

**IPBES 2<sup>nd</sup> workshop on modelling Nature Futures scenarios  
task force on scenarios and models  
under the 2030 IPBES rolling work programme**  
Online, 25 and 28 April 2022

## **Report of the IPBES task force on scenarios and models on the second part of its workshop on modelling nature futures scenarios under the 2030 IPBES rolling work programme**

### **Final report**

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## DISCLAIMER

The IPBES Bureau and Multidisciplinary Expert Panel (MEP) authorized an online workshop on modelling nature futures scenarios that was organized by the task force on scenarios and models. The first part was organized in January 2021 and the second part in April 2022. This workshop report describes the second part of the workshop. The report has been prepared by the task force on scenarios and models and was reviewed by all workshop participants. It has not been reviewed, endorsed or approved by the IPBES Plenary.

## Executive summary

This document presents the findings of the workshop on modelling nature future scenarios that was held online on 25 and 28 April 2022. The workshop was organized by the IPBES task force on scenarios and models in the context of the implementation of objective 4 (b) of the IPBES 2030 rolling work programme.

The objectives of the workshop were to share experiences in using the draft Nature Futures Framework (NFF) and to define a strategy to increase the modelling work based on the NFF by the broader scientific community.

Throughout the two days of the workshop, participants recognised considerable progress in developing and applying the NFF. Many studies using the draft NFF had emerged in recent years, both qualitative and more recently quantitative studies. The NFF was increasingly used in scientific publications and there was evidence of uptake by the scientific community. The workshop demonstrated a wide range of NFF applications. Challenges were discussed, both in exploring multiple values of nature and in the development of new scenarios for the future of nature and people.

Participants expressed the need for future work on the basis of the NFF and the workshop demonstrated sufficient interest from multiple scientific communities in contributing to that work. Participants discussed ideas for coordinating efforts with the Shared-Socioeconomic Pathways community (including modelling of indirect and direct drivers), the large-scale biodiversity and ecosystem services modelling community and the local-level scenario modelling community.

Workshop participants suggested the following relevant follow-up activities:

- Continue ongoing work by the task force to catalyse efforts to operationalise the NFF;
- Develop an NFF website as a forum to showcase examples and share experiences;
- Explore opportunities for in-person meetings at upcoming conferences, such as the planned sessions at the Scenarios Forum and World Biodiversity Forum, and eventually organize an in-person workshop on modelling the NFF later in 2022, bringing together communities outside the context of IPBES;
- Create the conditions for funding the scientific work of the NFF, by promoting collaborative science across countries and regions;
- Submit articles to the special issue on operationalizing the NFF (Sustainability Science).

## Introduction

In decision IPBES-7/1, the Plenary of IPBES established the task force on scenarios and models for the implementation of objective 4 (b) of the rolling work programme up to 2030, to support policy through the advanced work on scenarios and models of biodiversity and ecosystem functions and services.

The IPBES task force on scenarios and models, in accordance with its draft deliverables and proposed work plan, is working on further developing the Nature Futures Framework (NFF) as a tool to catalyse the development of new scenarios for future IPBES assessments by the scientific community, and the development of models to quantify the impact of such scenarios on biodiversity and nature's contributions to people by the modelling communities. Based on the draft description of the NFF and its methodological guidance, the task force has conducted a series of consultations with relevant stakeholders and modelling communities in the period up to the ninth session of the IPBES Plenary. These consultations were intended to collect feedback on the usability of the NFF and contributions to its methodological guidance for catalysing the development of the next generation of scenarios. The NFF will be presented to the IPBES Plenary at its ninth session, together with related methodological guidance.

As part of this process, the task force on scenarios and models organized the first part (online) of this workshop on modelling Nature Futures Scenarios in January 2021 (workshop report available). The second part of the workshop was held on 25 and 28 April 2022 and provided an opportunity to collect feedback on successes and challenges towards improving the operationalization of the NFF, and to explore next steps to increase modelling work based on the NFF by the broader scientific community.

This report focuses on the second part of the workshop, and was prepared by the technical support unit on scenarios and models and reviewed by the task force and all workshop participants.

## I. Objectives

The workshop objectives were to:

1. Share experiences in using the draft NFF in modelling case studies and to identify successes and challenges towards improving the operationalization of the NFF;
2. Define a strategy to increase modelling work based on the NFF by the broader scientific community and to explore the next steps for doing so, including a plan on how to engage key modelling communities.

## II. Organization and main outcomes

The second part of the workshop 'modelling Nature Futures Scenarios' was held online on 25 and 28 April 2022. It was structured into two sessions of 3.5 hours, including plenary and breakout group sessions. The agenda of the workshop is set out in appendix I. The list of participants is provided in appendix II. The same participants were invited to the first and second part of the workshop.

The workshop was opened on the first day by the Executive Secretary of IPBES, Anne Larigauderie, followed by a welcome from Shizuka Hashimoto, on behalf of both co-chairs of the task force, who also provided a recap of the work done since the first modelling workshop. Subsequently, a number of NFF case studies were presented, followed by breakout group discussions and a plenary discussion.

The second day of the workshop started with a presentation by Henrique Pereira, on behalf of the organizing team of the workshop, laying out a possible path for the development of multi-scale scenarios for IPBES by multiple scientific communities. Then kick-start talks were given by various communities, sharing ideas for the development of Nature Futures scenarios, followed by breakout discussions.

The main outcomes of the workshop were:

- 1) Shared understanding of ongoing NFF modelling

The workshop provided an opportunity for participants to share experiences with the modelling of scenarios using the draft NFF. A wide range of applications at multiple scales was presented and

discussed. It was recognised that the NFF foundations and methodological guidance had been substantially updated since the first part of the workshop. The number of publications referring to the NFF was increasing and there was evidence of uptake by the scientific community.

## 2) Lessons learned from modelling the NFF to date

The case study presentations shared successes and challenges in using the NFF. The case studies showed that the NFF allows looking at multiple policy goals together, allows being explicit about the values within those policy goals and can foster the analysis of pathways to meet those visions. Facilitating the use of a plurality of approaches for a better future for nature has been one of the key goals of the NFF.

