Situation report: Yellow crazy ants (*Anoplolepis gracilipes*) in Tuvalu 2024

Prepared for the Government of Tuvalu and the Food and Agriculture Organization of the United Nations (FAO), by Monica Gruber, Wellington, New Zealand for TCP/TUV/3901. June 2024, updated August 2024

Left to right: yellow crazy ant worker and queen; three workers; two workers, all from Northeast Arnhem Land, Northern Territory, Australia. Characteristic features of the workers include long slender bodies, long legs and antennae and large eyes. Images courtesy of Phil Lester (used with permission).

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1 Introduction

Anoplolepis gracilipes (yellow crazy ant or YCA) is one of the five ant species listed among 100 of the world's most damaging invasive species (Lowe et al. 2004) and is found in almost every country and territory in the Pacific islands' region (Gruber et al. 2017). Considering it's wide distribution, reports of impacts are relatively sparse, and in some countries, the ant is thought to have no negative effects.

However, the yellow crazy ant has several characteristics that contribute to sporadic major impacts. The ant is well-known for unpredictable, and sometimes repeated population explosions, occasionally followed by collapses (Abbott and Green 2007; Gruber et al. 2013; Cooling and Hoffmann 2015). Competition is the major population regulation mechanism among ant species, and the high numbers that YCA populations can attain allow them to outcompete other ants.

The abundance of the ant is often compounded by monopolization of carbohydrate resources, typically through *mutualisms* with plant pests. These mutually beneficial relationships in turn compound the abundance of both species. At high abundances these ants cause harm to people, infrastructure, agriculture, the economy, the environment and biodiversity (Gruber et al. 2022).

The ant is tolerant of a wide range of habitats (Wetterer 2005), and it is unlikely to decrease in distribution due to changes in climate (Bertelsmeier et al. 2015; Bertelsmeier et al. 2016). Like other invasive ants, the yellow crazy ant often only causes problems when there has been some disturbance to the natural balance of nature. Introductions of new invasive species, such as the mutualisms described earlier, are one example of such disturbance. Urbanization, forest clearing, and other types of land degradation are other examples.

The best management option, preventing arrival (through biosecurity), is likely only possible in the dwindling number of locations that the ant has not reached in the Pacific region. Eradication, that is the complete removal, of YCA and other ant populations has proven difficult, and often fails (Hoffmann et al. 2011; Hoffmann et al. 2016). Even when eradication of ants appears successful in the short-term, long-term monitoring and effective biosecurity are essential to ensure eradication is maintained (Gruber et al. 2016-).

There are no biological controls for any ant species. The primary means of control is through a range of chemical options, but many carry environmental risks (Gruber et al. 2016-). However, these options are constantly being improved. The recent interest in genomic approaches to invasive animal control shows some promise for ants (Allen 2021), including YCA, as does the use of viruses and other micro-organisms (Cooling et al. 2014; Cooling et al. 2017). However, these tools are still far from being operational.

The first report YCA from Tuvalu was in 1870 (Wetterer 2005), so the ant has been present for a very long time. Although the current distribution is not known for certain, it is likely to be in most, if not all, islands and atolls in the country.

In 2022, the then Prime Minister of Tuvalu Kausea Natano requested assistance from FAO to manage problems that were being caused by YCA, which was affecting food security. FAO initiated steps to respond to the problem. Although FAO records show the Prime Minister was referring to "red ants" Matio Lonalona, director of Agriculture, confirms that he was referring to YCA.

In response, FAO is implementing the project TCP/TUV/3901 *Improved food and nutrition security by reducing the spread of YCA in Tuvalu*. The project aims to assist Tuvalu through an assessment of the current YCA situation, strengthening capacities of key stakeholders in managing the high problem areas, and in establishing long term systems for sustainably managing the pest. It is expected this will strengthen capacities to prevent, contain and mange YCA from further spread among the islands in Tuvalu.

Although YCA is likely to be the primary ant species of concern in Tuvalu, concerns were raised about "red ants" and "tiny black ants" (the later in Nukufetau). In Funafuti, tropical fire ants (which are reddish in colour) have been observed in higher numbers than previously and are causing problems for people. One aim of the project is to confirm which species of ants are having problems around the country. This report sets a baseline for the work by:

- Summarizing activities to date on YCA management in Tuvalu.
- Describing the invasive ants present in Tuvalu and their current known distributions.
- Describing and ranking of priority sites in Tuvalu, based on reported impacts.
- Developing a program for visiting the priority islands.
- Summarizing issues and recommendations.

The planned next step is for in-country partners to visit the priority islands (and others if time, ferry schedules and funds allow), to scope the nature of the problem(s) in more detail, confirm the species of concern and identify or sample mutualistic plant pests for identification. This work will be supported by a guide for non-experts to assess YCA and other invasive ants.

2 Summary of previous surveys and interventions to manage YCA

2.1 YCA in Tuvalu: 1870-2014

There are no records of YCA causing problems in Tuvalu from their first report in 1870 (Wetterer 2005), to sometime shortly before 2014. Matio Lonalona reports that older people recall YCA being present for a long time, but not causing any problems.

In other places, yellow crazy ant abundance and population dynamics are driven by mutualisms with plants pests, which can be severe enough to transform the environment (O'Dowd et al. 2003). For example, on Christmas Island in the Indian Ocean, the arrival of a new scale insect was the stimulus for driving YCA population explosions (O'Dowd et al. 2003).

Perhaps, the arrival of new plant pests was the initial driver for YCA problems reported in the early 21st century in Tuvalu. However, in other cases, such as Tokelau, plant pests were not responsible for such population explosions, rather the YCA seemed to rapidly increase in abundance shortly after arrival, but after a lag period of unknown length (Gruber et al. 2013). This could be what happened in the outer islands of Tuvalu, which might not have had YCA for as long as Funafuti.

2.2 SPC survey of Funafuti, Niulakita and Nukulaelae: October-November 2014

The issue of YCA reaching harmful levels was first raised with SPC sometime before 2014 by the Tuvalu Agriculture department. The ants were reported to have reduced both land and coconut crab populations on several motu, thereby threatening food security. The most critical of these was Motutala motu[1] in Nukulaelae atoll.

The Tuvalu government and SPC conducted a survey of YCA in 2014, and documented all ant species found (Vaqalo et al. 2014). The intention at the time was advising on eradication or reduction of YCA numbers on several islands, with the most severe problems reported in Nukulaelae atoll, particularly Motutala.

The survey was carried out on Fongafale motu (the main motu in Funafuti atoll, and Tefala and Fua Akea motu), Niulakita Island, and five motu in Nukulaelae atoll. SPC identified the ant species found (18) among the different localities.

Yellow crazy ant was present over most of Fongafale, some parts of Niulakita Island and three of five motu surveyed in Nukulaelae atoll. Two other motu in Nukulaelae where YCA was known to be present could not be visited due to time constraints. Recommendations included biosecurity, awareness-raising, inspections and surveillance, and a suggestion to attempt eradications[2].

Abundance of YCA was not quantified by the team using standard card counts, rather they used number of ants caught in pitfall traps. In Nukulaelae YCA abundance was considered denser on Motutala than Fangaua. On Motutala YCA was the only ant species trapped. Half the ants trapped on Tumiloto were YCA, and just under half were YCA on Fangaua. Very few YCA were trapped on Asia and Mulitealua.

[1] Name used by Matio Lonalona and SPC but named Motala in public sources such as Google Maps.

[2] The definition of eradication in the Vaqalo et al. (2014) report: "Intentional extirpation of geographically discrete populations of a species, irrespective of whether other discrete populations still remain within the landscape", is not entirely correct. Eradication is the complete removal, but eradication can only be successful if reinvasion is prevented. If discrete populations of ants remain in the landscape, they will reinvade and so an eradication attempt in one part of an island, for example, would be wasteful. The definition in the report is used by some to justify failed eradications.

On Fongafale YCA were most prevalent around the Airport and Hotel compounds, and the Taiwanese Technical Mission farm compound. The ants were reported to be absent from Tefala and Fua Akea.

In Niulakita abundances were like Fongafale.

The report noted that YCA were associated with aphids and mealybugs on "the islands" but did not specify which species or on which island groups or motu they were found.

Some comments were made in the report about the spread of YCA among islands, such as "an important finding which was true here was that fact that YCA was unable to naturally spread to the nearby islands." However, this was based on inference, and was not tested as implied. In other places it is more likely than not that YCA has spread by flight to nearby islands, and dispersal by flight has been observed (Abbott et al. 2014). The evidence on the ability of YCA to disperse by flight remains inconclusive, and so should always be considered a risk.

