

## Early Detection and Rapid Response Plan for Myoporum Thrips (*Klambothrips myopori*) on Maui



Department of Land and Natural Resources, Division of Forestry and Wildlife  
Maui Invasive Species Committee  
Hawaii Department of Agriculture, Plant Pest Control

## Table of Contents

<b>INTRODUCTION.....</b>	<b>3</b>
<b>BACKGROUND .....</b>	<b>4</b>
Description of pest.....	4
Native and exotic range .....	4
Dispersal potential .....	5
Biological impact.....	6
Ecological impact.....	6
<b>EARLY DETECTION.....</b>	<b>6</b>
Monitoring interval.....	6
Monitoring methods.....	6
Materials list for monitoring .....	7
Monitoring sites .....	7
<b>RAPID RESPONSE.....</b>	<b>8</b>
Communication and delegation of responsibility .....	8
Restrict inter-island transport of naio.....	9
Physical control.....	9
Materials list for physical control .....	9
Chemical control.....	10
Materials list for chemical control .....	10
Delimiting surveys and prophylactic control .....	11
Outreach.....	11
<b>RECOMMENDATIONS.....</b>	<b>11</b>
<b>REFERENCES.....</b>	<b>11</b>
<b>CONTACTS .....</b>	<b>13</b>
<b>APPENDICES.....</b>	<b>14</b>
Appendix A. Hawaii Department of Agriculture specimen submittal form .....	14
Appendix B. Draft letter to landowner or business.....	15
Appendix C. Myoporum thrips field identification handout.....	16
Appendix D. Myoporum thrips field monitoring data sheet.....	18
Appendix E. Table of naio locations on Maui .....	19
<b>LIST OF FIGURES</b>	
Figure 1. Adult <i>Klambothrips myopori</i> .....	4
Figure 2. Immature <i>Klambothrips myopori</i> .....	4
Figure 3. Curled and galled naio.....	5
Figure 4. Beginning of leaf dieback.....	5
Figure 5. Map of naio populations on Maui.....	8
Figure 6. Flowchart of protocol for detection and control .....	12

## I. INTRODUCTION

Myoporum thrips or naio thrips (*Klambothrips myopori*) is a recent invader to Hawaii. This insect pest was first detected in California in 2005, where it has caused high levels of mortality in ornamental *Myoporum* species used for landscaping in residential areas, parks and along road margins. The pest was first detected in Hawaii in 2008 attacking the native *Myoporum sandwicense*, locally known as naio. Hawaii Department of Agriculture (HDOA) was notified in February 2009, and subsequently initiated delimiting surveys to assess the extent of the infestation. Based on initial surveys it was determined that the pest was widely distributed across West Hawaii, but was not yet present on any other islands. HDOA moved to restrict the inter-island transport of all naio in May 2009. The restriction has subsequently been amended to restrict the movement of naio from Hawaii Island, but allow transport between islands where myoporum thrips are not yet present. To date, the distribution of myoporum thrips in the State remains restricted to Hawaii Island.

While naio is most dominant in dry forests, and lowland and upland shrublands, the species also populates mesic and wet forest habitats as well as coastal strand communities. Naio is distributed across all of the main Hawaiian Islands, and is present from sea-level to upwards of 3000 meters. The loss of this species would represent a significant biological and structural loss to native forest habitats. The decline or extinction of naio would be a cultural loss as well, as the wood of naio was utilized by native Hawaiians for purposes including, but not limited to, ornamental pieces and gunwales on outrigger canoes, house posts, fishing net spacers, and long-burning torches for night fishing.

Given their small size and documented ability to be transported over long-distances as a result of both natural and human-mediated causes, there is a high likelihood that myoporum thrips will further disperse within the State. The purpose of developing an early detection and rapid response plan for myoporum thrips is to increase awareness of this destructive pest, as well as provide protocol guidance, organization and facilitate cooperation between the following agencies and land managers: Department of Land and Natural Resources (DLNR), Hawaii Department of Agriculture (HDOA), Maui Invasive Species Committee (MISC), National Park Service (NPS), and United States Fish and Wildlife Service (USFWS), The Nature Conservancy (TNC), and Maui Land and Pineapple (MLP).

Each agency or organization will be responsible for monitoring select naio populations. This division of labor will decrease the workload of any single agency or organization and increase the monitoring focus from any one population. This plan outlines specific early detection and monitoring methods to increase the likelihood of detection in the event myoporum thrips are introduced to the island of Maui, as well as rapid response protocols to increase the likelihood the pest will be contained or eradicated once it is detected.

It is necessary to assume pest detection so that a rapid response plan can be implemented, assuring the best probability toward pest eradication. Partners will have the ability to initiate a rapid and coordinated response, using both physical and chemical control methods, with the goal of eradicating myoporum thrips, and protecting Maui's naturally occurring naio populations.