The cases showed that the NFF has proven to be useful for understanding how people perceive the future of their landscape and discuss related matters. Therefore, the NFF provides a platform for dialogue between different stakeholders. More actionable knowledge was needed on how to use it and to deliver on multiscale scenarios for nature futures across scale, systems and regions remained a challenge.

## 3) Building a NFF community of practice: Way forward

Possible ways forward on how to increase modelling work based on the NFF by the broader scientific community were discussed, following a set of presentations by leading experts. Follow-up actions were discussed, including:

- Participation in the Scenarios Forum and World Biodiversity Forum later in 2022 as useful opportunities to connect to the broader community:
  - Forum on Scenarios for Climate and Societal Futures: Relevant sessions on catalysing the development of scenarios by communities around both biodiversity and climate scenarios, and opportunities for changing the Shared-Socioeconomic Pathways (SSP) framework and linking SSPs to NFF;
  - World Biodiversity Forum: Deliver a plenary presentation on the draft NFF to make it known to the broader community and participate in sessions on challenges and opportunities for using the NFF for scenarios and modelling;
- Organisation of an NFF scenario analysis workshop later in 2022 or in early 2023. The workshop would be organized by the modelling community itself (outside of IPBES);
- Development of a NFF website on case studies and projects to share experiences.

### **III. Overview of general discussions and presentations**

#### **A. Experiences with using the Nature Futures Framework (NFF)**

The following case studies were presented:

- i. Mapping the SSPs/RCPs onto the Nature Futures Framework at the global scale (Mark Rounsevell)
- ii. Modelling sustainable urban visions (Natalie Rosales)
- iii. Forest water services - modelling exercise in the black forest (Rasoul Yousefpour)
- iv. NFF-Essential Biodiversity Variables (EBV) analyses for conservation post-2020 (HyeJin Kim)
- v. New paths for modelling freshwater nature futures - work in progress (Jan Kuiper)
- vi. Using the NFF as a lens for developing pluralistic land use scenarios for Europe (Peter Verburg, invited speaker)
- vii. Operationalizing the Nature Futures Framework in the High Seas (Laura Pereira, William Cheung).

A detailed summary of the case study presentations and discussions is provided in appendix III. After the case study presentations, participants discussed experiences with the use of the draft NFF in breakout groups.

## **B. Catalysing NFF modelling by the broader scientific community**

An introduction to the way forward was given by Henrique Pereira. The expert group on scenarios and models had developed the NFF in consultation with stakeholders. The NFF had been discussed or applied in several publications and there was evidence of uptake by the scientific community.

The NFF had proven to be useful for understanding how people perceive the future of their landscape and to facilitate discussions on related matters. It had remained challenging to deliver on multiscale scenarios for nature futures across scale, systems and regions. Suggestions for ways forwards were shared in kick-start talks by experts for the communities:

1- Shared-Socioeconomic Pathways community, including modelling of indirect and direct drivers:

- 1a: SSP/RCP climate change scenarios framework (Brian O’Neill, invited speaker)
- 1b: From shared socio-economic to sustainable development pathways (Alexander Popp)
- 1c: General thoughts (Paula Harrison and Kasper Kok)

2- Large-scale biodiversity and ecosystem service modelers:

- 2a: Linking ecosystem services, land use change and general equilibrium economics at the global scale (Justin Johnson)
- 2b: Biodiversity scenario modelling & the NFF (Carlo Rondinini)
- 2c: Fish-MIP model & Scenarios (Derek Tittensor)

3- Local-level scenario modeling:

- 3a: Biosphere futures (Garry Peterson)
- 3b: Applications of the Urban Nature Future Framework (Perrine Hamel, invited speaker)

Details of the talks are provided in appendix IV.

The kick-start talks served as inspiration for further discussions in breakout groups on the transition to increased NFF modelling by the broader scientific community. The following points were highlighted by the breakout groups (Table):

Breakout group	Group 1- Coupling NFF and SSPs	Group 2- Large scale biodiversity / ecosystems	Group 3- Local scale scenarios
<p><b>What does success look like and what are the challenges?</b></p>	<ul style="list-style-type: none"> <li>- Negative SSPs should not be discarded: there is added value in disruptive scenarios. SSPs could be used as context scenario with obstacles that need to be overcome in order to reach desirable futures</li> <li>- The SSPs most beneficial for nature could be used and feedbacks from drivers to ecosystems build in.</li> <li>- Coupling NFF and SSPs would require a mind shift in transformative scenarios and would result in a significantly different framework</li> <li>- Considering climate and biodiversity together will allow addressing synergies and trade-offs</li> <li>- The NFF is supporting diversity and allows for both mapping existing scenarios to the NFF and building new scenarios with stakeholders</li> <li>- The SSP and RCP frameworks were developed as a matrix. One way of merging these frameworks with NFF would be to start with the SSP 1.9 or SSP 2.6 scenario baseline and move towards the NFF. In a next step, the NFF could be mapped on the matrix and the climate policy axis be replaced with biodiversity. Similarly to climate scenarios, changes in lifestyle and technology result in different scenarios for biodiversity and ecosystem services.</li> <li>- Degrowth (shrinking rather than growing economies) and non-economic options should also be considered for positive futures.</li> <li>- Scenario names such as ‘regional rivalry’ or ‘fossil fuel development’ should be changed, as the characteristics of these narratives have a great impact on public perception and policy discussions.</li> <li>- The NFF makes more sense and would result in more positive scenarios for local applications</li> <li>- New models are required to develop <i>transformative</i> scenarios.</li> </ul>	<ul style="list-style-type: none"> <li>- Providing comprehensive and concrete guidelines and tools to model NFF scenarios is a challenge. For example, the identification and quantification of indicators for multi-scale modelling (global-local scales) and for participatory-quantitative modelling is difficult.</li> <li>- Multi-scale/cross-sectorial Nature Future scenarios could be developed in an integrated way in time for the next IPBES global assessment</li> <li>- Current modelling barriers and constraints affect, for example, modelling ‘nature as culture’</li> <li>- A community of collaborations between different modelling and scenarios communities would be welcomed; e.g., SSP and NFF.</li> <li>- More initiatives engaging with policymakers to support uptake of NFF scenarios would be welcomed, for example the preparation of policy briefs</li> </ul>	<ul style="list-style-type: none"> <li>- There is a lack of models and theories to model some of the NFF perspectives, e.g., ‘nature for nature’ (NN) and particularly ‘nature as culture’ (NC). There are issues at all scales.</li> <li>- At the local scale there is a diversity of approaches used, often by practitioners. However, these are often not published.</li> <li>- It is a challenge to upscale small transformative changes at local scale, or determine ‘how much’ change is required to make a difference and how such a ‘substantive’ change could be modelled.</li> </ul>

