BRIEF COMMUNICATIONS

Intercepting the first rat ashore

Keeping islands free of rats may be harder with isolated invaders as these evade conventional trapping.

A single Norway rat released on to a rat-free island was not caught for more than four months, despite intensive efforts to trap it. The rat first explored the 9.5-hectare island and then swam 400 metres across open water to another rat-free island, evading capture for 18 weeks until an aggressive combination of detection and trapping methods were deployed simultaneously. The exceptional difficulty of this capture indicates that methods normally used to eradicate rats in dense populations are unlikely to be effective on small numbers, a finding that could have global implications for conservation on protected islands.

Invasive rodent species severely disrupt island ecosystems[1,2]. Although rats can be eradicated from islands[2,3], they often reinvade: at least 11 New Zealand islands have been reinvaded since 1980 by Norway rats (*Rattus norvegicus*)[4]. It is difficult to eliminate rats in the early stages of invasion[3,5]. This may be related to unusual behaviour by the animals, because the problems exceed those expected from the proportionally lower probability of detection due to low population density[6]. This behaviour could be monitored by releasing individual, radio-collared rats on to rat-free islands[7].

The uninhabited and forested Noises Islands (Motuhoropapa and Otata) off northeast New Zealand have been reinvaded by Norway rats at least six times between 1981 and 2002 (ref. 4); however, by 2004 they had been rat-free for more than two years. In November 2004, we captured an adult male Norway rat by using a chocolate-baited trap (Table 1, method 1) on the uninhabited and forested Pakihi Island, which lies 30 km to the southeast. The rat was fitted with a radio collar and a DNA sample taken from its tail before it was released on a beach on Motuhoropapa (area, 9.5 hectares). Our aim was to study the behaviour of this solitary invading rat and to test its susceptibility to standard methods of detection (independently of radio-tagging) and elimination. (For details of methods, see supplementary information.)

Table 1 | Attempts to detect and eliminate a rat

	Method	Number	Exposure (h)
1	Live trap	30	10
2	Snap trap	20	70
3	Waxed device	15	70
4	Tracking tunnel	15	70
5	Trained dogs	2	16
6	Permanent grid	20	250
7	Peanut butter bait	20	50
8	Buried traps	5	40
9	Poison bait	5	30

Different strategies were used intensively on two islands to track and trap a single rat after its initial capture (by method 1) and release: methods 2–5 were used on Motuhoropapa; methods 5–9 were used on Otata. Further details of the devices and detection methods are available in supplementary information.

Space invader: rats can swim between islands.

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The rat traversed the entire island before settling after 4 weeks in a home range of about a hectare, as defined by radiotelemetry. All attempts from weeks 4 to 8 to capture or detect the rat using conventional techniques failed (Table 1, methods 2–5). This failure was surprising because devices 2, 3 and 4 had been laid at double the density that had been used to eliminate previous populations[8].

After 10 weeks, the radio signal was lost. Fresh signs of the rat subsequently appeared in a 100-metre grid of bait stations and tracking tunnels (Table 1, method 6) on Otata (area, 21.8 hectares), which lies 400 m across open water[8]. Genetic fingerprinting of rat faeces found on this island confirmed that this was the same individual as the one released on Motuhoropapa (results not shown).

From weeks 12 to 16, different techniques were used to try to eliminate the rat on the second island (Table 1, methods 5–9). Positive signs using methods 5–7 showed that it had visited various sites. However, the rat was not caught until 18 weeks after its release, when it was finally killed in a trap that had been baited with fresh penguin and set where trained dogs had found concentrated rodent scent.

Norway rats can supposedly swim up to 600 m (ref. 1) but, to our knowledge, this is the first record of a rat swimming hundreds of metres across open water. Although Motuhoropapa had previously supported 4.2 rats per hectare and contains forest plants, invertebrates and sea birds as uncontested food sources[8], the rat still swam to another island, possibly prompted by the absence of conspecifics.

Field studies of rat dispersal have previously focused on high-density populations, from which juveniles escape because of competition for food and territory[9,10]; however, new invaders may behave differently[5]. Our findings confirm that eliminating a single invading rat is disproportionately difficult, not only because of atypical behaviour in the absence of conspecifics, but also because bait can be less effective in the absence of competition for natural food sources. Our results may help in the design of conservation strategies to keep islands free of invasive rodents.

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