## II. BACKGROUND

### A. Description of pest

*Klambothrips myopori* (Thysanoptera: Phlaeothripidae) are referred to as myoporum thrips or naio thrips. The insect is narrow, dark brown to black, approximately 2-2.5 mm, with fringed wings and a long posterior tube (Figure 1). It is a gall-inducing thrips, which causes damage to plants as a result of feeding with cone-like mouthparts. Immature thrips are shaped like the adults but vary in appearance from white to orange and are wingless (see Figure 2). Eggs are small, milky, and oblong in shape, and difficult to observe without magnification.



Figure 1. Adult *Klambothrips myopori*.



Figure 2. Immature *Klambothrips myopori*.

### B. Native & exotic range

To date myoporum thrips have only been documented from California, Hawaii and Tasmania. Myoporum thrips were first discovered in Southern California in 2005 and were linked to extensive damage of landscape and nursery stock of *Myoporum laetum*, a species that is not native to California. The thrips was undescribed prior to its detection in California; a species description was prepared and published in 2007 based on that discovery.

Myoporum thrips were detected on Hawaii Island in December 2008. Given their wide distribution, and naio mortality observed at that time, it is likely the species was present on Hawaii Island for several years prior to their initial identification. The pest has infested the north and west side of Big Island and is slowly spreading to the south and east. Survey data and observations of naio mortality indicate that the center of the infestation is in the saddle area between Mauna Kea and Mauna Loa, where naio is a key component of the native plant community.

Recent molecular data analyses have determined that myoporum thrips are native to Tasmania. Survey entomologists visited sites across Australia and New Zealand, and sampled thrips species on *Myoporum insulare*, a host plant native to the region. Molecular analyses confirm that California and Hawaii populations are closely related to one another, as well as to the population sampled in Tasmania.

### C. Dispersal potential

The presence of *Klambothrips myopori* in Tasmania, demonstrates a history of successful dispersal across the 200-mile Bass Strait. This precedent indicates that the species is likely capable of naturally dispersing across the Hawaiian Islands as well. Wind dispersal of the species is common, and it is possible that myoporum thrips could spread from its current range on Hawaii Island to Maui via wind. The Alenuihaha Channel which separates Hawaii Island from Maui is just 30 miles wide. This pathway of introduction would be optimal in the absence of prevailing trade winds, when southerly winds (Kona winds) are dominant.

Myoporum thrips are not merely at risk of being moved naturally via wind, they are at risk of being moved through unintentional transport by people on plants and goods. The distribution of infested nursery stock played a role in the establishment of myoporum thrips at sites across Hawaii Island. Naio out-plants in the city of Hilo were found to be infested early in 2009 due to the transportation of infested nursery stock from nurseries in Waimea.

At this time, human mediated transport is the most likely pathway by which the species will disperse to Maui. Given the number of visitors and residents who travel inter-island daily, as well as the continuous shipment of nursery plants and goods between islands, there exists a significant risk for transport and establishment of this pest species. Oahu is the epicenter for transport in the State, and the frequent movement of people and goods from Hawaii Island to Oahu, and from Oahu to Maui provides a pathway for myoporum thrips dispersal. HDOA is enforcing a 2009 suspension of inter-island certification for naio plants being transported from Hawaii Island. However naio plants are still being grown by some Hawaii Island horticulturalists and it is possible that the pest could be transported inadvertently on plant species other than naio, if infested naio plants were grown in close proximity and then exported for sale by Maui distributors.

The risk of introduction by natural resources personnel, hunters and/or members of the National Guard working and training on Hawaii Island has been identified as another pathway for potential introduction of myoporum thrips to Maui.



**Figure 3. Curled and galled naio.**



**Figure 4. Beginning of leaf dieback.**

#### D. Biological impact

Adult and immature myoporum thrips feed on foliage, causing leaf distortion and inducing the development of leaf-galls on host plants. Leaf curls/folds create protected areas in which the pest can feed and reproduce. Heavy infestations result in leaf curling, branch dieback, defoliation and host plant mortality (see Figure 3 & 4).

#### E. Ecological impact

High levels of infestation and mortality have been observed at Hawaii Island monitoring sites over the last three years. Mortality rates have been increasing each year, ranging from 30-50%. And mortality of naio has been documented at over 90% at select sites.

If myoporum thrips were to become established on Maui, it is likely that an infestation by the pest would result in comparable damage to Maui naio populations. As on Hawaii Island, ornamental naio out-plantings are included in landscape plantings on commercial properties, at resorts, and in some residential areas. Naio occurs in lower densities in native habitats on Maui than Hawaii Island. While this could initially slow the dispersal of the pest, die back and mortality are still likely to result, and the probability of local extirpations of naturally occurring naio may increase.

