



Recommendations of the IUCN Citizens' Assembly on Synthetic Biology in relation to Nature Conservation

Bangkok, Thailand, 26 January 2024

IUCN Res123 Citizens' Assembly

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Introduction

The Convention on Biological Diversity provides a working definition of synthetic biology as “a further development and new dimension of modern biotechnology that combines science, technology and engineering to facilitate and accelerate the understanding, design, redesign, manufacture and/or modification of genetic materials, living organisms and biological systems” (SCBD 2022). Synthetic biology applications have been demonstrated to, and will continue to, impact nature conservation.

On the one hand, synthetic biology could open new opportunities for nature conservation. For instance, it may offer some solutions to currently unsolvable threats to biodiversity, such as those caused by invasive alien species, diseases, and climate change. Such opportunities could also be indirect, perhaps through allowing sustainable intensification of agriculture and thus reducing pressure on natural ecosystems elsewhere.

On the other hand, applications of synthetic biology could impose new risks for nature. Poorly implemented or governed, it could, for example, introduce unwanted and/or unintended genetic traits into native species, jeopardising their persistence. Other risks could be indirect, such as through the use of synthetic biology to open new agricultural frontiers, threatening biodiversity through land conversion.

Shaping a coherent nature conservation policy on synthetic biology is challenging for multiple reasons. Synthetic biology is a broad term and encompasses many types of products/applications, many of which have dissimilar uses and intended outcomes. The technology is expanding extremely rapidly. The subject is complex and misconceptions are rife. Maybe most challenging, the issue is highly polarised across the conservation community (and society as a whole), with small proportions of conservation stakeholders strongly opposed to, or supportive of, the technology, and many as-yet-undecided as to what the best policies might be. To resolve these issues, collaboration between countries is essential, as is collaboration across levels of governance from indigenous peoples and local communities through to multilateral environmental agreements.

In this light, at the IUCN World Conservation Congress in Hawai‘i, USA, in September 2016, IUCN Members adopted Resolution 086 (IUCN 2016). This Resolution mandated the development and publication of an assessment on synthetic biology and biodiversity conservation, under the authority of the Chairs of all six of IUCN’s independent expert Commissions, and the IUCN Director General. This assessment was published in 2019 as “Genetic Frontiers for Conservation” (Redford et al. 2019), with an accompanying “Synthesis and Key Messages” for policy-makers (IUCN 2019).

Building from this, the IUCN World Conservation Congress in Marseille, France, in September 2021 adopted Resolution 123 (IUCN 2021), establishing a process for the development of an IUCN policy, to include both an inclusive process across the Union and the appointment of a Policy Development Working Group.

IUCN Council deliberated the Resolution at Part I of their 108th Meeting (online in November 2022) and in their 109th Meeting (in Gland, Switzerland in May 2023), and adopted Decisions C108/2 (IUCN 2022) and C109/8 (IUCN 2023) which approved a process for the implementation of the Resolution and revised Terms of Reference for the specific bodies involved. This documentation provided specifications to the details of the inclusive process (including for it to encompass a “Citizens’ Assembly” as a competent and timely process of participatory and anticipatory technology assessment) and of the Policy Development Working Group.

In this context, this report details the recommendations on Synthetic Biology in relation to Nature Conservation from the IUCN Res123 Citizens' Assembly to the IUCN Res123 Policy Development Working Group.

IUCN Res123 Citizens' Assembly Process

Citizens' Assemblies are part of a broad class of participatory & anticipatory assessment methods, designed to integrate new voices into science policy discussions (CSPO-ASU 2024). Specifically, they share three key characteristics (OECD 2020). First, they are deliberative: they have access to accurate and authoritative information, weigh evidence on different options, and seek common ground and group recommendations. Second, they are representative, in being selected from a given population through stratified random sampling. Third, they are intended to have impact and so are linked directly to public decision-making processes.

Citizens' Assemblies are typically convened to address polarised societal questions from among the population of a single country. Recent examples include the Australian Citizens' Jury on Genome Editing (2021) and the Irish Citizens' Assembly on Biodiversity Loss (2023). To undertake the IUCN Res123 Citizens' Assembly on Synthetic Biology in relation to Nature Conservation, IUCN modified this approach to undertake a stratified random selection of citizens' assembly participants from among the "population" of IUCN Government and Civil Society Members. This is because it will be these 220 Member governments and 1,200 Non-Governmental and Indigenous Peoples' Organisation Members who will vote on adoption of the IUCN Policy on Synthetic Biology in relation to Nature Conservation at the IUCN World Conservation Congress in October 2025.

Further to the process agreed to by IUCN Council (2022, 2023), the participant selection for the IUCN Res123 Citizens' Assembly on Synthetic Biology in relation to Nature Conservation was undertaken live in the meeting of the IUCN Council's Programme and Policy Committee on 23 May 2023 (Annex I). The selection was stratified to select 16 IUCN Members as follows:

- Two IUCN Members from each IUCN Statutory Region
- Eight IUCN Category A Members (Governments) and eight IUCN Category BC Members (Civil Society)
- Eight women and eight men

Initial invitations to the selected IUCN Members were issued on 23 June 2023. In total, ten IUCN Members declined participation due to existing time commitments or other reasons; where an IUCN Member declined participation, a new invitation was issued to the next IUCN Member selected in the given IUCN Statutory Region and IUCN Membership Category, until all participants were confirmed.

All IUCN Members were requested to provide a primary participant and also a reserve participant, as a backup in case any situations arose where the primary participant was unable to participate. Selected IUCN Members were requested to consider other dimensions of diversity (e.g., youth and indigenous participation) in finalising participants. The invitations established that Citizens' Assembly participants were not required to have existing expertise in synthetic biology, but that fluency in either English or French or Spanish, the three official languages of IUCN, was required. All Citizens' Assembly participants were offered honoraria to provide an equitable mechanism to compensate for their engagement, on the basis that their roles were selected rather than nominated.

