HISC Grant #C91701/4504214: Detection and Control of Invasive Species on the Island of Hawaii – **Rapid `Ohi`a Death Program**

Final Report to the Hawaii Invasive Species Council

Rapid Ohia Death Detection and Response

Facing down a devastating forest disease, Early Detection Technician and UAV Pilot Dustin Swan takes a moment to appreciate the breathtaking beauty of an `ohi`a lehua in full bloom in the Kohala Mountains.

The threat presented by Rapid `Ohi`a Death (ROD) to the watershed and native ecosystems of Hawaii can hardly be overstated. `Ohi`a is not merely a tree in the forest, it is THE tree, the dominant component of the canopy in critical watershed, and comprising 50% of all trees on the island of Hawaii. Our native forest birds, invertebrates, understory plants, ferns and moss that capture mist & rain to recharge the watershed, all rely on `ohi`a for food, shelter, and support. The ROD EDRR Team is focused on three critical objectives of the 2016 ROD Strategic Response Plan: Surveillance, sampling, and response, with an overall goal of containing new, isolated outbreaks of the disease.

Project funds supported one half of the salary costs of the ROD Project Coordinator, and most non-salary operations costs for the team, while separately awarded DOFAW funds covered the remaining costs of the five-person response team.

Expected Outcomes:

- **Conduct aerial surveys to map new outbreaks and the progression of ROD 4x per year; 1.4 million acres surveyed for ROD by Helicopter, 480 acres by UAV:**

  BIISC surveyed all ohia forests on Hawaii Island 2x and priority areas an additional 2x, using Digital Mobile Sketch Mapping (DMSM) developed by the US Forest Service. 2018 surveys covered approximately 1.4 million acres by helicopter. To avoid duplicate reporting, these acres are not included in the tabular datasheets submitted every six months to HISC, but are logged in the statewide ROD GIS system.

  Unmanned aerial systems have been fully integrated into ROD response efforts, using two primary work flows. The first is to deploy a UAV to spot and obtain a precise GPS coordinate for one or more suspect trees previously identified during aerial surveys. Once

the GPS coordinates are obtained, staff can load the points onto a hand-held device and quickly walk to each suspect tree to obtain a sample. Alternatively, the UAV may be sent along pre-defined transect lines to map out suspect trees across a large area of concern. The imagery collected by the UAV is "stitched" into a precise map of the area, and individual suspect trees can be located form the comfort of the office. The final map can then be used to plan the collection of samples and response operations. UAVs are also being used by partners at UH Hilo to monitor the progression of ROD in several study sites, described below. In 2018 BIISC flew 4,876 acres via UAV in support of the ROD response project.

- **Conduct follow-up sampling to verify ROD presence in suspect trees:**
  Aerial surveys led to sampling of 2,760 trees over the life of the project, by BIISC and agency partners. Due the nature of the pooled multi-agency data, collected via Survey 123, BIISC did not separately track to number of samples contributed by our staff, however BIISC covered an area of 8,918 acres during sampling efforts. In addition to island-wide surveys on private land, BIISC provided field support to Hawaii Volcanoes National Park by assisting with sample collection in the park one week each month.

