Eradicating exotic pests with 'infertility genes' may be possible

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University of Adelaide researchers have shown that it may be possible to eradicate populations of invasive pest animals through the inheritance of a negative gene - a technique known as gene drive.

Invasive pests cost agricultural industries around the world hundreds of millions of dollars and are a major threat to biodiversity and the environment. Spreading deleterious genes (such as genes causing sterility) through pest populations using gene-drive technology is viewed as a potential 'silver bullet' for conservation science and agriculture. The technology could also be applied for public health benefit, to control the spread of diseases by animals such as mosquitoes.

The University of Adelaide researchers developed a realistic mathematical model to predict whether gene drives could be used to eradicate populations of invasive mice from islands. Islands would be the most likely testing grounds for gene drives, to minimise the risk of spread to non-target populations.

Published in the journal *Proceedings of the Royal Society B*, the researchers showed by computer simulation that a single introduction of 100 mice carrying a gene drive causing sterility could eradicate an island mouse population of 50,000 individuals within 4 to 5 years.

"If viable, this technology offers a humane, targeted solution for invasive species control. This could complement or even replace traditional control methods such as culling, trapping and poison baiting, as well as

more advanced biocontrols such as rabbit haemorrhagic disease," says lead author and mathematical ecologist Dr Thomas Prowse, from the University of Adelaide's School of Mathematical Sciences.

"Our paper indicates that controlling invasive pest populations using gene drives may be feasible, but certainly the hype around this new technology is still some way ahead of the science."

The researchers found a way to defeat the evolution of resistant genes which could thwart the use of this technique for population control. But, they say, good gene-drive design is critical.

Gene drives work by overcoming the laws of natural selection which would typically remove detrimental genes from a population.

"New CRISPR/Cas9 gene editing technology enables the gene drive to replicate itself during egg and sperm production - this ensures that it is passed on to the next generation and ultimately results in spread through the entire population. Our results indicate that placing the gene drive in a fertility or viability gene will eventually cause the population to crash," says Professor Paul Thomas, a molecular geneticist in the University's School of Biological Sciences.

Even so, evolution still upsets this process by producing resistant genes which don't accept the gene drive. The researchers showed that a technique allowing 'multiple shots on goal' overcame this problem.

"The next necessary step will be development of gene drives in laboratory mice under secure conditions to enable improved modelling of this potential for pest eradication," says Professor Thomas. "This will provide the critical data needed to debate the important questions that remain around biosecurity, regulation and ethics."

More information: Dodging silver bullets: good CRISPR gene-drive design is critical for eradicating exotic vertebrates, *Proceedings of the Royal Society B*, rspb.royalsocietypublishing.or … .1098/rspb.2017.0799

Provided by University of Adelaide

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