

Biosphere Reserves Institute, University for Sustainable Development Eberswalde

Science and Research in, for and with UNESCO Biosphere Reserves

Conference Proceedings

16–20 May, 2022, Schorfheide-Chorin Biosphere Reserve, Germany



SCIENCE AND RESEARCH IN, FOR, AND WITH UNESCO BIOSPHERE RESERVES

Conference proceedings, including the Eberswalde Declaration

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This abstract interpretation of a Biosphere Reserve was created during the conference at a workshop held by artist Ilona Kálnoky.

Opening Remarks

Shamila Nair-Bedouelle
Assistant Director General for Natural Sciences, UNESCO

»Ladies and gentlemen,

For the past 50 years, UNESCO's Man and the Biosphere (MAB) programme has sought to reconcile human beings with nature through its network of Biosphere Reserves. Today, these number 727 in 131 countries. Some 22 of these are transboundary. Last year, we even reached a milestone with the creation of the first Biosphere Reserve spanning five countries. This is the Mura-Drava-Danube Biosphere Reserve, which is shared by Austria, Croatia, Hungary, Serbia, and Slovenia and spans almost 1 million hectares. The Lima Action Plan highlights the extent to which opportunities for research and training contribute to the smooth running of Biosphere Reserves. This conference will be essential to shed light on what this research has achieved and to guide future pathways for UNESCO Biosphere Reserves. May I wish you all a stimulating conference, and I look forward to working with all of you.«



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Bettina Hoffmann
State Secretary, Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

»Dear participants of the conference,

I would like to warmly welcome all of you. A special welcome from Germany to the international guests from around the world. Welcome to the Schorfheide-Chorin Biosphere Reserve. It is a special place. Of the 16 UNESCO Biosphere Reserves in Germany, it is one of the three oldest. There is a wealth of experience here, which can surely also benefit and provide inspiration for this very important UNESCO event. I am delighted that over 100 researchers from more than 40 countries have gathered here to discuss current issues relating to the UNESCO programme Man and the Biosphere – the MAB programme for short. My particular thanks go to the Eberswalde University for Sustainable Development and its Biosphere Reserves Institute for the excellent work organising this international conference. The outcomes will certainly be successful and far-reaching and lead to further innovations in the MAB programme. I wish you every success and good results.«



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Stefan Lütkes
Chairman of the German MAB Committee

»Dear participants of the conference,

On behalf of the German MAB National Committee, I would like to thank you all for your participation and for your contributions. This international research conference – I have to mention this – was held for the last time in 2011 in Dresden under the motto 'For life, for the Future – Biosphere Reserves and Climate Change'. Today, after more than ten years, we can build on the results achieved back then and move forward. The aim of our event here is to even better bundle the resources of climate protection and nature conservation and to jointly develop strategies to counter global warming and the loss of animal and plant species and their habitats even more effectively. Let me say that I am particularly pleased that this extremely important research conference can take place here in a UNESCO-recognised Biosphere Reserve. This is not only inspiring and motivating, but will definitely lead to new and goal-oriented results and also to further innovations in the MAB programme of UNESCO! I wish you all a successful conference.«



© Stefan Lütkes



Manja Schüle
Minister, Brandenburg Ministry of Science, Research and Culture

»Dear conference participants,

The Biosphere Reserves Institute (BRI) of the Eberswalde University for Sustainable Development (HNEE) was founded in 2019. Within a short time, BRI has made a name for itself among Biosphere Reserves regionally as well as nationally and internationally as a high-profile research institution and think tank. This project exemplifies the role of Brandenburg universities as important drivers of innovation in research, teaching, and [knowledge] transfer, and it underlines the HNEE's distinctive profile and special focus on sustainability transformation, which is crucial for all of us. With the application for recognition of BRI as a UNESCO partner institute, the HNEE has taken another significant step towards top-level renown. The BRI is funded by the Future Programme of the Universities of Applied Sciences in Brandenburg, which was launched by my ministry in 2018 and which also paved the way for this conference. I am thrilled to see young researchers from so many countries coming together to share research findings, views, and experiences. Therefore, I have gladly accepted the HNEE's request to be the patron of this conference. I wish you all a very pleasant stay in Brandenburg and a successful and delightful conference!«



© Karoline Wolf

Axel Vogel
Minister, Brandenburg Ministry of Agriculture, Environment and Climate Protection

»Dear conference participants,

With [its] three UNESCO Biosphere Reserves, Brandenburg has long been a member of the large [worldwide] family of Biosphere Reserves. The three Biosphere Reserves are part of the system of 15 large natural landscapes of Brandenburg, which also includes 11 nature parks and the Lower Oder Valley National Park. In Schorfheide-Chorin, in the Spree Forest, and in the Elbe Brandenburg River Landscape, ideas are being tested and projects implemented to promote the sustainable and climate-friendly coexistence of people and nature now and for the future. During the conference, it will be very exciting to hear how you have initiated developments in your Biosphere Reserves, how you are tackling problems, and, in general, what ideas you are using to bring the Biosphere Reserves' mission statement 'Man and the Biosphere' to life. Conversely, I hope that you will take away one or two suggestions from us in Brandenburg. With this in mind, I wish you a successful conference and a fruitful exchange of ideas.«



© Kristin Baument



»» *I truly believe
in what we call
‘open science’.*



Introduction

Historical background

Since its establishment in 1971, UNESCO's Man and the Biosphere (MAB) programme has placed strong emphasis on problem-oriented research. During its first two decades, the programme's primary focus was on research organised around 14 thematic "project areas", some of which involved particular environments (e.g. various types of forests, islands, and mountains), whereas others involved interactions between people and their environments (e.g. the impacts of agrichemicals and pollution, major engineering projects, and urban areas). Within each project area, field projects were organised in countries around the world. Research covered the themes identified for each project area, with training and capacity-building being major components, especially in developing countries. By 1982, the MAB programme had become a large intergovernmental science programme that included 1,030 field projects in 79 countries and that involved over 10,000 researchers (UNESCO, 1983).

From the beginning of the programme, a further activity involved developing a framework for comparable sites for international, problem-oriented research in representative ecosystems with different levels of human impact – namely Biosphere Reserves (BRs). The activities that were intended to be carried out in these sites included research, biodiversity conservation, monitoring, education, and training (UNESCO, 1974). The first BRs were designated in 1976. Some were used for field projects within the MAB programme's project areas, but many were not. Often, these BRs were more or less the "favourite" research sites among scientists involved in national MAB Committees. The first International BR Congress was organised in Minsk (formerly USSR; now Belarus) in 1983.

By the 1990s, the project areas had been disbanded, thereby leaving the network of BRs as the central component of the MAB programme. Most BRs were only – or primarily – sites for biodiversity conservation despite the emergence of the concept of sustainable development in the 1980s and its implicit inclusion in strategic documents related to BRs. Research did take place in many BRs, but primarily in the natural sciences, with research in the social sciences or of an interdisciplinary nature being less common. The international coordination of research or learning activities across BRs was limited even though these activities had always been recognised as a cornerstone of the programme.

Only with the emergence of the Statutory Framework for the World Network of BRs (WNBR) at the International Conference on BRs in Seville in 1996 did the gradual transformation of BRs into true "sites of excellence to explore and demonstrate approaches to conservation

and development on a regional scale" (UNESCO, 1996: 16) begin (Reed and Price, 2019). One of the three functions of BRs that this document defined was "logistic support – support for demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development" (UNESCO, 1996: 16). Nevertheless, the international co-ordination of research or learning across BRs has generally remained limited, though there have been exceptions. The MAB website does not mention research as such but states that the WNBR "promotes North–South and South–South collaboration and represents a unique tool for international cooperation through sharing knowledge, exchanging experiences, building capacity and promoting best practices" (<https://en.unesco.org/biosphere/wnbr>).

The Statutory Framework remains the WNBR's foundational document. Since the Seville conference, there have been two global congresses on BRs: one in Madrid in 2008 and one in Lima in 2016. Both of these congresses produced an action plan for the WNBR (UNESCO, 2008, 2016). The conference in Eberswalde in May 2022 served as a response to specific calls in the Lima Action Plan (LAP) to contribute both to the implementation of research-related goals and to the achievement of the UN Sustainable Development Goals (SDGs).

Context for the conference

As of June 2022, the WNBR comprises 738 BRs in 134 countries. Being recognised as a site of excellence – or model region – for sustainable development implies that a BR should develop in line with the SDGs, including those relating to responsible consumption and production, sustainable cities and communities, climate action, and diverse life both on land and below water. The achievement of these goals requires dedicated and transformation-oriented research, the targeted use of scientific results, and – in this regard – information exchange between BRs. Accordingly, the LAP includes a number of actions relating to research in individual BRs (Actions 1.4 and 1.6 as well as five actions under Outcome A4) and calls for establishing an adequate research infrastructure. Outcome B7, for example, foresees "an active and open interdisciplinary network of scientists sharing the Man and the Biosphere (MAB) vision and mission". This outcome is to be achieved by "an international network of scientists, working in and with BRs" (Action B7.1) and by "a joint research and knowledge agenda" (Action B7.2) for this international network. In addition, Action B4.1



calls for “opportunities for collaborative research, implementation and monitoring in regional and thematic networks”. Achieving such outcomes would also contribute to SDG 17 regarding partnerships.

Thus far, these actions have not been sufficiently implemented. The current positive examples in the WNBR are not effectively disseminated either among BRs or more widely, and the coordinated promotion of research in this global network and its regional sub-networks remains limited. Thus, targeted exchange is needed.

In order to support this exchange and the research-related aims of the Lima Action Plan, the Biosphere Reserves Institute (BRI) at Eberswalde University for Sustainable Development took up the idea of a global research conference related to BRs that had emerged during the EuroMAB meeting in 2019. In 2021, the BRI developed a project proposal for external funding and attracted the interest of the German Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection. Through the Federal Agency for Nature Conservation, the ministry provided funding for the conference, with co-financing from the federal state of Brandenburg.

The Biosphere Reserves Institute (BRI) at Eberswalde University for Sustainable Development

UNESCO Biosphere Reserves have been a major focus of Eberswalde University for Sustainable Development, Germany, since its re-establishment in 1992. The spatial proximity of prominent German BRs to HNEE has been and remains highly advantageous. Hence, the university aimed to make Biosphere Reserves a long-term focus of its research work. When the university had the chance to apply for a new and innovative field of research and teaching in 2018, several HNEE professors jointly developed a relevant programme proposal. The Brandenburg Ministry of Science, Research and Culture granted programmatic funding to HNEE for this proposal, which became the financial foundation of a new institute, the BRI. The institute aims to intensify the university’s research on, in, and for Biosphere Reserves and to systematically use Biosphere Reserves as places for transformative sustainability research. Therefore, strengthening and promoting research in, for, and with Biosphere Reserves is synergistic with the institute’s own purpose. The idea of holding research conference was thus endorsed on all sides.

Conference participants

The key goals of the conference were to develop strategies for future action based on the answers to the following questions:

- What research questions are currently being investigated in BRs? How can the results be used?
- What achievements have been made in terms of promoting research in BRs since the LAP was adopted?
- What are the most effective framework conditions, concepts, and approaches for fostering targeted research and innovation in BRs?

In order to achieve these goals, two main groups of participants attended the conference after having been selected by the international Project Advisory Group (PAG) based both on their submitted abstracts and in consideration of the need to have a balanced representation of the different regional MAB networks – namely AfriMAB, ArabMAB, Ibero-American MAB, EuroMAB, and the four Asian MAB networks. On the first two days of the conference, presentations were held by early career scientists (ECs) – that is, students, PhD candidates, and practising scientists who had received the highest degree in their field (e.g. BSc, MSc, or PhD) within the previous seven years. The ECs were then joined by research managers from the following areas:

- international, national, sub-national, and local science-funding organisations and institutions (ministries, funding institutions, regional and local authorities, etc.),
- the MAB Committees,
- universities and research institutions – including UNESCO Chairs – that undertake research in BRs, and
- BRs that are active in research.

In addition, a number of scientists who have been active in research in, for, and with BRs gave keynote speeches throughout the conference.

Conference structure and outcomes

The two parts of the conference – that is, current research and research management – did not take place independently; rather, they were closely interwoven in order to be mutually beneficial. The structure of the conference is presented in *Figure 1*.

Figure 1 displays the overall concept of the conference and moves from an assessment of the current situation regarding research and research management in BRs to the identification of future needs. For parts of the conference, the ECs and research managers were divided into thematic groups in order to facilitate presentations and information exchange. These groups represented the topics of

1. biodiversity and climate change,
2. the innovative and sustainable use of natural resources,
3. sustainable societies and economies, and
4. ecosystem services.

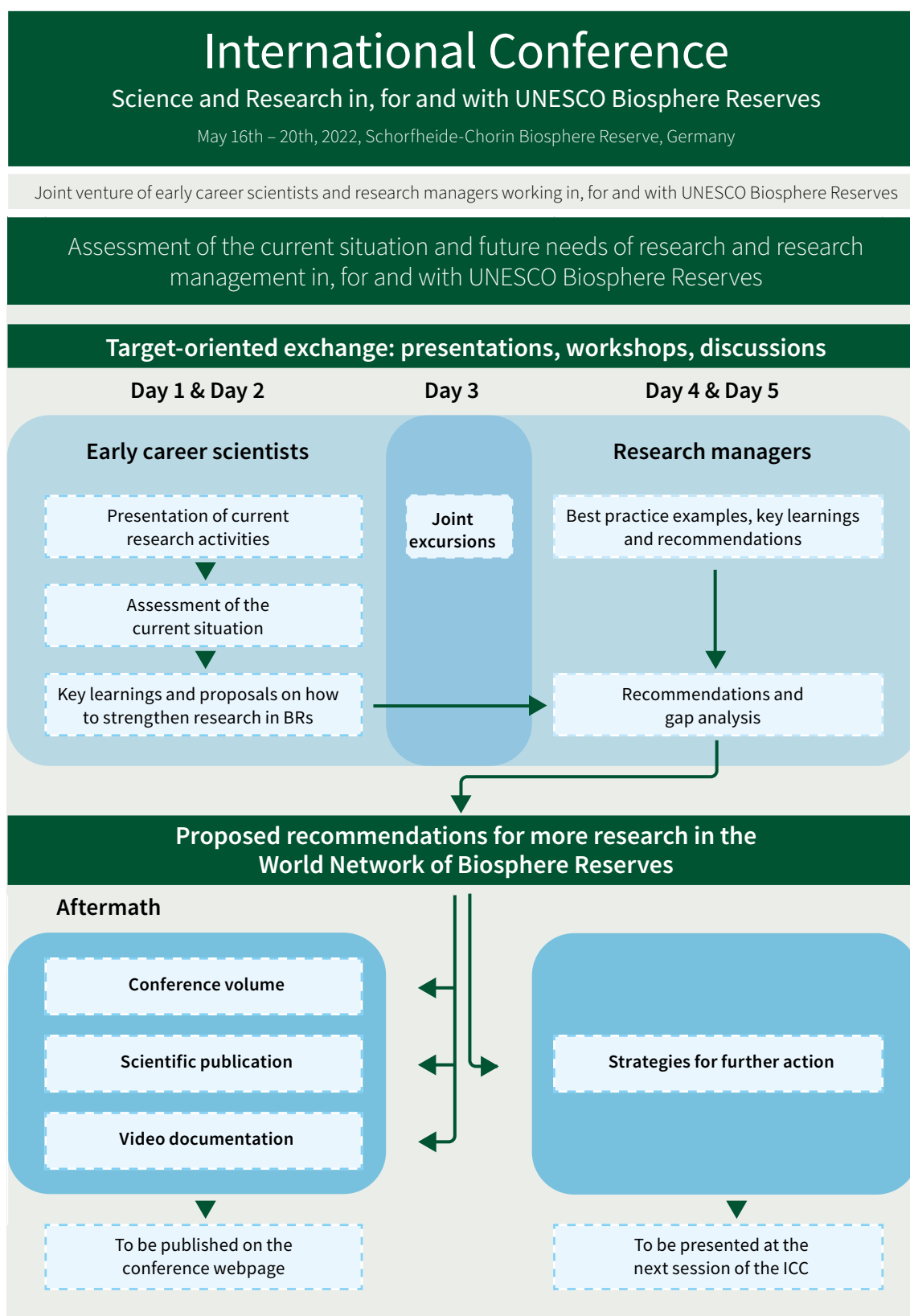


Figure 1 Structure of the conference



The ECSs presented their recent results and shared their experiences with scientific work in Biosphere Reserves. Based on this exchange, they developed proposals on how the framework conditions for research in Biosphere Reserves could be improved. The proposals were presented to research managers, members of the PAG, and other senior scientists who were present at the conference. These research managers complemented the ECSs' proposals with elements of successful research support. Based on the groups' presentations and recommendations, future guidelines were developed. The workshops allowed recommendations for action to be further developed, and field excursions fostered informal exchanges and learning in different parts of Schorfheide-Chorin BR. The contributions to and outcomes of the conference are included in this volume.

The main outcome – the Eberswalde Declaration – was presented at the 34th session of the International Coordinating Council (ICC) of the MAB programme (13–17 June, Paris) four weeks after the conference. Furthermore, the Eberswalde Declaration is part of the corresponding German Report on the national implementation of the MAB programme (summary of activities since the 33rd session of MAB ICC, July 2021 – May 2022). On 17 June, The MAB ICC endorsed the Eberswalde Declaration and agreed to include it in the council's final report – a

great achievement for all organisers of and participants in the conference. The formal endorsement can be found in the ICC meeting report (Item 20, para. 305, DECISION: 306: “The MAB ICC endorsed the Eberswalde Declaration and agreed to include it in the council's report” (Annex 6).

In commemoration of the 25th anniversary of the death of Dr. Magda Staudinger, who provided essential impulses for the founding of the UNESCO MAB Programme in the 1960s and 1970s, Dr Lutz Möller and Dr Marlen Meißner, representing the German Commission for UNESCO awarded some of the ECSs for their scientific achievements during the opening ceremony on Tuesday, 17 May. The four ECSs were selected by independent experts and each received 500 euros and a certificate. The award funds have been made available by Danone Waters Germany. The prize winners – arranged into thematic groups – are listed below:

BIODIVERSITY AND CLIMATE CHANGE

Amar Maruf (Indonesia): Exploring the potential role that patron-client relationships play in social resilience to the impacts and risks of climate change among small-scale Sama-Bajau fishers in Wakatobi National Park, Indonesia

INNOVATIVE AND SUSTAINABLE USE OF NATURAL RESOURCES

Eduardo Luna (Mexico): Inter-organisational comparison of evaluation use in a Biosphere Reserve



SUSTAINABLE SOCIETIES AND ECONOMIES

Divya Rajeswari Swaminathan (India): Agricultural transformation among the Soliga Indigenous People: A case study from the Sathyamangalam Forest, India

ECOSYSTEM SERVICES

Recca Sajorne (Philippines): Micro- and macro-plastic pollution along sandy beaches in Puerto Princesa, Palawan Island, the Philippines

Reed, M. G. & Price, M. F. (Eds.) (2019)
UNESCO Biosphere Reserves: Supporting Biocultural Diversity, Sustainability and Society. Routledge, Abingdon and New York.