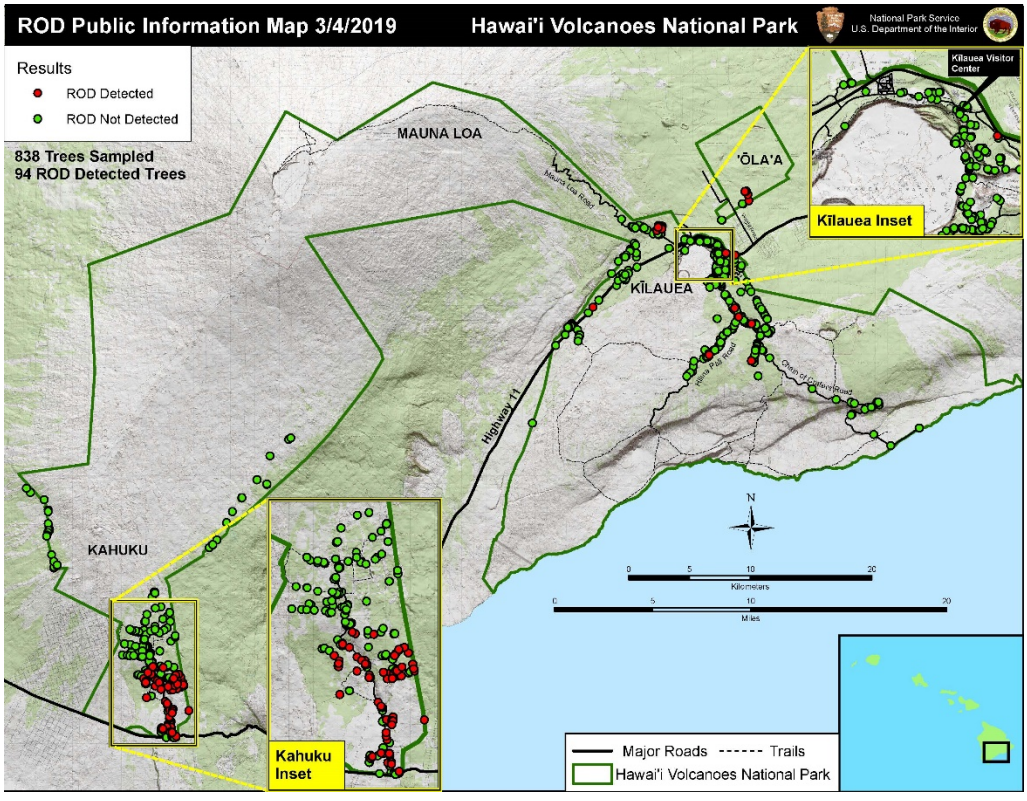

Figure 3: Map of samples collected and tested within Hawaii Volcanoes National Park. Reprinted with permission of HAVO.

- **Test and implement rapid response actions to contain isolated ROD outbreaks where possible:** Currently the recommended action to contain new ROD outbreaks is to cut down diseased trees and cover the wood with a tarp. The theory is that by taking the tree down, we remove a source of inoculum from the air column that could infect other trees nearby and across the island or island chain. The tarp prevents the exposed wood from being infested with beetles, and traps beetles that could emerge from the wood, limiting both frass production and any incidental movement of inoculum via the beetles themselves.

  This approach is limited to trees that can be safely felled without directly striking and infecting their nearest neighbor, and is applied only in new, isolated outbreaks. This is believed to be an effective intervention, modeled after the management of similar diseases elsewhere in the world, but the efficacy in ROD management has not yet been directly tested. Without purposely infecting a large acreage of healthy forest, it seems unlikely that a statistically significant experimental design can be accomplished. Therefore, rather than testing the efficacy directly, the ROD Working Group turned to the Spatial Data and Visualization Lab at UH Hilo for a solution. Dr, Ryan Perroy and former BIISC UAV Pilot Timothy Sullivan are using Unmanned Aerial Systems to monitor and compare sites where new outbreaks were felled, and where they remained unmanaged. Though the sample size will be small, should provide some idea of the effectiveness of the felling and tarping approach.

  Felling and tarping can be hazardous to staff, costly, and time consuming. BIISC has also invested a significant amount of time supporting the work of researchers to develop alternative methods, including the application of insecticide to reduce the production of wood boring dust (frass). In 2018 BIISC felled 122 trees and experimentally treated 59 trees with insecticide.

- **Provide monthly updates at the ROD Working Group Meeting:**

  BIISC provided monthly updates at every ROD Working Group Meeting, hosted ROD EDRR Working Group meetings, and attended the ROD Science Team and ROD Outreach Working Group meetings.

- **Collaborate with Maui programs to develop response options:**

  The ROD Working Group had anticipated that Maui would be the first neighbor to discover a new outbreak of ROD, and worked with a consultant and the Maui Working Group to assist in developing an Incident Command/Operations Plan for Maui. When ROD was instead detected on Kauai, BIISC provided direct support in planning, assisted with hands-on survey, sampling, an sanitation trainings on Hawaii Island, and (in January 2019) flew to Kauai to train additional staff in survey and sampling techniques.

