

Restoring the Flow: Stream Life Slowly Returns After Rabbit Eradication on Macquarie Island

Dr Richard Marchant

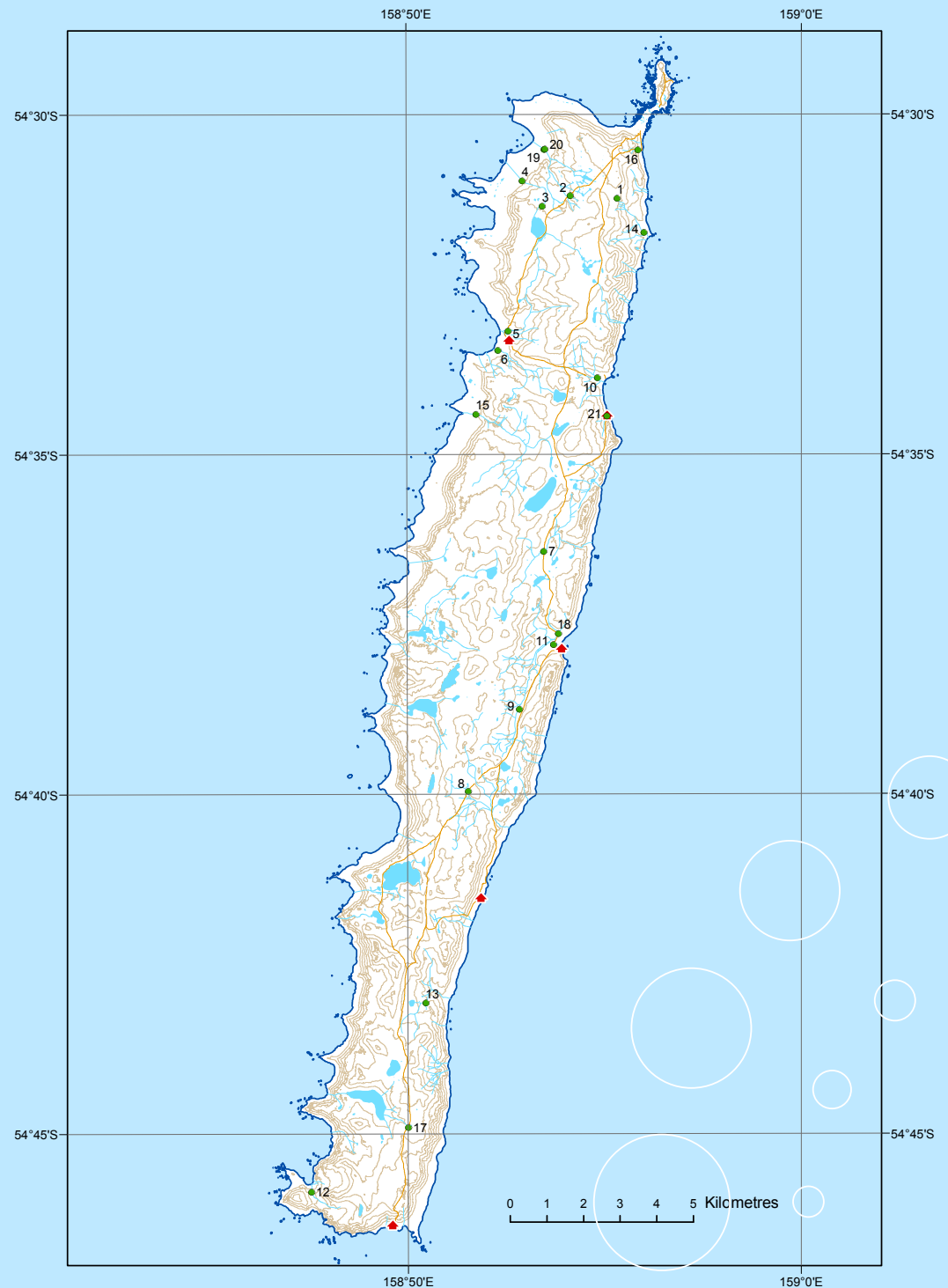
JUNE 2025


doi.org/10.33548/SCIENTIA1293

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The remote streams of subantarctic Macquarie Island are home to low diversity freshwater invertebrate communities with an unusual taxonomic composition. However, over a century of grazing by introduced rabbits dramatically degraded surrounding vegetation, increasing erosion and disturbing stream ecosystems. Following rabbit eradication in 2016, Dr Richard Marchant of Museums Victoria and colleagues from the University of Canberra and the Australian Antarctic Division investigated whether the island's streams were recovering ecologically. Their study reveals a slow but measurable resurgence of invertebrate taxa, particularly in areas with moderate prior damage and vegetation regrowth, though full recovery remains uncertain.