UNESCO (1974)
Task force on criteria and guidelines for the choice and establishment of Biosphere Reserves. MAB Report Series 22, UNESCO, Paris.

UNESCO (1983)
Backgrounder: the MAB programme. UNESCO, Paris.

UNESCO (1984)
Conservation, science and society. UNESCO, Paris.

UNESCO (1996)
Biosphere Reserves: The Seville strategy and the statutory framework of the World Network of Biosphere Reserves. UNESCO, Paris.

UNESCO (2008)
Madrid action plan for Biosphere Reserves. UNESCO, Paris.

UNESCO (2016)
A new roadmap for the Man and the Biosphere (MAB) programme and its World Network of Biosphere Reserves: MAB Strategy (2015-2025); Lima Action Plan (2016-2025); Lima Declaration. UNESCO, Paris.



**Esteban Alejandro Valencia Torres |
Escuela Politécnica Nacional, Ecuador**

»I truly believe in what [we call] ‘open science’. I think the most important contribution in order to enhance BR management is open collaboration of information, data-bases, and data gathering that can be shared with all the involved stakeholders so they can help to develop better policies and management. I think that all of us are responsible for the management and care of BRs as we need to conserve all these resources for future generations.«

**Julie Ostrem |
University of Alberta, Canada**

»I think that BR[s] can improve this research work through continuous collaboration. Keeping that door open for communication on both sides – both the researchers and then the practitioners – as well as facilitating continuous communication between the two groups is something that can strongly improve the BR concept in general.«

**Jarrold Cusens |
University of Bergen, Norway**

»I’d like to develop ways to integrate the values of different types of people and different ways [of] how people value nature into planning and manag[ing] sustainable development, biological conservation, and – in general – sustainability. For me, BRs provide a bridge between society and research.«

**Miguel Moreira |
University of Lisbon, Portugal**

»We [held] workshops in all BRs [in] Portugal. The most common [topic] was communication, in all its [aspects]. The people attending the workshops said that it’s something that should be improved, and that’s one of our main goals: to improve the communication with all local communities, local stakeholders, and managers.«

**Coline Rozanes |
Communauté d’Agglomération du Pays
de Saint-Omer, France**

»I think it could be good if each BR works with one or more scientists. For me, it would be good to have a place to share [...] knowledge with the BR managers, but also with the stakeholders, like farmers, the citizens, or the local industry. We have to create some space, some workshops where we can share [our] knowledge with all these stakeholders.«

Eduard Müller |
UNESCO Chair on Biosphere Reserves
and Natural and Mixed World Heritage
Sites, University for International
Cooperation, Costa Rica

»BR[s] were initially conceived as science sites. We have the possibility to [take] really bio-regional approaches where we bring all the different actors, stakeholders, all the different conditions – be [it] ecology, be [it] production, be [it] organisation, or governance – into the same area. So, [this] actually opens great possibilities to do holistic, integrated, modern, transdisciplinary – whatever you want to call it – research that moves us away from reductionist solutions.«

Saida Messgo-Moumene |
BLIDA 1 University, Algeria

»For us, this research conference [...] was a great opportunity to learn and to listen to very interesting presentations that focus on the same topics that we're interested in. For us, in Algeria, BR[s] are very good places for sustainable development and also for doing a lot of research and sharing knowledge [and] also to [learn] about conditions and people or communities that are living there. According to the scientific discussions of the presentations, I think that we all have the same goals: It's about preservation, protection, or conservation of biodiversity for sustainable development. For me, this means that the biosphere is alive with diverse life, health, and sustainable development.«

Mmoto Leonard Masubelele |
South African National Parks, South
Africa

"I think the creation of knowledge helps in the different countries. [...] [T]he country representatives[, in particular,] are supposed to be sort of custodians of that type of research. Because there are different areas within a BR and different stakeholders, it often happens that some have data and others don't have data. There's a lot of duplicating and doing the same thing over and over. So, I think there's a need for a proper database.«

Anthony Blair Dreaver Johnston |
Indigenous Nation Mistawasis
Nêhiyawak, Canada

"All research has to be grounded in natural law. Natural law is the law of nature, of which human beings are a part [...]. It's the one law that can't be changed by human beings. It is the law in which Mother Earth will heal herself. We can't stop that. The more we abuse her, the more she will heal herself, and that's what creates climate change, biodiversity loss, and desertification. We have to understand that. We have to live our lives, shelter ourselves, feed ourselves, clothe ourselves according to that law. We've been violating that law, and that's why we have environmental problems. Research has to be grounded in that truth.«

The Eberswalde Declaration

UNESCO Biosphere Reserves: Knowledge for a better future together, fostering a new generation

Under the leadership of the Biosphere Reserves Institute (BRI) at Eberswalde University for Sustainable Development (HNEE), more than 100 early career researchers, UNESCO Biosphere Reserve (BR) managers, and national and international BR experts from 46 countries met in the Schorfheide-Chorin BR in Germany from 16–20 May 2022. Together, they developed the present proposal in order to strengthen science, Indigenous and other knowledge systems, as well as research in, for, and with UNESCO Biosphere Reserves.

The conference was supported by the German Federal Agency for Nature Conservation (BfN), with funds from the Federal Ministry for Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) and with funding from the Brandenburg Ministry of Science, Research and Culture.

During the first half of the conference, the early career researchers had energetic discussions on their experiences and formulated their expectations for better implementation of the UNESCO MAB programme. In the second half of the conference, science practitioners as well as Indigenous and other knowledge-holders from a) agencies, b) BRs, and c) academia presented examples of best practices and reviewed the results of the early career researchers.

After intense discussions across and among regions, genders, ages, and specialisations, the participants wish to **make** the International Coordinating Council of the Man and the Biosphere (MAB ICC) programme **aware** of their **key conclusions, proposals, and recommendations for action** by the MAB ICC, the MAB programme, other relevant elements of the UNESCO Secretariat, MAB National Committees, UNESCO Member States, and other relevant stakeholders.

The 2016 Lima Action Plan calls for an active and open interdisciplinary network of scientists and other knowledge-holders who share the MAB Vision and Mission – a network that aims to develop a joint agenda on research and knowledge-exchange. The conference can be regarded as an important first step towards establishing such a network. At the request of the participants, the BRI at Eberswalde University for Sustainable Development offers to explore ways in which such a network could be further developed in an efficient and sustainable manner.

As the MAB programme is an inter-governmental science programme, the conference participants stressed the urgent need to revitalise and boost the MAB programme's focus on research, knowledge-sharing, training, and education by using the BRs of the refreshed, strong, and growing World Network of Biosphere Reserves (WNBR) as spaces for innovative sustainability research and partnerships. These spaces should have a particularly strong emphasis on youth and Indigenous Peoples.

Considering global challenges and increasing risks, the MAB programme must foster inter- and transdisciplinary research in order to play a much stronger role in combating the climate- and biodiversity crises and in promoting human well-being. This requires new forms of adaptive and innovative sharing of all types of knowledge that are supported by effective international knowledge-exchange.

The participants formulated specific recommendations for all relevant target groups, namely

- the UNESCO Secretariat,
- the UNESCO member states,
- the MAB National Committees,
- individual WNBR BRs,
- subnational administrations,
- research institutions, and
- funding agencies and the donor community.

These recommendations are listed in Annex 1.

Eberswalde, 20 May 2022

Annex 1 to the Eberswalde Declaration

“Science and research in, for, and with UNESCO Biosphere Reserves”

Recommendations of the conference:

The participants of the conference recommend that ...

→ the UNESCO Secretariat

- define and actively communicate thematic research priorities;ⁱ
- encourage new – and strengthen existing – thematic networks;ⁱⁱ
- continuously develop the evaluation of BRs and make the results accessible;ⁱⁱⁱ and
- provide a regularly updated, comprehensive, and easily accessible database of basic BR data;

→ the member states

- increase funding and identify other ways to improve framework conditions for research in BRs;
- create a regularly updated, comprehensive, and easily accessible database of basic BR data for the availability of comparable data, and
- increase the communication and visibility of research and science in BRs;

→ the MAB National Committees

- set and communicate research priorities for BRs on the national scale and – together with other regional MAB National Committees – on a regional scale and
- support access to data on BRs for researchers and institutions;

→ the individual WNBR BRs

- attract researchers to work in and investigate the challenges faced by BRs by
 - a) making existing research results accessible,
 - b) actively reaching out to researchers,
 - c) holding research conferences in BRs,
 - d) setting up long-term continuous monitoring, and
 - e) making long-term monitoring data accessible;
- approach local universities and research institutions, partner with them, and jointly develop a research agenda;
- approach and work with UNESCO chairs and UNESCO Category II centres and institutes;
- identify and communicate local research needs and

priorities that have been identified through dialogue and in consultation with stakeholders; and

- communicate and publish research results;

→ sub-national administrations

- define research priorities together with BR administrations on the BR territory;
- interact with BR management boards, Indigenous Peoples, and local communities in order to develop guidelines for research in BRs; and
- support UNESCO MAB awareness of and engagement with BRs on BR territory.

→ research institutions

- strive for demand-driven research from BRs and local communities, co-create research questions, and collaborate on equal terms;
- interact with BR administrations about research objectives in a transparent way;
- weave Indigenous and traditional knowledge with other forms of knowledge;
- consider local communities as equal partners;
- publish results in a FAIR (Findable, Accessible, Interoperable, Reusable) manner; and
- share knowledge and outcomes with BR stakeholders in an iterative manner;

→ funding agencies and the donor community

- strengthen the funding for research (including long-term research and monitoring) in, for, and with BRs.

ⁱ Research priorities can be set in parallel both at the global scale and at regional scales. Research priorities could be set in a participatory process via an online survey among all BRs with the guidance of the MAB Scientific Advisory Board.

ⁱⁱ New thematic networks could focus on topics considered important for many BRs (e.g. climate change, urbanisation, rural outmigration, education, youth involvement, and BR governance).

ⁱⁱⁱ In particular, evaluations should also encourage reporting failures and unexpected results. These evaluations should be used for learning and adaptive management.



Conference Proceedings

Key Lectures

On Monday, 16 May, the first part of the conference for and by early career scientists was opened with a key lecture from two MAB Youth Spokespersons. Alicia M. D. Barraclough and Rebecca Y. Laibich gave the conference a global context by speaking from the perspective of a young scientist and young Indigenous knowledge-holder, respectively. The two early career scientists talked about the importance of learning from the past and of incorporating experiences in an intergenerational way. Alicia M. D. Barraclough summarised the challenges and benefits of work in, for, and with Biosphere Reserves that had been mentioned during the MAB Youth Forum in 2019. From these aspects, she derived questions that were to be addressed at the conference. In a panel discussion, Alicia M. D. Barraclough addressed some of these questions to Rebecca Kwalia, an Indigenous knowledge-holder from the Kenyan Mount Elgon Biosphere Reserve. This exchange was followed by a panel discussion on “Indigenous knowledge in, for, and with UNESCO Biosphere Reserves”. Lawrence McDermott – a member of the Shabbath Bajwan First Nation located in Eastern Ontario – highlighted the notion that different knowledge systems need to be understood and interconnected in order to meet the current challenges of the biodiversity and climate crises.

On Tuesday, 17 May, as part of the opening ceremony, Pierre Ibisch held a lecture on “The global ecosystem crisis, UNESCO Biosphere Reserves, and research. Time for a wake-up call?” By illustrating the urgency of solving the biodiversity and climate crises, Pierre Ibisch provided a global context for Biosphere Reserves and the conference aims. He additionally highlighted the notion that potential risks need to be considered in Biosphere Reserve management as well as within science and research. Wednesday, 18 May, was the day for interlinking both parts of the conference. In this endeavour, Maureen Reed and Martin Price discussed the history of the MAB programme with regard to science. By illustrating the changes that have occurred over the last decades, the researchers derived information as to why and how the focus on science and research in the WBNR needs to be renewed.

Thursday, 19 May, began with a lecture by Lisen Schultz from the Stockholm Resilience Center on “Lessons and learning opportunities that Biosphere Reserves can offer to sustainability science”. Looking back on her 20 years of experience in working with Biosphere Reserve research, Lisen Schultz highlighted critical frontiers in which a focus on both practice and research should continue. In this remarkable journey, she reminded the audience of the idea of BRs as model regions and upscaled her learnings and approaches from the BR level to the global level.

This scientific view was followed by three presentations on current research management related to BRs. The three speakers – who represented different types of institutions – provided different perspectives on the current state and possibilities of research management.

The first lecture was held by Birthe Thormann from the Federal Agency for Nature Conservation in Germany, who provided a governance perspective with examples from Germany and Austria that she had compiled together with Günter Köck from the Austrian MAB National Committee. Birthe Thormann additionally explored what role ministries, governmental agencies, institutions, and MAB Committees can play in promoting research and science in Biosphere Reserves.

In a second lecture on research management, Martha-Marie Vogel from the MAB UNESCO Secretariat gave an overview of research-related projects in UNESCO’s current MAB programme. Moreover, from an administrative perspective, she revealed that UNESCO works in different regions and supports the research goals of the WBNR on different scales.

Last but not least, Inger Elisabeth Måren – UNESCO Chair on Sustainable Heritage and Environmental Management at the University of Bergen – analysed current BR research management from the perspective of academic institutions. She highlighted findings from a workshop on science in a BR that she had hosted at the EuroMAB 2019 meeting in Dublin and compared resulting proposals with the current situation.

A few selected paragraphs from these speeches can be found below. The full speeches can be listened to on YouTube.

Day 1 <https://www.youtube.com/watch?v=eCrXxQ0V4ZI>

Day 2 <https://www.youtube.com/watch?v=u0hA8BVG15>

Day 3 <https://www.youtube.com/watch?v=tjRy-f0i4Dc>

Day 4 <https://www.youtube.com/watch?v=EdRteXKjFZc&t=7247s>

SCIENCE AND RESEARCH IN, FOR, AND WITH UNESCO BIOSPHERE RESERVES: BENEFITS AND CHALLENGES (UNESCO MAB YOUTH SPOKESPEOPLE: ALICIA M. D. BARRACLOUGH & REBECCA Y. LAIBICH)

Alicia M.D. Barraclough (University of Bergen):

»We were talking about what conservation work is like. It is problem-solving, it’s action-oriented, it’s partici-

patory, and it weaves different ways of knowing. [...] I consider myself a sustainability scientist, which means that my work is problem-focused or [involves] problem-solving. It is action-oriented. It is [not] disciplinary. [...] We have prepared a presentation to put the conference a little bit in context.« [...]»

»The first challenge that we identified was the one that we all know very well: That we're in the middle of a biodiversity crisis. [...] The second challenge that I wanted to point out is a poor economy, which fails to support development projects and fosters corruption [and] crime. [...] [I'm talking about] the social context that we're all embedded in. The systems [in this social context] are so much bigger than what Biosphere Reserves can really [tackle]. [We must deal with] the lack of political will, the corruption, the dangers that many people face even doing conservation work in some places in the world. [...] The third challenge that I want to talk about – before I finish talking about challenges and we can go into looking at solutions – is focused on the young people in this room. There's this feeling sometimes that we're here to save the day and we're going to become leaders and we're going to solve all the issues and the challenges that I just presented, and that's such a heavy burden to bear. And at the career stage that we're in, we face severe job insecurity. [...] How difficult it is to be in an academic system that doesn't support building relationships with stakeholders over [the] long term!« [...]»

»We face all of these challenges. But we are in a make-it-or-break-it moment. We are, this year, hopefully going to finally get around to [creating a] post-2020 biodiversity framework of the convention of biological diversity. [In] tackl[ing] the biodiversity crisis and [...] reconnect[ing] humans to the rest of the biosphere – what role can Biosphere Reserves play? [The Network of Biosphere Reserves is] a network of sites with 50 years of experience [in] experimenting for sustainable development, [in] generating knowledge which is useful and actionable. We have an incredible resource with a lot of experience and with a lot of [information]. It's up to us how to [move] it forward [...] [by] learning from our past mistakes, decolonising our science and the way that we do conservation.«

»I just had two closing inquiries [that are] maybe [...] interesting for this conference: [...] How do we learn from what we have done so far? We have a 50-year-old programme with a lot of experience [in] different ways of doing conservation, different ways of doing sustainability science, different ways of trying to develop transdisciplinary / interdisciplinary ways of working with lots of different stakeholders and rights holders – a really important heritage. How do we really integrate it right? [...] There's actually so much knowledge that's already been generated. So how do we actually integrate it as early career researchers without repeating the same things over and over? How do we critically engage with what is the most pressing need? We are in the middle of an ecological

emergency, so we need to figure out how to be effective. How do we move forward? Hopefully, this conference will mark some way. There's probably more than one way, so maybe [we can pinpoint] one of the ways.«

[Dialogue-based part of the presentations:]

Rebecca Cherop Kwalia
(Mount Elgon Biosphere Reserve, Kenya):

»We use knowledge as part of development, [and] we reflect back to see our challenges. Then, from there, we come up with a framework on how [to move] forward. It's good to share this knowledge with the young generation because they are the people who are going to create innovations that will be used for the future, and they can create something sustainable such that we can maintain [...] knowledge as well as develop [...] societies in the process.« [...]»

»In terms of sustainability, we try to ensure that the reserve is well maintained. When researchers come in, there are trust issues from the local communities. They feel like you're going to [change] their traditional way of doing things. They don't understand that it's part of innovation and that it's good to document that. I believe scientists have a lot of opportunities at the reserves. Where I come from, there are opportunities for medicine because part of the Mount Elgon community uses trees as herbs, and some of those trees have treated some diseases which have not been able to be treated by [...] Western medicine. I think it's an opportunity for research if such a plant can be worked on. We can come up with something. Then, we have the issue of traditional foods: During the olden days, [people] were able to [gather] seeds for future use. But change in agriculture has made a difference [to] that. We are slowly losing the Indigenous varieties of the various plants. [One] example is sweet potatoes.« [...]»

