



**MINISTRY OF AGRICULTURE
COOK ISLANDS**

COOK ISLANDS



FRUIT FLY

EMERGENCY RESPONSE PLAN



Ministry of Agriculture

Ministry of Agriculture
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COOK ISLANDS

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INTRODUCTION

Fruit flies are one of the world's most economically significant pest of horticulture and attack a wide range of fruit and vegetables. A majority of these fruit fly species are exotic to the Cook Islands and many of these are found in neighboring Pacific Island countries such as French Polynesia, Samoa, Tonga etc. The Cook Islands has only two types of fruit fly species, *Bactrocera melanotus*, an endemic species of the Cook Islands, and *Bactrocera Xanthodes* commonly found throughout the Pacific.

Fruit flies damage fruits by laying eggs in the fruit or on the outside skin. Larvae emerge from the eggs and immediately burrow into and feed on internal structures of the fruit. Bacterial infection often results in the partial or complete degradation of the fruit. Larvae eventually emerge at the surface of the fruit and drop to the ground where they pupate in soil until they emerge as adults. Fruit fly life cycles vary according to species and environmental conditions.

Fruit flies cause direct damage to fruits and vegetables which lead to yield loss depending on fruit fly species, population and season. In addition, fruit fly infestation can result in serious losses in trade value and export opportunities due to strict quarantine regulations imposed by most importing countries. As a result, it is critical that fruit fly species are adequately managed to ensure producers can maintain, enhance and develop access into domestic and international markets.

When prevention of exotic fruit fly incursion fails, eradication is the preferred course of action. Eradication can be successful and cost effective solution in response to an early detection of exotic fruit fly incursion.

Managing fruit flies requires a combination of procedures and these include:-

1. Monitoring
2. Baiting
3. Trapping
4. Fruit collection

These procedures are issued subject to Part 9 of the Biosecurity Act 2008 to respond to any Biosecurity emergency measures.

The application of biosecurity measures to manage fruit flies in the field and in trade is a significant cost to the Cook Islands Government. The recent Oriental fruit fly (*Bactrocera dorsalis*) eradication program cost the Cook Islands \$246,000NZD dollars.

AMENDMENTS

This is an evergreen document that will need to be reviewed and amended from time to time or after a Fruit Fly Emergency Response has been carried out to ensure up to date information is documented for effective and efficient response to fruit fly emergencies.

The Ministry of Agriculture is responsible for maintaining, updating and distributing the amended versions of the plan.

Version II as at February 2018

ACKNOWLEDGEMENTS

The National Environment Service (NES), in cooperation with the Ministry of Agriculture gratefully acknowledges the financial assistance provided by the Secretariat of the Pacific Regional Environment Programme (SPREP), United Nations Environment Program (UNEP) and the Global Environment Facility (GEF). This document was produced as part of the Cook Islands Invasive Alien Species Project under the regional GEF #3664 Prevention, control and management of invasive alien species in the Pacific Islands.

This document, the Cook Islands Fruit Fly Emergency Response Plan 2018 is written and prepared by Elizabeth Munro (NES - Senior Biodiversity Officer), to ensure that all components required to effectively and efficiently respond, to a fruit fly incursion is captured and made easy to follow and implement.

To ensure this document is in-line with the Ministry of Agriculture Policies and the Biosecurity Act 2008, appreciation goes to Ngatoko Ngatoko (Director of Biosecurity Services) and Pavai Taramai (Senior Biosecurity Officer) for their assistance.

The baseline information for the development of this document was collated from the production of the Agriculture Field Report released by the Ministry of Agriculture and gratitude goes to Dr Matairangi Porea (HOM) and the staff of the Ministry of Agriculture.

ACRONOMS

BSD	Biosecurity Director
EMCI	Emergency Management Cook Islands
ER	Emergency Response
FAO	Food and Agriculture Organization
FBM	Fruit fly Base Manager
FF	Fruit Fly
FFM	Fruit fly Field Manager
FOM	Fruit fly Operations Manager
GEF	Global Environment Fund
HOM	Head of Ministry
MOA	Ministry of Agriculture
SPREP	Secretariat of the Pacific Regional Environment Programme
UNEP	United Nations Environment Program

DEFINITIONS

Bactrocera melanotus	Native fruit fly species of the Cook Islands
Bactrocera xanthodes	Introduced/established fruit fly species into the Cook Islands
Biosecurity Director	Biosecurity Director, designated under section 74 of Biosecurity Act 2008
Biosecurity Zone	Area declared in response to a biosecurity emergency under section 69 of the Biosecurity Act 2008
Detection	Confirmed identification of exotic fruit fly find
Eradication	The application of measures to eliminate a pest or disease from an area
Exotic fruit fly	species of fruit flies <u>other</u> than <i>Bactrocera melanotus</i> (<i>endemic species</i>) and <i>Bactrocera xanthodes</i> (Pacific fruit flies)
Hot spot	Area or site where an exotic fruit fly has been trapped. The area could be either one or more traps.
Island Council	Island Council established under the Outer Islands Local Government Act 1987
Ministry	Ministry of Agriculture
Officer	any officer of the Ministry of Agriculture
Pa Enuā	Those islands of the Cook Islands except Rarotonga
Quarantine Zone	A restricted area imposed by an Authorised officer where by the movement, production or existence of an exotic fruit fly or any fruit fly host is brought under regulation in order for the introduction or spread of an exotic fruit fly is prevented, controlled or eradicated to prevent further damage by the exotic fruit fly.
Response	Actions undertaken by the ministry as a result of the detection of fruit fly species in the Cook Islands, to demonstrate that the pest has not established itself or to contain and eradicate it and demonstrate that this action has been successful.
Secretary	Secretary of the Ministry of Agriculture
Specimens	An organism or part of an organism collected and preserved for scientific research
Surveillance	The fruit fly trapping and host fruits surveys that is undertaken to collect, record and monitor data on the presence or absence of an exotic fruit fly species.

SCOPE

The Cook Islands Fruit Fly Emergency Response Plan defines the processes to be followed should there be a detection of an exotic fruit fly that has breached our biosecurity system. This plan is a guide to respond quickly and effectively to a fruit fly outbreak before the species spread and become established.

The scope and purpose of the fruit fly emergency response plan is to:

