Big-headed ant control roll-out on St Helena

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St Helena National Trust









DPLUS104

Conserving St Helena's endemic invertebrates through invasive invertebrate control

Introduction

St Helena has over 420 endemic invertebrates in both endemic (e.g. Cloud Forest, Horse Point) and non-endemic habitats. Invasive ants are likely to have a devastating effect on the fauna as there are no indigenous species of ants on the island, therefore the endemic invertebrates evolved without having to cope with these highly efficient social predators (Key et. al 2021).

A number of invasive ant species build their nests in micro-habitats that are important to the endemic invertebrates, in particular in standing and fallen dead wood, in forest and in scrub, and also under stones and amongst plant litter in dry places. They then eliminate the existing endemic invertebrate fauna (Key, Fowler, Pryce 2021).

The Big-headed ant *Pheidole megacephala* (BH ant) is the most abundant invasive ant species on the island, it is found island-wide, including on endemic gumwood trees, which is likely to damage the trees and decrease the number of endemic invertebrates on site. They prey on any living or dead invertebrates (including endemics) and can destroy habitats such as deadwood. St Helena has over 20 endemic restoration habitats, these sites are special to the island as they are most vulnerable to invasive species.

Eradicating the BH ant is not feasible as they are found island-wide and in inaccessible terrain and in a wide range of habitats. However, suppressing the Big-headed ants in accessible locations like Peak Dale gumwoods (an important invertebrate endemic site) is possible. St Helena has a huge abundance of endemic invertebrates in different habitats (endemic and non-endemic) therefore disseminating the poison directly on the ground is not practical, as this might cause harm to the endemic fauna. Therefore, bait stations and other measures are being used to mitigate impacts. This is the first attempt to reduce numbers of the BH ant on St Helena and this document explores methods for mitigation.

This BH ant control will also act as a test that can be implemented if the population booms in the future that needs to be controlled – as seen on other islands such as the Seychelles.

Poison information

The product used to suppress the ants on the endemic sites was Maxforce. The active ingredient in the poison is Hydramethylnon, which:
(1) is well known and is an effective treatment for the BH ant;
(2) is a slow –acting toxicant that the BH ants will take the bait back to the nest and share it with the queen and the rest of the colony;
(3) is unlikely to contaminate groundwater because it does not dissolve in water and will bind to the soil;
(4) will breakdown rapidly in environmental conditions to less harmful metabolites (Ref Hydramethylnon general fact sheet).
(5) The ingredient used as an attractant is unknown, however it is advertised as being used to control the BH ant. Maxforce is a granulate substance.

Habitat

The roll-out has been conducted at four sites with endemic flora, e.g. Gumwood trees (*Commidendrum robustum*), Rosemary (*Phylica polifolia*) and Ebony (*Trochetiopsis ebenus)*. These sites were chosen because of high abundance of the target species (BH ant) and based on understanding gained from the trial phase it is unlikely there would be any impacts on the endemic fauna and flora. See the roll-out site section, below for further details of the chosen sites.

The sites were smaller in size from the previous trial phase to minimize the impacts on the environment and due to these being restoration sites and so being fenced off, which could have had an effect on the ants recolonizing due to the sites being long and thin.

Roll-out sites

Barren Ground (205882, 8231213)

Description: Barren ground is a restoration site located on the North-west on the island. It is easily accessible via the main road and steeply sloped within a forestry area. The size of the site is 816 square meters and is fenced off.

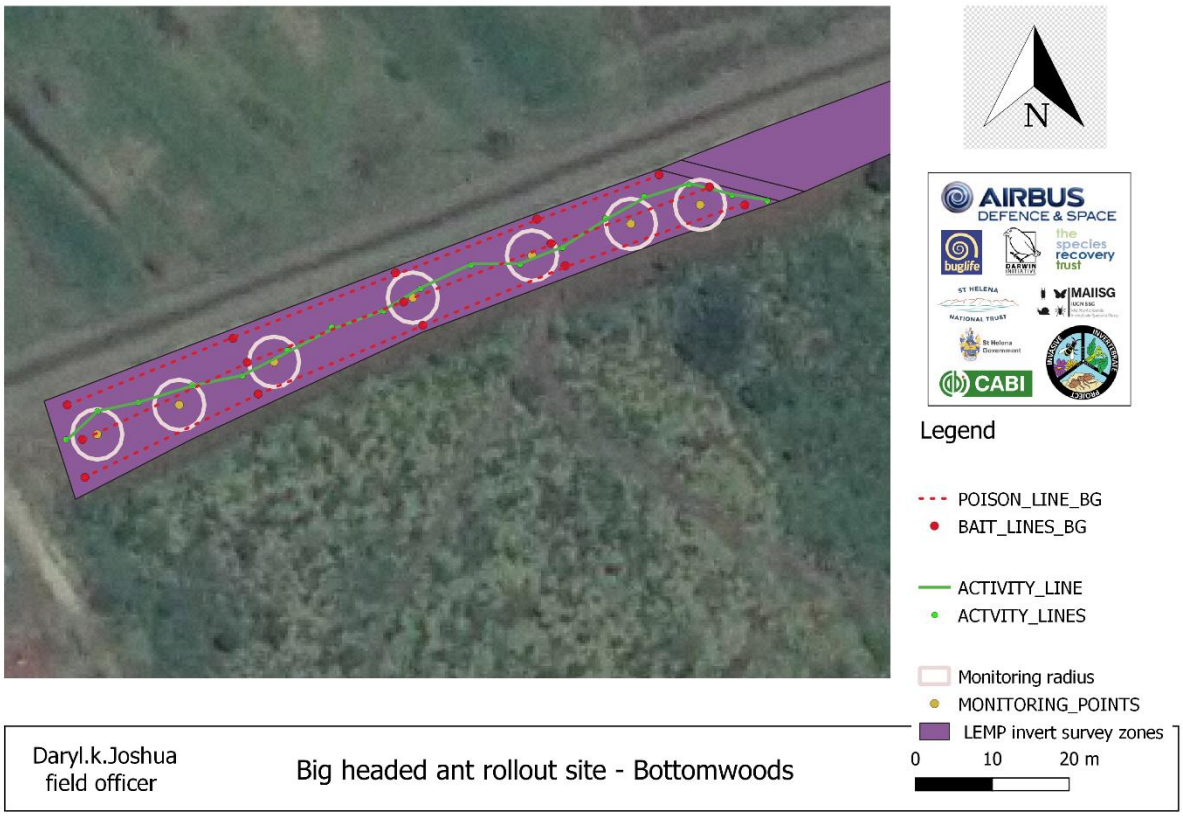
Ecology: Barren ground is populated with endemic St helena flora, Rosemary trees (*Phylica polifolia*) and Gumwood trees (*Commidendrum robustum*). There was a high abundance of the target species and a low impact of control on non-target endemic invertebrates. The grass was cut on the site just before our control work started, plants that were cut including Blue weed (*Ageratum conyzoides*) and Everlasting flowers (*Xerochrysum bracteatum*). The cut area covered approximately 60% of the site.



Bottom Woods (214089, 8235065)

Description: Bottom woods is a LEMP restoration site on the eastern-side of the island. It is easily accessible via main road and is a flatland area. The size of the site was 2100 square meters.

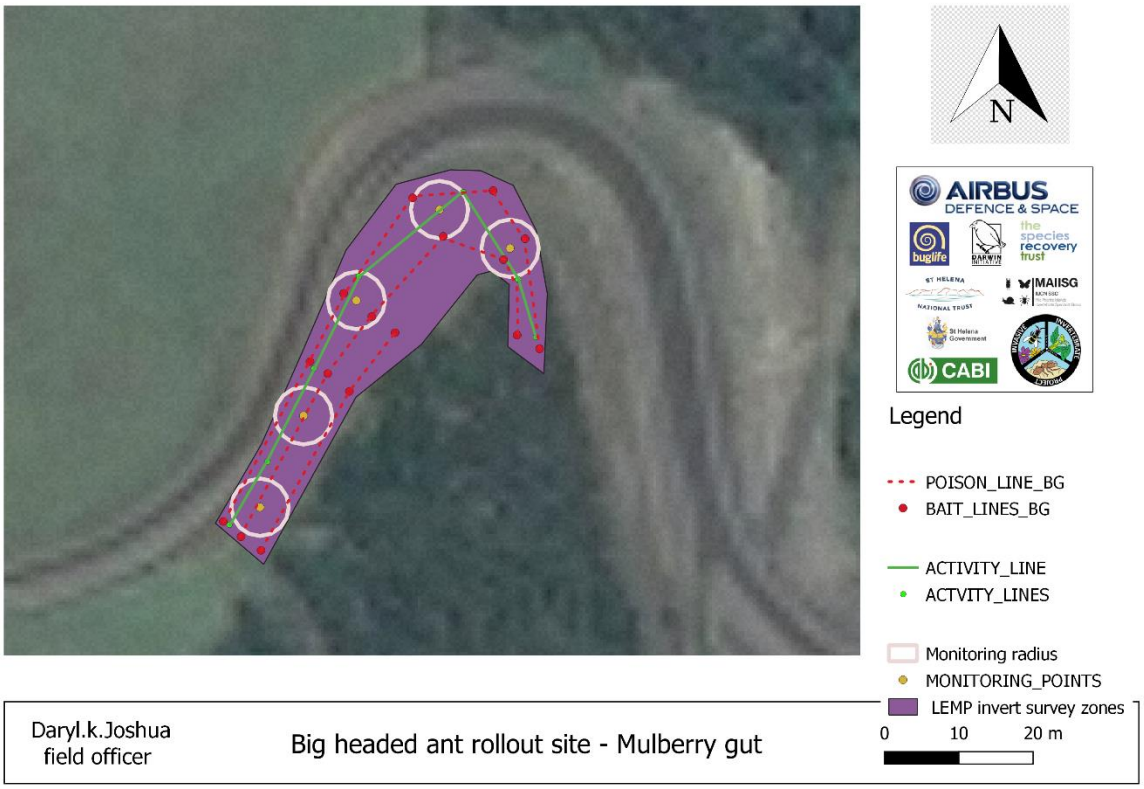
Ecology: This site is dominated with Gumwood trees (*Commidendrum robustum)*, Dwarf ebony (*Trochetiopsis ebenus)* and a few Rosemary trees (*Phylica polifolia*). There was a high abundance of BH ants the target species.