»For my own work, it's hard to convince people that honey can be economically empowering because they don't understand how you're going to get [the product on] the market, how are you going to [get] by-products from honey, like candles and propolis. It's a challenge to recruit people to do that. At the same time, I'm in an area that has been affected by de-forestation because we use trees for cooking firewood. So, it's a process. We have to start [by] planting the trees, and then, we can [work on] project[s] together.«

INDIGENOUS KNOWLEDGE IN, FOR, AND WITH BIOSPHERE REGIONS (LAWRENCE MCDERMOTT & REBECCA CHEROP KWALIA)

Lawrence McDermott:

»I am a member of the Shabbath Bajwan First Nation, located in a territory in Eastern Ontario. We're part of a larger network of Algonquin communities. That net-

work has both formal aspects and informal aspects. As [our] Elder Commander used to say, 'Nobody can claim the land'. We can claim our rights to the land, but it's the Great Spirit who created the land, and we're gifted the opportunity to live upon it in our short time here on the Earth. It's important that we be mindful that we've received it in reasonably good shape from our ancestors. We have a responsibility to be thinking about future generations – we say seven. We have to make our decisions about how we sustain ourselves on this land with that mind. There's no such thing as [...] traditional knowledge – [knowledge is] localised, and it's shaped by the life around us.« [...] »

»Now, we're seeing significant climate-change symptoms, and all of this is connected. We've really bought into being a superior species. But if we're so smart, how come we've got the kind of problems we've got? I'm seeing it becoming more important that – no matter how we might identify – we understand these two knowledge-transfer systems and our responsibilities to them and [that we] learn to co-create both in terms of inclusivity and diversity not only of people's ancestry, but of knowledge systems. [...] You have to train, and you need legitimate teachers to build that cross-cultural capacity.«

»Canada chose to pursue its international treaty obligations to the conventions on climate change, biodiversity, and desertification through a co-governance of Indigenous oral and Western written [knowledge]. To make that work, embraced a concept [called ethical space that was] created by a professor at the University of Saskatchewan [...] and further developed by Reg Croshu, a Blackfoot elder. «[...]»

»I think of people [as being] better connected with the needs of other beings. It might put climate change and biodiversity in a little different perspective – one that's actually much more wholesome and less about self-interest and commodification. The kind of system change, the kind of human transformation which also has to be social and cultural as well as economic and environmental is not going to happen without understanding both written knowledge transfer and oral knowledge transfer. There's no time for despair. We have to believe in hope, and if we look around us at the animals, the trees... they're still doing what they were created to do, and the birds are still singing. So, we can learn a lot from them about dealing with the challenges we humans have created.«

Rebecca Cherop Kwalia:

»In terms of Indigenous knowledge, I believe we use knowledge for survival and development. We look back and understand where we are coming from, [and] we look forward and come up with innovations that can create sustainable communities. In terms of sharing that knowledge, I want to introduce the sustainable development goals and how they can [be woven] in[to] these

communities because if we are able to economically empower this group, we have [the] potential of ending hunger, we will eliminate poverty, we will create gender equality, we will ensure responsible consumption and production in the process because we will be taking care of our environment. We will also take a stand on climate action because that's the issue that is [affecting] our Biosphere Reserves [...]. The climate is changing. [The way] it was when I was growing up is totally different [...] now. The times [when] we are expecting rain and the times [when] the rain actually comes are totally different now.«

»So, [we need] a call to action for a partnership between different institutions [and to determine] what part can we play in the process of creating a sustainable community, what part can we play in ensuring that [...] the process of our consumption is responsible and [that] we are able to continue producing for the future.«

»I think it will be sad if we end up telling our grandchildren stories of how this place used to be so good. We should preserve it so that they can see it for themselves. At least it [would be] easier for us to tell them the stories of the work we've done so far to ensure [that] the place is still the same rather than telling them how [the world] was [once like] a picture they cannot [even imagine].«

THE GLOBAL ECOSYSTEM CRISIS, UNESCO BIOSPHERE RESERVES, AND RESEARCH. TIME FOR A WAKE-UP CALL? (PIERRE L. IBISCH)

[Referring to the 2022 Global Risks Report by the World Economic Forum:]

»All these green risks are environmental risks, and they [have been] the top runners now for the last few years. This is new. So, economists recognise biodiversity and [...] natural resources. It's also interesting, always, to see what is missing. For example, [in this report,] published in January, there is no geo-political risk. There is only geo-economic confrontation, only geo-economics. This also means, [here] it comes, the black swan, all of the sudden. One month later, [there is war in Europe,] and [...] the [entire] situation has changed, maybe for a long while. And what I feel is especially exciting [is that] this World Economic Forum for a few years now [has] also [been] working and thinking quite systemically, looking at all the interrelationships and the complexity of the risk[s] because they [do] not exist[...] one next to the other, but they [...] interact, they [...] concatenate and converg[e].«

»Is it time for a wake-up call? I think, no. You are awake. But maybe we [should] reflect more on the Biosphere Reserves as a role model. If we still stick to role models of the last century, are they fit for [this] purpose? Are they ready to confront the challenges in this world of the 21st century, which is hot, flat, and crowded? We could say

the full world [...] is the VUCA world: volatile, uncertain, complex, ambiguous – definitely risky, and yes, finally hitting the limits [of] growth. So, are you awake? Are the Biosphere Reserves awake, up to the challenges? Are you prepared for the black swans? [What] will they look like? Are we good enough at conserving not only what we have, but especially the properties of [...] dynamically changing systems? And this changeability also has to be conserved. Conservation isn't what it used to be. Are Bio-

»I feel, no, this is not enough. We need much more effort [...] in [...] this endeavour. And do we use Biosphere Reserves as a source of inspiration and motivation? Very often. And of course, [they] must be much more than that. [To] conclude, I guess that we do not need a wake-up call. [...] Biosphere Reserves do not need a wake-up call. But [we] possibly [need] a lot of reflection – honest reflection [on] the situation [that] we [are] in. And we all tend to escape sometimes from this reality, and this – maybe –



sphere Reserves effective against all the odds, [against] all the bad and evil which is not just in the surroundings of the Biosphere Reserves? We've seen it. It's happening also within. Yes, it's time to recognise, many know, [that] Biosphere Reserves are not about just preserving ancient cultures or things like that for glorious legacy. So, are they [...] laboratories that produce [...] unexpected innovations? [...]

»We have some 'white swans' already – some birds that we 'produce' and that are [a] 'game changer' in a positive sense. Are our Biosphere Reserves [a] source of inspiration and motivation in this world of depression and frustration? I think so, yes. And now, [on to] research-related questions: Is research ready and good at 'bird-watching'? Do we do enough 'black swan horizon scanning'? Is science sufficiently self-critical, brave, outspoken? Is science transformative, and is it grounded in values? What kind of values [...] might [these] be? I'm very much in favour of eco-humanist values where we see [...] people in the centre of our action[s] but where everything is embedded in the ecosystem. So, we have to [come] to grips with our position in this global ecosystem. We [must] stop thinking that we are something that is outside [of] or external to [...] ecosystems and [that] we just buy our ecosystem services. No, we are dependent components of this system, and we should treat it as such. So, is science really helping Biosphere Reserves set[...] up these innovation laboratories, these living labs? Is this enough?»

is the biggest risk of all of them: that we are not willing [...] to really face all these different challenges and risks [anymore]. So, let us celebrate humans, human diversity, [and] cultural diversity as part of this marvellous wonderful world we have. Thanks very much for coming, and thank you for doing all this together.«

RESEARCH FOR SUSTAINABILITY AND BIOSPHERE RESERVES (MAUREEN REED & MARTIN PRICE; MODERATION: ALICIA MAY DONNELLAN BARRACLOUGH)

AB:

»So, a lot of these thematic areas and coordinated research slowly faded or fell away in the 90s, and I'm wondering why you think that happened and if you have any kind of explanation for it.«

MP:

»Well, I've been thinking about that, and other people in the room may have other thoughts, but my feelings are the following on why the thematic networks disappeared: One thing, scientists like to move on to new projects. National and European funding agencies rarely provide more than a few years of funding. MAB was the flavour of the decade in the 70s and into the 80s, but no longer once we got into the 90s. It was still there, it was still an inter-governmental science programme, but I think the interest of many of the scientists and the funding agencies [...] ran out. Also, what was happening – the

new flavours of the month [...]: There was the IGBP [the International Geosphere Biosphere Programme] and the International Human Dimensions Programme. These big global-change research programmes were starting up in the late 80s, and of course, some of the people who were in MAB got involved with those. But they didn't keep the [ir] MAB involvement, and although these new structures – like IGBP and IHDP – recognised the need for a global set of research sites and the concept of Biosphere Reser-

ing to continue with new questions and new kinds of approaches. I think that's really exciting. There are still some structural issues in place. Within universities, there are still the traditional reward structures for faculty members who are doing research. Some of those structures are going to have to change, as well. The concerns around funding [mentioned by Martin] remain. Martin mentioned that from the 1980s and 90s, MAB was no longer the flavor of the day or the decade. Those things are



ves had become more interdisciplinary, [...] they were still only or mainly conservation sites. So, it wasn't very easy to sell them as a global network of research sites. So, they were there, but people were not really able to focus on them.«

»It wasn't until [...] 1996 at the Seville Conference, when the Statutory Framework for the World Network of Biosphere Reserves was finalised, that this gradual evolution of sites [into] truly 'sites of excellence to explore and demonstrate approaches to conservation and development on a regional scale' began. The Biosphere Reserves became more and more the focus of the MAB programme – as they are today – rather than internationally coordinated science, though there was some international knowledge-exchange. [...] There were some challenges, but we are rising above the challenges again.«
[...]

AB:

»Martin has outlined some of the challenges of project areas and thematic areas and coordinated research falling away, but you've also spoken about this emergence of a new and a different way of doing science, the new kind of new flavor of the MAB programme. So, where are we now? Where does this leave us now?«

MR:

»I think we're going to continue. Particularly, [as] I see with the new early career researchers here, we're go-

also going to have to change in addition to those institutions that provide funding. We have to think about what their criteria are for assessing excellence in research. Our ideas about what constitutes science and what constitutes knowledge and learning probably have to change, as well.«

»Interestingly, now UNESCO as well as many scientists [...] are really advocating for Biosphere Reserves to be considered for their role in the post-2020 Biodiversity Framework so that they can be recognised as other effective area-based conservation measures, or OECMs [...]. If this recognition is bestowed, then Biosphere Reserves internationally will draw greater attention to the network, but [that] can also result in another layer of compliance that Biosphere Reserves may have to meet if they're going to be recognised as these OECMs. Ultimately, they may get greater recognition, as [may] the stakeholders and rights holders who work in Biosphere Regions. But I think that kind of idea fits with one of the recommendations that we made in the book, or [with] a couple of the recommendations. One is to demonstrate the value that Biosphere Reserves have for national and international priorities. For those of you who were here last night, I think Pierre was charging Biosphere Reserves to [become] relevant, in a sense, at the end of the day. It also means that we need to continue th[e] movement [in order] to engage with and really support diverse knowledge-holders and knowledge systems in a very good way.«

MP:

»What's next, I hope, is that we will get a move towards what is in the Lima Action Plan, which is to have not just an international network of Biosphere Reserves [the World Network of Biosphere Reserves], but an international network of Biosphere Reserve scientists. In scientists, we should include other people who have knowledge, too. That's actually the wording that's in the Lima Action Plan: 'knowledge-holders and scientists'. [...] We

[second] thing is this notion of tailored participation [or] strategic collaboration [that aims] to identify these win-win situations [and] that can then build trust to later on work on the more challenging things because of course, there're always trade-offs and conflicts when you try to create sustainability. The third thing is the importance of support from formal institutions. Of course, volunteer work and local work is really important, but unless you have [...] ongoing support from formal institutions, the-



are finally moving towards it, and we've still got one or two years of the Lima Action Plan to go. So, let's hope that from this meeting, we can have that network so [that] we [can] have international collaborative science within the MAB programme [again]. Because it's not that science isn't being done in Biosphere Reserves, as we've heard the last two days. There's plenty of it going on. The challenge is that it's not connected. So, there are people doing research on a particular topic that someone else is also probably working on or [that] someone else [...] needs to know the answers [to] or ha[s] some ideas [about], whether it's about natural sciences, social sciences, interdisciplinary approaches, governance [...]. This is really my vision, and it's what's in the action plan: To really think about a shift from coming to this meeting as individuals to be being part of a network that will thrive in the future and reinvigorate the MAB programme.«

LESSONS AND LEARNING OPPORTUNITIES THAT BIOSPHERE RESERVES OFFER TO SUSTAINABILITY SCIENCE (LISEN SCHULTZ, STOCKHOLM RESILIENCE CENTER)

»[...] I wanted to [share] five lessons that we have learned as sustainability scientists from Biosphere Reserves on how you actually do sustainability. The first thing is this importance of a holistic and attractive vision for your work and some kind of positive outcome that you can foresee that will be good for both people and nature. The

re's a risk of these things just burning out. You need [...] support [- sometimes -] from [...] the government or the municipality or something long-term that can make this collaboration happen over time. Four[th] is the importance of continuous learning and adaptation because this is complex work [that is] always shifting. There will be new ideas and new opportunities and always new crises [...] to address[, as well]. So, hav[ing] that learning mindset is important. Then, finally – but not least important – is to have concrete and visible actions that build momentum. People are tired of just talking; they want to see action. So, it's really important to have those aspects in the Biosphere Reserve management, as well.« [...]

»Some final words just on research and management and how we can collaborate. This picture helps me at least understand what [it] is about. It is, of course, about integrating knowledge: bringing together different kinds of knowledge, getting the right disciplines, the right data in place, building [on] that new knowledge. But it's also about integrating people: getting the right collaborators, building new relationships. And that – together – is what actually creates this transdisciplinary research in action. I think [that] in all of these sectors or these segments, we can improve, but we can also learn quite a lot from how the Biosphere Reserves operate. Three frontiers [are important to mention]: After some 20 years working with Biosphere Reserve research, this is what I see as critical at this point to continue focusing on both in practice and [in] research: The first one is to help develop these posi-

tive visions for people in the biosphere: How can we live together? How can we meet the needs of 10 billion people in a way that actually protects other types of life on this planet? This is where biosphere research can really help both locally and globally in creating those positive visions.«

»The other one is the learning that [...] happen[s] in Biosphere Reserves... this everyday learning that you all ge-

»So, those are just my three exciting topics for the future, and then [I would like] to end with [a] quote from Jurassic Park. I think it's a nice quote. When I started off, way before [my work with] the mangroves in my teenage years, I was so worried about the ozone hole that was discovered in the 80s. When I was a teenager, there was the loss of rainforest, the Chernobyl accident, the seals that were dying [off of] the Swedish coast, and no one knew why. Th[at] time of my life was really desperate. I was thinking



nerate. How can we scale up that learning? How can we scale it out, and how can we scale it deep? What I mean about that is: How can these Biosphere Reserves move from being islands of sustainability to really support[ing] sustainability on a global level? And there, science has a critical role to play because Biosphere Reserve managers are really swamped with just doing this work on an everyday basis. Scientists can hopefully come in, help with the reflection, help with sort of distilling these lessons, conveying them to policy-makers and people working on similar initiatives outside Biosphere Reserves.«

»This final thing is an exciting field: I [have] notice[d] that more and more businesses are realising that there is no business on a dead planet and that actually, they need to find ways of maintaining those systems [that] they are dependent on. They need to maintain ecosystems, they need to maintain societies if they are to be able to operate in the future. So, under what conditions is it possible for companies to contribute to biosphere stewardship? I know that some Biosphere Reserves [...] also work [...] with businesses locally, but I think in most cases, it's about sponsorship or things like that. I think what's most exciting [...] is when companies actually come in with their innovations and entrepreneurship [and] provid[e] the services to really meet those sustainability challenges or [to] address them. That's when we can really get something going so that the company in their very core [...] work[s] with sustainability and creat[es] a profit from that somehow.«

that I [was] part of a species that is a parasite on planet Earth, and I d[id]'t want to be that. 'The planet would be better without people' was my notion back then until I started thinking about what the planet without people would look like. I started feeling that, actually, there would be no one here to sort of appreciate the beauty of this planet. There would be no one here to create music and arts and all of the things that people do. And I realised also that I love a lot of people, and so I thought: Maybe it's better if I start working towards a world where people can collaborate with the biosphere and live here in a more positive way. That's why I went into biology, the mangroves [...], the Biosphere Reserves, and then Jurassic Park: 'Life finds a way'. Life is truly adaptive and fantastic, and I hope that human life will also find a way. That's where I end. Thank you so much for your attention.«

SITUATION ANALYSIS OF RESEARCH MANAGEMENT IN CONNECTION WITH BIOSPHERE RESERVES

Research in, for, and with UNESCO Biosphere Reserves from a governance perspective – Examples from Germany and Austria (Birthe Thormann, Federal Agency for Nature Conservation Germany / Secretariat of the German MAB National Committee, & Günter Köck, Austrian MAB National Committee)

»[...] In my presentation, I'd like to explore which role 'administration[s]' – like ministries, governmental agen-

cies and institutions, and MAB Committees – can play to promote research and science in Biosphere Reserves. To understand the role of research within the national MAB programme, first, we should be aware that the structure of the national MAB programme is very different from country to country. We will see that this structure can define the role of science and research. For this purpose, we will have a look at Germany and Austria – two countries that at the first seem quite similar. They are neighbour-

good to promote Biosphere Reserves as attractive research areas for universities to attract researchers and students. In this [endeavour], Austria seems to do quite well. Second, it is important to have [...] close cooperation and information exchange between the Biosphere Reserves, the MAB Committee, and the research community that helps to integrate science and research. The National Committee can also highlight the importance of science and research. For example, it can



ring countries, and both are German-speaking. We will compare the structure of the MAB programme, and from that, we will see what that means for research. And finally, we'll identify success factors for promoting research.«

»Indeed, there are many similarities between Germany and Austria, also regarding the MAB programme. Both countries have more than one Biosphere Reserve: Austria has four, and Germany has 16 UNESCO Biosphere Reserves. The MAB programme also shares a similar history: Germany joined the programme in 1976, and Austria in 1972. They both have a National Committee, both almost from the beginning. So, both countries can be called veterans [because] they are long-standing members with [...] extensive experience. However, there are differences. One profound difference with relevance for science and research is the structure of the national MAB programme, especially the organisational anchoring of the National Committee. Let's have a closer look at the two countries!« [...]