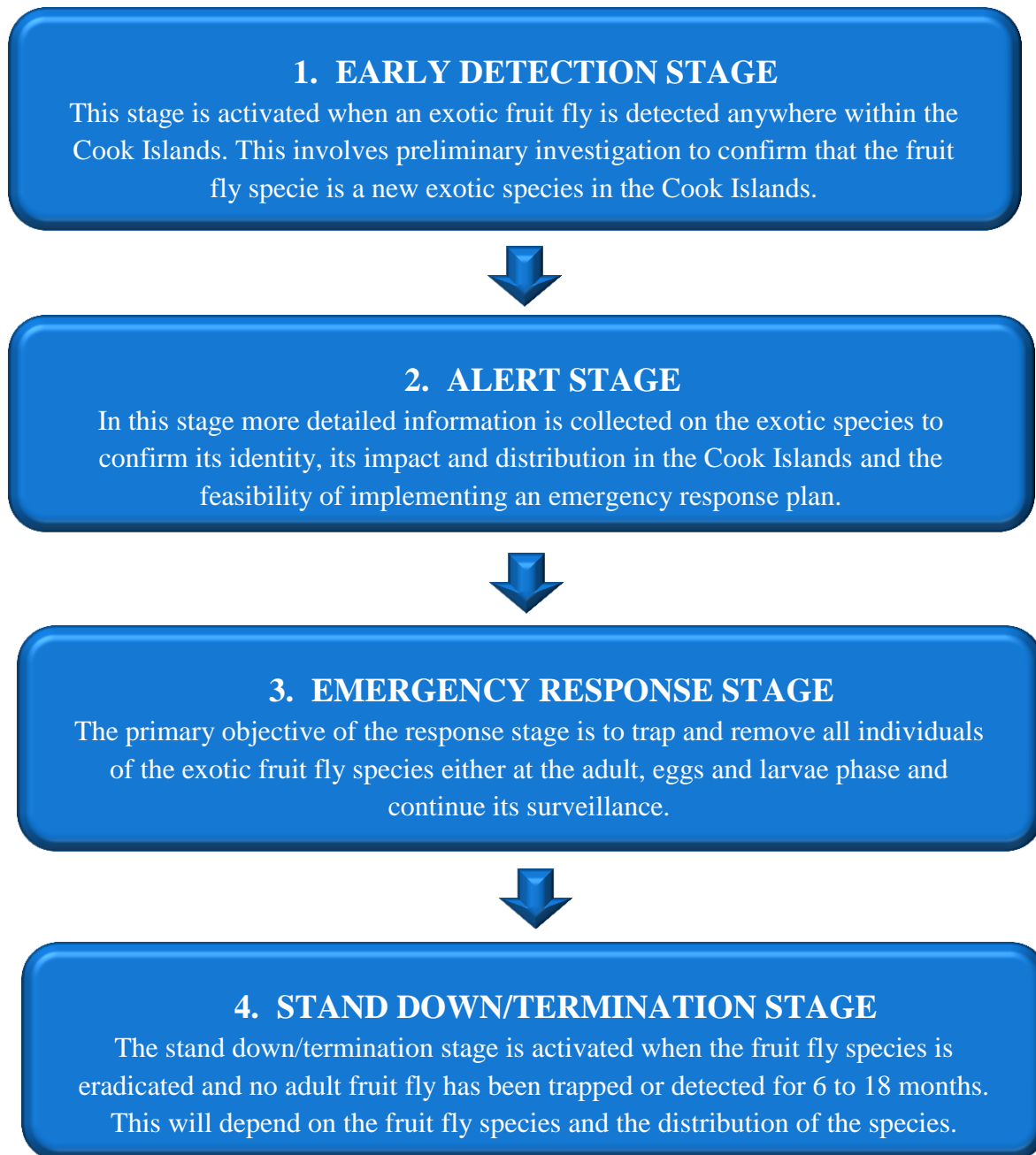
- Rapidly and effectively respond to exotic fruit fly species detected in the country
- Ensure measures are in place to carry out an exotic fruit fly response
- system in place to monitor exotic fruit fly species
- Clearly define the roles for relevant parties and individuals involved in the fruit fly emergency response
- Define the roles of agencies involved in the fruit fly emergency response
- Ensure effective and timely communication between national government ministries, regional organizations and members of the general public, in relation to exotic fruit fly species outbreaks.
- Ensure the public is effectively notified of response activities

ACTIVATION PROCEDURE

This fruit fly emergency response plan has four key stages of action. These are;

- Step 1* *Early Detection stage*
- Step 2* *Alert stage*
- Step 3* *Emergency Response stage*
- Step 4* *Stand Down/Termination stage*

Figure 1 Activation Stage Outline



FRUITFLY EMERGENCY RESPONSE STAGES

1. EARLY DETECTION STAGE

The early detection stage starts when an exotic fruit fly species is intercepted and reported in one of the fruit fly surveillance traps set-out around the island for the purpose of monitoring and detection of any new fruit fly species. This stage ensures the credibility of the report, that the fruit fly species is not *B. melanotus* and *Xanthodes*.

The initial detection steps:

Field specimen: If an adult exotic fruit fly is detected in a surveillance trap and confirmed as a fruit fly species other than *B.melanotus* and *B.xanthodes* then the next step is conducted.

Specimen identification: Once the fruit fly species is confirmed as species other than *B.melanotus* and *B.xanthodes* an entomologist and/or an officer with the skills or knowledge in species identification will carry-out a preliminary species identification to determine the fruit fly species. If the fruit fly species is confirmed as species other than *B.melanotus* and *B.xanthodes* and is an exotic species then the next step is conducted.

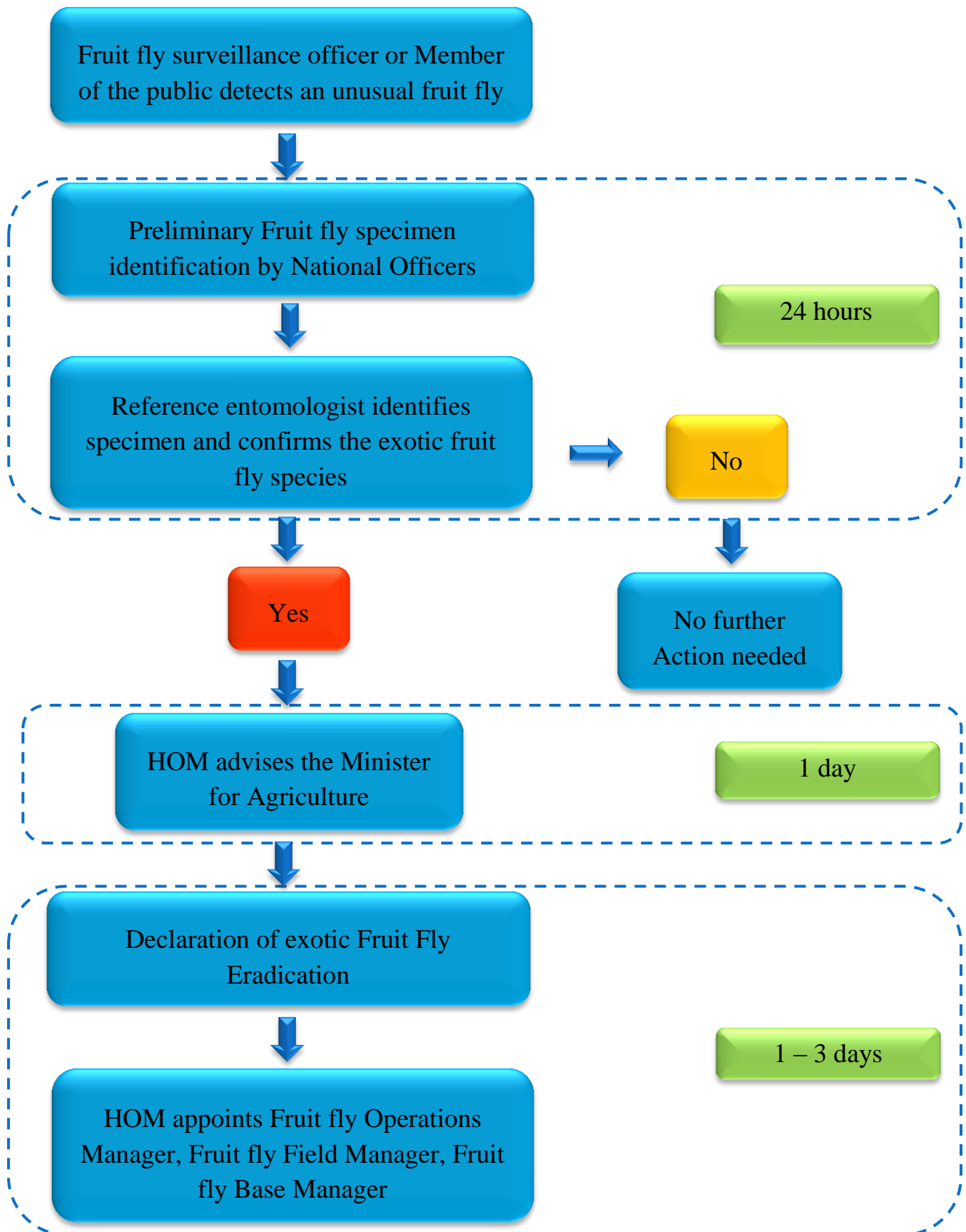
When an entomologist and/or an officer in the Cook Islands confirms the fruit fly species is an exotic species that is detrimental to the Cook Islands environment, the specimen is sent to an international reference entomologist. Photos of the specimen can be used for speedy initial identification and sent to the international reference entomologist for confirmation. The photograph must highlight key external characteristic lines on the thorax and abdomen of the fruit fly. A specimen is preserved and sent off as soon as possible for formal identification and DNA analysis. When a report is received confirming the fruit fly species is other than *B.melanotus* and *B.xanthodes* then the next steps are conducted.

