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**PILOT APPLICATION OF STERILE INSECT  
TECHNIQUE FOR THE ORIENTAL FRUIT FLY,  
*BACTROCERA PHILIPPINENSIS*, IN NAOWAY  
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ABSTRACT

The sterile insect technique for the Oriental fruit fly was pilot tested in Naoway, a 12-ha islet about 1.5 km. southeast of Guimaras Island. The Oriental fruit fly population (male) in the islet was first estimated at 3,432 using the mark-release-recapture experiments. From August to October 1995, six releases of sterile fruit flies (male and female) at biweekly intervals were conducted in the islet. Except for the 7 wild fruit flies collected by a trap 10 days after the first release, not a single fly was collected from the pilot site thereafter. Furthermore, field collections of infested fruits yield only 6 pupae on the first and zero on the subsequent collections. The results suggested that SIT proved successful in Naoway Islet. For Guimaras, an island-wide implementation of SIT could be undertaken after reducing the wild male fruit fly population by field sanitation and the male annihilation method in order to overflood the wild population with sterile fruit flies.

INTRODUCTION

Prior to an island-wide eradication of the Oriental fruit fly, *Bactrocera philippinensis* in Guimaras Island, pilot releases of sterile fruit flies were made in Naoway, a 12-ha islet, situated 1.5 km southeast of Guimaras. The islet is about 320 m in width at the widest part and 840 m long (Fig. 1). About 200 people live in the islet where fishing is the main occupation. This paper reports on experiments conducted to estimate the population density of Oriental fruit fly and to determine the effect of sterile fruit fly releases on the population of the wild fruit flies in the islet.

## MATERIALS AND METHODS

### Population estimate

Fruit flies used in these experiments were reared using the artificial diet developed at the Philippine Nuclear Research Institute. The first mark-release-recapture experiment was done in March, 1995 (Trial 1) under the supervision of an IAEA expert, Dr. J. Koyama. At 2 days before eclosion, fruit fly pupae were irradiated with 50 Gy and mixed with fluorescent dye at 4 g/l of pupae. The pupae were placed in polyethylene bags, provided with coolant in a styrofoam container and then transported by air to Iloilo and then by boat to the NMRDC in Guimaras. The pupae were placed in fly cages and provided with protein hydrolysate, sugar and water. Ten days after emergence, the marked flies were transported to Naoway Islet. The following morning, two sites (A and B in Fig. 1) were selected in the islet and the marked, sterile flies were released per site by allowing them to fly freely for 30 min from an open cage set up at these sites. About 8000 - 9000 flies were released per site.

Four hours after the release, twenty-five traps containing methyl eugenol, a male attractant, (96%) and malathion (4%) were hung on approximately 4 ha-area around each release site. These traps were hung 50 meters apart in lattice pattern four hours after the release and the flies recaptured 24 - 48 hrs later. The collected trapped flies were brought to the NMRDC where distinction was made between the marked sterile flies and the wild unmarked ones by ultraviolet light detection of the fluorescent dye. The heads of the flies separated from the bodies were crushed on a filter paper with a concrete nail previously soaked in a mixture of acetone and ethanol (4:1). The filter paper was then exposed under an ultraviolet lamp and the number of marked and unmarked heads from each trap was counted. Similar experiment was repeated in August, 1995 (Trial 2) and the Oriental fruit fly population was estimated by the Lincoln Index (Lincoln, 1930) using the following formula:

$$N = \frac{n \times M}{m}$$

- where N = number of wild flies  
n = number of captured wild flies  
M = number of marked and released flies  
m = number of recaptured marked flies