»[Now], let's come to the conclusions: We see that science and research play an important role in both countries. However, the [two countries] have a [...] different approach and perspective that relates to a different administrative structure in the background. In both cases, the support of science and research is quite successful. If we have a look at both countries together, we can identify several success factors or maybe also [possibilities] to foster science and research. First, it is

emphasise the importance of research in the context of periodic reviews by recommending, for example, the development of a research concept. [...] [T]he German National Committee – with its link to the Federal Agency for Nature Conservation – has a [particular] strength in policy advice. For example, it also issues so-called position papers and may use this instrument in the future to strengthen the role of science and research. Last but not least, an important element is the funding of projects. Thank you for your attention.«

Research in, for, and with UNESCO Biosphere Reserves – UNESCO's MAB programme (Martha-Marie Vogel, MAB UNESCO Secretariat)

»From this, I [now turn] to different projects. So, what we were already addressing a bit the day before yesterday: this WNBR data-management system. There's a [strong] need to have quantitative information about BR[s] available so that you can also do better research with them. At the moment, we have nomination and review files, but there's not a good overview on the webpage [regarding where] to download and access the data. One [important thing] is to have geospatial data available from the BR [...]. So, [...] in 2020, [we] to set up a data campaign because we have different concepts for this project. We wanted to start with data collection to collect quantitative digital data on the BR because lots of the data is outdated [and] also because [...] the system of periodic

reviews only tak[es] place every 10 years [...]. To have this updated information, to do this data collection, one big part was to develop this questionnaire. [...] We did a pilot campaign in January 2021, and since July, we [have been] collecting this data on a global scale. It's already a challenge for us to reach all the BR[s]. So, this survey is still ongoing, and one big part is to have this geospatial data. We also ask for data on governance and on biodiversity and [on] different monitoring [systems]. From this

has different angles with five BR[s] in Germany, [including] the Schaalsee Biosphere Reserve. In the German and Polish BRs, [the project] is focused on peatland restoration [and] on how to support [that]. [In] the Spanish BR, [the] focus [is] on electric cars and [on] how to use electric cars [as a] new means of transport. It is an ongoing project [that aims to find] different ways of how [we] can work on climate mitigation.«



survey, we will be building this relational database. This will be a database hosted at UNESCO. The big part, then, is the visualisation part – there will be a webpage where we have interactive functions and where we have these maps with geospatial data. We want to have downloadable data not only for the shape parts, but also for other components. This is [a] work in progress, with the aim to have basically this interactive webpage with all UNESCO sites. So, there's in-house cooperation. It's a huge project, and we are really looking forward to this, but it will still take some time. We will need to discuss [...] what data will [really] be [...] available and how to deal [...] with incomplete data.«

»There are also other [ongoing] projects. There's a new project called UNESCO Experts Network for Earth, with the idea to link experts to sites. We have different sites with needs, and we have a huge network of experts. How can we make use of that? It's voluntary experts that get their travel funds basically to go to the sites and then to work with the sites on different questions. The sites can request what they would need, and [...] matching [should be] done by UNESCO. I invite you to check that [out]. There's still the possibility – also as [a] young volunteer expert – to say that you are interest[ed] in contributing to that programme. Eventually, you can [submit] your application [...]. [The programme has to do with] restor[ing] the] human–nature relationship. Another project [that is] ongoing: UNESCO [also] has [...] partnerships with the private sector. The Climate Mitigation Project in Europe

»[Next], we move from Europe to the Amazon region: There's a[n] ongoing] project [...] with eight BR[s]. My colleagues will be there working with the local communities on re-forestation and rehabilitation of degraded lands. Another project in Africa – a long-term project – is in the Biosphere and Heritage of Lake Chad, [which is] called BIOSPALT. There, the aim was to help with the creation of [a] new BR. There's a system of monitoring because Lake Chad has a lot of problems. There, you can see the link between environmental and social systems: The idea is to work on poverty reduction, ecosystem restoration, and capacity building [in order] to develop [a] new BR. Another project in Africa and the Southern region with a strong link with research [involves] working on these observatories for climate change. [...] There is the link to make use of available products for flood and drought forecast and then [to] use them in [a] BR [in order] to have these early warning systems and [to] inform the BR [of] hazards that will come with climate change.«

How can universities and other research institutions mobilise to conduct more research in, for, and with Biosphere Reserves (Inger Elisabeth Måren, UNESCO Chair on Sustainable Heritage and Environmental Management, University of Bergen)

»During EuroMAB 2019 in Dublin, Pam Shaw and I ran a workshop on how science can contribute to BRs. Practical actions [that] we identified were [as follows]: BRs can

identify good research questions [that can] be presented to university supervisors. This is a win-win situation because we need good projects for our students, and we don't always have the time to develop these. This encourages [the] co-creation of good projects, but it demands a key person both [on] the university side and on the BR side. And then, [turning] to [the] research strategy: BRs need to include collaboration with universities in their strategy plans, and universities should write [this collaboration] in[...] theirs, as well. BRs should also have [...] scientific committees [that are] perhaps [split] 50/50 [between] natural sciences and social sciences, like in France.«

»According to [...] Lima Action Plan 8.4, every BR should have partnerships with universities and research institutions to ensure bottom-up processes. I think this is very important to stress. Some examples of best practices [are as follows]: We can promote BRs as partners in research collaborations and projects and nurture personal connections. This may be followed by a governing document that everybody signs to agree on objectives. This has been successful, for example, in territories with Indigenous Peoples. In the US, [...] charter[s have been used] to reach certain objectives [...]. Also, we can discuss relationships with [the] federal government. A budget dedicated to maintain[ing] and build[ing] relationships through the scientific MAB Committees for funding meetings and networking may be a good platform [for] exchange[ing] ideas, as the UNESCO Chair from the Basque Country [has] experienced.«

»We also identified some big ideas. Remember, this workshop was three years ago, so now, we can check if we can cross off any of these on the list: • Make a survey distributed to all BRs: How do BRs involve scientists? I think that's exactly what the former speaker was mentioning – that BRs have received this survey now. So that's underway. • Arrange an international conference for scientists working in BRs [to] discuss[...] these issues in line with the recommendations of the UNESCO Chair conference arranged in Genova in 2017. I believe this is the conference we're at now, so, 'Check!' • Make a searchable site for BRs, for instance, biospheresmart.org or others. I think that's also work [that is currently] underway. • Make the 10-year periodic review more frequent, for instance, [by requiring] annual reports to national authorities. I don't know what the discussion is on this point; I don't know if we can say, "Check!" [to] that.«

»Here are some suggestions for what the next steps could be based on this workshop with probably 30, 40, 50 researchers, and so, it's a summary of many voices (that's why I wanted to present this instead of just giving my reflections on this): • Create a charter on how to conduct research in BRs. • Info-sharing needs to be prioritised from UNESCO and down. • Increase [...] communication (many others have also mentioned this). • There is a lack of available web resources, so [we should] create

a place for info-sharing. • Update BR strategic plans and transparency on UNESCO websites. • Conduct high-level lobbying for UNESCO at Brussels to highlight Biosphere Reserve work and the role of Biosphere Reserves. (This was the EuroMAB conference, which is why this point is here.) • UNESCO Headquarters should make it easier to acquire research money [via] research platform development, facilitat[ion], and bringing in seed money. Today, UNESCO helps [by being the] public face of communication and branding, but we need more support for internal work and support for cross-learning opportunities. I hope we can reflect on those points and see if our work [can] mov[e] forward. Thank you very much.«

Outcomes of the thematic sessions

The first two days of the international conference were filled with presentations by early career scientists who conduct research in, for, and with UNESCO Biosphere Reserves. The participants were sorted into 4 groups, in which their study topics were presented and discussed. Rapporteurs in each group condensed the variety of presentations into global summaries as well as proposals for better research in, for, and with Biosphere Reserves (BRs).

■ GROUP A: CLIMATE CHANGE AND BIODIVERSITY (RAPPORTEUR: FABIO WEISS)

Group A's 11 presentations covered a diverse range of topics and included large-scale studies as well as small case studies and experiments. The researchers were ecologists, social scientists, data scientists, and even aerospace scientists by training, but many of them took multi-disciplinary approaches to their questions. Their chosen topics ranged from addressing heat extremes, climate forecasts, and climate-change prevention and adaption to dealing with vegetation and wildlife. Another focus was on new research methods. There were also presentations on how using different biodiversity metrics improves biodiversity monitoring, how geodata can map ecosystem services, and how satellite imagery and drones can be used to monitor and map a BR that is virtually inaccessible otherwise. Joint experiences included problems with data availability, administrative obstacles, and therefore also reliance on informal contacts. Based on these common quests, the researchers call for better-documented and archived data and metadata in BRs. As BRs are biodiversity hotspots, the researchers also warn of the high risk of biodiversity loss, the pressure of climate change, and the daily conflict with deteriorating conditions.

■ GROUP B: INNOVATIVE AND SUSTAINABLE USE OF NATURAL RESOURCES (RAPPORTEUR: JARNE JARGOW)

The re-occurring topics in the 12 very diverse talks given by the members of Group B were innovation, a sense

of place, adaptive management, and the gaps between concepts and reality in BRs. The presentations began with “old” innovations based on local people’s interests and the use of Indigenous knowledge systems. Furthermore, a psychologist talked about how local people’s sense of place can transform communities and BRs. Participants reported that innovation on the ground was not recognised, sometimes not even by the innovators, who find their actions quite normal and therefore do not explain what they are doing. Additionally, two presentations that included a meta-analysis of 69 Biosphere Reserves revealed that research on innovations in agriculture is not easily found because agriculture is mostly seen as a negative influencing factor, thereby concealing its transformative opportunities. It was apparent in several presentations that the concept of innovation and the innovations in the BRs did not match, thereby leading to a gap between concepts and reality.

A second topic of discussion was adaptive management. Participants stated that there is always an “easy way”, which is wrong, and a “right way”, which is, of course, complex and difficult. When choosing the “right way”, failure is the first step to learning. However, recent investigations have revealed a limited margin for reporting failure and unexpected results in BR evaluations. Currently, evaluations seem not to lead to change and to instead only be completed in order to justify policies that are already in place. Additionally, an evaluation model that was designed to increase the overall knowledge base for long-term strategies in BRs was presented. The researchers in Group B thus recommend an ethnographic approach as well as participatory measures with feedback loops in order to induce understanding, to minimise the risk of oversimplification, and to help people develop a sense of place. The fast production of scientific knowledge – which only needs to be integrated in order to make a change – was identified as a significant benefit of BRs.

■ GROUP C: SUSTAINABLE SOCIETIES AND ECONOMIES (RAPORTEURS: CAROLINE MEYER AND MARTIN BALÁŠ)

Across the globe, 12 research projects were conducted that focused on social structures, recent developments, and governance and management issues in BRs. There was a diverse set of approaches and applied methods, which also reflected the diversity of challenges and problems in the BRs. The first day began with presentations on how management practices and governance structures could be better assessed and monitored. This was followed by input on the issue of involving local and Indigenous communities in the policy and development of BRs. On the second day, the topic of stakeholder engagement and communities as drivers for change was further elaborated and discussed. The researchers noted that a positive element of BRs is their potential as platforms that could allow for collaboration and cooperation between various different stakeholder groups. The final

presentations dealt with local perceptions of cultural landscapes and transformative challenges in socio-ecological systems. In the course of all presentations, two overarching topics were identified: (the lack of) capacities and (the possibilities of) collaboration. The researchers highlighted both the need for “connecting forces” that unite BRs beyond personal relationships and the importance of inclusion and accessibility in collaborative endeavours. The group concluded that there is a need for increased participation opportunities, especially for Indigenous Peoples as well as for the youth.

■ GROUP D: ECOSYSTEM SERVICES IN BIOSPHERE RESERVES (RAPORTEURS: CHARLOTTE GOHR AND ANGELA DICHTÉ)

Group D comprised case studies from 11 different countries, including Egypt, Uzbekistan, Norway, and Malaysia. Several researchers used remote sensing to assess the ecological effectiveness, ecosystem services, and land-cover changes in BRs, while others investigated plastic litter pollution or micro-plastics in seawater and biomarker identification. Three reports presented degradation factors in fisheries and contributions made by nature to people in BRs. The last presentations reported on the conservation status, livelihood interventions, and cultural values of BRs. In the lively discussions after each presentation, the following conclusions were drawn: The name “Man and the Biosphere” refers to human–nature interaction, which is at the core of ecosystem services. Therefore, BRs are ideal for researching these services. However, the individual BRs should provide information on what forms of research are needed. Additionally, the researchers call for increased awareness, research, equipment, and investment in education. One researcher called for a transition from the concept of ecosystem services to the concept of nature’s contribution to people.

In all groups, researchers noted similar challenges for research activities – namely data accessibility, bureaucratic obstacles, and concept–reality gaps (e.g. between maps or official reports and the actual BRs on the ground, or between knowing and doing). However, the benefits of and opportunities for scientific research in BRs were also acknowledged. Finally, the opportunities that the international conference presented and the possibility of getting to know and exchanging ideas with researchers from all over the world were highly appreciated by all participants. A compilation of the collected challenges and benefits can be found in the annex. Together with elements of best practice from research management, these challenges and benefits have been merged into the Eberswalde Declaration.



Research Projects by Early Career Scientists

■ GROUP A: CLIMATE CHANGE AND BIODIVERSITY

Aissaoui, Yousra: Assessment of climate change, aquaculture, and biodiversity in Tunisia's Ichkeul National Park

Yousra Aissaoui⁽¹⁾, Ibtissem Ghorbel-Abid⁽²⁾, Ayadi Trabelsi Malika⁽³⁾

Global climate change is recognised as a threat to the survival of countless species and to the health of global ecosystems worldwide. Indeed, over the last century, global ecosystem biodiversity, in particular, has been declining and has faced a growing threat from climate change, especially in regions already characterised by water deficits and environmental contamination problems. Our study thus aimed to assess and diagnose the trophic status of Bizerte Lagoon and Ichkeul National Park in the Southern Mediterranean. Bizerte Lagoon is

a semi-enclosed Mediterranean ecosystem on Tunisia's northern coast. Our investigation into the mineralogical and geochemical sediments and waters of the system formed by Bizerte Lagoon, Lake Ichkeul, and the Tinja Channel shed light on the complex schema of physico-chemical exchanges and anthropogenic interactions with environmental constituents that take place there. The investigation found that conducting shellfish farming within an integrated, multi-trophic aquaculture farm as a higher trophic level consumer reduced the area needed for aquaculture, thereby allowing mangroves to maintain their integrity and biodiversity.

While aquatic biodiversity generally appears to be much more heavily impacted by human activity than terrestrial biodiversity, it is critical to recognise the significant benefits of integrated multi-trophic aquaculture in terms of conserving aquatic biodiversity.

Our three-year study in Bizerte, Tunisia, confirmed the influence of high entropic pollution, which has exacerbated global warming. The industrial leaching of domestic sewage that is rich in phosphates has also promoted cyanobacterial proliferation by contributing excessive nutrients to the system. The negative ecological consequences of this leaching for lake function include the loss of biodiversity of both flora and fauna in addition to the degradation of the quality of riparian life.

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The approach used here to study coastal lagoons and other transitional ecosystems could additionally be used to assess and predict the evolution of the trophic status of these environments as well as in decision-making by civil authorities, engineers, economists, investors, and other interested stakeholders.

The Mediterranean is highly vulnerable to climate change, which can cause temperature variations as well as eutrophication, harmful algae blooms, water stress, sea-level rise, acidification, and diseases. All of these threats could affect the aquaculture sector. This situation highlights the need for specific scientific information that assesses the vulnerability certain areas to climate change and related phenomena and that identifies appropriate adaptation and mitigation measures.

Botha, Nina: Climate change prevention and adaptation strategies in UNESCO Biosphere Reserves of South Africa

Nina Botha; Julius Maximilians University of Würzburg, Germany

Humanity has degraded the environment to such an extent that we have now irreversibly changed global climatic patterns, thereby pushing ourselves into a new epoch

called the Anthropocene. This climate change threatens not only vulnerable ecosystems, but also the people who depend upon them for survival. It is therefore imperative to find effective ways of both conserving the environment and sustainably fulfilling societal needs. The UNESCO Biosphere Reserve Man and the Biosphere programme addresses these issues by encouraging novel research on human–nature interactions in various fields, thereby extending conservation beyond the boundaries of formally protected areas while also promoting sustainable development. Research on human–nature interactions in Biosphere Reserves helps create mitigation and adaptation strategies for climate change. However, the question arises as to how individual Biosphere Reserves in Africa have implemented these measures and what is needed to achieve the temperature targets set out in the Paris Agreement.

The research method used in my study involved an online questionnaire sent to 100 members of the UNESCO AFRIMAB network as part of a Delphi study. Initial results indicate that respondents were mainly from (1) tropical, (2) wetland, and (3) marine, coast, and island thematic networks in Africa. Most of the reported climate change adaptation and mitigation projects were related to sustainable fishing, followed by adaptations in agriculture, adaptations in forestry, and enhancements in biodiversity conservation in transformed landscapes. Biosphere

Reserves were reported to play a mostly coordinating or partner role in these projects. Several items were mentioned that encouraged climate-change-related projects, with the most frequently mentioned being financial availability and a change of community mindset regarding the use of natural resources.

The challenges posed by the research collection process generally included a lack of Internet connection, language barriers, and response rate. More specifically, challenges arose due to the BR managers' lack of understanding of the research process and to the researchers' ethical responsibilities. The benefits of working with the MAB network included its support and help in developing and testing the research tool with experts in both climate change and AfriMAB. The MAB network also simplified the distribution of the questionnaire.

In conclusion, the support and use of the various networks contributed significantly to the development of my research. Although challenges arose when the research process was not fully understood, these issues could be mitigated.

Dajka, Jan-Claas: Modelling drivers of biodiversity change emphasise the need for multivariate assessments and re-scaled targeting for management

Jan-Claas Dajka (1),(2),, Josie Antonucci di Cavalho (1),(3), Alexey Ryabov (2), Gregor Scheiffarth (4), Lena Rönn (5), Rob Dekker (6), Kimberley Peters (1), (2), (3), Bo Leberecht (7), Helmut Hillebrand (1),(2),(3)*

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Running title: On re-conceptualising biodiversity monitoring

Target audience: Our modelling approaches should be of interest to biodiversity scientists. Moreover, the implications of re-scaling management targets could represent a goal for ecosystem managers who wish to improve biodiversity monitoring.

Summary:

Current policy and goals that aim at conserving biodiversity and managing biodiversity change are often formulated on a global scale. On smaller scales however, biodiversity change is more nuanced and leads to a plethora of trends in different metrics of alpha diversity and temporal turnover. Therefore, large-scale policy targets do not translate easily into local or regional management decisions for biodiversity. Using long-term monitoring data from the Wadden Sea (Southern North Sea), we combined structural equation models and general dissimilarity models in order to enable a better overview of the drivers of biodiversity change. Only a few commonalities emerged because birds, fish, macroinvertebrates, and phytoplankton differed in their response to certain drivers of change. These differences were additionally dependent upon the biodiversity aspect in question and upon which environmental data were recorded in each monitoring programme. No single biodiversity metric or model sufficed to capture all ongoing change, which requires an explicitly multivariate approach to biodiversity assessment in local ecosystem management.

Yoba Alenga Extasié: Bat sonotype as a novel insight into the Congo Basin Rainforest dynamic

Yoba Alenga (1),(2), Claude Mande(2), Guy-Crispin Gembu(2), and Anne Laudisoit (3)

Tropical forest ecosystems are currently undergoing an exponential regression of their surface areas, with subsequent habitat loss and fragmentation. The effects of such disturbances on bats are quite significant and are even leading to a decline in populations. In order to ensure the maintenance of bat populations, it is important to preserve their habitats. This preservation involves highlighting preferential habitats as well as factors related to bat foraging sites.