Dieback and mortality of naio will necessarily impact the native fauna that rely on naio for food and/or habitat. Naio is a host to many insect herbivores, seed predators, borers and pollinators. Species that specialize on naio are at particular risk. However even species such as yellow-faced bees, which do not use the plant exclusively, but forage on it as a year-round nectar source, are likely to be adversely impacted.

### III. EARLY DETECTION

#### A. Monitoring interval

It will be the responsibility of each agency to monitor designated naio populations for myoporum thrips (Figure 5, Table 1). Not every agency will have access to the same resources, therefore monitoring intervals may vary. Naio populations should be monitored quarterly, or at a minimum of twice per year.

#### B. Monitoring methods

- 1) Visit monitoring sites at scheduled intervals (quarterly, semi-annually - to be determined by responsible agency/organization)
- 2) Visually inspect all naio present, OR a subset of naio plants (10 individuals in a given area), depending on the number of naio present at each site
- 3) Examine a minimum of 20 branches/leaf terminals on each plant for evidence of myoporum thrips presence
  - Curled and/or bumpy leaves, terminal dieback, or dead branches are all common indications of thrips presence

- Chlorotic (yellowing/browning) leaves, or leaves that are limp, dead or dying but have no curls or bumps are not indicative of thrips damage
- 4) If myoporum thrips presence or damage is suspected:
  - Refer to Myoporum thrips field identification handout (Appendix D)
  - Photograph the suspected damage
  - Collect a sample and place in a sealed ziplock bag or otherwise secure container
  - The sample should include the terminal branch where damage has been observed, and/or individual thrips
- 5) Every sample submitted for identification will be accompanied by the HDOA “Specimens Submitted for Identification” form (Appendix A)
- 6) Contact DLNR-DOFAW, MISC and HDOA to inform of possible detection
- 7) If myoporum thrips are confirmed, follow protocol outlined in Figure 6.
- 8) If naio thrips are not detected, submit monitoring datasheets to DLNR-DOFAW Entomologist and/or Forest Health Specialist for data entry and management.

