Population Protecting Implants - Targeted Control of Problem Individuals to Mitigate *CAT-astrophic* Predation

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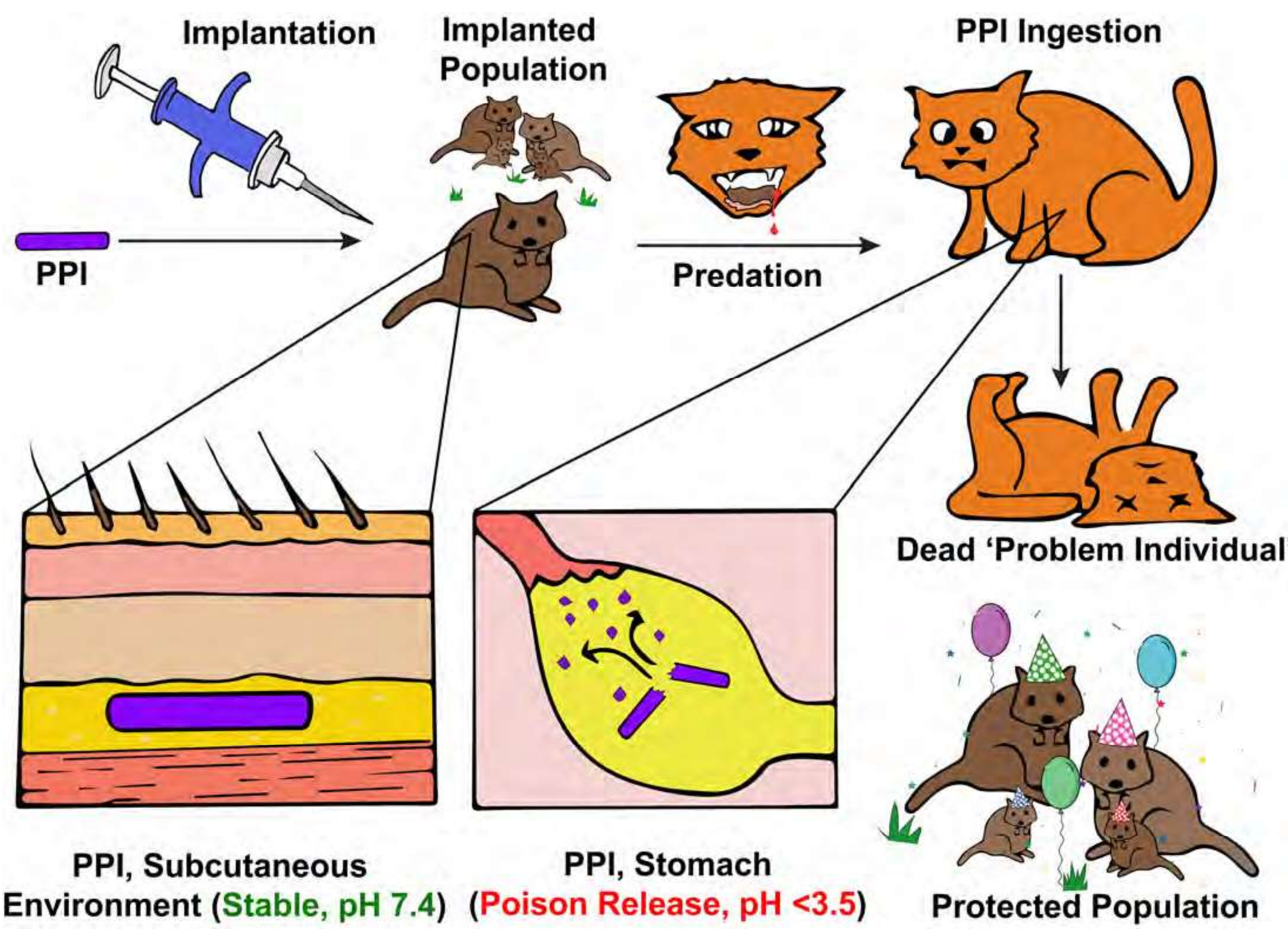
Feral cats (*Felis catus*) present the greatest predatory threat to Australian mammals. They occur across more than 99.8 percent of Australia's landscape and kill more than eight hundred million mammals annually, with the majority being native species. Small terrestrial mammals are most susceptible to predation due to their 'meal-size' and naivety to introduced predators. Efforts to mitigate the catastrophic effects of feral cat predation generally involve the attempted removal of feral cats from a target landscape and subsequent attempts to re-establish populations of threatened species through reintroduction (or translocation) programs within the area.