Appointment of Fruit fly Operations Manager (FOM): If the report received confirms the species is an exotic species then the secretary is advised. The Secretary then appoints a Fruit fly Operations Manager (FOM) who will conduct the fruit fly programme. *The FOM will be responsible in all the operations of the fruit fly eradication program and will report to the HOM on its operations and progress.*

Appointment of Fruit fly Field Manager (FFM): The Secretary will appoint a Fruit fly Field Manager (FFM) who will report to the FOM. *The FFM will be responsible in all field operations of the fruit fly eradication program such as the Surveillance Trapping and Eradication Application.*

Appointment of Fruit fly Base Manager (FBM): The Secretary will appoint a Fruit fly Base Manager (FBM) and will report to the FOM. *The FBM will be responsible for all fruit fly base operations such as preparation of materials for field operations and species identification/confirmation.*

Figure 2 Flow Diagram of the Fruit fly Early Detection Stage



2. ALERT STAGE

The alert stage is triggered by the HOM when confirmation is received that the fruit fly species is a new pest to the Cook Islands and that further urgent action is required to control this new species. Detailed information on the species is collated and reported to the HOM to decide on a response and advise the Minister of Agriculture.

The following steps are followed in the Alert stage;

1. **Detailed information on the species:** More detailed information is collated on the species, site where detected, the impact it causes to agriculture crops and the environment, a list of its host plants in the Cook Islands. Countries where the fruit fly is found on, the biology of the species and possible pathway of entering the country.
2. **GIS Map Zoning:** A GIS map is produced to determine the hot spot area and other areas to be zoned in various meters from the first point of discovery, (300, 500, 1000 and so on). Once the hot spot area is determined the quarantine zone is set and the movement of any fruit and vegetables out of the area are banned.
3. **Quarantine Zone Surveillance traps:** An intense trapping in the quarantine zone is carried out. This intense trapping using Lynfield Traps are used to determine the distribution of the fruit fly. Distance from each trap in the quarantine zone is determined as well as the rest of the zones.
4. **Quarantine Zone host plant survey:** A survey is carried out to identify host fruit trees, vegetables, etc that are in season and plan for these to be removed from the trees.
5. **Assess feasibility of Emergency Response:** When information 1 to 4 above is collated by the FOM and reported to the HOM, the HOM will recommend a response and advise the Minister of Agriculture. Emergency Management Cook Islands (EMCI) should also be notified of the situation.
 - a. **Emergency Response Trigger:** The emergency response stage is triggered if the fruit fly is found to be an exotic fruit fly species that will cause social, financial and environmental loss and that it is at a stage where it has not widely distributed and can be managed.
6. **Public awareness:** A news article is released by the HOM to the public to announce the new species of fruit fly.
7. **Securing funding:** The HOM and FOM will seek financial assistance from government and/or regional agencies to assist with the fruit fly control program. A budget cannot be predetermined until an incursion happens for this is dependent on the distribution of the fruit fly in the country. The last fruit fly (*Bactrocera dorsalis*) eradication program cost the Cook Islands \$246,000NZD dollars.

3. EMERGENCY RESPONSE STAGE

The Emergency Response Stage is triggered once the HOM advises the Minister of Agriculture that eradication of the exotic fruit fly is the most appropriate response option thus initiating the eradication program. The eradication program includes trapping and removal of adult fruit flies and continues surveillance to monitor distribution and presence. The appointed managers in stage 1 commence with their key management functions. A media release is also made to announce the public of the new species and the requirements needed to maintain its spread.

The key steps of the emergency response stage include the following;

- **Eradication**
- **Surveillance**
- **Host fruit Collection**
- **Data Recording**
- **Education and Awareness**
- **Assess Feasibility of Stand down stage**

ERADICATION

There are two key processes when eradicating Fruit flies;

- **Male Annihilation Technique**
- **Protein Bait Spray**

These two techniques, Male Annihilation Technique and Protein Bait Spraying, traps and kills adult fruit fly species in the field. Male Annihilation Technique is also used to determine the distribution of fruit fly.

Male Annihilation Technique

Male annihilation technique involves the trapping of male fruit flies using trapping stations and block baits impregnated with male lure such as Methyl Eugenol (ME), Cue Lure and Trimedlure (TI)/Capilure (Clr) that are effective attractants to various Fruit fly species. These male lures are mixed with rapid kill insecticides, Malathion and Fipronil.

Surveillance Traps is a male annihilation technique used to determine the presence and distribution of fruit flies in an area. (See details below under surveillance)

Block bait is another male annihilation technique used where dry coconut husk/fiber are cut into blocks and impregnated with a male lure and a rapid kill insecticides to control male fruit fly population. This technique is called the Cocomat bait and the density of blocks or traps is dependent upon the extent and geographic location of the outbreak. (see Resources for fruit fly emergency response program for materials and distribution)

A male annihilation technique is applied in unison with bait spraying to effectively eradicate the exotic fruit fly.

Photo 1: Block Bait (Left - chip board block and right - coconut husk block (cocomat))



Photo 2: Cocomat Bait



Protein Bait Spray

The protein bait attracts females and acts as a food attractant and its effectiveness relies on the fact that immature females need a protein meal for developing mature eggs. The bait spray residue on the foliage is ingested by the flies and kills them. Because the bait spray relies on its attractant properties for its mode of action, overall coverage of the tree canopy is unnecessary and a 'spot spraying technique' is adequate.

Bait spraying is a mixture of protein and Malathion EC 50/Fipronil and is applied in unison with Male Annihilation. Bait sprays within the outbreak zone and outbreak area should continue to be applied for 2-3 generations (3month) after the last fly or larva has been detected. The baiting program may be expanded into the quarantine zone if results from the delimiting survey indicate this is required.

SURVEILLANCE

Male Annihilation Traps or Surveillance Traps serve as a monitoring tool for the effectiveness of any eradication program. Surveillance traps monitor fruit fly population, distribution and presence of fruit fly within an area. Once an adult fruit fly is identified, the number of surveillance traps is increased within that area to capture the flies and remove them from the environment, even after an infestation is believed to be eradicated. The increased number of traps and their inspection interval remains high for several months before the area is officially declared eradicated.

Surveillance traps are placed, starting at 200 meters apart from the point of discovery in the Biosecurity Zone, followed by 300m within the next zone, 500m then 1km. Trap distance is dependent on the exotic species and number caught in the traps. The traps are checked every two days for two to three weeks to determine the distribution and population of the exotic fruit fly. This is reviewed depending on the distribution and population.

To determine the distribution of the exotic fruit fly in the Cook Islands Surveillance Traps are sent to the Pa Enea.

Surveillance Trapping continues for 4 – 6months before it is reduced. Surveillance Traps made out of Chinese takeaway containers (Lynfield Trap) is used for surveillance trapping to determine the presence and distribution of fruit fly.

