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A look to the future: new and innovative invasive wildlife management and eradication technologies

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Certain wildlife tools and discoveries have been true "game changers" for invasive species management and eradications on islands. For example, research ~20 years ago demonstrated that low doses of acetaminophen (pain-relief medicine) are toxic to invasive brown treesnakes (*Boiga irregularis*) in Guam and that these snakes will eat carrion (Savarie et al. 2000). These salient discoveries now have been combined to assemble a bait, deployed via helicopter, to efficiently reduce brown treesnakes without impacting nontarget species (Siers et al. 2020). Innovations like these that cause dramatic field changes are like past military discoveries such as lie detector testing, facial recognition software, and Uncrewed Aircraft Systems (UAS).

Below is an overview of 3 cutting-edge technologies that are being eagerly pursued, but are not yet operational, for invasive wildlife management to build efficiency, reduce environmental impacts, and/or improve animal welfare practices. Rodents (*Rattus* spp.) offer a great first test group for new technologies because of their frequent use as laboratory test animals and their severe negative impacts on humans and native species.

First, gene drives are being explored as a tool for invasive species management on islands. Recently, scientists have genetically modified (GM) laboratory house mice (*Mus musculus*) using CRISPR-Cas 9 gene editing technology and gene drives to ensure that up to 95% of offspring produced following matings with the GM mice are the same sex (e.g., all male). In principle, large quantities of such lab-reared GM mice could be introduced to an island to eliminate the invasive pest mouse population (Gierus et al. 2022). Field trials are being considered, and refinements are in progress as modeling efforts reveal it may take about 28 years to eliminate a pest mouse population from a typical island when using this technology (Gierus et al. 2022).

A second novel technique in development is the use of interfering RNA (RNAi) to inhibit synthesis of specific proteins that are vital for survival of the invasive pest species. Such technology could be used to cull or eradicate a pest population (Horak 2020). Current research pursuits include identifying the most promising vital functions to target and the most viable delivery of the RNAi to the active (cellular) site following the pest's ingestion or exposure to the RNAi (Horak 2020).

A third tool developing is a species-specific toxicant with less nontarget impacts than traditional toxicants. Norbormide is such a toxicant that has been pursued against *Rattus* since the 1960s, yet taste aversion has led to decreased efficacy. However, palatability improvements to norbormide baits have resulted in extensive laboratory efficacy successes and promising field trials that bode well for its use in future rat control and eradication efforts (Shapiro et al. 2020).

In summary, harnessing molecular processes, such as gene drives, CRISPR-Cas 9, and protein synthesis pathways, as well as reengineering old chemicals like norbormide for species-specific toxicants, are potential game changers for future wildlife management including island-wide invasive species eradications.

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