What should we call evolution driven by genetic engineering? Genetic welding, says researcher

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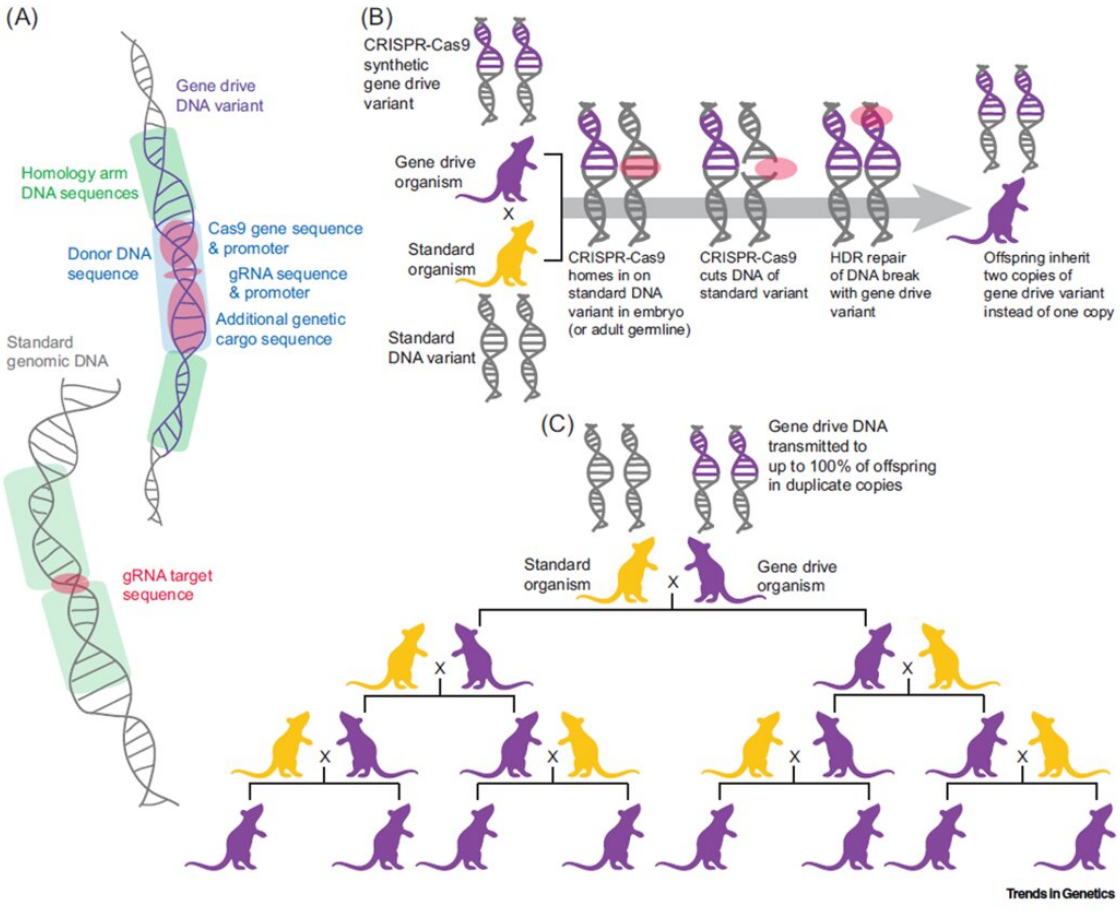

A figure explaining that gene drive transmission is non-Mendelian. Credit: Cutter, 2023

With CRISPR-Cas9 technology, humans can now rapidly change the evolutionary course of animals or plants by inserting genes that can easily spread through entire populations. Evolutionary geneticist Asher Cutter proposes that we call this evolutionary meddling "genetic welding." In an opinion paper published March 28 in the journal *Trends in Genetics*, he argues that we must scientifically and ethically scrutinize the potential consequences of genetic welding before we put it into practice.

"The capability to do genetic welding has only taken off in the last few years, and much of the thinking about it has focused on what can happen in the near term," says Cutter of the University of Toronto. "Ethically, before humans apply this to natural populations, we need to start thinking about what the longer-term consequences might be on a time scale of hundreds or thousands of generations."

In classical Mendelian genetics, we think about genes having a 50:50 chance of getting passed from parent to offspring, but this isn't always the case. In a natural phenomenon known as "genetic drive," some genes are able to bias their own transmission so that they are much more likely to be inherited.

Genetic welding is the human-mediated version of this—introducing genes that have an unfair advantage when it comes to heritability into natural populations. Because these genes spread easily and rapidly through populations, they result in much faster evolutionary change than

the usual slow plod that we see from natural and artificial selection. Also, in contrast to natural selection, genetic drives and genetic welding can perpetuate genes that don't necessarily benefit the organisms that carry them, making them an attractive potential method to control problematic/invasive/disease-bearing species.

Genetic welding in this way has been proposed as a tool for controlling disease-bearing mosquito populations and invasive species. It could also be used to genetically engineer endangered species to be resistant to infectious pathogens that threaten them with extinction. "It raises the question of how much should humans intervene into processes that are normally beyond our control," says Cutter.

"If ethicists, medical practitioners, and politicians decide that it is acceptable in some cases to edit the germ line of humans, then that would open the possibility that genetic welding could be used as a tool in that regard," says Cutter. "This would open a much bigger can of worms by virtue of the fact that genetic welding could change the entirety of a population or species, not just a few individuals that elected to have a procedure."

Though it might be difficult to experimentally assess the long-term implications of genetic welding, Cutter says that thought experiments, mathematical theory, computer simulations, and conversations with bioethicists could all play important roles, as could experiments in organisms with short lifespans and rapid reproduction.

More information: Synthetic gene drives as an anthropogenic evolutionary force, *Trends in Genetics* (2023). DOI: 10.1016/j.tig.2023.02.010

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