Pacific INVASIVES INITIATIVE

DELIMITING SURVEYS FOR INVASIVE ANTS

Title: Delimiting Surveys for Invasive Ants

Author: Natasha Doherty (Pacific Invasives Initiative)

Reviewers: Dr. Margaret Stanley (University of Auckland)

Dr. Ben Hoffman (Commonwealth Scientific and Industrial Research Organisation)

Dr. Cas Vanderwoude (University of Hawaii)

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Contents

1. *Anoplolepis gracilipes*

1.1 Description

Common Name: Yellow Crazy Ant (YCA)

Size: About 5 mm

Colour: Yellow brownish colour with a darker brown gaster

General description: The YCA is one of the largest invasive ants. The ant, also known as the long-legged ant is notable for its remarkably long legs and antennae. YCA workers are monomorphic (one form), displaying no physical differentiation. It has a yellow-brownish body colour, and is weakly sclerotized.

Please visit the following links for detailed identification of YCA:

- AntWeb: http://antweb.org/getComparison.do?rank=species&genus=anoplolepis&name=gracilipes&project=&project
- Pacific Invasive Ant Key (PIAkey) contains: http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Anoplolepis_gracilipes.html

Impacts:

- Major environmental and agricultural pest, as well as a human nuisance.
- High densities can have direct impacts on native 'keystone' species and on species of conservation value. This can alter community structure and species composition and affect ecosystem processes.
- Mutualism between YCA and honeydew-secreting homoptera can cause population outbreaks of these generalist herbivores and lead to canopy dieback.
- Commonly nests at the base of plants, sometimes undermining crops, such as sugarcane and coffee.
- Household and village pest. Formic acid sprayed by the ants can cause skin burns and irritate the eyes of fieldworkers

Dispersal mechanisms:

- Human-mediated dispersal – colonies are accidentally transported to new locations by humans (e.g. in potted plants, containers, rubbish, machinery etc)
- Natural dispersal – Budding: queen ants walk to new site, accompanied by worker ants. In ideal conditions ant colony expansion and budding may occur regularly.

For more information on YCA:

- AntWiki: http://www.antwiki.org/Anoplolepis_gracilipes
- Global Invasive Species Database (GISD): http://www.issg.org/database/species/ecology.asp?si=110&fr=1&sts=sss&lang=EN
- Landcare Research – Manaaki Whenua (Landcare): http://wwwold.landcareresearch.co.nz/research/biocons/invertebrates/Ants/invasive_ants/documents/angora.pdf

Yellow Crazy Ant Images:

1.2 Delimiting Survey

General protocols

- Surveys should be done when temperature does not limit ant activity. For example early morning (6am-10am) and late afternoon (3pm – 6pm). Work times can be extended on days when there is cloud cover and/or relatively cooler temperatures.
- A team of no less than three people is required to assess infestation boundaries, unless there is clear demarcation of areas surveyed for less than three people to cover the area required.
- Disturbance of the litter layer, soil or infrastructure at assessment points is considered beneficial to stimulate ant activity.
- The survey where no YCA are found around the suspected limit of the infestation need to extend no less than 100m from all detection points.

Mapping protocols for infestations

- Start at a known infestation point. The team forms a line, with people spaced at least 15 m apart.
- Walk together in any direction, preferably, initially along a landmark (e.g. road edge) continuously surveying microhabitats (very small, specialized habitat, such as a clump of grass or a space between rocks) by direct visual searching until no YCA have been found by any team member for at least 100 m.
- The continuous survey (e.g. along a road) will constantly assess microhabitat (e.g. tree base, rock) spaced no further than 15 m apart, for at least 5 seconds per microhabitat.
- When the boundary is believed to have been found, the team re-aligns in what is thought to be perpendicular to the infestation, such that one person is within the infestation confirming the presence of the ants, and all others are outside confirming the absence of the ant.
- The team continues to search, constantly re-adjusting their direction based on the presence/absence of YCA. Ultimately, the team will walk in a circle to finish in the same location where they identified the first boundary.
- Flagging tape can be used at detection points to visually aid estimating distances and direction. Flagging tape can also be used to assist in identifying the infestation boundary (typically every 20 m).
- A GPS point indicating presence/absence of YCA is collected at every inspection location. The GPS data is entered into a GIS to display the infestation extent and survey intensity.
- The survey where no YCA are found around the suspected limit of the infestation need to extend no less than 100m from all detection points.