Breakout group	Group 1- Coupling NFF and SSPs	Group 2- Large scale biodiversity / ecosystems	Group 3- Local scale scenarios
<b>How can this be achieved?</b>	<ul style="list-style-type: none"> <li>- The Scenarios Forum can provide an opportunity for discussion with the SSP community/ICONICS. Relevant considerations include:               <ul style="list-style-type: none"> <li>o ICONICS is broadening up, both in terms of methodology and the scientific community.</li> <li>o The window of opportunity for revising the SSP narratives is closing soon after the Scenarios Forum.</li> <li>o The biodiversity community can provide SSP variants and engage with ICONICS, engage in revising the SSPs, or provide biodiversity policies for the SPA, similarly to climate policies.</li> </ul> </li> <li>- Related to the IPBES transformative change and nexus assessments:               <ul style="list-style-type: none"> <li>o Organize a workshop with a diverse group of people to attempt the coupling and mapping of the NFF and SSP in practice.</li> <li>o Subsequently, a perspective or review paper could be prepared on this exercise, explaining what worked and what didn't work, mapping existing scenarios.</li> <li>o A few illustrative SSP/NFF examples could be developed, which experts could take forward.</li> </ul> </li> <li>- Consider multiple pathways with combinations of different socioeconomic scenarios</li> <li>- Related to the major changes to the SSP framework: Mitigation and adaptation could be replaced with more generic concepts (reactive, proactive)</li> </ul>	<ul style="list-style-type: none"> <li>- Existing studies/projects could be encouraged and leveraged to apply the NFF and develop ways to overcome challenges to modelling the NFF.</li> <li>- Existing modelling approaches could be used in the short-term to start addressing immediate challenges and building momentum; for example the Biodiversity and Ecosystem Services Scenarios-based Model Intercomparison (BES-SIM).</li> <li>- Approaches tailored to the NFF could be used for comprehensive applications in the long-term.</li> <li>- A website or informal portal on case studies and projects could be developed to share experiences.</li> <li>- Communicating of NFF findings/experiences to provide seed for further development</li> <li>- Explore funding and expanding collaborations</li> </ul>	<ul style="list-style-type: none"> <li>- Promote a better understanding of the different perspectives and nature values of the NFF.</li> <li>- Promote a better understanding of the different possible ways of living with nature</li> <li>- Develop NFF case studies and use cases as exemplars.</li> <li>- Share toolboxes, open-source datasets and databases to support a community of practice around the NFF.</li> <li>- Use databases to identify gaps in existing communities of practice and clarify who is or could be using scenarios and where could the NFF approach benefit the identification of transformative pathways?</li> <li>- New indicators could be developed and existing indicators used, including Essential Ecosystem Service Variables (EESVs) or Essential Biodiversity Variables (EBVs)</li> </ul>
<b>Key players to be involved</b>	<ul style="list-style-type: none"> <li>- IPBES scenarios and models task force</li> <li>- The ICONICS/Scenarios Forum</li> <li>- IPBES transformative change and nexus assessments</li> </ul>	<ul style="list-style-type: none"> <li>- The Biodiversity and Ecosystem Services Scenarios-based Model Intercomparison (BES SIM) modelling teams</li> </ul>	<ul style="list-style-type: none"> <li>- Actors in urban settings, e.g., urban planners;</li> <li>- Actors involved in local-scale environmental governance, e.g., Local Governments for Sustainability (ICLEI);</li> <li>- ILK communities;</li> </ul>

<b>Breakout group</b>	<b>Group 1- Coupling NFF and SSPs</b>	<b>Group 2- Large scale biodiversity / ecosystems</b>	<b>Group 3- Local scale scenarios</b>
			<ul style="list-style-type: none"><li>- Actors involved in local case studies related to rural environments and the ocean;</li><li>- Global Land Programme (GLP)</li><li>- The Group on Earth Observations Biodiversity (GEO BON);</li><li>- Archeological/anthropological key players to consider changes over time in human communities.</li></ul>



## IV. Next steps

The workshop showed the significant efforts that were undertaken in the development of the NFF. Examples for the use of the draft NFF in exploring multiple values that people place on nature and for developing new scenarios for the future of nature were shared. Participants expressed the importance of their continued support to this work and acknowledged sufficient interest from the relevant scientific communities. A strategy was discussed to increase the modelling work based on the NFF by the broader scientific community, with next steps to engage key modelling communities.

The workshop participants identified the following relevant follow-up activities:

- **IPBES scenarios and models task force, ongoing activity**  
Catalysing modelling efforts to operationalise the NFF (continued)
- **Develop website to share examples and projects** as starting point to coordinate community engagement
- **Participate in Forum on Scenarios for Climate and Societal Futures, 20-22 June 2022**
  - Good opportunity to interact with the process working on revisions of the SSPs. The programme includes relevant parallel sessions related to climate and biodiversity scenarios and plenary sessions on ways forward in catalysing the communities around both biodiversity and climate scenarios. Hence participation in the Forum is a good opportunity for changing the SSP framework and linking to NFF.
  - Plenary presentation on scenarios for IPBES assessments
  - Sessions on biodiversity/ecological scenarios and modelling, including “Catalysing climate and biodiversity coupled scenarios for assessments and policy”
- **Participate in World Biodiversity Forum, 26 June – 1 July 2022**
  - Plenary presentation on the draft Nature Futures Framework to broader community
  - Sessions on ‘Challenges and opportunities for using the IPBES Nature Futures Framework for scenarios and modelling’
- **Organize an in-person workshop** at the end of 2022  
Depending on the results of the Scenarios Forum and the World Biodiversity Forum, potentially an in-person workshop could be organized (not by IPBES) towards the end of 2022 which would bring together communities outside the context of IPBES.
- **Contribute to Special Issue**  
A Special Issue in Sustainability Science will be published on applications using the NFF. Papers are welcomed (extended deadline) and interested authors were invited to contact Carolyn Lundquist directly. Link to the special issue: <https://link.springer.com/article/10.1007/s11625-021-01014-w>

## V. Closing session

Closing remarks were given by Carolyn Lundquist on behalf of the co-chairs of the task force on scenarios and models. The co-chairs thanked all participants for an inspiring meeting and for their constructive input and look forward to continuing working together.

