Progress Report (November 2007)
Hawaii Invasive Species Council Grant
Community level impacts of invasive ants in Hawaiian coastal communities

Tracking number 47, Coastal Impacts of Invasive Ants
Principle Investigators: Sheldon Plentovich, Doctoral Student, Dr. Sheila Conant, Professor and Department Chair

1) Research the effects of two species of introduced ants (big-headed ant, *Pheidole megacephala* and tropical fire ant, *Solenopsis geminata*) on arthropods and nesting seabirds on small islets offshore of Oahu, Hawaii.

Progress summary: Since fieldwork was completed in June 2005, we have hired four part-time lab assistants to help with insect sorting and data entry. We've currently sorted all of approximately 930 pitfall trap samples and 50 of 300 sweep net samples. We are currently attempting to identify rare species with the help of entomologists at Bishop Museum. In addition to the lab assistants, two undergraduates have helped us sort insect samples and enter and analyze data on specific groups of insects. Both undergraduates gave excellent poster presentations at the 2007 Albert Testers Symposium at the University of Hawaii. In addition to this progress regarding our arthropod samples, we have submitted the manuscript "Detrimental effects of two widespread invasive ant species on growth and survival of colonial nesting seabirds in the Hawaiian Islands" for review to the journal *Biological Invasions* (see attachment 2). The manuscript was submitted in October 2007.

2) Reduce population sizes of these introduced, ecologically-dominant insects in their current range by application of target-specific protein-based insecticide in order to investigate their influence on community structure and composition.

Progress summary: AMDRO was applied to the two treatment islets (North Mokulua and Mokuauia) in February 2003 and 2004. The initial application resulted in the eradication of *P. megacephala* from Mokuauia and a significant reduction in the population of *S. geminata* from North Mokulua. On North Mokulua, *S. geminata* densities fell from 24.6 to 0.56 ants per bait card. Total numbers fell from 273 to 9 (all of which were found at one of 15 points). On our untreated islet (South Mokulua) ant numbers declined, but much less dramatically from 503 to 330 during the same period. *S. geminata* densities remained low on the treated islet for around six months and then rebounded in the absence of continued application of AMDRO. We will have a better understanding of how long AMDRO reduced ant densities once our pitfall trap data has been entered and analyzed. Regardless, based on this information as well as an additional study with similar results from Kakadu National Park (Hoffman and Connor 2004), AMDRO does not appear to be effective at eradicating *S. geminata*.

On Mokuauia, which had extremely high densities of *P. megacephala*, we were able to reduce ant densities from 135 individuals per bait card to 0. Total numbers declined from 2029 to 0 on Mokuauia, while increasing on Popoia, the untreated islet. After 3 years, big-headed ants still have not reappeared in our samples. Based on this study and Hoffman and Connor (2004), AMDRO appears to be extremely effective at eradicating *P.*

megacephala. The eradication of *P. megacephala* (which often exclude other invasive ant species in moist areas) was followed by a subsequent increase in Glaber ants (*Ochetellus glaber*) and the appearance of *S. geminata* in our samples. However, ant densities have remained below the original densities of *P. megacephala*. During a recent (November 2006) visit to the islet, we found only a single individual of *S. geminata* and locally high densities of two ant species previously unknown from this islet, *Tetramorium bicarinatum* and *Anoplolepis gracilipes*.

We are currently analyzing our data on effects of AMDRO on nontarget arthropods. The outcome of this experiment will weigh heavily on our future recommendations on the how to control ants in coastal areas.

3) Test the hypothesis that ant densities will be lower on experimental sites than on control sites.

Progress summary: See summary for #2.

4) Test the hypothesis that arthropod populations and communities will differ between experimental and control sites.

Progress summary: As mentioned in section 1, we are currently sorting through the remainder of our sweep net samples. We have not formally analyzed any data on specific groups of species at this time. We have noticed an apparent increase in endemic spiders (Family Lycosidae), endemic seed bugs (Family Lygaeidae), dark-winged fungus gnats (Family Sciaridae) and various introduced beetles (Order Coleoptera) on treated islets. The arthropod community on Mokuauia appears to be quite different in the absence of the invasive ant *P. megacephala*. We look forward to exploring these findings once the insect samples have been sorted and the data has been entered. We have completed the coarse sorting of the pitfall trap samples and are currently attempting to identify the rarer insects to species with the help of the entomologists at Bishop Museum.

5) Test the hypothesis that growth rate and fledging success of Wedge-tailed Shearwater chicks will be higher and the number of chicks injured by fire ants will be lower on experimental than on control sites.

Progress summary: See draft - Attachment 2.

6) Develop a rationale, guidelines, and techniques for controlling or eliminating ants on offshore islets.

