When Are We Obligated To Edit Wild Creatures?

BIG QUESTIONS OPINION ESSAY

Kevin Esvelt August 30, 2019 8 MINUTE READ

Cows on a pasture, who, among other mammals, could experience immense suffering from the New World screwworm. (© Creaturart/Fotolia)

Combining CRISPR genome editing with the natural phenomenon of gene drive allows us to rewrite the genomes of wild organisms. The benefits of saving children from malaria by editing mosquitoes are obvious and much discussed, but humans aren't the only creatures who suffer. If we gain the power to intervene in a natural world "red in tooth and claw," yet decline to use it, are we morally responsible for the animal suffering that we could

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The scenario that may redefine our relationship with the natural world begins with fine clothing. You're dressed to the nines for a formal event, but you arrived early, and it's such a beautiful day that you decided to take a stroll by the nearby lake. Suddenly, you hear the sound of splashing and screams. A child is drowning! Will you dive in to save them? Or let them die, and preserve your expensive outfit?

The philosopher Peter Singer posited this scenario to show that we are all terrible human beings. Just about everyone would save the child and ruin the outfit… leading Singer to question why so few of us give equivalent amounts of money to save children on the other side of the world. The Against Malaria Foundation averages one life saved for every $7000.

But despite having a local bias, our moral compasses aren't completely broken. You never even considered letting the child drown because the situation wasn't your fault. That's because the cause of the problem simply isn't relevant: as the one who could intervene, the consequences are on your head. *We are morally responsible for intervening in situations we did not create*.

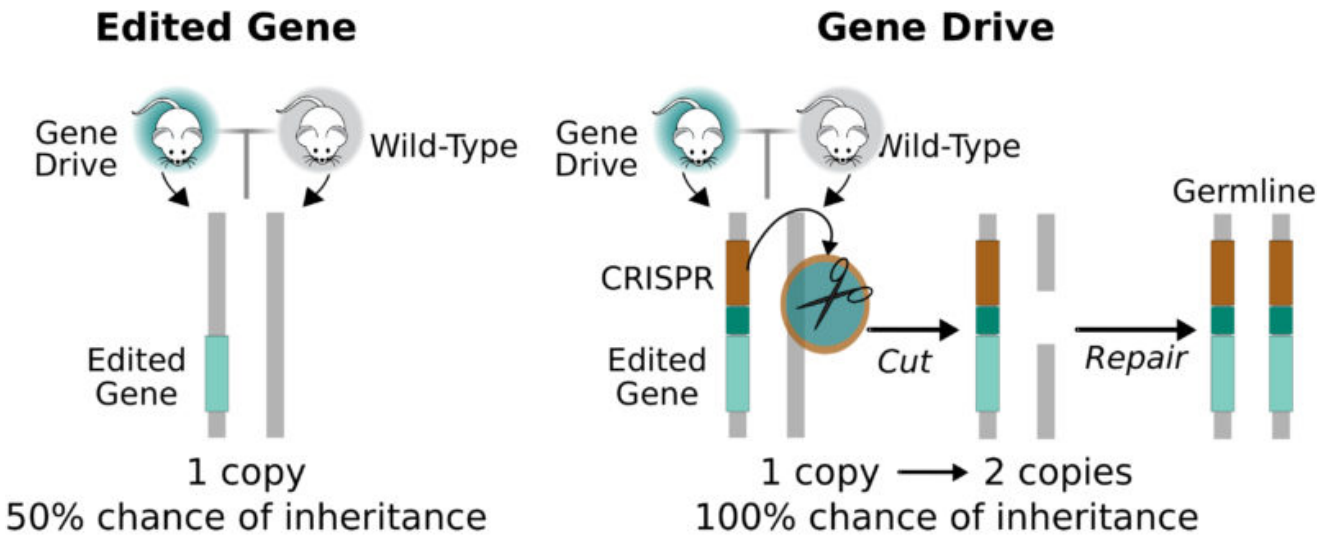
There is a critical difference between Singer's original scenario and the one above: in his version, it was a muddy pond. Any adult can rescue a child from a muddy pond, but a lake is different; you can only save the

child if you know how to swim. *We only become morally responsible when we acquire the power to intervene.*

Few would disagree with either of these moral statements, but when they are combined with increasingly powerful technologies, the implications are deeply unsettling. Given the power to alter the workings of the natural world, are we morally obligated to use it? Recent developments suggest we had best determine the answer soon because, technologically, we are learning to swim. What choices will we make?

Gene drive is a natural phenomenon that occurs when a genetic element reliably spreads through a population even though it reduces the reproductive fitness of individual organisms. Nature has evolved many different mechanisms that result in gene drive, so many that it's nearly impossible to find an organism that doesn't have at least one driving element somewhere in its genome. More than half of our own DNA comprises the broken remnants of gene drives, plus a few active copies.