The advice given on safety equipment (respirators, safety boots, gloves and so on) was not necessary for the Antoff© product, which is non-toxic to people.

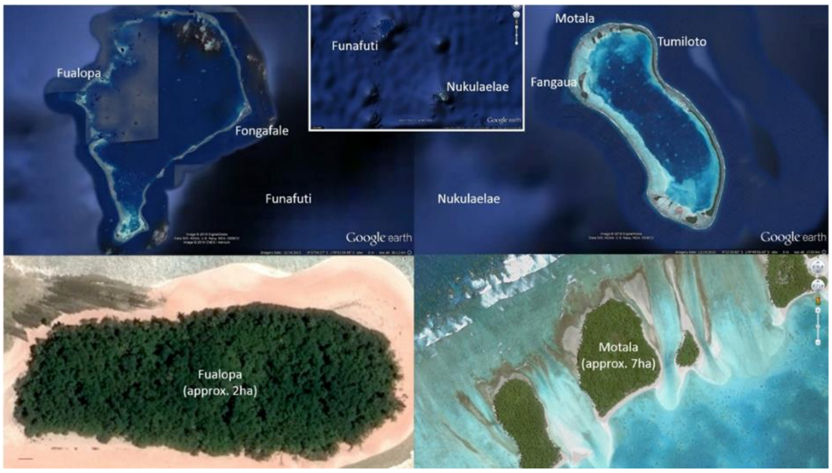
2.3 Pacific Biosecurity workshops and treatment in Funafuti: April 2017

In 2016, the (then) Director of Agriculture Sam Panapa and (then) Biosecurity Chief Matio Lonalona requested my assistance to manage YCA. The department had been proactive and applied to the Canada Fund for support but were unsuccessful. At the time I was managing a programme funded by New Zealand Ministry of Foreign Affairs and Trade (NZ MFAT) to improve biosecurity and control of YCA and other ants in the region, with in-country assistance primarily for Kiribati and Tokelau. NZ MFAT permitted diversion of a small amount of funding for Tuvalu.

My (then) colleague Allan Burne and I developed a management plan for YCA (Burne and Gruber 2017). I was able to visit Tuvalu, assess the YCA problem on several motu in Funafuti atoll, meet with the Kaupule, and train the Agriculture team, Kaupule representatives and Maclean Vaqalo (formerly at SPC) in YCA assessment, control, and monitoring. I supplied some treatment product (Antoff©; 96kg), spreaders and other equipment for treatment. The initial scope was to systematically quantify the problem in Funafuti atoll (specifically Fongafale and Fualopa islets) and Nukulaelae atoll (specifically Fangaua, Motutala and Tumiloto islets) and some parts of Niulakita. Fualopa and Motutala were trial treatment sites (Figure 1).

As it was not possible to travel to Nukulaelae, the scope of the visit was limited to Funafuti. It eventuated that YCA on Fualopa were at too low abundance to be treated[3] so Tepuka, where the ant was at high abundance, was treated (~ 8 Ha). Interestingly, Matio Lonalona observed that the abundance on Fualopa had declined since his previous visit. This decline is consistent with a potential population crash.

Figure 1: Funafuti and Nukulaelae atolls, Tuvalu, showing locations of YCA in the Management Plan. The focal sites were initially Fongafale (main inhabited motu) and Fualopa (conservation motu) in Funafuti atoll and Fangaua (main inhabited motu), Motutala/Motala (conservation motu) and Tumiloto (a popular picnic site) in Nukulaelae atoll.



[3] When YCA is at low abundance treatment can leave residual toxins in the environment, the ants will not eat all of it. Residual product can be eaten by crabs and other non-target species. The active ingredient, Fipronil, could leach into the lagoon, putting fish and marine invertebrates at risk. If treatment is undertaken when the ant is at high abundance, all the treatment product is eaten by the ants, and the environmental risk minimized or eliminated.

Scale insects were noted on large trees at the landing site at Tepuka, but they were not observed in the interior of the motu, or at least were not common. Treatment of these scale insects was recommended, together with monitoring of the results of YCA treatment over time.

The abundance of YCA was high, but it was not uncomfortable to spend time in Tepuka as the ants were not too bothersome. Their numbers decreased by ~96% three days after treatment (point card counts declined from 420[4] to 16).

I recommended that backpack blowers would be a good solution to the dense vegetation on Tepuka (and elsewhere) as the blowers can spread treatment product much further.

The team met the Minister (Ministry of Natural Resources and Land at the time) who informed us that YCA were affecting life on Nui atoll and stressed that this should be the most urgent next treatment site.

At the end of the visit it was agreed that I would arrange to have 20 tubes of VanquishPro©[5] sent to Funafuti, to treat trees where YCA were foraging on Tepuka, and I would investigate the cost of sending blowers for Antoff©. Unfortunately, it was discovered that VanquishPro© was classified as Dangerous Goods (environmental hazard) and had specific shipping requirements. We were unable to ship this product to Tuvalu.[6] To the best of my knowledge this product still retains this classification, but it has been carried in checked baggage to Tokelau and Kiribati by others without concerns.

A quote for blowers was sourced, but I cannot find records any being sent, or any further correspondence on the VanquishPro©. The type of blower/mist duster is described here. Essentially it is a petrol-driven mist sprayer that can be converted to blow small pellets (like the Antoff© product) and is useful for targeting yellow crazy ants in trees where they forage (and nest).

2.4 Tuvalu Agriculture work in Nui: June 2017

The Tuvalu Agriculture department sourced additional YCA treatment product from Australia for further treatment outside Funafuti (400kg, sufficient to treat ~40 hectares). In June 2017 Matio Lonalona and colleagues visited Nui to assess the problem and conduct treatment (on Fenuatapu).

The plan was to treat the entire motu to prevent resurgence of YCA populations. Unfortunately, there was insufficient treatment product to complete the work, and Sam and Matio reported that the island was "severely infested" by YCA.

2.5 GEF 6 RIP-supported control of YCA on islands of conservation concern: 2019-now

The GEF 6 Regional Invasives Project (GEF 6 RIP) - *Strengthening national and regional capacities to reduce the impact of Invasive Alien Species on globally significant biodiversity in the Pacific* was initiated in 2019. The GEF 6 RIP is funded by the Global Environment Facility, implemented by the United Nations Environment Programme and executed by the Secretariat of the Pacific Regional Environment Programme.

As part of this project, Tuvalu had requested assistance to control YCA, and approved USD10,000 of their GEF 6 RIP allocations for the work. As the GEF 6 RIP is focused on biodiversity, SPREP was obliged to ensure the funds were to be used only where biodiversity was a concern. Although this could have included Motutala, controlling YCA for the direct benefit of people and food security was out-of-scope.

I was working on the biosecurity aspects of the project until April 2024 and provided support to SPREP for the YCA work. Sam Panapa (now working as a consultant) is the Tuvalu coordinator for this project.

2.5.1 Extension officer reports in 2023

In January 2023, to find out more detail on the problems being experienced, I asked Sam Panapa and Matio Lonalona to survey Agriculture extension officers from Nanumanga, Niutao, Nanumea, Nukufetau and Nui, which were the places that were reporting YCA as a problem at that time (Panapa and Lonalona 2023). I

[4] Card counts >100 are typically recorded as 100, because this is well above the threshold suggested for treatment (37; Boland et al. 2011; Gruber et al. 2018), and at higher numbers the results can be quite variable. However, it is still a good indication of high abundance

[5] VanquishPro© is a paste treatment product that is used in sensitive areas, such as where animal are penned, around homes and where children are present. The product can be applied out of a child's reach.

[6] It was not entirely clear what the specific reason for the shipper's refusal. Products having environmental harm can be shipped in small quantities. Fipronil, the active toxin in VanquishPro©, and Antoff©, is the reason for this classification. However, Antoff© does not carry this DG classification, despite the concentration of the toxin being the same as VanquishPro©. We were told by the shipping agent (DHL) that Tuvalu had a complete prohibition on the import of dangerous goods, which was not the case.

had hoped that this could provide some justification for SPREP to change some of Tuvalu's allocations to support the YCA work. Responses were received from Nui, Nanumanga, and Nukufetau.

Table 1: Responses from Agriculture extension officers to questions on YCA impacts on their islands. In hindsight, in each question I should have specified YCA, phrased them all as open-ended questions, and I should have asked about scale insects, but this was done in a hurry at the time.