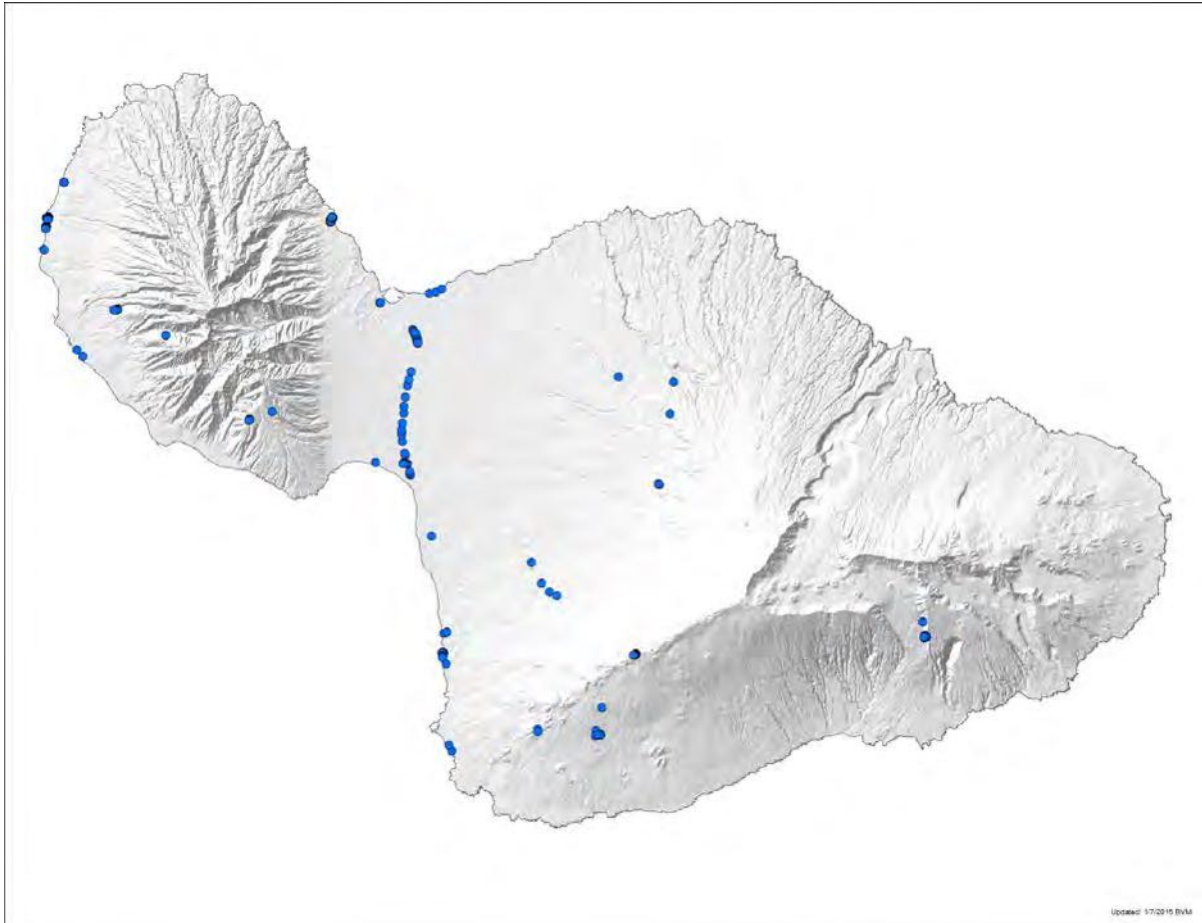
#### Materials list for naio monitoring

- 1) Datasheets
- 2) Hand clippers
- 3) Camera
- 4) Ziplock sealable sandwich bags
- 5) GPS

#### C. Monitoring sites

It is not possible to predict where myoporum thrips will first become established on Maui. Areas such as airports and ports, which support high human and cargo traffic, frequently serve as initial points of infestation for new pest species. However on Hawaii Island it appears that myoporum thrips initially became established in an interior, natural area with limited access, therefore even more remote natural area sites are important monitoring targets.

Monitoring sites have been identified on Maui based on the presence of either out-planted or naturally occurring populations of naio. Businesses that may sell or transport potted naio plants have also been identified for monitoring. Each site has been assigned a priority level (1, 2, 3), to indicate the likelihood of infestation, and monitoring priority. Those that rank highest (1) are near potential entry sites such as ports and military bases; rank 2 sites are other easily accessible sites and important natural areas; and 3 are remote and isolated populations not likely to be sites of early introductions.



**Figure 5. Distribution of known naio populations on Maui.**

#### **IV. RAPID RESPONSE**

##### **A. Communication and delegation of responsibility**

Once confirmed, the agency who detects the myoporum thrips will be responsible for notifying all other partner agencies (refer to Section V. Contacts).

If myoporum thrips are detected in a:

- 1) nursery or landscape planting, MISC will take responsibility as lead agency
- 2) forest or natural area (non-federal lands) DLNR will take responsibility as lead agency
- 3) USFWS Refuge, USFWS will take responsibility as lead agency in consultation with DLNR and MISC
- 4) NPS lands, NPS will take responsibility as lead agency in consultation with DLNR and MISC
- 5) Private landowners will consult with DLNR and MISC



### B. Restrict inter-island transport of naio from Maui

In the event myoporum thrips are confirmed on Maui, DLNR-DOFAW will submit a written request to the HDOA Administrator to immediately suspend the inter-island movement of naio plants from Maui. The temporary ban on inter-island movement of naio plants should be enforced pending the completion of delimiting surveys to assess the distribution of the pest.

If it is determined that myoporum thrips are widely established on Maui, and control measures are unlikely to be successful, HDOA could propose an interim rule to formalize the ban. If it appears that the infestation is localized and eradication is an option, the temporary HDOA ban will remain in place until after eradication efforts are determined to have been successful.

### C. Physical control

Plants less than 2 meters in height which are confirmed to host myoporum thrips will be immediately targeted for removal. If permission is obtained from the landowner, plants will be cut and vegetation will be bagged and removed for disposal.

- 1) Spray infested plants liberally with insecticidal soap or oil (ex. Safer® Brand Insect Killing Soap or Safer® Brand BioNEEM Insecticide/Repellent). Focus the spray on areas suspected to be infested, and leaf terminals closest to the apical meristem where myoporum thrips tend to aggregate.
- 2) Carefully clip off branches suspected to be infested with myoporum thrips and place them in durable garbage bags.
- 3) When all infested vegetation has been removed, cut and pack the remainder of the vegetation into durable garbage bags for disposal.
- 4) Ensure that bags containing infested vegetation are carefully sealed, and handled/transported with care to reduce likelihood of the bags ripping or tearing.
- 5) Bags containing infested material can be transported to the Maui Invasive Species Committee office (located at 820 Piihola Road, Makawao, HI 96768), where material will be frozen for 1 week.
- 6) Where possible, individuals who conduct removal efforts for infested naio should change into clean clothing immediately following project completion. Clothing worn during naio removal should be bagged and laundered (washed and dried in a dryer) before being worn again to any field site.

Materials list for physical control:

- 1) Insecticidal soap or oil
- 2) Rubber or latex gloves
- 3) Hand clippers
- 4) Loppers
- 5) Durable garbage bags
- 6) Change of clothing

#### D. Chemical control

Naio plants may be chemically treated prior to assessing removal options, or as an alternative to removal options if 1) the area of infestation is extensive, 2) permission is not given to remove the infested plants, or 3) the naio is located in a natural area.