## Acknowledgement

The organizing team for the workshop is kindly acknowledged for their efforts in preparing the workshop: Henrique Pereira, Brian Miller, Paula Harrison, William Cheung, Mary Gasalla and Shizuka Hashimoto.

## Appendix I - Agenda

### Agenda overview

Date	Monday 25 April (Day 1)	Thursday 28 April (Day 2)
Time	15:00-18:30 CEST	20:00-23:30 CEST
Topic	Share experiences on the use of NFF, identify successes and challenges	Increase NFF modelling by the broader scientific community; define next steps

### Day 1 – Monday 25 April 2022, 15:00 – 18:30 CEST

Time (minutes)	Agenda item
Objectives of day 1:	
<ul style="list-style-type: none"> <li>• Share experiences on the use of the Nature Future Framework (NFF)</li> <li>• Reflect on successes and challenges towards improving the operationalization of the NFF</li> </ul>	
10 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Welcome</li> <li>• Objectives of the workshop and agenda</li> <li>• Poll</li> </ul>
10 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Recap of the work performed by the task force since 1<sup>st</sup> modelling workshop (co-chairs)</li> </ul>
90 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Case studies presentations and pitches</li> <li>• Q&amp;A</li> </ul>
20 min	<b>Break</b>
50 min	<b>Breakout groups</b> <ul style="list-style-type: none"> <li>• Further methodological steps and collaborations to advance NFF modelling</li> </ul>
25 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Collection of feedback from each breakout group</li> </ul>
5 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Wrap-up of day 1 and closing</li> </ul>

**Day 2 – Thursday 28 April 2022, 20:00 – 23:30 CEST**

<b>Time (minutes)</b>	<b>Agenda item</b>
Objectives of day 2:	
<ul style="list-style-type: none"> <li>• Define a strategy to increase modelling work based on the NFF by the broader scientific community</li> <li>• Explore the next steps for doing so, including a plan on how to engage key modelling communities</li> </ul>	
10 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Presentation by the task force on the need to increase modelling work based on the NFF modelling</li> </ul>
60 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Kick start talks: How can the communities get involved with the NFF?               <ol style="list-style-type: none"> <li>1) SSP communities / indirect and direct drivers modelling</li> <li>2) Large scale biodiversity and ecosystem service modelling</li> <li>3) Local level scenario modelling</li> </ol> </li> <li>• Discussion</li> </ul>
50 min	<b>Breakout groups</b> <ul style="list-style-type: none"> <li>• Increase modelling work based on the NFF by the broader scientific community</li> </ul>
30 min	<b>Break</b>
25 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Collection of feedback from each breakout group</li> <li>• Discussion</li> </ul>
30 min	<b>Plenary</b> <ul style="list-style-type: none"> <li>• Discuss and agree on next steps</li> <li>• Wrap-up</li> </ul>
5 min	<b>Closing</b> statements by co-chairs

## Appendix II - List of participants

<b>NOMINATED PARTICIPANTS</b>	
<b>Name</b>	<b>Affiliation</b>
<b>Akçakaya, Resit</b>	Stonybrook University, Turkey
<b>Akinyemi, Felicia Olufunmilayo</b>	University of Bern, Switzerland
<b>Ausseil, Anne-Gaelle</b>	Manaaki Whenua Landcare Research, New Zealand
<b>Balkovic, Juraj</b>	International Institute for Applied Systems Analysis, Austria
<b>Bundy, Alida (apologies)</b>	Fisheries and Oceans, Canada
<b>Calamari, Noelia</b>	National Institute of Agriculture Technology, Argentina
<b>Castro Diaz, Ricardo</b>	Universidad Federal do Rio Grande, Colombia
<b>Garcia, Claude</b>	Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), France
<b>Hernández, Gladys</b>	Centro de Investigaciones de la Economía Mundial (CIEM), Cuba
<b>Hui, Cang</b>	Department of Mathematics, Stellenbosch University, South Africa
<b>Janssen, Annette</b>	Wageningen University, the Netherlands
<b>Kok, Kasper</b>	Wageningen University and Research, the Netherlands
<b>Larsen, Morten Andreas</b>	Technical University of Denmark
<b>Liu, Yunhui</b>	Agricultural University, China
<b>Luque, Sandra</b>	Institut National de la Recherche Agronomique, France
<b>Marín, Mauricio</b>	Universidad del Desarrollo, Chile
<b>Maury, Olivier</b>	Institut de recherche pour le développement (IRD), France
<b>Metzger, Jean Paul (apologies)</b>	University of Sao Paulo, Brazil
<b>Oliveira, Bruno</b>	University of São Paulo, Brazil
<b>Pandit, Pranav</b>	University of California One Health Institute, USA
<b>Perez, Natalie</b>	Consejo Nacional de Ciencia y Tecnología (CONACYT), Mexico
<b>Pintar, Valentino</b>	Ministry Economy and Sustainable Development, Croatia
<b>Pulatov, Bakhtiyor</b>	State Committee for Ecology and Environment Protection of the Republic of Uzbekistan
<b>Rashleigh, Brenda</b>	US Environmental Protection Agency, USA
<b>Rising, James</b>	London School of Economics and Political Science (LSE), UK
<b>Rounsevell, Mark</b>	University of Edinburgh, UK
<b>Salako, Gabriel</b>	Kwara State University, Nigeria
<b>Santika, Tr</b>	Natural Resources Institute, University of Greenwich, UK
<b>Schwarz, Nina (apologies)</b>	University of Twente, the Netherlands

