Threatened Species Recovery Hub

National Environmental Science Programme

Invasive Flatworms on Macquarie Island

Information paper

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Cover image: Flatworm survey volunteers Aimee and Kristen. Image: Melissa Houghton

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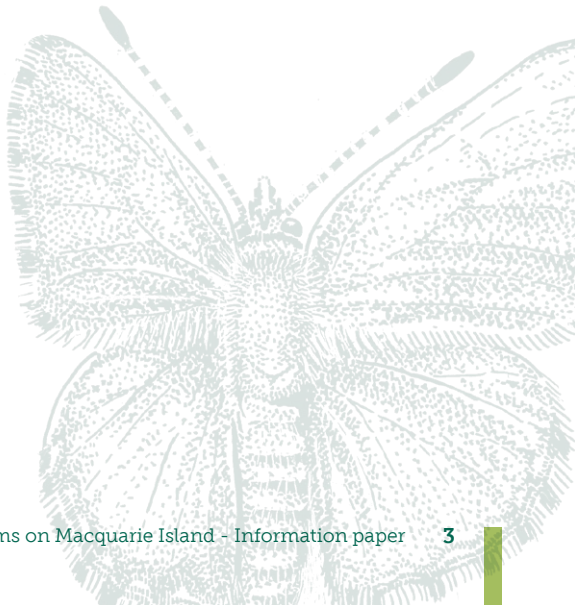

Island-wide invertebrate monitoring was undertaken as part of AAS 4305 project (Post eradication monitoring of Macquarie Island). Melissa Houghton undertook field surveys between 2015-2018 (Houghton 2020). We found that *Kontikia andersoni* has significantly expanded its range since a previous survey in 2004. *Arthurdendyus vegrandis* was not detected during the surveys, despite additional focused searches in the area of its recorded occurrence in 2004.

Background on invasive invertebrates

Macquarie Island's invertebrate fauna is made up of over 350 species, mostly mites and springtails, with 44 endemics and at least 40 species of established non-native invertebrates (Greenslade 2006; Houghton 2020). Most established non-native invertebrates on Macquarie Island are small and flightless detritivores (Houghton 2020). In addition, there are several large-bodied, non-native macro-detritivores, including the slug *Derocerus reticulatum* (Limnacidae), earthworms (Lumbricidae), two terrestrial Crustacea including (*Puhuruhuru patersoni* (Amphipoda: Taltridae) and *Styloniscus otakensis* (Isopoda: Styloniscidae), and two predatory flatworm species (Platyhelminthes: Geoplanidae), *Kontikia andersoni* and *Arthurdendyus vegrandis*. These two flatworms are the focus on this report. Flatworms have the ability to regenerate asexually from fragments, but as hermaphrodites they also sexually reproduce and produce egg cocoons (capsule-like), which can be attached to surfaces, leaf litter or soil via a small stalk.

Invasive flatworms on Macquarie Island

Flatworms were first discovered on Macquarie Island at two creek-side sites on the south-eastern coast of Macquarie Island (near Lusitania Bay) in 1997 by R. Blakemore whilst conducting earthworm surveys (Greenslade et al. 2007). The flatworms are thought to be introduced from New Zealand more than 100 years ago, associated with commercial seal and penguin harvesting activities (Figure 1) (Greenslade et al. 2007). The flatworms collected by Blakemore in 1997 were later identified as *Kontikia andersoni* and *Arthurdendyus vegrandis*, both novel species to Australia (Winsor and Stevens 2005). *Kontikia andersoni* and *Arthurdendyus* flatworms are serious pests in the UK, where they impact native soil fauna through their voracious predatory feeding habits, with consequences for soil nutrient cycling (Sluys 2016). Greenslade et al. (2007) conducted a baseline survey for flatworms on Macquarie Island in 2004, which included 182 sites in the south-east 'target area', and an additional 511 sites island wide. No surveys were conducted in restricted areas (Special Management Areas) designated for seabird conservation, including the south-eastern coast of the island, i.e. south of Lusitania Bay. The 2004 survey confirmed both flatworm species had spread from their likely region of introduction. However, no location data is available for the 511 sites across the island that were recorded as 'absences' for both flatworm species.