- 1) Myoporum thrips confirmed to be present in a **landscape planting** (ornamentals, commercial, industrial, institutional and recreational areas including athletic field and parks). Plants should be treated with both a soil drench and a foliar spray.
  - Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray
  - Allectus (Imidacloprid+Bifenthrin) may be applied as a soil drench and/or as a foliar spray
  
- 2) Myoporum thrips confirmed to be present in a **nursery**:  
Plants should be treated with both a soil drench and a foliar spray.
  - Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray
  
- 3) Myoporum thrips confirmed to be present in a **natural area**:  
Plants should be treated with both a soil drench and a foliar spray.
  - Safari (Dinotefuran) may be used as a soil drench and/or as a foliar spray, but may not be used when a naio plant is flowering.

Individuals who conduct control efforts for infested naio should change into clean clothing immediately following treatment. Clothing worn during naio treatment should be bagged and laundered (washed and dried in a dryer) before being worn again to any field site.

Following treatment, sites should be checked weekly for evidence of myoporum thrips presence to assess efficacy of treatment, and determine whether further action is needed (ex. physical removal of the plant or treatment with non-restricted insecticidal soaps or oils). Systemic insecticides will be reapplied per label specifications, two weeks following the initial treatment. Research suggests that successful systemic insecticide treatments kept plants free of naio thrips for 60 days, therefore plants should be checked weekly until 60 days post treatment(s), at which point control options will be reassessed.

Materials list for chemical control:

- 1) Insecticide
- 2) Water
- 3) Sprayer/pesticide applicator
- 4) Personal protective equipment (eyewear, long-sleeves, gloves, closed toed shoes)
- 5) Durable garbage bags
- 6) Change of clothing

#### E. Delimiting surveys and prophylactic control

Immediately following the detection and confirmation of myoporum thrips on Oahu, delimiting surveys of naio plants will be conducted within a 3-mile radius of the known point

or area of infestation. Where possible, surveys may also be completed to assess naio populations outside this radius. If the pest is confirmed to be present at additional sites, the surveys will expand accordingly across the island.

If permissions are obtained, naio plants within the 3-mile radius buffer zone will be treated with a systemic insecticide to prevent the establishment of myoporum thrips that may still be present in the area. These naio populations will also be monitored (every two weeks?) following treatment. Further control options will be assessed at 60 days post treatment, and will be determined based on the efficacy of control measures implemented in the area of infestation.

#### F. Outreach

Outreach must be conducted to inform landscapers, horticulturalists, nurseries and other businesses that handle naio plants. Outreach could be conducted in person through site visits, and/or by sending a notice to the individual or business (Appendix C).

## V. RECOMMENDATIONS

Continue to survey for additional naio populations on Maui

Hold annual meetings to revisit Early Detection and Rapid Response Plan with partners and relevant staff

## VI. REFERENCES

Bethke, J. A. and D. A. Shaw (2008). Myoporum thrips control. University of California Cooperative Extension San Diego County. [www.smgrowers.com/info/Myoporum.pdf](http://www.smgrowers.com/info/Myoporum.pdf)

Bethke, J. A., D.A. Shaw, D. Li, M.Whitehead, and B.V. Mey (2011). Winter 2011: Regional Report: Biology and Control of the Myoporum Thrips. University of California Nursery and Floriculture Alliance News.  
[http://ucanr.edu/sites/UCNFANews/Regional\\_Report\\_San\\_Diego\\_and\\_Riverside\\_Counties/Winter\\_2011\\_Regional\\_Report\\_Biology\\_and\\_control\\_of\\_the\\_myoporum\\_thrips/](http://ucanr.edu/sites/UCNFANews/Regional_Report_San_Diego_and_Riverside_Counties/Winter_2011_Regional_Report_Biology_and_control_of_the_myoporum_thrips/)

Mound, L.A. & Morris, D.C. 2007. A new pest of *Myoporum* cultivars in California, in a new genus of leaf-galling Australian Phlaeothripidae (Thysanoptera). *Zootaxa*. 1495 : 33–45.

