CHAPTER 6: RESEARCH PROGRAM

This chapter describes the status and outcome of actions carried out under the direction of the program’s Research Specialist (RS). It contains on-going actions proposed in the OANRP Year End Report of 2005-2006¹ and builds upon findings presented in the OANRP Year End Report of 2006-2007². Reference to these documents will be indicated by the abbreviation YER followed by the year. This chapter includes some projects carried out in 2007 but not included in the 2007-2008 YER due to a gap in employment.

Program objectives outlined in 2005-2006 centered on improving control methods for slugs (Mollusca: Gastropoda) and the black twig borer (Xylosandrus compactus). These remain a focus of study with some new additions (Sphagnum palustre control). Research findings are organized by pest species.

All statistical analyses were performed with Minitab Release 14 software of Minitab Inc. (Ryan et al. 2005). Significance during hypothesis testing was characterized by p-values less than 0.05. Nonparametric statistical methods were used to analyze datasets with non-normally distributed residuals and dissimilar variation between groups, otherwise parametric methods were used.

6.1 BLACK TWIG BORER (BTB) TRAP-OUT STUDY

6.1.1 Introduction

Xylosandrus compactus (black twig borer or BTB) is a major threat to a number of rare and endangered plants, notably Flueggea neowawraea (Euphorbiaceae). Published documentation is lacking, however OANRP and the DLNR have observed these species to suffer under BTB attack. Sequestered within the plant pith, BTB cannot be removed manually or with pesticides applied on the plant surface. Greenhouse collections of F. neowawraea are treated with the systemic insecticides Merit (Bayer Crop Research, Triangle Park, NC) applied as a root drench and Marathon (Olympic Horticultural Products, Mainland, PA) applied to the base of the plant in granular form. Neither is legal to use in a natural setting, but a Special Local Needs (SLN) Label (Nagamine and Kobashigawa 2003) could be pursued with permission from the manufacturer, HDOA and USFWS. OANRP is currently engaged in the process of SLN approval for a molluscicide, Sluggo and have found the process to be lengthy. Rather than embark on this long process for BTB management, OANRP looked for solutions which could be put into use immediately if found to be effective.

6.1.2 Methods

OANRP tested the efficacy of modified Japanese Beetle Traps equipped with high-release ethanol bait (AlphaScents, NJ) and Vaportape insecticidal strips (Hercon Environmental, PA) to reduce BTB gallery formation in a target tree species (F. neowawraea). Prior tests demonstrated this lure to effectively capture BTB (Dudley et al. 2007) but it was unknown whether traps could be used to control BTB populations locally. We conducted field experiments to determine whether a ring of 6 traps placed around F. neowawraea could reduce attack rates relative to a control group (YER 2007, Figure 5.1.1). Work took place at two F. neowawraea stands, 250 m apart, located within the Kahanaiaiki Management Unit at an elevation of 2000 ft (YER 2007, Fig. 5.2.1). The two sites, referred to here as Up Gulch (UG) and Down Gulch (DG), provide habitat for 37 and 24 trees respectively. Trees were reared in the greenhouse and planted by OANRP on February 17, 2005, February 22, 2006, (UG) and January 27, 2007 (DG). DG contains 24 trees, seven of which were transplanted from a nearby site, Pteralyxia Gulch (PG), where they


2009 Makua and Oahu Implementation Plan Status Report
had been doing poorly. These seven, plus an additional 19 plants were originally planted at PG on December 10, 2003.

A total of 10 trees at the DG site and 20 trees at the UG site were included in this study. All trees were 1 meter or more in height. Half of the trees at each site were randomly assigned to a treatment (traps) or control (no traps) group for a total of 15 replicates per group. The rate of attack was determined using counts of new entry holes divided by the height of the tree accumulated over time. This method has been used elsewhere (Gillette et al. 2006) to evaluate the success of experimental repellents. Using white latex paint, we marked existing holes on 30 _F. neowawraea_ and recorded new holes on a weekly basis for six weeks. Prior to trap deployment attack rates had been monitored at irregular intervals for one year.

### 6.1.3 Results and discussion

Post-treatment results were mixed (see figure below). While those trees receiving traps had a consistently lower rate of attack compared to the controls, these differences were not significant when adjusted for pre-existing differences between the two groups.