Equipment Required

- Flagging tape, measuring tape, GPS

2. *Monomorium floricola*

2.1 Description

Common Name: Biocoloured Trailing Ant (BTA)

Size: About 2 mm

Colour: Black and light brown

General description: BTA is a small and slender ant and can be distinguished by its distinctive bicoloured body; pale body with a darker brown head and gaster.

Please visit the following links for detailed identification of BTA:

- AntWeb: http://www.antweb.org/description.do?name=floricola&genus=monomorium&rank=species&project=hawaiiants
- PIAkey: http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Monomorium_floricola.html

Impacts:

- BTA is a common but minor agricultural and indoor pest in urban areas.

Dispersal mechanisms:

- Human-mediated dispersal – colonies are accidentally transported to new locations by humans (e.g. in potted plants, containers, or rubbish)
- Natural dispersal – Budding: queens walk to a new nesting site, accompanied by worker ant. And flight, species can fly to new location.

More information on BTA can be found at:

- AntWiki: http://www.antwiki.org/Monomorium_floricola
- GISD: http://www.issg.org/database/species/ecology.asp?si=1755&fr=1&sts=sss&lang=EN
- Landcare: http://www.landcareresearch.co.nz/publications/factsheets/Factsheets/monomorium-floricola

Bicoloured Trailing Ant images:

3. *Pheidole megacephala*

3.1 Description

Common Name: African Big Headed Ant (ABHA)

Size: Minor workers about 2 mm long

Major/Soldier workers about 3-4 mm long

Colour: Ranging in colour from a pale yellow to a very dark brown

General description: There are two types of worker ants, the major, or soldier ant (3 – 4 mm) and the minor worker (2 mm). The common name of African big headed ant derives from the soldier's extremely large head, which has large mandibles that may be used to crush seeds. The colour of both morphological form of ABHA varies from yellowish-brown or reddish-brown to nearly black.

Please visit the following link for detailed identification of ABHA:

- PIAkey: http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Pheidole_megacephala.html

Impacts:

- Displaces most native invertebrate communities directly through aggression and, as such, is a serious threat to biodiversity. Evidence also exists of reductions in vertebrate populations where this ant is extremely abundant.
- Effects on plants and horticultural crops can be direct through seed harvesting, or indirect through harbouring phytophagous insects which reduce plant productivity. It is known to facilitate the invasion of introduced plant species.
- ABHA is also known to chew on irrigation pipes, telephone cabling and electrical wires

Dispersal mechanisms:

- Human-mediated dispersal -BHA is transported by freight (land and sea), translocation of machinery/equipment, garden waste and soil from areas of infestations.
- Natural dispersal – Budding: queen ants walks to new site, accompanied by worker ants to a new nesting site

More information on ABHA can be found at:

- AntWiki: http://www.antwiki.org/Pheidole_megacephala
- GISD - http://www.issg.org/database/species/ecology.asp?si=132&fr=1&sts=sss&lang=EN
- Landcare: http://www.landcareresearch.co.nz/publications/factsheets/Factsheets/pheidole-megacephala

Images of African Big Headed Ant:

Minor worker

Major worker

3.2 Delimiting Survey

General protocols

- Surveys should be done when temperature does not limit ant activity. For example early morning (6am-10am) and late afternoon (3pm – 6pm). Work times can be extended on days when there is cloud cover and/or relatively cooler temperatures.
- A team of no less than three people is required to assess infestation boundaries, unless there is clear demarcation of areas surveyed for less than three people to cover the area required.
- Disturbance of the litter layer, soil or infrastructure at assessment points is considered beneficial to stimulate ant activity.
- Buffer zone for ABHA is 20 m

Mapping protocols for infestations

- An approximate limit of the infestation is first determined by inspecting the presence of ABHA moving away from the area of known infestations until the ant can no longer be found. The team forms a line, with team members spaced at least 15 m apart.
- Walk together in any direction; preferably initially along a landmark (e.g. road edge) continuously surveying microhabitats until no ABHA are found by any team member for at least 20 m.
- The process is repeated along informal transects spaced approximately 20 m apart, which cross the perceived boundary, radiating out from the infestation.
- The exact limit of the infestation is confirmed by attracting the ants to spoonful's of tuna placed every 2 m for a further 20 m from where the ants were last observed.
- The tuna lures are inspected after approximately half an hour for the presence/absence of ABHA
- Flagging tape can be erected at detection points to aid in estimating distances and direction. Flagging tape can be erected as required to allow easy identification of the infestation boundary (typically every 20 m).
- A GPS point indicating presence/absence of ABHA is collected at each location inspection. The GPS data are entered into the project GIS to display the infestation extent and survey intensity.
- A Buffer zone of no less than 20 m needs to extend around the suspected limit of the infestation