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However, in Congolese forests, bats are studied using mist netting. Such capture methods have the disadvantage of being invasive and time consuming and of potentially exposing researchers and their assistants to pathogens. In addition, these methods do not effectively sample open habitats, high canopies, or net-shy species. When studying bats, it is hence critical to use acoustic methods, which have the advantage of being less invasive and offer the possibility of monitoring bats both at a distance and over long periods of time. Moreover, acoustic methods can also be used to study a wider – or different – taxonomic range of species than can net-capture surveys.

We thus combined acoustic surveys and capture–mark–recapture methods in order to study relationships between bats and their preferred habitats as well as to identify the functional role of bats that had been captured or recorded in their natural habitat. A total of 42 bats were captured that belonged to 13 species, including 5 species of frugivorous bats and 8 insectivorous bats.

The frugivorous bats – namely the species *Scotonycteris bergmansi*, *Casinycteris arginnis*, *Myonycteris torquata*, and *Epomops franqueti* – are associated with the dispersal of 16 tree species in the Yangambi Man and Biosphere Reserve (*Aidia micrantha*, *Allanblackia floribunda*, *Anonidium mannii*, *Barteria nigritana*, *Canarium schweinfurthii*, *Coelocaryon preussi*, *Dacryodes edulis*, *Mammea africana*, *Maranthes glabra*, *Microdesmis yanfungana*, *Musanga cecropioides*, *Pycnanthus angolensis*, *Staudtia gabonensis*, *Strombosia grandifolia*, *Strombosiopsis tetrandra*, and *Panda oleosa*), while the species *Megaloglossus woermanni* ensures the pollination of the plant species *Maranthes glabra*.

Acoustic monitoring revealed the presence of 11 sonotypes, namely of the species *Chaerephon pumilus*, *Macronycteris gigas*, *Macronycteris vittatus*, *Doryrhina cyclops*, *Rhinolophus fumigatus*, *Neoromicia nana* / *Scotophilus dinganii*, *Pipistrellus nanulus*, *Pipistrellus rueppellii*, *Nycteris arge*, *Myotis bocagii* and *Glauconycteris superba*.

The type of habitat (primary forest) leads to significant increases in bats' foraging activity. Moreover, the medium to high density of the understorey and the medium opening of the canopy both exert significant influence on bat activity and call structure.

Our research was successfully conducted thanks to the cooperation of the reserve's administration, and financial support for the research was provided by the CIFOR through the FORETS project. The results of the research will be capitalised upon in order to support conservation efforts in other protected areas of the DRC, to support biodiversity monitoring, and to put in place necessary and effective measures for sustainably managing forest ecosystems. The complementarity of acoustic monitoring and capture is crucial to understanding the mecha-

nisms that govern the aggregation of bat assemblages in order to assess bat activity and the ecosystem services that bats provide.

Klinger, Yves: Distribution and management of the invasive garden lupine (*Lupinus polyphyllus*) in the Rhön Biosphere Reserve

Yves P. Klinger, Division of Landscape Ecology and Landscape Planning, Justus Liebig University Gießen, Germany

The semi-natural grasslands found in the UNESCO Rhön Biosphere Reserve in central Germany are remarkably diverse ecosystems. However, these grasslands are being affected by global change. During the last decades, land-use change and a warming climate have favoured the spread of several problematic species. One species of particular concern is the invasive garden lupine (*Lupinus polyphyllus* Lindl.), which is among the most widespread invasive plants in all of Europe. Historically, the species was introduced during the first half of the 20th century to the Rhön Mountains, where it was widely used for roadside greening and soil melioration in newly planted spruce forests. Due to recent changes in land-use management, the garden lupine has spread from roadsides to adjacent grassland areas, where it threatens native biodiversity. In order to develop effective management strategies for the species, detailed knowledge about its distribution and dispersal pathways is crucial. To that end, we (1) assessed the spatial distribution of the garden lupine and (2) studied its dispersal via grassland management.

In a first study, we assessed the spatio-temporal distribution of the garden lupine. We mapped the species' distribution in a heavily invaded part of the Biosphere Reserve and compared this distribution with a 20-year-old map showing lupine distribution. Based on the spatial patterns, we derived management recommendations that target key invader stands. In a second study, we assessed the long-distance dispersal of the species. As the garden lupine is presumed to spread via grassland-management practices, seed dispersal via mowing and pasturing was analysed in cooperation with local farmers and shepherds.

We found that the garden lupine has spread significantly throughout the last decades and can be considered a major threat to grassland biodiversity in the Rhön Biosphere Reserve. The species' current spatial distribution is closely tied to features of the underlying landscape and to its invasion history. Furthermore, we were able to show that grassland management is indeed at risk of facilitating the spread of the species given its currently inadequate management. However, the spread of the garden lupine can be mitigated by adapting management schemes. Such adaptation goes hand in hand with increased effort for local farmers, shepherds, and conservation

managers. Furthermore, controlling the garden lupine is complicated by conflicting conservation goals.

Overall, the spread of invasive species such as the garden lupine poses a challenge to Biosphere Reserves, local administrations, and landscape managers alike. Moreover, in the future, more problematic species are likely to be introduced to Biosphere Reserves. In order to reduce the negative effects caused by these species, holistic land-use concepts that consider relevant conservation targets, invasive species management, and local perspectives are needed.

Maroini, Amina: Understanding heat extremes in Sub-Saharan Africa: Projected changes in UNESCO Biosphere Reserves

Authors: Amina Maroini, Alessandra Giannini, Martha-Marie Vogel, Host Institution: IPSL-LMD, France

Sub-Saharan Africa has been identified as one of the most vulnerable regions to climate change and as an area in which an increase in the intensity and frequency of temperature extremes can be already observed. However, the local impact of extreme events on key sectors remains uncertain and has yet to be quantified. Sub-Saharan Africa contains 86 UNESCO-designated biosphere reserves (BR), which should serve as “observatories for climate change” and are thus ideal regions to study projected changes in heat extremes.

Better understanding how such extremes are changing in a warming world would enable adaptation action and allow us to better prepare for such events in order to avoid the most severe impacts. Therefore, we explore the changes in impact-relevant climate indices and pay particular attention to human heat stress as well as to temperature and precipitation extreme indices by using projections from state-of-the-art global climate model projections (i.e. the CMIP6 multi-model ensemble) under a high-emission “business-as-usual scenario” (ssp585). We additionally analyse projected changes in global warming levels from 1.0° C to 3.0° C relative to pre-industrial levels in the 86 sub-Saharan African UNESCO BRs, which span monsoon, wet, dry, and Mediterranean climate regions.

We additionally identify hotspots of high levels of health risk due to heat stress in BRs with monsoon and rainy climates. High health risk is associated with different relations between temperature and precipitation changes. BRs with a Northern Hemisphere (NH) monsoon climate reach high health risk earlier (as early as at a global warming of 1.0° C) compared with other climate classes. BRs with a NH monsoon climate also begin with higher temperatures, and the projected temperature increase occurs together with a strong increase in precipitation. In Southern Hemisphere (SH) monsoon and rainy clima-

te BRs, high health risk is projected to occur only with a global warming of +3.0° C, with values being highest overall in the SH monsoon region compared with in the rainy climate region. Since the SH monsoon region is projected to experience an intense future drying, this finding suggests that the strong increase in extreme temperature is driven by an amplification of land warming through land-atmosphere feedbacks. In addition, we use BR population data to identify high-risk hotspots for heat stress exposure. In particular, we find that limiting global warming to +1.5° C instead of +2° C would lead to a nearly two-fold reduction in the projected population exposure to high health risks.

In order to quantify the local impacts of heat, a more in-depth analysis is needed, notably by assessing the vulnerability of BR populations and ecosystems to the impacts of heat in the current and future climate. Qualitative data that identify (1) how local people experience the impacts of heat on health and (2) what measures are taken to support resilience to heat extremes by local stakeholders and/or (3) indigenous knowledge could serve as a baseline for this vulnerability assessment.

Using the updated 2020 data on BR populations, we investigated how many people in sub-Saharan African BRs would be impacted by heat stress. Our results emphasise the substantial benefits of limiting global warming to +1.5° C instead of +2° C because half a degree of difference between two warmer future climate states can considerably affect the projected exposure of the population to high health risks. This finding highlights the importance of implementing mitigation and adaptation measures and policies in line with the MAB Strategy. Indeed, biosphere reserves can and should serve as study sites for rapidly developing and monitoring solutions to the challenges of climate extremes on humans and ecosystems, which would assist in developing both resilience and mitigation strategies and practices.

Márquez Govea, Lázaro: Results and relevant experiences from scientific research and monitoring in the Guanahacabibes Peninsula Biosphere Reserve

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The Península de Guanahacabibes Biosphere Reserve is located on the western end of the Cuban archipelago and is the only Antillean Island territory with coasts on both the Caribbean Sea and the Gulf of Mexico. This peculiar location gives rise to a unique natural environment that is characterised by distinctive species, habitats, ecosystems, and landscapes that have been preserved as a result of a development model that fosters various uses of natural resources through sustainable management practices.

Research gaps on the structure of mangroves, the dynamics of coastal vegetation, community perceptions of climate change, and the conservation status of key species of local fauna have been identified. As a result, we posed following research question: What impacts do scientific research and monitoring programmes have on the effective management of the biosphere reserve? Standardised protocols were used to monitor mangroves and coastal vegetation, a survey was developed to assess local people's perceptions of climate change, and the Spatial Monitoring and Reporting Tool (SMART) was used as an advanced technique for studies on biodiversity.

A detailed description of the structure of the mangrove was obtained. Mangroves were assessed as currently being capable of allowing fulfilling their basic functions, even when damage is caused by extreme natural events. Coastal vegetation was also evaluated, and the response dynamics of this ecosystem to the effects of hurricanes was studied. Relevant experiences from sea turtle monitoring programmes were obtained via citizen science in order to determine the dispersal patterns of invasive species. Evidence was additionally obtained on how local people perceive events related to climate change.

The challenging elements of the research included (1) training local residents to assimilate to the used protocols and (2) the temporary interruption of the monitoring series due to natural disasters and as a consequence of the COVID-19 pandemic over the last two years.

Beneficial factors for carrying out scientific research programmes and monitoring include the presence of a team of qualified specialists who work in the biosphere reserve, access to funds from international cooperation, and long-standing interaction with scientific and academic institutions.

We were able to demonstrate that scientific research and monitoring programmes allow us to expand our knowledge about the state of conservation of biodiversity and natural resources in addition to providing evidence on the impacts produced by natural and man-made events. Moreover, such programmes make it possible to generate up-to-date scientific knowledge on select conservation and management strategies and to formulate use regulations based on functional zoning.

Maruf, Amar: Exploring the potential role that patron-client relationships play in social resilience to the impacts and risks of climate change among small-scale Sama-Bajau fishers in Wakatobi National Park, Indonesia

Amar Maruf (1), Asnarulkhadi Abu Samah (2), Nobaya Ahmad (3), Hanina Halimatusaadiah Hamsan (2)*

As one of the internal dynamics at play within fishing communities, the patron-client relationship (PCR) plays a potential role in determining the social resilience that fishers have to the impacts and risks of climate change. However, most PCR studies have only covered intermediaries as the principal patrons, whereas other patrons – such as governmental and non-governmental actors – have been largely neglected. Furthermore, previous studies have also explored the relationships between social capital and climate change adaptation. However, several aspects remain underexplored, such as how the elements and types of social capital form in the specific patron-client relationship, how such relationships contribute to social resilience (in terms not only of coping and adaptation, but also of transformation), and why particular arrangements between patrons and clients can support or hinder the capacities required to better respond to climate uncertainties and risks.

Our study explored the potential role that the patron-client relationship plays in social resilience to the impacts and risks of climate change among Sama-Bajau small-scale fishers in Wakatobi National Park, Indonesia. A case study was purposively selected when undertaking the study. The study area was Wangi-Wangi Island in Wakatobi, Indonesia, where most Sama-Bajau fishers in the Wakatobi District reside. The study included 15 fishers and eight patrons, who were all involved for five months. Field observations, informal talks, and official document analyses were carried out in order to enrich and cross-check the primary data. The findings indicate that

1. fishers and their patrons have a common perception of the impacts and risks of climate change;
2. patron-client relationships within the Sama-Bajau fishing community are characterised by debt, kinship, pure business, fishery policy, and conservation;
3. Sama-Bajau fishers have developed diverse strategies to either cope with, adapt to, or transform potential impacts and risks of climate change because they can make use of various types of social capital thanks to their relationships with different patrons;
4. fishers can reduce the dark side of social capital (e.g. the syndrome of dependency and the long-term sustainability of coastal and marine resources) that is often

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- embedded within single-patron relationships by optimising benefits from relationships with other patrons;
5. Sama-Bajau fishers' capacity to withstand the impacts and risks of climate change evolves from coping to transformative measures based on their preference of whether to restore, secure, or enhance their own well-being as well as based on the patron network they have maintained and the level of trust and norm of reciprocity they have practised; and
 6. engaging in diverse networks could be a good form of resilience not only for the human system, but also for ecological systems.

In conclusion, the greater the number of PCRs and the more varied the types of social capital are, the weaker the dark side of these relationships is and the better the social resilience of Sama-Bajau fishers to the impacts and risks of climate change is. Exploring the role of female fishers and fishers' homemakers in determining the social resilience of fishing households to internal and external socio-economic, political, and environmental stressors represents a fruitful path for future research.

Moreira, Miguel: Portuguese Biosphere Reserves as model areas for new insights into mapping and assessment of ecosystem services

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Biosphere Reserves (BRs) have been identified as places for learning about sustainable development and that emphasise the importance of achieving the UN Sustainable Development Goals (UNSDGs). Nevertheless, Portuguese BRs lack recognition from society as well as from local, regional, or national entities as privileged instruments and areas for valuing and sustainably developing territory.

Our study involved assessing ecosystem services (ESs) – which play a fundamental role in mitigating and adapting to climate change – and the sustainability of BR communities and territories. In a first step, we gathered all available geographical and bioclimatological information in order to map the current and potential ESs provided by Portuguese BRs. This ecosystem mapping followed the European MAES approach (Mapping and Assessment of Ecosystems and their Services), in which a crosswalk was defined for harmonising all land use and land cover (LULC) classes from the different sources of landcover data gathered for this purpose. The bioclimatological information was also included as a LULC class in which two parameters – namely thermotypes and ombrotypes – were included as additional spatial layers in order to more precisely define the different habitats that are present at all BRs by using a common bioclimatic classifi-

cation of all inland territories. Secondly, with the output of the stakeholders' participatory approach in each BR, the key ESs were identified and valued, leading to the endogenous and identity ES mapping, in which local actors were regarded as fundamental players in sustainable territory management actions.

Despite its relevance, the concept of ESs is hardly implemented in decision-making processes, especially when it is not explicitly treated individually in different areas of intervention. Studies have shown the importance of involving different stakeholders at the beginning of the ES assessment. A participatory approach with stakeholder contributions is essential for addressing the interests of different actors in ESs, thereby helping to develop the mechanisms for managing, conserving, sustainably using, and valuing ESs.

In our study, by using participatory methodologies, we identified the key ESs provided by the Portuguese BRs and determined their potential and main threats in the target areas. Finally, for the ES mapping, an innovative methodology was developed and applied to the Portuguese BRs that included the previous assessments together with information on ecosystem conditions using the list of MAES indicators that were most relevant for the ES mapping (e.g. vegetation quality index – NDVI; soil organic carbon; protected areas). Using this holistic assessment, which encompasses the ecological, economic, and social perspectives of the different ESs, it will be possible to define guidelines for mitigating and adapting to climate change scenarios that are centred in biodiversity and natural resources as the key providers of ESs while simultaneously enhancing BRs as model areas for achieving the UNSDGs.

Tuyizere, Diogene: Preliminary evidence of upland plant encroachment in high-elevation wetlands of Volcanoes National Park (Volcans Biosphere Reserve), Rwanda

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Wetlands are among the most threatened habitats on the planet due to various anthropogenic activities (Zedler & Kercher, 2005; Stephenson et al., 2020). Altered wetland hydrology may induce encroachment by both native and invasive upland plant species (Sepp et al.,

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2021), which affects wetland biodiversity (Wilcox et al., 2018) and threatens the existence of wetland ecosystems (Andersen & Steidl, 2019). Upland species encroachment has been well documented elsewhere (Auken, 2000) but given little attention in the Afrotropics (Andela et al., 2013). Therefore, in our study, we used stratified random sampling of nested plots of 10 m × 10 m for trees, 5 m × 5 m for shrubs, and 1m×1m for herbs (total = 164 plots inside, 72 plots outside, soil moisture at base and at 2m) and statistical analyses (Chi-square tests, Wilcoxon test, Pearson correlation test, and QGIS) to produce maps.

No effects of wetland size on the density of upland woody plants was found (estimate = -0.482; SE = 1.338; z-value = -0.360; P = 0.719). Although we found no evidence that woody upland plants establish themselves on particularly dry micro-sites within wetlands, median moisture levels were higher at the base of the woody plants (55.0 %; SD = 17.4 %) than at two meters of depth (50.0 %; SD = 19.7 %; W = 3,192; P < 0.001), and relative densities both inside and outside the wetlands varied significantly across woody upland species ($\chi^2 = 153.89$; df = 6; P < 0.001), which suggests that certain species are more prone than others to encroaching on wetlands.

Challenges during the study included topographic factors, the presence of dangerous animals, the need for a research permit, and the limited study support. Our study should prove useful in the management of wetlands as a whole in Volcanoes National Park (VNP) by enabling adaptive management decisions to be taken after evaluating the arrival dates of the colonising plant species and estimating rates of upland plant encroachment or vegetative succession. Indeed, we now have baseline data on upland plant encroachment and wetland desiccation. Our study suggests that woody and herbaceous upland plant species are encroaching considerably upon VNP's wetlands, which requires further monitoring across years and seasons. Such monitoring efforts will aid sustainable management efforts that are focused on maintaining the ecological integrity of these wetlands.

Valencia, Esteban: Development of a methodology for monitoring ecosystem hotspots in the Chocó Andino Biosphere Reserve using unmanned aerial vehicles and satellite imagery

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According to the latest global report from the Convention on Biological Diversity [1], one of the primary causes of biodiversity loss is agricultural practices, which account for an estimated 70 % of terrestrial species extinction. Due to the dearth of historical data on the state and degree of the conservation of these ecosystems, de-

veloping programmes and policies for their protection and management is challenging [2]. The Chocó Andino biogeographical region covers an area of approximately 19 mil hectares and occupies territory in three countries: Panama, Colombia, and Ecuador. Located in Ecuador, the Chocó Andino BR has an area of 286,805 ha [3] and contains significant biodiversity hotspots with numerous implications for the regional ecosystem. Thus, periodic and precise monitoring is necessary to map and find patterns in the region's biodiversity in order to contribute to the formulation of conservation policies [4].

