Project: <u>Community level impacts of invasive ants on Hawaii's offshore islets</u>

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Introduction

Biological communities are often dominated by a single species or a limited group of species. This species or group, sometimes referred to as an ecological dominant, greatly influences the composition and overall nature of the local environment. Alien species also have the potential to invade communities, become dominant and thereby influence the nature and composition of the community. Alien species have been identified as the primary cause of the extinction or extirpation of a variety of species including plants, arthropods, birds and mollusks. The replacement of native species with generalist alien species diminishes distinctions between once distinct biotas. This process of impoverishment has been called *biotic homogenization* and reduces diversity on a global scale.

The Hawaiian Islands are one of the few places in the world where ants and other social insects are not part of the native fauna. Currently, more than 44 species have been introduced to the Hawaiian Islands and are suspected of having significant impacts on native communities. Some of these species have reached very high densities and are clearly the dominant invertebrates in many areas. Anecdotal observations and comparisons of invaded vs. uninvaded areas on oceanic islands indicate that invasive ants disrupt arthropod communities in high-altitude shrubland, forest ecosystems, and coastal areas. On Kauai, substantial declines in native cricket populations were observed in areas invaded by big-headed ants, *Pheidole megacephala*. On Maui, areas with the invasive Argentine ant (*Linepithema humile*) had significantly fewer arthropods than did areas that had not been invaded. In a study conducted throughout the Hawaiian Islands, native spiders in the genus *Tetragnatha* were excluded from areas invaded by *P. megacephala* and the long-legged ant, *Anoplolepis gracilipes*.

Oahu's offshore islets offer an opportunity to use experimentation to increase understanding of how introduced ants affect native plants, arthropods and ultimately entire communities. Some of Oahu's 17 offshore islets have escaped extreme degradation due to their isolated nature, rugged terrain, and reduced human traffic. Hawaii's Division of Forestry and Wildlife (DOFAW), Non-game management program currently manages 13 islets. Various management activities such as the eradication of

rabbits from Manana have maintained or vastly improved conditions on specific islets. Currently DOFAW, U. S. Fish and Wildlife Service, and University of Hawaii are working towards the goal of restoring the native flora and fauna to Oahu's offshore islets. With this long-term goal in mind, we are interested in one aspect of the restoration process: how ecosystems react when invasive ants are controlled or eradicated.

Along with a variety of invasive plant species, Oahu's offshore islets are home to at least 14 species of invasive ants. Two of those species (*P. megacephala* and *Solenopsis geminata*) are now the dominant invertebrates and both species are known to negatively impact arthropod populations. However, little is known about how they affect other parts of the biological community or what happens to natural communities when they are controlled or removed. Our objectives are:

- Identify ant species and densities on Oahu's offshore islets;
- Collect baseline information on seabird nesting success and arthropod and plant populations;
- Test the efficacy of AMDRO® as an ant control agent on two of four offshore islets and monitor negative impacts to non-target arthropods by sampling arthropods immediately before and after application;
- Monitor changes in arthropod and plant populations and seabird nesting success on islets where ants have been controlled and compare to control islets; and
- Erect educational signs to better inform the public about invasive species and restoration ecology.

Alien ants on a seabird chick
Photo by C. Vanderlip

Ant damage to seabird foot
Photo by K. Wood

Methods

Two pairs of islets similar in topography, geology, vegetation composition, and ant species were selected. One pair of islets (the Mokuluas) is side-by-side and is perhaps the most visited and photographed pair of islets in Hawaii. The other pair of islets (Mokuauia and Popoia) is separated by approximately 15 miles. Baseline surveys were conducted to gain a better understanding of arthropod and plant populations and seabird nesting success prior to the eradication of ants.

In February 2003, the ant control agent AMDRO® was used to control or eradicate ants on one member of each pair of islets (Moku Nui and Mokuauia). Pitfall traps were set immediately before and after application of AMDRO® to identify any negative impacts to non-target arthropods. AMDRO® was reapplied as necessary and was broadcast again in February 2004. Twenty-four months of post-treatment surveys were conducted to quantify changes in islet flora and fauna. Arthropod, vegetation and seabird nesting success surveys were conducted at 15 randomly selected points on each of four islets. Terrestrial arthropods were sampled quarterly using pitfall traps and sweep nets starting in February 2002. Three Wedge-tailed Shearwater burrows were associated with each of the 15 points. Burrows were monitored at least three times; once soon after eggs hatched, again in the middle of the season and finally near the end of the season. Wedge-tailed Shearwater chicks were weighed, wing chord, tarsus, and culmen were measured and chicks were checked for parasites and injuries associated with the presence of invasive ants.

Preliminary Results:

Ant control, Pair 1 (Moku Nui and Moku Iki): Tropical Fire Ant (*S. geminata*) numbers were reduced significantly following the application of AMDRO® on Moku Nui. Ant numbers remained the same on the untreated islet (Moku Iki). *S. geminata* numbers remained low on the treated islet for more than 6 months and then spiked dramatically in the absence of continued application of AMDRO®.

Ant control, Pair 2 (Mokuauia and Popoia): Big-headed ants (*P. megacephala*) were eradicated from Mokuauia following one application of AMDRO® and have not been observed on the islet since 2003. Densities of *P. megacephala* remain high on the untreated islet (Popoia). The removal of big-headed ants on Mokuauia was followed by increased numbers of other ant species including *Ochetellus glaber, S. geminata, Plagiolepis alluaudi* and more recently, *Anoplolepis gracilipes*.

Effects of ants control on the native plant, Ilima (*Sida fallax*): The reduction of ant numbers on Moku Nui coincided with a reduction in scales, aphids and mealybugs and a significant increase in leaf cover in *S. fallax*. Leaf cover on the treated islet averaged 76%, while leaf cover on the untreated islet, where scale, aphid and mealybug densities remained high averaged 53%.

Effects of ant control on the hatching success, growth and fledging success of nesting seabirds: There was no difference in growth, condition or fledging success of shearwaters on the pair of islets dominated by *P. megacephala*. On islets dominated by *S. geminanta*, significantly fewer injuries (38% vs. 100%) to seabird chicks were observed on the treated islet vs. the untreated islet. During the period of reduced *S. geminata* densities on Moku Nui, hatching success and fledging success were significantly higher than on the untreated islet. Eight percent of shearwater chicks sustained severe injuries from fire ants (see photo). These individuals weighed significantly less than chicks with none, mild and moderate injuries from fire ants and most did not fledge.