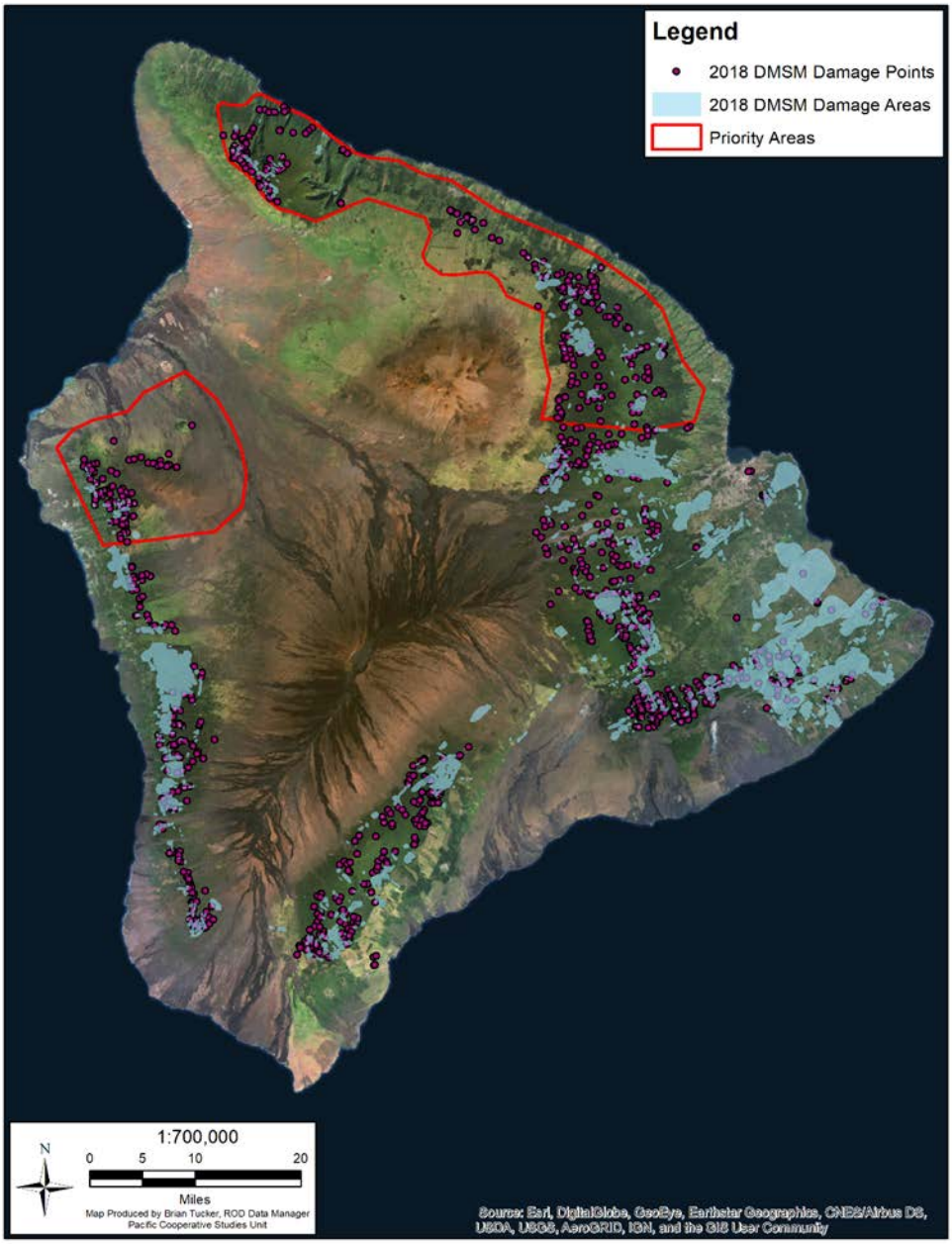

Figure 1: ROD survey map produced using Digital Sketch Mapping (DSM, USDA Forest Service). Data is acquired during helicopter surveys by trained surveyors, marking points and polygons that appear symptomatic for ROD over an active GIS map on digital tablets. Priority areas were surveyed 4x/yr, other areas 2x/yr.