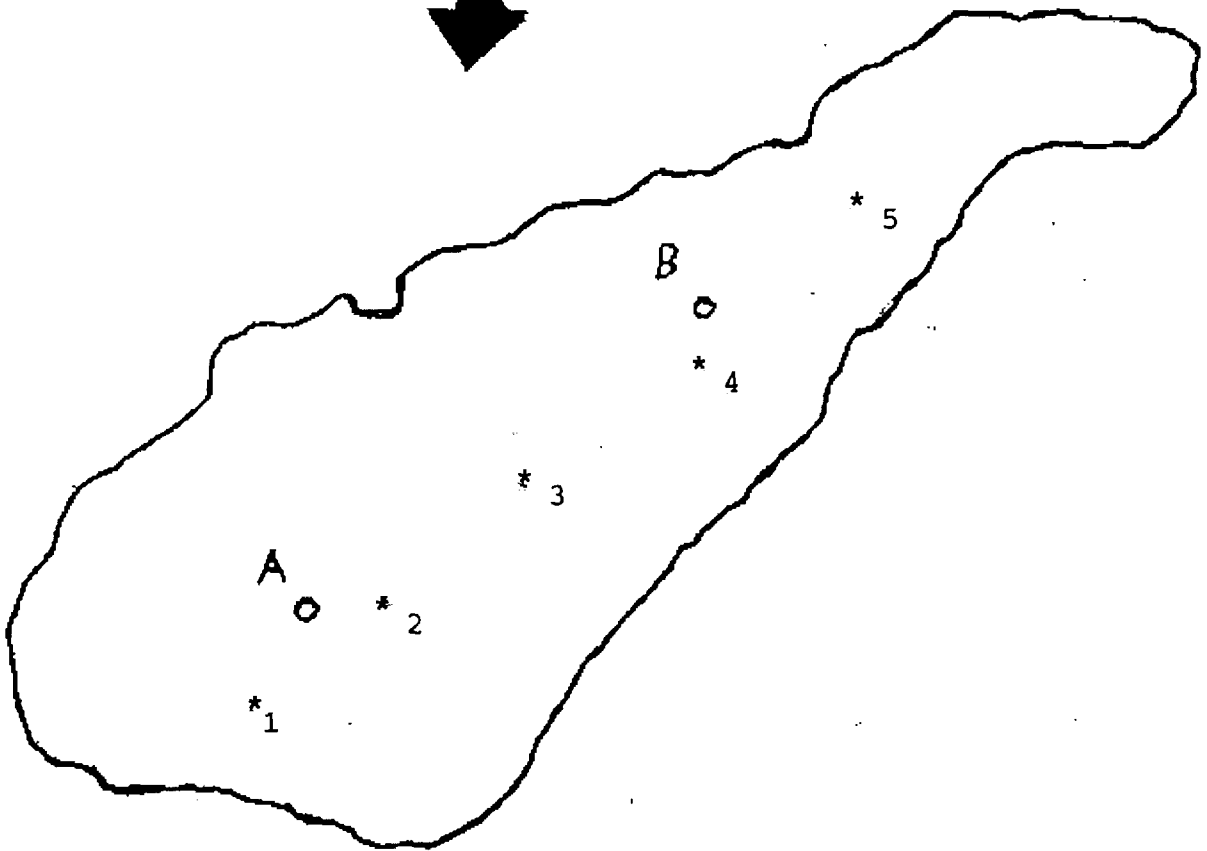
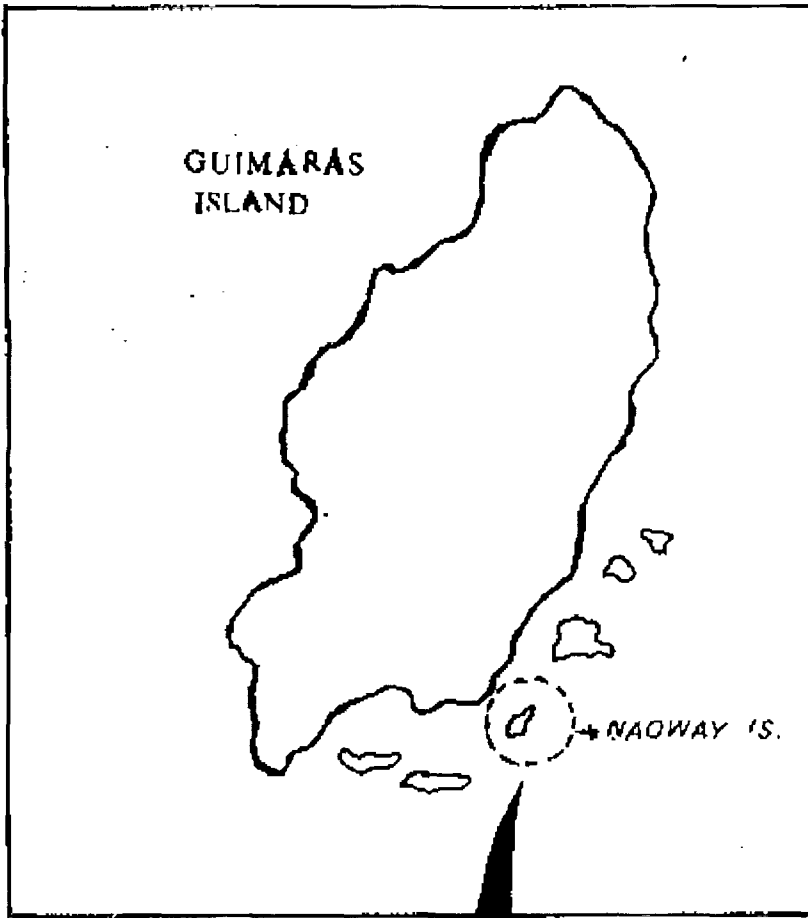