Photo 3: Lynfield Surveillance Trap



HOST FRUIT COLLECTION

Host fruit collection involves the removal of any host fruit and vegetable in the Biosecurity Zone. All host trees and plants are stripped of any fruit and vegetable including fallen fruits are removed. These fruits and vegetables are removed and destroyed within the Biosecurity Zone. Host plants in the surrounding buffer zone may also be removed to minimize the immigration of new adults into the area.



Photo 4: collecting of fruits from the ground and taken to designated hole for burial

A designated area preferable in the Biosecurity Zone is assigned for the burial of all fruits and vegetables. To ensure fruit flies do not emerge, the fruits are buried and covered with soil at a height of about 0.5 to 1 meter.



Photo 5: covering of fruits with soil

DATA RECORDING

Accurate recording and reporting are essential for determining the progress of the program. Records of the program from the first sighting or phone call and all processes that follow, such as the trapping, baiting, fruit collections etc are to be kept safe. This information should be filed in such a way that any important records can be easily located later for assessment and to determine the status of the exotic fruit fly as well as assist with the write up of the final fruit fly Report.

The FOM will instruct the FFM and FBM to keep records of the operation for their reports.

Tables below are samples of record sheets carried out on Aitutaki.

Table 1: Record sheet of surveillance trap in Aitutaki

OFF Surveillance Trap Locations on Aitutaki								
DATE					10.06.13	10.06.13	20.06.13	20.06.13
Island	District/Village	Locations/owner	GPS Position	Host tree	B. dorsalis	B. xanthodes	B. dorsalis	B. xanthodes
Aitutaki	Amuri	Majorie Moera	10	Guava	14	2	66	4
Aitutaki	Amuri	Toa Isamaera	11	Bread fruit	24		3	1
Aitutaki	Amuri	Pacific Resort	12	Chestnut	51	0	95	2
Aitutaki	Amuri	John Winchester	13	Chestnut	45	0	54	2
Aitutaki	Amuri	Nane Herman	14	Spondias	33	0	20	1
Aitutaki	Amuri	Teiti Teiti	15	Mango	28	0	14	0
Aitutaki	Amuri	Mokoenga Ratu	16	Carambola	42	0	15	0
Aitutaki	Airport	Spider	17	Ano	3	0	4	0
Aitutaki	Airport	End N/E Runway	18	Pandanus	0	0	0	0
Aitutaki	Airport	Vai O Mokora	19	Pandanus	0	0	0	0
Aitutaki	Airport	David Nicholls	20	Pandanus	1	0	0	0
Aitutaki	Airport	Tangi	21	Ano	11	0	0	0
Aitutaki	Airport	Inano Beach	22	Tauinu	25	0	0	0
Aitutaki	Airport	Moana Resort	23	Calophyllum	30	0	14	0
Aitutaki	Amuri	Black Rock	24	Chestnut	11	0	8	0
Aitutaki	Amuri	Terepoto	25	Paw paw	25	0	24	0

Table 2: Data sheet of surveillance trap in Aitutaki

Weeks in December 2013	Fruit Flies Trapped	Site (Hot Spot)	Follow up Action	Responsible Officer
1	6	Vaipae	Protein Bait Spray & Fruit collecting	Junior, Pepe & Fred
2	4	Vaipae	Protein Bait Spray & Fruit destroying	Junior, Pepe & team
3	2	Vaipae	Protein Bait Spray & Fruit collecting	Junior, Fred, Pepe & team
4	0	Vaipae	Protein Bait Spray & Fruit collecting	Junior, Fred & team

EDUCATION AND AWARENESS

Various social media tools should be applied to ensure the public is made aware of the eradication program. These public announcements should inform the public of the threats fruit fly can cause once established on the island. These announcements should also inform them about the eradication program, Biosecurity Zones and areas where fruits and vegetables are not to be taken out of the area.

Awareness should also be made in schools where students can be taught on the fruit fly life cycle and the threats it can cause to the Cook Islands agriculture, environment and economy. Trading partners and neighboring countries should also be officially contacted to notify them of the fruit fly outbreak.

Awareness material produced by Ministry of Agriculture on Oriental Fruitfly



ASSESS FEASIBILITY OF STAND DOWN STAGE

The stand down stage is triggered when no exotic fruit fly is found in the surveillance traps for 6 to 18 months. The collation of information and data from the surveillance program will determine when the appropriate time for the stand down stage is initiated.

4. STAND DOWN/TERMINATION STAGE

The stand down/termination stage come to effect when the eradication is successful and no exotic fruit fly has been found in the surveillance traps for 6 to 12months. A report of the exotic fruit fly eradication program with data evidence of no recording of exotic fruit fly shall be submitted to the HOM. The HOM will meet with the fruit fly advisors to determine the stand down/termination stage of the program. The HOM will inform the Minister of Agriculture and will also inform all agencies, trading partners and other relevant regional institutions.

REPORTING

The FOM will instruct the FFM and FBM to provide regular written report during the fruit fly operation and to also prepare a final report on the whole fruit fly operation within a week after the field operation is terminated. The FOM will provide a written report of the fruit fly operation to the HOM to consider a stand down/termination of the fruit fly emergency response program.

The report will include;

- Overview
- Operations procedures
- Discussion made
- Results
- Budget
- Challenges
- Recommendations

The HOM will discuss the written report with the FOM, FFM & FBM and finalize the report before submitting this to the fruit fly Advisory committee. The report will then be submitted to the Minister of Agriculture for endorsement. The HOM will also release a public notice in the newspaper and other media sources of the outcome of the fruit fly operation.

RESOURCES FOR FRUITFLY EMERGENCY RESPONSE PROGRAM

It is noted that some of the resources required for the fruit fly program cannot be stored long term however resources required for continuous monitoring of fruit fly be purchased and stored at MOA. Resources required to carry-out a fruit fly emergency response program are highlighted below.

CONTROL CENTERS

National Control Center	The Ministry of Agriculture main office will be the National Control Center for any fruit fly eradication program in the Cook Islands.
Island Administration	For an eradication program in any of the Pa Enuu, the Island Administration will designate an appropriate site as the control center.

HUMAN RESOURCES

Human resources are the key to carrying out a fruit fly control program. The fruit fly Operations Manager will be responsible in ensuring people are available to carry out the program. Annex IV lists key fruit fly personnel.

The Ministry of Agriculture Secretary will seek assistance from other Agencies such as Ministry of Health, National Environment Service and any other agency, to request for their assistance with the fruit fly control program. Volunteers may also be requested to assist with the program, in particular the Pa Enuu.



Photo 6: Ministry of Agriculture staff stapling cocoMATs together

The HOM of Agriculture may also form a fruit fly Advisory Committee to provide advice on the control of fruit fly in the Cook Islands. The advisory committee may be made of key stakeholders and experts on fruit fly control.

Request may also be made to SPC or any agency outside of the Cook Islands to assist with the fruit fly eradication program.