The final Citizens' Assembly composition reflected the diversity of the IUCN Membership accordingly. In addition to the diversity across IUCN Statutory Regions, Membership Categories, and sex, there was also substantial diversity of ages within the Citizens' Assembly participants, with a range from 30–64 years, and an average age of 42 years. In the final reckoning, one of the selected participants was unable to attend the deliberation meeting.

The Terms of Reference for the IUCN Res123 Citizens' Assembly on Synthetic Biology in relation to Nature Conservation, as established by IUCN Council (2022, 2023), set the process' objective as being to "contribute to the inclusive process by ensuring a voice for the "silent majority" of the IUCN Membership into the process for development of the "IUCN policy on synthetic biology in relation to nature conservation", as mandated in operative clause 1 of IUCN Resolution WCC 2020 Res 123" (Annex II).

Specifically, the roles of the Citizens' Assembly participants were established as being: 1) to participate in training, responsive to needs expressed by the participants, to develop a common understanding regarding synthetic biology and its interactions with, and implications for, nature conservation; and, 2) to produce this report summarising the recommendations for the IUCN Res123 Policy Development Working Group regarding content of the "IUCN policy on synthetic biology in relation to nature conservation". In addition, all Citizens' Assembly participants are invited to attend the 2025 IUCN World Conservation Congress.

In support of these roles, IUCN recruited training and facilitation support through the IUCN procurement process, again following the process and Terms of Reference specified by IUCN Council (2022, 2023). The International Centre for Genetic Engineering and Biotechnology (ICGEB) and One Planet Solutions (OPS) were selected to serve these roles.

The Citizens' Assembly process encompassed four elements, as follows:

1) Establishment of a group on the IUCN Engage platform, to allow electronic exchange and communication among the Citizens' Assembly participants, and between the participants and the trainers and facilitators, and the IUCN Secretariat support staff.

2) Undertaking a training needs assessment (Annex III). This was prepared by ICGEB/OPS, and ran from 9–20 October 2023.

3) Convening a training workshop. The training course and agenda (Annex IV) were developed by ICGEB/OPS in response to the needs identified from participants through the training needs assessment. The training workshop was convened from 20–24 November 2023, and kindly hosted by the IUCN East & Southern Africa Regional Office in Nairobi, Kenya (requiring an average of ~20,000km travel per participant). At the end of the training workshop, Citizens' Assembly participants completed an anonymous questionnaire to state their initial priority topics to be covered in the deliberation workshop.

4) Convening a deliberation workshop. The agenda (Annex V) was developed by ICGEB/OPS on the basis of the topics proposed by Citizens' Assembly participants at the end of the training workshop. The deliberation workshop was convened from 22–27 January 2024, and kindly hosted by the IUCN Asia Regional Office in Bangkok, Thailand.

This report provides the recommendations from the IUCN Res123 Citizens' Assembly deliberation workshop accordingly. The recommendations are organised into six key topics, reflecting the priority issues identified by Citizens' Assembly members. These encompass Stockpiling Resources and Knowledge Gaps, Synthetic Biology Definition and Policy Scope, Assessing Risks and Benefits, Indigenous Peoples and Local Communities (IPLCs) Involvement and Rights, Awareness-Raising & Trust, and Access and Benefit Sharing (ABS). The formulation of each Principle and Recommendation was a collaborative effort, shaped through collective deliberation. To gauge consensus, each element underwent anonymous voting. The two instances where 100% consensus was not achieved are

acknowledged in footnotes, ensuring a clear and transparent representation of the Citizens' Assembly's collaborative decision-making process.

The report introduction, IUCN Res123 Citizens' Assembly process, acknowledgements, references, and appendices were drafted by the IUCN Secretariat and reviewed and approved by the Citizens' Assembly participants. The main text recommendations (pages 7-14) were written and approved by the Citizens' Assembly participants directly.

Recommendations

Underpinning values and principles

The IUCN Res123 Citizens' Assembly on Synthetic Biology in Nature Conservation acknowledges that there are a number of values that underpin and align with the principles and recommendations outlined within this report. These values are:

- V1. Fostering trust.**
- V2. Transparency.**
- V3. Respect.**
- V4. Goodwill.**
- V5. Inclusivity.**
- V6. Public participation.**
- V7. Avoiding bias.**
- V8. Fairness.**
- V9. Accessibility.**

The above values have been reflected strongly in our work and it is identified that these are highly aligned with the IUCN's values.

In addition to these values, there are a number of transversal principles that the Citizens' Assembly identified that should be applied across all considerations and applications of synthetic biology for nature conservation:

- V10. Pro Natura¹.**
- V11. Science-based.**
- V12. Precaution.**

We recommend that the policy working group acknowledges the importance of these values and principles, and ensure their work on the development of the policy demonstrates these values and IUCN's ongoing work on the application of synthetic biology in nature conservation.

Topic 1: Stockpiling resources and knowledge gaps

The following principles and recommendations related to stockpiling resources and filling knowledge gaps are aimed at ensuring access to robust, equitable and transparent information about applications of synthetic biology in nature conservation.

Principles

T1.P1. Synthetic biology is an emerging field with limited available information. Knowledge gaps should be filled using the best available data including peer reviewed data and articles, firsthand experiences from other synthetic biology projects, and traditional knowledge.