Question	Nui	Nukufetau	Nanumanga
Are the ants coming into people's homes?	Yes	Yes	Yes, there are a lot of ants coming into people's homes and a lot of other places
Are the ants getting into food that has been left outside?	Yes	Yes	Yes, the ants are everywhere, and they get into any types of food that are left outside
Are the ants getting into food that has been left inside?	Yes	Yes	Yes, they are also getting into food that has been left inside
Are the ants crawling on people while they are sleeping?	Yes	Yes	Yes, here on the outer island, the ants can really crawl on people while they are sleeping, especially when people don't use the mosquito coil. Also, the people who sleep in local houses (umu)also face this problem when they sleep.
Have the ants been seen attacking animals such as pigs, chickens, crabs?	Sometimes	Yes, sand crabs, lizards	Yes, that is the problem we are mainly facing now on coconut crabs, other crabs and chickens as well
What have people said to the extension officers about the ants?	We really need assistance to minimise and manage the abundance of YCA on the island. Not only that but it seems to be aggressive and harms the land crabs, chickens, coconut crabs and other invertebrates	They are still disturbed by ants (yellow crazy ants and tiny black ants)	The people say they really want to get rid of the ants as they are destroying the crabs (different species) and chickens and getting into their food and houses

In July 2023 Richard Griffiths from Island Conservation visited Funafuti, as part of GEF 6 RIP work to scope rat eradication. He reported high abundance of YCA in Tepuka, but no YCA on Falefatu. However, this report and those of the extension officers, were insufficient justification for SPREP to release the GEF 6 RIP funds for treatment products. SPREP asked that I survey Funafuti's motu so they could release the funds.

2.5.2 Tuvalu Priority Ecological Sites Restoration Plan 2022 – 2025

As part of the GEF 6 RIP project, at the request of SPREP, Sam Panapa developed a restoration plan for priority sites (Panapa 2022). I reviewed the YCA management components of draft plan. The plan had provision for treatment of 6 hectares.

The YCA component of the plan included control and monitoring of the ant between 2022 and 2025. However, this work did not start until 2023 (see also sections 3.7 and 3.8).

2.6 Luke Halling visit: July 2023

In July 2023, Luke Halling visited Tuvalu to undertake fruit fly and YCA assessments in Tuvalu on behalf of FAO, to respond the then Prime Minister's request. The SPC team were also there to undertake fruit fly surveys.

It was intended that Luke would visit Niulakita and Nukulaelae. Unfortunately he was unable to visit these islands because of bad weather and ferry schedules. Luke conducted a survey of several sites in Fongafale and found YCA in variable abundance.

At the Department of Agriculture Agroforestry site Luke and the Agriculture team observed YCA at their highest numbers, with a card count of 50.[7] The ants were abundant over a 40m strip across the width of Fongafale. The ants were foraging on papaya fruit and supported very high densities of soft scale insect (possibly *Parasaissetia nigra*) on an edible fig (*Ficus* sp.), and to a lesser degree on noni/nonu (*Morinda citrifolia*) flowers and climbing coconut trees. Luke assumed the ants were looking for food, although a source was not found. Yellow crazy ants nest in trees, so that may have been the case. When the ant's gaster (abdomen) is full of sugar it takes on a striped appearance where the segments have been stretched. In the field this feature can help locate the nest by identifying whether the ants are coming from (empty gaster) or going to the nest (full gaster) when foraging.

At the southwest end of Fongafale, Luke also observed YCA in relatively high numbers (30 ants per card count), but no significant food sources were observed. At the northern end of Fongafale, YCA were at a similar level of abundance. Luke found that YCA were foraging up to the high tide line, with a nest in a hollow branch of a beach mahogany (*Calophyllum inophyllum*) that extended beyond the high tide line. When YCA are in high abundance, they will often forage this close to water, and one early sign of high abundance is that the ants will "greet" you on arrival to a motu.

In the most disturbed areas of Fongafale, including Vaiaku town, Luke found that the tropical fire ant (TFA; *Solenopsis geminata*) was the most prevalent and dominated food sources, including mealybugs, food scraps and animal remains.

The tropical fire ant has been present in Tuvalu since at least 1976 (Wetterer 2011). However, it can be confused with the red imported fire ant (RIFA; *Solenopsis invicta*), the most serious invasive ant, and identification should be confirmed with a microscope. Two Tuvalu Agriculture department officers were trained in invasive ant identification in 2023, and other officers have been trained in the past, so they should be able to confirm the species with certainty, which is strongly recommended.

2.7 Pacific Biosecurity survey of Funafuti motu: September 2023

In September 2023 I visited Tuvalu for biosecurity activities for the GEF 6 RIP and conducted basic ant surveillance with members of the Agriculture and Environment teams.

Like Luke, I found that TFA were prevalent in Vaiaku (Fongafale).

Sam Panapa and I, along with Agriculture and Environment department staff, visited several motu in Funafuti, including Tepuka, Falefatu, Fua Akea, Fualopa, and Fualefeke in Funafuti.

No YCA were observed on Falefatu, although they could be present at low numbers. Many longhorn (black) crazy ants (BCA; *Paratrechina longicornis*) were visible, but their abundance was not formally assessed.

No YCA and only a few BCA were observed on Fua Akea. Fua Akea is a protected motu, one of only two locations recorded for Tepukapili (*Lepidodactylus tepukapili*). This is a globally threatened reptile, with an IUCN classification of critically endangered. The gecko was recorded from only on three motu in Funafuti, but now it is limited to as few as two motu as one has succumbed to climate change and no longer exists. Because of Fua Akea's conservation status, to avoid causing harm or disturbance, we did not enter the interior of the motu.

On Fualopa, YCA abundance was low and not noticeable except around nests at the base of (mostly) *Pisonia* trees. Based on Matio's earlier comments that the YCA abundance had declined, as it had declined further over the six intervening years, it appears the population has crashed and stabilized. Plant pests were not surveyed.

We briefly visited Fualefeke (there was a misunderstanding about the need to visit there). It was raining (YCA are less commonly seen in the rain), and YCA were not obvious.

Tepuka was treated in 2017, so I had hoped this would lead to population crash as elsewhere, but something has led to a resurgence.

On Tepuka, we found extraordinarily high abundances of YCA. The ant was more abundant than some of the most extreme incidents ever recorded, including Christmas Island (Australia) and Tokelau, and the

[7] Usually, a series of card counts are done. Luke's survey used single point counts, which is perfectly acceptable for a general survey.

abundance was much higher on Tepuka than before we undertook treatment in 2017 (point card counts. It was unpleasant to stand in one place for more than a few seconds and the ants rapidly climbed up legs.

I recorded some video to demonstrate YCA abundance: 20230911_134755.mp4 20230911_135138.mp4

Plant pests (Figure 2; identification to be confirmed), were prevalent and potentially driving YCA abundance. I was not certain that these were the same scale insects we found in 2017, and there was insufficient time to get samples for identification. Also I did not see the ants tending the scale insects and wondered if the casings we saw (Figure 2) were empty. It is uncertain how extensive the scale insects are on Tepuka, their species, or whether that is driving YCA abundance.

Figure 2: Sam Panapa pointing out plant pests on an *Asplenium* fern in Tepuka.

Sam reminded me that last time we had a conservative 10 m buffer zone as rain was forecast (and eventuated), and we avoided the inland lake. The residual population alone might have resulted in YCA resurgence. However, one, untested hypothesis is that for YCA (or any ants that experience cyclical population explosions and crashes), treatment might interfere with the natural population dynamics and result in resurgence (Lester and Gruber 2016). The YCA population on Fualopa might have experienced such a crash, however there were no scale insects observed there. If scale insects continue to remain on Tepuka, the YCA population is unlikely to experience a crash.

We discussed future work for Tepuka and decided the next YCA treatment should use the standard with the 5 m buffer (i.e., to the edge of vegetation) and there should be provision of treatment of the scale. Sam advised he knows of an effective, environmentally treatment for the scale. I had provided backpack sprayers for treatment of cane toads, and these could be used to treat the scale insects. <u>It is essential that the scale insects are effectively managed.</u>

I suggested, given the level of YCA abundance, it would wise to plan two treatments of YCA in 2025 (around three months apart), to try to take the pressure off Tepukapili, and then monitor the ants and scale insects every 6 months. But this would have to be done in conjunction with aggressive, and possibly on-going, control of the scale insects, to prevent another YCA resurgence.