Equipment Required

- Flagging tape, measuring tape, GPS, Tuna, Spoon, White plastic card to place tuna on

4. *Tetramorium bicarinatum*

4.1 Description

Common Name: Pennant Ant

Size: About 3.4 to 4.5 mm

Colour: Colour of head, mesosoma and waist varies from light yellow-brown to bright orange-yellow, gaster deep brown or blackish brown.

General description: Pennant Ant can be well identified because of its distinctly sculptured mandibles, rectangular nodiform petiolar node with antero- and posterodorsal angles at about the same height, and its characteristic bicolouration.

Please visit the following link for detailed identification of ABHA:

- PIAKey - http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Tetramorium_bicarinatum.html

Impacts:

- Minor urban nuisance entering houses and nesting in gardens
- Capable of stinging

Dispersal mechanisms:

- Human-mediated dispersal – colonies are accidentally transported to new location by humans (e.g. in potted plants, containers, or rubbish)
- Natural dispersal – Budding: queen ant walks to new site, accompanied by worker ants.

Pennant Ant images:

More information on Pennant Ant can be found at:

- AntWiki: http://www.antwiki.org/Tetramorium_bicarinatum
- Landcare: http://www.landcareresearch.co.nz/publications/factsheets/Factsheets/tetramorium-bicarinatum

5. *Tapinoma melanocephalum*

5.1 Description

Common Name: Ghost Ant

Size: Between 1.3 - 1.9 mm

Colour: Distinctively bicoloured: head (including antennae, except for first 2 segments), and sides of alitrunk blackish-brown; dorsal alitrunk (except propodeum) and legs pale yellow. Gaster mostly pale, sometimes with brown patches.

General description: Ghost ant is a very small species with a dark head that contrasts with the paler appendages and gaster. It has a single, flattened waist segment that is often hidden by the gaster, eyes that lie within the outline of the face, and no erect hairs on the mesosoma.

Please visit the following link for detailed identification of Ghost Ant:

- PIAkey: http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Tapinoma_melanocephalum.html

Impacts:

- Household pest can form nest inside dwellings and will compromise food sources.

Dispersal mechanisms:

- Human-mediated dispersal - In urban environments colonies may occupy, and be transported on, a huge variety of household goods, e.g., laptops, potted plants, luggage, cut flowers, instrument-case lining, piles of clothing, etc.
- Natural dispersal – Budding: queen walks to new site accompanied by workers.

Ghost Ant images:

More information on Ghost ant can be found at:

- AntWeb: http://antweb.org/getComparison.do?rank=species&genus=tapinoma&name=melanocephalum&project=&project=
- AntWiki: http://www.antwiki.org/Tapinoma_melanocephalum
- GISD: http://www.issg.org/database/species/ecology.asp?si=959&fr=1&sts=sss&lang=EN
- Landcare: - http://wwwold.landcareresearch.co.nz/research/biocons/invertebrates/Ants/invasive_ants/documents/tapmel.pdf

6. *Wasmannia auropunctata*

6.1 Description

Common Name: Little Fire Ant (LFA)

Size: About 1.5 mm

Colour: Orange in colour and the gaster is the same.

General description: LFA is a small ant that is widely regarded as the most dangerous threat to the Pacific Island region. This species has a monomorphic worker caste with 11-segmented antennae, two-segmented antennal club, antennal scrobes, short antennal scapes that do not surpass the posterior margin of the head, a gradually sloped mesosoma, and strong propodeal spines.