T1.P2. Information should be objective, robust, of high quality and representative for

¹ In case of doubt about the release of synthetic biology, the decision must be taken in harmony with nature considering the least harmful alternatives. Synthetic biology will not be released when the potential adverse effects are excessive in relation to the benefits derived from them.

synthetic biology and its impact on nature conservation, and data gathering processes should be ongoing and adaptable.

T1.P3. Equitable access to data resources and information is important.

Recommendations

T1.R1. Develop tools for knowledge and resource-gathering from trusted sources that enable equitable access to data resources and information access.

T1.R2. Develop an approach for monitoring and evaluating available information, data and knowledge gaps.

T1.R3. IUCN should perform a role in gathering and sharing reliable information about the use of synthetic biology in the context of nature conservation for a wider audience, including developing a knowledge hub and providing assistance for developing regulatory frameworks.

T1.R4. Enhance transparency of available data about both potential risks and benefits of synthetic biology.

Topic 2: Synthetic biology definition and policy scope

The following principles and recommendations are aimed at ensuring that the definition of synthetic biology, in the context of nature conservation, is clear, easy to understand and widely accepted. Furthermore, the scope of the policy should be inclusive and encompass both the intended and unintended impacts of synthetic biology on people and nature, including non-conservation applications.

Principles

The definition of synthetic biology should:

T2.P1. Be clear and easy to understand.

T2.P2. Be broad and widely accepted.

T2.P3. Future-proof in order to ensure that new and emerging technologies are covered by the definition (many products of biotechnology may fall within the scope of synthetic biology).

The policy scope should:

T2.P4. Be inclusive and acknowledge the importance of diversity and different values.

T2.P5. Encompass the intended and unintended impacts of synthetic biology on people and nature (in terms of Access and Benefit-Sharing, social and economic benefits, biodiversity etc.).

T2.P6. Be in the context of nature conservation but should not exclude the impacts of non-conservation synthetic biology applications on nature (e.g., agricultural applications).

Recommendations

We recommend that the IUCN Res123 Policy Development Working Group:

T2.R1. Develop a definition of synthetic biology and policy in the context of nature conservation to ensure consistent regulation and indicate what the scope of the policy does not cover in the context in synthetic biology. The definition should be encompassing enough that it doesn't require other definitions to understand².

T2.R2. Avoid naming specific technologies in the definition of synthetic biology so that it doesn't require frequent updating as new technologies and synthetic biology products emerge. The definition of synthetic biology should be periodically reviewed to ensure that it is still accurate.

T2.R3. Align the IUCN synthetic biology policy with relevant existing protocols, international guidelines, and goals.

T2.R4. Ensure that the scope of the policy should be inclusive in terms of addressing issues of diversity, equity and accessibility. The scope should encompass the intended and unintended impacts of synthetic biology on people and nature (in terms of Access and Benefit-Sharing, social and economic benefits, impacts on biodiversity, etc.) including non-conservation applications.

T2.R5. Recommend that the IUCN should provide supporting information with the policy that explains how it sits alongside wider definitions and existing international agreements to aid public understanding of the subject.

T2.R6. Recommend that the IUCN should be involved in future negotiations for defining synthetic biology and its scope (e.g., Convention on Biological Diversity, other international or regional frameworks)³.

Topic 3: Assessing risks and benefits

The following principles and recommendations regarding risk assessment policies and methodologies relate to the use of synthetic biology applications impacting the conservation of nature, both those intended for conservation and non-conservation uses.

Principles

T3.P1. Risk and benefit analysis should be case-specific, comprehensive and transparent, when considering a synthetic biology application. When examining the impacts of a synthetic biology application on nature conservation, both risks and benefits should be considered on a case-by-case basis that is comprehensive and transparent. This should include intended and unintended impacts of conservation and non-conservation synthetic biology applications, be weighed against the use of other methods or non-intervention, and be placed in the context of the synthetic biology application's intended purpose.

² One participant felt that it is not the role of the policy development working group to develop a definition of synthetic biology and that it is unclear what would be the additional information that a conservation context could bring to it.

³ Two participants dissented, noting that this recommendation is not clear on the role that IUCN is expected to serve or which specific fora to which their advice on this topic should contribute.

T3.P2. Varying international boundaries and geopolitical spaces exist and there is a need for aligning policies for risk assessment. There are global implications for the use of synthetic biology applications, both positive and negative, with varying risk assessment approaches in place or in need of development, recognizing that international agreements may apply (e.g., Cartagena Protocol on Biosafety).

T3.P3. Biosafety and the reduction of harm to nature are key components of risk assessments when considering synthetic biology applications. Risk management and assessment practices may incorporate other factors (e.g., socioeconomic considerations). The concept of liability and redress is important in relation to damage to conservation of nature.

T3.P4. The Precautionary Principle, step-by-step approach, and problem formulation should be followed when developing risk assessment policies that enable the safe use of synthetic biology applications. Uncertainty related to potential adverse effects from the use of synthetic biology applications should be reduced to the greatest extent possible, while recognizing that the presence of uncertainty should not unduly delay the use of these applications when urgent action is needed.⁴

Recommendations

T3.R1. Develop measures for monitoring and incorporate reversibility and containment measures into risk management and assessment policies. Incorporate indicators and early warning systems into post-release management practices to allow early intervention, reversal, containment or other mitigation measures both at the national and international levels.

T3.R2. Prioritise transparency, likelihood of intervention success, and Precautionary Principle considerations in risk assessment policy formulation specific to established and emerging synthetic biology applications. Evaluate the potential for the viability of a synthetic biology application in relation to alternative interventions or lack of intervention, using appropriate data and analytical tools to estimate level and likelihood of risk, making data, tools, and conclusions accessible.

T3.R3. Consider using existing best practices when formulating risk assessment policies. As necessary, IUCN should assess, refine, propose, and develop best practices in risk assessment and provide illustrative examples that encompass both potential risks and benefits.

