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Proceedings of the Vertebrate Pest Conference

Title

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Permalink

<https://escholarship.org/uc/item/2j6187s5>

Journal

Proceedings of the Vertebrate Pest Conference, 29(29)

ISSN

0507-6773

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Publication Date

2020

Control of Invasive Ship Rats, *Rattus rattus*, on Goat Island, New Zealand (Abstract)

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ABSTRACT: Invasive ship rats (*Rattus rattus*) are the major threat to the native species and ecosystem of Goat Island (9.3 ha), New Zealand. The island is only 100 m away from the mainland, which imposes a risk of incursions by rats swimming over. Accessibility depends on weather and tide times which makes regular trap servicing complicated. In 2016 we extended an existing trapping grid of 8 kill traps (DOC200; Department of Conservation, New Zealand) with 10 self-resetting traps (Goodnature A24s; Goodnature Limited, Wellington, New Zealand) to improve current management and ideally achieve eradication. Before our study started, DOC200s on the island had not been serviced for six months. Rats were active even during the day and rat numbers were assumed to be high. The DOC200 kill traps were lured with an egg and A24s were lured with Goodnature automatic lure pumps (ALP) baited with chocolate formula for rats. The A24s were equipped with Goodnature digital strike counters to document the number of rats killed by the self-resetting traps. All devices were on average checked every 49 days from August 2016 to October 2017. DOC200s were reset after triggering or after three months, whichever occurred first. ALPs were replaced in January and July 2017. Gas cartridges of the A24s were replaced when the strike counter showed 20 or more.

A substantial number of rats were killed on the island (242 by A24s and 27 by DOC200s) in 8,838 uncorrected trap nights between August 2016 to October 2017 (Table 1). The initial number of individuals killed by A24s in the first month after deployment in August 2016 was high. The number of rats removed by A24s remained at a high level from November 2016 until June 2017. The number of A24 kills varied widely between the beginnings of the breeding seasons across the two years, with 46 individuals killed between September and November 2016 but only 4 kills between August and October 2017. Even though initial trapping success was high, eradication could not be achieved and the self-resetting traps did not perform better than traditional kill traps once rat abundance was low. The Goodnature A24 has shown the potential to work effectively for initial knock-down when rat numbers and activity were high. The advantage over traditional single kill traps, like the DOC200, was the low need for servicing. However, once the population density was reduced to a lower level, this advantage vanished. Most kills by A24s happened during the breeding season in 2016 in the first third of the study. In the last three months of the project the kill numbers did not differ meaningfully from the DOC200 kill numbers. Even though trapping numbers were low, rat abundance was still assumed to be high. After our study had finished rat control on the island using these devices was continued by local community volunteers. A further 357 rats were caught between June 2018 and March 2020, indicating no decline in rat captures. On 1 September 2019 and 1 March 2020 tracking tunnel indices were 100% (K. Tricklebank pers. commun.).

In March 2020 initial cost for a DOC200 was NZD\$145.00. The purchase costs for a Goodnature A24 with lure and gas for 6 months was NZD\$169.00 (excluding digital strike counter). For the first six months the differences in costs were moderate. However, after six months, the material costs for servicing a DOC200 was NZD\$0.55 (one freerange egg), or less when using peanut butter. The servicing cost for a Goodnature A24 is NZD\$19.00 (gas cartridge + ALP). On Goat Island, servicing costs for a six months period were approximately NZD\$9.00 for eight DOC200s and NZD\$190.00 for ten A24s. Higher costs for A24 purchase and servicing compared to DOC200 were not compensated by noteworthy higher kill numbers once rat numbers were reduced. However, A24s performed well during peak times and labour costs were not considered in our study. Self-resetting devices at one per hectare did moderately reduce rat numbers in an area where kill trap maintenance was time and cost intensive but suppressing to very low rat numbers or achieving eradication requires additional investment in the system (e.g., a combination of different tools including toxins or a higher density of devices).

KEY WORDS: black rat, efficacy, invasive species, island, *Rattus rattus*, rodent control, rodents, self-resetting traps, ship rat, trapping

Proceedings, 29th Vertebrate Pest Conference (D. M. Woods, Ed.)

Paper No. 7. Published June 29, 2020. 1 p.

Table 1. Numbers of ship rats killed by eight DOC200 and ten Goodnature A24s and days between trap servicing from August 2016 to October 2017 on Goat Island, New Zealand.

Date	A24	DOC200	Days
Aug 2016	38	3	53
Sep 2016	3	4	53
Nov 2016	46	3	41
Jan 2017	73	3	76
Mar 2017	11	2	38
May 2017	42	5	63
Jun 2017	19	2	54
Jul 2017	3	1	28
Aug 2017	3	2	27
Oct 2017	4	2	58
Total	242	27	491