Scientists have long dreamed of harnessing gene drive to block mosquito-borne disease, with little success. Then came CRISPR genome editing, which works by cutting target genes and replacing them with a new sequence. What happens if you replace the original sequence with the edited version *and* an encoded copy of the CRISPR system? Gene drive.



CRISPR is a molecular scalpel that we can use to cut, and therefore replace, just about any DNA sequence in any cell. Encode the instructions for the CRISPR system adjacent to the new sequence, and genome editing will occur in the reproductive cells of subsequent generations of heterozygotes, always converting the original wild-type version to the new edited version. By ensuring that offspring will all be born of one sex, or by arranging for organisms that inherit two copies of the gene drive to be sterile, it's theoretically possible to cause a population crash. (Credit: Esvelt)

When my colleagues and I first described this technology in 2014, we initially focused on the imperative for early transparency. Gene drive research is more like civic governance than traditional technology development: you can decline a treatment recommended by your doctor, but you canâ€™t opt out when people change the shared environment. Applying the traditional closeted model of science to gene drive actively denies people a voice in decisions intended to affect them – and reforming scientific incentives for gene drive could be the first step to making all of science faster and safer.

But open gene drive research is clearly aligned with virtually all of our values. It's when technology places our deepest moral beliefs in conflict that we struggle, and learn who we truly are.

Two of our strongest moral beliefs include our reverence for the natural world and our abhorrence of suffering. Yet some natural species inherently cause tremendous suffering. Are we morally obligated to alter or even eradicate them?

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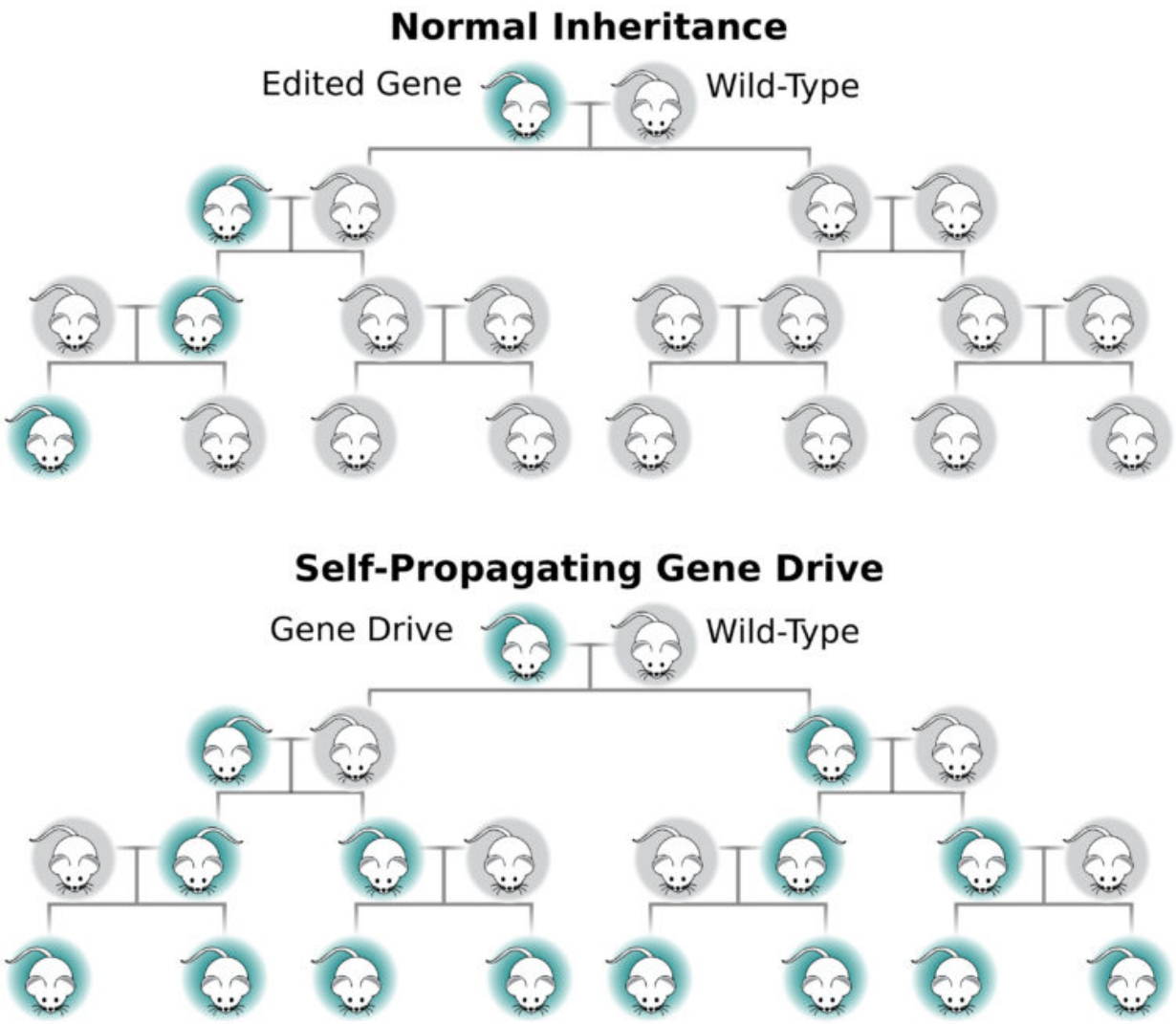
Judging by history, the answer depends on who is doing the suffering. We view the eradication of smallpox as one of our greatest triumphs, clearly demonstrating that we value human lives over the existence of disease-causing microorganisms. The same principle holds today for malaria: few would argue against using gene drive to crash populations of malarial mosquitoes to help eradicate the disease. There are more than 3500 species of mosquitoes, only three of which would be affected, and once malaria is gone, the mosquitoes could be allowed to recover. It would be extremely surprising if African nations decided *not* to eradicate malaria.