MAPS

Once the exotic fruit fly has been confirmed a GIS map is produced and hard copies printed. The Maps will;

- Highlight where fruit fly species are found
- Quarantine zone and a grid to determine distance or the area
- Location of Lynfield traps
- Flight pattern for aerial cocomat bait distribution



Map 2: Map highlighting quarantine zone (red dashed line), area exotic fruit fly detected (yellow circle) and distribution of surveillance traps (i)

MALE ANNIHILIATION TECHNIQUE

Surveillance traps

Lynfield Traps Materials

- Chinese Food containers
- Soldering iron (make holes in the Chinese containers)
- Surplus of dental wicks for traps
- Steel wires
- Long nose plier
- Methyl Eugenol (lures)
- Malathion (Insecticide)
- Surveillance recording sheet



Photo 7: Lynfield trap on tree

Surveillance Trap mix for Cue lure and Methyl eugenol lure

- Ratio 1:20
- 10ml malathion and 200ml lure in 1L water

Lynfield Trap preparations

- Holes of size of 5cm are made on the sides of Chinese container using soldering iron
- Two cotton wicks are twisted around steel wires
- Steel wire are threaded through the Chinese container lids
- Cotton wicks are dipped into the lure
- NOTE: Ensure when dipping wicks in the lure that the lure does not drip in or around the container

Lynfield Trap Distribution

- Location of traps from each other – starts at 200 meters apart from the 1st point of discovery or circle, then 300 within the next circle, 500m then 1 km.
- Remain deployed for 3 months or 3 generation to the Fruit Fly life cycle
- Recharge the traps with Methyl Eugenol (ME) every Month and collect flies every 2 days period for the next month then weekly thereafter.
- Best to hang traps on host trees, 1.5 or 2 meters above ground in amongst the leaves and fruits.

Block Baiting

Block Materials

- sheet of Fiber board
- Coconut husk
- Methyl eugenol (Me)
- Malathion (preferred insecticide)
- Fipronil (alternative insecticide)
- Wide trays/bins with lids for dipping
- Hammers
- Cordillidos (used to connect 2 cocomat for aerial drops)
- Nails 2.5 inch
- Bush knives
- Tie-wires
- Gloves
- Pliers
- Buckets
- Face mask
- Overalls
- Safety boots
- Safety glasses



Photo 8: CocoMat nailed to a tree

Male Lures

Cue lure (Cl)

Methyl eugenol (Me)

Block Mix

- Mix ratio: 80% Methyl Eugenol + 20% Malathion (~70%ME + 30% Fipronil)
- 1,000 blocks = 14,000mls of mixture (14 litres)
- 11.2L of ME + 2.8L of Malathion 50EC = 14L mixture solution
- Impregnate 14ml of male annihilation lure (ME) + insecticide with Block materials

Block Preparation

- Fibreboard blocks size - 50mm x 50mm x 5mm (commercially prepared)
- Coconut husk blocks (CocoMATs) Size - 50mm x 50mm x 5mm

Soaking of Blocks

- Treat 500 blocks at a time (inside 7L mixture solution) in a soaking bin/open square wide flat plastic bin/drum.
- Soak blocks in bin/drum for 2 hour and stir to make sure all side of the block come into contact with mixture solution
- Remove blocks from soaking bin/drum and drain excess and place them in a dry bin/drum overnight
- Pre-nailing blocks (with 2.5 inch nail) and put them in small buckets ready to be distributed in the field

Block Distribution

- Obtain daily plan from Operation Manager/Team Leader
- Walk in straight line in direction agreed by Team Leader
- Nail Blocks at 50m (100 normal walking pace) intervals to fruit trees
- Nail blocks 2m above ground, above your head
- Nail blocks in shady places out of sun
- Make sure your blocking line is separated from your 2 neighbours by 50m
- Regroup regularly at an agreed place for updates (eg.on roads for coordination)
- Work out ways of getting blocks to difficult to reach areas

The density of blocks or baits will be dependent upon the extent and geographic location of the outbreak. Suggested densities are as follows:-

- Not less than 400 blocks per km² in the field 50m x 50m
- Not less than 1,600 blocks per km² in residential areas, 25m x 25m
- Not less than 2,500 blocks per km² in rural areas, 20m x 20m
- 1 block minimum per urban backyard,
- 1 block per 25 trees in managed orchards, and
- 1 block per 4 trees in derelict orchards

Aerial Block Preparation

- Cocomats are dipped in Fipronil insecticide then dried overnight
- Cocomats are then sprayed with 5.5 ml Methyl Eugenol (70 cocomats are sprayed for 25 to 30 seconds)
- Two cocomat blocks are joined together by a cordillidos to ensure the blocks tangles on tree branched when dropped from a light plane during distribution over the hills.

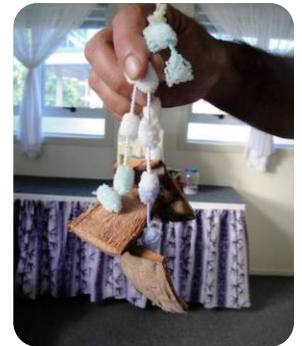


Photo 9: Cocomats connected by cordillidos for aerial distribution

Aerial Block Distribution

- Flight path is determined approximately 50m apart (see photo below)
- Each block is dropped thru a tube, every two seconds to get an approximate distribution of 50 to 70 meters apart based on an average flight speed of 70km/hr.



Photo 10: Flight path for aerial distribution

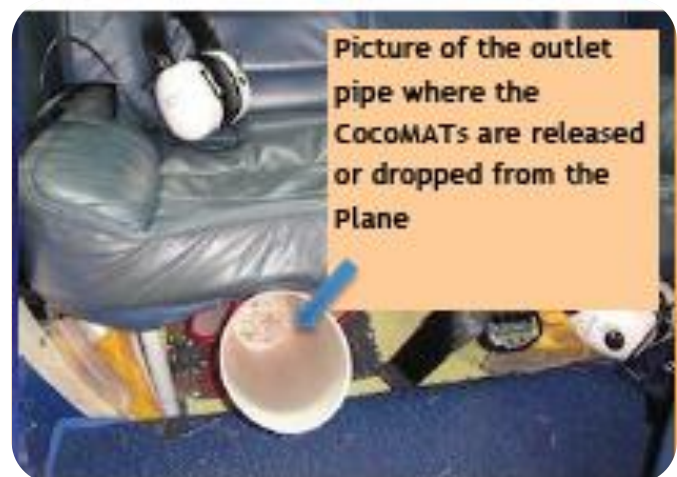


Photo 11: Outlet for cocomat aerial distribution

PROTEIN BAIT

Materials

- Sprayers / nap sacks (5L)
- Protein Bait
- Malathion (preferred insecticide)
- Fipronil (alternative insecticide)

Protein Bait Mix

To make 1 litre mix solution

- Protein – 50ml
- Malathion – 4ml (7ml for Fipronil)
- Water - 946ml

Protein Bait Field Application

- Protein bait should be applied in 100 ml dose spots at 100 spots per hectare
- in urban areas 6-8 spots per household property should be applied
- Baiting at a once weekly interval must also be conducted within the 1.5 km outbreak area.
- Bait sprays within the outbreak zone and outbreak area should continue to be applied for 2-3 generations (3month) after the last fly or larva has been detected.
- The baiting program may be expanded into the quarantine zone if results from the delimiting survey indicate this is required,



Photo 12: Bait Spray: Spraying of Protein Bait on the under leaf of a pawpaw tree.

