

US defence agencies grapple with gene drives

National security community examines the risks and benefits of technology to quickly spread genetic modifications.

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Researchers hope to use gene drives to wipe out mosquitoes that carry malaria.

The JASONs, a group of elite scientists that advises the US government on national security, has weighed in on issues ranging from cyber security to renewing America's nuclear arsenal. But at a meeting in June, the secretive group took stock of a new threat: gene drives, a genetic-engineering technology that can swiftly spread modifications through entire populations and could help vanquish malaria-spreading mosquitoes.

That meeting forms part of a broader US national security effort this year to grapple with the possible risks and benefits of a technology that

could [drive species extinct and alter whole ecosystems](#). On 19 July, the US Defense Advanced Research Projects Agency (DARPA) announced US\$65 million in funding to scientists studying gene-editing technologies; most of the money will be for work on gene drives. And a US intelligence counterpart to DARPA is planning to fund research into detecting organisms containing gene drives and other modifications.

“Every powerful technology is a national security issue,” says Kevin Esvelt, an evolutionary engineer at the Massachusetts Institute of Technology in Cambridge, who won DARPA funding to limit the spread of gene drives. Esvelt says he also attended last month’s JASON meeting in San Diego, California, where he outlined how would-be bioterrorists might weaponize gene drives. But he is far more concerned about the potential for accidental release of gene-drive organisms by scientists, he says. “Bio-error is what I’m worried about.”

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So, too, is the US military, according to Renee Wegrzyn, the DARPA programme officer leading its ‘Safe Genes’ initiative, which supports research on restraining gene drives. The technology has been developed in recent years in fruit flies, mosquitoes and other organisms, using CRISPR gene editing. A UK-based team [hopes to begin field tests of gene drives in *Anopheles gambiae* mosquitoes](#), the main carrier of malaria in Africa, as soon as 2024. “I’ve been very excited to watch the advances, but I’ve noted with increasing concern that the advances are outpacing biosecurity,” Wegrzyn says.

The JASONS’ gene-drive discussion involved around 20 scientists, according to Philipp Messer, a population geneticist at Cornell University in Ithaca, New York, who attended the meeting. (As a German citizen, he was identified as a foreign national and accompanied by an escort.)

“I’m not used to that kind of conference,” says Messer, who says he told the group about his lab’s efforts [to study the evolution of resistance to CRISPR gene drives in fruit flies](#). “We just had open discussions about this technology and what we think the current state of the field was and

what we think the problems are.” Gerald Joyce, a biochemist at the Salk Institute in La Jolla, California, and a JASON member who Messer says co-organized the meeting, declined to comment on the meeting, which is likely to lead to a classified report.

Gene drive countermeasures

Under the DARPA programme, seven teams won four-year contracts. Esvelt plans to develop CRISPR gene drives in nematode worms — a fast-reproducing model organism — that are designed to spread a genetic modification in a local setting and then fizzle out, a concept that other scientists are pursuing. He and the other teams receiving military funding also plan to develop tools to counter rogue gene drives that spread out of control. Such methods include chemicals that block gene-editing or ‘anti-gene drives’ that can reverse a genetic modification or immunize unaltered wild organisms so they are resistant to a gene drive.

These tools could combat a gene drive deployed to do harm, such as those that engineer insects to transmit diseases more effectively or deliver toxins. But such countermeasures are far more likely to be deployed against accidental gene-drive releases from research labs, says Esvelt. Lax or non-existent biosafety guidelines for working on gene-drive organisms increase the odds of a release, he says.

Other efforts are afoot to fund work studying the national security implications of gene drives. Next week, the Intelligence Advanced Research Projects Agency (IARPA), which is part of the Office of the US Director of National Intelligence, will hold a meeting about a planned funding programme for detecting genetically modified organisms that are potentially harmful, including ones that contain gene drives.

Todd Kuiken, who studies policy relating to synthetic biology at North Carolina State University in Raleigh, is glad to see gene-drive research receive more funding. But he has qualms about the US military’s interest in the field; with Safe Genes, DARPA has become the world’s largest government funder of gene-drive research. Kuiken worries that this could sow suspicions about gene drives in parts of the world that view the US military in a less-than-favourable light, including countries that stand to benefit from the elimination of disease carriers such as mosquitoes.

Esvelt shares those concerns but sees military support as the only way,

for the time being, to advance gene-drive technology, while making it safer for eventual deployment. Private funders such as the Bill and Melinda Gates Foundation, in Seattle, Washington, and the Tata Trusts, a Mumbai-based charity, have spent tens of millions on gene-drive research, but this funding has been directed to specific projects or institutions; other government funders have not yet made large contributions to the field. “No one else is offering us large amounts of money,” Esvelt says.

The DARPA programme explicitly prevents the release of gene-drive organisms and requires contract winners to work under stringent biosafety conditions and to disclose their planned experiments to the public — measures that should reduce the risk of any accidental release, Esvelt adds. “If what you’re worried about is your cowboys running amok and causing trouble, then what you really want to do is employ the cowboys to make sure they stay out of trouble.”

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