T3.R4. Emphasise a case-by-case approach in risk assessment policy formulation for synthetic biology applications, incorporating both intended and unintended impacts. New risk assessment methodologies specific to synthetic biology applications may be necessary. These methodologies should: encompass both potential risks and benefits; consider socioeconomic factors; be case-by-case; incorporate feedback and perspectives from diverse stakeholders, including Indigenous Peoples and Local Communities; build upon past experience and knowledge; be complementary to existing methods; and recognize the scale and complexity of introducing new technologies and their applications to ecosystems.

⁴ Although ultimately reaching unanimous consensus, while discussing risk assessment, some Citizens' Assembly members disagreed as to the extent of the Precautionary Principle in developing risk assessment policies. One perspective was that the Principle is essential and should be fully followed when developing risk assessment policies. The other perspective felt that the Principle is important and only needs to be recognized while developing these policies.

T3.R5. Evaluate current frameworks for liability and redress regarding damage to nature conservation in the context of synthetic biology applications, providing guidance on updating these frameworks as necessary.

Topic 4: Indigenous peoples and local communities (IPLCs) involvement and rights

The following principles and recommendations regarding IPLCs involvement and rights are aimed at ensuring that the IUCN recognizes and supports the aspirations and rights of IPLCs on the use of synthetic biology in nature conservation.

Principles

T4.P1. Awareness, Advocacy and Education. Education, advocacy and increased awareness of Free Prior and Informed Consent is essential.

T4.P2. Recognition. The views and rights of IPLCs are recognised.

T4.P3. Access to Information. Information is widely available for all IPLCs in accessible language and content.

T4.P4. Equity of Voice. The aspirations and “voice” of IPLCs are respected, valued, amplified and always considered equal. Free Prior and Informed Consent should always seek to represent and involve a wide range of IPLCs and other involved communities and respect IPLC cultural protocols.

T4.P5. Impact and Unintended Impact. Free Prior and Informed Consent is required when a synthetic biology application has a potential or actual impact and/or an unintended impact on nature, or has derived benefit from this application. Synthetic biology applications should only be applied and/or implemented if supported by IPLCs.

T4.P6. International Engagement, Guidelines and Agreements. Active engagement and participation of IUCN in the Free Prior and Informed Consent process at an international level. Alignment with existing international agreements and protocols, e.g. United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

Recommendations

We recommend to the IUCN Res123 Policy Development Working Group that the IUCN:

Awareness, Advocacy and Education

T4.R1. Actively provide training, capacity building and a channel for participation in Free Prior and Informed Consent (both within IUCN membership and within IPLCs).

T4.R2. Recognises, facilitates and enables access to technical expertise and information, drawing from the constituency membership expertise.

Recognition

T4.R3. Advocates that the development of synthetic biology applications should be aligned with values expressed in traditional knowledge of nature conservation when applied within indigenous territories.

T4.R4. Recommendations on Free Prior and Informed Consent for synthetic biology should be in alignment with relevant global policies and any protocols developed by

the communities that they are engaging with (e.g., UN Declaration on the Rights of Indigenous Peoples, Convention on Biological Diversity).

Equity of Voice

T4.R5. Advocate for equal opportunity for the contribution and participation of IPLCs in Free Prior and Informed Consent.

T4.R6. Provide a channel for and/or actively facilitate multi-voiced participation in Free Prior and Informed Consent.

T4.R7. Advocate that the process of Free Prior and Informed Consent takes place in a transparent way without pressure, intimidation, or bias.

T4.R8. Facilitate communication and engagement between different stakeholders and IPLCs.

T4.R9. Promote and facilitate the engagement and participation of IPLCs in decision-making processes.

Impact and Unintended Impact

T4.R10. Advocate for a decision-making framework on the use of Free Prior and Informed Consent when applying synthetic biology applications as an emergency provision.

International Engagement, Guidelines and Agreements

T4.R11. Support and advocate for the development of, and guidance on, best practice approaches in Free Prior and Informed Consent.

T4.R12. Ensure Free Prior and Informed Consent be included in the IUCN policy on the use of synthetic biology.

T4.R13. Play a role in engagement and facilitation of the negotiations for any new agreements on synthetic biology and Digital Sequence Information, to promote that all future agreements incorporate Free Prior and Informed Consent principles.

Topic 5: Awareness-raising & trust

The following principles and recommendations are aimed at ensuring that the IUCN is a trusted expert at all levels on the use of synthetic biology for nature conservation. This includes collecting, communicating, and sharing current, accurate and unbiased information and fostering public, regulatory, and member understanding and public engagement.

Principles

T5.P1. Transparency is essential to ensure the public has trusted sources of information on synthetic biology.

T5.P2. Data, guidelines, and information should be unbiased, science-based, and respecting a range of stakeholder views in order to build trust.

T5.P3. It is vital to facilitate public engagement, debate, and understanding of synthetic biology for nature conservation through accessible information and active public consultation and participation.

T5.P4. IUCN members should have access to guidance on the appropriate application of synthetic biology for nature conservation.

Recommendations

Transparency

T5.R1. Ensure transparency in the creation and implementation of policies and strategies relating to synthetic biology, by sharing information, and being clear about inputs, methodologies, and review processes.

T5.R2. Be explicit and open about sources of data, including potential biases, interests, and gaps.

T5.R3. IUCN should ensure transparency over its funding and financial assistance for its work on synthetic biology for nature conservation, including the IUCN Res123 Citizens' Assembly and Policy Development Working Group.

Avoiding Bias and Respecting a Range of Views

T5.R4. Respect and seek to understand stakeholders' views and facilitate this to be shared.