Please visit the following links for detailed identification of Ghost Ant:

- AntWeb: http://antweb.org/getComparison.do?rank=species&genus=wasmannia&name=auropunctata&project=&project=
- PIAkey: http://itp.lucidcentral.org/id/ant/pia/Fact_Sheets/Wasmannia_auropunctata.html

Impacts:

- LFA is a significant agricultural pest; stinging agricultural workers and increasing populations of homopteran insects.
- Direct negative impact on many animals: both invertebrates and vertebrates. LFA has been attributed to reducing invertebrate species diversity and reducing overall abundance of flying and tree-dwelling insects. Global incidents of blindness in domestic and wild animals have been reported.
- Due to sting aversion, LFA is a major hindrance to crop picking globally in all types of crops causing gardeners to restrict any gardening activities until dusk when ant activity is minimal.

Dispersal mechanisms:

- Human-mediated dispersal - well known for being transported via human commerce and trade, potted plants, cuttings, foliage and produce (e.g. bananas, taro, pineapple)
- Natural dispersal – Budding: in favourable years the population may spread up to 500 m. Some spread on floating vegetation/debris during flooding.

Images of Little Fire Ant

More information on LFA can be found at:

- AntWiki: http://www.antwiki.org/Wasmannia_auropunctata
- GISD: http://www.issg.org/database/species/ecology.asp?si=58&fr=1&sts=sss&lang=EN
- Hawaii Ant Lab: http://www.littlefireants.com/fact%20sheet%203%20-%20lfa%20survey.pdf
- Landcare: - http://wwwold.landcareresearch.co.nz/research/biocons/invertebrates/Ants/invasive_ants/documents/wasaur.pdf

6.2 Delimiting Survey

General protocols

- Surveys for LFA can be done during anytime of the day, as they forage 24/7. However, bait should be placed in shady areas as LFA will avoid sunny spots. Bait can also be placed in trees.
- A team of no less than three people is required to assess infestation boundaries, unless there is clear demarcation of areas surveyed for less than three people to cover the area required.
- Disturbance of the litter layer, soil or infrastructure at assessment points is considered beneficial to stimulate ant activity.
- The survey where no LFA are found around the suspected limit of the infestation need to extend no less than 50m from all detection points.

Mapping protocols for infestations

- Start at a known infestation point, the team forms a line, with people spaced at least 15 m apart.
- Walk together in any direction; preferably initially along a landmark (e.g. road edge) continuously surveying microhabitats until no LFA have been found by any team member for at least 50 m.
- The continuous survey (e.g. along a road) will constantly assess microhabitats (e.g. tree base, rock, drum) spaced no further than 15 m apart, for at least 5 seconds per microhabitat.
- The exact limit of the infestation is confirmed by attracting LFA to spoonful's of canned tuna (or sausage meat or cat food) placed every 2 m for a further 50 m from where LFA were last observed. The baits are then inspected after approximately half an hour for the presence/absence of LFA.
- When the first boundary is believed to have been found, the team re-aligns in what is thought to be perpendicular to the infestation, such that at one person is within the infestation confirming the presence of the ants, and all others are outside confirming the absence of the ant using the tuna baits.
- The team continues to search, constantly re-adjusting their direction based on the presence/absence of LFA. Ultimately, the team will walk in a circle to finish in the same location where they identified the first boundary.
- Flagging tape can be erected at detection points to aid in estimating distances and direction. Flagging tape can also be erected to allow easy identification of the infestation boundary (typically every 20 m).
- A GPS point indicating presence/absence of LFA should be collected at each location inspection. The GPS data are to be entered into the project GIS to display the infestation extent and survey intensity.
- The survey where no LFA are found around the suspected limit of the infestation need to extend no less than 50m from all detection points.

Equipment Required

- Flagging tape, measuring tape, GPS, Bait (tune, cat food, sausage meat), Spoon, White laminated cards 10 cm x 10 cm

7. Appendix 1

7.1 Ant Surveillance Methods

Prepared for the PII Island Biosecurity Training Course by: Disna Gunawardana, Plant Health and Environment Laboratory, Ministry of Agriculture and Forestry, Auckland, New Zealand.

Ant surveillance needs to be conducted both visually and using attractant baits.

1. **Visual Surveillance**: Visual Surveillance is conducted over the entire surveillance area, regardless of presence of ant habitat, by walking systematically over the area looking for ants. Where debris is present and easily moved, the item/s should be shifted to facilitate the inspection. Any suspect ants found should be collected and identified. Always label the ant sample as a visual sample, and the location need to be marked on the ground and recorded on a map or survey form that indicates the area where they were found so that the site could be re-visited for further investigation.

