Prepared for the Ministry of Primary Industries

Pest Incursion Plan for the Rosy Wolf Snail (*Euglandina rosea*)

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Sourced from Sharp (2017).

Executive Summary

Recently, a small colony of *Euglandia* rosea (hereon referred to as Rosy Wolf Snails) has been found in Northport, Marsden Point. The incursion was discovered on cargo ships by workers at the Northport Port while moving boxes of fruit imported from the United States. It is unknown how the snails passed through biosecurity checks, but it is assumed they burrowed into the plywood of the fruit boxes. While the incursion is not thought to have spread farther than Northport at the time being, this species is known to be highly invasive. We alert the Ministry of Primary Industries to this issue with suggestions for eradication measures to protect New Zealand's population of native snails and unique biodiversity. This incursion of Rosy Wolf Snails requires urgency and immediate action to prevent any ecological damage.

Multiple colonies of the snails have been found, creating risk for a rampant spread due to their rapid reproductive capabilities. They are notorious predators with a large appetite for other snails, as well, pointing to a significant threat for native snail populations. On a more positive note, New Zealand's environment is not ideal for the thriving of Rosy Wolf Snails, as it is often too cold and too dry for their liking. They will most likely remain in the most northern parts of the North Island, contained to Northland, according to climate matching models. This is not to say the incursion issue is any less urgent since the snails are known to be highly adaptive to their environments. Swift action is required to solve the problem before adaptation occurs and creates more damage, especially since it is difficult to predict potential distribution and timeframe.

An incursion of Rosy Wolf Snails would have an immense impact on New Zealand and could cost hundreds of thousands of dollars in damages to agriculture and tourism, alone. This figure does not even include the disruption on the native snail population that will then have a cascading effect on all New Zealand's biodiversity, destroying ecosystem services throughout the country. According to current literature and data, the Rosy Wolf Snail has invaded other places, like Hawaii, Florida, and the Pacific Islands, with no complete success in eradicating them. If this incursion is taken seriously and action is taken immediately, New Zealand can learn from other places' mistakes and have a higher chance of controlling the invasion fully. This report includes recommended methods of eradication, including active removal, habitat alteration, and protective barriers. These require a group of professional staff and funding to be successful.

The elevated risk associated with the Rosy Wolf Snail, along with the extensive amount of literature about successful invasions worldwide, underscores the urgency of this report. It is pressing that the MPI takes immediate action and implements measures to fully mitigate the potential impact of this snail in New Zealand.

Biology & Ecology

The Rosy Wolf Snail is a relatively large snail in comparison to others with a pink body and a pinkish reddish-brown shell (Texas Invasive Species Institute, 2009). They are native to the southeastern United States but are highly adaptive to other environments. They are often found in gardens and landscapes, favouring mulch and plywood. They have been introduced to other environments as a method to keep herbivorous snails and slugs in check to preserve gardens. They may appear to be a great species for biocontrol for other snails because they exclusively eat other snails and slugs, but their incredible carnivorous adaptations make them more invasive themselves than helpful. They move three times faster than most snails and have chemical receptors that allow them to follow the slime trails of their prey (Clifford et al., 2003). They are also known to eat their own kind, making them in the top 100 worst invasive species in the world (Brodie et al., 2012). They are cross-fertilising hermaphrodites, which means they have both male and female reproductive parts but require a partner for fertilisation (Cook, 1985). This also allows them to mate with any other Rosy Wolf Snail. They lay about 25 - 40 eggs a year with eggs hatching after 30 days and the snails living up to 2 years (Texas Invasive Species Institute, 2009). The Rosy Wolf Snail has a relatively short life cycle, so they reach sexual maturity fast. They also immediately start feeding on prey when they hatch and do not go through a larval stage.

Summary of pest's history of damage overseas

In the past, regions around the world have used the Rosy Wolf Snail as a biocontrol species. Places like Hawaii, Florida, and the Pacific Islands intentionally introduced the Rosy Wolf Snail to control other invasive species, but in all cases the snail grew to become a major threat to all native snail species. Based on literature and their similar climates (discussed in the section below), Hawaii is the most relevant case study to the situation in New Zealand now. They were introduced in Hawaii to combat the invasive giant African snails, but there was little success with this and rather than managing the problematic snail species, the Rosy Wolf Snail became invasive itself (University of Michigan Museum of Zoology, 2016). Some efforts were put in place to eradicate the Rosy Wolf Snail after it became invasive in Hawaii. This included manual collection and predator exclusion barriers (Department of Land and Natural Resources Division of Forestry and Wildlife, 2020). These methods have been partially successful, but due to the widespread distribution there has been no success with completely eradicating the species (Costello et al., n.d.).