<b>Seebens, Hanno</b>	Senckenberg Biodiversity and Climate Research Center, Germany
<b>Shannon, Lynne</b>	University of Cape Town, South Africa
<b>Stehfest, Elke</b>	PBL Netherlands Environmental Assessment Agency, the Netherlands
<b>Visconti, Piero</b>	International Institute of Applied Systems Analysis (IIASA), Austria
<b>Yamakita, Takehisa</b>	Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan
<b>Yousefpour, Rasoul</b>	University of Freiburg, Germany
<b>Yue, TianXiang</b>	Institute of Geographical Sciences and Natural Resources Research, Chinese Academy of Sciences, China

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## RESOURCE PERSONS

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### For integrated assessment models

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<b>Popp, Alexander</b>	Potsdam Institute for Climate Impact Research, Germany
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### For BES-SIM models

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<b>Arneth, Almut</b>	Karlsruhe Institute of Technology, Germany
<b>Ferrier, Simon (apologies)</b>	Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
<b>Guerra, Carlos</b>	Martin Luther University Halle-Wittenberg, Germany
<b>Harfoot, Mike</b>	UNEP World Conservation Monitoring Centre (WCMC)
<b>Hickler, Thomas</b>	Senckenberg Research Institute, Germany
<b>Jetz, Walter</b>	Yale University, USA
<b>Johnson, Justin</b>	University of Minnesota, USA
<b>Leclere, David</b>	International Institute of Applied Systems Analysis (IIASA), Austria
<b>Martins, Ines</b>	University of York, UK
<b>Marques, Alexandra</b>	PBL Netherlands Environmental Assessment Agency, the Netherlands
<b>Purvis, Andy</b>	Natural History Museum, UK
<b>Rondinini, Carlo</b>	Sapienza University of Rome, Italy
<b>Schipper, Aafke (apologies)</b>	PBL Netherlands Environmental Assessment Agency, the Netherlands
<b>Thuiller, Wilfried</b>	Laboratoire d'Ecologie Alpine (LECA), France
<b>Tsuchiya, Kazuaki (replacing Ohashi, Haruka)</b>	National Institute for Environmental Studies, Japan

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## LIAISON EXPERTS

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<b>Chan, Kai (transformative change assessment liaison expert)</b>	University of British Columbia, Canada
<b>Harmackova, Zuzana (values assessment liaison expert)</b>	Global Change Research Institute of the Czech Academy of Sciences

<b>Lenzner, Bernd (Invasive Alien Species assessment liaison expert)</b>	University of Vienna, Austria
<b>Tittensor, Derek (sustainable use assessment liaison expert)</b>	Dalhousie University, Canada

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**MEMBERS OF THE TASK FORCE  
ON SCENARIOS AND MODELS**

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<b>Abbasov, Rovshan (MEP member)</b>	Department of Geography and Environment, Khazar University, Azerbaijan
<b>Acosta-Michlik, Lilibeth</b>	Global Green Growth Institute, Seoul, Republic of Korea
<b>Ahmed, Khaled Allam</b>	Nature Conservation Sector, Ministry of Environment, Egypt
<b>Beard, Douglas (Bureau member)</b>	United States Geological Survey, USA
<b>Bosch Pereira, Laura</b>	Centre for Complex Systems in Transition, Stellenbosch University, South Africa and Stockholm Resilience Centre, Stockholm University, Sweden
<b>Cheung, Wai Lung</b>	Institute for the Oceans and Fisheries, The University of British Columbia, Canada
<b>Denboba, Mekuria Argaw</b>	Addis Ababa University, Ethiopia
<b>Diaw, Mariteuw Chimere (MEP member)</b>	African Model Forests Network (AMFN) Secretariat, Cameroon
<b>Durán, América Paz (fellow)</b>	Instituto de Ecología y Biodiversidad, Santiago, Universidad de Chile
<b>Dutra de Aguiar, Ana Paula (apologies)</b>	Instituto Nacional de Pesquisas Espaciais (INPE), Brazil
<b>Gasalla, Maria</b>	Universidade de Sao Paulo, Brazil
<b>Halouani, Ghassen (fellow)</b>	Galway-Mayo Institute of Technology, IFREMER (Institut Français de Recherche pour l'Exploitation de la Mer), France
<b>Harrison, Paula</b>	Centre for Ecology & Hydrology, UK
<b>Hashimoto, Shizuka (co-chair and MEP member)</b>	University of Tokyo, Japan
<b>Jyothis, Sathyapalan</b>	National Institute of Panchayati Raj, India
<b>Karlsson-Vinkhuyzen, Sylvia</b>	Wageningen University, the Netherlands
<b>Kim, HyeJin (fellow)</b>	German Centre for Integrative Biodiversity Research (iDiv), Germany
<b>Kuiper, Jan (fellow)</b>	Stockholm Resilience Centre, Stockholm University, the Netherlands
<b>Lundquist, Carolyn (co-chair)</b>	National Institute of Water and Atmospheric Research New Zealand, USA
<b>Leadley, Paul</b>	Universite Paris-Sud, France
<b>Miller, Brian (fellow)</b>	United States Geological Survey, USA
<b>Pereira, Henrique</b>	German Centre for Integrative Biodiversity Research (iDiv) Martin Luther University Halle-Wittenberg, Germany

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<b>Peterson, Garry</b>	Stockholm Resilience Centre, Stockholm University, Sweden
<b>Pichs Madruga, Ramon</b>	Centre for World Economy Studies (CIEM), Cuba
<b>Saysel, Ali Kerem</b>	Boğaziçi University Institute of Environmental Sciences, Turkey
<b>Yu, Dandan</b>	Nanjing Institute of Environmental Sciences (NIES), Ministry of Ecology and Environment (MEE) of China
<b>Zambrana Torrelio, Carlos</b>	George Mason University, USA