Progress summary: Rationale, preliminary guidelines and techniques for controlling ants on offshore islets have been communicated to biologists and managers via the 2004 Albert Testers Symposium (Best Paper award), 2005 Hawaii Conservation Conference, 2006 Wildlife Society annual workshop, 2007 EECB seminar and various meetings focusing on the topic. In August 2007 we presented our paper "The effects of invasive ant control on growth and survival of nesting seabirds in the Hawaiian Islands" at the annual meeting of the Ecological Society of America in San Jose, California. We are continuing to work closely with biologists David Smith and Jaap Eijzenga of DLNR

and Chris Swenson of USFWS on these issues. Guidelines and techniques will be refined as we analyze our data and will be published over the next year.

7) Produce at least two scientific papers on how ant control affects arthropod populations, plant populations, and seabird condition and nesting success.
Progress summary: Our manuscript entitled "Detrimental effects of two widespread invasive ant species on growth and survival of colonial nesting seabirds in the Hawaiian Islands" is currently being reviewed for publication in *Biological Invasions*. The manuscript was submitted in October 2007. We are currently writing our second paper entitled "The effects of hydramethylnon on invasive ants and non-target arthropods on small offshore islets in the Hawaiian archipelago" and hope to submit it for publication within the next 4 months.

8) Share information with partner agencies managing lands in Hawaii on Amdro's efficiency at controlling and/or eradicating specific species of ants.
Progress summary: Information has been shared formally via the 2005 Hawaii Conservation Conference, Offshore Islet Symposium, 2006 Wildlife Society annual workshop, 2007 EECB seminar, and 2007 Ecological Society of America meeting and informally at various meetings pertaining to ant control on offshore islets. I actively collaborate with state and federal biologists (David Smith, Jaap Eijzenga and Chris Swenson) in regard to ant control issues on offshore islets. We have also been working with U. S. Fish and Wildlife Service Biologist Brenda Zaun on topics pertaining to invasive ant problems at Kilauea Point National Wildlife Refuge.

9) Communicate results via meetings and public presentations including University of Hawaii's Evolunch, Hawaii Conservation Conference and one international meeting.
Progress summary: A special symposium focusing on offshore islets was held at the 2005 Hawaii Conservation Conference in Honolulu, Hawaii. Preliminary results from this project were presented by Sheldon Plentovich at the request of conference organizers. In addition, Sheldon Plentovich has communicated results of this project at the following venues since receiving this grant:

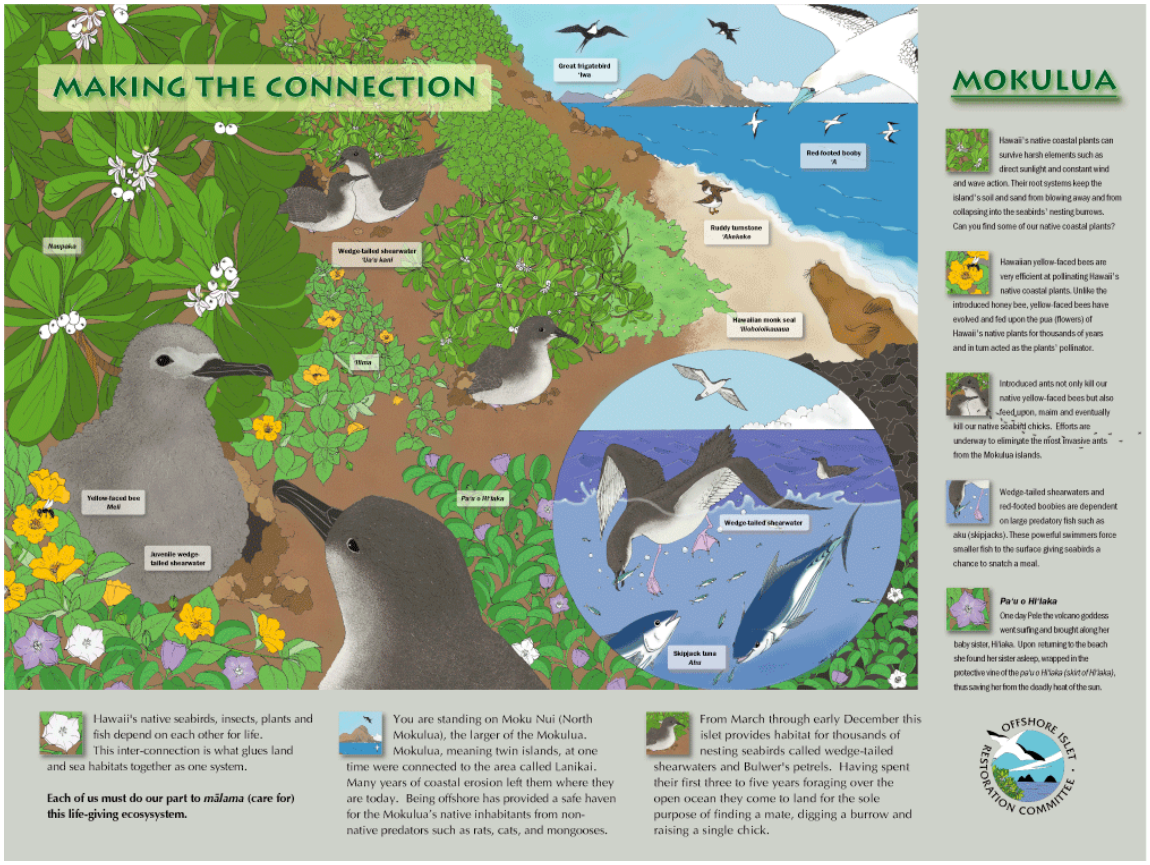
2007. The effects of invasive ant control on growth and survival of nesting seabirds in the Hawaiian Islands. Annual meetings of the Ecological Society of America, San Jose, CA.
2007. Community-level of invasive ants on Oahu's offshore islets. University of Hawaii, Ecology, Evolution and Conservation Biology EvoLunch.
2006. The effects of invasive ants on hatching success, growth and fledging success of Wedge-tailed Shearwaters (*Puffinus pacificus*) in Hawaiian coastal communities. Wildlife Society annual workshop, Invited Speaker.
2005. Seabird Conservation in Hawaii. Hanauama Bay Evening Lecture Series, Invited speaker.
2005. Invasion of the ants: Alien ants on Hawaii's offshore islets. Hawaii Conservation Conference, Invited Speaker.
2005. Interview by Sunny Lewis on Hawaii Public Radio focusing on the negative effects of introduced ants to Hawaii's natural communities.
Media attention: In addition, the following three articles have appeared in the Honolulu Advertiser that focus on different aspects of this project.