Our project established a multi-agent monitoring framework using unmanned aerial vehicles (UAVs) and satellite imagery in order to assess the state of the Chocó Andino BR's most vulnerable ecosystems. UAVs are remote sensors that have many advantages when it comes to gathering information, and depending on the payload carried, the collected information can contribute to different aspects of biodiversity, such as species mapping, territorial planning, and strategies for ecosystem restoration. On the other hand, satellite data yield critical information and provide extensive coverage of areas that can be reviewed quickly and without resorting to mere visual assessments of the landscape. Satellite images make it easy to gather information about vegetation and water coverage at low cost and with good enough accuracy for certain applications. In this context, our work techno-economically assessed the feasibility, periodicity, and resolution of monitoring with both agents for three representative pilot zones. These pilot zones were defined based on the ground altitude and the topology conditions for deploying both platforms. For UAVs, the mission, performance, and endurance were computed using parametric and simulation codes.

The use of both approaches enabled us to compare them and accurately tune the UAV performance accordingly such that the UAV mission evaluation could predict the amount of energy and time required for monitoring. On the other hand, satellite imagery was used to define NDVI maps, DEMs, forest distribution, and BR biomass. These quantitative evaluations enabled us to assess the suitability of both monitoring agents and to create a thematic map for use with the monitoring agent. In conclusion, our work demonstrated the techno-economical suitability of a multi-agent monitoring framework in which mission requirements were considered for optimising surveillance activities depending on the agent that was used to gather the imagery. We additionally highlighted the specific strengths that high- and low-fidelity methods of assessing UAV performance have for gathering data in the Chocó Andino BR, and the satellite data enabled us to collect maps for different analyses that should prove useful for future historical analyses and prospective models. Finally, we were able to provide a thematic map of the biosphere's exploration zone that highlights areas in which remote monitoring is more efficient and practicable than is traditional monitoring.



Weiss, Fabio: Long-term population trends of ground beetles (Coleoptera: Carabidae) in old-growth beech forests in the Schorfheide-Chorin Biosphere Reserve

Re-assessing ground beetles in the lowland beech forests of the Schorfheide-Chorin Biosphere Reserve

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An increasing number of studies have reported declines in insect populations from a variety of taxonomic groups in different habitats, yet the full extent of this crisis remains unclear. We are thus currently conducting a repeated survey of ground beetles (Coleoptera: Carabidae) in lowland beech forests based on a previous study from 1999–2001. The majority of the 12 sampled beech forest sites are situated within the Schorfheide-Chorin Biosphere Reserve. Five of the sites are strict reserves with high conservation value, two of which are part of the UNESCO World Natural Heritage. Since 2020, we have sampled ground beetles using the exact same methods as 20 years earlier and at the original locations with the goal of temporally comparing abundances, biomass, and biodiversity metrics. Data collection remains ongoing, and first results are expected in early 2023. Insights from a similar research project (Weiss and Linde, in prep.) suggest considerable decreases in

abundance and biomass between the two considered periods, to which severe droughts (2018–2020) might have contributed considerably. Our research will deliver another important puzzle piece in the investigation into insect decline and the impact of extreme weather events, which are expected to occur more frequently as climate change progresses.

Research projects such as ours contribute to the investigation into global environmental changes in Biosphere Reserves (Lima Action Plan). These projects support Biosphere Reserves in the reserves' otherwise cost- and labour-intensive monitoring objectives and thus help to preserve regional biodiversity (Seville Strategy). Moreover, our study demonstrates the importance of archiving research data and meta-data from previous studies as these data might be relevant for future research. Good and long-lasting relations between the administrations of Eberswalde University for Sustainable Development and the Schorfheide-Chorin Biosphere Reserve have critically contributed to the feasibility of this project. However, systematic information from research carried out in Biosphere Reserves remains generally lacking. The accessibility of existing data should thus be improved, for example, by using a central database to unlock the scientific potential of Biosphere Reserves and to foster future research and cooperation with external partners.



■ GROUP B: INNOVATIVE AND SUSTAINABLE USE OF NATURAL RESOURCES

Cervantes Zamora, Nikole Gloriana: How the UNESCO Biosphere Isle of Man can engage with local businesses

Nikole Cervantes Zamora; UNESCO Biosphere Isle of Man

The Isle of Man was designated a UNESCO Biosphere in 2016 in recognition of its unique environment, culture, heritage, and economy. The Biosphere Isle of Man is administered by a stakeholder partnership group that is chaired by the Isle of Man's Chief Minister and that has members from tourism, farming, conservation, education, commerce, culture, heritage, non-governmental organisations, and the third sector. The Biosphere Isle of Man's main work involves executing different projects in connection with crucial sectors within the Isle of Man.

The UNESCO Biosphere & Business project was designed as a result of the arising need to engage local businesses with the Biosphere Isle of Man, and vice versa. The principal idea was to allow companies to become more involved, to highlight the positive steps taken thus far, to investigate the limitations that companies can identify, and to actively engage more businesses without enforcement or regulation.

The project was carried out using a participatory action research methodology and was analysed from the perspective of environmental psychology. It was divided into two execution stages: an analysis stage and an experimentation stage. During the analysis stage, a sense of community or belonging was identified among the Biosphere Isle of Man's business partners, which served as the basis for the second phase, in which the businesses participated in a series of activities that they had proposed themselves.

One of the main challenges that the Biosphere Isle of Man's business partners identified was the lack of clarity on what a biosphere is. Since they did not understand what it means to be a Biosphere Reserve, they did not know how to become more involved even though they had already carried out actions in line with the biosphere's work. The project allowed the Biosphere Isle of Man to be viewed from a holistic perspective in which a crucial relationship could be seen between nature and people. The project results and the ideas proposed by the participants were integrated into the new Biosphere Isle of Man 2021–2026 strategy and inspired activities that are currently being carried out.

Dabard, Caroline: Sustainability innovations. Enhancing the transformative

Dabard, Caroline Hélène (1); Gohr, Charlotte (1); Mann, Carsten (1); Martín-López, Berta (2)*

A surprisingly high number of sustainability innovations have taken place in a rather peripheral French region. In fact, we were able to find 109 projects in various sectors and at different development stages that have created a tangible sustainability dynamic in Fontainebleau-Gâtinais Biosphere Reserve. Sustainability innovations include novel products, behaviours, processes, organisations, services, markets, and values that induce positive changes in a specific socio-ecological context in terms of socio-ecological integrity and equity. In the field of transition and innovation studies, many scholars have argued that space matters – that is, that innovations are highly context-dependent. Nonetheless, studies often focus on regions and innovations with high visibility, thereby overlooking less obvious regions and novelties, such as local organic farming and alternative trade schemes. However, we expected that these rather “discreet” innovations would prove relevant to fostering a comprehensive societal transformation towards sustainability and that peripheral regions might also go through change processes. We therefore carried out a study in Fontainebleau-Gâtinais Biosphere Reserve – a peri-urban region south of the French capital city of Paris. Using a snowball identification approach, we found 109 projects and administered a survey to 61 of them. We then applied three analysis approaches to our data:

First, a cluster analysis allowed us to identify sustainability innovation patterns and types. Sustainability innovations appeared in various sectors, mostly in agriculture, trade, civil society movements, education, and tourism. Sustainability innovations were very often found to be innovative in their regional contexts. For example, consumer cooperatives were frequently frontrunners in their region but participated in a trend of similar projects nationally or globally. Furthermore, innovation actors often showed ambitious sustainability goals and sought to reduce negative environmental impacts while promoting social sustainability, for example, through fair wages or by raising awareness. In line with these multiple goals, single projects frequently consisted of multiple novelties, such as new products and new organisational forms.

Second, using a social network analysis, we explored how innovative networks are organised in the region and which actors play a central role. We found a strong dominance of the local regional nature park in innovative networks as well as strong links within agricultural produ-

cers and local alternative shops. Moreover, the Biosphere Reserve administration proved to be well known in the region yet to have little impact on ongoing projects.

Third, a spatial mapping unravelled actor- and network distribution patterns, thereby highlighting the influences of urbanisation, socio-economic factors, and accessibility. Different spatial patterns were found across the Biosphere Reserve that related to administrative structures and urbanisation. With our exploratory research, we contributed both to innovation theory – by identifying different ideal types of sustainability innovations – and to a better understanding of geographic, place-based innovative dynamics for sustainability. This contribution can – in turn – help to inform regional innovation governance during sustainability transitions. For instance, we were able to unravel synergies between ongoing innovative dynamics and the Biosphere Reserve missions, thereby highlighting strategies that Biosphere Reserve administrations can use to enhance their transformative potential.

Hulihalli Manjunatha, Sharath: Human-wildlife interactions: A case study from Bandipur National Park, India

Sharath Hulihalli Manjunatha (1), Divya Rajeswari Swaminathan (2);

Human-wildlife (HW) conflicts are common in and around protected areas (PAs). From an anthropocentric perspective, HW conflicts can occur when wildlife damages crops, injures or kills domestic animals, or threatens or kills people. From an animal-centric perspective, human encroachment on natural areas may pressure wildlife into expanding their territory. Our study focuses on the socio-economic and ecological perspectives of human-wildlife interactions and draws from the case study area of Bandipur National Park (BNP), an important wildlife habitat in Southern India. BNP is situated in the Mysore and Chamarajanagar districts in Karnataka, India, and forms part of Nilgiri UNESCO Biosphere Reserve. The park is spread over an area of 913.04 km². Socio-economic impacts and conflicts between wild animals and people living in adjacent areas of BNP have rarely been explored. Hence, our study focused on the impacts of HW conflicts in BNP. We used a multi-tier methodology with both qualitative and quantitative techniques. Individual interviews and group discussions with people around BNP and direct interviews with forest officials were conducted. Moreover, satellite images were analysed in order to shed light on changes in forest cover and habitat loss.

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In BNP, the population of Asian elephants and Bengal tigers has been gradually increasing in recent years, and the human population has also grown both in and around the BNP perimeter. National Highway 766, which passes through BNP, has thus become a deadly road for animals. Our study found that several animals have been killed in road accidents, which indicates that the natural habitat in which these wild animals live is unsafe for them. Agricultural expansion around BNP is damaging the natural habitat. During the dry season, animals rush towards agricultural fields in order to find food and water. Frequent forest fires are also causing habitat loss in vast areas, which is leading many animals to move to agriculture fields. One of the major reasons why animals are moving out of the protected area has to do with habitat loss due to deforestation, forest fires, and invasive plants. Satellite images indicate that the northern part of BNP is gradually being overtaken by shrubs and is being covered with invasive plants that are not compatible with the wild animals currently in the area.

During our study, we travelled to interior regions of BNP, where affected people live inside and around the forest in areas that are less accessible due to poor network connectivity. In BNP, HW conflict data are not openly accessible to everyone due to government regulations. It is also challenging to obtain permission to collect data on the region. Due to COVID-19 restrictions, we were not able to collect quantitative data from the forest department. During our field work, however, Indigenous People from the area helped us by providing food and accommodations. They also provided a guide to help us navigate through the area safely.

The BNP Forest Department is currently implementing measures to mitigate HW interactions, such as installing solar fencing and natural barricades, creating a night traffic ban on NH 766, and raising awareness for wildlife protection. However, these measures are not sustainable and have not proven effective. Compensation for crop and human damage has been poor and difficult to obtain. If we do not properly manage HW interactions in BNP in the near future, we will have to face increasing HW conflicts. People around BNP have already begun migrating to bigger cities in search of jobs due to crop damage, loss of life, poverty, and worry about attacks from wild animals. Finally, our study revealed that if we can mitigate this conflict in a sustainable manner, BNP could become the one of the best regions of HW co-existence on earth.

Kone, Loua Serge Patrick: Improving the performance of cocoa-based agroforestry systems in the Taï Biosphere Reserve transition zone

Sustainable agrosystem management on the outskirts of protected areas: The case of the Taï Biosphere Reserve (south-west Ivory Coast)

KONE Loua Serge Patrick (1), (2); SORO Kafana (2); KONATE Mory Latif (1)

Due to anthropogenic pressures on protected areas, cocoa-based agrosystems in nearby areas could contribute to the conservation of plant biodiversity at these protected sites as well as to their sustainable management. However, as studies dealing with questions of cocoa-based agrosystems – particularly in the western transition zone of the Taï Biosphere Reserve – are almost non-existent, our study was urgently needed. We therefore used Landsat 2020 satellite images to highlight the land saturation of the western periphery of the Taï Biosphere Reserve by mapping the land use of cocoa-based agrosystems. Similarly, we conducted an agro-ecological and socio-economic diagnosis of cocoa-based agrosystems and recorded the constraints that limit the production of agrosystems.

Cocoa-based agrosystems occupy the entire western periphery of the Taï Biosphere Reserve but are more concentrated in the central and southern regions. Overall, 132 species belonging to 35 families were inventoried. Among these species, 25 were declared vulnerable and endemic according to the criteria of the IUCN Red List. The average values of the calculated diversity indices were 2.902 (Shannon) and 0.586 (Piélou). The density of trees associated with the agrosystems was evaluated at an average of 13 stems/ha and displayed a remarkable abundance of *Cola nitida*, *Citrus sinensis*, *Persea americana*, *Mangifera indica*, and *Ficus mucuso*. Two categories of production constraints were recorded: agronomic constraints and environmental constraints. For the agronomic constraints, we observed strong parasite pressure and orchard ageing. For the environmental constraints, high rainfall and the effects of climate change were noted. Non-natives and foreigners were found to be most involved in exploiting cocoa-based agrosystems. In the vegetative phase, family and wage labour is used; however, in the production phase, the helper group is used.

In sum, cocoa-based agrosystems cover the entire study area but are more concentrated in the central and southern regions and have good potential for conserving the biodiversity of woody plants. Foreigners are the most involved in exploiting the agrosystems. They use all means possible in the cocoa value chain in order to ensure good yields, and they face enormous difficulties that do

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not allow them to control the yield of their farms. Some results – such as spatio-temporal dynamics – have not yet been obtained as the study is still in progress. The challenges that our study has faced include (1) the lack of data on cocoa farming for a zone that is considered to be high in cocoa bean production, (2) the fact that this crop occupies a central position in the economy of Ivory Coast, (3) the focus of the Biosphere Reserve's management on conserving the interior, and (4) the usefulness of the new technologies (i.e. remote sensing) in managing natural resources. The factors that have proven beneficial in realising this study include the fact (1) that it serves as a complement to my first study, (2) that it involves positive cooperation between the Ivorian Office of Parks and Reserves (OIPR) and village authorities, and (3) that it receives funding from the UNESCO MAB programme through the 2021MAB Young Scientist Grant.

Laibich, Rebecca Yego: Indigenous knowledge

Rebecca Laibich

Conflicts of interest: The author declares no conflicts of interest; Institution: Multiplant International Medicinal Conservation Garden Arboretum, Kenya

Restoring degraded forests in order to enhance biodiversity and ecosystem services as well as to mitigate climate change and adaptation is now a major priority around the world. Our study evaluated the success of the Multiplant International Medicinal Conservation's (MIMC) Community Reforestation Project in the Cheptandan stream, Kenya, by assessing the project's ecological attributes.

Measures of plant richness, diversity, vegetation structure, invasive plants, and ecological processes were contrasted across a chronosequence of habitats under restoration (0 years old, 3 years old, and 5 years old) and were compared with a reference forest habitat (remnant natural forest). Native tree species recruitment and vegetation structure increased with restoration age. Ecological processes – represented by the composition of pollination and seed dispersal traits in all of the habitats under restoration – were similar to the reference habitat. However, low tree density and an increase in alien invasive species (IAP) cover with increasing restoration age were identified as threats to reforestation success.

We therefore recommend enrichment planting and an effective IAP management strategy that promotes more rapid habitat restoration while reducing site maintenance costs. Enrichment planting should focus not only on increasing tree species density and richness, but also on including species with missing pollination and seed dispersal categories.

Keywords: ecosystem processes, invasive alien plants, pollination, seed dispersal, ecological restoration, sustainable development, species diversity, vegetation structure

Luna Sánchez, Eduardo: Inter-organisational comparison of evaluation use in a Biosphere Reserve

Eduardo Luna Sánchez; Autonomous University of Queretaro, Mexico

In the conservation field, the *raison d'être* of evaluations is to improve the effectiveness of organisations so that they are able to better deliver on their central goals. The information derived from evaluations is expected to be able to generate results and – specifically – to enable decisions to be made and projects to be managed through adaptations. However, it is unclear whether evaluations are truly useful for learning about how to manage protected areas or whether they measure what is needed in order to improve performance. The objective of my research was thus to compare the way in which different organisations use evaluations in a Biosphere Reserve located in central Mexico, with the goal of establishing similarities and differences in the degree to which these organisations use evaluations as a learning tool.

The phenomenon was described in four organisations that implement natural resource management projects – namely a local government, a federal agency, a public university, and a non-governmental organisation (NGO). Framed as a case study, an analysis of institutional documents was combined with semi-structured interviews in order to gain access to the desired information. Results revealed important differences between the four organisations. While the federal agency and the NGO had the most diversified evaluation systems and covered the ideal purposes of accountability, organisational learning, and fundraising, the evaluation system used by the public university was found to be more limited and was even non-existent in the case of the local government. Thus, at the artifact level, both the federal agency and the NGO were better positioned to learn from evaluations. In turn, a series of factors that shaped the organisational evaluation systems were highlighted and explain why a disconnect between theory and practice was present.

These factors were systematised in order to distinguish between three levels: methodological, organisational, and institutional. Although there were exceptions, the staff of the organisations mentioned the predominance of summative evaluations based on the delivery of predetermined, quantifiable results. Consequently, the limited margin of reporting failures and unexpected results on the one hand and the bias towards reporting numbers above process analyses on the other hand were found to be major obstacles in using formative evaluations. Based on the obtained knowledge, ad hoc interventions were designed in order to strengthen the evaluative capacity of each of the studied organisations.

Messgo-Moumene, Saida: Impact of the use of bio-inputs on some plant species of industrial interest in Algeria

Saida Messgo-Moumene (1), Lillia Oualha (1), Naima Bou-tekra (1), Smain Chemat (2)

In Algeria, a high diversity of phylogenetic resources exists thanks to the presence of different biotopes (humid, sub-humid, sub-arid, and arid). This plant diversity could be sustainably valorised in industry but is threatened by several constraints, such as the overexploitation of soil, the excessive harvesting of plant species, chemical toxicity, the resurgence and aggressiveness of pests, and climate change. In this sense, our objectives lie in researching and using bio-inputs with a high potential for cultivating plant species of industrial interest, in domesticating and multiplying phylogenetic resources, in conserving plant diversity while preserving the environment, and in providing extracts to an industry that uses plant materials and/or high-quality plant secondary metabolites.

For these purposes, we assessed the growth parameters, essential oil (EO) yields, phenolic compound yields and content, vitamin C content, and antioxidant activity of plant species intended for food production and processing and of fruit juices of plant species intended for food production and processing. Additionally, we performed GC/MS analyses of EO samples of *Pelargonium graveolens* and *Thymus numidicus* grown under the effect of bio-inputs.