2. **Attractant Bait Surveillance:** Attractant Bait Surveillance need occur only in favoured ant habitats (see below for list). Both protein-based baits and sugar baits should be used. Baits can be prepared and laid in small plastic pots (jars). When the baits are collected the lid is replaced and any ants recruiting to the bait are trapped inside. Density of bait placement is based on a minimum of two baits per equivalent of a 15 m × 15 m grid (225 m^2). Separate protein and sugar based baits must be composed and laid as follows:

   a. *Protein-based bait composition***.** Prepare protein bait by smearing a line of blended peanut butter and soybean oil (the size of half a pea), and a line of raw, fatty sausage meat to the inner side of each bait container, maintaining a 1 cm gap between the two smears. (If predicted temperatures are greater than 25°C, ensure a larger quantity of sausage meat is applied to prevent bait drying out).

      OR

      Canned tuna could be used if the above ingredients are not available. (Simple method)

   b. *Sugar-based bait composition.* Prepare a sugar based bait pot by placing a small plug of cotton wool (approx. one third of cotton ball) soaked in 30% sugar solution inside of each container

      OR

      Smear light coloured jam inside the pot.

   c. Only fresh baits are to be used to ensure consistent attractiveness to foraging ants.

Bait pot placement is to be implemented as follows:

- Bait pots need only be laid in areas of favoured ant habitat. Where there is no favourable ant habitat in a 15 m × 15 m grid, no baits need be placed;
- Where favourable ant habitat is found, at least one protein-based and one sugar-based bait pot must be placed in the 15 m x 15 m grid;
- The bait pots are to be placed 10 m apart where possible. A minimum of 1m between bait pots must be met at all times. Spacing between protein and sugar bait pots should be at least 1m apart.
- All bait pots laid must be able to be traced back to place of location, in case of an exotic ant detection where the area needs to be investigated;

Environmental conditions

- Both visual and attractant bait surveillance can only be conducted when the air temperature is consistently at mid 20oC and below 36 C (measured in a sheltered and shady position) with little or no wind.
- Bait pots shall be placed in the shade where practicable. Surveillance should not occur during or after rain while the sealed surface is still wet. Also no rain should occur between placement of bait traps and their retrieval.
- Bait pots must be collected at or close to 1/2 hour following placement to prevent baits drying out. However if large numbers are recruiting to baits, reduce the time the bait is exposed to the ants to 20min, 15min or 10min., or alternatively consider doubling quantity of bait in each pot.

Label Format for collected ant specimens

Site name, where collected, collector: initials and surname

Date collected: month spelt out and year in full

Solomon Islands
Henderson, Honiara
Mango tree trunk
M.A. Thomas
30 August 2011

Favoured Ant habitats

The list of favoured habitats is long and should serve as a check list to reinforce habitat preference principles.

1.	Tree trunks (visual inspection and bait at base if appropriate).
2.	Flowers.
3.	Shrubs and poles.
4.	Building edges and foundations.
5.	Hard seal (concrete/asphalt) slab edges.
6.	Cracked concrete/asphalt and junctions between pavers
7.	Disturbed sites.
8.	Drains and culverts.
9.	Electrical generators and fittings.
10.	Exposed rocks.
11.	Fence palings.
12.	Grass areas.
13.	Verges.
14.	Hot water pipes and heaters.
15.	Isolated weeds.
16.	Logs.
17.	Loose gravel.
18.	Low vegetation (including grass).
19.	Plant pot bases.
20.	Road margins.
21.	Rubbish piles.
22.	Shiny/corrugated surfaces.
23.	Soil.
24.	Tree crotches and hollows.
25.	Vertical surfaces.
26.	Weed and plant re-growth.
27.	Wooden structures.
28.	Underneath stones, concrete rubble, timber and debris

7.2 Ant Specimen Preparation Techniques for Identification

Prepared by: Disna Gunawardana, Plant Health and Environment Laboratory, Ministry of Agriculture and Forestry, Auckland, New Zealand and Eli Sarnat, University of California, Davis, USA.

For short term storage, ants can be placed in 70-75% ethyl alcohol. If ants are to be used in molecular tests, those specimens should be stored in 95% ethyl alcohol.

