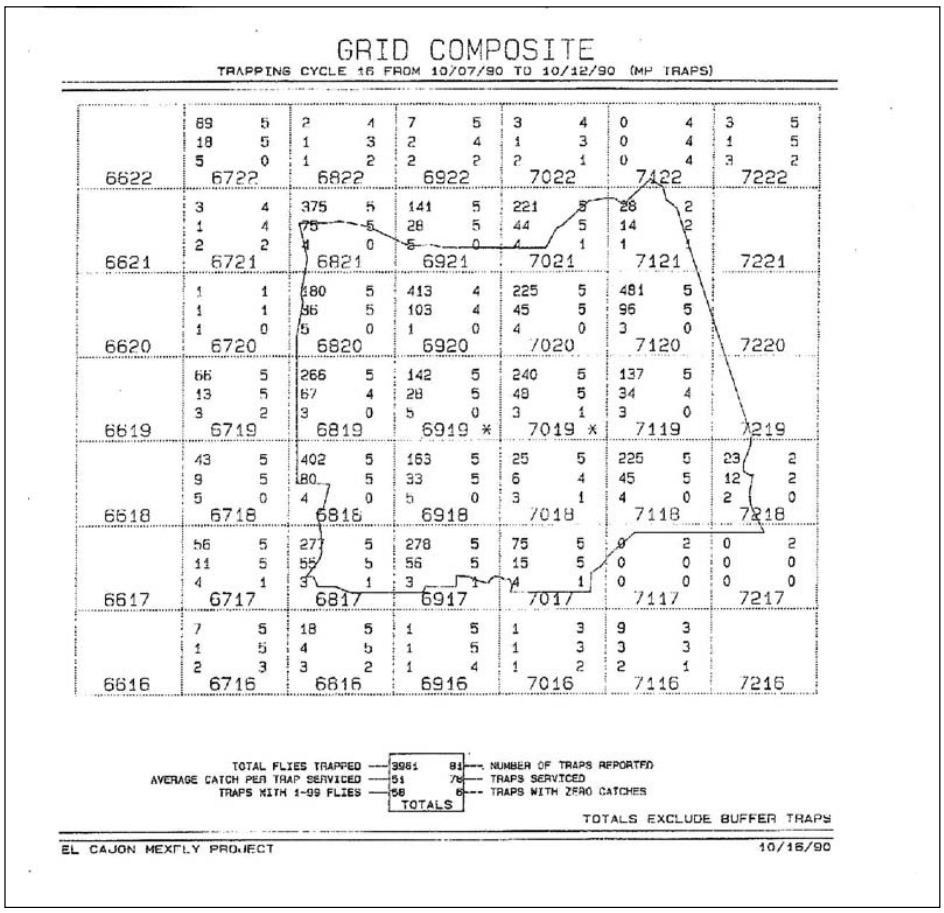

FIGURE 13.1
Cunningham report.

within each square mile. As well, this report provided additional information that was absent from the previous reporting system. This report now included an account of the total number of flies retrieved in each trap rather than a single number for the square mile. This since has been referred to as the Cunningham Report (**Figure 13.1**).

In the California programmes of the early 1990s the reports were again modified due to the increase in size of the treated area and sterile fly numbers being recovered. Sterile flies retrieved were grouped into categories and displayed electronically on a grid printed using colour codes. Basic categories are as follows: 1) skipped or lost traps; 2) zero flies trapped; 3) 1–99 flies trapped; 4) 100–999 flies caught; and 5) 1000+ flies caught. Procedures used since in eradication and preventative release programmes generally follow the reporting system used in the Cunningham Report. Minor modifications have been incorporated based on local needs without endangering the integrity of the data presentation.

13.2 RECAPTURE INDICES AND EVALUATION PARAMETERS

There are certain conditions that the sterile flies should meet to assure proper performance in the field. Some of the most important are: sterile fly age and nutritional reserves when released, longevity, host finding and mating competitiveness. Managers will have to ensure that these conditions are met in order to release competitive insects in the field.

Interpretation of recapture, based on the following indices, will assist in measuring sterile fly performance:

- Sterile fly distribution in the field (percentage of traps with capture)
- Sterile fly/trap/day (FTD) as a measure of sterile fly relative abundance and survival
- Sterile to wild ratio (S:W Ratio)

Achieving the established values for each index, together with adequate quality control parameters, will ensure proper performance of the sterile insects in the field.