Results were promising and revealed that plant biomass, the yield of extracts and secondary metabolite contents, and the antioxidant activity of the tested crops and cultivated medicinal plants had been optimised and correlated with the chemical composition and the type of bio-inputs, the emergence of new EO chemotypes, and the phenolic compound extracts of the treated plants of *P. graveolens* and *T. numidicus*. The quantitative and qualitative variability of biomolecules was noted (in some cases, there was an absence or presence of biomolecules and variable proportions in comparison with controls). Furthermore, some endemic strains of *Trichoderma* spp. that had been tested as bio-inputs in the studied plant species demonstrated variable performance, with T5 and T11 performing best.

The research study faced several challenges, including the insufficiency of the samples harvested from the biosphere; the lack of equipment, means, and a financial

budget; and the high cost of the phytochemical analyses needed to conduct a complete research study. Moreover, some dosages and analyses could not be completed – such as analyses of phyto-hormones and soil – or had to be delayed due to the absence of standards for controlling and comparing the quality of the samples. Some other difficulties were related to the insufficient availability of sources of literature that discuss and compare the obtained results. However, the most important challenge was related to the two-year delay (2020/2021) in field experiments due to the COVID-19 pandemic.

Nevertheless, our research yielded multiple benefits as well as several scientific articles and bilateral cooperations. Indeed, two PhD thesis – one each on *P. graveolens* and *T. numidicus* – were carried out, two scientific articles were published in the *Allelopathy Journal* in 2022, and one research project (D00L05UN09012210001) as well as three co-supervised theses were conducted: two PhD theses with El Mansoura University (Egypt) and one Master of Science thesis with CIHEAM BARI (Italy).

Ogundele, Olusegun Michael: Evaluating the potential of the participation of women and youths in the UNESCO/FRIN GEBR project in Omo Forest Reserve

Olusegun Michael Ogundele; Nigerian MAB Youth Forum and the Nigerian Youth Biodiversity Network, Nigeria

UNESCO Biosphere Reserves are recognised natural sites dedicated to conserving and protecting the benefits that nature has to offer humanity and the environment. Natural ecosystems are best kept in their undisturbed, natural states by establishing Biosphere Reserves. Moreover, the forest communities and indigenous peoples who live in these reserves are well trained in how to best interact with the natural ecosystem without altering any part of it and without depending entirely on forest resources. Additionally, these peoples have the options of taking advantage of alternative sources of income. In implementing this UNESCO international framework, the Forestry Research Institute of Nigeria (FRIN) in Ibadan and the UNESCO Multi-Sectoral Regional Office in Abuja developed the Green Economy in Biosphere Reserves (GEBR) project.

The GEBR project serves as a vehicle for training forest communities and indigenous peoples who live within Biosphere Reserves in alternative means of livelihood that reduce both total dependence on forest resources and the exploitation of wildlife resources within these reserves. In my research, I evaluated the participation of women and youths in Omo Forest Reserve as part of the UNESCO/FRIN GEBR project. Women and youths are the most vulnerable groups to the dangers of biodiversity loss and climate change effects on natural ecosystem services within the biosphere reserve. Therefore, in order to mitigate these effects, the UNESCO MSRO in Abuja and

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the FRIN in Ibadan designed a project to empower women and youths in the biosphere reserve with alternative green economy skills, which include snailery, grasscutter domestication, fishery, and mushroom farming. This GEBR project also aimed to reduce the pressure on biosphere forest resources and to stop the exploitation of wildlife resources at Omo Forest Reserve.

Data were collected through quantitative and qualitative research methods. Quantitative methods involved the use of a semi-structured questionnaire, and the qualitative methods involved the use of participatory appraisal techniques. Two hundred farming families (amounting to ca. 1,500 people) indirectly benefited from the GEBR alternative livelihood activities, and the socio-economic status of the beneficiaries improved by 10%. Male respondents (81.70 %) outnumbered female respondents (18.30 %), which indicates that more male than female inhabitants are present in the biosphere forest communities. While men showed strong preferences for snail farming, wildlife domestication, and raising fruit tree seedlings, women showed preferences for snail rearing and apiculture.

My research revealed that the GEBR project is sustainable and can be transferred to the next generation of inhabitants because our survey indicates that a large number of these inhabitants are married and within the age bracket of 31-50 years, with most being women and youths.

Romera, Mari-Carmen: Towards inclusive environmental governance in the Arganeraie Biosphere Reserve, Morocco

Mari-Carmen Romera Puga, UNESCO MED Center / CTFC, Spain

The Arganeraie Biosphere Reserve (BR) in Morocco was established in 1998. Today, the reserve covers 2.5 million hectares and hosts more than 3 million people. As a result, it has proven to be a complex social-ecological system to govern. I thus drew on post-normal conservation science and environmental governance studies to investigate environmental governance processes within the biosphere reserve and to shed light on their outcomes and challenges to date. First, I analysed how Moroccan institutions are managing this vast territory. Second, I examined the perceptions of an extended peer community of decision-makers. Third, I identified the constraints and synergies of this top-down approach to governance concerning local populations and their bottom-up approaches. My research adds an empirical case study to the North African region and addresses two main weaknesses of UNESCO BRs worldwide: (1) effective governance and (2) shortcomings in BR implementation.

By using an ethnographic approach, I point out how the low strategic priority and weak political will regarding

the Arganeraie BR may be hindering inclusive environmental governance. Based on my main findings, I suggest (1) some critical aspects for improving the existing governance system, (2) various baseline needs and barriers that can be addressed in advance, (3) a set of drivers, and (4) several proposals for inclusive governance in the Arganeraie BR. The influencing factors of inclusive environmental governance that are perceived as being the most critical by the extended peer community of decision-makers are coherence; inclusiveness, dialogue, fairness, and trust; legal framework, policy, and politics; political and institutional commitment, resolve, and leadership; shared understanding; shared space and transparency; and awareness, communication, and support. The most significant challenge of the research process was posed by the vast extension of the BR. In addition, issues of language and cultural context as well as cultural dynamics, national and international bureaucracy, timing, and logistics required special attention.

A major strength of the research process was the research design, which was ethnographical, participatory, and open to participants' feedback at several points. This design was effective in minimising the risk of oversimplification on a such a complex topic as multi-scale inclusive governance. Additional strengths included the ability to validate results with local researchers and key stakeholders, networking, and the adopted ethics and values. These strengths fostered trust, enhanced data quality, and helped in grasping the complexity of the situation.

Overall, in the Arganeraie BR, inclusivity remains far from being achieved due to unspoken and behavioural constraints. Thus, in order to advance towards inclusive governance, the variety of analysed influencing factors should be progressively addressed both from the bottom up and from the top down, and the factors should be integrated. My study should prompt academia as well as policy- and decision-makers to identify and enhance synergies that allow for a shared vision of their own territories.

Rozanes, Coline: Accompanying the agro-ecological transition of a territory of high environmental and cultural value – A case study of the Audouard Marsh Biosphere Reserve

A systematic literature review

ROZANES, Coline; Communauté d'Agglomération du Pays de Saint-Omer, InTerACT unit (UniLasalle), France

Agriculture is currently being confronted with different challenges, including the need to preserve biodiversity, to ensure food security, to adapt to climate change, and of course, to guarantee a decent living for farmers. In order to achieve these objectives, the challenge for Bio-

sphere Reserves (BR) is to engage in an agro-ecological transition – that is, to make food systems sustainable in order to maintain a balance between ecological rationality, economic viability, and social justice.

By systematically reviewing the literature, we are currently analysing agriculture in areas of high natural and cultural value (HNCV) in BRs and examining how scientific research has dealt with this sector. This systematic literature review uses two databases extracted from Scopus: one on HNCV areas (BRs, natural parks, Natura 2000, conservation areas, etc.) and one on BRs.

The analysis of the frequencies of the nominal groups and their networks has revealed that the lexical field of agriculture is present in the HNCV areas and in the BRs but is not the main theme there. The issue of transitioning to a more sustainable form of agriculture is also present but does not appear as a developed object of study.

One of the challenges to researching BRs involves accompanying territories in their agro-ecological transition, particularly at two levels:

1. the level of providing technical support for farmers to change their practices (experimentation, innovation, etc.) and
2. the territorial level, which involves both participation from all stakeholders who work in the agricultural location and the future of this location within the BR.

In moving forward with this study, it will be interesting to more clearly refine the research scope and to analyse – via a qualitative study – how scientists have investigated the agro-ecological transition and its innovations in these territories. Moreover, I will also examine the added value / benefits of scientific research on agricultural issues in areas of high natural and cultural value.

Strobelt, Simon & von Kocemba, Michèle: Implications of Biosphere Reserve management for biodiversity conservation and socio-economic development in Uganda. The case of the Mount Elgon Biosphere Reserve

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The East African network of UNESCO Biosphere Reserves (BRs) aims to develop holistic approaches to landscape management that involve the strong participation of local communities and that balance environmental, economic, and social needs in order to reduce the high pressure that is put on natural resources, to conserve biodiversity, and to foster the sustainable development of the region. However, many East African BRs are characterised by a general lack of data on the monitoring and evaluation of their long-term effectiveness.

In order to overcome this research gap, to increase our overall knowledge base, to develop an efficient evaluation model, and to consider long-term strategies for increasing the effectiveness of UNESCO BRs in East Africa, we conducted a stakeholder- and community-based case study on the effectiveness of the Mount Elgon BR in Uganda that focused on the BR's three main functions. Working with an interdisciplinary methodological approach, we conducted ten focus group discussions, 16 stakeholder interviews, and several field visits to all nine administrative districts of the BR. In addition, empirical data were collected in the bordering BR in Kenya in order to yield a complete analytical picture of the wider region. Our results reveal that neither the community nor the stakeholders have much knowledge about the existence of the BR. Moreover, the cultural and socio-economic interests of the local population are not sufficiently covered by the implemented landscape management strategy, and the heavily militarised protection of the alleged core zone threatens the livelihood and safety of the local population as well the region's overall peace.

We thus conclude that awareness creation, community participation, access to adequate resources, and compensation mechanisms under the framework of a revised and reactivated BR approach are urgently required in order to ensure successful biodiversity and nature conservation as well as conflict resolution / human well-being in the area in the future.

■ GROUP C: SUSTAINABLE SOCIETIES AND ECONOMIES

Balas, Martin: Advancing the monitoring of tourism in Biospheres Reserves - the case of Schorfheide-Chorin Biosphere Reserve

Martin Balaš, Biosphere Reserves Institute, University for Sustainable Development Eberswalde, Germany

With the Lima Action Plan, Biosphere Reserves have been declared model regions for integratively achieving the Agenda 2030 for sustainable development, which includes a focus on preserving habitats and landscapes as well as biodiversity while simultaneously initiating exemplary sustainable economic and socio-cultural development. Sustainable tourism is seen as a potential economic factor for these regions and should contribute to fulfilling the function of a Biosphere Reserve. However, it is not yet possible to properly assess the full potential or the risks and costs of tourism development due to the lack of monitoring that is needed to evaluate both the achievement of the objectives and the environmental and social impacts of economic development in Biosphere Reserves.

My PHD project thus addresses the gap of missing impact-related information on sustainable development in the tertiary sector of Biosphere Reserves. The work aims

to reconcile existing monitoring activities with current global and regional approaches to measuring the sustainability of tourism as an economic sector. It develops a systematic approach that enables comprehensive monitoring, which focuses on the performances of environmental and socio-economic flows at the level of local/regional tourism destination (here: Biosphere Reserve).

Sustainability indicators were developed via desk research and focus groups with tourism professionals, both of which considered experiences with assessment systems and recent measurement developments. The indicator-based assessment framework was tested in the Schorfheide-Chorin Biosphere Reserve in Germany. The central source of data at the regional level was the approach of existing socio-economic tourism monitoring in Biosphere Reserves (Job et al. 2013), which had been conducted in the region in 2020/21. In total, 29,764 individuals were reached via counts, short interviews, and longer interviews in a field study during 16 survey days in the Biosphere Reserve. These data allowed different visitor types to be calculated and enabled tourism turnovers as well as income effects for the Biosphere Reserve to be estimated.

The data were then supplemented with an extensive survey of tourism businesses in the Biosphere Reserve in March/April 2022 that used a hybrid distribution mode. Of the 865 existing tourism businesses in the region, 123 responded to the survey, which yielded a response rate of 14%. In the first rapid and preliminary analysis, about half of the respondents provided detailed information on their economic situation; however, only about 15% provided data on environmental costs. Consequently, about 80–90% of the developed sustainability indicator framework is expected to be able to be applied using the generated information. Thus, the used approach has application potential in the extended monitoring of the tertiary sector in Biosphere Reserves (Monitoring Criteria 24). Nevertheless, the findings also reveal the importance of working together with stakeholders at the destination, of creating a trusting and collaborative atmosphere, and of embedding such a monitoring system in overall strategic tourism management.

Kwalia, Rebecca Cherop: Indigenous communities and biodiversity conservation

How beekeeping can contribute to conserving our environment, Rebecca Kwalia, Lomut Honey, Mt. Elgon, Kenya

Beekeeping promotes food security and biodiversity. In our research, we explore the benefits provided by bees and the ways in which bees are instrumental to biodiversity. Our interest lies in wild bees. We identify the key contributions that these bees play and determine how we can develop sustainable beekeeping practices that protect our environment.

The focus of our work is on the rural communities on the slopes of Mt. Elgon in Kenya. Our study aims to establish how land use has affected the bee population and what this effect means for the overall environment. We additionally examine how the communities around the mountain can contribute to conservation by adopting sustainable practices while also making a livelihood from their efforts.

Our study results have established a decline in the bee population in the communities living around the mountain that can be mainly attributed to changes in land use as well as to deforestation. These communities use pesticides that lead to the death of bees. They have also cut down trees, thereby leaving behind no habitat in which the bees can thrive. Wildflowers have also disappeared. Future studies should focus on how combining wild bees and managed bees can improve biodiversity. Consideration should also be given to studies that investigate how a change in human activities and beekeeping can lead both to sustainable development in the area and to an improved standard of living.

Leguía Cruz, Marcelo: Biosphere Reserves as a model for sustainably developing land and the local community: The case of the La Campana-Peñuelas Biosphere Reserve in the biodiversity hotspot of central Chile

Marcelo Leguía-Cruz, Universidad de Playa Ancha, Valparaíso, Chile

Biosphere Reserves (BRs) are territories that have fragile ecosystems with conservation potential and that include communities that participate in managing the territory. Chile has 10 such territories with different characteristics but that all strive to conserve ecosystems through a sustainable development model. In Chile, the performance of these UNESCO-designated conservation categories is not monitored individually or as a network of reserves at the national level. As a result, I evaluated the development model by studying the La Campana Peñuelas Biosphere Reserve, which has great potential for human use and is located almost entirely in the Valparaíso Region as well as (to a lesser extent) in the Santiago Metropolitan Region, two of the most populated regions in the country. The BR territory was analysed from a territorial planning perspective on a regional scale, and elements of the analysis were integrated into a territorial model. The performance of the BR was evaluated with indicators and variables that are used in the action strategies that have been proposed for BRs worldwide. Perception surveys were completed by members of the community that inhabits the BR, and relevant actors in the territory were interviewed.

Both the surveys and the interviews validated and proposed measures for improving performance indicators in the BR. Despite what would have been expected based

on territorial planning processes, the analysed instruments yielded an important finding for BRs: The territorial model is able to capture a reality of land use and activities that is not related to the current zoning model of the BR, which consists of gradual conservation rings (core, buffer, and transition). The performance evaluation yielded disparate values for each evaluated indicator; however, the overall average performance of the BR was low, which demonstrates the weaknesses of the local community participation system of BR management. Validation and consultation with the community revealed the negative perception of the work carried out by the management body of the BR and also uncovered important issues for the future governance of this territory, including the availability of water, social participation, and the integration of Native Peoples.

Meier, Caroline: Worldview(s) in UNESCO – Examining the perspectives of local and/or Indigenous communities in the early discourse on UNESCO research problems

Caroline Meier; Biosphere Reserves Institute, Eberswalde University for Sustainable Development, Germany

UNESCO's Man and the Biosphere (MAB) Programme appears to be an encouraging model for the often-called-for "engagement of indigenous peoples and local communities" (Tengö, et al., 2017). The programme is committed to generating local, bottom-up solutions and has developed a holistic approach since its establishment in 1971. UNESCO explicitly stresses its recognition of "traditional and local knowledge in ecosystem management" (UNESCO, 2017, p. 12). However, as Ferreira, Zimmermann, Santos, and von Wehrden (2020, p. 5496) state, "the relevance [of] and broad interest in the biosphere reserve enterprise does not translate [...] into a successful implementation, as there is a considerable gap between the concept and its practical realization." Our project aims to reveal structural injustices in UNESCO's MAB that arguably impede the programme in attaining its own goals. The project thus investigates the reasons that it remains a challenge to integrate/interweave local and/or indigenous perspectives into global environmental programmes even though their importance is widely recognised.

A historical critical discourse analysis of UNESCO's founding General Conference resolutions (1945–1946) aids in identifying the root causes of persisting power inequalities in both UNESCO and MAB. The tentative results of this discourse analysis suggest that a Western-centric discursive hegemony developed early within UNESCO and restricted the space for alternative perspectives on UNESCO's underlying concepts of culture, education, and science to be heard. On that basis, our analysis of the discourse on nature and the environment (1945–1960) further suggests that there were no alternative unders-

tandings of human–environment relations discussed in UNESCO's early programme.

Historical investigations into UNESCO are facilitated by the easy accessibility of archival material. Furthermore, both UNESCO and MAB are delimited research objects that offer a wide range of case studies, which allows generalisable research results to be produced.

Ostrem, Julie: Creating, sustaining, and improving collaboration across Canadian Biosphere Reserves

*Julie Ostrem and Glen Hvenegaard
University of Alberta, Canada*

Did you know that Canada is home to 19 designated UNESCO Biosphere Reserves (BRs)? From the emerald valleys of the west coast to the fresh frost of the subarctic and the towering maritime cliffs, Canada's BRs come in many shapes and sizes and have diverse cultures and environments. This variation provides a unique opportunity for extensive knowledge sharing as well as for identifying the most effective and innovative methods of collaboration. Our study examines current forms of collaboration across Canadian UNESCO BRs. Fourteen Canadian BR representatives completed interviews in the winter of 2021 with the goal of uncovering common benefits of, barriers to, and enablers of collaboration. Additionally, participants explored the potential for future collaborations and shared recommendations from practitioners' perspectives for best practices when collaborating across agencies and biospheres.

Our research findings highlight the importance of adequate organisational and individual capacity in enabling collaboration. Participants also stressed the indispensable role of the Canadian Biosphere Reserve Association (CBRA) as a connecting force that unites all Canadian BRs with more than merely personal relationships. Participants described the importance of inclusion and accessibility in collaborative endeavours and specifically discussed their desire for increased participation opportunities for Indigenous Peoples and youth.

