



# GENE DRIVES

## Governance Must be International From the Start

“Gene drive” has been heavily promoted as a “breakthrough” technology for meeting the goal of New Zealand being predator free by 2050.

However even before such a gene drive has been properly developed, the scientist behind the concept has recognised that in its original form at least, it should not be used because it cannot be confined to target areas and could wipe out a species globally.

The immediate implication - that international governance must be in place before any use of the technique can be contemplated – is a wake up call ringing not just for scientist advocates.

Government officials have also remained blinkered to the threats to New Zealand and have opposed the strengthening of arrangements that are vital to proper governance of the technology.

### Predator Free Aspirations, International Governance Realities

A gene drive is a technique for engineering or eliminating a species in the wild. It gained attention in conservation circles following the discovery that a new genetic engineering technique (CRISPR Cas9) could be used to overcome the laws of natural inheritance and quickly drive a sterility gene through a population.

When the Government set out its plan for a *Predator Free New Zealand*, it stated that “[t]he predator free goal is dependent on breakthrough science” and “[t]he use of gene drive and other techniques, could, for example ... lead to an eventual collapse of the possum population”.<sup>1</sup>

As gene drive is a form of genetic modification, it falls under GMO regulation. Yet while other GM applications such as GM crops are said to be confinable to certain areas, or at least national boundaries, the purpose of a gene drive is to broadcast a gene until that trait has colonised a population or entire species. The pre-eminent US scientific body, the National Academies of Sciences, reviewed gene drive in 2016 and stated: “a gene drive knows no political boundaries”.<sup>2</sup>

For that reason, the Academy notes, proper governance of gene drive cannot be left to individual states:

Gene drives do not fit well within the existing regulatory logic of confinement and containment because they are designed to spread a genotype through a population, making confinement and containment much more difficult (or even irrelevant) and the environmental changes introduced by release potentially irreversible.

...

Research on gene drives is global. Responsible governance will need to be international and inclusive, with clearly-defined global regulatory frameworks, policies, and best practice standards for implementation.<sup>3</sup>

Purpose-built international regulation is a minimum condition recognised by a wide range of commentators, from ethicists to biotech entrepreneurs. As *The Economist* magazine puts it: “A decision by one nation, or one group, to release them might eventually affect every country where the species exists. Governance arrangements must be international from the start”.<sup>4</sup>

**“a gene drive  
knows no  
political  
boundaries”**

US National Academy of Sciences

The Cartagena Protocol on Biosafety is a first port-of-call for providing governance of gene drives as it is designed to address the risks presented by GMOs when these move across borders. Established under the Convention on Biodiversity, this treaty is founded on the principle of prior informed consent with respect to the transboundary movement of living modified organisms (LMOs). It puts a duty on an exporting party to seek prior informed consent from the destination country (Article 7).

However the protocol’s rules focus on intended movements across the border of a single nation, and do not provide for consent processes for unintended movements across borders. A paper co-authored by one of the developers of the CRISPR gene drive technique identifies a series of other gaps in the protocol including that it does not “define standards for assessing effects, estimating damages, or mitigating harms” and that its sister Nagoya Protocol does not “define rules governing liability and redress for damage”.<sup>5</sup>

The National Academies of Science also identifies significant gaps:

Given that the United States is not a Party to the Cartagena Protocol, it is a major gap in international governance that the United States does not have a clear policy for collaborating with other countries with divergent systems of governance, especially when such countries may, in fact, lack the capacity to assess the safety of gene drive research, undertake public engagement and societal dialogue, and maintain regulatory institutions.<sup>6</sup>

## **Unintended Spread Across Borders**

The unintended spread of a gene drive could have serious and irreversible effects. A release in New Zealand could result in a gene drive organism invading another country, and wiping out or seriously reducing the viability of local populations of that species.