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*Bonn secretariat*

Larigauderie, Anne	Executive Secretary
Schiele, Simone	Head of work programme

*Technical support unit for scenarios and models*

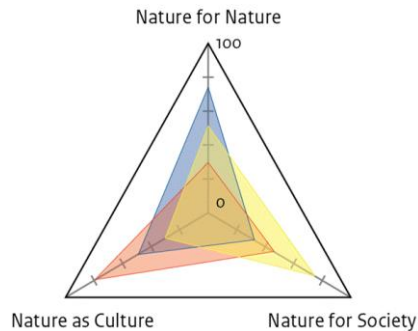
Dankers, Caroline  
Foldesi, Csaba  
Jacobs, Claire  
Lazarova, Tanya  
Nuesink, Nienke  
Schoolenberg, Machteld

## Appendix III - Case study presentations

This appendix provides a summary of the case study presentations and resulting discussions/insights.

### Mapping the SSPs/RCPs onto the Nature Futures Framework at the global scale (Mark Rounsevell)

The presenter showed a preliminary comparison between the existing SSP/RCP framework and the NFF to understand how they were related, specifically regarding tradeoffs. The presenter explained how the SSP scenarios were mapped on the NFF and illustrated how well the SSPs performed in terms of benefits to nature. He added that the triangle used allowed to improve across the three dimensions, with or without trade-offs.



*After Kim et al.*

From the discussion it became clear that this was a better representation than the classic NFF triangle and showed that SSPs related to deterioration across all dimensions. The audience marked this as interesting because it clarified that in reality normative scenarios would need to be developed that improve nature futures with all three perspectives and this was not happening in the current set of scenarios. The audience saw this as a clear demonstration of the need for a new approach that would lead to positive scenarios for nature.

The audience asked if there could be common indicators across the value perspectives, since in this case study the indicators for each value perspective were presented separately. In other words, the question was whether it would be possible to have a comparative framework across the scenarios, not just at the aggregated level but at the specific indicator level. The presenter explained that the indicators were mapped on the NFF dimensions independently, while sometimes the same indicator was used to represent different dimensions. Thus different indicators could play a role in different dimensions. He added that the model itself would internalize many of the relationships of individual indicators and they would not be derived or calculated independently from one another.

A discussion was held on the tensions between trade-offs and that they could be critical. One of the participants highlighted that having 3 dimensions dependent on one another would allow representation of benefits in all three dimensions as well as trade-offs, and this was an important outcome of the case study.

### Modelling sustainable urban visions (Natalie Rosales)

The presenter shared her experiences with the use of the NFF for modelling sustainable urban visions. She explained that the main opportunities identified for the use in urban planning were the fact that NFF perspectives are interrelated (values could be translated into incremental interventions for conserving urban biodiversity at multiple scales), and that it could be used to create scenarios based on positive visions of nature and set national/local policy objectives to shape promising and sustainable urban futures.

### Forest water services - modelling exercise in the Black Forest (Rasoul Yousefpour)

The presenter demonstrated a study where a hybrid forest model and the NFF were used to assess how the thinning interval of forests would influence the water yield. He explained that what worked well in the use of the NFF, was setting goals (a combination of NFFs) and finding pathways. One of the bottlenecks identified by the presenter in applying the NFF was the issue that pathways change direction under climate change scenarios (RCPs).



NFF-EBV Analyses for conservation post-2020 (HyeJin Kim)

The presenter introduced a case study which looked at how global biodiversity frameworks worked together to move conservation actions forward in land protection. She explained that the NFF protection regimes were used in an analytical framework, having applied an earlier version of the draft post-2020 global biodiversity framework, which was still under revision. The presenter explained that the results so far showed the importance of regular evaluation of protected areas on their status and trends using a broader range of indicators beyond the area of measure, and optimizing the use of models and observation data. She added that this would suggest an integrative assessment on diverse roles, values and benefits of nature in implementing the post-2020 global biodiversity framework with the potential use of the NFF.

New paths for modelling freshwater nature futures - work in progress (Jan Kuiper)

The presenter stated that freshwater biodiversity was very rich but also threatened. It was also underrepresented in global environmental assessments, especially in forward-looking scenarios and models. The presenter highlighted that the NFF was a valuable opportunity here, but more actionable knowledge would be needed on how to use it. He mentioned that a conceptual paper was in progress where some concepts were listed for the three values perspectives. An integrated approach would be envisaged to develop scenarios and quantifying them. Indicators were being looked into, and how to quantify values for these indicators. The presenter concluded that the GLOBIO aquatic model was relevant here and would be a good basis to start from.

Using the NFF as a lens for developing pluralistic land use scenarios for Europe (Peter Verburg, invited speaker)

The invited speaker presented a case where the NFF framework was used to elaborate different ways of implementing the Green Deal targets. These targets were difficult to integrate in the SSP framework, and the NFF was used to decide on how the policy targets could be implemented. Policy targets like the expansion of protected areas, restoration, and planting trees were implemented by translating the NFF-perspectives to spatial rules in the model. The targets pushed for similar EU-wide trends, regardless of the NFF scenario, yet their spatial dimensions differed. A novel combination of scenario types was made, where:

- the SSPs were used for broad societal and economic trends; and
- NFF was used as a 'normative framing' for implementation of broad policy targets.

Results presented by the speaker showed that the Green Deal targets could turn out differently in the future for different areas of Europe, depending on the way the normative framework was used for implementing these. He hoped that this research would lead to more discussion on the ways in which these targets are implemented, not just on their development.

A discussion was held on how spatial allocation rules and thresholds were derived. The speaker explained that each policy target was implemented in a different way. With regard to the 3-million-trees target, this was based on historical evidence where reforestation is likely to be successful. The speaker clarified that it would depend on the rules that would be set. For instance, for urban areas, peri-urbanization was expanding rapidly. So in the 'nature for nature' perspective, the current trends were tweaked towards compact urbanization. But there was uncertainty in the associated implications, and a participatory process would enable further refinement. The speaker added that the aim of the study was not prediction, or the development of exact models but rather showing alternative ways of visioning implementation and how they could affect landscapes and nature's contributions to people.