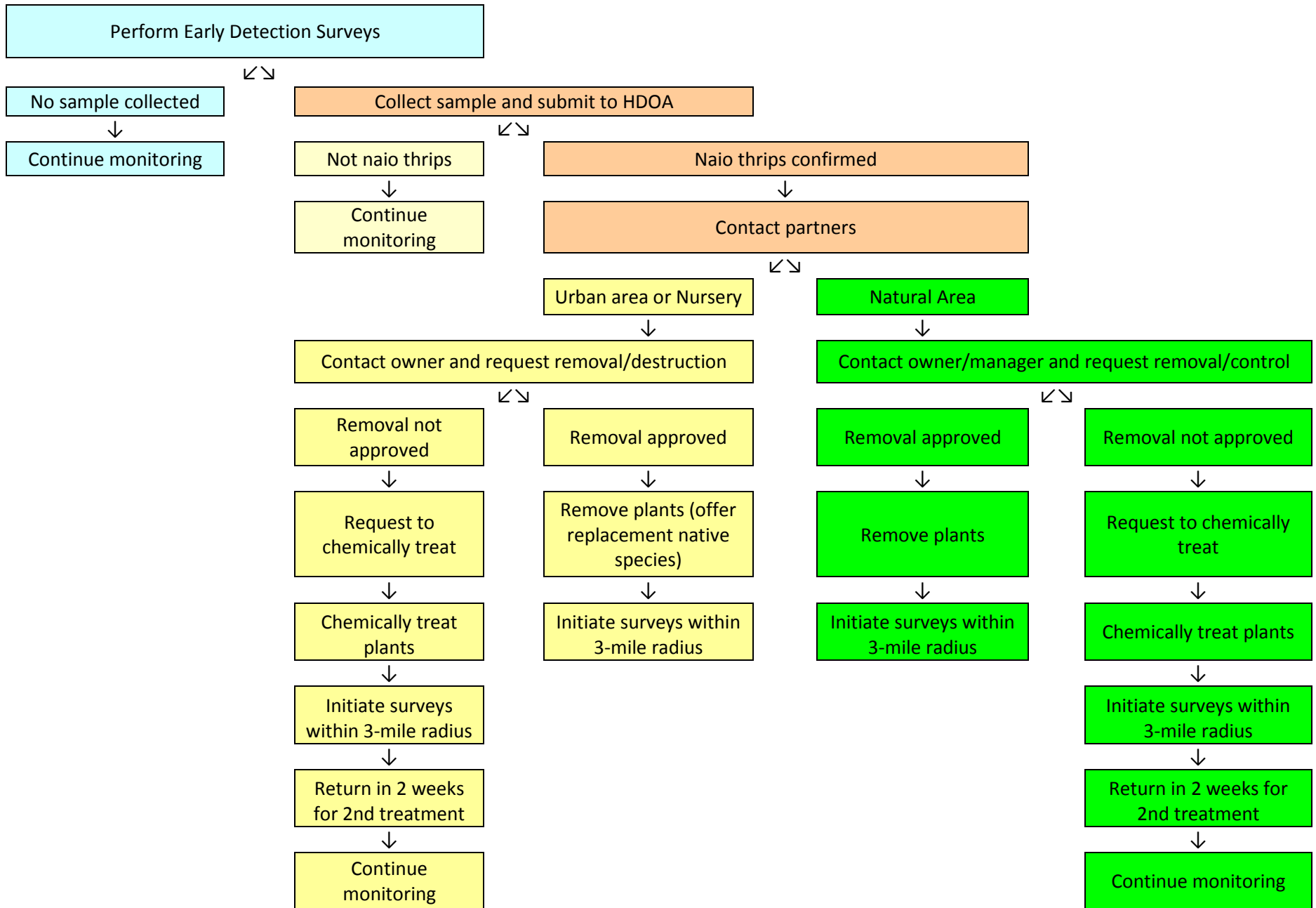


Figure 6. Flowchart explaining the protocol for naio thrips monitoring, detection, and eradication.

## VII. CONTACTS

### **Department of Land and Natural Resources, Division of Forestry and Wildlife**

Cynthia King: Entomologist, (808) 640-8687, [cynthia.b.king@hawaii.gov](mailto:cynthia.b.king@hawaii.gov)  
 Robert Hauff: Forest Health Coordinator, (808) 587-4174, [robert.d.hauff@hawaii.gov](mailto:robert.d.hauff@hawaii.gov)  
 Scott Fretz: Maui Branch Manager, [scott.fretz@hawaii.gov](mailto:scott.fretz@hawaii.gov)  
 Lance DeSilva: Maui Forestry Manager, [lance.k.desilva@hawaii.gov](mailto:lance.k.desilva@hawaii.gov)  
 Bryon Stevens, NARS Specialist, [bryon.stevens@hawaii.gov](mailto:bryon.stevens@hawaii.gov)

### **Hawaii Department of Agriculture**

Neil Reimer: Plant Industry Administrator, [Neil.J.Reimer@hawaiiomt.onmicrosoft.com](mailto:Neil.J.Reimer@hawaiiomt.onmicrosoft.com)  
 Amy Takahashi, Plant Quarantine Branch Chief, [Amy.N.Takahashi@hawaii.gov](mailto:Amy.N.Takahashi@hawaii.gov)  
 Mach Fukada: Maui Entomologist, (808) 873-3949

### **Maui Invasive Species Committee**

Teya Penniman: MISC Manager, [misc@hawaii.edu](mailto:misc@hawaii.edu)  
 Adam Radford: MISC Operations Manager, (808) 573-6472, [aradford@hawaii.edu](mailto:aradford@hawaii.edu)  
 Brooke Mahnken: MISC Operations/GIS Specialist, [mahnken@hawaii.edu](mailto:mahnken@hawaii.edu)