- April 23, 2005. “Isle students teach on Earth Day: A group from Lanikai Elementary School puts up informative signs on Mokunui”, by Diana Leone. Honolulu Star Bulletin.
- April 26, 2005. “Lanikai kids do their part to protect Mokulua islets”, by Jan TenBruggencate. Honolulu Advertiser.
- May 2, 2005. “Ants are threat to native bee”. by Jan TenBruggencate. Honolulu Advertiser.

10) Post educational signs on the Mokulua islets outlining research and restoration efforts.

Progress summary: Educational signs designed by students at Lani kai Elementary under the direction of Sheldon Plentovich were posted on the Mokuluas during the summer of 2005. The posting generated media coverage including two television stations and both Honolulu newspapers. Newspaper articles also generated subsequent media coverage on the effects of invasive ants on native invertebrates. See Attachment 1 for illustrations of both signs.

Attachment 1.
Educational signs posted on the Mokuluas during summer 2005.



MOKULUA

Hawaii's native coastal plants can survive harsh elements such as direct sunlight and constant wind and wave action. Their root systems keep the island's soil and sand from blowing away and from collapsing into the seabirds' nesting burrows. Can you find some of our native coastal plants?

Hawaiian yellow-faced bees are very efficient at pollinating Hawaii's native coastal plants. Unlike the introduced honey bee, yellow-faced bees have evolved and fed upon the pua (flowers) of Hawaii's native plants for thousands of years and in turn acted as the plants' pollinator.

Introduced ants not only kill our native yellow-faced bees but also feed upon, maim and eventually kill our native seabird chicks. Efforts are underway to eliminate the most invasive ants from the Mokulua islands.

Wedge-tailed shearwaters and red-footed boobies are dependent on large predatory fish such as aku (skipjacks). These powerful swimmers force smaller fish to the surface giving seabirds a chance to snatch a meal.

Pa'u o Hi'iaka

One day Pele the volcano goddess went surfing and brought along her baby sister, Hi'iaka. Upon returning to the beach she found her sister asleep, wrapped in the protective vine of the *pa'u o Hi'iaka (skirt of Hi'iaka)*, thus saving her from the deadly heat of the sun.

Hawaii's native seabirds, insects, plants and fish depend on each other for life. This inter-connection is what glues land and sea habitats together as one system.

Each of us must do our part to *mālama* (care for) this life-giving ecosysystem.

You are standing on Moku Nui (North Mokulua), the larger of the Mokulua. Mokulua, meaning twin islands, at one time were connected to the area called Lanikai. Many years of coastal erosion left them where they are today. Being offshore has provided a safe haven for the Mokulua's native inhabitants from non-native predators such as rats, cats, and mongooses.

From March through early December this islet provides habitat for thousands of nesting seabirds called wedge-tailed shearwaters and Bulwer's petrels. Having spent their first three to five years foraging over the open ocean they come to land for the sole purpose of finding a mate, digging a burrow and raising a single chick.

OFFSHORE ISLET RESTORATION COMMITTEE