TOO MUCH TO LOSE

YELLOW CRAZY ANTS IN THE WET TROPICS

Australia has a small window of opportunity to keep the Wet Tropics safe from yellow crazy ants. **Lori Lach** and **Conrad Hoskin** consider the potential costs of failure.

Photos: David Wilson

Australia's Wet Tropics rainforests pulse with life. Butterflies flit, spiders attend their glistening webs, skinks dart into the leaf litter, insects of myriad sizes and colours scurry. Quiet observation may be rewarded with a frog camouflaged in leaves or a praying mantis stalking prey.

Now picture walking into a rainforest invaded by yellow crazy ants. The ground and tree trunks still teem with life, but of just one species. The diversity seen is mainly in the prey carried by ants – spiders, beetles, earthworms, other ants. If an animal is too heavy, the ants eat it in place, seeking out moist tissues such as eyes to begin their formic acid assault. Quiet observation is nigh impossible because standing in one place too long will have you covered in the little beasts.

Yellow crazy ants, named for their frenetic movements, have invaded over 200 hectares of rainforest in and adjacent to the Wet Tropics World Heritage Area near Cairns and Kuranda and over 500 hectares of adjacent residential land and cane farms.

Knowing what these ants have done elsewhere gives us plenty of reasons to be worried if they aren't eradicated.

A versatile ant

Yellow crazy ants are one of the world's worst invaders. So widely have they spread, their origins are not clear. They probably came from Asian rainforests, travelling across the tropics with trade. In many places they reach extraordinary densities, as high as 20 million per hectare on Christmas Island.

Several traits contribute to their success. They're omnivorous and aggressive, readily spraying formic acid from their abdomen when on the attack. And, apart from some aversion to strong sunlight and low temperatures, they'll forage day and night, on the ground and in the canopy.

Their nesting habits are also versatile. Turn over any rock or disturb the right patch of leaf litter and you're likely to see thousands of workers grabbing eggs, larvae and pupae, and possibly a queen or two running for cover. Just about any hollow not subject to extreme temperatures will do for a nest – a coconut husk, bamboo section, discarded car part or drink can. So, wherever they land after a sea voyage, these ants have a good chance of finding suitable food and nest sites.

The potential for knock-on effects in a system as complex and interconnected as the Wet Tropics rainforest is very high.

The biggest impact of yellow crazy ants on vertebrates is likely to be much less insect prey. Frog metamorphs, young birds and other small animals will be at risk from direct attack by the ants. The endangered Kuranda treefrog (Litoria myola), shown above, is at imminent risk as yellow crazy ants have invaded one of its few breeding sites. *Photos: Ray & Sue Photography (cassowaries), Conrad Hoskin*

Also aiding their success is an unusual social structure. Native species such as green tree ants have territory wars and defend to the death their patch of greenery and food resources. Their colonies are prevented from getting too big by aggressive neighbours, and members of one colony are never accepted into another. Yellow crazy ants, on the other hand, act as one big happy sisterhood, or supercolony. A worker or queen from one nest is likely to be accepted into another. By saving their aggression for other species, they can spend more time and energy finding food. When numbers build up, a queen or two walk off with some workers to establish a new nest. The colony boundary can advance by a metre a day.

Why we should worry

Yellow crazy ants have established in the Wet Tropics too recently for their impacts to be evident, so decisions about what to do must be based on their known impacts elsewhere, educated guesses about their impacts in the Wet Tropics, and what could be lost if they stay.

Most of what we know about these ants comes from Christmas Island. They were there for over 50 years before they became numerous enough to be seen as a problem. This coincided with the arrival from southern Asia of a lac scale that produces copious honeydew, suggesting that availability of sugar fuelled a population explosion. Some patches of the Wet Tropics already have similarly high densities of yellow crazy ants.

The high densities on Christmas Island caused a cascade of changes, beginning with the killing of millions of the iconic red land crabs. Dramatic in its own right, this also transformed the forest understorey, resulting in more leaf litter and seedlings. The canopy also changed as the scale insects tended by yellow crazy ants multiplied and killed mature trees. Another invader, the giant African land snail, benefiting from fewer predaceous crabs and more leaf litter, increased 250-fold in invaded forests, while the island thrush, emerald dove, Christmas Island gecko and others became rarer. The ants likely played a role in Australia's two most recent extinctions, that of the Christmas Island pipistrelle and Christmas Island forest skink. Researcher Kirsti Abbott, who studied yellow crazy ants on the island before treatments began, says she 'will never forget the stench of death' in forests taken over by the ants.

Yellow crazy ant invasions elsewhere have also had sobering consequences – in Arnhem Land they eliminate any ants larger than them, in Hawai'i they maim and kill wedgetail shearwater chicks, and on islands across the Pacific and Indian Oceans they reduce populations of native ants and other invertebrates. Crops, including sugarcane, macadamia, mango, and coconut, are also affected, due to the ants tending sap-sucking insects and killing the predators of crop pests.