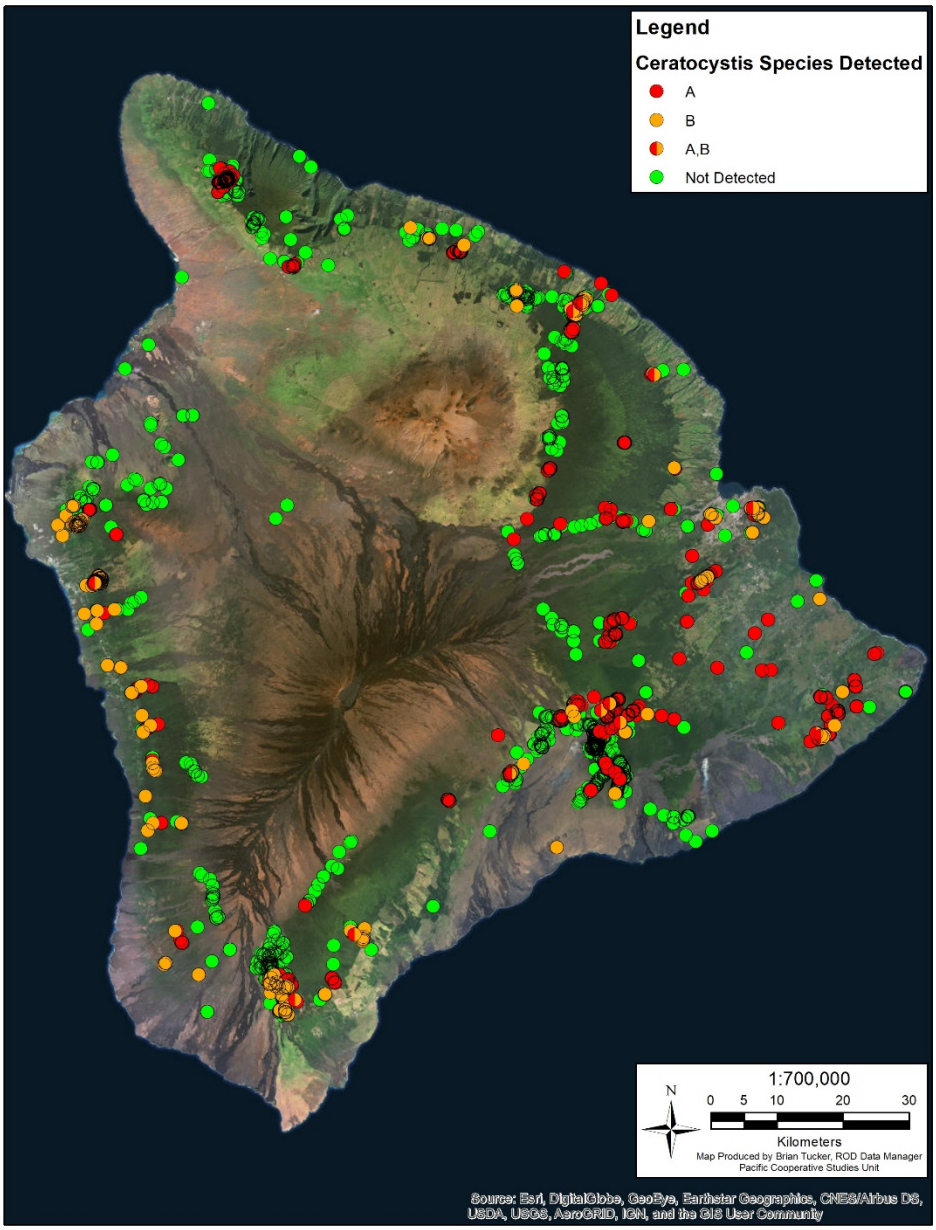

Figure 1: Map of ROD Samples collected on Hawaii Island and tested for presence of Ceratocystis lukuohia (Species A) and C. huliohia (Species B)