Mulberry Gut (212582, 8235506)

Description: Mulberry gut is a LEMP restoration site on the Eastern-side of the island and is easily accessible via main road. This site was fenced off to 1228 square meters and is an unusual shape as it is alongside a road bend.

Ecology: It is densely populated with endemic Gumwood trees (*Commidendrum robustum)* and Rosemary (*Phylica polifolia)*, this site is close to a roadside with fenced off farmland adjusted on the other side of the road and signs were in place for the public. There was a high abundance of the BH ants the target species.



Longwood Farm (213299, 8235353)

Description: Longwood farm was the non-treatment site, it is also a LEMP restoration site on the eastern-side of the island. The size of this site was 1176 square meters.

Ecology: This site is densely populated with Gumwood trees (*Commidendrum robustum)* and Dwarf ebony (*Trochetiopsis ebenus)*. There was a high abundance of the BH ants the target species.



Scooping phase

Monitoring the BH ant activity

As learnt from the previous trials the BH ant was attracted to tinned tuna, therefore this was also used to monitor the BH ant activity during the roll-out phase. The activity was monitored using vials baited with tin tuna, set out in line with 2 meters between each tube and, these were left out for 2 hours. Then the ants at each tube were counted. It was recommended to change the time to put out the lures from the trials, instead of 10am to 2pm, they were only left out for 2 hours. This was because the tuna was drying up due to the hot weather and it also reduced the likelihood that the rodents would take them.

Non-target invertebrate risk assessment

The non-target invertebrate surveys pre-treatment analysis together with historic invertebrate records for the Species lists, to give an idea of what endemic and other non-target invertebrate fauna may occur on site. Then an expert invertebrate panel assessed the risk of applying poison bait in bait stations might have on the non-target endemic invertebrate species that might be present on each site.

Benefit survey – assessment of possible risks and beneficial effects on numbers of non-target invertebrates

To make sure there was minimum to no impact on the other non-target invertebrates and to assess whether the removal of BH ants had beneficial impacts on the endemic invertebrate fauna, a general targeted survey was developed to monitor Hemiptera, as from the trials showed potential positive impacts after the BH ant numbers reduced and they are top prey items for the BH ants.

Sweep netting and beating was methods used on the foliage and sieving the leaflitter were used to monitor Hemiptera and data was analysis for the population change.

The survey data was also used to understand if the removal/reduction of the ants had a beneficial impact on other endemic invertebrate species on the sites.

Monitoring timeline

All of the BH ant activity, non-target survey and beneficial impact assessment on invertebrate monitoring took place one week before the bait stations were deployed and on the same day the bait stations were picked up, then two, four and eight weeks after the poison was placed. This allowed to determine if the BH ant numbers had declined and to understand the impact on the invertebrate populations in the surrounding area.

Treatment phase

To protect St Helena's endemic flora and fauna the ant poison was placed into homemade bait traps, these were 30cm length of irrigation pipe that were plugged of at both ends with dowels and taped with 3mm diameter holes (to only allow ant access) drilled into the pipe and placed out on site for one week, each containing 1 tbsp (10g) of poison bait (diagram B).



Diagram A – Ant station

The roll out phase started on 26th October 2022, starting with an assessment of ant activity and invertebrate non-target/beneficial impact survey was conducted on all sites. The baits were deployed between 2nd to 4th November 2022 and left out for one week and picked up between 9th to 11th November 2022.

General observations post treatment

- Recommended for next time creating a buffer zone outside the immediate zone to stop ant colonies from integrating back into the zone after poison. It has also been suggested to use of wasabi to deflect the ants from the site but trials on this would need to be conducted first.
- There was less BH ant activity on the vegetation and under stones after the poison was deployed
- The poison should be set out for a longer period e.g. 2 weeks and the survey should be carried out for more than 8 weeks to see if ants are recolonizing
- It was observed while conducting the surveys that the BH ant was preying on the Gumwood leafhopper

Results

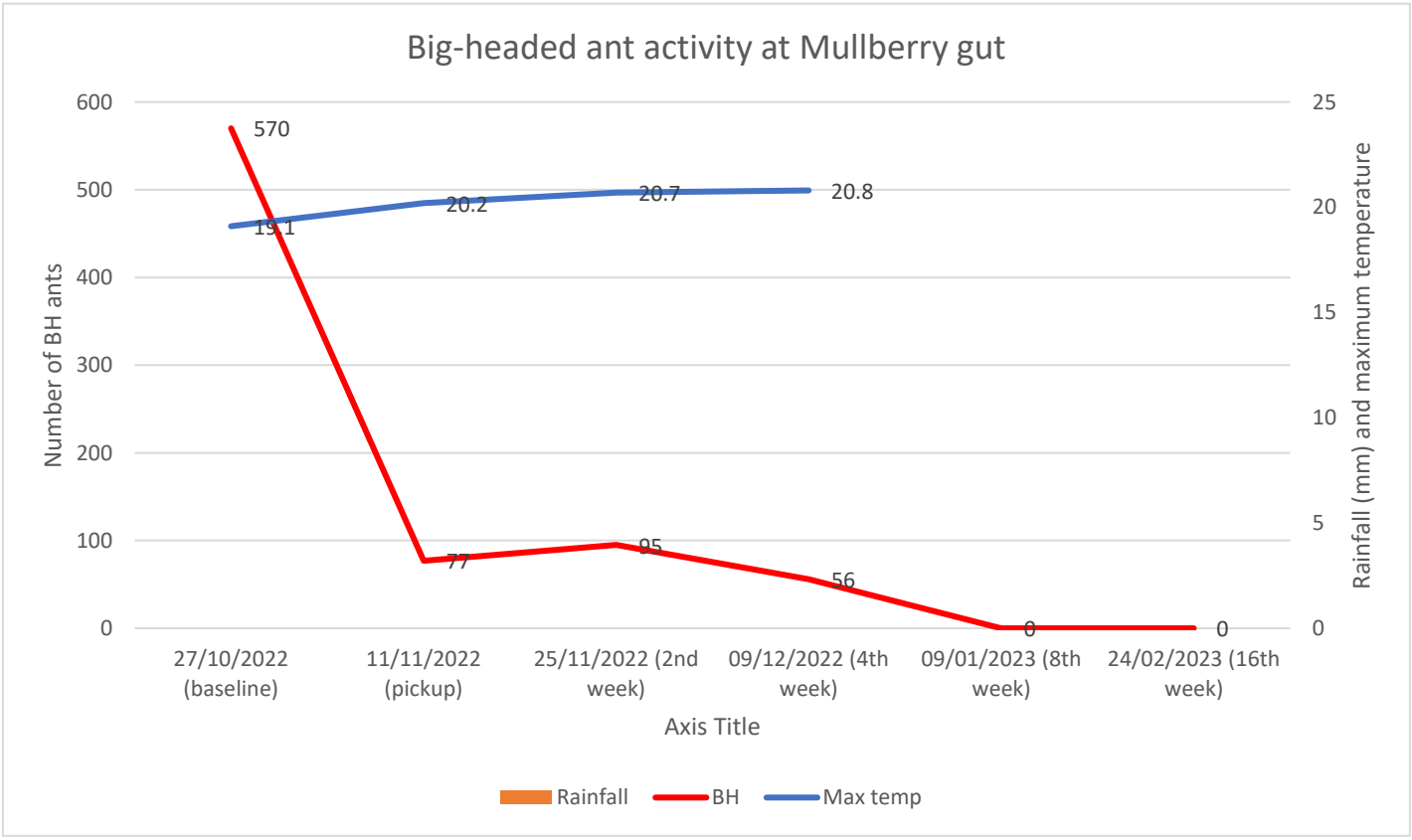
Mulberry gut

As shown in Graph A below, during the baseline survey before the poison was placed into the environment, 570 individual BH ants were recorded, this decreased by 86% to only 77 individuals after the poison was removed from site. They then increased to 95 individuals by 23% but decreased to 0 by the 8th week. There was no other species of ants found on site throughout the roll-out phase.