As for what's at stake, the Wet Tropics World Heritage Area is the second most irreplaceable world heritage site on the planet, according to a 2013 IUCN study. Of Australia's butterfly species, 58% live in the Wet Tropics, as do 40% of the birds, 36% of the mammals, 25% of the frogs and over 20% of the reptile species. Even more mind-blowing is the proportion of species unique to the Wet Tropics. Millions of years of isolation from rainforest areas to the north and south has resulted in very high levels of endemism. For example, of the 35 frog species in Wet Tropics rainforests, 29 occur nowhere else, an incredible 80% endemism.

Based on impacts elsewhere, the ecology of the ants, small amounts of research in the region, and educated guesswork, we anticipate that if the invasion is thorough, much of the Wet Tropics fauna will be affected. Direct impacts will come through predation and harassment, and indirect impacts through removal of invertebrate prey, and disruption of ecological processes such as decomposition, pollination, and seed dispersal. The potential for knock-on effects in a system as complex and interconnected as the Wet Tropics rainforest is very high.

A complexity of consequences

Last year, with an enthusiastic team of students from James Cook University and with eggs donated by the Australian Butterfly Sanctuary, one of us (Lori) compared how often yellow crazy ants and native green tree ants attack cruiser butterfly caterpillars. Green tree ants are one of the first insects to disappear when yellow crazy ants invade, despite having a well-earned reputation for aggression. Within a few hours, yellow crazy ants killed 88% of the caterpillars while just 20% were killed by green tree ants. The difference wasn't in the attacking ability of the ants – both

Green tree ants (left) and other ants often disappear from sites invaded by yellow crazy ants. The high rate of predation by yellow crazy ants will likely change invertebrate communities with consequences for their important rainforest functions. ***Photos: Martin Cohen (ants), Conrad Hoskin***

readily killed any spiny caterpillars they encountered – it was in the numbers of ants. The extraordinary abundance achieved by yellow crazy ants means they are far more likely to find any prey.

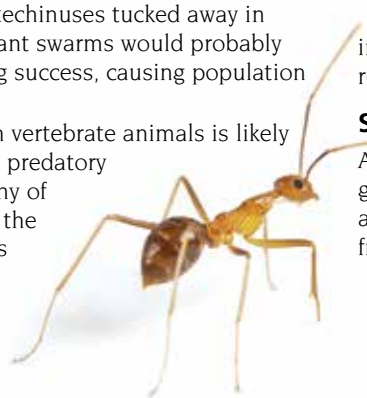
More ants mean more ant-mouths to feed, so yellow crazy ants can't afford to be picky about their sources of protein. We don't know how many insect species occur in the Wet Tropics – one study of five sites along one range found more than 4000 – but if you watch yellow crazy ants in the rainforest behind Cairns or Kuranda, you can see an array of this diversity passing by in the ants' mandibles and disappearing into the nest. Although some insects are likely to have effective defences, the ants have tremendous potential to reduce the unique invertebrate diversity of the Wet Tropics.

Predation of vertebrates seems less likely because they are larger and can run, hop, or fly away. But many are small – endemic microhylid frogs are only 1–2 cm long – and big things start small. Hatchling skinks and metamorph frogs are likely to be overwhelmed by the ants. The endangered Kuranda treefrog has a tiny distribution, and yellow crazy ants have infested one of the handful of rainforest creeks in which it breeds. Ants preying on metamorphs during the vulnerable few days when the tiny frogs with tails loiter on the edge of a stream could be a major threat.

Nestling birds, small (such as fantails and gerygones) to large (cassowaries), may also be vulnerable to injury or death from formic acid attack. Although adults vigorously defend their nest, they may not be able to stop an onslaught of ants.

Small mammals and lizards face similar risks. Think of leaf-tailed geckos on tree trunks or antechinuses tucked away in hollow logs. Daily harassment by ant swarms would probably affect their condition and breeding success, causing population declines through time.

However, the greatest impact on vertebrate animals is likely to come from less food due to the predatory efficiency of yellow crazy ants. Many of the 600-plus vertebrate species in the Wet Tropics feed mainly on insects and other arthropods. Species such as the many skinks and frogs that eat nothing but small invertebrates could be badly affected.



Predation by yellow crazy ants is also likely to change invertebrate communities, which could have far-reaching effects, for invertebrates are essential decomposers, detritivores, herbivores, pollinators, seed dispersers, predators, and prey.

The ants' hunger for sugar will also have consequences. You can tell there is something liquid and sweet up a tree when yellow crazy ants come down with fat, stripey rear ends. One of their main sugar sources is honeydew, excreted from bugs like aphids and scales that suck sap from plants. Attending ants can prevent natural enemies of these bugs from attacking, thereby allowing bug populations to build-up, to the detriment of the host plant. If the bugs make more honeydew than the ants can use, it drips on the leaves below, attracting sooty mould, which impairs photosynthesis by covering leaves.

