Testimony for Topic 2: Gene-editing in the Natural World

Advisory Panel To Better Understand and Make Recommendations Regarding the Implications of Genome-editing Technology for the Citizens of the State

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1. Brief background of relevant experience

I have a PhD in ecology and have spent 40 years in conservation, based in a university, NGOS (TNC and WCS) and most recently as an independent practitioner and consultant[1]. I have spent the last ten years working on the intersection between conservation and synthetic biology. The first major effort was a meeting in Cambridge, UK that for the first time brought together people from both of these two areas.[2] I was then asked by the International Union for Conservation of Nature (IUCN) to chair and put together a working group to examine the intersection of conservation and synthetic biology that resulted in a Technical Assessment[3], several international presentations and a resolution voted on at the World Conservation Congress in France last year. Most recently, with my colleague Bill Adams we published a book on the topic, "Strange Natures. Conservation in the era of synthetic biology."[4]

2. Key Messages from International Union for Conservation of Nature's Task Force on Synthetic Biology and Biodiversity Conservation (edited by KHR)[5]

Part of the IUCN Task Force work referred to above was production of a set of key messages for policy makers. I include an edited version of these as part of my testimony as they were written for policy makers and provide an appropriate summary of the work of the group as well as providing important background material for the Committee's deliberations.

1. Conservation implications

Synthetic biology has important implications for the conservation and sustainable use of biological diversity that are both direct and indirect. While most synthetic biology products are not designed as conservation applications, some of these will nonetheless have substantial impacts on conservation practices and outcomes.

2. New tools

New tools are needed for effective conservation and sustainable use of biological diversity. In recent years, global, regional and national measures promoting biodiversity

[1] Archipelago Consulting: https://archipelagoconsulting.com
[2] https://www.cambridge.org/core/journals/oryx/article/synthetic-biology-and-the-conservation-of-biodiversity/3FADF2D127D8F61389946FD3BBC3CA4C
[3] https://portals.iucn.org/library/node/48408
[4] https://yalebooks.yale.edu/book/9780300230970/strange-natures/
[5] https://portals.iucn.org/library/sites/library/files/documents/2019-012-En-Syn_0.pdf

conservation have resulted in some successes, but biodiversity continues to decline globally. Biodiversity conservation requires the continued application of proven approaches but scaling these efforts up to the level necessary to reverse the declines will continue to be a major challenge, given the seemingly intractable nature of some of the threats. Some synthetic biology applications, if appropriately designed and targeted, could enhance biodiversity conservation, for example, by mitigating threats and increasing species' resilience to them.

3. Rapid growth
The practice of synthetic biology is increasing rapidly, with major developments being promised and some delivered across multiple sectors. Over the last 15 years there has been a five-fold growth in companies with public and private investment approaching US$ 10 billion over this period. Synthetic biology labs are found throughout the world in academic, corporate and non-traditional spaces like community biotech labs; increasingly young people are being taught to use these technologies. The distributed nature of access to synthetic biology techniques presents both opportunities and challenges for the conservation community.

4. Beneficial conservation impacts
Synthetic biology may be beneficial to conservation and sustainable use of biodiversity. For example, by protecting threatened species against disease or climate threats, eradicating invasive species, increasing genetic diversity in small populations of threatened species, restoring a proxy of an extinct species, remediating degraded ecosystems, or product replacement.

5. Detrimental conservation impacts
Synthetic biology may be detrimental to conservation and sustainable use of biodiversity. Detrimental effects may stem from the movement of genes, or escape of engineered gene-drive-carrying organisms, impacting non-target populations or species, changes to ecological roles played by target organisms, broader ecosystem effects, product replacement that exacerbates a conservation problem, socio-economic effects of product replacement on livelihoods and on production and consumption patterns, distracting funding from other conservation approaches, and moral hazard reducing the urgency and importance of biodiversity conservation

6. Values and worldview
Values, worldviews, and lived experiences influence the development, assessment and governance of synthetic biology. Thus, to produce evidence for conservation-relevant decision making, scientific methods and norms operate within contexts defined by the framing of problems and solutions, the integration of multiple perspectives and types of expertise, and who is trusted to produce credible knowledge Community and stakeholder engagement have been proposed to help navigate this complexity.

7. Indigenous and local communities
Indigenous and local communities are key actors in research, governance and decisions around synthetic biology for conservation. Synthetic biology has potentially significant positive and negative impacts on local and indigenous communities, which manage,

govern, reside in or depend on a large part of the world's biodiversity. Historically there has been limited engagement with indigenous and local communities at both the project and global level. Recently there have been calls for recognition of the rights of indigenous and local communities in decision making around synthetic biology and engineered gene drive. There have been some attempts to involve them in synthetic biology initiatives

8. Governance
Multiple existing governance structures are relevant to synthetic biology, but synthetic biology and engineered gene drive raise questions and challenges for these frameworks. Relevant governance frameworks include international, regional and national legal frameworks as well as religious, customary and indigenous governance systems, and scientific norms and practices. Challenges relate to the extent to which current and future synthetic biology and gene drive applications are covered by existing regulations, norms and processes, implementation and enforcement in the context of accessibility of parts and tools, different levels of governance capacity among jurisdictions, mechanisms to address environmental harm, particularly transboundary impacts, and the ability of governance frameworks to keep up with the rapid pace of technological innovation

3. "What should the State of Maine do regarding gene editing within your field in order to best benefit Mainers in the next 5 years?

I would suggest that the Committee consider the following as loci of action within the next 5 years:

1. Create training experiences for students in middle and high school. Numerous curricula exist and public schools in other states (perhaps Maine as well?) are actively involved in teaching students[6]. These courses would not be just about the technology itself but also about the important governance and ethical issues surrounding potential uses of synthetic biology.
2. Create incentives, if they do not exist, to create teams for high schools and colleges to field iGEM teams to participate in regional, national and global iGEM jamborees[7].
3. Create or incentivize a network of business in the State using synthetic biology and publicize their work to draw other businesses to Maine.
4. Look into the USDA's pending decision on whether to allow genetically altered chestnuts to be planted outside of experimental plots in order to recreate native chestnut forests[8]. If approved, there is work going on at UNE by Professor Klak that might facilitate planting of chestnuts in Maine. Consider if this is something that the Penobscot might want to consider on their lands.
5. Conduct a State-wide poll that uses carefully developed educational materials to assess the citizens' opinions and concerns about possible uses of synthetic biology.[9]

[6] See for example: https://biobuilder.org/education/for-teachers/
[7] https://jamboree.igem.org
[8] https://allianceforscience.cornell.edu/blog/2020/08/usda-to-decide-fate-of-american-chestnut-restoration/
[9] For example see: https://www.liebertpub.com/doi/full/10.1089/genbio.2022.0024

6. Create a citizen panel to evaluate possible uses of synthetic biology applications in agriculture and conservation.
7. Create incentives for development and deployment of industrial uses of synthetic biology – perhaps involving a retooling of parts of the forestry industry.

4. "What should the State of Maine do regarding gene editing within your field in order to best benefit Mainers over the next generation?"

I would suggest that the Committee consider the following as loci of action within the next generation:

1. Continue with the previous 7 suggestions.
2. Create and fund an active research program that would examine the potential of synthetic biology to help in nature-based solutions[10] including carbon sequestration.

Thank you for the opportunity to make this contribution and I stand ready to provide additional information to the Committee if useful.

[10] https://www.iucn.org/our-work/nature-based-solutions