From the beneficial survey (Graph B) the abundance of BH ants on the vegetation decreased rapidly after the poison was deployed. The number of non-target species stayed relatively steady throughout the survey, however there was an increase in Leafhoppers (*Cicadellidae*) at the end of the survey, but there was no increase at the null treatment site. The only endemic invertebrate found on site (table 1) was the leafhopper *Sanctahelenia decellei*. The baseline survey to the 8th week showed this species increased to 22 by 46%, which could be due to decline in ants as the increases was in parallel with ants decline, but it could also be due to seasonality and weather conditions. Throughout the roll-out phase there was no rainfall and the temperature were average.

An additional survey was conducted on the 16th week and no BH ants were found, which shows they may have been eradicated from this site.

Graph A: BH ant activity at Mulberry gut



graph B: Beneficial survey at Mulberry gut

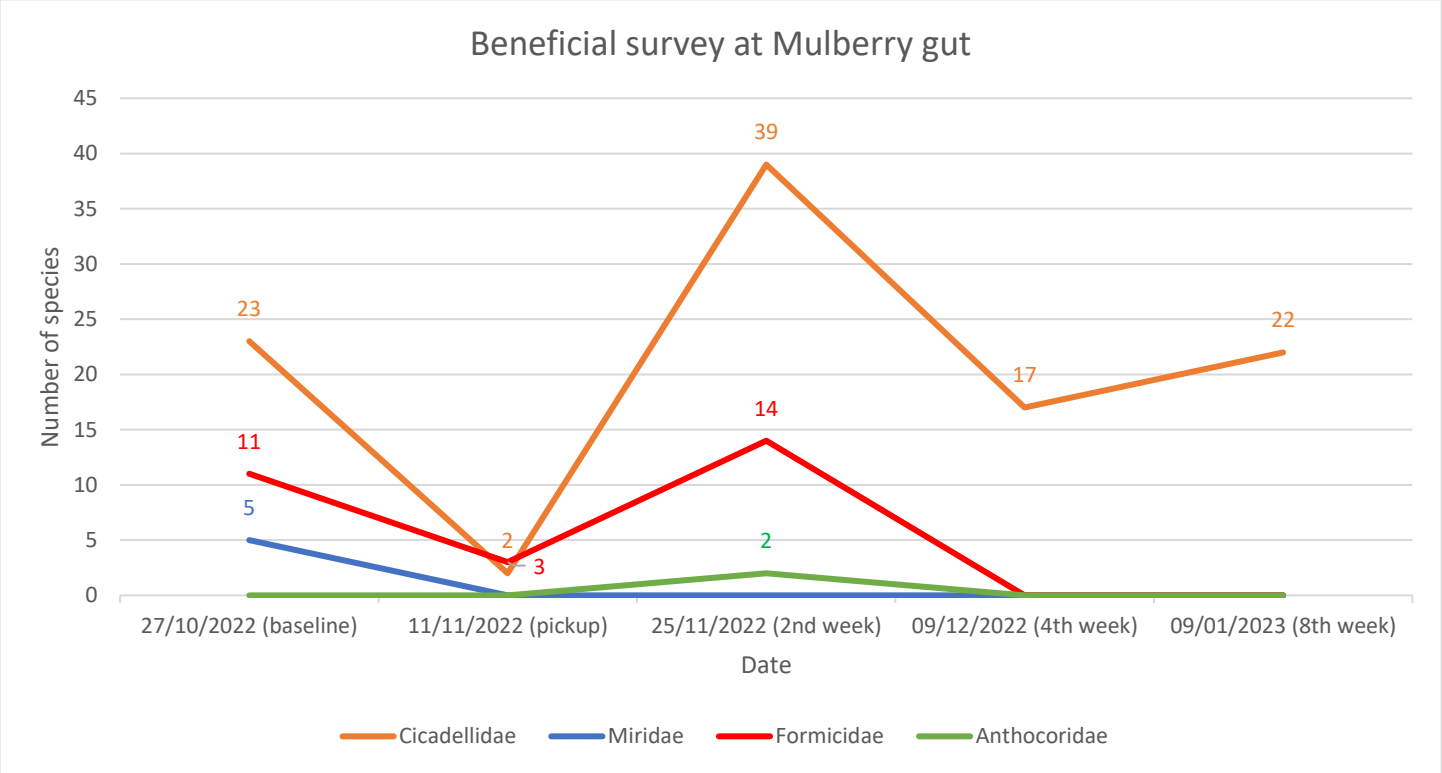


Table 1: Endemic invertebrates at Mulberry gut

Mullberry gut	Baseline	Pickup	2nd week	4th week	8th week
Sanctahelenia decellei	3	1	8	17	17

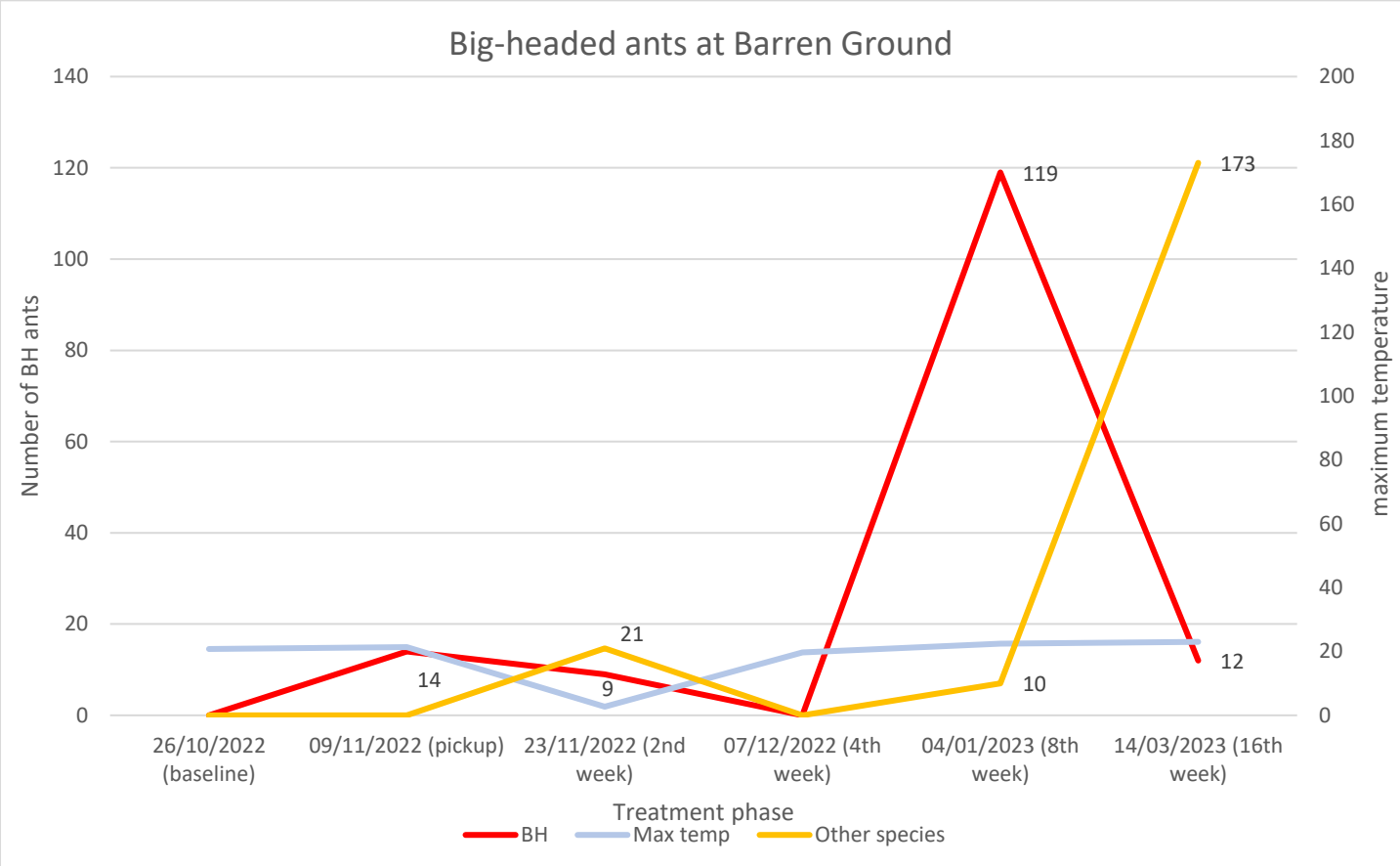
Barren ground

On Graph C below, the baseline for this site recorded no BH ants in the lures however they were observed amongst the vegetation. Before the poison was placed on site, the vegetation had been cut which disturbed the ants using the flowering vegetation, the toxin was applied but had no effect on them as they recolonized by the 8th week. Therefore, cutting obviously impacts the BH ant numbers and behavior and so should be avoided before control work. The other species of ants found on site was *Plagiolepis alluaudi* but a low abundance.