Ecological Influencers of Macquarie Island

Freshwater ecosystems on remote islands are fundamentally different from those on continental landmasses. Unlike mainland rivers, where insects and other aquatic invertebrates often form diverse communities with many routes for recolonisation, island stream life has far fewer species and limited migration capabilities. Unsurprisingly, these systems often fall under the scientific radar. Macquarie Island, a subantarctic World Heritage Site halfway between Australia and Antarctica, is one such place. Isolated by vast ocean expanses, Macquarie's stream beds are home to a limited range of small worm, crustacean, flatworm, and fly larvae species.

In 1992, ecologists first surveyed 15 stream communities on Macquarie Island and found them to contain approximately 12 taxa per site, on average. However, as researchers returned in later years (2008 and 2010), they noticed a troubling trend: both biodiversity and species abundance were in decline, with an average of only 7.4 and 8.4 species per site, respectively. They determined that the most affected communities were at sites that had experienced the highest degree of vegetation damage. The culprit? A once widespread but invasive island inhabitant - rabbits. It is the ecological aftermath of that grazing that Dr Marchant and his colleagues sought to understand. In their study '*Slow recovery of stream invertebrates on subantarctic Macquarie Island after eradication of introduced rabbits and regrowth of vegetation*', they attempt to determine the rate of recovery of stream invertebrate communities following rabbit eradication on Macquarie Island.

Eradicating Rabbits

European rabbits were introduced to Macquarie Island in 1878. Over the next century, their numbers boomed, from 50,000 to more

than 350,000 at their peak in the 1970s, causing severe overgrazing of the island's vegetation. As plants vanished, so did the protective cover they offered against erosion. With bare soils exposed, sediment washed into streams, likely changing water chemistry, increasing turbidity (water cloudiness), and disrupting the food and habitat of aquatic invertebrates. Due to the *Myxoma* virus spreading across the island in 1978, rabbit numbers dwindled, but nevertheless bounced back to 200,000 by 2006, with visible impacts on stream invertebrate richness and abundance evident by 2008.

Previous research suggested a direct link between rabbit-driven vegetation loss and the decline in invertebrate diversity. But could those communities recover if the source of disturbance was removed?

In 2011, Australia launched a bold campaign to remove all rabbits from the island. By 2014, Macquarie Island was declared rabbit-free, with no rabbit observations recorded for the previous three years. Two years later, in 2016, Dr Marchant and his team reanalysed the stream biodiversity to find out whether the invertebrate communities had begun to recover.

A Glimpse Beneath the Surface: How the Study Was Done

To assess recovery, Dr Marchant and his team resampled 13 of the original 15 stream sites that had originally been surveyed in 1992, 2008, and 2010. Using consistent methods, they collected invertebrates from the stream beds and preserved the samples for identification. They also measured water quality, specifically electrical conductivity and turbidity, and evaluated the regrowth of surrounding vegetation using photographic comparisons.



Invertebrate abundance was gauged using a simple index: how many of the five samples at each site contained a given species. This approach, used in all previous surveys, allowed for meaningful comparisons over time, even though total species numbers were small.

Ecosystem Recovery: Slow Progress

The 2016 data painted a picture of partial and uneven recovery. On average, about 8.2 invertebrate species were found per site, similar to the numbers seen during rabbit overpopulation in 2008 and 2010. However, this was still significantly lower than the 11.6 species per site recorded in 1992. This may suggest that the number of refuges for freshwater invertebrates (i.e. areas where species have survived and can recolonise other ecosystems from) on Macquarie Island may be low, leading to slow recovery.

Importantly, no new invertebrate species appeared in 2016, a result likely tied to the island's geographic isolation, which restricts natural recolonisation from other regions. However, of the 19 species previously observed, 15 were found in the samples. Several species that had sharply declined during the rabbit years, such as some oligochaete worms and flatworms, showed slight rebounds in abundance. Others, like *Nais elinguis* and *Mesenchytraeus* worms, had remained relatively stable across all years.