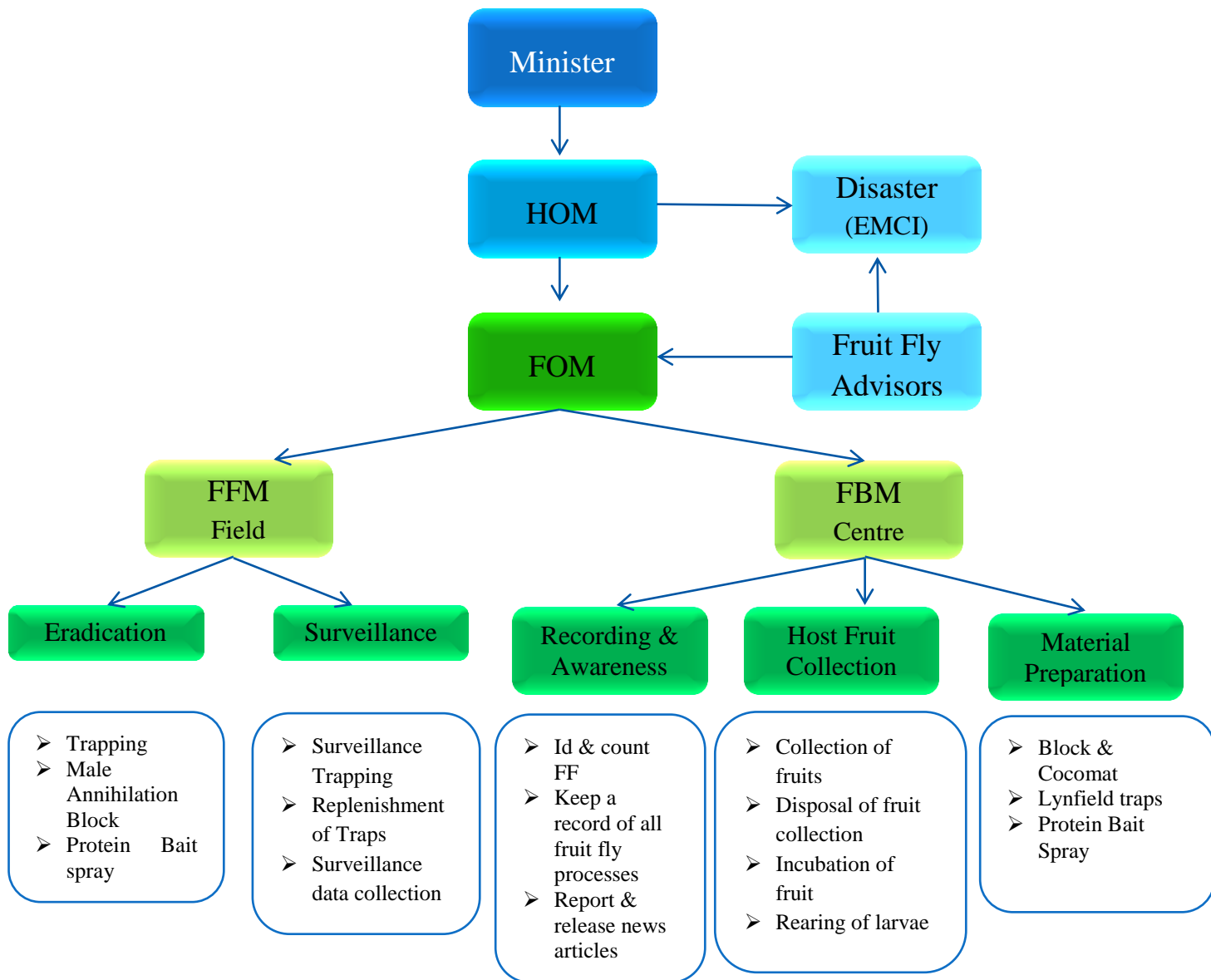
TRAINING

All key staff involved in the operational elements of the fruit fly control program need training to perform their functions properly. Key training needs are

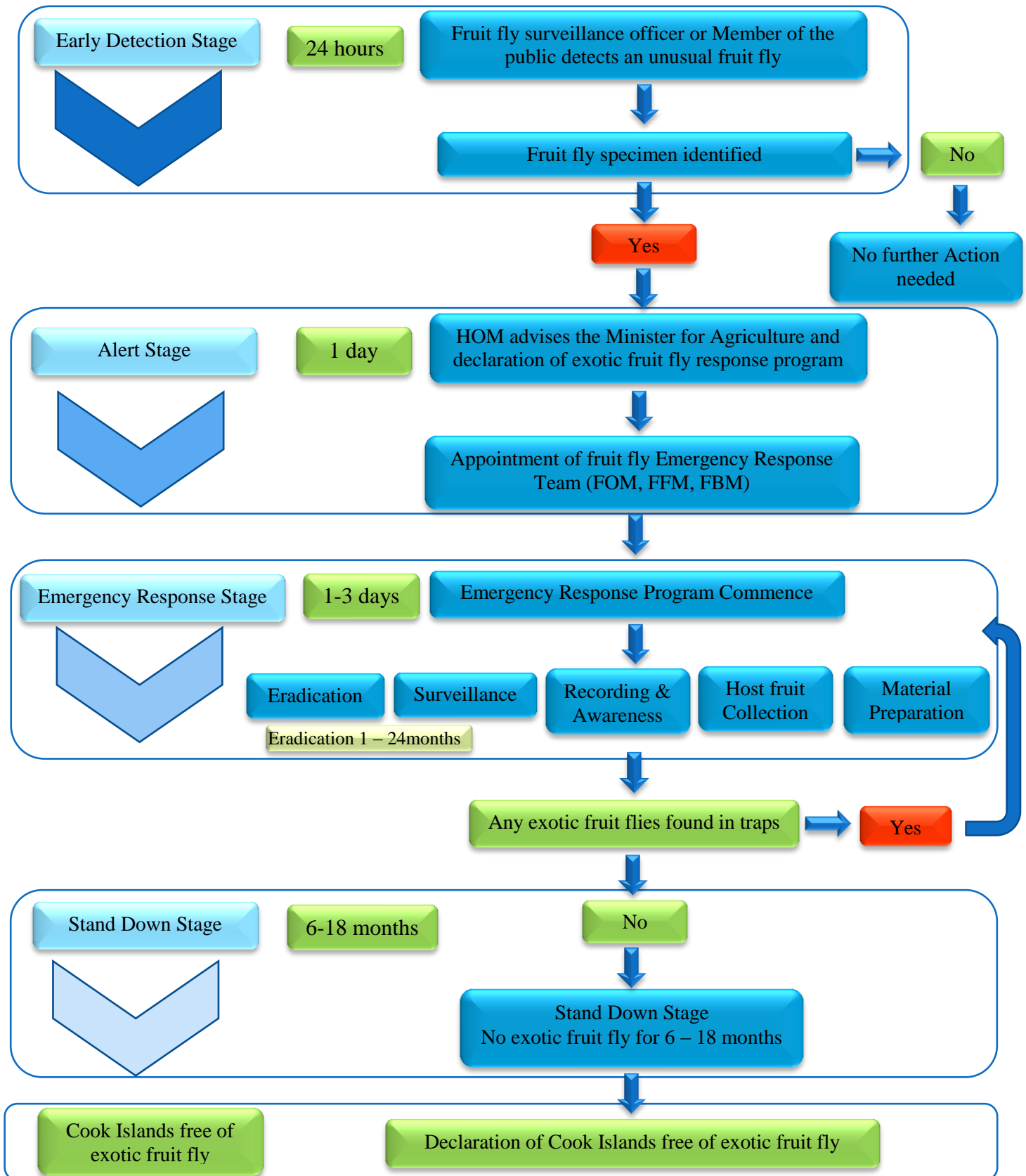
- Ensure staffs level of understanding of the impact exotic fruit fly species can cause to the Cook Islands are made.
- Raise the level of understanding of the team of the command and control structure and decision making processes.
- Train staff on application of baits
- Train staff on handling of traps and use of chemical attractants to ensure no cross contamination.
- Personnel trained on safe handling of chemical

Training objective	Audience for Training	Outcomes
Staff fully trained on application of bait traps	All staff taking part in dispersing bait trap	Bait traps successfully applied and exotic fruit flies reduced
Safe handling of chemical	Staff responsible for mixing of insecticides Personnel handling the block baits	insecticide handled safely No cross contamination of chemicals
Staff understand Fruit fly life cycle	All staff	Understand fruit fly cycle and able to determine when flies are at a mature stage
Data recording	Staff carrying out surveillance trapping	Clear data of surveillance traps recorded

FRUITFLY EMERGENCY RESPONSE STRUCTURE



FRUITFLY EMERGENCY RESPONSE FLOW CHART



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APPENDIX I FRUIT FLY LIFE CYCLE

Members of tephritidae undergo complete metamorphosis and pass through the following stages:

- Egg
- Larva (caterpillar)
- Pupa
- Adult (fly).