The species most often referred to in discussions on using gene drives in conservation here – the possum – raises immediate concerns. “The possums that have become invasive in New Zealand originated in Australia”, a recent *Nature* article observes. “If some sort of gene-driven ‘suicide possum’ made its way back there, it could wreak havoc on the native populations” – where it is valued in its natural habitat.<sup>7</sup> Such a scenario is simply a

question of when, not if, says the president of the Australian Academy of Sciences: “Once gene drives are released into wild populations in other countries, they will inevitably reach Australia”.<sup>8</sup>

And the reverse – an invasion of a gene drive organism from another country to New Zealand - has the potential not only to harm native conservation species, but could have serious economic consequences if it affected farming systems.

As New Zealand’s experience with the rabbit calicivirus disease attests, it is not just natural migration or an accidental shipment that is of concern. Once developed and widely spread in one country, entities could act outside the law to take a gene drive and transfer it across a border – for whatever reasons - just as the calicivirus disease was illegally brought from Australia to New Zealand in 1998.

**“Once gene drives are released into wild populations in other countries, they will inevitably reach Australia”**

Australian Academy of Sciences

## **Government officials oppose protections at international level**

Given this exposure, New Zealand would be expected to be leading efforts to secure international governance arrangements. And in order for New Zealand to be credible when insisting on vetting a gene drive release in another country, it would need to ensure that other potentially affected nations participate in any gene drive release it may contemplate.

Yet New Zealand’s approach to international governance discussions to date has been directed in entirely the opposite direction. It has opposed progressive reforms and even dismissed their relevance.

The main focus for this discussion was the December 2016 Cancun meeting of the parties to the Convention on Biodiversity.

**“This isn’t an issue for New Zealand, being a remote island with no physical borders”**

NZ Officials

There it pursued a policy position that no changes are needed to existing biotechnology regulation – including the governance of gene drives.<sup>9</sup> In keeping with this stance, New Zealand was one of three countries to reject even a basic biosafety measure: “Australia, New Zealand and Canada ... suggested deleting text on applying the precautionary approach when considering the release of gene drives until thorough risk assessments are performed.”<sup>10</sup> New Zealand also voted against a proposed moratorium on the use of gene drives.<sup>11</sup>

In documents prepared in advance of this UN meeting, New Zealand officials stated in response to the issue of unintended spread of GMOs (such as a gene drive organism):

“This isn’t an issue for New Zealand, being a remote island with no physical borders.”<sup>12</sup>

And in a contribution to the Convention on Biodiversity more recently, New Zealand maintained that the adverse effects of GMOs such as gene drive organisms “are no different” to other forms of GMOs.<sup>13</sup>

Given the evidence available at the time (which the Sustainability Council drew to officials’ attention prior to the December meeting)<sup>14</sup>, it is extraordinary that New Zealand could have adopted such positions. To what extent officials who led the negotiations were influenced by the previous administration’s political advocacy for Predator Free 2050, or were pursuing a more general *laissez-faire* position on biotechnology regulation, is unclear. However, new research published in November 2017 highlights the implausibility of New Zealand’s stance and that policy will need to be not just reviewed but largely reversed.

## Actually, It’s Too Risky

Kevin Esvelt, the pioneer of the idea that gene drive could be used to eliminate pests for conservation purposes, has concluded that the universal gene drive he first promoted is too risky to use in the wild. In a paper co-authored with Landcare scientist Neil Gemmell, they report on mathematically modelling the risk of the genetically altered animals spreading beyond their intended target zone and found the risks were serious. As the New York Times reported:

The model revealed that a gene drive would be remarkably aggressive. It would take relatively few engineered organisms to spread a new gene through much of a population. “It only takes a handful” Dr. Esvelt.

...

“The very idea of a field trial is that it’s a trial that’s confined to an area. Our model indicates that this is not the case,” says Dr Esvelt. “The kind of gene drive that is invasive and self-propagating is in many ways the equivalent of an invasive species,” he said.<sup>15</sup>

Any attempt to target just New Zealand populations of possums, rats and stoats would carry a significant risk of the gene drive animals also invading other nations. “We are highly skeptical that it would be safe to release a self-propagating drive system capable of spreading beyond the target local population unless international spread is the explicit goal” the paper states.<sup>16</sup> “I badly misled many conservationists who are desperately in need of hope” Esvelt said.<sup>17</sup>

The quest for applying gene drive to conservation is far from over however.