From the table 2 shown below, the only endemic invertebrate found at Barren ground was another leafhopper the undescribed Ghost hopper was found on the Rosemary and Gumwood trees, which increased by 20%. Again, this could reflect the reduction of BH ants on the vegetation or other factors. There was a small abundance of another ant the Little yellow ant *Plagiolepis alluaudi* on this site.

An additional survey was conducted on the 16th week and there was in population of BH ants however, the population of other species had increased; *Plagiolepis alluaudi* and *Nylanderia bourbonica.*

Graph C: BH ants at Barren ground



Graph D: Beneficial survey at Barren ground

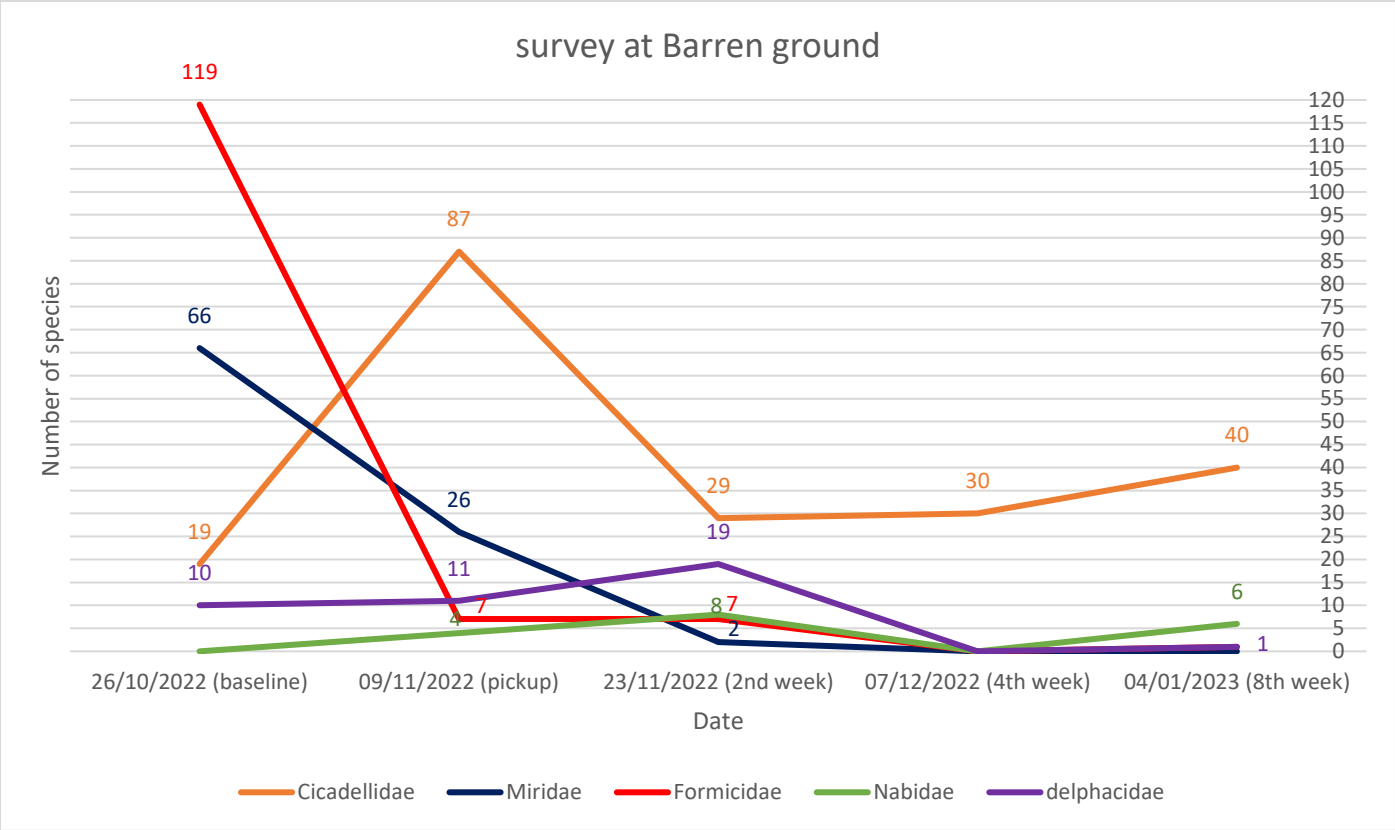


Table 2: Endemic invertebrates found on Barren ground

Barren ground	Baseline	Pickup	2nd week	4th week	8th week
Ghost hopper	0	4	10	26	12

Bottom woods

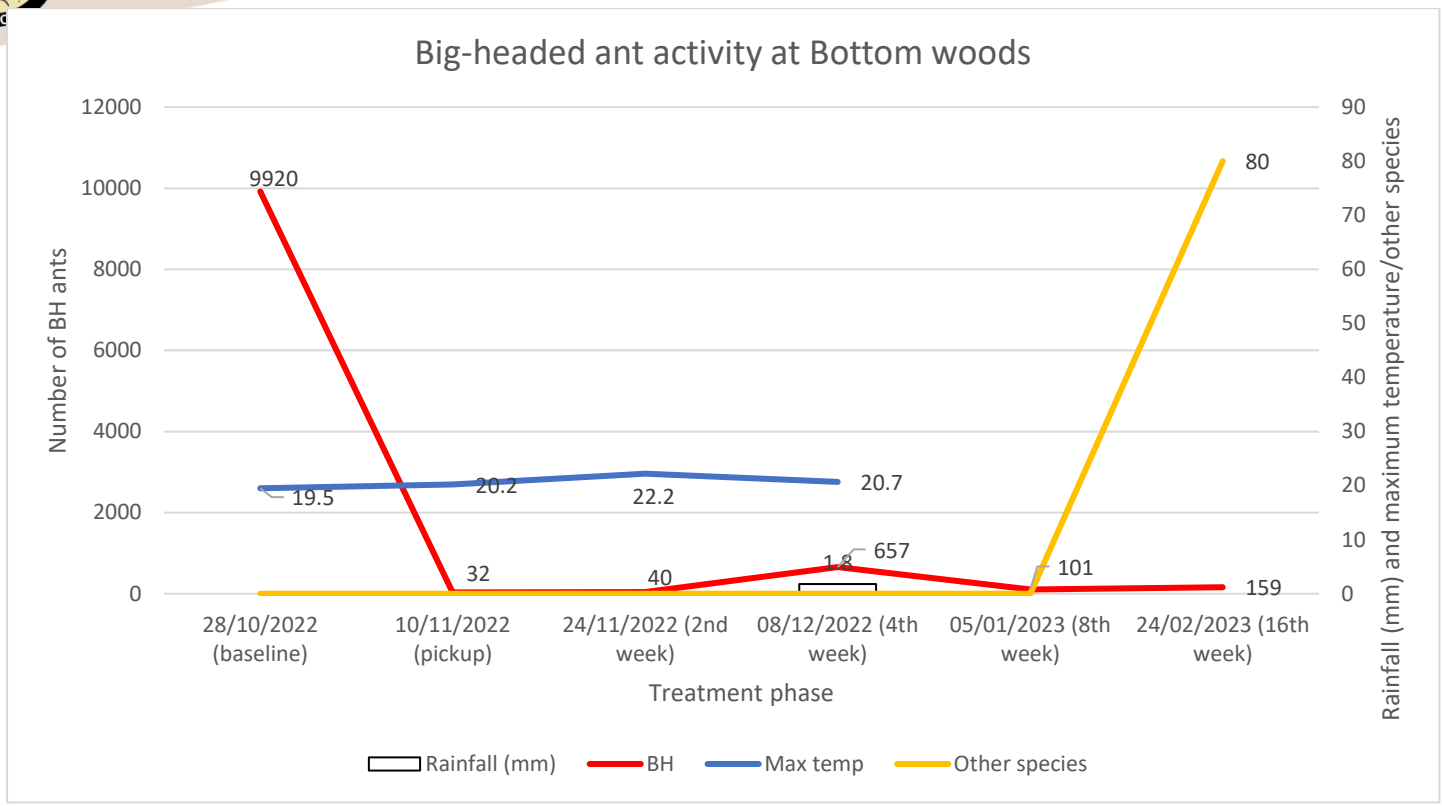
Graph E shows results from Bottom woods had a high abundance of BH ants at 9920 individuals when carrying out the baseline survey, one week before the poison was applied, this included recording on the vegetation. After the poison was set, the numbers decreased rapidly by 99% with only 32 individual BH ants recorded at week 0. However, it did start to increase by the 4th week to 657 individuals but by the 8th week it had decreased again to 101 individuals.

The beneficial impact survey showed that the BH ant on vegetation and in leaf litter had also decreased rapidly by the 8th week, see graph F. The abundance of benefiting invertebrates had a steady increase throughout the roll-out phase, particularly the leafhoppers, which peaked at week four. Again, it is possible this could have been due to a decline in BH ant activity, as this increase was not as clear at the null treatment site. Six individuals of the little yellow ant (*Plagiolepis alluaudi)* was found in leaflitter at the bottom of the site before the poison was set, however no more was found after poison was placed.

