



## Unintended Effects of Genetic Manipulation

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POSTED: JUNE, 2016

### **Potential Unintended Consequences of Gene-Drive Technology Require Extensive Risk Evaluations, Concludes NAS Panel**

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The goal of new gene-drive technology – to rapidly “drive” engineered genetic sequences into as much of the population of a species as possible – “makes it especially important to minimize the potential for unintended consequences,” and too little is now known about how to do that to support open environmental releases of gene-drive modified organisms, concludes a major new review of the technology.

It observes that researchers are developing the technology at a “breathtaking” pace and adds: “The considerable gaps in knowledge about potential off-target (within the organism) and non-target (in other species or the environment) effects necessitate a collaborative, multidisciplinary approach to research, ecological risk assessment, development of public policy, and decision making for each proposed application of a gene drive technology.” The report, *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*, was produced by a committee of the prestigious U.S. National Academies of Sciences, Engineering, and Medicine (NAS).

Gene-drive technology involves inserting new genetic sequences into an organism’s genome in such a way that the new genetic material will be sexually reproduced in the offspring of the modified organism at rates that apparently could, at least in some circumstances, approach 100 per cent, versus the 50-per-cent rate of typical Mendelian inheritance. “The potential for gene drives to spread throughout a population, to persist in the environment, and to cause irreversible effects on organisms and ecosystems” the report concludes, “calls for a robust method to assess risks.” But it warns: “The lack of guidance from the U.S. federal government applicable to ecological risk assessment for the gene drive research community is a critical gap.” And it states that the Institutional Biosafety Committees at research institutions funded by the U.S. National Institutes of Health, which are supposed to supervise research safety, “may not have the expertise or resources to evaluate the biosafety of gene drives effectively.” Nor are they prepared to evaluate biosecurity or “willful misuse” issues. Proposals to use this new technology in ways that could drive an entire species to extinction “will be intrinsically objectionable to some people,” the committee adds, and will “require especially careful review.”

The committee noted a “widespread sense” among both researchers and commentators that gene drives may harm non-targeted species or ecosystems. One example it cited was the potential for a gene drive designed to suppress a non-native weed population to lead to such unexpected effects as “the loss of habitat for native species or even the establishment of a second, more resilient invasive species.” The committee also emphasized the importance of studying and evaluating the risk of horizontal transfer of a gene drive from the intended species to some other species in the wild.

Nonetheless, the committee recommended that research and development of gene-drive technology should go forward in laboratories and in “highly controlled” field trials. They are justified, the committee says, because gene drives have significant potential benefits “for basic and applied research.” The results are also needed to effectively evaluate the technology’s ecological risks, the report states. Proponents, as the committee notes, have suggested the technology’s potential benefits could include eliminating an invasive weed or eradicating particular diseases carried by insects.

The committee also issued a series of recommendations to reduce risks and to increase “public engagement” in the continued development of the technology. It urges funders of gene-drive work to put more money into other areas of research – including “population genetics, evolutionary biology, ecosystem dynamics, modeling, ecological risk assessment, and public engagement” – to address related gaps in the knowledge needed to fully evaluate gene drives. The report singles out two of those – population genetics and ecosystem dynamics – as especially important areas in which progress has not been advancing as fast as is gene-drive technology.

The two funders of this NAS review were the U.S. Defense Advanced Research Projects Agency (DARPA), which told the committee it was interested in potential beneficial applications and worried about possible intentional malicious uses, and the Bill and Melinda Gates Foundation, which is a major funder of gene-drive research aimed at fighting malaria.

You will find a copy of the full report, *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*, at <http://dx.doi.org/10.17226/23405>.

### **Source**

National Academies of Sciences, Engineering, and Medicine (2016). *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*. Washington, DC: The National Academies Press. <http://dx.doi.org/10.17226/23405>.