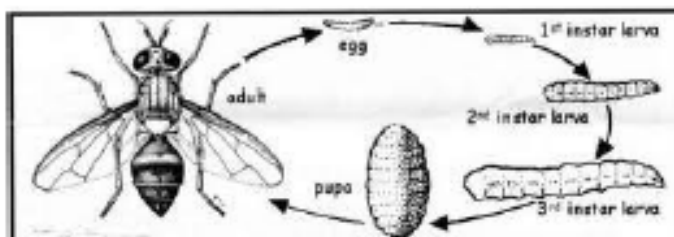


Figure 1: General fruit fly life cycle (Chris Lambkin)

Plant Health Australia describes the life cycle in the fruit fly handbook based on many studies of Queensland Fruit fly. This is consistent with a US study of 53 species of *Bactrocera* fruit flies.

The general life cycle is described as follows:

- Adults mate, usually in the foliage of plants surrounding or near the host but not necessarily on the host.
- Eggs are deposited (using an ovipositor) just under (3mm) the flesh of the favoured host fruit for the species. They are generally white, banana shaped and approximately 1mm in length. Infested fruit may show 'sting' marks on the skin and may be stung more than once by several females.
- In a short period of time, usually a few days, larvae hatch and begin to consume the fruit in which they find themselves. To the naked eye, the larvae resemble blowfly maggots. They are creamy white, legless, blunt-ended at the rear and tapered towards the front where black mouth hooks are often visible.
- The larvae develop through three larval stages to become about 9 mm long and pale yellow when fully grown.
- After an additional number of days ranging between 4 and 12, the larvae drop from the fruit and become pupae in the soil. The mature larvae can 'jump' by curling into a 'U'-shape and then rapidly straightening.
- Adult flies emerge 7-10 days later (although this can extend to several weeks in cooler conditions) from their pupal cases in the soil and burrow towards the surface where they inflate their wings and fly away.
- The adult flies congregate on foliage and fruit to feed on bacterial colonies for about a week before sexually maturing and mating. Adults may live for many weeks with females continuing to lay eggs throughout their lifecycle.

(Margosian *et al* 2007)





Fact Sheet: Oriental Fruit Fly (*Bactrocera dorsalis*)

Bactrocera dorsalis is a major economic pest and utilises a wide range of commercial, edible and rainforest fruits. Found mainly in Asia it's mainly restricted to the tropical and sub-tropical regions. Eggs won't hatch below 13°C so is restricted largely to the northern, summer climate in New Zealand.

Assessment of risk

Establishment in NZ	Economic impact	Market Access
Entry pathway	Host range (incl. kiwifruit)	Treatment required
Ease of establishment	Plant health	Area freedom required
Ease of detection	Crop productivity	Movement control
Ease of eradication	Crop protection	Quarantine requirements

Key: ■ High risk ■ Moderate/unknown risk(?) ■ Low risk

Description & Life cycle

The adult, is noticeably larger than a house fly, has a body length of about 8.0 mm and wing length about 7.3 mm. The colour of the fly is very variable, but there are prominent yellow and dark brown black markings on the thorax.



The ovipositor is very slender and sharply pointed. Eggs are laid below the skin of the host fruit. These hatch within a day (although delayed up to 20 days in cool conditions). The egg is white, elongate and elliptical measuring about 1.2 mm.



The third instar, which is a typical maggot in appearance, is about 10 mm in length and creamy white. The larvae feed for another 6-35 days, depending on seasonal temperatures, before dropping to the soil to form a tan to dark brown puparium about 5 mm in length. Adults emerge after 1-2 weeks.



Distribution

Found mainly in Asia, OFF is widespread throughout much of Pakistan, India, Sri Lanka, Myanmar, Indonesia, Malaya, Thailand, Cambodia, Laos, Vietnam, southern China,

Taiwan, Philippine Islands, Ryukyu Islands (including Okinawa), Micronesia, Mariana Islands (Guam, Rota, Saipan, Tinian), Bonin Islands, and Hawaiian Islands.

It has been introduced to Palau, Hawaii, Nauru and Tahiti, and has been eradicated from southern Japan (Ryukyu Is) and Mauritius.

Host & Climatic Range

The oriental fruit fly has been recorded from more than 150 fruit and vegetables, including citrus, guava, mango, papaya, avocado, banana, loquat, tomato, surinam cherry, rose-apple, passion fruit, persimmon, pineapple, peach, pear, apricot, fig, and coffee. Avocado, mango, and papaya are the most commonly attacked.

Is a high priority pest identified for: Apple/Pears, Avocado, Banana, Citrus, Summerfruit, Tropical fruit and Vegetables

OFF is mainly found in warmer, tropical areas. Eggs will not develop at temperatures below 13°C, although the adult fly may be able to cope with colder temperatures.

Impacts

The damage to crops caused by OFF result from, oviposition in fruit and soft tissues of vegetative parts of certain plants, feeding by the larvae, and decomposition of plant tissue by invading secondary microorganisms. Larval feeding damage in fruits is the most damaging.

In addition to physical damage OFF inflicts economic damage due to costs associated with quarantine and monitoring programmes, limits on exports from fruit fly infested areas and quarantine treatments of fruits from fruit fly infested areas.

Dispersal ability	Ease of detection	Ease of Eradication
<p>Adult flies can disperse over long distances through flight. There is evidence that OFF adults can fly at least 50 - 100 km.</p> <p>The transport of larvae in infested fruit can result in global movement, giving these flies an extreme risk rating.</p>	<p>OFF can be monitored by traps baited with male lures. Males are attracted to Methyl eugenol (O-methyl eugenol) at a range of up to 1 km</p>	<p>Ripe host fruits need to be destroyed.</p> <p>A cover and bait spray combination can be used.</p> <p>OFF was eradicated from northern Japan using Methyl eugenol bait/kill traps.</p> <p>Sterile insect release can work to control population growth.</p>

NOTE: There are a number of other flies in the Bactrocera family that are very similar in appearance, but differ in their ranges and specificity around host plants.

[Bactrocera correctae](#), guava fruit fly

[Bactrocera invadens](#)

[Bactrocera cucurbitae](#), melon fly

Fact Sheet: Queensland Fruit Fly (*Bactrocera tryoni*)



QFF is a very serious pest of a wide variety of fruits and some vegetables and is a particular threat to the northern parts of NZ. Damage levels can be up to 100% of unprotected fruit and being indigenous to Australia the trade is in a similar crop maturity time zone to New Zealand.

Assessment of risk

Establishment in NZ		Economic impact		Market Access	
Entry pathway	High risk	Host range (incl. kiwifruit)	Moderate/unknown risk(?)	Treatment required	Moderate/unknown risk(?)
Ease of establishment	Moderate/unknown risk(?)	Plant health	Moderate/unknown risk(?)	Area freedom required	Moderate/unknown risk(?)
Ease of detection	Moderate/unknown risk(?)	Crop productivity	High risk	Movement control	Moderate/unknown risk(?)
Ease of eradication	Moderate/unknown risk(?)	Crop protection	High risk	Quarantine requirements	High risk

Key: ■ High risk ■ Moderate/unknown risk(?) ■ Low risk

Description & Life cycle

The adult female is approximately 6-8 mm long, has a wing expanse of 10 to 12 mm, and has mostly transparent wings marked with brown. The fly is reddish brown with yellow markings.