Distribution & Likelihood of further spread in New Zealand

Over half of New Zealand's grapes and citrus fruit are imported from the United States, so the chances are high that the Rosy Wolf Snail entered the country through cargo boxes. This most

likely occurred at the Northport Port in Marsden Point since it is a common entry point for cargo ships carrying imports. The North Island of New Zealand also has a warmer and more temperate climate than the South Island, so the Rosy Wolf Snail is more likely to thrive there (Figure 1). The climate of New Zealand is not necessarily ideal for this species because they prefer warmer and more humid conditions.

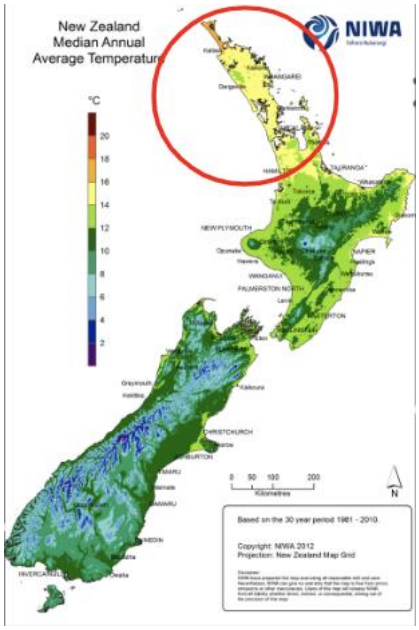

Figure 1: Map of New Zealand's Median Annual Average Temperature with a circle indicating where the incursion would occur. Sourced from National Institute of Water and Atmospheric Research (NIWA) (n.d.).

According to a climate matching model between the Whangarei Aero weather station in New Zealand and weather stations in Hawaii, Florida, and Guam from 1985 data (Figure 2), the climates are similar but not the same (Climate Matching Tool, n.d.). With 1.0 being the exact same, the north of New Zealand has the most similar climate to Hawaii at a value of 0.60. Florida and New Zealand are similar with a value of 0.46, but New Zealand's climate seems to be very different than Guam with a value of 0.39. All these values are relatively low, meaning that New Zealand's climate is not ideal for the Rosy Wolf Snail since it thrived and became invasive in the other three places. The cold and dry conditions of New Zealand may create an environment where the Rosy Wolf Snail is hanging on in small numbers rather than spreading around the country rapidly. Although, in the warmer summer months where there are high populations of native snails, the Rosy Wolf Snail could thrive and become a threat to the native biodiversity of New Zealand. This suggests that the distribution of the incursion could be limited, but I believe the adaptability of this species creates a high likelihood to spread around the northern part of the North Island if no immediate action is taken. Data shows that Rosy Wolf Snails are capable of aestivation and

hibernation to survive dry and cold seasons (CABI, 2019), so the incursion is not to be taken lightly even if New Zealand's climate points to be less than ideal.

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Climate Matching Tool				
Date accessed: 2023-10-11				
		Climate station group one: 1985		
	Station	Opaeula 870 (USA)	Tavernier (USA)	Wsmo Agana (GUM)
Climate station group two: 1985	Whangarei Aero (NZL)	0.598930241828208	0.461018936357902	0.385552529607515

Figure 2: A table comparing climates from New Zealand, Hawaii, Florida, and Guam. Sourced from Climate Matching Tool MPI (n.d.).

Risk Assessment

Due to their carnivorous behaviour and potential for rapid expansion, Rosy Wolf Snails pose a large threat to native fauna in New Zealand. We have seen native extinctions in places like Hawaii where the snail invaded (Gerlach et al., 2020). There are already many endangered or threatened snail species in New Zealand caused by predators and habitat loss, like *Paryphanta spp.*, *Placostylus spp.*, *Amborhytida spp.*, and *Powelliphanta spp* (Te Ara, n.d.). These snails have valuable functions in the ecosystem, like breaking down leaf litter and eating other invertebrates. Decline of these species could cause knock-down effects and have negative impacts on the entire ecosystem. The ecosystem also could be disrupted through possible habitat alterations of the threatened native species. If they alter their behaviour to avoid the Rosy Wolf Snail predation, this in turn could change their preferred habitat or time spent in the open, leading to a loss of prey for other native fauna that depend on snails for their survival. This could also impact the native flora of New Zealand since snails can distribute seeds and fungal spores through their feeding and movement. With changed behaviour, or the disappearance of native snails overall, there are adverse consequences on the distribution and diversity of plants. The disruption of ecological balance would disrupt the entire ecosystem, not just native snails in New Zealand.

Recommendation

Clearly, it is vital for action to be taken as soon as possible to prevent any possible spread from occurring before the infestation reaches a critical level. Aggressive eradication is essential and can be done through a professional staff approach. While a public interventionalist approach may seem appealing with encouragement of volunteer monitoring and awareness in media because it is less expensive, it is purely reliant on the efforts of the community. This incursion requires an intensive approach that guarantees positive impacts.