### **US Fish and Wildlife Service**

Josh Fisher: Invasive Species Biologist, (808) 792-9452, [Joshua\\_Fisher@fws.gov](mailto:Joshua_Fisher@fws.gov)  
 Mike Richardson: Entomologist, (808)792-9448, [Mike\\_Richardson@fws.gov](mailto:Mike_Richardson@fws.gov)  
 Jared Underwood: [jared\\_underwood@fws.gov](mailto:jared_underwood@fws.gov)

### **National Park Service**

Raina Kaholoaa: [Raina\\_Kaholoaa@nps.gov](mailto:Raina_Kaholoaa@nps.gov)  
 Patti Welton: [patti\\_welton@nps.gov](mailto:patti_welton@nps.gov)

### **Plant Extinction Prevention Program**

Hank Oppenheimer, [hmo3500@earthlink.net](mailto:hmo3500@earthlink.net)

### **The Nature Conservancy**

Pat Bily, [pbily@tnc.org](mailto:pbily@tnc.org)

### **Hawaiian Islands Land Trust**

James Crowe, [james@hilt.org](mailto:james@hilt.org)

### **Starr Environmental**

Forest and Kim Starr, [fstarr@hawaii.edu](mailto:fstarr@hawaii.edu)

### **ADDITIONAL CONTACTS:**

Maui Botanical Gardens  
 West Maui Mountains Watershed Partnership  
 Leeward Haleakala Watershed Partnership  
 East Maui Watershed Partnership

Maui Association of Landscape Professionals  
 Maui Outdoor Circle

VIII. APPENDICES

Appendix A. Hawaii Department of Agriculture specimen submittal form

<p>PPC-24 6/09</p> <p style="text-align: right;">Collection # _____</p> <p style="text-align: center;"><b>Specimens Submitted for Identification</b></p> <p style="text-align: center;">Hawaii State Dept. of Agriculture, Plant Pest Control Branch</p> <p>Island/State/Country: _____</p> <p>Location: _____</p> <p>Collected by: _____ Date: _____</p> <p>Submitted by: _____ Date: _____</p> <p>Habitat: _____</p> <p>Host (Scientific Name): _____</p> <p>Host (Common Name): _____</p> <p>Plant Part Affected:</p> <p><input type="checkbox"/> Foliage <input type="checkbox"/> Fruit <input type="checkbox"/> Flower <input type="checkbox"/> Seeds <input type="checkbox"/> Stem <input type="checkbox"/> Trunk <input type="checkbox"/> Roots</p> <p>Plant Symptoms: _____</p> <p>Degree of Infestation: <input type="checkbox"/> Light <input type="checkbox"/> Medium <input type="checkbox"/> Heavy</p> <p>Insect Stage Collected: <input type="checkbox"/> Immature <input type="checkbox"/> Pupa <input type="checkbox"/> Adult</p> <p>Notes: _____</p>	<p>Order: _____ Family: _____</p> <p>Genus/Species/Author: _____</p> <p>Common Name: _____</p> <p>Det. by: _____ Date: _____</p> <p>No. of specimens to be added to collection: Pinned _____ Vials _____ Slides _____</p> <p>New Record: _____ <input type="checkbox"/> Entered in Database</p>
<p>PPC-24 6/09</p> <p style="text-align: right;">Collection # _____</p> <p style="text-align: center;"><b>Specimens Submitted for Identification</b></p> <p style="text-align: center;">Hawaii State Dept. of Agriculture, Plant Pest Control Branch</p> <p>Island/State/Country: _____</p> <p>Location: _____</p> <p>Collected by: _____ Date: _____</p> <p>Submitted by: _____ Date: _____</p> <p>Habitat: _____</p> <p>Host (Scientific Name): _____</p> <p>Host (Common Name): _____</p> <p>Plant Part Affected:</p> <p><input type="checkbox"/> Foliage <input type="checkbox"/> Fruit <input type="checkbox"/> Flower <input type="checkbox"/> Seeds <input type="checkbox"/> Stem <input type="checkbox"/> Trunk <input type="checkbox"/> Roots</p> <p>Plant Symptoms: _____</p> <p>Degree of Infestation: <input type="checkbox"/> Light <input type="checkbox"/> Medium <input type="checkbox"/> Heavy</p> <p>Insect Stage Collected: <input type="checkbox"/> Immature <input type="checkbox"/> Pupa <input type="checkbox"/> Adult</p> <p>Notes: _____</p>	<p>Order: _____ Family: _____</p> <p>Genus/Species/Author: _____</p> <p>Common Name: _____</p> <p>Det. by: _____ Date: _____</p> <p>No. of specimens to be added to collection: Pinned _____ Vials _____ Slides _____</p> <p>New Record: _____ <input type="checkbox"/> Entered in Database</p>

Appendix B. Draft letter to landowner or business requesting permission to survey for myoporum thrips and remove or chemically treat naio plants