T5.R5. The IUCN policy working group should take a science-based approach to the IUCN policy, taking into consideration the views of IPLCs on synthetic biology for nature conservation.

T5.R6. In sharing information about synthetic biology, IUCN should be transparent about available data about potential risks and benefits.

Public Engagement and Accessibility of Information

T5.R7. IUCN should create a long-term holistic communication strategy around synthetic biology for nature conservation to address a diverse and inclusive range of stakeholders and audiences (e.g., local communities, science community, governments, businesses, etc.).

T5.R8. IUCN should communicate information about synthetic biology in an accessible manner, including making use of open source platforms and using clear, easy-to-understand language and technology that the public can engage with.

T5.R9. IUCN should facilitate public conversation about the use of synthetic biology for nature conservation through direct public engagement and participation activities, such as citizen assemblies, conferences, and workshops.

Support for IUCN Members and stakeholders

T5.R10. IUCN should develop and offer knowledge, guidance, and capacity building for IUCN Members and stakeholders on the use of synthetic biology for nature conservation, building on the broader values of IUCN.

T5.R11. IUCN should offer best practice guidance about public communication of using synthetic biology for nature conservation, leveraging its member organisations to promote awareness of the benefits and concerns of synthetic biology.

Topic 6: Access and benefit-sharing (ABS)

Within the context of synthetic biology in nature conservation and the application of Access Benefit-Sharing the following apply. The principle of Access and Benefit-Sharing is that genetic resources may be accessed, and the benefits that result from their use are shared between the people or countries using the genetic resources, combined with the people or countries that provide genetic resources.

Principles

T6.P1. Access and Benefit-Sharing principles are internationally applicable to synthetic biology in the context of nature conservation.

T6.P2. Access and Benefit-Sharing is inherent throughout the lifecycle and subsequent derivatives of synthetic biology applications.

T6.P3. Intellectual Property should be open access for nature-based conservation applications in recognition of the biodiversity crisis. Intellectual Property restrictions should not be a hindrance to nature-based conservation applications.

T6.P4. Ensure intergenerational equity. When regulating synthetic biology benefits, Access and Benefit-Sharing for future generations should be incorporated.

Recommendations

T6.R1. IUCN should play an active and guiding role in the promotion, and monitoring of Access and Benefit-Sharing policies and methodologies, including Digital Sequence Information, and offer best practice guidance.

T6.R2. IUCN should encourage governments to offer incentives (e.g., lower taxes) to companies that share benefits of synthetic biology applications for nature conservation.

Acknowledgements

IUCN (2021) established the overall oversight for implementation of WCC 2020 Res123 as resting with IUCN President Razan Al-Mubarak. Within IUCN's Council, the regular consideration of progress in implementation of the Resolution sits under the Programme and Policy Committee, Chaired by Sue Lieberman (IUCN Councillor elected from North America and the Caribbean). In 2022, the Programme and Policy Committee appointed a Working Group of three Councillors to provide operational oversight to the process, comprising Bibiana Sucre (IUCN Councillor elected from Meso and South America) as chair, Hilde Eggermont (IUCN Vice-President and IUCN Councillor elected from West Europe) and Peter Cochrane (IUCN Vice-President and IUCN Councillor elected from Oceania). In this capacity, Bibiana Sucre attended the Nairobi training session and Peter Cochrane attended the Bangkok deliberation session, both as observers.

Co-chair of the IUCN Policy Development Working Group on Synthetic Biology in relation to Nature Conservation, Zabta Shinwari, served as an observer to the two Citizens' Assembly in-person meetings; on behalf of his Co-Chair Julia Maria Oliva, and the other 14 Policy Development Working Group members.

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Annex I: Citizens Assembly Stratified Randomised Selection Protocol

Selection completed live in IUCN Council Programme and Policy Committee, 23 May 2023, using Microsoft Excel without macros and a standard randomised sorting protocol.

General Approach: All Members were stratified by Region and Member Category into columns, and a parallel column was filled with random numbers between 0 and 1 (eg. 0.260181139). Then all the columns were sorted by rows to order the random numbers from smallest to largest, which randomly rearranged the Member order in each column, and the first Member name in the sorted column was selected.

Spreadsheet setup:

1. In an excel sheet. IUCN Members were stratified by Region and Member Category into 16 columns with each column colour-coded in alternating ways (Columns A:P). Row 1 was headers:

- a. ie: Column A contained all Category A Members in the Africa Region coded light green;
- b. Column B contained all Category B & C Members in the Africa Region coded light blue
- c. Column C contained all Category A Members in the East Europe, North and Central Asia Region coded light blue
- d. Column D contained all Category B & C Members in the East Europe, North and Central Asia Region coded light green
- e. Column E contained all Category A Members in the Meso and South America Region coded light green;
- f. Column F contained all Category B & C Members in the Meso and South America Region coded light blue
- g. Etc.

2. Column Q was set up to choose the gender requested from the columns coded light green.

- a. Q2 = 'Female'
- b. Q3 = 'Male'

3. Column R was the random column. It started blank and was filled with random numbers using an unknown seed during the process.

4. Cell U2 contains the formula '=rand()' that was be pasted into the cells in the random column (column R)

Pre-defined Selection Protocol:

Several steps are related to preventing Excel from recalculating the random numbers once they are assigned.

1. Set Calculations Options to 'Manual'. Ribbon > Formulas > Calculation > Calculation Options. This stops random numbers from being re-calculated in Excel
2. Copy 'random formula' in U2 and paste into 'random' column (R2:R255), so that it fills the grey cells (Column R) with the formula '=rand()'.