An island-wide invertebrate survey in 1994 which included timed searches for macro-invertebrates at 67 sites did not detect either *A. vergrandis* or *K. andersoni* (Davies and Melbourne 1999). The locations for these sites are also not available. However, Greenslade et al. (2007) reported that all 67 sites were outside the area they later defined as the 'target area' for flatworm searches.

From the baseline distribution data established by Greenslade et. al (2007), we aimed to clarify the current distribution of flatworms based on i) an invertebrate trapping program in key vegetation communities ii) focused searches in areas where flatworms had been previously detected and iii) a comprehensive island-wide survey for flatworms.

Method

Invertebrate trapping program

Comprehensive invertebrate surveys were carried out at 24 sites across Macquarie Island during three consecutive sampling seasons (2015-2018) (See Houghton et al. 2019 and Houghton 2020 for detailed trapping and surveillance methodology). These sites covered a range of dominant vegetation communities

Comprehensive island wide flatworm survey

We designed a comprehensive survey to determine the distribution of flatworms on the island. Sites were situated approximately 1 km apart along the coast. Nearby suitable habitat (i.e. vegetated and damp) was identified in which to conduct a timed hand search. Additional to the coastal sites, four cross-island transects following major drainage areas were also surveyed, with sites spaced every 500 m. Timed searches were made by hand, either by 1, 2 or 3 people.

Figure 1. *Lusitania Bay, Macquarie Island, where New Zealand flatworms are thought to have been introduced more than 100 years ago with commercial seal and penguin harvesting activities. Image: Melissa Houghton*

Results

Invertebrate trapping program

K. andersoni was found at six of the 24 island-wide monitoring sites, of which four were outside its previously known distribution. Of these four new sites, two were on the west coast, with only a single *K. andersoni* detected at each site during the three years of monitoring. At the other two new sites where *K. andersoni* was detected (one on the east coast, the other on the southern coast) it was abundant across years.

Comprehensive island wide flatworm survey

During the island-wide flatworm survey, *K. andersoni* was found at 29 of the 103 sites. Twenty-four of the 29 were outside its previous distribution in 2004. Overall, *K. andersoni* was found to occupy most south-eastern coastal areas, as well as inland areas in the centre of the island. Its detections spanned the east coast between Brothers Point and Hurd Point, demonstrating east coast range extensions of more than 7 km north and 6.4 km south since 2004.
Five positive detections of *K. andersoni* were from the west coast, with at least 3.5 km of unsuitable habitat separating these detections and the western extent of its range in 2004.

Figure 2. *Adult* K. andersoni *in tussock litter, Hurd Point. Image: Melissa Houghton*

Findings

Arthurdendyus vergrandis

Arthurdendyus vergrandis was not detected at any sites during our surveys between 2015-2018, even though one of the sites overlapped directly in with an area where *A. vergrandis* had been detected by Greenslade et al. (2007). Rocks, stones and debris were regularly upturned and examined, known techniques for *A. vergrandis* detection based on the previous 2004 survey. This result surprised us given the multiple trap methods and inclusion of timed searches. It is possible that *A. vergrandis* persists on the island within the limited areas described by Greenslade et al (2007), but at a much lower abundance than K. andersoni. Indeed in 2004, Greenslade et al. (2007) found *K. andersoni* more widespread and at least three times more abundant than *A. vergrandis*.

