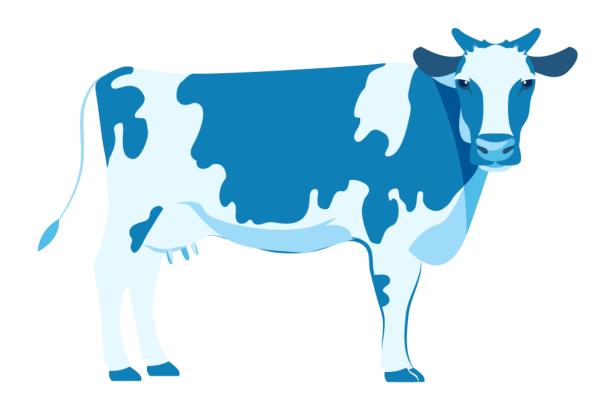


Genetic Frontiers in Conservation An Assessment of Synthetic Biology and Biodiversity Conservation

Kent H. Redford, Chair IUCN Task Force on Synthetic Biology and Biodiversity Conservation

When we think of cows

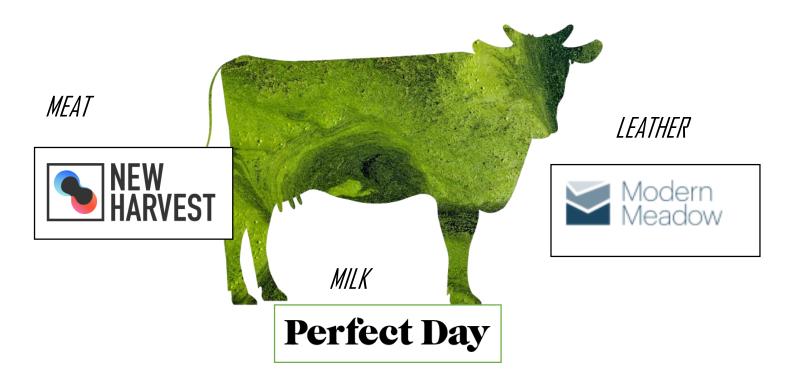


We think of products from cows:

- Leather
- Meat
- Milk

What if we could get 'cow products'......without the cows?

Products from cow genes inserted into algae – with the application of the tools of <u>synthetic biology</u>:



Synthetic biology and Agriculture



- 1. Transform type of photosynthesis
- 2. Create new domestic crops
- 3. Increase disease resistance
- 4. Improve animal production

Synthetic biology changes in human health



- 1. Develop new drugs
- 2. Improve drug effectiveness
- 3. Improved nutrition
- 4. New vaccines!

But there had been little consideration of synthetic biology and biodiversity

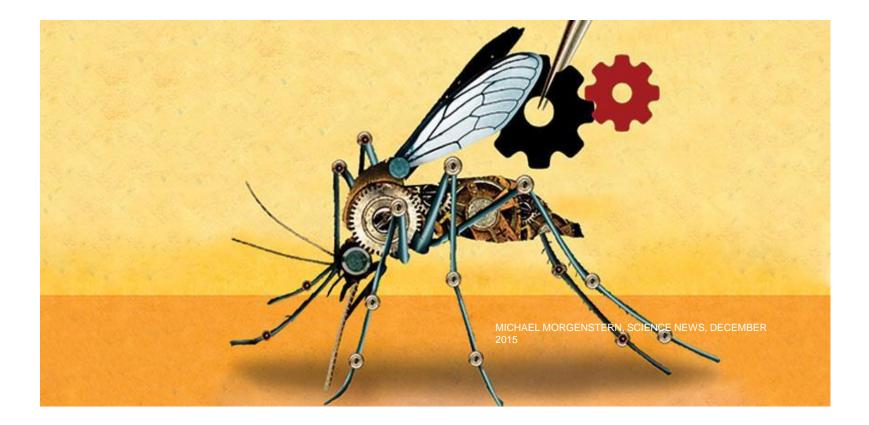


IUCN World Conservation Congress 2016

Resolution 086 – "Development of IUCN policy in biodiversity conservation and synthetic biology...."