The endemic invertebrates (table 3) found at Bottom woods was the common Gumwood leafhopper *Sanctahelenia decelli,* Melliss's tumbling flower beetle *Glipostenoda mellissiana* and St Helena seed bug *Nysius sanctahelenae.* The *Sanctahelenia decelli* increased from the beginning of the roll-out phase to the 8th week but this could be due to reduced predation from ants due to suppression or due to weather or seasonality – similar to results seen with other leafhoppers. The other two endemic species were only recorded after the ants hadn't been seen on site for a number of weeks.

There was an additional survey conducted at the 16th week to see if the ants had recolonized, 80 individual Little yellow ants (*Plagiolepis alluaudi*) were found in the activity assessment and 159 individual BH ants. This suggests that the BH ants have moved back to the site, but at lower numbers and the Little yellow ant has also colonized as they weren't recorded in the original baseline survey.

Graph E: BH ants found at Bottom woods



Graph F: Beneficial survey at Bottomwoods

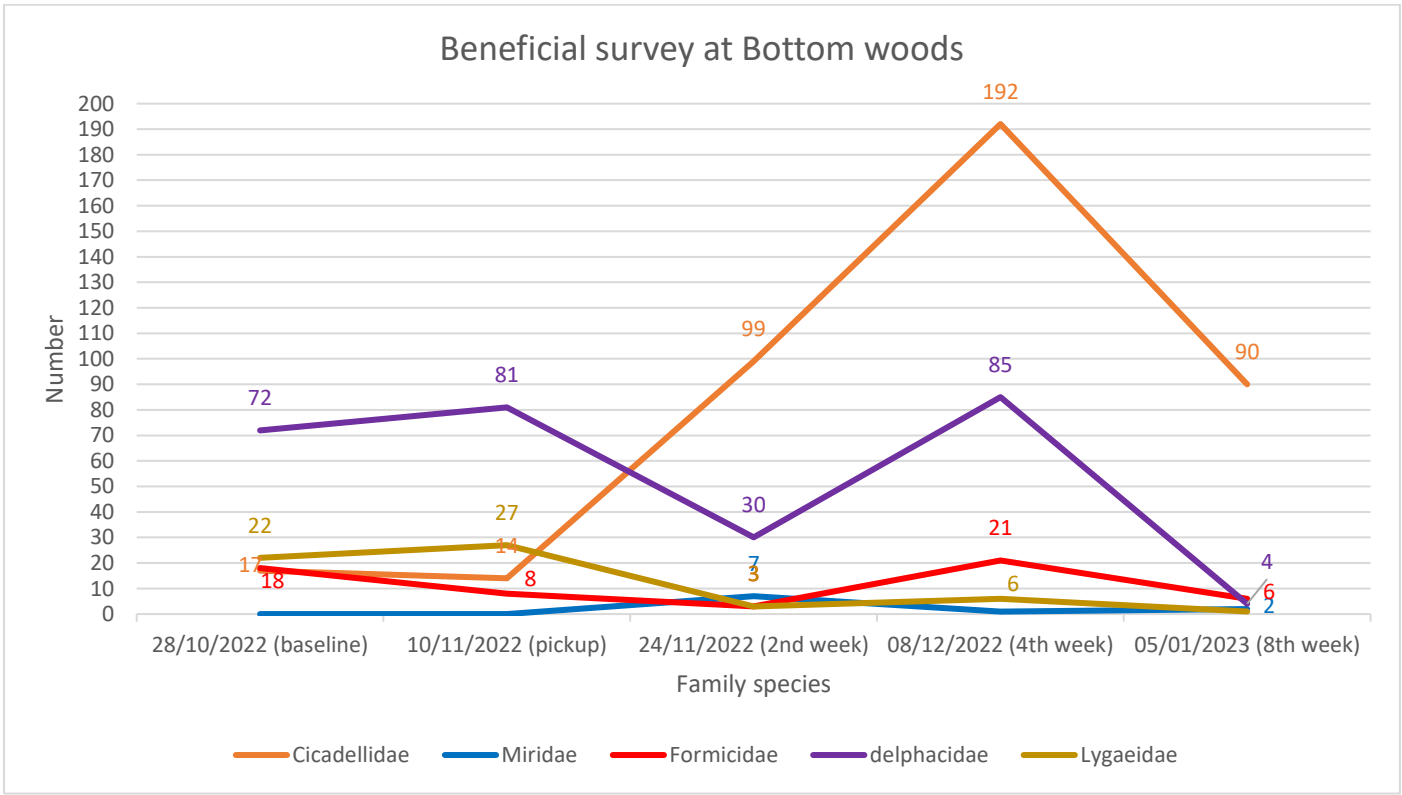


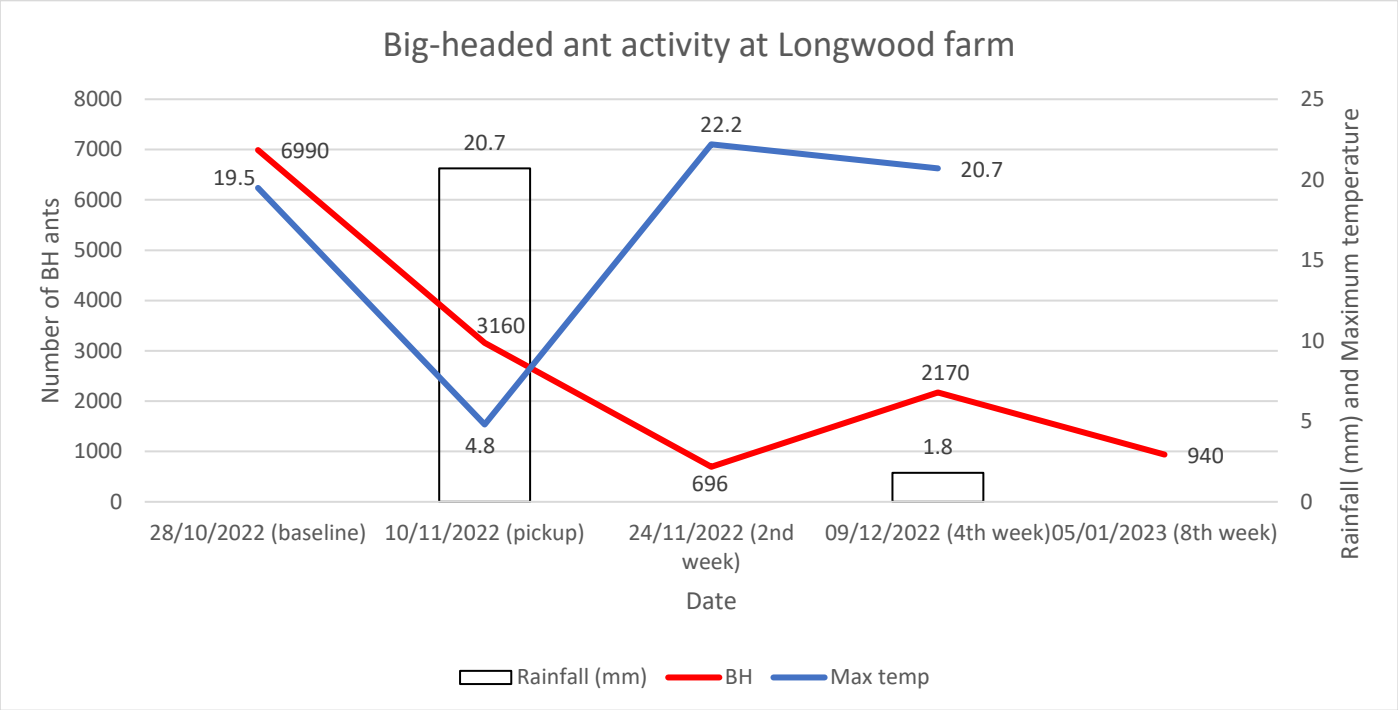
Table 3: Endemic invertebrates found Bottomwoods

Bottom woods	Baseline	Pickup	2nd week	4th week	8th week
Sanctahelenia decellei (Gumwood leafhopper)	12	10	66	31	36
Glipostenoda mellissiana (Melliss's tumbling flower beetle)	0	0	0	0	1
Nysius sanctaehelenae (St Helena seed bug)	0	0	0	1	1

Longwood farm

Longwood farm was the null treatment site. There was a decrease in the abundance of BH ants after the 2nd week after the poison was picked up (Graph G), however this could be due to the low temperature and high rainfall, however it still by far had the highest BHA numbers compared with the treated sites. The endemic invertebrates that was found on site was the Gumwood leafhopper *Sanctahelenia decelli* and St Helena seed bug *Nysius sanctaehelenae* (Table 4). It is worth noting that the *Sanctahelenia decelli* numbers on the null treatment site did fluctuate but stayed roughly the same compared with the treatment sites.