Kontikia andersoni

Kontikia andersoni has considerably expanded its range to the south, west and north, now occurring across much of the island. Its distribution along the east coast now far exceeds the limits described by Greenslade et al (2007), who predicted a 10m-yr rate of spread from its likely point of introduction at Lusitania Bay. Our surveys extended its southern limit, as we detected it as far south as Hurd Point, and its new northern limit is just north of Brothers Point. These new limits indicate that between 2004 and 2018, *K. andersoni* has spread at rate of ~500m/yr since 2004. It has not only spread north and south along the east coast away from Lusitania Bay, but also now occurs in the interior of the island, being found around Mt Law up to an altitude of ~170 m. For the first time the species was detected on the west coast of the island, where it occurs intermittently over 11.4 km.

Kontikia andersoni was prevalent in moist soils and leaf litter, and on or adjacent to tracks during our survey and in 2004. Given this, it is possible that its rapid range expansion has been facilitated by human activities.There was a drastic increase in foot traffic on the island by field workers and detection dogs during the recent Macquarie Island Pest Eradication Project (2011 – 2014), both off and on the established track network.

Kontikia andersoni identification

Kontikia andersoni are distinctive, and due to their relatively large size (up to 2 cm) are easily detected by the naked human eye. They have three bands of dark dorsal stripes running lengthwise along their tan-coloured body (Figures 2, 3 and 4). Egg capsules are small, round and dark, laid either in the damp soil, on the soil surface or attached via a small stalk to a hard surface.

Figure 3. *Adult* K. andersoni *in Stilbocarpa (Macquarie Island Cabbage) litter, Red River outlet. Image: Melissa Houghton*

Kontikia andersoni habitat

Kontikia andersoni were typically found on the ground surface over decaying plant material and amongst wet leaves and litter up to 1-2 cm deep (See Figures 2, 3, and 4). Individuals were detected in wet sites, rather than damp or dry sites. *K. andersoni* favoured wet litter of tussock (*Poa foliosa*) and Macquarie Island cabbage (*Stilbocarpa polaris*). Where these plant species were absent, e.g. away from the coast, on inland tracks, Lusitania Creek catchment, Green Gorge tarn area and Mt Law, flatworms were associated with wet moss beds and small *Epilobium* spp.

Management recommendations

- We recommend educating field officers on the known distribution and identification of both flatworm species.
- K. andersoni is highly likely to invade the northern end of the island where the reseach station is situated. This presents considerable biosecurity concerns.
- To mitigate human-mediated dispersal of *K. andersoni*, we recommended washing and/or sanitising of boots, shoes, walking poles and other equipment in contact with the soil when leaving invaded areas. Washing could occur in streams or water bodies at the boundaries of flatworm habitat, preferably in fast-running water and close to the sea. Use of a suitable biocide spray could be effective, although complicated by potential effects on native fauna. Note Virkon®, which has previously been applied to boots for biosecurity purposes on the island, is not effective for invertebrates (Bartlett et al. 2021).
- Neither *Arthurdendyus* flatworms nor *K. andersoni* are known to be present in other parts of Australia, including Tasmania, except for Macquarie Island. Both flatworms pose environmental and agricultural risks, based on their impacts elsewhere. Preventing their potential introduction to Tasmania is advisable.
- Once established at the research station, there is a greater risk of flatworm propagules attaching to outdoor stored cargo which is then transferred from Macquarie Island to Tasmania. Care must also be taken to ensure people and cargo transferred directly from the field to the resupply ship do not transfer propagules. Rigorous cleaning including washing and/or sanitisation of cargo and equipment is advised. Cargo that has been in contact with the ground in infested areas should be cleaned.
- We recommend annual surveys and searching for flatworms around the research station and cargo loading sites. Specific attention should be given to suitable habitat.

Figure 4. *Adult* K. andersoni *in Stilbocarpa litter, Red River outlet. Image: Melissa Houghton*

Future research recommendations

- A repeat whole island flatworm survey should be undertaken to update the distribution and invasion rate of both species, preferably in 2023.
- The diet preferences of *K. andersoni* on Macquarie Island are currently unknown. It thus remains unclear how the predatory flatworm is impacting native invertebrates, soil properties and plant communities. Further work investigating this impact, and identifying preferred prey, would be valuable for future management of the island.

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Further information:
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