- to *undertake an assessment*...
- to *examine* the organisms, components and products resulting from <u>synthetic</u> <u>biology</u> techniques and the impacts of their production and use, which may be beneficial or detrimental to the conservation and sustainable use of biological diversity and associated social, economic, cultural and ethical considerations; and
- to *assess the implications* of <u>gene drive</u> and related techniques and their potential impacts on the conservation and sustainable use of biological diversity as well as equitable sharing of benefits arising from genetic resources

Gene Drive was one of the synthetic biology applications considered



IUCN Task Force

 $\bigstar \mathsf{IUCN} \ \mathsf{Commission} \ \mathsf{members} \ \mathsf{and} \ \mathsf{Secretariat}$

- ✤ Natural, social sciences
- ✤ Governments, NGOs, Academia, Business
- ✤Indigenous Peoples
- Africa, North America, Latin America, Europe, Asia, Australasia



IUCN Technical Subgroup

Lead authors of Assessment

IUCN Commission, Secretariat & Specialist Group members

- Natural, social sciences
- ✤Governments, NGOs, Academia, Business
- \bullet Indigenous Peoples
- Africa, North America, Latin America, Europe, Asia, Australasia



Technical Assessment – May 2019

Genetics Frontiers for Conservation:

An Assessment of Synthetic Biology and Biodiversity Conservation

EVIDENCE-BASED

220+ pages text English, Spanish, French Online appendices



Genetic Frontiers for Conservation

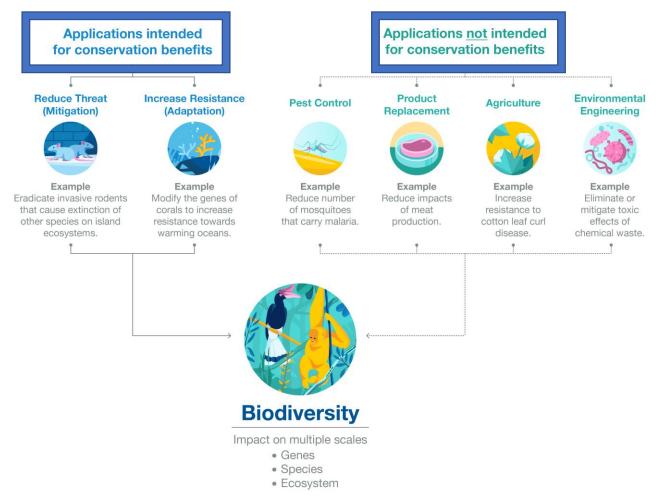
An Assessment of Synthetic Biology and Biodiversity Conservation Lorem ipsum dolor sit amet, consectetur adipiscing eiit, Itaque primos congressus copulationesque.



Proposed applications of synthetic biology for conservation Global 7 Continent 3 6 Region Eradicating invasive rodents from islands. Country 2 Controlling invasive mosquitoes to prevent bird extinctions in Hawaii. Synthetic biology to address conservation threats to black-footed ferrets. 3 Transgenic American chestnut for potential forest restoration. 4 Island(s) Corals and adaptation to climate change/acidification. 5 Horseshoe crab replacement for *Limulus amebocyte lysate* test. 6 Gene drive approach for malaria vector suppression in Africa. 7 Addressing honey bee colony collapse. 8

Ways that synthetic biology can affect conservation

Ways that synthetic biology can affect conservation



Key Messages



Conservation implications: Important implications



New tools: *conservation needs them*



Rapid growth: *of synbio globally – 5x increase*



Engineered gene drive: *unproven, great potential plus & minus*



Beneficial conservation impacts: *possible but untested*



Detrimental conservation impacts: *possible but untested*



Values and worldview: *influence development and assessment*



Indigenous and local communities: *key actors in research and decisions*

Governance: *existing structures may be challenged*

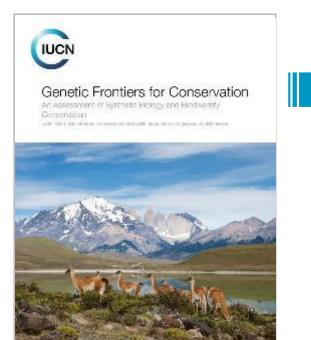


9

Risk assessment: *not what Assessment is - for technology or cases*

DRAFT IUCN Principles on the Intersection of **Biodiversity Conservation and Synthetic Biology**

Technical Assessment



Draft IUCN Board **Motion**

IEEN Policy on Synthetic Biology and Biodiversity Conservation

V: 22 February, 2019 PURPOSE STATEMENT

τ.

The purpose of this policy is to guide decisions relating to the potential use of synthetic Noticey (inducting singlesened gave drive) and the divertant indirect impacts that these technologies might have an Nodiventity and its conservation, sustainable ass, and tak and equivable sharing of the benefits it provides to people. The policy is based on a technical assessments and uses definitions established in the glassing therein and in the Annexto this document. The application of this policy is intended to minimize the potential risks and maximize the potential benefits posed by synthetic biology to the concervation of biodiversity.