The first step I recommend is forming the professional staff team for rapid response. They should survey and map the areas of incursion to understand the extent using data collection and field studies. Once the extent is understood, the team should both contain and quarantine the point of entry at Northport Port. The imports received at this port, especially the crates of fruit, should be thoroughly inspected before entry is allowed. Stricter biosecurity controls should prevent any more snails from entering the country, but action must be taken on the ground to physically remove the snails that have been able to enter already. For eradication, I propose a combination of active removal, habitat alteration, and potentially protective barriers. If removal and habitat alteration methods are put in place soon enough, protective barriers may not be needed. I do not recommend the introduction of another biocontrol species since New Zealand's ecosystem is unique and sensitive to invasive species. In other places, the Rosy Wolf Snail was introduced with the intention to control other invasive species, and New Zealand cannot afford a mistake like this with another species (Clark et al., 1984).

There are currently no baits or traps that are effective at capturing the Rosy Wolf Snail, so manual collection is required. This requires training to team in identifying the snails in the wild, which can prove difficult. The focus should be on the adult Rosy Wolf Snails because they are the easiest to spot and identify. In addition, if a large percentage of the adults are removed, the rates of reproduction will decrease and incursion will be less expensive focused on one life stage (Oates & Resources For The Future, 2012, pp. 239–297). A monitoring program should also be put in place to track the snail populations over time and the distribution of the snails. Manual collection itself is a great start for a small population of adult snails, but if the Rosy Wolf Snails reproduce as quickly as expected, more incursion methods will be needed.

Habitat alteration paired with manual collection is recommended to control the incursion of snails. It is vital to use targeted alteration so that the native populations of snails are not impacted by the strategies put in place. This includes identifying the specific areas the Rosy Wolf Snails are most concentrated and leaving unaffected areas undisturbed. Also, native vegetation management should be prioritised to keep native snails safe. By promoting the growth of native plants that native snails like and that Rosy Wolf Snails are less attracted to, the environment will be less favourable for the Rosy Wolf Snails while remaining undamaged for native snails. If the incursion reaches an extreme rate, moisture levels of the areas Rosy Wolf Snails prefer should be altered. Diverting water sources or minimising irrigation in those areas would prevent them from thriving in the environment, especially since New Zealand is already a drier climate than what they are used to. This should only be done if other methods are not working, since adjusting moisture levels in these places could create issues for native snails as well.

If the previously mentioned strategies do not work to mitigate the incursions, protective barriers are recommended. This method is more expensive but are vital if the snails remain invasive after other attempts to get rid of them. The ideal barrier was designed by the Oahu Army Natural Resources Program (Figure 3) and has angled flange, sharp copper wire, and electrical wires to create difficulty for the Rosy Wolf Snails (Department of Land and Natural Resources Division of Forestry and Wildlife, 2020). The angle of the flange and the cut copper create two different barriers that are problematic to cross for the snails, but there is an extra boundary of protection with electrocution if they can make it through. From materials to labour costs, this barrier could cost up to hundreds of thousands of dollars to install around Northland. The barrier technology could also have adverse effects on the native snail population. This is a last resort recommendation, but it is important to keep in mind because the cost of a largescale incursion of Rosy Wolf Snails in New Zealand are much larger than the cost of the barriers.

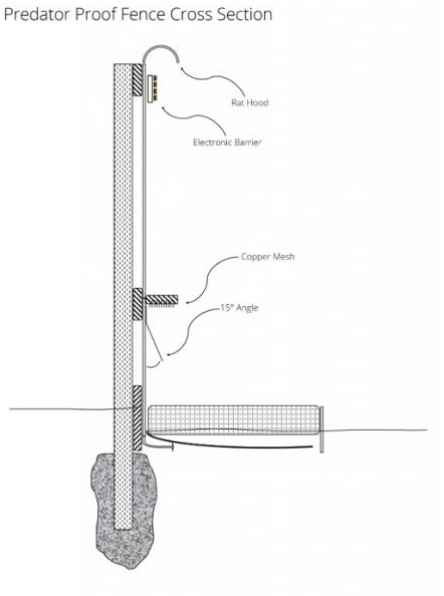

Figure 3: Cross section of the predator free barrier developed by the Oahu Army Natural Resources Program. Sourced from Hawaii Department of Land and Natural Resources (2020).

This report has included three different levels of incursion management. The faster the methods are implemented; the more money is saved and the less the ecosystem is altered from the presence of an invasive species. On top of these plans, it is necessary to consult with the iwi in Northland before action is implemented, given their role in biodiversity kaitiakitanga. This includes Ngāi Takoto, Ngāti Kurī, Te Aupōuri, Te Rarawa, Ngāti Kahu, Ngāti Kahu ki Whangaroa, Ngāpuhi, Ngātiwai, and Ngāti Whātua (Te Puni Kōkiri Ministry of Māori Development, n.d.).

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