The audience concluded that the study demonstrated exactly why the NFF was developed, i.e., to show that there are multiple ways of reaching the same overall environmental goals. Implementing those goals for the 3 value perspectives would lead to different spatial allocations. This plurality of approaches for a better future for nature was one of the key goals of the NFF. Another goal was to show that representation and improvement of biodiversity and ecosystem services can be improved compared to the current SSPs. The SSPs were not sufficiently positive for nature. The speaker concluded that a next step for analysis would be to evaluate if the different scenarios deliver what is hoped for, in order to draw conclusions for better policy implementation.

Operationalizing the Nature Futures Framework in the High Seas (Laura Pereira)

The presenter introduced a series of 7 workshops on participatory scenarios to address the lack of available information. In these workshops, challenges were discussed for the High Seas, including pathways, key interventions needed and brainstorming on possible scenarios. A range of participatory approaches were used (surveys, storytelling, interviews, etc.). The outputs of the participatory scenarios were stories and artistic representations of the High Seas NFF futures and pathways. She also noted that scientific papers were in progress. Each of the three NFF scenarios were used to identify important indicators (environmental, societal, political) and models relevant for monitoring, modeling and/or informing decision-making. A next step would be modelling, for which two project ideas were developed. The presenter highlighted that some of the social constructions of boundaries taken for granted in governance systems could be reconsidered in the NFF scenario development framework, and that arbitrary boundaries might lose relevance in the future.

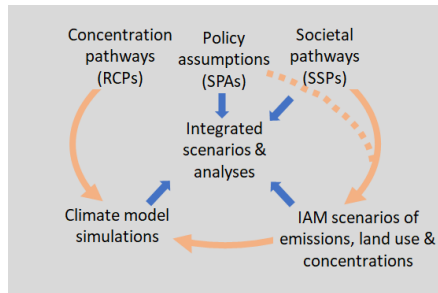
## Appendix IV – Kick-start talks for communities of practice

This appendix provides a summary of suggestions for ways forward shared in the kick-start talks by experts for the three communities.

### 1- Shared Socioeconomic Pathways community, including modelling of indirect and direct drivers

#### 1a- SSP/RCP climate change scenarios framework (Brian O’Neill, invited speaker)

The invited speaker presented the SSP-RCP climate change scenarios framework, including the linkages and potential opportunities for the NFF to intersect with the climate change scenario framework.



The SSPs, the narratives and the quantitative elements fed into the integrated assessment model (IAM) scenarios to produce projections of future land use and emissions. A review done in 2019 on the use of the SSPs showed that they are used quite a lot in IPCC and IPBES processes (about 400 papers published, most climate impact-related). The framework would be open to new ideas. The speaker identified some issues to be further developed and possibly relevant for IPBES, being:

- Extensions to the framework: Further work in income distribution, spatial vulnerability, determinants of biodiversity
- Additional “reference” scenarios: Impacts and/or policy in the reference scenario, Example: IPBES scenarios built on SSP-RCP-ISIMIP
- Adding or removing scenarios, questions such as: High scenario too high, No “degrowth” scenario, Variants of existing scenarios, New Shared Policy Assumptions
- Scenarios of outcomes
- Coupled Model Intercomparison Project CMIP7 and the role of climate model emulation.

A discussion was held on the possibility of creating a version of SSP1 that would be more positive. The speaker explained that in theory an SSP1 variant could be created that would be more positive for biodiversity in the way(s) desired. In practice, how to do it would depend on what would need to be changed or added. If a different climate future was needed, then new RCPs could be generated. If new socioeconomic conditions should be focused on, then a new SSP or variant of an existing SSP could be added. If new policies are most important, then adding a biodiversity-oriented SPA (Shared Policy Assumption) could be included. At the time, it was a conscious decision to make the SSP pathways about climate change (not to make them broader). To move towards broadening them, the community was open to concrete ideas regarding what a new scenario would be like.

The speaker added that the new set of scenarios was still in the conceptualization stage, but that a simple update of the quantitative elements in the SSPs – updated trajectories for population growth, Gross Domestic Product (GDP), etc., was underway. Drafts of those would be presented for feedback at the Scenarios Forum. Whether and how IAMs would then update their runs, and on what time frame, would be discussed there. Updates to narratives, adding new SSPs, etc., would be longer term projects due to the time they take.

#### 1b- From shared socio-economic to sustainable development pathways (Alexander Popp)

The presenter started by mentioning that the possibility of reaching an even better world than the SSP1, representing a sustainability pathway, was highly debated. It would be important for IPBES and the biodiversity world, to also know the consequences for human wellbeing, especially for using the Nature Futures Framework (NFF). In practice, land interacts with most Sustainable Development Goals (SDGs) but most SSP applications were only focused on climate.

The context of sustainable development was broader than only climate, also being about interactions. The presenter shared some thoughts on what is needed from the NFF. In his view, a broad perspective, not just only focused on climate or biodiversity but also on the human perspective, would be needed. A study was done in 2021 as a starting point to assess what the sustainable development pathway was for climate action, but within the UN 2030 SDG agenda. The presenter finally added that models could be improved, but that what would be needed was an uncertainty analysis of input ‘in the best way’ to biodiversity ecosystem service models, or as an in-depth assessment framework that had the option to feed back the outcomes of ecosystem services biodiversity to the level of human wellbeing.