I. ADDIENCE FOR POLICY

The onlinee of this policy is all constituent parts of IUCN, including Members, Commission Service of Coursel, and National and Regional Committees This policy is therefore included to go the work of TICN Neerber organizations, Commission members, Secretariat staff, Council and National and Regional Committees. The policy is dealineeded to inform others involved or interested in worth Sie biology Confusions engineered gene drive) within and beyond the conservation continuanty

BOUPS OF FOLICY

This policy assess all aspects of the application of the tools and rechnologies of synthetic biology (referring organisms, components, and y reducts developed using synthetic Noticg, and historing explorement generatively, is returned to their possible regardle and positive impacts on Machinesky at genetic, creater, and exception levels, on the conversation and sustainable use of biodiversity, and on the fair and exclusive starting, of the benefits it provides to people.

IV. CONTEXT OF THIS FOLLOW

Giolal, regional, and national concernation measures promoting biodiventity construction have required in some measures, but blocheard ty continues to deal he globally. To address certain threats to blocheardly, any tools are needed for effective. conservation and a statistable cas of biological diseasity that complement existing case. The field of synthetic biology is developing rapidly, with multiple implementers, both potentia ly negative and potentially positive, for bladiansity conservation. More generally, the increasing field of synthesis biology poses potential risks and benefits to a large number of domains, including lood screarly, agriculture, track, locally, energy, and chronic. As a reach, synthetic blocksy is new the screas of national and informational

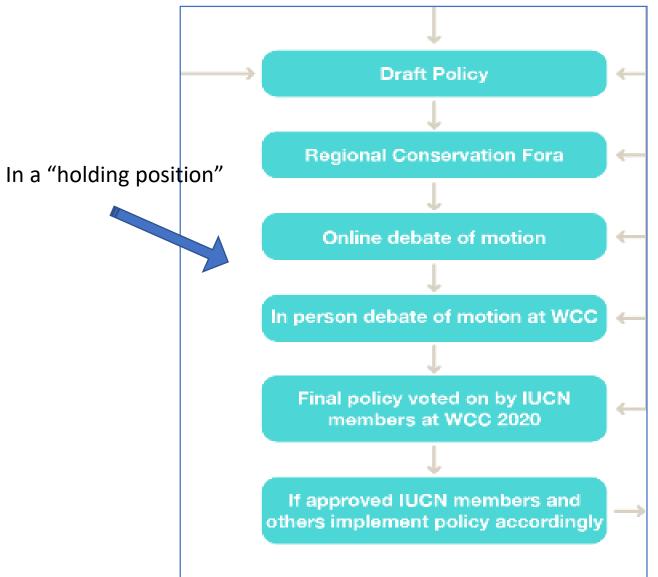
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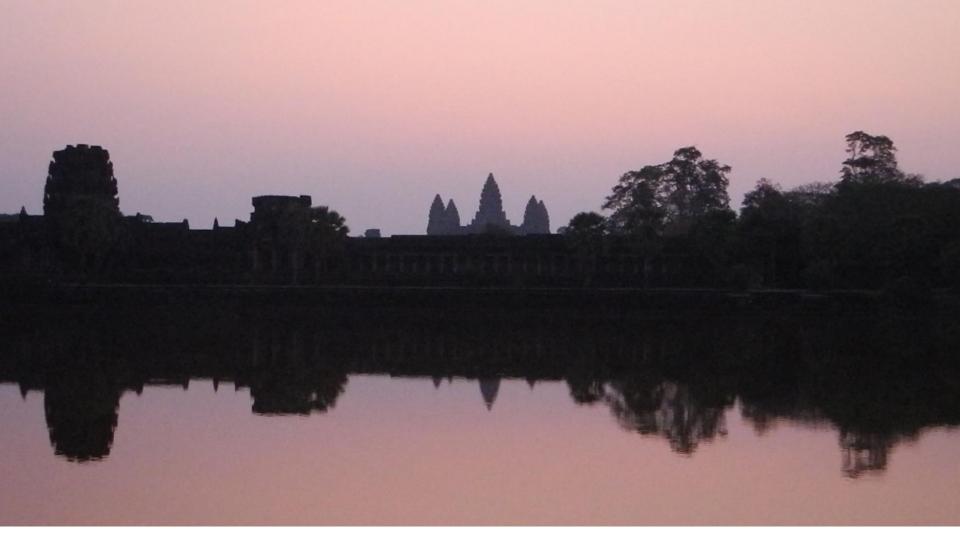
<u>Draft</u> IUCN Principles on the Intersection of Biodiversity Conservation and Synthetic Biology

IV. Key Considerations for applications

- <u>Case-by-case</u> decision-making;
- For applications of synthetic biology intended for conservation goals, <u>evaluation of existing alternatives</u>;
- For applications of synthetic biology intended for purposes other than conservation, steps to ensure that such applications do not threaten biodiversity and its sustainable use;
- <u>Staged assessment of risks and benefits;</u>
- <u>Governance;</u>
- Knowledge gaps and research needs;
- Knowledge transfer and capacity building;
- Potential introduction of moratoria.

Where are we now in the process?





Thank you