The abdomen is constricted at the base, flared in the middle, and broadly rounded at the tip excluding the ovipositor in females. Adults can live for many weeks. Female flies usually mate once or twice. Male flies mate multiple times.



QFF lay eggs in maturing and ripe fruit on trees and sometimes in fallen fruit. Females can lay several hundred eggs during her lifetime. Eggs are small (< 1 mm long), white in colour and banana shaped.



When fully grown larvae are about 6 to 8 mm long and pale yellow. Larvae feed for 10 - 31 days on the host fruit, before dropping to the soil to pupate.



QFF numbers tend to increase in spring when temperatures are warm and there is ready availability of suitable host fruit. Under favourable conditions one generation takes about four weeks.

Distribution

QFF is indigenous only to Australia, but like other *Bactrocera* spp. is known by experience to have the potential to establish adventive populations in various other tropical areas. It is the major fruit fly pest species in eastern Australia and is the target of major control and quarantine programmes

It occurs in large populations throughout eastern Australia from Cape York (Queensland) to East Gippsland (Victoria). It is also established in New Caledonia and the Austral Islands.

Host & Climatic Range

QFF can attack a wide range of fruit, fruiting vegetables and native fruiting plants. The main hosts are mostly tree fruits: avocados, plums, mangoes, peaches, citrus, passionfruit.

QFF is found in warmer areas of Australia, but has been found in Tasmania (similar climate to NZ). The adult fly may be able to cope with colder temperatures. QFF are most active in warm humid conditions and after rain. QFF might be seen walking on the undersides of leaves or on maturing fruit. They readily take flight if disturbed

Impacts

Large numbers commonly occur in Australia in March and April at a similar time that many fruit crops are maturing in New Zealand.

The damage to crops caused by QFF result from, oviposition in fruit and soft tissues of vegetative parts of certain plants, feeding by the larvae, and decomposition of plant tissue by

invading secondary microorganisms. Larval feeding damage in fruits is the most damaging.

In addition to physical damage QFF inflicts economic damage due to costs associated with quarantine and monitoring programmes, limits on exports from fruit fly infested areas and quarantine treatments of fruits from fruit fly infested areas.

Dispersal ability	Ease of detection	Ease of Eradication
<p>There is evidence that Queensland Fruitfly adults can fly at least 50 - 100 km.</p> <p>Dispersal of larvae also occurs in (usually ripe) host fruit.</p>	<p>QFF can be monitored by traps baited with male lures. Males are attracted to Cue lure (4-(p-acetoxyphenyl)-2-butanone) or a mixture of methyl eugenol and cue lure are effective at a range of up to 1 km</p> <p>QFF is also attracted to wet food lures such as protein and citrus juice although these lures are less effective.</p>	<p>Ripe host fruits need to be destroyed.</p> <p>A cover and bait spray combination can be used.</p>



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Oriental Fruit Fly invasion in the Cook Islands



Oriental fruit fly (OFF) was first noticed in Rarotonga on 9th of May 2013 when 22 male adult flies were intercepted at one of the male annihilation Methyl Eugenol (ME) lure traps installed on 27th April 2013 around Rarotonga. The suspected exotic fruit fly was collected and then referred to Dr. Maja Poeschko, Entomologist, Ministry of Agriculture (MOA) who viewed the flies under a stereo microscope and based on morphological characteristics identified the flies as the Oriental fruit fly species, *Bactrocera (dorsalis) dorsalis* (Hendel).

Subsequently, five males of the discovered fruit fly were sent to New Zealand Ministry of Primary Industry, Plant Health Entomology Laboratory (PHEL) on 20th May 2013 for further taxonomic analysis and confirmation. The NZ MPI PHEL referred the specimens to Dr. Richard Drew at Griffith University for morphological and molecular analysis. The results of taxonomic analysis from NZ MPI PHEL and Dr. Drew were relayed back to the Cook Islands government on 28th May 2013 confirming the exotic fruit fly to be indeed the Oriental Fruit Fly, *B. (dorsalis) dorsalis* (Hendel).

OFF is very destructive pest of fruit and vegetables with a host range of over 117 plant species. The pest is native to the Asian continent and prevalent in many Asian countries. Apart from its incursion into the Cook Islands, OFF is also present in Hawaii and French Polynesia. The pest was found in Guam in 1948 and Commonwealth of Northern Mariana Islands in 1936 but was subsequently eradicated from both these territories in 1965. The pest was eradicated from Nauru in 1999.

Immediately after intercepting OFF in Rarotonga, MOA intensified fruit fly trapping throughout the island group to determine the full extent of the pest occurrence and population

density. About 10 traps were sent to each of the other islands.

In Rarotonga traps were installed about every half a km around the coast. Results of weekly trap clearances confirmed OFF presence in four coastal locations. At these 'hotspots' a systems approach of intensified trapping was initiated. Sixteen traps were placed within 250 meter radius and another set within a 500 meter radius as buffer zone.

Trap catch cleared on 28th May 2013 from Aitutaki recorded a high population of OFF from traps placed a week earlier. As of 7th June, the results of trap surveillance clearances from all the islands of Cook Islands confirmed that OFF was only present in Rarotonga and Aitutaki.

Three methods of eradication for OFF have started for Rarotonga - crop hygiene and sanitation, male annihilation blocks and protein bait spraying. A similar eradication campaign for Aitutaki will soon start pending arrival of supplies.



For further information, contact Dr. Maja Poeschko, Entomologist, Ministry of Agriculture, P.O. Box 96, Rarotonga, Cook Islands. Phone: (682) 26720; Fax: (682) 21881; Emaja240961@yahoo.co.nz or Māclea Vagalo, Entomologist, Land Resources Division, Secretariat of the Pacific Community, Private Mail Bag, Suva, Fiji Islands, Phone: (+679) 3379431(d)/3370733 ext 431, Mobile: (+679) 9393355 Fax: (679) 3370021/ 3386326, website: www.spc.int/led

APPENDIX IV KEY PERSONNEL FOR FRUITFLY PROGRAMME

Below is a list of key personnel responsible for the fruit fly monitoring program in the Cook Islands. The following list is to be regularly updated by MOA.

Island	Personnel Address
Rarotonga	<p>HOM Ministry of Agriculture Rarotonga Ph: +682 28711/28710</p> <p>Dr Maja Poeschko Senior Research Officer Ministry of Agriculture Ph: +682 28711/25403</p> <p>Maru Nganu Biosecurity Officer Ministry of Agriculture Ph: +682 28711/28710</p> <p>Biosecurity Office Ph: +682 28711/28710</p>
Aitutaki	<p>Pepe Raela Agriculture/Biosecurity officer Island Administration Ph: +682 31700 Mobile + 682 57513</p>
Mauke	<p>Vaine Keu Agriculture/Biosecurity officer Island Administration Ph: +682 35141</p>
Mitiaro	<p>Tokai Ngaiorae Agriculture/Biosecurity officer Islands Administration Ph: +682 36108</p>
Atiu	<p>Bob Teata Agriculture/Biosecurity officer Island Administration Ph: +682 33269</p>
Mangaia	<p>Nuku Koroa Agriculture/Biosecurity officer Islands Administration Ph: +682 34289</p>
Pehnryn	<p>Tutavake Andrew Agriculture/Biosecurity officer Ph: +682 42100</p>

Palmerston	Taepae Masters Agriculture/Biosecurity officer Island Administration Ph: +682 37620
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