![Damage to F. neowawraea by BTB over time before (white shaded area) and after (grey shaded area) trap deployment. The control group of trees (N=15) are shown in black squares with a dotted black mean connect line while the treatment group is shown in grey circles (N-15). Attack rate on the X-axis is displayed in units of new holes (twig borer galleries) per meter of tree height per day. Bars are ± one SEM.](image)

Despite the failure of trapping to appreciably reduce damage to _F. neowawraea_, some useful information was obtained. First, it was discovered that baseline levels of attack were extremely high. At the peak of twig-borer season trees in the control group accumulated three new entry holes per 1 meter of bole length every two days. This possibly over-estimates twig borer damage however, because not all newly drilled holes result in the successful formation of a gallery. Second, the traps consistently yielded a steady number of beetles, at times as high as 100 or more. Each insect trapped was a gravid female due to the insects’ somewhat unique reproductive behavior. Males are incapable of flight, and upon hatching, they mate with related females and remain within the gallery, never to emerge (Hara and Beardsley 1979). Third, the traps did not exhibit a hypothesized potential counter-productive effect of increasing attack
rates on *F. neowawraea*. This might have occurred if the traps attracted more beetles to the area than would naturally occur.

Future research with more replicates may find that traps can serve as a sink for BTB on a small scale, slowing damage to *F. neowawraea*. Nonetheless, the data presented here suggest that trapping alone does not prevent appreciable numbers of BTB’s from forming galleries within the host plant. As a result, we plan future tests with a combination of repellents and attractants. Also possible is the use of injection systems to more safely deliver systemic insecticides to the plant. In the meantime, we are deploying traps with high release ethanol bait as a means of both monitoring numbers of twig borer and as our only current means of combating this threat.

### 6.2 MOLLUSCICIDE SPECIAL LOCAL NEEDS LABELING (SLN) STATUS

#### 6.2.1 Introduction

Slug control has been shown to effectively enhance survivorship of *Cyanea superba* and *Schiedea obovata* (Joe and Daehler 2008); however, no molluscicides are labeled for conservation use. With guidance from USFWS and HDOA, OANRP has worked with the manufacturer of the organic molluscicide, Sluggo (Neudorff, Germany) to expand its use as a conservation tool under a SLN label. Such labeling would allow for expanded use of Sluggo outside of agricultural and residential areas within the State of Hawaii. In support of an SLN, OANRP has conducted field studies under an Experimental Use Permit granted by HDOA in 2007 and current through February 2010. Research to date (section 5.3, YER 2007) shows Sluggo is effective against the target pest and safe to use in a forested setting.

#### 6.2.2 Project Status

No new research is required from HDOA for the SLN label (L. Kobashigawa *pers. comm.* Aug. 2009). USFWS is awaiting a draft label for review after which they will proceed with a Section 7 consultation (K. Swift *pers. comm.* Oct. 2009). OANRP is in contact with Sluggo company representatives to produce a draft SLN label for USFWS review in early 2010.

### 6.3 SPHAGNUM PALUSTRE IMPACTS AND CONTROL

The following research was presented as a poster at the 2009 Hawaii Conservation Conference (Honolulu Convention Center, Honolulu HI) under the title: Smothered in Sphagnum: Managing Moss at Kaala. A color version of this section can be viewed in poster format at: [http://www.botany.hawaii.edu/faculty/duffy/DPW/HCC-2009/](http://www.botany.hawaii.edu/faculty/duffy/DPW/HCC-2009/)

#### 6.3.1 Introduction

The high level of expertise required for bryophyte identification has meant that invasive mosses have been given little attention in Hawaii. *Sphagnum palustre*, a bog moss, was purposely introduced to the Kaala Natural Area Reserve (NAR) on Oahu in the 1960s (Hoe 1973) from the Big Island, where it is thought to be indigenous (Hotchkiss *et al.* 2002). Though *Sphagnum*, on Oahu, cannot produce spores, an eightfold increase in the size of the core infestation has been observed over the last 12 years. Through vegetative reproduction, *Sphagnum* now occupies an area estimated at 1.25 ha.

*Sphagnum* impacts in Hawaii are not well documented; nonetheless, bryologists consider it a threat to endemic bryophytes and speculate it may prevent regeneration of *Metrosideros polymorpha*, an endemic tree species (Waite 2007). Results of a formal Weed Risk Assessment following the model developed by Dachler and Denslow (2007) demonstrate *Sphagnum* is “likely to be invasive in Hawaii and on other Pacific Islands” (Clifford and Chimera 2009). Elsewhere, *Sphagnum* species are known to strongly modify their habitat. *Sphagnum* has morphological attributes which favor the formation of highly-saturated, heat-retaining, nutrient-poor, acidic soils. These conditions enhance their growth at the expense of vascular plant growth (van Breeman 1995).