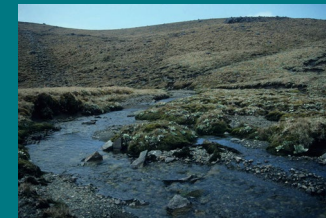
Dr Marchant also considered that the vegetation damage caused by rabbits may not be the only factor affecting the invertebrate biodiversity. However, analyses of stream water quality showed little change over time, as turbidity remained essentially the same as in 2008, while electrical conductivity increased slightly, possibly due to temporary changes in salt deposition from wind.

Perhaps the most telling recovery was not in the water, but above it. The vegetation that rabbits once decimated had begun to return. Sites primarily located on the island's upland plateau were previously subjected to low or moderate rabbit grazing, and they showed persistence of native plant species like *Poa foliosa* and the distinctive megaherbs *Stilbocarpa polaris* and *Pleurophyllum hookeri*. Meanwhile, lower-elevation sites along the coastal terrace had been heavily grazed of native, palatable plants, and in their place less desirable but resilient species, such as *Acaena magellanica* and *Poa annua*, maintained their grip, leaving less room for native species recovery.

The Big Picture

So, what do these findings mean? The recovery of Macquarie Island's stream invertebrates is underway, but it is slow and incomplete. Even five years after the total eradication of rabbits, the invertebrate communities had not bounced back to their 1992 levels, which they themselves may not even reflect pre-rabbit conditions. This lag suggests that even when the immediate stressor, in this case, rabbit overgrazing, is removed, the deeper ecological damage persists. Sediment loads, altered nutrient cycling, and missing vegetation cover likely continue to influence stream conditions and limit the pace of biological recovery.

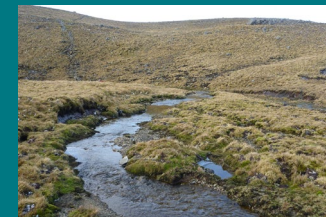
Macquarie Island's streams are a case study in ecological vulnerability and resilience. The findings highlight both the fragility of freshwater ecosystems on isolated islands and the importance of long-term ecological monitoring. Without baseline data from the 1990s, these changes in stream biodiversity and abundance may have gone unnoticed, and vital restoration efforts would not have been possible. Ongoing monitoring will be crucial to track whether these recovering systems continue to improve, or whether they plateau into a new, altered state.



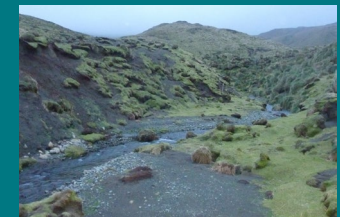
Site 2, 1992



Site 5, 1992



Site 2, 2010



Site 5, 2010



Site 2, 2016



Site 5, 2016

^ Site 5 suffered a severe degree of grazing by rabbits, while Site 2 suffered a low degree of grazing by rabbits.



MEET THE RESEARCHER



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Dr Richard Marchant is an ecologist specialising in aquatic insects and invertebrates inhabiting river ecosystems, with a focus on species composition, diversity and population dynamics. His research career began nearly 50 years ago studying brine shrimp in the salt lakes of western Victoria. He later investigated the ecology of riverine amphipods in Ontario, Canada, and tropical invertebrates in Kakadu National Park of the Northern Territory of Australia. For the past 40 years, he has worked at Museums Victoria, conducting extensive fieldwork in Victoria, southern New South Wales, and Macquarie Island, a remote sub-Antarctic location. Dr Marchant is the scientific editor of the *Memoirs of Museum Victoria*, an associate editor of *Marine and Freshwater Research*, and serves on the editorial board of *Freshwater Biology*. He has also been secretary of the Australian Freshwater Sciences Society and Australia's national representative to the International Society for Limnology. His work continues to inform and advance freshwater ecological research.

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FUNDING

Australian Antarctic Science Program



FURTHER READING

R. Marchant, B.J. Kefford, M. Houghton, J. Wasley and C. K. King (2023) Slow recovery of stream invertebrates on subantarctic Macquarie Island after eradication of introduced rabbits and regrowth of vegetation. *Marine and Freshwater Research*, 2023, 74, 1171–1177. DOI: <https://doi.org/10.1071/MF23009>

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