Another sugar source is nectar. Ants are in most cases poor pollinators, operating instead as nectar thieves that deprive genuine pollinators and may lead to reduced seed set. Lori once spent days capturing 'empty' yellow crazy ants going up a tree, and 'full' ones coming down, to calculate that they ate nectar equivalent to 37% of their body weight. Multiply that by millions of ants and it equals a lot of stolen nectar.

The ants also take sugar from extrafloral nectaries, exuded by plants such as wattles from glands rather than flowers. Plants can benefit from ants at nectaries when they deter plant-eating animals. But yellow crazy ants aren't as good at protecting plants as the native green tree ants they displace.

About a quarter of the 2840 species of vascular plants found in the Wet Tropics occur nowhere else. Those that offer sugary resources could end up worse off.

Social and economic costs

A draft 2012 cost-benefit analysis by the Queensland government, which considered only limited impacts on agriculture and domestic dwellings, found that costs would range from $115 million to over $3 billion if the ants were not treated.

These numbers represent real problems for real people.

CONTROLLING YELLOW CRAZY ANTS

Like all ants, yellow crazy ants are hard to kill because the queens are well-protected in the nests. Unless the queens are killed, the colony will survive. Methods that only affect the workers (such as household sprays) are a waste of time. Worker ants need to take bait back to the nest and share it with the larvae and queens. So, the bait needs to be tasty, easy to handle, and still toxic after dilution within the nest. To treat large areas, the bait also needs to be easy to apply aerially. With yellow crazy ants, we have found that food preferences change seasonally, so a bait that works in one season may not work in another.

Russett Park resident Mikhaila Jacoby searches for yellow crazy ants at one of the Kuranda treefrog streams. ***Photo: Conrad Hoskin***

A Bentley Park couple had their new air conditioner burnt out when the ants nested in it. Paul Devine, an avid gardener in Russett Park, surrendered his garden to the ants because 'it's not just unpleasant to be there, it's impossible.' Dino Zappala, a cane farmer in Edmonton, found that growing cane in a heavily infested area is money-losing. And Frank Teodo, Dino's neighbour, has twice been temporarily blinded by yellow crazy ants invading his bed and spraying formic acid in his eyes.

The government analysis didn't include costs such as diminished property values and lost tourism. And many impacts can't be costed.

The invasion and control so far

Despite the extraordinarily special values of the Wet Tropics World Heritage Area, the effort to eradicate yellow crazy ants has been sporadic, slow and underfunded. Success is far from guaranteed.

The ants were first discovered in Queensland in 2001 on an industrial property in Cairns. In 2004 they were declared a Class 1 Pest. That year they were found in Edmonton, south of Cairns, and in 2008 they were found in suburban Cairns at Bentley Park. These areas were treated by Biosecurity Queensland. At least 27 other infestations, from Brisbane to Cairns, were reported between 2001 and 2010. But it wasn't until 2011, when Frank Teodo, a cane farmer in Edmonton with property adjacent to the World Heritage Area, had thick swarms on his patio and his dogs were temporarily blinded and scarred, that the ants started making headlines. By February 2012, Biosecurity Queensland had spent $660,000 treating infestations around the state, with the aim of eradication. But at the end of 2012, Biosecurity Queensland ceased all treatments, declaring that eradication from the state was not feasible.

The area infested around Cairns was then an estimated 300 hectares. By the time the Wet Tropics Management Authority managed to obtain funding from the federal government in late 2013, the ants had spread across 570 hectares. Now, it is more than 800 hectares, about equal parts residential areas, cane farms, and rainforest.

The Wet Tropics Management Authority aims to eradicate the ants within and next to the World Heritage Area. However, the $1.9 million funding over five years obtained under the Caring for Our Country scheme is not enough to do the job. Most of this money is used to buy bait and hire a helicopter to spread it. The expansion of the treatment area has overstretched the original budget, leaving little money to measure treatment effectiveness, delimit infestation boundaries, look for new infestations, or engage with the community. A difficult decision has just been made to focus on containment rather than eradication while treatment is fine-tuned and more resources are sought.

For many tasks, the authority relies on help from residents, Biosecurity Queensland, Conservation Volunteers Australia, James Cook University, CSIRO, local governments and others. The value of these contributions has exceeded $3.3 million.

Residents have been vital to the effort. Frank Teodo has given tours of his invaded farm to politicians, who have become motivated to help after seeing the ants and hearing Frank's account of being blinded for 11 days. Russett Park resident Mikhaila Jacoby has amassed a taskforce of over 70 volunteers to take over the delimitation, baiting and monitoring of the 30 hectare infestation in her neighbourhood.