Generally, predation of the population of threatened mammals must be reduced to less than ten percent until a sufficient population has been established. However, there is no effective landscape-scale method of controlling feral cats, and existing programs are marred by the inability to remove feral cats from a target landscape altogether. The failure to remove feral cats from a target landscape can be due to the lack of universal pertinence of current control methods. Factors such as landscape suitability (e.g., exclosure fencing) or proximity to urban environments (e.g., poison baiting) can prevent the use of these control methods due to the resistance of feral cats to the control methods. In addition, it is rarely possible to maintain a completely predator-free landscape, as the continued intrusion of feral cats into the landscape often occurs.

Invariably, the presence of feral cats within a landscape in which a

Top: Kyle Brewer is a PhD candidate at the University of South Australia. Kyle is pictured here with a quokka (*Setonix brachyurus*) at Adelaide Zoo.



An illustrated overview of the Population Protecting Implant concept. Image: Kyle Brewer and Doctor Todd Gillam.

reintroduction program is established is met with swift predation and the decline of reintroduced native mammals. In many cases, a single control-resistant feral cat, or 'problem individual', has been responsible for destroying most, if not all, the reintroduced native mammals. Furthermore, 'problem individuals' have contributed to the collapse of some reintroduction programs. These results outline the dire need to protect reintroduced mammal populations from 'problem individuals' and, ultimately, improve the successful conservation outcomes of a reintroduction program.

The project aims to develop the Population Protecting Implant (PPI) – a device that could selectively target 'problem individuals' and safeguard native mammal populations during reintroduction programs. The PPI is a small implant designed to mimic the size and shape of the identification microchips, currently used in domestic pets. Similarly to the microchip, the PPI would be injected under the skin of a native mammal using a conventional microchip syringe implanter.

The PPI performs a distinctly different function to a microchip. It is manufactured with an outer 'smart' coating responsive to its environment and an inner core containing a lethal poison. Following implantation, in a selected population of native mammals, the 'smart' coating protects the implant, enabling it to remain inert for the life of the mammal. However, if preyed upon by a feral cat (i.e., a 'problem individual'), the PPI enters the acidic stomach environment of the predator, resulting in the dissolution of the 'smart' coating and the release of the poison contained within the core. Ultimately, resulting in the death of the 'problem individual' and protecting the remaining native mammal population, as no further predation can occur.