3. Calculate Random Numbers: Ribbon > Formulas > Calculation > Calculate Now. This applies the formula '=rand()' in R2:R255, filling each cell with a different random number between 0 and 1.
4. Without clicking again, press Control + C to copy that column to save the values, so they are only calculated once.
5. Right click and paste that column as static values (second from left with 123). This stops the random numbers from being re-calculated.
6. Select columns A:R and sort by 'random' . Ribbon > Data > Sort & Filter > Sort > By random > Values > Smallest to largest). This sorts the rows in each column by the random numbers in column R.
7. The first entry in each column that is not white space is the selected participant for that Region and Membership Type. If needed, reserve participants can be selected in order within each column.
8. The gender requested for all the light green columns will be determined by the topmost gender sorted in column Q. The light blue columns will be assigned the alternative.

Annex II: Citizens' Assembly Terms of Reference

Composition: A minimum of sixteen individuals selected in a stratified random fashion from across the IUCN Membership, with stratification ensuring regional and gender balance and balance between the two IUCN houses (ie Government and Civil Society), as well as seeking indigenous and youth engagement, under the assurance of the IUCN Council Programme and Policy Committee Working Group. Citizens' assembly members are not required to have existing expertise and interest in synthetic biology. Fluency in either English or French or Spanish, the three official languages of IUCN, is required; whispering translations will be provided by the IUCN Secretariat to assist any citizens' assembly members requiring this.

Objective: Contribute to the inclusive process by ensuring a voice for the "silent majority" of the IUCN Membership into the process for development of the "IUCN policy on synthetic biology in relation to nature conservation", as mandated in operative clause 1 of IUCN Resolution WCC 2020 Res123.

Specific roles:

- 1) Participate in training, responsive to needs expressed by the citizens' assembly members, to develop a common understanding regarding synthetic biology and its interactions with and implications for nature conservation;
- 2) Produce reports with recommendations and summary deliberations for the Policy Development Working Group regarding content of the "IUCN policy on synthetic biology in relation to nature conservation".

Mode of operation: 1) At least two in-person meetings, one to participate in training, the second to deliberate and produce recommendations; 2) Address ongoing issues by email or electronic meetings as needed; 3) Attend the 2025 IUCN World Conservation Congress; 4) Receive honoraria to cover opportunity cost of engagement time (on the rationale that citizens' assembly members are selected at random rather than through nomination).

Annex III: Citizens' Assembly Training Needs Assessment

Section 1: Demographic Information. Gather information about participants' backgrounds and demographics to better understand the diversity of the IUCN Citizens' Assembly.

1. Gender
2. Age
3. IUCN Geographic Region (<https://www.iucn.org/regions>)
4. Affiliation
5. Highest Education Level
6. Years of Experience in Nature Conservation

Section 2: IUCN and Nature Conservation. Explore participants' familiarity with the IUCN and its role in nature conservation worldwide

7. IUCN is a Union of:
8. With which of the following statements do you agree? [check all that apply]

Section 3: Understanding Synthetic Biology. Assess participants' knowledge and comprehension of the fundamental concepts of synthetic biology

9. How familiar are you with the terms: genetics, genetic engineering, modern biotechnology, synthetic biology?
10. Which of the following definitions best suits your concept of synthetic biology? [check one]
11. Please provide a brief description of how you would describe synthetic biology
12. Are there specific aspects or terms related to synthetic biology that you find particularly confusing or challenging?

Section 4: Importance of Synthetic Biology for Nature Conservation. Investigate participants' perceptions of the relevance and significance of synthetic biology in the context of nature conservation.

13. Do you believe synthetic biology has relevance to nature conservation?
14. What is synthetic biology primarily focused on? [check one]
15. Which of the following is an application of synthetic biology relevant to nature conservation? [check one]
16. Please match the following synthetic biology techniques with what you believe their potential conservation applications might be:
17. Understanding of potential negative and positive Synthetic Biology Impacts on: genetic diversity, species diversity, ecosystems, nature conservation
18. Can you mention examples or scenarios where synthetic biology might impact nature conservation positively or negatively?
19. Open-ended response for negative scenarios [50 words maximum]

Section 5: Potential Synthetic Biology applications for nature conservation. Examine participants' awareness and opinions on potential applications of synthetic biology in conserving biodiversity.

20. Please rank the following conservation applications of synthetic biology from – in your view – the most socially acceptable (5) to least socially acceptable (1):
21. Please rank the following potential applications of synthetic biology in terms of – in your view – their potential for contributing to long-term environmental sustainability (5 = Most Sustainable, 1 = Least Sustainable):

22. Please rank the following synthetic biology applications according to – in your view – their perceived risk to natural ecosystems (5 = Highest Risk, 1 = Lowest Risk):
23. Please rank the following conservation challenges based on which – in your view – could benefit the most from synthetic biology interventions (5 = Greatest Benefit, 1 = Least Benefit):
24. Please rank the following synthetic biology applications in terms of – in your view – their potential for public acceptance and support (5 = Most Accepted, 1 = Least Accepted):

Section 6: Synthetic Biology Policy and Regulations. Evaluate participants' understanding of policies and regulations related to synthetic biology and its environmental impact.

