Integrating ecology and technology to create innovative pest control devices

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Abstract

The development of innovative pest management and monitoring tools requires the integration of animal ecology, toxicology and design engineering. Resetting, multi-kill devices offer substantial advantages over current baiting or trapping techniques. This research outlines the development and testing of a long-life, resetting, toxin delivery systems for predator control, which has recently been laboratory and field trialed on stoats (*Mustela erminea)* and weasels (*M. nivalis*). Results of laboratory trials showed similar responses to stoats and weasels after a 40% PAPP paste was delivered onto the sternum. Both species groomed the paste off within approximately 4 minutes of application and death occurred after an average of 40 minutes for stoats and 32 minutes for weasels. A pilot field trial was also conducted with proof of concept demonstrated and no non-target interference recorded. Findings provided valuable feedback to design engineers which lead to the development of an improved 'Mark II' design. Long-life toxin delivery systems could be deployed to control a variety of pest species and further developments of these tools are ensuring their use for widespread field applications.

Keywords: *Mustela erminea,* para-aminopropiophenone, resetting toxin delivery systems

Introduction

Pests such as black rats (*Rattus rattus*), stoats (*Mustela erminea*), ferrets (*M. furo*) and possum (*Trichosurus vulpecula*) continue to cause major harm to New Zealand's biodiversity. To ensure the survival of native species on the mainland, continued predator control is vital. However, current control strategies rely largely on labor intensive trapping. Current traps are costly in terms of dollars per kill due to the need to frequently check and, where necessary, reset them. There is a need for reliable, cost-effective and safe devices which enable a large number of kills in a manner that eliminates environmental and ecological problems, eliminates the need for costly repeated applications of bait and substantially reduces the frequency of consumable resupply. In a new fusion of ecology and engineering skills we are looking beyond current toxic baits and control methods to develop novel resetting toxin delivery systems which take advantage of an animal's natural behavior (such as grooming).

Materials and methods

Resettable toxin delivery systems were developed by Connovation Ltd, which dispensed 1 gram of a toxic spray (containing 40% PAPP) to animal's sternum after they triggered a treadle mechanism. Each device was capable of approximately 100 doses and was also fitted with a counter and a 2-minute 'timeout' to allow animals to escape following dosage (therefore clearing the device for the next individual).

Initial trials focused on stoat and weasel (*Mustela nivalis*) interactions with devices and their success in triggering systems to get a non-toxic dose of spray. After proof of concept was achieved para-aminopropiophenone (PAPP) was included within the system as a humane toxin. Resettable tunnels were placed in the animal's cage with fresh meat as a lure. Animals were monitored with motion sensing video cameras for the following information: times until device triggered, time until grooming, onset of symptoms, ataxia, coma and death.

Following the success of lab trials these resettable toxin delivery systems were then trialed at a field site in the Blue Mountains, West Otago, New Zealand. Results of these trials were used to provide feedback to design engineers to ensure optimisation of the devices

Results

Laboratory trial results demonstrated that both stoats and weasels triggered the toxin delivery systems and were successfully dosed with PAPP. The average time until grooming after toxin deliver was 4.2 min for both species. Average time until coma was 24 min (range 20-33 min) for stoats and 18 min (range 14-58 min) for weasels. Death occurred after an average of 40 min for stoats (range 29-59 min) and 32 min for weasels (range 20-77 min).

The pilot field trial results confirmed that stoats interact and trigger devices in a natural setting, while no non-targets were affected. Initial engineering problems associated with deploying a long-life device have were fed back to design engineers, which lead to the production of a 'Mark II' device with improved effectiveness.

Discussion

Results of laboratory trials showed similar reactions for weasels and stoats to PAPP delivered in a resettable toxin delivery system. Both species groomed PAPP off shortly after it was dispensed on to fur and responses suggested that PAPP dispensed in this manner was effective and humane. Similar efficacy has been achieved with PAPP in meat baits, with trials showing stoats died quickly after eating the PAPP bait with first symptoms occurring from six to 40 min after ingestion and death between 15 and 85 min (Eason et al., 2010).

The pilot field trial demonstrated that these toxin delivery devices were capable of providing a resettable, multi-kill device with a design which prevented non-target interference. Devices could be left unattended in the field for long periods, hence eliminating the need for costly repeated applications of bait or trap resetting.

In order to meet the challenges facing pest vertebrate pest control in New Zealand and overseas, a strategic approach needs to be taken which incorporates the development of new baits and toxins with resetting, multi-kill, long-life tunnel toxin delivery systems. Resetting systems using PAPP have proven extremely effective at killing both stoats and weasels. Systems are now being modified to target other mammalian pests such as brushtail possums and feral cats (*Felis catus*).

References

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