I also suggested to the Environment department it would be wise to survey Tepuka for Tepukapili as soon as possible. As biodiversity is the responsibility of the Environment department, I discussed this with Reuben Kausea, acting head of Environment. Reuben thought that Tepukapili was threatened by an introduced gecko, but the species is/are not known.

I later discussed the Tepukapili problem with James Reardon, a reptile specialist from the New Zealand Department of Conservation who I had brought to Tuvalu to advise on the cane toad problem. James advised that there were potentially five invasive geckos that could be present on some or all the motu. He advised that surveys were needed to confirm which species were present, and whether Tepukapili was on other motu.

James advised an extensive atoll wide survey for Tepukapili, as just because it hasn't been detected elsewhere doesn't mean it is not on other motu. James thought that this would require a couple of reptile specialists[8] spending 1-3 nights on each motu (less than three if they detected Tepukapili on the first night. If the Tepukapili were safe, that is no presence of invasives geckos/few invasive gecko species, on several motu the situation on Tepuka is not so urgent. If there are no Tepukapili on other motu (but there are some remaining on Tepuka), translocation to safer motu would be worth considering. But that would be up to Tuvalu. This would require funding.

I suggested this survey to the Environment Director over email, and that with Tuvalu's permission, James and I would seek funding to do this work. However, I received no response. I advised SPREP of the issue and left it for them to pursue, potentially as part of the GEF 6 RIP.

While in Funafuti I had discussions with Matio and his team about the status of YCA around the country. Selotia Tausi (the deputy director of Agriculture) had recently visited Niutao and treated YCA using products left over from our trip in 2017. But she said that YCA were in low abundance, and she treated where the community said it was a problem. She seemed to not know of the existence of the management plan. It was not clear if the ants were YCA, and if they weren't the treatment product is probably not appropriate. After six years the treatment product might no longer be effective, depending on how it was being stored.

Evolini Mami (the head of biosecurity) had visited Niulakita and said ants were not a problem there.

We also discussed whether TFA is a problem, and it is quite a concern on Fongafale. The ants are abundant, and people were concerned as small children were getting stung. As well as being painful, the sting can result in very itchy blisters that small children naturally scratch, and which was reported to lead to infection. As we know, ulceration of sores is common in tropical environments, so TFA should be addressed as a priority health issue.

I discussed other treatment options for ants with Matio (residual barrier or treatment sprays, such as ATTRATHOR©) if the issue is simply that people are disturbed by the ants coming into their homes. ATTRATHOR© could also be effective for TFA. This product is proven to be effective on YCA and is recommended for all ant species and insects such as cockroaches. Again, it contains Fipronil as the active ingredient, so must be treated with respect to avoid harm to the environment.

I left the Agriculture team with some more Scott spreaders from New Zealand. As well as additional Antoff© and scale insect treatment products, there might a need for more spreaders for the Antoff©, and residual treatment products.

As part of the GEF 6 RIP project I purchased four units of ATTRATHOR© and seven hand-held sprayers, which I will bring during my next visit. As with the VanquishPro©, I was unable to have ATTRATHOR© shipped to Tuvalu.

2.8 GEF 6 RIP-supported treatment of YCA in Tepuka: 2024

SPREP had a budget of USD10,000 for treating YCA in Funafuti on conservation motu. I advised it was probably more economical to ship a pallet rather than just enough to treat Tepuka (see costs in Table 2).

The contract between SPREP and ACT was signed in early December 2023. The supplier was advised that the product only needed to be in Tuvalu before the next dry season (approximately April 2024), which gave them plenty of lead time for manufacture.

Prior to the contract signing there was some discussion around payment and intermediary banking arrangements, which added a few days the time to confirm the order.

[8] The species of gecko that are likely to be present require trained skills to identify them. There is no one in Tuvalu who has such skills.

The product was manufactured in January 2024, and the Bill of Lading issued on 29 January 2024. It was initially advised by the supplier that the goods arrived in Tuvalu on 19 March 2024, however this could have been into Fiji as they did not arrive in Tuvalu until 11 April. So the total shipping time was 73 days.

Table 2: Details of Antoff© ordered from ACT ordered by SPREP for Tuvalu, to give an indication of recent costs, amount of product and area that could be treated.

Qty	Description	Unit Price	TOTAL (AUD)	Total KG	Treatment Area (HA)
32	ANTFP12 - ANTOFF Fipronil Ant Bait 12kg pail	312.00	9,984.00	384	40-70
1	FREIGHT - Sea Freight to Funafuti, Tuvalu	2,364.00	2,364.00	-	-
	TOTAL	-	12,348.00	-	-

2.9 YCA status update in June 2024

I asked Sam and Matio for an update on the status and responses to questions that arose while developing the situation report.

1. Before reporting to SPC, were there reports of YCA causing problems anywhere in Tuvalu? Any stories you've heard from older people would be useful.

   Matio: Other old peoples believed that the YCA were presented in Tuvalu a long time ago but less or no damage at all. They saw these ants around pig pens but not crazy as of recent years.

2. Has the work on YCA control in Tepuka started, or is it still being planned?

   Sam: It's still in the planning stage.

3. Have the insects that might be facilitating YCA on Tepuka been identified, and if so, what are they?

   Sam: no they have not yet been identified.

4. Have any biological controls for scale/mealybugs been released in the past in Tuvalu (what they were, were they were released and approximately when would be good to know)?

   Matio: There are biological controls for scale/mealybugs. Biocontrol agents have been released in the late 2000s for the coconut scale in Nanumanga.

5. I don't have any records for YCA in Vaitupu, do you know if they are there?

   Matio: In recent years, all the outer islands raised their concerns for the abundance and nuisance of the YCA around their houses and villages where most of the peoples are residing.

   Sam: Yes, the YCA is present in Vaitupu.

6. Has YCA been reported as causing problems in Vaitupu?

   Sam: Yes. It is severe in areas outside the village, and the ants are killing land crabs.

7. Can we get an update from Nukulaelae on whether YCA are still a problem there, and on which motu, as an update to the trip with SPC in 2014?

   Matio: For Nukulaelae, the presence of the YCA in Motutala is still there with little concern. YCA was spreading to the main islands but not severe compared to other outer islands.

8. Can we get a report from Nanumea about whether they have concerns (or not) about ants (YCA or any others)?
   Matio: as for Q6.
9. Can we get an update from Nui as to which motu YCA are a problem on?

   Matio: We'll try to get an update from Nui, especially from the Extension Officer on which motu are affected.

2.10 TCP/TUV/3901 Funafuti inception workshop August 2024

The workshop was held to introduce The Ant Survey Guide to Department of Agriculture and Live and Learn staff, and representatives from the farmers' cooperative Tokialofa. On the first day of the meeting, the attendees reflected on their experiences and reports of yellow crazy ants and other ants in Tuvalu.

Itaia Lausaveve

Itaia is a former Director of Agriculture and now leads Live and Learn.

Noticed an increase in Niulakita after Cyclones Nina and Kina in 1995/1996, because of damage to trees.

The ants were severely affecting chicks, which suffered mortality of around 30%.

In Funafuti, they started spreading around 2008/2009 around the Palagi Road area.

Then reports came from Nui, Nukulaelae and Nanumea.

Has observed that yellow crazy ants exclude the red ants.

Uatea Vave

Uatea is a former Head of Extension for Agriculture and is the lead for the yellow crazy ant project at Live and Learn. Today was his first day on the project.

There were no problems that he was aware of in Funafuti but in around 2000 there were outbreaks reported Motutala/Motala[9], Nukulaelae and Nui.

Coconut crabs were being attacked and eaten from the inside.

In Nanumaga chicks were attacked and eaten.

Uatea went to Nui with Matio to undertake treatment in around 2018., using the Antoff broadcast method. The most affected area was where people were living and the ants were going into homes, in cooking areas and on food scraps. The baiting decreased the numbers.

He has noticed the red ant (tropical fire ant)[10] increasing.

They treated Papaelise in 2021 and there have been no complaints since.

In 2021 YCA numbers in Tepuka were not high.

On Wednesday, in discussions with Uatea and Konelio, the point was raised the Nui had put biosecurity restrictions on items taken to Telikiai, a popular picnic motu. The restrictions included a prohibition of taking coconut and firewood, as these are prime nesting sites for ants.

Selotia Tausi

Selotia is a former Deputy Director of Agriculture, and now works with Live and Learn.

She agreed with Uatea and Itaia that the problem was not so serious before.

She confirmed that in Niutao, there were two areas (about 10 m X 15 m) that the residents were concerned about. She found there were no ants in the first area, and only a few in the second area. Selotia advised the villages to keep the areas clean to reduce the abundance of the ants.