25. Are you aware of any existing policies or regulations related to synthetic biology in your region or country? [check one]
26. Do you believe that existing policies and regulations adequately address the potential impacts of synthetic biology on biodiversity and nature conservation? [check one]
27. Please provide a brief explanation of your perspective [50 words maximum]
28. Do you think there is a need for additional international or regional policies or regulations on synthetic biology and its impact on nature conservation? [check one]
29. Please elaborate your response [50 words maximum]
30. Have you ever been involved in discussions or decision-making related to the development of policies or regulations on synthetic biology or biodiversity conservation at any level (local, national, regional, international)? [check one]
31. If yes, please briefly describe your involvement [50 words maximum]
32. Have you ever participated in community-level discussions or decision-making related to the potential impacts of synthetic biology on local biodiversity and nature conservation? [check one]
33. Please rank the role local communities and indigenous knowledge can play in shaping policies and regulations related to synthetic biology and nature conservation
34. Please rank the following advantages of incorporating community perspectives and bottom-up approaches into the development of policies and regulations on synthetic biology and nature conservation
35. Are you familiar with any examples of community-based initiatives or bottom-up approaches to regulating synthetic biology?
36. If yes, please describe them briefly [Open-ended response; 50 words]

Section 7: Synthetic Biology and the IUCN Citizens' Assembly and Policy Development Processes. Assess participants' awareness of the role of the IUCN Citizens' Assembly in shaping policies related to synthetic biology and conservation.

37. Are you familiar with the IUCN's policy development process? [check one]
38. Are you familiar with any policies or policy development process targeting synthetic biology in other international processes/fora which are relevant to nature conservation? [check one]
39. If yes or somewhat, please briefly describe your understanding [50 words maximum]
40. Please rank the following ways the IUCN can engage with local communities and indigenous groups to ensure their perspectives are considered in synthetic biology policy development
41. What is your interpretation of the role the IUCN Citizens' Assembly on Synthetic Biology in Relation to Nature Conservation should serve in shaping IUCN policies related to synthetic biology and conservation?
42. Other (please specify): [Open-ended response; 50 words maximum]
43. Please rank specific topics or issues related to synthetic biology and nature conservation that you believe the IUCN should prioritize in its policy development

process (Select all that apply in order of priority, #5 being the highest; and provide your own suggestions if you would like).

Section 8: Case Studies on Synthetic Biology. Present participants with case studies illustrating both positive and negative impacts of synthetic biology on the environment for evaluation and discussion.

Please review the following case studies related to synthetic biology and its potential implications for nature conservation. For each case study, answer the following questions:

- **Case A:** A genetically modified microorganism designed through synthetic biology techniques to break down specific pollutants in water is released into a polluted freshwater ecosystem. Over time, these microorganisms become an integral part of the ecosystem due to their superior pollutant-degrading abilities
 - 44. How can the genetically modified microorganisms designed to break down pollutants benefit the freshwater ecosystem? [check one]
 - 45. What function did synthetic biology play in achieving the impacts on the freshwater ecosystem? [check one]
- **Case B:** An engineered maize variety designed through synthetic biology techniques resists drought conditions. While this crop thrives in water-scarce regions, it attracts a specific species of herbivorous insect pests.
 - 46. What is the main reason for the rapid multiplication of herbivorous insect pests? [check one]
 - 47. How can a significant decline in native plant species in an ecosystem affect overall species diversity? [check one]
- **Case C:** Scientists develop an engineered mosquito designed through synthetic biology techniques to combat the spread of the malaria parasite. When released into an endemic region, these modified mosquitoes effectively reduce the population of parasite-carrying mosquitoes.
 - 48. What is the primary goal of releasing engineered gene drive mosquitoes in an ecosystem, as described in the scenario? [check one]
 - 49. How can a sudden decrease in mosquito populations influence the local ecosystem, as mentioned in the case study? [check one]
- **Case D:** The fungal disease chytridiomycosis has been devastating amphibian populations worldwide. Scientists employ synthetic biology to develop a genetically modified bacteria that can be applied topically to amphibian skin. The modified bacteria inhibit the growth of the chytrid fungus. When applied in the wild, this approach helps curb the spread of chytridiomycosis.
 - 50. How does synthetic biology contribute to mitigating Chytridiomycosis in amphibians? [check all that apply]
 - 51. What is the potential impact of using synthetic biology to mitigate Chytridiomycosis on biodiversity? [Select one]
- **Case E.** An invasive fast-spreading aquatic plant that has invaded freshwater bodies in both Country A and Country B. Scientists in Country A have developed a genetically modified microorganism through synthetic biology techniques. This microorganism is engineered to target and eliminate the invasive plant while leaving native aquatic plants unharmed.

52. Which mechanisms or approaches do you believe are most important for international governance and regulatory frameworks concerning the use of genetically modified microorganisms across borders? [Check all that apply]

53. To facilitate international cooperation between Country A and Country B, what methods do you think are crucial for addressing potential risks and social concerns with the use of such modified microorganism? [check all that apply]

Section 9: Training Needs and Preferences. Collect data on participants' training needs, preferences, and areas of interest in synthetic biology.

54. What specific topics or areas related to synthetic biology would you like to learn more about? Please rate your interest on a scale from 1 (least interested) to 5 (most interested) for the following topics:

55. Any other: open-ended response [50 words maximum]

Section 10: Additional Comments. Provide participants with an opportunity to share additional thoughts, comments, or suggestions related to synthetic biology and nature conservation.

57. Interest in holding a one-to-one conversation with the trainers? [check one]

56. Is there anything else you would like to share regarding your training needs, preferences, or suggestions for the training program? (Open-ended; 50 words maximum)

Annex IV: Citizens' Assembly training workshop agenda



ICGEB International Centre for Genetic Engineering and Biotechnology

Synthetic Biology: IUCN Citizens' Assembly Training 19 – 25 November 2023. Nairobi, Kenya

In this collaborative learning, we aim to foster a shared understanding of synthetic biology's intricate interactions with and implications for nature conservation. Tailored for the members of the IUCN Citizens' Assembly, our sessions will unravel the fundamentals of synthetic biology, explore its potential environmental impacts, and delve into global policy landscapes.