In addition, application of area-wide SIT can be assessed by a series of evaluation parameters that can be summarized as follows:

- Egg sterility measurements
- Determining larval infestation levels in the preferred host in the area
- Reduced presence of wild flies in traps

The SIT evaluation parameters should be selected based on the objectives of the action programme. For example: 1) re-establishing export protocols once levels of immature and adults detected decrease below a set threshold, in cases of low prevalence areas, 2) declaration of fly free area with three generations of the pest without detection in cases of eradication programmes, etc. Other evaluation parameters could be used to document programme progress.

13.2.1 DESCRIPTION OF RECAPTURE INDICES

- Sterile insect distribution in the field

Sterile insects should be properly distributed in the area, and a minimum of 90% of traps with sterile fly capture over a release area would be an acceptable level of fly distribution. Attention will have to be paid to areas with consistent lack of sterile flies which will mean problems with trapping or in the efficiency of the sterile fly distribution. One solution for low recapture in particular areas would be to add additional sterile flies.

- Sterile Fly/Trap/Day (FTD) as a measure of sterile insect relative abundance and survival

Adequate sterile flies presence in the field (measured by sterile fly recapture in FTD) (IAEA 2003) will allow for sterile:wild fly interaction. Action programmes should ensure that the minimum required ratios of sterile to wild flies are present in the area at all times (See Section XI). Knowledge of sterile insect survival (FAO/IAEA/USDA 2003) is relevant to define if additional releases are needed and when they are needed to ensure sterile fly availability in the field.

- Sterile to wild ratio (S:W Ratio)

The S:W ratio should be defined and assessed according to the objective of the programme (see Section 8.2) (FAO/IAEA/USDA 2003). This critical over-flooding ratio should be maintained above the pre-established minimum at all times within the area of concern. Trapping should be used to corroborate sterile:wild ratios. Additional releases would be necessary if sterile fly numbers drop due to sterile fly mortality, migration of sterile or wild populations or other causes.

13.2.2 Description of evaluation parameters

- Egg sterility measurements

This measurement is performed by collecting host fruit in the field. Field collectors should ensure that oviposition marks are present before removal of the fruit from host trees. Fruit should be taken to facilities for dissection. Eggs extracted from the fruit should be processed as described in the Sterility Tests Section (Procedures Section 2.5) of the Manual for Product Quality Control and Shipping Procedures for Sterile Mass-Reared Tephritid Fruit Flies (FAO/IAEA/USDA 2003). This test would be difficult to implement under high availability of fruit and very low population levels inherent to eradication programmes.

- Determining larval infestation levels in the area in the preferred host

Larval infestation levels are measured as numbers of larvae/kilogram of fruit host. In this case, host fruit with infestation symptoms should be collected from preferred hosts from the area subjected to sterile insect releases and brought back to the fruit processing laboratory. Fruit is allowed to finish ripening in order to allow final larval development and egression under laboratory conditions. Measurements of fruit weight should be taken and the number of larvae per kilogram of fruit estimated. This will provide a value of infestation that can be compared periodically to determine the progress in population reduction. This procedure is described in detail in the Fruit Sampling Section of Moscamed Programme Field Operations Manual (Reyes *et al.* 1986, Programa Regional Moscamed 2003, Programa Moscamed 1990).

- Reduced presence of wild flies in traps

The predicated result of SIT is to reduce population numbers as releases continue over time. This result should be reflected in a reduction of the wild population as measured by trap captures and the corresponding $FTDf_{ertile}$ index. The results of a fruit fly control programme can be compared periodically using the $FTD_{fertile}$ index over time.

- Negative trapping for at least three generations.

In the case of an eradication programme, after a number of generations of sterile insect release, it is expected that the wild population will be eliminated from the treated areas. An assessment of this condition would be to measure the absence of wild flies by maintaining the same level of trapping for at least three generations after the sterile fly release programme has been completed (IAEA 2003). The negative trapping over the course of three generations will confirm eradication (FAO 2006). The time should be adjusted based on the life span of the different developmental stages of the insect which is determined by the prevailing environmental conditions present in the area and by the trade protocols (Tassan *et al.* 1983 and Anon. 1997).

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