Fig. I. Map of Naoway Islet. (A and B: Release sites for population estimation, 1-5 : Release sites for pilot SIT)



## **Sterile fruit fly release**

Upon calculation of the estimated density of wild Oriental fruit flies on Naoway Islet, releases of sterile fruit flies were conducted at biweekly intervals from August to October, 1995. Marked and sterile pupae were packed in polyethylene bags and transported to Guimaras in styrofoam box provided with coolant through the commercial airlines. Upon arrival at the NMRDC in Guimaras, the pupae were allowed to emerge in large cages and provided with food and water. After 2 - 10 days from adult eclosion, both male and female flies were released in Naoway Islet. One day before the release, cages of emerged flies were transported to Naoway by jeepney and then by pump boat. Sterile flies were released at 7 - 8 AM from five release sites (1 ~ 5 in Fig. 1) on the islet. About 120,000 to 130,000 sterile flies (male and female) in each release and a total of about 1 million sterile flies were released for 6 release times.

The effectiveness of the sterile fly releases was determined by exposing 5 check traps baited with the poisoned methyl eugenol on each of the 5 release points. Collection of trap catches was made before the succeeding release was conducted. Flies caught in each check trap were crushed on filter paper and examined under an ultraviolet lamp to differentiate the marked (sterile) from the unmarked (wild) fruit flies.

Both wild and cultivated fruits of the different plants in the islet were collected and brought to the NMRDC. The collected fruits were then placed on top of coir dust contained in a plastic basin, covered and after 10 days examined for any larva or pupa. The pupae were counted and kept in small fly cages for adult emergence.

## **RESULTS AND DISCUSSION**

### **Population estimate**

Estimation of the number of wild pest population is a prerequisite for the successful control of insect pests with the sterile insect technique. Results of population estimate are shown on Table 1. The density of the wild Oriental fruit fly population on Naoway was estimated at 304 and 268 male fruit flies per ha when conducted in March and August 1995, respectively, or a mean of 286 per ha. In Hawaii, different values of Oriental fruit fly captures were collected. For instance, in 1987, highest Oriental fruit fly captures occurred in December and lowest in April. However, in 1988, highest captures were observed in August and the lowest in February (Vargas, et al, 1990).

In the case of melon flies, Tanaka, et al. (1978) estimated the density at their most abundant season (October - December) in the southern part of Okinawa Island

Table 1. Male Oriental fruit fly (OFF) population estimated by mark-release-recapture study in Naoway Is.

Particulars	Trial 1		Trial 2	
	A*	B*	A*	B*
No. of marked and released flies (M)	8963	9123	9168	8970
No. of recaptured marked flies (m)	417	305	67	42
No. of captured wild flies (n)	41	52	11	3
Estimated number of wild flies (N)**	881	1555	1505	641
Density per hectare (N/4)	220	388	376	160
Mean	304		268	
Estimated population of OFF in Naoway Islet***	3,432			

\*

Release site

\*\*

Estimated to be distributed in 4 ha-area around each release site

\*\*\*

Estimated from mean density of 2 trials

to be about 500 males/ha. However, in another experiment done in December, Ichinohe, et al (1978) concluded that the density of wild male melon flies in the same area and season was 622 per ha. These data showed a variation in results even with the same species. In another island, Kudaka Island, which is about 120 ha, the density of the male melon fly varied from 109 to 238/ha (Kawasaki, 1991).