Papaelise (Funafuti) was also a problem for people and Agriculture treated the area in 2018.

Apparently, the problem has gotten worse in Niutao, with the ants coming into homes. Yellow crazy ants were apparently everywhere (affecting all homes). But this was an area of only about 1 hectare around the umu cooking areas. Other houses away from that area were not affected.

Luuni Tuinau

Luuni is from Suni village. He came from Nukulaelae. The yellow crazy ants were noticed there in 1966. They thought the ants were imported by people from Nauru. They declared an emergency “just before he left (1981?)” as the problem was so bad, and agriculture and biodiversity were being affected.

Motutala/Motala, the agriculture island, was very bad.

The people burned trees and soil to try to get rid of the ants.

Sumia (?) at the far north of Fogafale in Funafuti is also very bad.[11] Yellow crazy ants affects gardens there.

Luuni mentioned that the YCA were “afraid of the longhorn/black crazy ants.

Sama Sapakuka and Kornelio Tuinanumea

Konelio works for Live and Learn and Sama works for Agriculture (Principal Agroforestry Officer).

They distributed bait in Nukufetau in 2018. The problem was very bad before.

Sama discussed the treatment on Nukufetau in 2018. They surveyed the whole island using card counts and prioritized and ranked 11 sites that they treated. When surveying they found lots of dead crabs and chicks. The treatment decreased the numbers of YCA, but the problem now is that nearby motu are also

[9] The name was used interchangeably by attendees.

[10] Some of the older attendees referred to yellow crazy ant as the red ant, which clarifies the report by the former Prime Minister.

[11] We tried to go there on Tuesday, but rain prevented us.

experiencing problems. People go there to collect coconuts. These are Motumua and Motulato and Funaauta, but there were not huge numbers in 2019, and there have been no reports since 2019. Monica said if the motu were close the ants could have flown there. The scientific evidence suggests that they don't fly, but the pattern of spread around atolls suggest that they do. Also, as YCA like to nest in rotting coconuts, they could float between islands.

The extension officer kept monitoring, and the ants affected home gardens. There were mealybugs and other ants around as well.

Pinau Teo

Pinau works for the Department of Agriculture. Before his current role he undertook a groundwater survey in 2018 in Nanumea. He observed that yellow crazy ants were very bad on Lakena motu.

Some discussion followed about whether there was treatment at any point on Lakena(no). No people live on Lakena, but it is used for agriculture, and has pulaka (swamp taro)cpits. Selotia reported that in 2024 there were no observable YCA in Lakena.

Lakena is about 2 km from the main motu.

Isamaeli Teo

It was Isamaeli's first day at work for Agriculture today. He saw ants in Niutao at Christmas time. People have been putting bowls of water under the legs of dining tables to stop the ants crawling onto food.

Jessica David

Jessica works for Tokialofa and is also a journalist. She thought that the YCA were affecting ccabs in Tepuka and heard they were othering people elsewhere, such as Niutao, Nanumaga and Nanumea, with Niutao the worst of the three., with YCA everywhere.

Peiliti Sosene

Peiliti stays in Funafuti, where he has seen YCA and lots of other ants. He used Mortein to get rid of them. In 2000 there were a lot in Nanumaga especially in Pulaka pits, and when they were looking for crabs.

Peleti Pole

Peleti works for Agriculture (Principal Livestock Officer). He knew that ants were a biodiversity threat but as a livestock officer it was all quite new to him.

Fialua Olonise

Fialua is now retired but was a Director of Agriculture. He oversaw the initiation of the Fiafia gardens, which are now the Taiwan Technical Mission and the Agriculture nursery. He co-founded Tokialofa in 2014, which has 20 members in Funafuti.

He works on crop projects and knows there are lots of ants but doesn't know which is which. He mentioned that black ants were in high abundance. These sounded like longhorn/black crazy ants.

We spent the rest of the day skimming over the guide. We talked about invasive species and biosecurity and how preventing the problems was more of a people issue than a technical one. We watched short videos of YCA and TFA, and talked about some of the gear that would be used to survey the outer islands, measure the abundance of YCA and so on.

We also visited a few sites in Fogafale, including the ones where Luke Halling had reported YCA at high abundance (the Agroforestry site and the far north of Fogafale) While there were more ants at the Fogafale site, they were not in high abundance to warrant concern. There were only a few ants in the north of Fogafale, also of no concern.

3 Ants of Tuvalu

3.1 Yellow crazy ant distributions in Tuvalu

The Pacific Invasive Ant Distribution Database (Gruber et al. 2017) records the distributions of the 18 worst invasive ant threats to the Pacific.

Matio Lonalona reported in June 2024 that all the outer islands raised their concerns for the abundance and nuisance of the YCA around their houses and villages where most of the peoples are residing. From this, it appears the major issues are around homes in the main inhabited motu, rather than in uninhabited motu.

If "all the outer islands" have raised concerns, it is difficult to prioritise islands for Live and Learn to visit, if all are having problems equally. This latest update also differs from reports from 2023, for example, that the ants were not having impacts in Niutao and Niulakita.

Table 3: Presence of YCA on all islands and atolls in Tuvalu, based on known reports at this time. Current known priority motu are highlighted in **bold** text. (N) or (S) indicates whether the island group is north or south of Funafuti, as ferries are scheduled accordingly.

Island/Atoll	Motu	Notes on priorities	Plant pests present?
Funafuti 30 motu	Fongafale	Not reported as a priority at any time.	Not surveyed, but many present (see SPC Pest List Database and Luke's report).
	Fualopa	Recorded as a priority before 2016. YCA numbers declined and are not a priority in 2017 or 2024. Population may have crashed.	Not surveyed but not obvious in 2017 or 2023.
	Tepuka	A priority since at least 2016, with urgent need for a solution from at least 2022.	Few observed in 2017, many observed in 2023, not identified, and might not be the same species as initially observed, or they might be several species.
	Falefatu	No YCA observed in 2023 but potentially present. Not a priority.	Not surveyed but not obvious in 2023.
	Tefala	No YCA observed in 2014.	Not surveyed but not obvious in 2023.
	Fua Akea	No YCA observed in 2014 or 2023 but potentially present. Not a priority unless confirmed.[12]	Not surveyed but not obvious in 2023.
	Fualefeke	YCA not obvious in 2023.	Not surveyed but not obvious in 2023.
Vaitupu (N) 9 motu	Asau	Present. Reported as severe in areas outside the village.	Not reported.
Nukufetau (N) 33 motu	**Savave**	Extension officers reported problems in 2023.	Not reported.
Nui (N) 21 motu	**Main island (perhaps motu also)**	Priority in 2017. Fenuafala was treated by Matio Lonalona and team in June 2017. Extension officers reported continuing problems in 2023.	Not reported.
	Tanrake	Not reported.	Not reported.
Nanumanga (N) 5 landlocked motu	**Main island**	Extension officers reported problems in 2023.	Not reported.
Niutao (N) 4 landlocked motu	Kulia	Selotia Tausi reported low abundance of YCA in 2023.	Not reported.
Nanumea (N)[13] 5 motu	**Lakena (not main island)**	Reported by Matio in 2024 generally as "all the outer islands have raised concerns".	Not reported.
Nukulaelae (S) 15 motu	Motutala	Reported by Matio in 2024 as of "little concern".	Not reported.
	Fangaua	Priority in 2014. Uncertain status in 2024.	Not reported.
	Tumiloto	Priority in 2014. Uncertain status in 2024.	Not reported.

[12] Fua Akea and Tepuka are the only remaining locations of Tuvalu's endemic gecko Tepukapili (*Lepidodactylus tepukapili*), which was only discovered relatively recently and is globally critically endangered.

[13] Nanumea is furthest north from Funafuti.

Island/Atoll	Motu	Notes on priorities	Plant pests present?
	Unnamed motu	Priority for community in 2014 but not visited by SPC. Uncertain status in 2024.	Not reported.
	Unnamed motu	Priority for community in 2014 but not visited by SPC. Uncertain status in 2024.	Not reported.
	Asia	Free from YCA in 2014 (or at numbers too low to be detected).	Not reported.
	Mulitealua	Free from YCA in 2014 (or at numbers too low to be detected).	Not reported.
Niulakita (S)[14] 1 island	Niulakita	Reported to be a problem in some parts of Niulakita in 2016. Evolini Mami reported ants were not a problem in 2023.	Not reported.