MONDAY 20 November 2023

- | | |
|---------------|---|
| 09:30 – 10:30 | • Opening and Introductions |
| 10:30 – 11:00 | • Coffee/tea break |
| 11:00 – 12:00 | • Biodiversity and the IUCN |
| 12:00 – 13:30 | • Lunch |
| 13:30 – 15:30 | • Fundamentals of Genetic Engineering and Synthetic Biology |
| 15:30 – 16:00 | • Coffee/tea break |
| 16:00 – 17:00 | • Synthetic Biology Applications |

TUESDAY 21 November 2023

- | | |
|---------------|---|
| 09:30 – 10:30 | • Policies and Regulations I |
| 10:30 – 11:00 | • Coffee/tea break |
| 11:00 – 12:00 | • Policies and Regulations II |
| 12:00 – 13:30 | • Lunch |
| 13:30 – 15:30 | • Environmental Impacts of Synthetic Biology Applications |
| 15:30 – 16:00 | • Coffee/tea break |
| 16:00 – 17:00 | • Hypothetical Case Study 1 |

WEDNESDAY 22 November 2023

- | | |
|---------------|---|
| 09:30 – 10:30 | • Environmental Risk Assessments I |
| 10:30 – 11:00 | • Coffee/tea break |
| 11:00 – 12:00 | • Environmental Risk Assessments II |
| 12:00 – 13:30 | • Lunch |
| 13:30 – 15:30 | • Synthetic Biology-based Conservation Projects I |
| 15:30 – 16:00 | • Coffee/tea break |
| 16:00 – 17:00 | • Hypothetical Case Study 2 |

THURSDAY 23 November 2023

- | | |
|---------------|---|
| 09:30 – 10:30 | • Biosafety and Biosecurity |
| 10:30 – 11:00 | • Coffee/tea break |
| 11:00 – 12:00 | • Socioeconomics and Ethics of Synthetic Biology Applications |
| 12:00 – 13:30 | • Lunch |
| 13:30 – 15:30 | • Synthetic Biology-based Conservation Projects II |
| 15:30 – 16:00 | • Coffee/tea break |
| 16:00 – 17:00 | • Hypothetical Case Study 3 |

FRIDAY 24 November 2023

- | | |
|---------------|--|
| 09:30 – 10:30 | • IUCN Policy Development Process |
| 10:30 – 11:00 | • Coffee/tea break |
| 11:00 – 12:00 | • Introduction to Deliberative Processes |
| 12:00 – 13:30 | • Lunch |
| 13:30 – 15:30 | • Wrap up and Closure |

SATURDAY 25 November 2023

- | | |
|---------------|--|
| 09:00 – 17:00 | • Field visit to the Nairobi National Park to learn from conservation actions underway in host country, and provide the opportunity for informal interactions between participants |
|---------------|--|

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Annex V: Citizens' Assembly deliberation workshop agenda⁵



ICGEB International Centre for Genetic Engineering and Biotechnology

IUCN Citizens' Assembly Deliberation Workshop 22 - 27 January 2024. Bangkok, Thailand

Deliberations by the Citizens' Assembly will inform the development of an IUCN policy on nature conservation and synthetic biology pursuant to IUCN Resolution 123 (2020)

Presentation
Q&A (Group Recall)
Deliberation
Groupwork (Pre-drafting)
Groupwork (Drafting)

		Monday 22nd	Tuesday 23rd	Wednesday 24th	Thursday 25th	Friday 26th
8.45	9.00	n/a	Day's Priorities and Objectives			
9.00	9.30	Introductions • Dindo Campilan , IUCN Regional Director, Asia Regional Office • Peter Cochrane , IUCN Regional Councilor Oceania and Member, IUCN Council Programme & Policy Committee Res123 WG • Zahra Shirwan , Co-Chair, IUCN Res123 Policy Development WG, and IUCN Citizens' Assembly Observer	Topic 1 Discussion: Stocktaking Resources and Knowledge-gaps	Topic 4 Discussion: IPLC Involvement and Rights	Parking Lot 1	Parking Lot 4
9.30	10.00		Topic 2 Discussion: Symbio Definition and Policy Scope		Topic 5 Discussion: Awareness Raising and Trust	Parking Lot 2
10.00	10.30					Parking Lot 3
10.30	11.00	Coffee / Tea				
11.00	11.30	Norms for Citizen's Assembly Deliberations	Topic 3 Discussion: Assessing Risks and Benefits	Topic 6 Discussion: Access and Benefit Sharing	Taking Stock 1	Breakout (Drafting)
11.30	12.00	Review of Priority Issues Raised by Citizens' Assembly Members			Topic 7 Discussion: Other	
12.00	12.30	Recap Nature Conservation and Synbio Applications				
12.30	2.00	Lunch				
2.00	2.30	Recap Biosafety and Biosecurity	Breakout (Topics 1-3)	Breakout (Topics 4-7)	Breakout (Drafting)	Group Review of Recommendations
2.30	3.00	Recap Environmental Risk Assessment				
3.00	3.30	Recap Access and Benefit Sharing				
3.30	4.00	Coffee / Tea				
4.00	4.30	Recap IPLCs and FPIC	Reporting Back: Emerging Principles and Recommendations	Reporting Back: Emerging Principles and Recommendations	Breakout (Drafting)	Wrap up and Next Steps
4.30	5.00	Recap Socioeconomic Considerations				
5.00	5.15	Day's Synthesis and Parking Lot				n/a
Saturday 27th: Field Visit to the UNESCO World Heritage Ayutthaya Historical City						

⁵ As the IUCN Res123 Citizens' Assembly meeting progressed, recognizing that drafting was complex, participants allocated more time to drafting principles and recommendations on Thursday, with Friday morning allocated to reviewing and then voting on the compiled text. A final review of the entire document was undertaken on Friday afternoon.