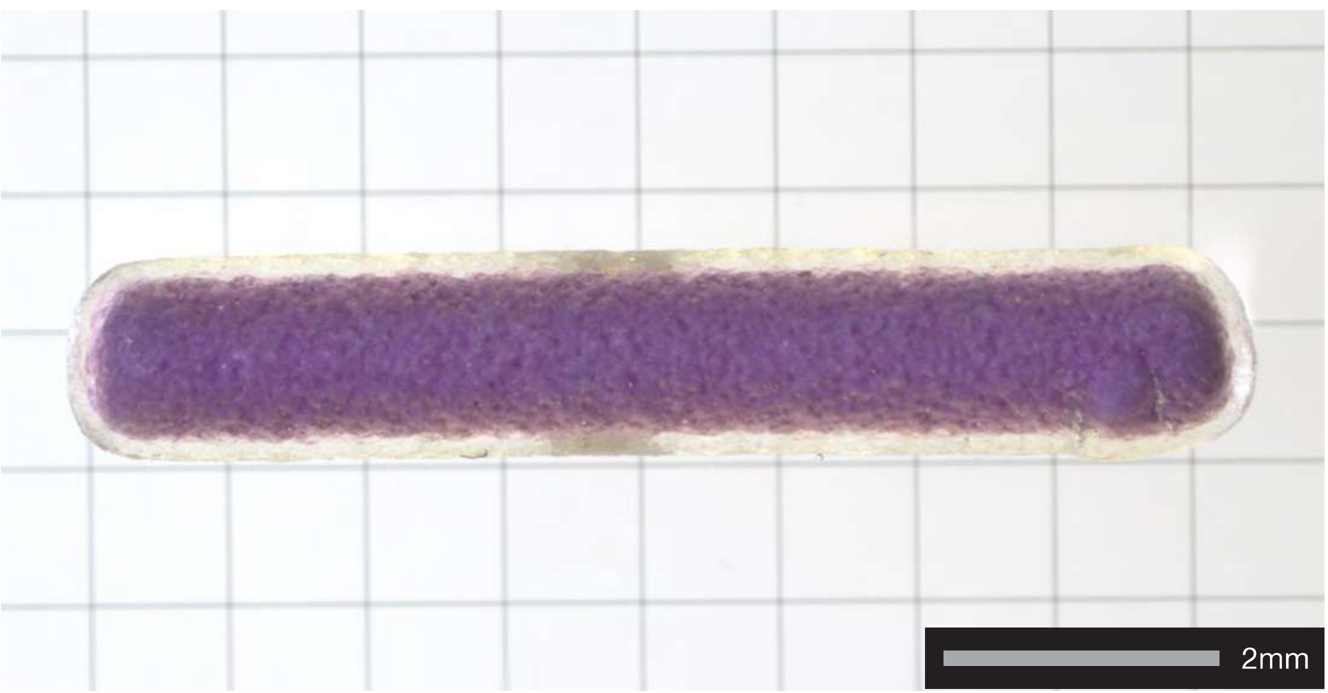
The PPI approach acknowledges and overcomes the challenging predatory behaviour of feral cats by artificially accelerating the much-needed evolution of anti-predator defences in prey naïve native mammals. In doing so, the project hypothesises that PPI's will selectively target the most dangerous and effective 'problem individuals' that prey upon reintroduced populations of native mammals. Mitigating the effects of 'problem individuals' will increase the success of mammal reintroduction programs as a result.

Initially, the project developed and tested PPI's containing a non-toxic core and optimised the design and manufacturing process until the PPI's exhibited favourable stability in vitro (i.e., outside the living organism), which took six months and in vivo (i.e., within the living organism), which took three months, and rapid release of the PPI's core material in vitro, which occurred within ninety minutes. Based on these favourable results, the project manufactured PPI's containing a toxic sodium fluoroacetate (1080 poison) core and confirmed their similar performance in vitro. In collaboration with colleagues at the University of Adelaide, researchers then demonstrated a proof-of-concept by implanting the toxic PPIs into animal carcasses fed to feral cats kept in an enclosed area (the sample size was three individuals). All three cats died within six hours of presenting symptoms of 1080 poison, showing that the toxic PPI's could rapidly release their poison cores in vivo and have the potential to be applied in the field.

Notably, the project needs to ensure that the 1080 poison contained within the toxic implant core will not diffuse through the 'smart' coating over a long period of time. Premature release of the 1080 poison from the implant core could toxify and potentially lead to the death of the implanted population of native mammals and must be avoided. The project will undertake accelerated in vitro stability experiments to determine whether the diffusion of 1080 poison from the implant occurs.

Overall, the results of this study will be used to manage 'problem individuals' to safeguard native mammal populations during reintroduction programs and aid conservation strategies for mitigating feral cats on a landscape scale.

FUNDS PROVIDED BY THE AUSTRALIAN WILDLIFE SOCIETY will be used to purchase specialised chromatographic equipment and consumables to undertake accelerated in vitro stability experiments that will determine whether the diffusion of 1080 poison from the implant occurs.



An optical microscopy image of a Population Protecting Implant, showing the 'smart' coating (transparent) and the 1080 poison core (purple). Image: Kyle Brewer.