graph G:BH ant activity at Longwood farm



Graph H: Beneficial survey at Longwood farm

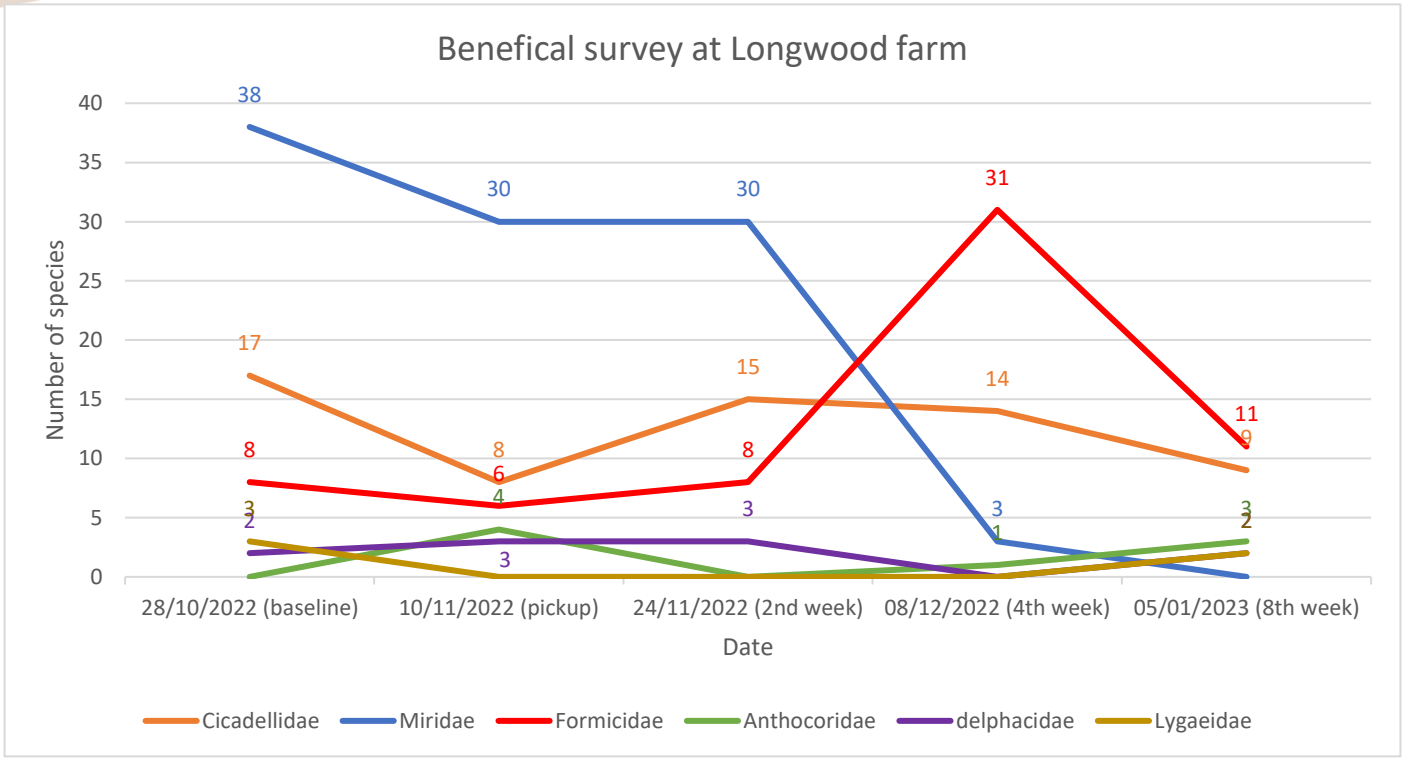


Table 4: Endemic invertebrates at Longwood farm

Longwood farm	Baseline	Pickup	2nd week	4th week	8th week
Sanctahelenia decellei	9	7	15	14	9
Nysius sanctaehelenae	2	0	0	0	0

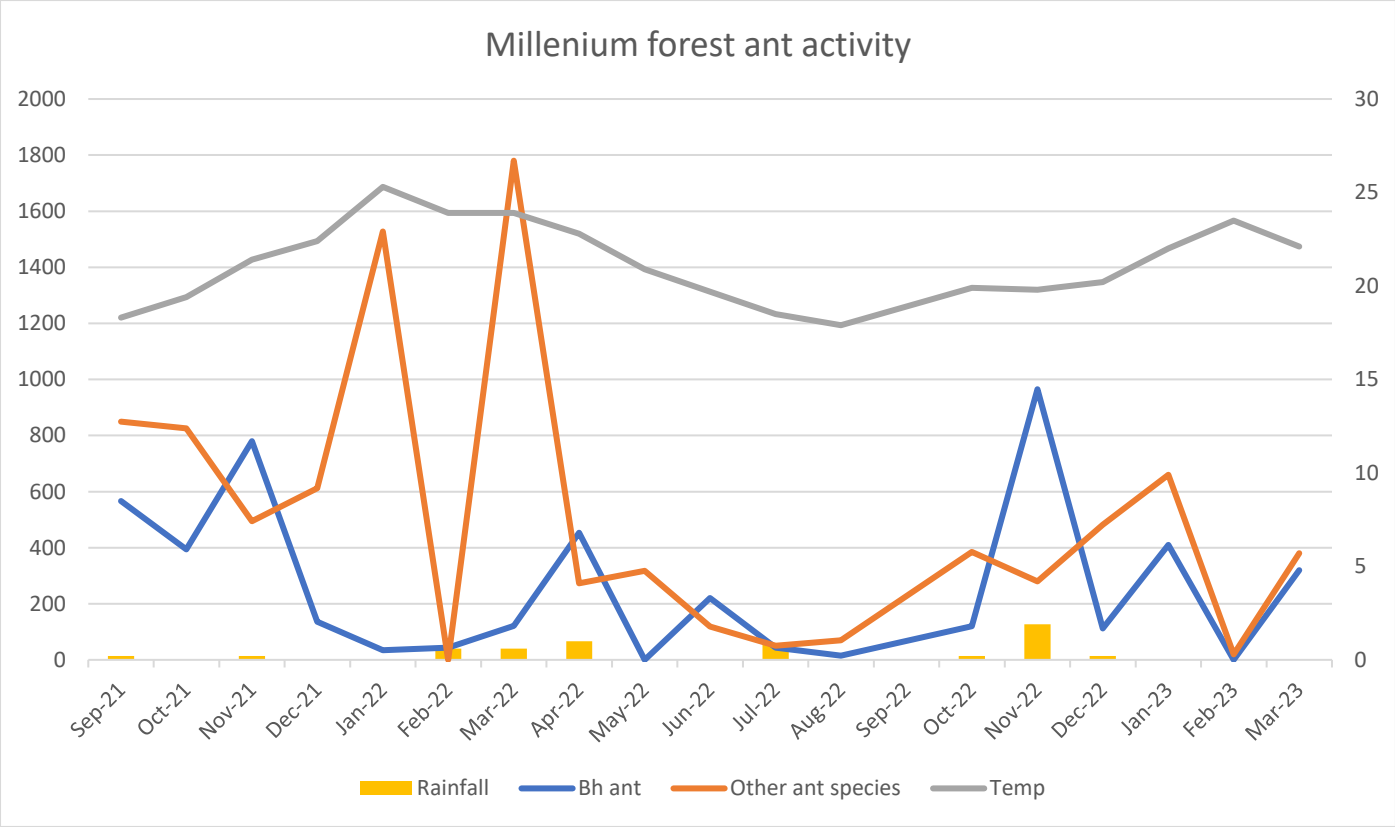
Millennium forest:

The Millennium Forest was used to determine the seasonal activity of the BH ant through monthly activity assessments from September 2021 to March 2023. The results showed that the BH ant abundance was highest in November 2022 and lowest in May 2022 (graph 8). This graph can be used to target when poison should be applied, however further monitoring is needed to understand annual fluctuations in BH ant numbers.

The graph shows that the BH ants are not affected by the rainfall as the abundance was still high during the rainfall.

Other species of ants included *Nylanderia bourbonica* and *Plagiolepis alluaudi,* these species were active all through the year and weren't affected by the rainfall and temperature.