For detailed study and long-term storage, ants should be point-mounted on insect pins. Pointing allows specimens to be easily manipulated while being examined with a microscope and is essential for viewing fine details such as sculpturing and pilosity. In all cases, ants, even large species, should be placed on points and not directly pinned.

Pinning of specimens:

- Individual points can be either hand-cut from strips of stiff, white, acid-free paper, or punched with a specially designed hand-punch or purchased from Entomological suppliers.
- The glue used to attach ants to the points should be water-soluble to allow for later removal if needed.
- Stainless steel insect pins of size 3 can be used to hold the points.
- Individual ants should be glued to the tip of the point with just enough glue to hold them securely but not so much that the lateral or upper surfaces are obscured.
- Specimens should be mounted upright, horizontal and with the point extending from the ant's right side.
- Place the ant at the very tip of the point with the point covering the first segment of the middle and hind legs nearest the body.
- Try to (very) gently pull the legs downward so that the outer surface of the body can be seen in side view.

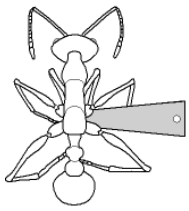

Fig.1: Top view of an ant mounted on a triangular point

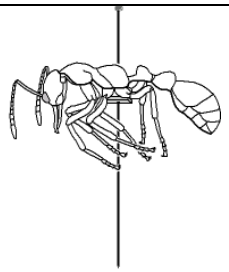

Fig.2: Side view of an ant mounted on a triangular point

(Figures taken from: Shattuck, S.O. 1999. Australian ants: Their biology and identification. Monographs on Invertebrate Taxonomy. p17)

Labelling

Once the specimens are properly mounted, the final step is to add labels. Labels should be the standard type used in entomology 12mmX 8mm.

Label should include as a minimum;

Location (Country and nearest named place); Date; Collector's name

Additional information should be included if available such as: the latitude, longitude and elevation of the collection site, a brief description of the habitat.

New Zealand, AK, Mt Eden,
100mSW One Tree Hill
$37^{0}30'$S $144^{0}13'$E, On apple leaves
21 Mar 2007
S.H.Anthony

Fig.3.Locality label-placed below the ant on the same pin.

FORMICIDAE

Nylanderia sp.

Det. J. Brown 2007

Fig. 4. Determination label– placed below the locality label.

References:

Shattuck, S.O. 1999. Australian Ants: Their biology and identification. Monographs on Invertebrate Taxonomy.Pp 226.

Walker, A.K. & Crosby, T. K., 1988. The preparation and curation of insects. DSIR Information Series 163. Wellington. Pp.91.

7.3 Bait and Toxin Information

Bait Preferred and Toxin Information Collected from "Review of the efficacy of baits used for ant control and eradication" (Stanley, 2004)

Scientific Name	Common Name	Attractant/bait matrix Preferred
Anoplolepis gracilipes	Yellow Crazy Ant	Protein-based. Bait matrix consisting of salt, sugar and yeast (marmite), and used coir (a waste product from the coconut-fibre industry) as the bait carrier, with animal fat used as the solvent for the toxin. The marmite (yeast) constituent of the bait matrix was highly attractive to A. gracilipes foragers (Haines & Haines 1979; Haines et al. 1993). Haines and Haines (1979) found A. gracilipes preferred solid protein baits rather than solid sugary baits. Sweet liquid bait formulations were almost as effective in the field as solid protein baits, but solid baits were more practical for large-scale applications
Monomorium floricola	Biocoloured Trailing Ant	Baits containing protein or oil based attractants are recommended (peanut oil shown to be highly attractive)
Pheidola megacephala	African Big Headed Ant	Tinned cat food or tuna were very effective baits for monitoring *P. megacephala* activity in an eradication programme in Australia Field trials in Malaysia found peanut butter (80% of ants) was strongly preferred over honey (20% ants) by *Pheidole sp.*
Tapinoma melanocephalum	Ghost Ant	Food presented in order of attractiveness: honey (60% ants) peanut butter (40% ants)
Wasmannia auropunctata	Little Fire Ant	Food presented in order of attractiveness to foragers: peanut butter honey honey water pineapple juice tuna oil dark karo syrup mint jelly light karo syrup soy bean oil orange juice molasses apple juice coca cola syrup Oil presented in order of attractiveness: soybean

Scientific Name	Common Name	Attractant/bait matrix Preferred
		tuna sunflower peanut safflower cod-liver