3.2 Other ant species in Tuvalu

The Ants of the Pacific database (Gruber et al. 2017) records the occurrences of all ants reported for countries and territories Pacific islands' region.

Table 4: Ants of Tuvalu. The table was been derived from the records of Vaqalo et al. (2014), which were reviewed during the creation of the Ants of the Pacific database (Gruber et al. 2017), with distributions up to date (to the best of my knowledge) at June 2024. The list is based primarily on the survey of Vaqalo et al. (2014), although earlier records exist.

English common name	Scientific name	Status[15]	Notes
Yellow crazy ant; long-legged ant; longlegged ant; YCA	*Anoplolepis gracilipes*	priority invasive	One of the five worst ant threats in the Pacific islands' region
	Brachymyrmex sp.	native?	Possibly *Brachymyrmex obscurior* or *Brachymyrmex cordemoyi*
	Monomorium ebeninum	introduced	Identification needs revision as this species is not recorded anywhere else in the Pacific islands' region. *Monomorium* is a large genus with very similar species that can be confused
Bourbon ant	*Nylanderia bourbonica*	introduced	
	Nylanderia vaga	introduced	
	Odontomachus simillimus	native	
Longhorn crazy ant; black crazy ant; brown crazy ant; BCA	*Paratrechina longicornis*	invasive	One of the 18 priority ant threats in the Pacific islands' region. Could be the "tiny black ant that has been reported as causing problems in Nukufetau. Although it is usually dark brown to black in colour it is only slightly smaller than YCA
	Pheidole fervens	introduced	
	Pheidole flavens	introduced	Identification needs revision as this species is not recorded anywhere in the Pacific islands' region. *Pheidole* is a large genus with very similar species that can be confused
African big-headed ant; coastal brown ant; ABHA	*Pheidole megacephala*	priority invasive	One of the five worst ant threats in the Pacific islands' region. Could be the "tiny black ant" that has been reported as causing problems in Tuvalu
	Pheidole rugosula	introduced	Identification needs revision as this species is not recorded anywhere in the Pacific islands'

[14] Niulakita is furthest south from Funafuti

[15] native, introduced, invasive, or priority invasive. Links to descriptive pages in the Pacific Invasive Ant Toolkit are provided to information of the worst problem invasive ants.

English common name	Scientific name	Status[15]	Notes
			region. *Pheidole* is a large genus with very similar species that can be confused
	Pheidole sexspinosa	native	
Tropical fire ant; ginger ant; TFA	*Solenopsis geminata*	invasive	One of the 18 priority ant threats in the Pacific islands' region. Likely to be the "red ant" that has been reported as causing problems in Tuvalu
Ghost ant	*Tapinoma melanocephalum*	invasive	Bothersome in kitchens. One of the 18 priority ant threats in the Pacific islands' region
Bicoloured pennant ant	*Tetramorium bicarinatum*	invasive	Annoying stings. One of the 18 priority ant threats in the Pacific islands' region. Can look reddish so could be the "red ant" that has been reported as causing problems in Tuvalu
	Tetramorium caldarium	introduced	
Similar groove-headed ant	*Tetramorium simillimum*	invasive	Annoying stings. One of the 18 priority ant threats in the Pacific islands' region. Can look reddish so could be the "red ant" that has been reported as causing problems in Tuvalu
Singapore ant; destroyer ant; ninja ant; destructive trailing ant	*Trichomyrmex destructor* formerly *Monomorium destructor*	invasive	Annoying stings; occasional outbreaks. One of the 18 priority ant threats in the Pacific islands' region. Could be the "red ant" that has been reported as causing problems in Tuvalu.

3.2.1 Identification of priority invasive ants in Tuvalu

General information on how to identify ants is provided in the Pacific Invasive Ant Toolkit, but the best resource for identification is the Pacific Invasive Ant Key (Sarnat 2008).

"Red ants" and "tiny black ants" were reported as causing problems. Although it has been confirmed that the "red ant" reported by the Prime Minister was a reference to YCA, the high abundance of TFA in Fongafale indicates that it should be confirmed that it is not causing concerns in the outer islands.

Potential species that match these general characteristics are identified below (Table 5), and samples of them should be collected for proper identification. Two Agriculture officers recently received training on identification of invasive ants in Fiji (2023) as part of a project on Early Detection and Rapid Response, so they should be able to be identified in Fongafale.

Table 5: Links to identification resources for the key invasive ants discussed in this report. The *comparison chart* pages on the Pacific Invasive Ant Key website are very useful for comparing to other similar ants. Note that the Pacific Invasive Ant Key uses scientific names. Sometimes scientific names change over time when species are reclassified. The website also sometimes generates a warning that comes up repeatedly "Content on this page requires a newer version of Adobe Flash Player. Do you want to download it now?" Click "Cancel" if this warning appears. The videos on the Pacific Invasive Ant Key website no longer work (as they use Flash player, which is obsolete). Versions of the videos can be found on the Pacific Invasive Ant Toolkit page for the ant.

English common name	Scientific name	Possible "red ant" or "tiny black ant"?	Indicative images[16]. The ruler divisions are 1 mm
Yellow crazy ant; long-legged ant; longlegged ant; YCA Video in the lab 1 and in the field 2.	*Anoplolepis gracilipes*	Confirmed as the "red ant" reported to FAO	

[16] The indicative images are all credit to Sarnat (2008), except *Tetramorium bicarinatum* (© Aareon696 on Reddit r/antkeeping).

English common name	Scientific name	Possible "red ant" or "tiny black ant"?	Indicative images[16]. The ruler divisions are 1 mm
Longhorn crazy ant; black crazy ant; brown crazy ant; BCA Video in the lab 1 and in the field 2.	*Paratrechina longicornis*	"tiny black ant" on Nukufetau?	
African big-headed ant; coastal brown ant; ABHA Video in the lab 1 and in the field 2.	*Pheidole megacephala*	"tiny black ant" on Nukufetau?	
Tropical fire ant; ginger ant; TFA Video in the lab 1 and in the field 2.	*Solenopsis geminata*	"red ant"?	
Bicoloured pennant ant Video in the lab 1.	*Tetramorium bicarinatum*	"red ant"?	
Similar groove-headed ant Video in the lab 1.	*Tetramorium simillimum*	"red ant"?	
Singapore ant; destroyer ant; ninja ant; destructive trailing ant Video in the lab 1.	*Trichomyrmex destructor* formerly *Monomorium destructor*	"red ant"?	

4 Provisional ranking of priority/islands sites

Based on the information presented in Table 3, it is proposed that the priority islands are Nukufetau, Nui, Nanumanga and Nukulaelae (Table 6 below). However, because of the uncertainty around the nature and intensity of the problems being experienced on the different islands, it is advisable to visit all the islands to confirm the situation in each.

Table 6: Suggested priority sites based on current information. The islands are presented in priority order, based on the impacts reported and observed. Funafuti is at the bottom of the list solely because it is easier to access. The potential extinction of Tepukapili would place it at the top of the list for biodiversity.

Island/Atoll	Motu	Justification
Nukufetau (N)	Savave	Extension officers reported problems in 2023. All islets badly affected (Konelio 2024). Supported by inception workshop.
Nui (N)	Main island (perhaps also motu)	Extension officers reported continuing problems in 2023.
Nanumanga (N)	Main Island	Extension officers reported problems in 2023.
Nukulaelae (S)	Fangaua and Motutala/Motala	Priority in 2014. Uncertain status in 2024.
Nanumea (N)	Lakena (not main island)	Reported by Matio in 2024 generally as “all the outer islands have raised concerns”.
Niutao (N)	Main island	Selotia Tausi reported a low abundance of YCA in 2023. Reported by Matio in 2024 generally as “all the outer islands have raised concerns”.
Niulakita (S)	Niulakita	Reported to be a problem in some parts of Niulakita in 2016. Evolini Mami reported ants were not a problem in 2023. Uncertain status in 2024.
Vaitupu (N)	Asau	Likely present, reported to be severe in areas outside the village, and the ants are killing land crabs.
Funafuti	Fongafale	Tropical fire ants reported to causing problems for human health and well-being.
	Tepuka	Tepukapili at risk of extinction. Impacts to coconut crabs and other crabs, invertebrates and reptiles.

5 Programme of visits based on priority islands and ferry schedules

5.1 Ferry routes

The ferry routes and schedules in Tuvalu are based around departures from Funafuti. The ferries make circuits of either the northern or southern groups of islands, with islands visited varying (Figure 3). There are four vessels, although Moeiteava is a cargo ship.

