

LETHAL GENE

Planet Earth is an excellent place to live. It's got just about everything we need. Unfortunately there are many things that we struggle to live with. Earth is also in some ways, a pretty awful place to live. And a lot of the times it's our fault, for example, the impact of feral wildlife. And sometimes it isn't our fault, for example, dengue fever that is spread by mosquitoes. But really, it doesn't matter whose fault it is.

Someone has to do something about it.

Over 20,000 people die each year from dengue fever. Dengue fever is a tropical disease carried by a mosquito, *Aedes aegypti*. It is caused by the dengue virus which is carried by this mosquito. People become infected with the disease after being bitten by the mosquito. Dengue fever has no approved vaccines and there are no antiviral drugs that work. So far, the only two ways to prevent the disease are removing large bodies of water, which is highly difficult in profoundly wet regions where the disease is usually found, or to spray organophosphate or pyrethroid insecticides.

Recently, a new method of exterminating the mosquito has been devised. In 2009 Oxitec, an insect control company, started working on a better way to prevent dengue fever. Instead of just spraying insecticide at the mosquitoes, they got the mosquitoes to create special offspring. Most people think that would just create more mosquitoes, which sounds a bit dumb, seeing that you're trying to eradicate them. But it's just one critical detail that can change everything.

That detail is where synthetic biology comes in. What Oxitec did in the laboratory was to breed vast amounts of mosquitoes of the genus *Aedes*, and inject the sperm cells of the male mosquitoes with a lethal gene. This lethal gene is a transgene. A transgene is a section of DNA that codes for a protein (in this case, a lethal toxin) and this gene can be transferred or taken from one animal and inserted into another animal. The transgene will be expressed in the animal that has received it (the transgenic organism). When the transgenic male mosquito reproduced with the female the offspring carried this transgene, and as the larva grew it produced more and more of this protein and before the growing mosquito exited the larval stage it expired. If the transgenic male mosquitoes are released into the wild, the end result should be a significant drop in the *aegypti* mosquito population.

The genetically modified (GM) mosquitoes were released during trials in Malaysia, the Cayman Islands and Brazil. Oxitec reported a 96% suppression of the *Aedes aegypti* population in Brazil. The Brazilian government was impressed enough with these results to give permission for the first commercial release of the GM mosquitoes into the wild.

There are obvious human benefits to utilising GMOs (genetically modified organisms) but anti GMO organisations have raised questions about the dangers involved. In this case, removing the *Aedes aegypti* mosquito from the habitat entirely may have serious long term effects on the ecosystem. Luke Riley, the campaign director of GM Freeze (an anti GMO group) claims that "if we remove an insect like the mosquito from the ecosystem, we don't know what the impact will be". If the mosquito larvae were to disappear from the habitat, the immediate effect would be a decrease in numbers of animals that feed on them, such as

dragonflies and frogs. After the lowering of predator numbers, the numbers of other species of mosquitoes would rise, and they might also be carrying a dangerous disease, possibly even worse than dengue fever. Scientists and governments need to be cautious before developing and using GMOs.

As well as environmental issues there are ethical considerations. If the experiment is more powerful than Oxitec speculate, we could potentially drive the *Aedes aegypti* mosquito to extinction. Is that OK? In the past humans have hunted many species to extinction, for example the thylacine. This is unanimously considered to be unacceptable. Does unintentionally causing an extinction using new technology make it any more acceptable?

Traditional ways of controlling pest populations are often inefficient and cruel. For example, laying poison baits for foxes results in pain and suffering for the animal and populations tend to bounce back with time. To me, the use of lethal transgenes in pest control is a very promising advance in synthetic biology. It is potentially more efficient and causes less trauma to individual creatures. Imagine Australia being free from the dreaded cane toad. We could return the ecosystem to the way it was before. It was a mistake to introduce this pest into our once healthy environment and now we have the technology to remedy this disaster. The list of applications is endless.

If we choose to use these biotechnology tools in a responsible manner and for the benefit of the whole human race all will be well.

The future is in our hands.

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