Graph I: Ant activity at Millennium forest

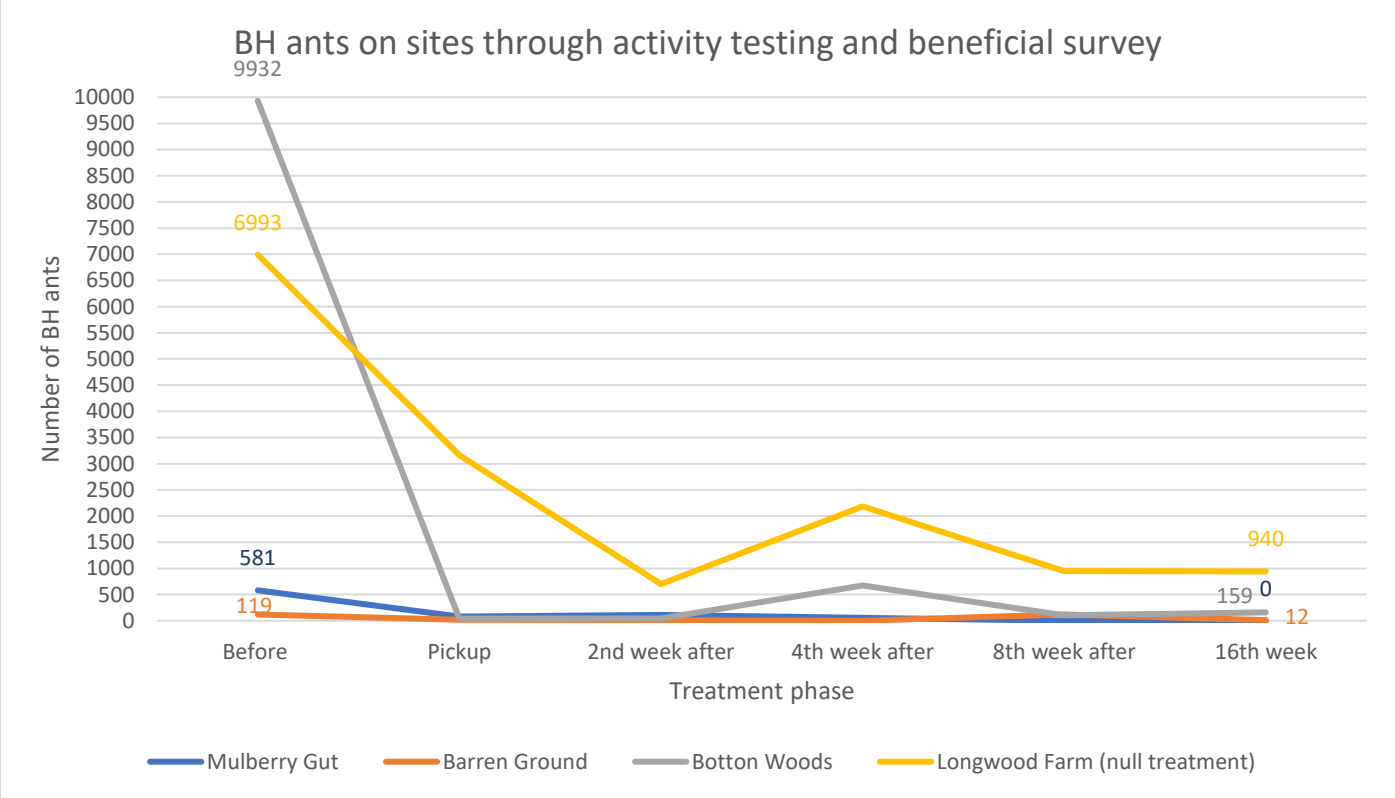


Conclusion

Throughout the roll-out phase, the poison has been successful in suppressing the BH ant populations on endemic sites. The poison was most effective at Mulberry gut and Bottom woods as the ants declined rapidly after the poison was set, see graph J. Barren ground was unsuccessful in suppressing the BH ants, as they appeared to be disturbed by the cutting of vegetation and were attracted to the flowers rather than the tuna lures. Although there was a decline in BH ants on the null-treatment site, however graph J clearly shows that the poison took the ants to much lower level compared with the null-treatment site numbers. However, the control grid design on endemic sites needs to be adapted to stop re-invasion from adjacent habitats.

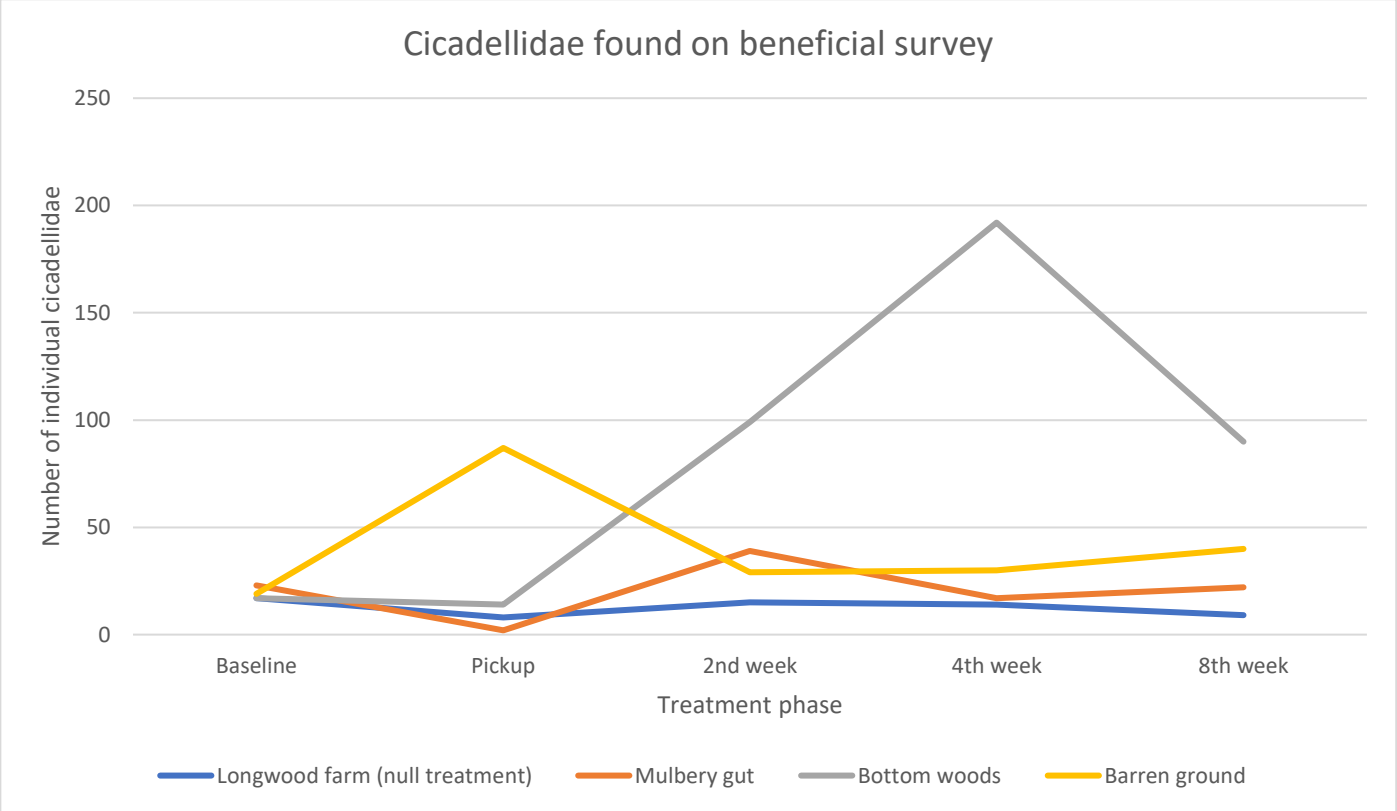
The monitoring site showed that the ants were more active during October-November before the poison was placed on the treatment sites.

See graph J below of the total of ant individuals from each site:



