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Title

Gene drives in our future: Challenges of and opportunities for using a self-sustaining technology in pest and vector management

Abstract

Gene drives are systems of biased inheritance in which the ability of a genetic element to pass between generations, and ultimately throughout a population, through sexual reproduction is enhanced. Gaps in knowledge of gene drives prompted the US National Institutes of Health and the Foundation for the NIH to ask the US National Academy of Sciences to convene an expert panel to provide an independent, objective examination of what is known about gene drives. The report, “Gene Drives on the Horizon,” outlines our knowledge relative to the science, ethics, public engagement, and risk assessment pertaining to gene drive research and governance of the research process. I will review features of the report and potential gene drive applications.

Researchers have studied naturally-occurring gene drive mechanisms throughout the 20th century but, until the advent of CRISPR/Cas9 for gene editing, were unable to develop a gene drive. Since early 2015, laboratory scientists have published four proofs-of-concept showing that a CRISPR/Cas9-based gene drive could spread a targeted gene through nearly all of a population of yeast, fruit flies, or mosquitoes. Applying this basic science, biologists propose using gene drives to address problems such as eradication of insect-borne infectious diseases and conservation of threatened and endangered species. Gene drives could potentially support agriculture by reversing pesticide and herbicide resistance in insects and weeds, and control damaging invasive species.

A major recommendation of the NAS report is that there is insufficient evidence to support release of gene-drive modified organisms into the environment. Importantly, the committee also notes that the potential benefits of gene drives for basic and applied research are significant and justify proceeding with laboratory research and highly-controlled field trials. I will discuss this and other recommendations related to funders, safe research practices, and implications for international coordination of regulatory and risk assessment frameworks.