



Figure 3. Reduction in slugs (bars are ± 1 SEM) are shown within the three treatment groups. Letters indicate groups that are significantly different from one another (MWU, $P < 0.05$). Note that the bimonthly small area treatment (BSAT) does not differ significantly from either other group. The monthly large area treatment (MLAT) significantly reduced slugs over the monthly small area treatment (MSAT).

Conclusion: Expanding the treatment area significantly improved slug suppression at West Makaleha and allowed for a longer interval between treatments. When treating areas ≤ 144 m², effective slug control can only be achieved by frequent application of Sluggo (every two weeks). Slugs will recover at such sites within one month's time. Sluggo application on individual plants should be avoided in favor of treating a large buffer around all plants in the area.

Future work: We are interested in learning whether Sluggo remains effective when applied less frequently than once a month (*e.g.* every six weeks or two months). Based on our previous work, we believe the longer the interval between treatments, the larger the treatment area must be to prevent slug incursion. Such trials may be attempted in the coming year.

7.3 Survey of Invasive Ant Species

Background: In Hawaii, ants are most likely to become established around disturbed areas frequented by humans such as bathrooms, campgrounds, fence lines, helipads, and roads (OANRP 2010).

As stated in previous reports (OANRP 2011), OANRP conducts annual surveys of invasive ants in high-risk areas using a standard protocol developed by University of Hawaii entomologists (OANRP 2010). Careful monitoring will increase our chances of early detection and eradication. Results from current and past surveys appear in Table 4. Medium-risk species are underlined and low-risk species are in regular italicized font. No high-risk species were detected. Risk was assessed using the factsheets provided by Saurat (Pacific Invasive Ant Key).

Management Unit	Ants recorded prior to 2013	Ants recorded 2013	Action needed?
Pahole	<i>Leptogenys falcigera</i> , <i>Paratrechina bourbonica</i> , <u><i>Solenopsis genimata</i></u> , <i>S. papuana</i> ,	<i>Solenopsis papuana</i> , <u><i>S. genimata</i></u> , <i>Plagiolepis</i>	Treatment for <i>S. genimata</i> will be attempted using Amdro fire ant bait.

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Kaluakauila	<i>Anoplolepis gracilipes</i> , <i>Cardiocondyla emeryi</i> , <i>Ochetellus glaber</i> , <i>Paratrechina bourbonica</i> , <i>Plagiolepis alludi</i> , <i>S. papuana</i>	<i>Anoplolepis gracilipes</i> , <i>Pheidole megacephala</i> *	Species present are widespread at the elevations found.
Kaala	<i>Ochetellus glaber</i> , <i>S. papuana</i> , <i>Tetramorium simillimum</i> , <i>Cardiocondyla venustula</i> , <i>C. wroughtoni</i> , <i>C. minutior</i>	No ants recorded	No ants detected in 2013. This area is very wet and ants found previously are in low numbers.
Helemano	No ants recorded	No ants recorded	No ants detected. This site will be discontinued.
Kahuku Training Area	<i>Pheidole megacephala</i> , <i>Anoplolepis gracilipes</i>	<i>Pheidole megacephala</i> , <i>Anoplolepis gracilipes</i>	Both species present are too widespread for control at the elevations found.
Pahole mid-elevation nursery (Nike site)	<i>Anoplolepis gracilipes</i> , <i>Cardiocondyla obscurior</i> , <i>Ochetellus glaber</i> , <i>Solenopsis papuana</i> , <i>S. geminata</i> , <i>Tetramorium bicarinatum</i>	<i>Solenopsis papuana</i> , <i>S. geminata</i> , <i>Ochetellus glaber</i>	Treatment for <i>S. geminata</i> will be attempted using Amdro fire ant bait.
Kaena East of Alau	<i>Monomorium floricola</i> , <i>Ochetellus glaber</i> , <i>Solenopsis papuana</i> , <i>Tetramorium simillimum</i> , <i>T. caldarium</i>	<i>Tetramorium simillimum</i> , <i>Ochetellus glaber</i>	All species detected are low-risk
Makaha	<i>Anoplolepis gracilipes</i> , <i>S. papuana</i>	<i>Anoplolepis gracilipes</i> , <i>Pheidole megacephala</i> *, <i>Technomyrmex albipes</i> *	All species widespread at parking lot, no ants detected at outplanting sites
Ekahanui	<i>Solenopsis papuana</i> , <i>Plagiolepis alluaudi</i> , <i>Technomyrmex albipes</i>	<i>Solenopsis papuana</i>	Species are low risk.
OANRP Baseyards	<i>Anoplolepis gracilipes</i> , <i>Pheidole megacephala</i> , <i>Technomyrmex albipes</i>	<i>Anoplolepis gracilipes</i> , <i>Pheidole megacephala</i> , <i>Technomyrmex albipes</i>	All species are well established. Suppression of ants will take place regularly to prevent accidental transport

Table 4. Above is a list of ant species that were found in each MU. New records for 2013 are indicated with an asterisk*. Medium-risk species are underlined, the rest are low-risk (Pacific Invasive Ant Key, Saurnat).

Ant Control Actions: Three infestations of the *Solenopsis geminata* (tropical fire ant or TFA) were identified and treated in 2011 by State and OANRP staff (infestations were at Pahole Mid-Elevation Nursery, Puu 2210, and Peacock Flats Campground). Followup monitoring in 2013 shows TFA has not recurred at Puu 2210, but, after a one-year absence, has been detected at the Peacock Flats Campground

and at the Pahole Mid-elevation Nursery. In the past, TFA has responded well to insecticidal baits containing the active ingredient hydramethylnon. With cooperation from the State DLNR who manage the campground and greenhouse areas, we will reapply this bait as needed. Further monitoring in 2014 is needed to ensure successful eradication.

7.4 Nike/Pahole Nursery Snail Invasion Detection Protocol

Background: In 2012 OANRP contracted Dr. R. Cowie and Dr. N. Yeung from the Pacific Biosciences Research Center at the University of Hawaii at Manoa to develop a protocol for detecting alien snail and slug infestations on plants at the Nike site nursery. As this greenhouse contains plants which will be used for habitat restoration, it is vital that no pests are accidentally introduced into natural areas.

Included in the greenhouse sanitation plan was the establishment of refuge traps around the perimeter of the greenhouse to detect alien snails before they enter. The authors stated: “Approximately 80 plastic containers (length 13 cm, width 10 cm, height 5 cm) will be put into the ground surrounding the nursery, approximately 5 meters out from the nursery and positioned 1 meter apart by OANRP personnel ... Each container will have a hole cut out of its bottom, approximately 6 x 4 cm to permit drainage. Each container will contain a piece of lettuce (food) and a piece of cardboard (shelter), each approximately 4 x 4 cm. Containers will be monitored by OANRP personnel every 3-4 days for any snails. Each container should be searched for at least 30 seconds, to ensure finding very small snails. On each occasion the lettuce and cardboard will be dampened as needed. Replace lettuce also as appropriate (if it has dried out or become rotten).” We installed 67 traps according to these specifications (with slight modifications due to materials available) in March of 2013. The placement of these traps is shown in Figure 4.