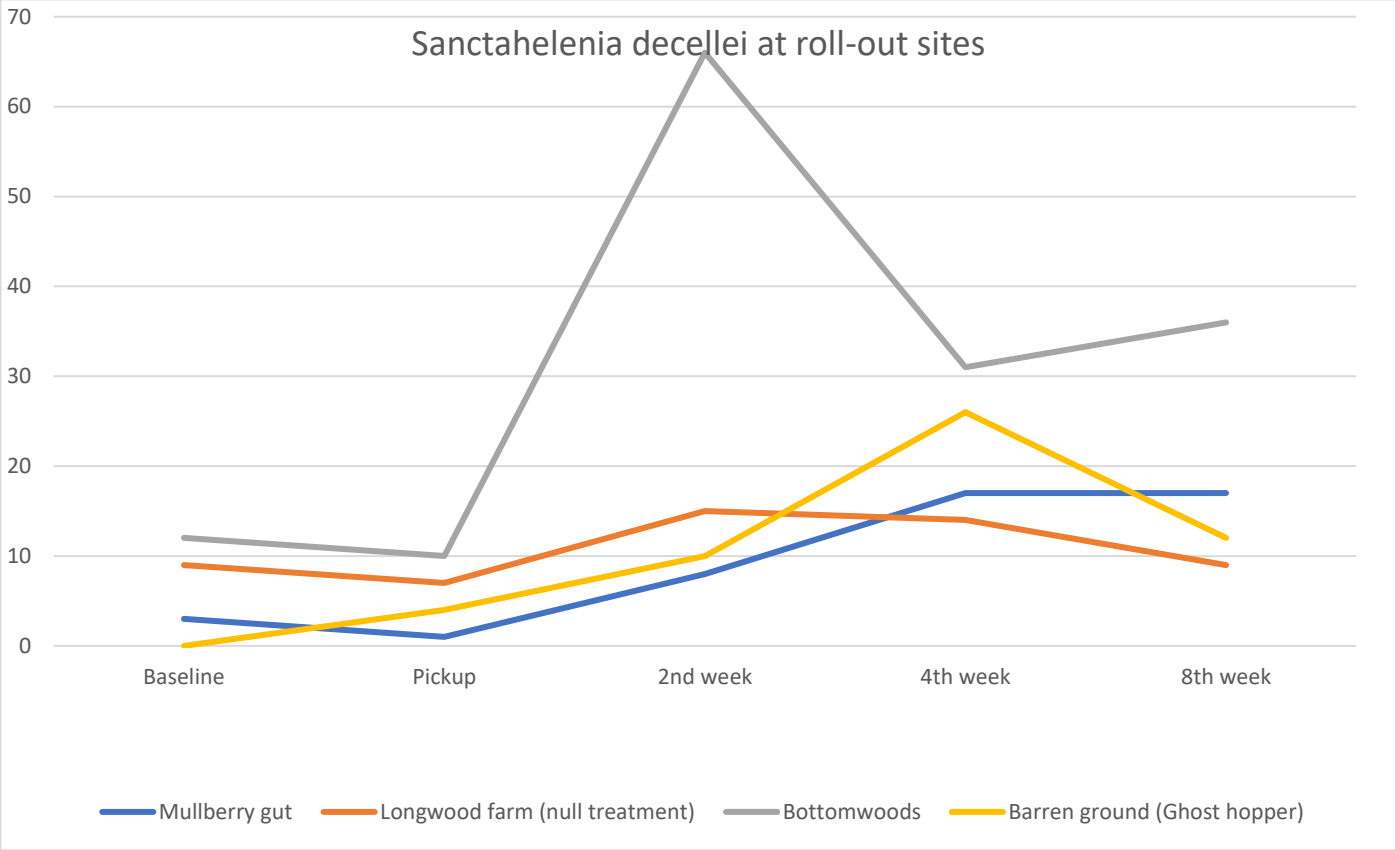
The poison had no discernable negative impact on the recorded endemic invertebrates on site. The endemic invertebrates that were found on the site was *Sanctahelenia decelli*, *Glipostendenoda mellissiana, Nysius sanctaehelenae, undescribed ghosthopper.* The abundance of endemic invertebrates did increase over the roll-out phase, this can most effective be seen in Graph K below, where the population did fluctuate, Cicadellidae (leafhopper) numbers were highest on the treatment numbers compared with the null treatment site. The most significance increase in leafhoppers was at Bottom woods, this was the site that had the highest number of BH ants pre-treatment and the most significant decline as a result of poison application.

Graph K: Cicadellidae found on vegetation from the survey



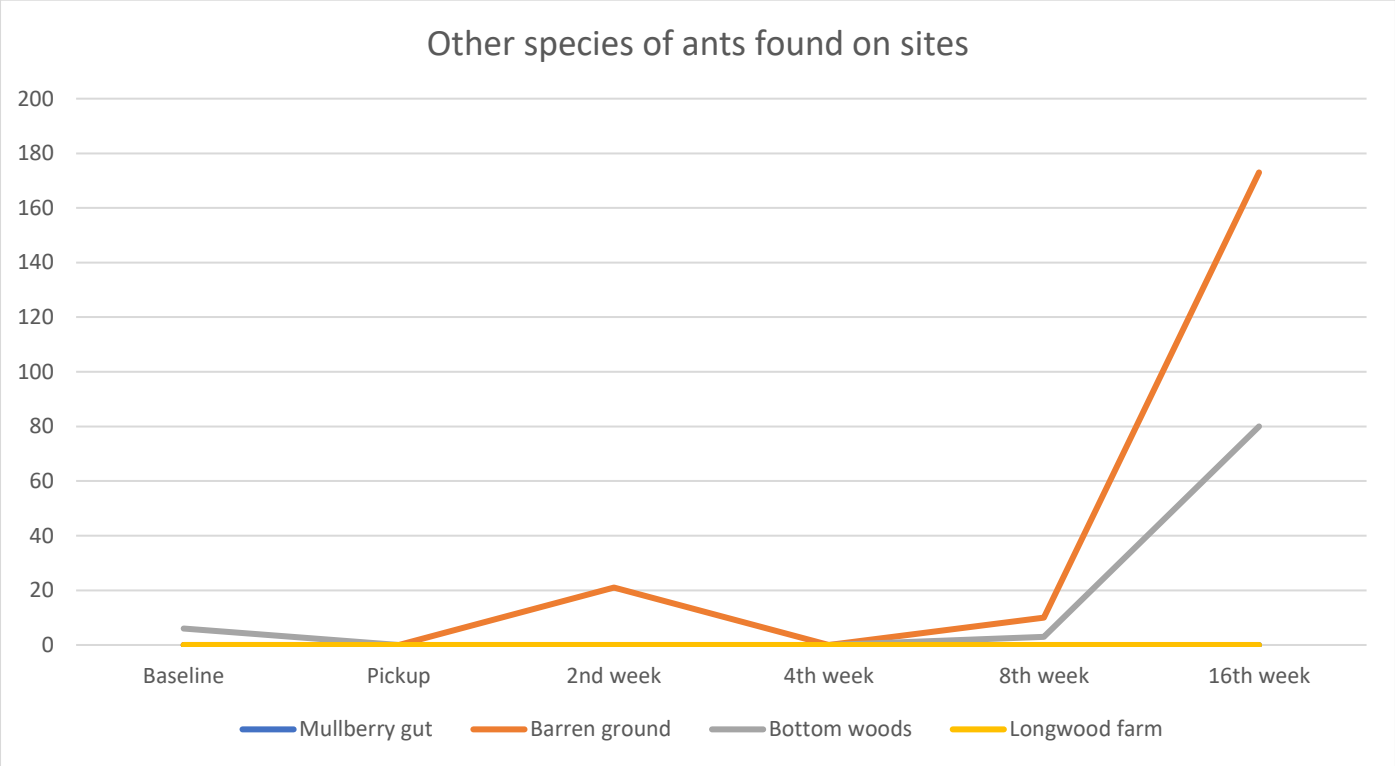
Sanctahelenia decelli was the most common endemic during the roll-out, as shown in graph L, whose abundance showed a steady increase on treatments sites in comparison with the null treatment site Longwood farm. Again, the most significant increase was at Bottom woods where the poison most reduced the BH ant numbers. These described changes could be from the decline of ants but also could be due to their seasonality or weather conditions. Further monitoring will need to be conducted to fully understand this relationship.

Graph L: *Sanctahelenia decellei* found on vegetation from the survey



The other species of ants that were observed at Bottomwoods and Barren ground, included *Nylanderia bourbonica* and *Plagiolepis alluaudi.* Graph M shows that the ant population increased rapidly after the poison was deployed on the 16th week. This could show they were affected by the poison however, returning back on site by the 16th week.

graph M showing other species of ants found on sites



Recommendation / limitations

When conducting the ant trials, it was suggested to use hanging bottles however, this method was trialed before the roll-out but there was no ant activity in the bottles and the vegetation was too dense, so vials and pipe traps stayed the same.

It was suggested to leave the tuna vials on site for only two hours instead of the whole day as the tuna was drying out and it limited the number of rodents from taking them.

The population of BH ants did significantly decrease after the poison was deployed however, they started to move back into the site by the 8th week. To reduce recolonization of the ants, a buffer zone would need to be conducted outside of the endemic sites to suppress the ants on site. This could be achieved by extending the treatment grid outside of the fenced endemic sites to create a buffer. There also needs to be more ongoing monitoring to understand the BH ant suppression, as well re-invasion on treated sites. To assess the effectiveness of the treatment in reducing the population density and prevalence of BH ants, it is recommended to monitor the activity and occurrence in study sites using a grid system covering the entire treatment area and buffer outside the site. The grid size depends on the size of the study area, this is to ensure the target ant movement is closely monitored within and outside the treated area. If no movement is detected between grids, it may indicate suppression of ant activity and low reproduction rate of the queen resulting to lower population density of the colony. Monitoring of post-treatment should be done in an interval of two months for the first years and quarterly for the following year.

Barren ground where the grass was cut during the treatment phase, this significantly changed the behavior of the BH ants and likely reduced the effectiveness of the treatment. Therefore, treatment activities should not be conducted around the timing of vegetation cutting or other habitat management.

From the monthly monitoring at Millennium forest, the results show that the best time for treatment is in November as this is when the BH ant abundance is at its highest.

Due to the topography of the island, the use of chemical control on bh ants may pose a risk of being washed out, especially during heavy rain which may cause contamination of water sources, waterways and bodies of water – this would particularly be an issue in the Cloud Forest. Therefore, it is recommended to source out the use of natural ingredients in repelling further encroachment of ant nest to a new area such as the use of wasabi extract and peppermint extract. A laboratory experiment showed promising results in repelling; however, field trials should also be conducted.

Rehabilitation of open and disturbed areas on the island will also contribute to reducing further encroachment of ant nest by regulating ground temperature, introducing different scents and volatile organic compounds which may break the dominance of the pheromones of invasive ant which are used as a form of communication for colonization, foraging and reproduction.

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