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These contributions are likely to be sustained only as long as there is hope of eradicating the ants from the area, and that requires more funding.

The best-funded eradication programs in Australia are those in which the federal and state governments share the costs. There are three such programs for tramp ants: one for electric ants in the Cairns region, which has cost almost $12 million over nine years, and two for red imported fire ants in southeast Queensland, costing over $292 million over 14 years. They are funded jointly in recognition that these ants would have major agricultural, health, economic, and environmental impacts if they were to spread across Australia. But joint funding is limited to those species that can be eradicated from the entire country, which means the Wet Tropics program is not eligible.

Obtaining adequate funding is not the only hurdle. The program is not allowed to treat creeks, whether dry or flowing, even though they are prime real estate for yellow crazy ants and leaving them untreated allows reinvasion into treated areas and further spread. The ants nest in and along dry creeks. When they begin to flow, the ants rescue their young and move to higher ground, amassing in the millions next to the flowing water. Groups of ants that break off and float downstream can establish new colonies. An appeal to the Australian Pesticides and Veterinary Medicines Authority to allow treatment of dry creek beds is underway.

Yellow crazy ants need sugar – from nectar and honeydew – to fuel their workers, and protein for the production of more ants. More workers will emerge from these pupae (above). ***Photos: Conrad Hoskin***

Potential for eradication

The future of the Wet Tropics World Heritage Area and nearby residents and cane farmers hinges on adequate funding and successful implementation of an eradication campaign. Fortunately, awareness among decision makers is rising. The federal government has asked the Wet Tropics Management Authority to submit a proposal specifying the tasks and funding required for eradication.

Australia has become a world leader in ant control, and we can realistically hope that eradication in the Wet Tropics will succeed. In the past 10 years, eradications of red imported fire ants from 8300 hectares on and around Brisbane airport and from 71 hectares in Yarwun, and of tropical fire ants from 252 and 59 hectares on the Tiwi Islands represent the four largest ant eradications in the world. The electric ant program is on track to eradicate 73 infestations totalling 133 hectares. In Arnhem Land, yellow crazy ants have been eliminated from more than 26 locations totalling 252 hectares. On Christmas Island, aerial baiting has reduced ant numbers and stopped the decline of red land crabs. In a world first for ant control, the planned release of a biological control agent – a wasp parasite of the scale insect that provides the ants with honeydew – could eliminate the need for ongoing baiting. New developments are on the horizon that may make treatment cheaper and more effective, with fewer risks to non-target species.

The other programs have each needed 3-4 years of research and trials to fine-tune treatment. With a similar investment in the Wet Tropics we could achieve similar success. We also have some of the other key ingredients of successful programs – committed stakeholders and an increasingly engaged community.

Prevention and early detection of new infestations are also essential. Yellow crazy ants rely on humans for long distance dispersal. New infestations can be started by the movement of infested soil, timber, or green or household waste. Fortunately, their visibility, distinctive colour, and frenetic movement make yellow crazy ants easier to detect than electric ants or other small ants. We can also take some comfort from the fact that unlike most ants, yellow crazy ant queens do not establish new colonies by flying to new nest sites.

The risk of reinfestation from elsewhere within the state or overseas is often cited as a reason to not attempt eradication from the Wet Tropics. But without data on existing infestations within the state and the main pathways of spread, we cannot assess the risk. Thirteen of Queensland's 30 known infestations in 2010 were in timber yards, strongly suggesting that movement of timber is a high risk pathway. We need to identify and mitigate such risks.

Yellow crazy ants are now about 800 metres from the catchment for Copperlode Dam, the water supply for the Cairns region. That means if we stopped treatments now, the ants could be in the catchment – and therefore forever beyond eradication with current methods – in as little as two years. For eradication of yellow crazy ants from the Wet Tropics to continue to be feasible, additional funding must come soon. The world heritage values at stake are surely worth much more than the $1.9 million currently allocated. ■

READING: Csurhes S, Hankamer C. 2012. *Pest animal risk assessment: Yellow crazy ant Anoplolepis gracilipes.* Biosecurity Queensland. ■ Lach L, Barker G. 2013. *Assessing the Effectiveness of Tramp Ant Projects to Reduce Impacts on Biodiversity.* A report prepared for the Australian Government Department of Sustainability, Environment, Water, Population, and Communities.

VIEWING: Check out a YouTube video called 'Yellow crazy ants rafting' taken by Frank Teodo

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DR CONRAD HOSKIN is a biologist in the College of Marine & Environmental Sciences at James Cook University in Townsville. His research is focused on biodiversity: what is out there, how we discover and describe it, and how species form and adapt. Projects include impacts and adaptations of invasive species, and conservation of rare frogs and reptiles. He has discovered and named over 20 reptiles and frogs in Queensland, including the Kuranda treefrog.