Figure 3: routes of ferries around Tuvalu (colour coded). Provisional priority islands are in bold text. The order in which different islands are visited can change between voyages. Special voyage routes are not included here unless they are a standard route also.

Routes:

Nanumea, **Nanumanga**, Niutao

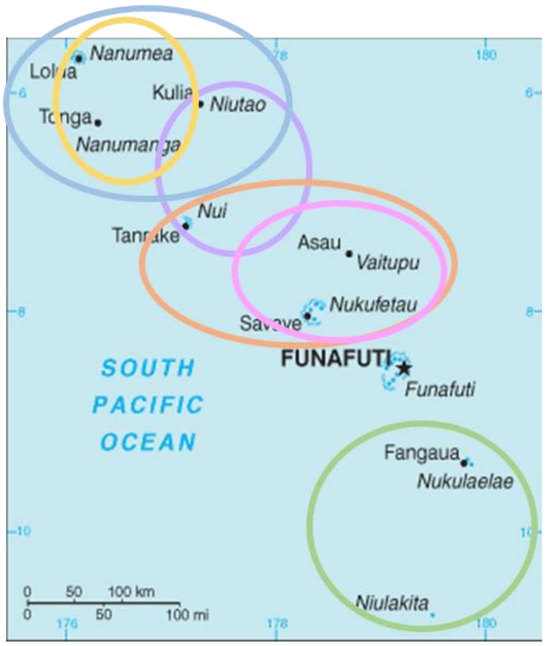
Nanumanga, Nanumea

Niutao, **Nui**

Nui, Vaitupu, **Nukufetau**

Nukufetau, Vaitupu

Niulakita, Nukulaela



5.2 Ferry schedules

Schedules vary according to maintenance needs and special voyages, such as government business and school terms. Schedules can change at short notice and are weather dependent. Ferries do not stay overnight at ports other than Funafuti. The schedule below in Table 7 provides an indication of typical sailings over a three-month period.

Table 7: Example ferry schedules for first quarter 2024. Different routes are colour coded as in Figure 3. Provisional priority islands are in bold text.

Ferry	Published schedule	Departure date	Days	Islands visited
MV Nivaga III	JANUARY VOY.NO. | PORT OF CALL | ETD NZ | DEPART AUCKLAND, NZ | 26-Jan-24 AM	January	N/A	None – return from service in New Zealand
	FEBRUARY VOY.NO. | PORT OF CALL | ETD FUN 1/24 | VTP Drop off MSS Students | 12-Feb-24 AM 2/24 | NMEA,NMAGA,NTO Normal Run | 13-Feb-24 AM 3/24 | NUI,VTP,NKFT Normal Run | 20-Feb-24 PM 4/24 | SUVA Drop off Students | 26-Feb-24 PM	February 12 February 13 February 20 February 26	1 6 5 N/A	Vaitupu* Nanumea, **Nanumanga**, Niutao **Nui**, Vaitupu, **Nukufetau** Suva* *Special voyages
	MARCH VOY.NO. | PORT OF CALL | ETD FUN 5/24 | NMGA,NMEA,NTO GG Tour | 12-Mar-24 AM 6/24 | NKITA,NKLL GG Tour | 19-Mar-24 PM 7/24 | VTP,NUI,NKFT GG Tour | 26-Mar-24 PM	March 12 March 19 March 26	6 6 5?	**Nanumanga**, Nanumea, Niutao* Niulakita, Nukulaelae* Vaitupu, **Nui**, **Nukufetau*** *Special voyages
MV Manu Folau	JANUARY VOY.NO. | PORT OF CALL | ETD SUVA | DEPART SUVA,FIJI | 16-Jan-24 PM 1/24 | NMEA,NMGA, Pick up new MP's to FUN | 26-Jan-24 AM 2/24 | NKFT,VTP Pick up new MP's to FUN | 31-Jan-24 PM	January 16 January 26 January 31	9 4 4	N/A – from Suva Nanumea, **Nanumanga*** **Nukufetau**, Vaitupu* *Special voyages
	FEBRUARY VOY.NO. | PORT OF CALL | ETD FUN 2/24 | NUI,NKFT, VTP Pick up MSS | 05-Feb-24 PM 3/24 | NKITA,NKLL Pick up MSS Students | 08-Feb-24 PM | MAINTENANCE 1 Week | 12-Feb-24 4/24 | NMAGA,NMEA Normal Run | 20-Feb-24 AM 5/24 | NTO,NUI Normal Run | 27-Feb-24 PM	February 05 February 08 February 12 February 20 February 27	2 3 7 6 6	**Nui**, **Nukufetau**, Vaitupu* Niulakita, Nukulaelae* Maintenance **Nanumanga**, Nanumea Niutao, **Nui** *Special voyages
	MARCH VOY.NO. | PORT OF CALL | ETD FUN 6/24 | VTP,NFTAU Normal Run | 05-Mar-24 PM | MAINTENANCE 1 Week | 12-Mar-24 PM 7/24 | NMEA,NMAGA Normal Run | 21-Mar-24 AM 8/24 | NKLL,NKITA Normal Run | 26-Mar-24	March 05 March 12 March 21 March 26	6 8 8 7?	Vaitupu, **Nukufetau** Maintenance Nanumea, **Nanumanga** Nukulaelae, Niulakita
Te Mauri	JANUARY VOY.NO. | PORT OF CALL | ETD FUN 1/24 | NKFT,NUI,VTP Drop off MPs | 03-Jan-24 PM 2/24 | NMGA,NMEA Drop off MPs | 11-Jan-24 AM 3/24 | NKLL,NKITA Normal Run | 18-Jan-24 AM 04/24 | NTO, NUI Pick up New MPs | 26-Jan-24 PM 05/24 | Nukulaelae Pick up New MPs | 31-Jan-24 PM	January 03 January 11 January 18 January 26 January 31	7 6 7 4 4	**Nukufetau**, **Nui**, Vaitupu* **Nanumanga**, Nanumea* Nukulaelae, Niulakita Niutao, **Nui*** Nukulaelae* *Special voyages
	FEBRUARY VOY.NO. | PORT OF CALL | ETD FUN 6/24 | NMEA,NMG,NTO, VTP Pick & Drop MSS Students | 05-Feb-24 PM 7/24 | KIRIBATI | 12-Feb-24 PM	February 05 February 12	6 N/A	Nanumea, Nanumanga, Niutao, Vaitupu* Kiribati *Special voyages

5.3 Suggested programme of visits to priority islands

The three priority islands are Nukufetau, Nui and Nanumanga.

Although Nui and Nukufetau can be visited in the same voyage, it is probably best to separate these to ensure enough time is spent on each island. If the visit to each island is to be undertaken within a single voyage (that is, within the turnaround time of the ferry) the work will need to be undertaken very efficiently and might not be able to be completed. For example, if plant pests and biological control insects need to be surveyed and samples collected, this might take several days depending on the size of the island. On the other hand, if it turns out that the ants are not having a major impact, the island is less of a priority anyway.

If we decide that the work cannot be completed within the turnaround time of the ferry, each visit will require staying on the island for approximately one week (potentially less for Nui and Nukufetau as voyages are more frequent).

Table 8: Suggested programme of visits and activities to priority islands.

Island/Atoll	Motu	Suggested activities
Nukufetau (N) Full visit ~ 6 days	Savave?	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. Confirm if the problem ants are using plant pests as resources. Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. Sample any potential biocontrol insects present, for identification in Fongafale.
Nui (N) Full visit ~ 7 days	Fenuafala?	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. Confirm if the problem ants are using plant pests as resources. Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. Sample any potential biocontrol insects present, for identification in Fongafale.
Nanumanga (N) Full visit ~ 8 days	Tonga?	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. Confirm if the problem ants are using plant pests as resources. Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. Sample any potential biocontrol insects present, for identification in Fongafale.

Brief stops on the other islands within the route would give the team the opportunity for a cursory survey of those islands, to quickly assess if there are YCA or other ant problems, but primarily to talk to the community. For example, Vaitupu and Niutao could be visited during the Nukufetau and Nui visits, and Niutao and Nanumea could be visited during the Nanumanga visit.

A short fourth visit could be undertaken to Niulakita and Nukulaelae for a cursory survey. This is recommended.

Table 9: Suggested program of activities for lower priority islands.