“I think some of my colleagues think we just shot them in the foot. We’re still excited about what gene drive has to offer,” Gemmell said. “But the tools we have right now are not optimal. We need something you can turn on and off or has a finite life.”<sup>18</sup>

New Zealand Herald reports have also shone a light on the work of a network that is scoping New Zealand offshore islands for their potential to host what could be the first outdoor trial of a gene drive.<sup>19</sup> The network has US military funds to trial gene drive in mice and has recruited Landcare as a local partner.

## International Governance that is Fit For Purpose

Now that even the foremost proponents of gene drive for conservation implicitly agree that at least the ‘universal’ form requires strict regulation, the focus of debate can move on from official denial that there is anything new about this technique.

It is clearly in New Zealand’s interests to have strong and credible international governance over development and use of gene drives, so that use of the technology in another jurisdiction does not harm our native biodiversity, public health or agriculture.

It follows that a prerequisite for considering the release of any form of gene drive is international governance arrangements that are fit for purpose. The new Government needs to realign New Zealand’s international representations accordingly.

Sustainability Council of New Zealand  
May 2018

The Sustainability Council gratefully acknowledges support from the New Zealand Law Foundation for research undertaken for the preparation of this briefing

<sup>1</sup> Cabinet Paper, Nathan Guy and Maggie Barry, *Accelerating Predator Free New Zealand*, July 2016, paras 8; 56.

<sup>2</sup> National Academies of Sciences, *Gene Drives on the Horizon: Advancing Science, Navigating Uncertainty, and Aligning Research with Public Values*, 2016, p. 6.

<sup>3</sup> Ibid

<sup>4</sup> The Economist, *Extinctions to Order*, 17 September 2016.

<sup>5</sup> Kenneth Oye, Kevin Esvelt et al, *Regulating gene drives*, Science Express, 17 July 2014.

<sup>6</sup> National Academies of Sciences, 2016, p. 8-9.

<sup>7</sup> Brian Owen, *Behind New Zealand’s wild plan to purge all pests*, Nature 541, 148–150, 12 January 2017.

<sup>8</sup> Fleischfresser S. 2017. Benefits and dangers in altering our evolutionary trajectory. *Cosmos Magazine*, May 2.

<sup>9</sup> New Zealand Delegation Brief, CBD, 2016, p 269. “To resist calls to develop further instruments, until there is a clear case that a synthetic biology-specific instrument is needed to manage impacts on biodiversity”.

<sup>10</sup> Earth Negotiations Bulletin, December 16 2017 9(676), <http://www.iisd.ca/download/pdf/enb09676e.pdf>

<sup>11</sup> New Zealand Delegation Progress Report 2, 8 December 2016, p 6.

<sup>12</sup> New Zealand Delegation Brief, Cartagena Protocol, 2016, p 46. Officials also stated that defining illegal and unintentional movements of GMOs across borders was “not considered ... necessary”.

<sup>13</sup> <https://bch.cbd.int/synbio/open-ended/discussion/?threadid=8598#8704>

<sup>14</sup> See also Sustainability Council, *Submission of Information on Synthetic Biology: Experience from New Zealand*, Submission to the CBD, June 2017, and a February 2017 edition of this briefing.

<sup>15</sup> Carl Zimmer, ‘Gene Drives’ Are Too Risky for Field Trials, Scientists Say, New York Times, November 16, 2017.

<sup>16</sup> Kevin Esvelt and Neil Gemmell, *Conservation demands safe gene drive*, PLOS Biology, November 16, 2017.

<https://doi.org/10.1371/journal.pbio.2003850>

<sup>17</sup> <https://www.gizmodo.com.au/2017/11/genetically-engineering-the-natural-world-it-turns-out-could-be-a-disaster/>

<sup>18</sup> ibid

<sup>19</sup> [http://www.nzherald.co.nz/nz/news/article.cfm?c\\_id=1&objectid=11952874](http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11952874),

[http://www.nzherald.co.nz/politics/news/article.cfm?c\\_id=280&objectid=11952990](http://www.nzherald.co.nz/politics/news/article.cfm?c_id=280&objectid=11952990)