#### 1c- Comments by Paula Harrison and Kasper Kok

Two speakers commented on the complementarity between the RCP/SSP framework and the NFF, and they mentioned that:

- Firstly, if the NFF was used in an exploratory way within the SSP framework, would it then be a variant of SSP1 or a whole new scenario?
- Secondly, the NFF could be used within the SSP1 (as shown in the Green Deal case study by presenter Peter Verburg). This provided the context and quantitative indicators on some socio-economic indicators like GDP. But within this context, the NFF was used to explore normative policy goals / the European Green Deal. Looking at the three axes of the NFF, the question would be how that would play out at biodiversity and ecosystem services future in Europe.
- Thirdly, regarded more from the NFF angle: Implicit in desirable futures for biodiversity was that they are also low climate change or climate-neutral futures. One could start from here to work together as a community to develop pathways of actions that are both relevant to climate policy and biodiversity policy. Some of the trade-offs and synergies between them could be taken into account, which would allow to compare across the pathways. Instead of starting those pathways in current conditions, one could stress those pathways using some of the more negative scenarios from the SSPs framework. For example, to assess if it possible to move in a pathway through a desirable future if we are moving from an SSP3 world.
- Something that had not been covered yet is the non-global SSP-community. A follow-up on the global SSP review was ongoing with focus on regional applications, about 200 of them. There are all kinds of sectors coming in that had nothing to do with climate but would be excellent extensions of the SSPs, and part of that was biodiversity related. There was a lot under the radar of the global initiatives that should be looked into. Part of it will be done at the Scenarios Forum, and part of it is still ongoing research. Another issue was that if you do local-level modelling of SSPs, they would be normative scenarios as well. A question would be how you could actually combine normative scenarios and explorative scenarios in one framework. There was a lot to be learned from the methodological aspects of where the SSPs had been applied at local level.

## **2- Large scale biodiversity and ecosystem service modelers**

### 2a- Linking ecosystem services, land use changes and general equilibrium economics at the global scale (Justin Johnson)

It was explained by the presenter that there was growing consensus that sustainability required considering the entire bio-ecosystem. There was a need to understand how the economy affects the biosphere but also how the environment affected the economy. The point that the economy was embedded in the biosphere could be missed here. This had been worked on in the past 5 years, connecting the economy to the environment with two models (GTAP-InVEST), to calculate how changes in six ecosystem services were affected by the economy but also affected the economy itself.

The presenter indicated as possible direction to go for NFF: Challenges were faced finding ‘good’ scenarios. Even the most sustainable SSP1 had significant macroeconomic losses from damaged ecosystem services. The next step would be how to use the NFF to identify our specific scenarios, create better scenarios and use these in the model presented here.

### 2b -Biodiversity scenario modelling & the NFF (Carlo Rondinini)

The presenter raised the question how NFF could interact with large scale biodiversity scenario modelling. The classic approaches to biodiversity modelling was the global pathways of socioeconomic development. The INSIGHTS model had been developed to detect trends. The main challenges for moving from the classical approach to NFF identified by the presenter were:

- How to translate NFF desirable future to quantitative target for biodiversity indicator to amount of pressure (driver);
- Additional issues with climate: Complex relationships with species;
- Another challenge was two-way coupling. The NFF impact on the biodiversity outcomes was expected but also on the provision of ecosystem service. Any endpoint of the NFF had an impact on the land clearing in the SSP scenarios.

### 2c- Fish-MIP model & Scenarios (Derek Tittensor)

The Fish-MIP model was introduced by the presenter. The model aimed to generate ensemble projections for marine ecosystems. Fish-MIP tied together a lot of ecosystem models. Marine ecosystem models had different conceptions on how marine ecosystems work, there is no common theoretical basis. It was quite challenging to compare them, nevertheless biomass changes under the different RCP scenarios had been compared. The models were being forced using RCPs, so climate impacts on species were known. But in the ocean, fishing and fisheries was a big driver. So, scenarios about other marine stresses would be needed to play out into the future. The presenter explained that to link the scenarios to the NFF was not straightforward. An idea was to map the oceanic system pathways OSP+ scenarios to the NFF triangle. This required likely additional specification (there are no cultural aspects right now) but this might be feasible.

In the OSP+ scenarios diet changes could be accounted for. Diet changes were important - and could make a nice link to the NFF. Diet was also very important in terms of marine/terrestrial trade-offs for food supply vs. ecosystem impacts.

For the OSP+, perhaps also feedbacks from fish stock to fleet dynamics could be considered, and to market. These feedbacks would propagate in these frameworks in some (though likely not all) ecosystem models (i.e., ecological change → less desirable for fishing → changes and redistribution of fleet dynamics and market impacts).

Other questions looked at in the study were if spatial changes of fish stock would be faster than expected. Or if the variance or speed of change could be considered to compare to adaptability of human society including cultural aspect of food. There were processes underway in Canada, that looked at the vulnerability of individual fishing communities to spatial changes in fish stocks (e.g., challenges involved with maybe needing to spend more on fuel as target species move). The presenter concluded that this would be an area that needs more exploration.

## **3-Local level scenario modeling**

### 3a- Biosphere futures (Garry Peterson)

The presenter mentioned that regarding socio-ecological futures, the research on local socio-ecological scenarios was growing, but the community was fragmented. Almost none of these used SSPs and they used scenarios for different reasons.

A website and database (<https://www.biospherefutures.net/>) had been prepared to serve a Community of Practice to share knowledge and experience, now getting a global mix of scenarios (currently 70 scenario case studies). It aimed to support IPBES assessments and tried to enable access to tools. The database could be searched to explore cases. This was a first round of the database and it aimed to further build the Community of Practice. The presenter invited people to contribute with their work.

### 3b- Applications of the Urban Nature Future Framework (Perrine Hamel, invited speaker, NanYang Technological University)

The invited speaker shared two examples where the NFF had been used:

- A first example was about analyzing values promoted by serious games (simulation tools for the environment). A number of 62 games had been reviewed that were relevant for nature-based solutions and urban planning. NFF had been used to assess the values. The ‘nature for society’ values appeared to be predominant.
- A second example showed an analysis of values embedded in urban futures in Indonesia, looking at new cities and at the future visions they embedded. NFF had been used to see what types of futures were promoted. Some thoughts on the urban NFF were shared by the speaker:

NFF appeared a useful communication tool and for education, with a lot of potential. In practice, there was an implementation gap (not used with stakeholders yet). To address this, socializing (blog posts) and/or a hackathon style event to catalyse the use of the framework, or an award (success projects) could be a nice way to promote the idea. The speaker concluded that for example the Local Governments for Sustainability (ICLEI) or IUCN and a consortium of research labs could potentially lead these efforts.