Island/Atoll	Motu	Suggested activities
Nanumea (N) Brief stop during Nanumanga visit	Lolua?	Survey community to discover extent of problems (if any), and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Depending on answer to above and time: • Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. • Confirm if the problem ants are using plant pests as resources. • Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. • Sample any potential biocontrol insects present, for identification in Fongafale. • If ants are not causing problems, provide advice on how to prevent problems occurring and what to do if problems occur.
Vaitupu (N) Brief stop during Nukufetau or Nui visit	Asau	Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. Sample any potential biocontrol insects present, for identification in Fongafale. If ants are not causing problems, provide advice to the community on how to prevent problems occurring and what to do if problems occur.
Niutao (N) Brief stop during	Kulia	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Depending on answer to above and time:

Island/Atoll	Motu	Suggested activities
Nukufetau or Nui visit		• Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. • Confirm if the problem ants are using plant pests as resources. • Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. • Sample any potential biocontrol insects present, for identification in Fongafale. If ants are not causing problems, provide advice on how to prevent problems occurring and what to do if problems occur.
Nukulaelae (S) Fourth visit with Niulakita	Fangaua	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Depending on answer to above and time: • Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. • Confirm if the problem ants are using plant pests as resources. • Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. • Sample any potential biocontrol insects present, for identification in Fongafale. If ants are not causing problems, provide advice on how to prevent problems occurring and what to do if problems occur. If the community confirm that Motutala is still being impacted, visit there and conduct above activities.
Niulakita (S) Fourth visit with Nukulaelae	Niulakita	Survey community to discover extent of problems, and where problems are occurring (in homes, outside homes, garden/crop plots, pigsties, environment, and so on). Depending on answer to above and time: • Confirm that the ants causing problems are YCA, or other (collect samples for identification if other ants are causing problems. • Confirm if the problem ants are using plant pests as resources. • Collect samples of plant pests that ants are, or could be, using as resources, for identification in Fongafale. • Sample any potential biocontrol insects present, for identification in Fongafale. If ants are not causing problems, provide advice on how to prevent problems occurring and what to do if problems occur. If ants are not causing problems, provide advice to the community on how to prevent problems occurring and what to do if problems occur.
Funafuti	Fongafale	Confirm that the ants are TFA, not RIFA. Provide options to minimize impacts. Identify all plant pests that ants could be using as resources. Identify biocontrol insects present. Develop program to rear biocontrol insects and distribute to outer islands.
	Tepuka	Collect samples and identify insects that YCA are using for resources. Develop program to control these insects. Develop program for biocontrol insects. Survey all of Funafuti for Tepukapili (seek assistance from Biodiversity funders).

6 Summary

Yellow crazy ants have been present in Tuvalu for over 100 years but have only started causing problems in the last ten years or so. The impacts of the ant have apparently varied over time, both decreasing, on motu like Fualopa and Motutala, and increasing on motu like Tepuka. The reasons for this variation are unclear, but plant pest mutualisms are likely to play a role, particularly in Tepuka.

One message that stands out from this review, is that the Tuvalu Agriculture department have been doggedly trying to gain traction on this problem for the last ten years. They have not relied solely on project funding, and have prioritised government funds, and proactively sought funding from elsewhere.

6.1 The role of mutualisms in promoting ant abundance in Tuvalu

There is no point in treating ant populations if their abundance is being driven by scale insects, mealybugs or aphids, unless those insects are effectively managed at the same time. If plant pests are present, they must be controlled with at least as much effort as YCA control.

Unfortunately, no records have been kept on which species of plant pests are being tended by YCA, except for Luke's report, which recorded *Parasaissetia nigra* on Fongafale.

As noted by Luke, insufficient records have been kept, and scale insects not managed. Lack of record-keeping has also led to some confusion about which ants are causing the problems, how they should be treated and what they should be treated with.

The SPC Pest List Database has some information on plant pests that are present, but not on their specific occurrence outside Fongafale.

For those plant pests that are present (such as Luke's report of *Parasaissetia nigra*), understanding what biological control insects are present, and others that could easily be imported (from Fiji) is also essential.

6.2 Other drivers of ant abundance in Tuvalu

Where plant pests are not driving the abundance, understanding the cause of YCA outbreaks, which might have occurred more than 100 years after their arrival, would be useful to understand whether long-lasting control can be achieved.

As YCA were found by Luke in relatively high abundances in some places in Fongafale, observational study of these populations might help understand the dynamics of YCA in the absence of plants pests. This would be useful for management of YCA throughout the Pacific islands' region, and elsewhere.

6.3 Managing ants in Tuvalu

Eradication of ants like YCA (that is complete removal on an entire motu), or attempts at eradication, are not recommended due to success being unlikely, and reinfestation is likely given the widespread distribution of YCA, the prevalence of plant pests, and the potential environmental harm caused by the toxins in the treatment products that are most effective.

We have no data on the long-term environmental impacts of the large amounts of the treatment products that are required for eradication. We also do not have data for the long-term environmental impacts of the treatment products in on-going, repeated control, so continued repeat application of the treatment product is also not recommended (Burne and Gruber 2017). Environmental concerns were raised in 2017 by Tuvalu fisheries and fisheries consultants (rightly so), and all treatment should be undertaken with the greatest caution.

Vaqalo et al. (2014) indicated that eradication was a possible goal of managing YCA, although it would be complex, time-consuming and expensive. After further discussion in 2017 we (Tuvalu colleagues, SPC and I) agreed that this was unrealistic. It is important to understand that a single application (even multiple applications if plant pests are driving the problem) will not result in YCA eradication. I am still not sure that the communities are fully aware of this (that their problems are unlikely to be permanently fixed), or of the potential for non-target harm. It is very important that the communities have realistic proper expectations of the outcome, and risks.

Other options are possible for managing YCA, but the options very much depend on the nature and extent of the problems, which are not entirely clear.

Invasive ants of several species are present throughout Tuvalu. Although there are many reports of problems, the severity of those problems currently is unclear. Because of the environmental risks of treatment, which could have permanent impacts and might make the problems worse, understanding the issues on the different islands is needed before recommendations for treatment can be made at this time, except for general self-help actions that can minimise impacts.

6.4 Other ants causing impacts

Although it has been clarified that the former Prime Minster was referring to YCA when he reported to FAO that "red ants" were causing problems, we have seen the TFA is causing problems for well-being in Fongafale.

Also "tiny black ants" have been reported causing problems in Nukufetau. These problems should be quantified, as YCA is not the only ant that can cause problems, and sometimes these ants require different approaches to treatment.

6.5 Biosecurity issues

Increasing biosecurity is unlikely to help prevent the spread of YCA or other invasive ants in Tuvalu as they are probably present everywhere, or almost everywhere, and have been for a long time.

Although biosecurity in general is important, it does not assist directly with the reported problems with the ants. As the pathways by which YCA arrived are not known, it is difficult to recommend what biosecurity improvements might be needed.

However, making sure that new plant pests such as scale insects and mealybugs do not arrive, and that those that are in Tuvalu do not spread, is a crucial biosecurity action, which could prevent these problems occurring in new places in Tuvalu.

Biosecurity actions need to prevent the arrival of species like *Pulvineria urbicola* (Neumann et al. 2014) and yellow lac scale (*Tachardina aurantiaca*). These are known to be strong mutualists with ants, and the yellow lac scale partnership with YCA has driven entire ecosystem collapse on Christmas Island in the Indian Ocean (O'Dowd et al. 2003).

7 Recommendations

Given the uncertainty of the status of YCA among the islands, it would be best for all islands to be visited. Even if the ants are not causing problems, it would provide an opportunity to share knowledge and information with the communities about ant problems. However, unless the work required could be completed while the ferry is at the island, this could mean staying up to a month in each island, which would not be efficient. Based on the current information, it is recommended that priority is assigned to Nukufetau, Nui and Nanumanga.

The following issues should be resolved prior to creating a management strategy for invasive ants in Tuvalu:

- Identification of "tiny black ants" and quantification of their impacts (primarily on Nukufetau).
- Quantifying the nature of impacts of YCA (and any other ants) causing problems throughout Tuvalu, such as well-being, crops, animal care, biodiversity. Identifying sensitive locations is needed, for example if the ants are causing problems around pigs, or homes with children, this will affect treatment decisions.
- Confirmation of whether YCA are using plant pests for resources.
- Identification of the plant pests that YCA is using for resources, throughout Tuvalu.
- Identification of plant pests that ants could use for resources.
- Identification of any biological controls for plant pests throughout Tuvalu.
- Potential biological control rearing and distribution plan.
- Providing advice to the communities. Even if ants are not causing problems, provide advice on how to prevent problems occurring and what to do if problems occur.

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