Based on our experimental estimation, the density of the Oriental fruit fly in Naoway was about 1/4 of that calculated for melon flies in Okinawa but within the range observed in Kudaka Island. Considering a difference in species and vegetation present in the test areas, such variation in the results is expected. From our calculations, the total number of male Oriental fruit flies in Naoway was estimated as about 3,432. This figure was therefore used as the basis for the number of sterile fruit flies released for the application of a pilot SIT in Naoway Islet.

#### Sterile fruit fly releases

Data on pilot releases are shown on Table 2. Approximately, 1,009,150 sterile flies whose ages ranged from 2 - 10 days were released at biweekly intervals from 5 release sites in the islet (Fig. 1). Except for the 7 unmarked (wild) fruit flies collected within 10 days after the first release, not a single wild fruit fly was collected from the test area until the last collection in November or three generations (it takes about one month for one generation) after initiation of the first fruit fly release. Initial overwhelmed ratio (male) of released sterile flies and estimated population on Naoway Islet was 22:1. The ratio of sterile:wild males indicated by trap catch was 648:1 at first release and  $\infty$  (infinity):1 on and after second release. Although Knipling (1955) suggested that a ratio in the field of 9 sterile to 1 fertile insect should provide reasonable assurance of a downward trend in most populations, some workers carried out sterile releases at far higher ratios. For instance, in the first eradication attempt against the melon fly made by Japanese scientists in Kume Island, the sterile:wild fly ratio exceeded 100:1 eight months after the beginning of the sterile insect release. As a result, the percentage of infestation of host fruits decreased to zero three months later (Koyama, 1982).

In addition, our first fruit collection data (Table 3) revealed about 6 pupae recovered from wild anino fruits where 3 fruit fly adults emerged. However, subsequent collections of both wild and cultivated fruits did not yield any pupa of the Oriental fruit fly.

Based on the data gathered, our results indicated that SIT proved to be successful in Naoway Islet. For Guimaras, an island-wide implementation of SIT could be undertaken after the wild population of Oriental fruit flies has been reduced to a low level by field sanitation and the male annihilation method. However, for the 60,000-hectare island, several millions of sterile fruit flies may have to be released each week continuously for a number of years before eradication may be achieved.

Table 2. Data on sterile Oriental fruit fly releases in Naoway Islet

Batch No.	Date of Release	No. of Sterile Fruit Flies Released (male & female)	Flies Recovered		Ratio of sterile:wild flies
			Marked (sterile)	Unmarked (wild)	
1	8/23/95	149,167*	4534	7	648:1
2	9/03/95	133,049	1,501	0	∞:1
3	9/18/95	179,620	669	0	∞:1
4	10/02/95	198,470	2,304	0	∞:1
5	10/11/95	122,313	5,808	0	∞:1
6	10/24/95	226,531	805	0	∞:1
TOTAL		1,009,150	15621	7	

\* Initial overwhelmed ratio of sterile:wild (male) was 22:1 based on the estimated population of OFF in Naoway Islet (3,432).



Table 3. Results of inspection on fruits collected in Naoway Islet

No. of collection	Date of collection	Fruit	Total weight (kg)	Oriental fruit fly collected	
				No. of pupa	No. of emerging adult
1	8/23/95	Atis	0.4	0	0
		Guyabano	0.3	0	0
		Anona	0.5	0	0
		Anino	0.2	6	3
		Magoparet	0.1	0	0
2	9/3/95	Atis	1.0	0	0
		Anino	0.1	0	0
3	9/18/95	Atis	0.4	0	0
		Guava	0.8	0	0
		An-an	0.1	0	0
		Anino	0.2	0	0
		Calachuchi	0.1	0	0
4	10/2/95	Guava	0.4	0	0
		An-an	0.1	0	0
		Anino	0.1	0	0
		Almond	0.1	0	0
		Calachuchi	0.2	0	0
5	10/10/95	Almond	0.6	0	0
		Anino	0.4	0	0
6	11/16/95	Almond	0.5	0	0

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