The more interesting question concerns our moral obligations to animals in the state of nature.

To anyone who doubts that the natural world can inflict unimaginable suffering, consider the New World screwworm, *Cochyliomyia hominivorax*. Female screwworm flies lay their eggs in open wounds, generating maggots that devour healthy tissue, gluttonously burrowing into the flesh of their host until they drop, engorged and sated, to metamorphose. Yet before they fall, the maggots in a wound emit a pheromone attracting new females, thereby acting as both conductors and performers in a macabre parade that consumes the host alive. The pain is utterly excruciating, so much so that infested people often require morphine before doctors can even examine the wound. Worst of all, the New World screwworm specializes in devouring complex mammals.

Every second of every day, hundreds of millions of animals suffer the excruciating agony of being eaten alive. It has been so throughout North and South America for millions of years. Until 2001, when humanity eradicated the last screwworm fly north of Panama using the â€œsterile insect techniqueâ€. This was not done to protect wild animals or even people, but for economic reasons: the cost of the program was small relative to the immense damage wrought by the screwworm on North American cattle, sheep, and goats. There were no obvious ecological effects. Despite being almost completely unknown even among animal rights activists, the screwworm elimination campaign may well have been one of the greatest triumphs of animal well-being.

Unfortunately, sterile insect technique isn't powerful enough to eradicate the screwworm from South America, where it is more entrenched and protected by the rougher terrain. But gene drive is.



Contrary to news hype, gene drive alone can't cause extinction, but if combined with conventional measures it might be possible to remove targeted species from the wild. For certain species that cause immense suffering, we may be morally obligated to do just that. (Credit: Esvelt)

South Americans may well decide to eradicate screwworm for the same economic reasons that it was eradicated from North America: the fly inflicts $4 billion in annual damages on struggling rural communities that can least afford it. It need not go extinct, of course; the existence of the sterile insect facility in Panama proves that we can maintain the screwworm indefinitely in captivity on already dead meat.

Yet if for some reason humanity chooses to leave the screwworm as it is – even for upstanding moral reasons, whatever those may be – the

knowledge of our responsibility should haunt us.

Tennyson wrote,

Are God and Nature then at strife,

That Nature lends such evil dreams?

So careful of the type she seems,

So careless of the single life.

Evolution by natural selection cares nothing for the single life, nor suffering, nor euphoria, save for their utility in replication. Theoretically, we do. But how much?

[Editor's Note: This story was originally published in May 2018. We are resurfacing archive hits while our staff is on vacation.]

Kevin Esvelt

Kevin M. Esvelt is an assistant professor of the MIT Media Lab, where he leads the Sculpting Evolution Group in exploring evolutionary and ecological engineering. The first to identify the potential for CRISPR "gene drive" systems capable of unilaterally altering wild populations of organisms, Esvelt and his colleagues defied scientific tradition by revealing their findings and calling for open discussion and safeguards before they demonstrated the technology in the laboratory. At MIT, the Sculpting Evolution Group develops local "daisy drives" for community-based environmental editing, which may be able to save endangered species and restore populations to their original genetics. Esvelt's work has appeared in major scientific journals, including Nature

and Science, and features regularly in popular media, including The New York Times, The New Yorker, and NPR.

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