STATE OF HAWAII  
DEPARTMENT OF LAND AND NATURAL RESOURCES  
POST OFFICE BOX 621  
HONOLULU, HAWAII 96809

CARTY S. CHANG  
DEPUTY CHAIRPERSON  
BOARD OF LAND AND NATURAL RESOURCES  
COMMISSION ON WATER RESOURCES ADMINISTRATION  
FIRST DEPUTY  
WILLIAM M. TANI  
DEPUTY DIRECTOR - WATER  
AGRICULTURE RESOURCES  
HEALTH AND SOILS REGULATION  
BUREAU OF SOIL SERVICES  
COMMISSION ON WATER RESOURCES ADMINISTRATION  
CONSERVATION AND COLLEGE LANDS  
CONSERVATION AND RESOURCES DEVELOPMENT  
ENVIRONMENT  
FORESTRY AND WILDLIFE  
HISTORIC PRESERVATION  
HAWAIIAN ISLAND RESOURCES COMMISSION  
LAND  
STATE PARKS

DATE (change letterhead if appropriate)

Dear \_\_\_\_\_,

The State of Hawai'i Department of Land and Natural Resources (DLNR), Hawai'i Department of Agriculture (HDOA) and the Maui Invasive Species Committee (MISC) are working to stop the spread of a harmful pest on Maui. We request permission to access your property in LOCATION (TMK X-X-X-XX-X-XX) to survey for the presence of myoporum thrips.

Myoporum thrips are tiny insects which cause enormous damage to naio plants when they feed with their straw-like mouthparts. The pest was found on the Big Island in 2008, and has since caused damage and death of ornamental and naturally occurring naio plants on the Big Island. As a result, many land owners on the Big Island have had to remove naio because treating the plants with insecticides has become too expensive. Plants that are not treated will exhibit curled leaves, branch dieback, and will eventually die. Aside from being a financially costly pest, myoporum thrips threatens the long-term survival of our native naio plants, and death rates of over 90% have been observed in some natural areas.

Myoporum thrips were only recently detected on Maui, and the State has initiated a Rapid Response Plan to prevent the spread of this pest and protect Maui naio. Naio plants infested with myoporum thrips have been found in proximity to your property, and because the thrips can be easily dispersed by wind, the insects may have spread to plants on your property. We ask for your cooperation in allowing DLNR, HDOA, and MISC staff to access your property and survey for this pest. Myoporum thrips are not easily observed, and our technical staff are trained to identify this pest. State law (Hawaii Revised Statutes, Chapter 520A) releases property owners from liability for persons controlling or eradicating invasive species on their property.

If myoporum thrips are found on naio on your property, we also request your cooperation in allowing the physical removal of the plant, or the localized treatment of the plant with an insecticide. Detecting and eliminating myoporum thrips is integral to the success of our rapid response plan. With your help we can protect our native naio, and stop the spread of this destructive insect pest.

Sincerely,

Lisa J. Hadway  
DOFAW Administrator

Appendix C. Myoporum thrips field identification handout





## Damage commonly observed on naio plants (NOT Myoporum Thrips)



**Issue:** Drought is an issue at many sites in dry areas.

**What to look for:** Leaves will droop and/or turn yellow or brown in color.



**Issue:** Other homopteran pests such as aphids, mealybugs, lacebugs and leafhoppers can cause damage to naio.

**What to look for:** Leaf bands or gentle curls often mark the site where feeding has occurred and can be mistaken for myoporum thrips damage. In contrast, myoporum thrips damage is bumpy or pock-marked in appearance.



**Issue:** Several stressors can impact the same plant. A combination of drought and mealy bug damage can be seen in this photo.

**What to look for:** Mealybugs and/or the white waxy substance they exude. Speckles of black sooty mold may also be seen on the naio leaves. This mold commonly grows on mealy bug and leafhopper exudate (waste). Sootymold is not associated with naio thrips.



**Issue:** Lacebugs can experience episodic outbreaks on naio.

**What to look for:** Feeding damage from these insects will cause naio leaves to turn yellow or brown in color, and curl gently. An adult lacebug (top of photo), and white immatures are usually visible on the foliage.

Appendix D. Myoporium thrips field monitoring datasheet.

**Tree**

**Infestation level:** 0 = no galls  
 1 = <1 - 33% galled  
 2 = 34-66 % galled  
 3 = > 66% galled

**Die back:** 0 = no die back  
 1 = <1 - 33% die back  
 2 = 34-66 % die back  
 3 = > 66% die back

**Site:**  
**Date:**  
**Observer:**

	1	2	3	4	5	6	7	8	9	10
Drought										
% tree canopy without black										
natural enemies										
Notes										
Branch number	Infestation	Die back	Infestation	Die back	Infestation	Die back	Infestation	Die back	Infestation	Die back
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

natural enemies: spiders, ladybugs (adults or larvae), lacewing (larva), ant hoco ridae (pirate bug), etc