Although outlined as a priority in multiple national and international strategic action plans, inter-biosphere collaborations are anything but ubiquitous in Canada. Our presentation thus also explores the current mechanisms of collaboration between Canadian BRs and describes significant enablers of collaboration, including trust, a backbone support agency, champions, common goals, and awareness and accessibility. Furthermore, our presentation includes an analysis of common barriers, including a lack of capacity, spatial and temporal differences, regulatory considerations, and organisational reluctance to collaborate. Moreover, we review what leaders in the field can do to offset these barriers. These findings can be used as a rationale for organisations to

apply for funding in order to increase capacity and offer more inclusive collaborative opportunities. Additionally, these findings are transferable to other sectors beyond BRs and shed light on collaborative theory in general. Through a combination of participant quotes, academic literature, and researchers' personal experiences, these findings will be revealed as part of a captivating and engaging presentation.

Przesdzink, Felix: Combining stakeholder- and social-network analysis to improve regional nature conservation. A case study from Osnabrück, Germany

Felix Przesdzink, Florian Fiebelkorn, Department of Didactics of Biology, University of Osnabrück, Germany

The local engagement of stakeholders in environmental resources – such as authorities, scientists, conservationists, and land-use actors – is essential both to effective regional nature conservation and to the sustainable management of environmental resources. This engagement enables transdisciplinary approaches to conservation issues and reduces land-use conflicts between stakeholders. Biosphere Reserves – which must coordinate the interests of different stakeholders – are particularly able to profit from effective stakeholder management.

Our research project aims to develop a blueprint for analysing and optimising collaboration among conservation stakeholders in a specific region by using the region of Osnabrück in north-western Germany as a case study. The current status of the stakeholder network was assessed using a social-network analysis and stakeholder interviews. Further interviews and questionnaires were used to create a stakeholder database that contains information about stakeholder interests, available resources, resource needs, organisational culture (OCAI scale), and environmental attitudes (NEP Scale, Myths of Nature Scale).

In the local network, discrepancies in information exchange between academics and practitioners as well as between practitioners and authorities were identified. An abundance of land-use conflicts was present, and cooperation between land-use actors and conservationists was nearly non-existent. Most stakeholders lacked the time for sufficient networking, which suggests that outsourcing this task to external stakeholder managers may be desirable for all sides.

The greatest challenges to the project involved persuading the large number of stakeholders to participate, providing funding for the project's long-term elements, and dealing with bureaucratic issues with local institutions, including our own university. The greatest benefits to the project included the presence of existing local networks as starting points and the possibility of passing along beneficial project results to regional authorities

as well as to the stakeholders themselves. Generally, we consider it easier to realise the developed approach in an existing Biosphere Reserve, where cooperative infrastructure and the interest in joint sustainable environmental management are already present.

Our stakeholder database for the Osnabrück region will be operational by mid-summer of this year, and our stakeholder consulting will subsequently begin a one-year testing phase. We plan to extend the project with trained communicators as network managers and with an online platform with microsites where all stakeholders can engage with the local public. Our concept is also transferable to other regions, especially Biosphere Reserves.

Schaal, Tamara: Exploring cultural landscape narratives to understand differences in meaning and their implications for governance

Schaal, Tamara (1),(5); König, Bettina (2),(3); Riechers, Maraja (1); Heitepriem, Nico (4); Schäfer, Martina (5); Leventon, Julia (6)

The notion of landscapes is now widely used in policy, management, and governance. Viewing landscapes as social constructs means that how they are perceived by humans is central. Dealing with and integrating different meanings and viewpoints presents a challenge for landscape governance. In particular, farmland abandonment and the resulting loss of traditional cultural landscapes have received less attention in the literature.

Our work within a transdisciplinary action research project in the Spreewald Biosphere Reserve suggests that different landscape understandings and future aspirations create challenges for collaborative efforts to preserve the cultural landscape. We adopted a social constructivist perspective on landscapes and a narrative lens in order to engage with different meanings and perceptions of the Spreewald cultural landscape. In order to identify the narratives, we drew on Q-methodology, which is a mixed-methods approach. We conducted 38 interviews with key stakeholders who work on topics ranging from nature conservation to water management and agriculture. Each interviewee ranked 37 photos that depicted elements of the cultural landscape based on what they thought the landscape should look like. We identified three narratives – nature, people, and land use – which

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represent archetypal ways of perceiving and relating to the cultural landscape. These narratives reveal how different meanings are ascribed to the landscape, how the landscape is valued, which landscape characteristics stand out, and what is perceived to be a threat.

Despite some overlap between these perspectives, the presence of different understandings of the cultural landscape poses a challenge to collaborative management. In particular, the absence of institutionalised coordination that could work across both the narratives and the three administrative districts within which the Biosphere Reserve is located presents a problem. Furthermore, the different understandings of the cultural landscape can be related back to conflicts with nature conservation during the creation of the Biosphere Reserve and to experiences with previous processes. Additionally, although biological, cultural, and linguistic diversity were mentioned, they remain fragmented between the narratives.

For our research project as a whole, the current regulatory framework created barriers to innovation approaches for cultural landscape preservation. Despite these challenges, the transdisciplinary project context in which the research was embedded provided benefits in terms of the ability to formulate the research question and to generate knowledge integration. In particular, these benefits were due to the funded “transfer agent”, who coordinated science–practise interactions within the project. Furthermore, the Biosphere Reserve administration supported the research process and helped with understanding the stakeholder landscape. In conclusion, our findings suggest that a joint vision could help address narrative tensions and provide a direction for both planning and management. Institutionalised coordination, in particular, could support such a process. Furthermore, a more integrative perspective could connect biological and cultural diversity.

Swaminathan, Divya Rajeswari: Agricultural transformation among the Soliga Indigenous People: A case study from the Sathyamangalam Forest, India

Divya Rajeswari Swaminathan and Sharath Hulihalli Manjunatha; Department of Geography, Bangalore University, Bengaluru, Karnataka, India

Agricultural transformation massively impacts the socio-economic and cultural conditions of Indigenous communities, especially for those living in remote montane forest areas. In most cases, the transition goes from low-input, low-output subsistence farming and agro-forestry practices to commercial farming. This transformation goes hand in hand with a shift away from – and a loss of – traditional knowledge systems and moves towards induced agricultural practices that use modern, science-based knowledge.

The main objective of our study was to understand how the agricultural transformation and designation of protected areas impacts the land uses and livelihoods of the Soliga communities who live in and around the Sathyamangalam Tiger Reserve in the state of Tamil Nadu, India. Our research used a multi-faceted methodological approach. A pre-study was conducted in order to select case studies and to collect first-hand local information that allowed us to narrow the research approach. The Soliga communities, their village heads, State Forest Department officials, and NGO representatives in the areas were interviewed. A three-tier methodology was carried out during the main field research period in India. Firstly, a literature review was used to develop a suitable, place-case specific, gender-sensitive analytical framework for assessing local knowledge of agricultural management. Secondly, GIS mapping was used to map the land use and land cover of the study areas over the past 10 years. Finally, qualitative participatory appraisals were used to derive narratives from past and current situations using semi-structured interviews, oral histories, and participant observations.

The locals provided support in terms of logistics and assisted in connecting with village networks through existing connections. The main challenges during the research phase involved obtaining permission from local authorities to enter the protected areas and interact with the Indigenous groups and accessing the villages due to their remote locations.

The outcome of the research helps both in understanding the underlying agricultural transformation processes and drivers of land-use changes in the Indigenous communities in this part of India as well as in recommending sustainable land-use policies and implementation programmes that better reflect the needs and concerns of the Indigenous communities. Our study highlights the positive and negative practical outcomes of the various policies adopted by the state of Tamil Nadu with regard to tribal rights to use forest land for crop cultivation. The pros and cons of state policies were recorded according to the local people’s perceptions and were used to evaluate how well the Tiger Reserve functions with regard to environmental protection and conservation.

Unthan, Nils: CREative Approaches For socio-ecological TRansitions (CRAFT). A comparative study of rural-peripheral Biosphere Reserves

Nils Unthan and Jacob Heuser, Department of Geography, University of Innsbruck, Austria

Although rural spaces have appeared with increasing frequency in (political) discourses in recent years and scientific discourses have been quick to discuss the potential of and call for critical-emancipated rural research, in comparison with urban topics, similar experimental and grassroots processes in rural areas have been largely

neglected. Fab labs and makerspaces are examples of such a futuristic and promising-sounding experimental urban-innovation orientation. The stereotypical attributions of rural areas, on the other hand, have borne witness to declining demographic developments, low educational levels, poorly developed economic diversity, and a general lack of infrastructure as the missing basis for creativity.

Nevertheless, multiple scholars have found that innovations increasingly often emerge in rural areas, especially in the form of local self-organisation, social movements, or alternatives to agriculture and food networks. Actors stand up for fundamental societal change that is often oriented towards discourses on human–environmental justice and climate justice as well as towards alternative, socio-ecologically compatible (re-)economic forms within the de-growth debate. These actors develop creative and problem-oriented approaches that aim to solve local manifestations of global challenges. In this way, they emancipate themselves and their environment from stereotypes and supposed path dependencies and can (re) produce spaces in socio-ecologically and economically responsible forms. In portraying specific types, rural social innovations can be understood in their heterogeneity of a broad actor landscape. This understanding ultimately provides profound insights into the mechanisms that explain the emergence or absence of these cells of transformation.

The UNESCO Biosphere Reserves lie at the heart of the debate on the role of model regions for sustainable development and transformation processes. Within the Man and the Biosphere programme, these reserves can be viewed as a platform for gathering approaches that foster socio-ecological transformation processes. The CRAFT study analysed factors that foster (or hinder) the emergence of social innovations and the role of Biosphere Reserves as enablers of transitions. In so doing, we found that social innovations emerge when approaches unfold that merge everyday practices with consciously set impulses. Actors are highly normative and regionally rooted, and regional and local relevance leads to regional and local contributions, respectively. Although their work is strictly oriented towards values and norms that are mostly in line with the UNESCO Biosphere Reserves' frameworks, the platform idea requires further strengthening in order to unleash the promising potential of upscaling niche approaches and transforming them into impactful processes on a larger scale.

The CRAFT study was funded by the Man and the Biosphere (MAB) programme of the Austrian Academy of Science (ÖAW) and co-funded by the Swiss Academy of Sciences (SCNAT).

Wilson, Georgina: Protected Area Management Effectiveness in Kruger to Canyons Biosphere Region, South Africa. Insights from the perspective of protected area managers

Georgina Wilson; Central European University, Austria and Hungary

Designating an area as a protected area (PA) is recognised as one of the most successful means of conserving biodiversity. However, despite an increase in the number and spatial extent of PAs, biodiversity loss continues. Protected Area Management Effectiveness (PAME) is defined as the extent to which a PA or PA network is managed in order to protect its values and to achieve its goals and objectives. PAME assessments were developed in part to support adaptive management within PAs and PA systems. The Kruger to Canyons (K2C) Biosphere Region is located in the north-east of South Africa and is a region with diverse geography, ecosystems, land uses, and cultures that is also rich in biodiversity. The formally protected land (Kruger National Park and provincial reserves) constitutes the core of the Biosphere Region, while the privately protected land makes up the buffer zone.

My research investigates how and to what extent PA management teams in the K2C Biosphere Region implement adaptive management in the form of PAME as well as how PAME can be improved. The project employs a mixed-methods approach, and data collection remains ongoing. As of April 2022, eleven questionnaire responses had been received, and seven respondents had been interviewed. Three additional interviews had also been conducted. Most respondents indicated that they definitely implement adaptive management in their PA and that adaptive management is described in their PA's management plan. Six of ten respondents indicated that their PA management plan makes reference to "effective management"; however, the majority of respondents stated that they do not monitor or evaluate management effectiveness. Several different methods – including some PAME tools – are used to monitor management effectiveness. Although the interview analysis remains incomplete, several themes have emerged. The issue of a lack of communication is common. Additionally, managers from smaller, non-connected PAs have noted that they do not have the capacity to utilise a PAME tool but that they are not necessarily opposed to using one in future.

My research has faced several challenges, which have mainly been a result both of the complicated system of organisation and governance structures present in the landscape and of the accessibility of certain data. However, the project has greatly benefited from the international partnership between a European university and a South African non-profit company. The project has helped nurture some relationships and – once completed – will make recommendations that will contribute to im-

proved PAME monitoring in the system, thereby strengthening the resilience of the Biosphere Region's core.

In conclusion, the knowledge and implementation of PAME tools in the K2C Biosphere Region varies, and some constraints exist for managers who wish to implement PAME monitoring or evaluation. These issues may present an opportunity to develop an easy-to-use tool that caters to the PAs with limited capacity. The need for improved communication has emerged as a key focus area that could improve the knowledge and experience of PAME in the region.

Yoo, Miyeon: Empowerment and sustainable development policies in Yeoncheon Imjin River Biosphere Reserve

Miyeon Yoo, Yeoncheon County, South Korea

As sustainable development becomes increasingly important, international protected areas in the Republic of Korea (ROK) are also gaining more attention as representatives of a local development strategy based on nature conservation. This has been particularly evident in areas with extensive regulations on regional development in the border region around the Korean Demilitarized Zone (DMZ).

Yeoncheon County forms a part of the border region in the ROK and is also a multi-designated area. In 2019, the Yeoncheon Imjin River Biosphere Reserve (YIBR) was created, which was also designated as a Hantangang UNESCO Global Geopark in 2020. The YIBR represents a very special case as it was created by the main government in 2012, but the local government and residents did not initially agree with the designation. After a three-year-long education project (supported by the Ministry of Environment), however, the local government agreed to the region's designation as a Biosphere Reserve (BR). Little attention has been paid to social science on BRs. Indeed, many researchers have focused on natural science or on the introduction of BRs. Even in research on the DMZ, the main topic has been natural science and the need to protect the area. In order to solve this problem, I studied the issue of how Yeoncheon County came to be designated as a BR. My study aimed to find ways of strengthening the capacity of local communities and regional development strategies to sustainably develop the border region.

The work included analyses of the process of and requirements for being designated as an international protected area (IPA), chronological analyses of the policy for the designation and protection of the border region as an IPA, and a case study on Yeoncheon County that analysed the capacity and potential of the border region. Analysis results revealed the following eight essential criteria for the designation and management of IPAs: (1)

natural resources, (2) operation budget, (3) management organisation, (4) local leaders and community, (5) sharing and communication with the local community, (6) governance building, (7) change and management plans for local development strategies, and (8) sustainable development of the local economy.

Regional development strategies in Yeoncheon are currently being implemented in connection with IPAs, and policies centred on green infrastructure are being promoted. Yeoncheon County was found to have secured the competencies required to be designated and protected as an IPA through a previously implemented capacity-building project for residents. Of course, the large number of educational programmes for local people, de-population, and the aging society in Yeoncheon have posed significant challenges to the area's designation as an IPA. However, the designation has also had benefits. For example, the region can serve as a good model for managing BRs in the local government and for transforming local government plans into sustainable development projects.

The policies of empowerment and sustainable development contribute to the sustainability of region. The YIBR thus serves as a good example of such a transformation. Through its various empowerment projects over the last 10 years, the YIBR is becoming a new leader in the ROK.

Zuklin, Tomas: Measuring the benefits of Biosphere Reserves for Sustainable Development Goals from an ecosystem governance perspective

Tomas Zuklin; University of Groningen, the Netherlands

Today, there are 727 Biosphere Reserves (BRs) that span all seven continents and cover all types of climates and environments. Since its inception, UNESCO'S World Network of Biosphere Reserves project has aimed to explore how humans can thrive and sustainably develop the environment while observing natural protection. The main goals of the International Union for Conservation of Nature (IUCN) have always aligned with the BR initiative, especially in recent years, when the IUCN developed its ecosystem governance theory – a governance model that has a net benefit for both humans and nature. The recently developed principles of ecosystem governance are (1) space, (2) participation, (3) sustainability, (4) conservation, (5) knowledge, and (6) adaptability. Research in this fields remains a work-in-progress and aims to develop a set of baseline indicators for assessing governance from the prism of the principles of ecosystem governance.

A significant amount of research has been conducted on management practices within the boundaries of BRs; however, we are currently facing a lack of governance-oriented inquiries. Assessing governance structures and methods is crucial to understanding not only the ef-



fectiveness of biosphere reserves, but also the efficiency and inclusiveness of decision-making practices. With the onset of the application of ecosystem governance theory by the IUCN, there is a need for assessment guidelines that are applicable to this new theory. Ecosystem governance theory is relevant to all sustainable development goals (SDGs), particularly to SDGs 10, 11, 13, 14, 15, 16, and 17. The ultimate question of my study therefore involves how to assess BRs from an ecosystem governance perspective in terms of sustainable development goals.

The greatest challenges to this research stem from the biosphere reserves themselves and also have to do with future reporting purposes. Since ecosystem governance theory remains a relatively new concept that is now widely used around the globe, assessments based on it require a new, separate assessment approach. Although management practices could prove to be effective in tackling specific issues, the governance process itself might lack the necessary ability to maintain the individual ecosystem governance principles.

The benefits of my research lie mainly in its ability to strengthen our knowledge of good governance practices through a unified assessment method. Creating such a database that relates to protected areas should be able to strengthen global research cooperation and improve the sharing of best practices globally.

In conclusion, my research (which remains ongoing, with new input for improvement being welcomed) aims to offer a basic framework for assessing biosphere reserve governance in line with the IUCN's ecosystem governance theory.

■ GROUP D: ECOSYSTEM SERVICES

Almashaqba, Zakaria Daoud Taha: Microplastics in seawater and zooplankton: A case study from the Terengganu Estuary and offshore waters, Malaysia

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The widespread accumulation and distribution of microplastics on the sea surface is raising concerns because the habitat is a feeding ground for zooplankton. As primary consumers, these organisms are closely connected to microplastic input in the marine food chain. Little comparative information currently exists about this problem in estuary and offshore systems. Our study thus investigates microplastic distribution in the surface water as well as the potential ingestion of microplastics by selected taxonomic groups of zooplankton from the Terengganu Estuary and offshore waters in Malaysia. Three types of microplastics – fibres, fragments, and pellets – were found in the surface water, and two types of microplastics – fibres and fragments – were detected in zooplankton. Fibres were the most commonly ingested type of microplastic among the zooplankton collected from offshore waters (94 %) and estuaries (77.7 %). The average sizes of the ingested fibres and fragments were $361.7 \pm 226.8 \mu\text{m}$ and $96.8 \pm 28.1 \mu\text{m}$, respectively, with a wider range of ingested sizes having been observed in offshore waters than in estuaries. The concentration of microplastics in seven zooplankton groups varied from $0.01 \pm 0.002 \text{ particles ind.}^{-1}$ (Harpacticoida) to $0.2 \pm 0.14 \text{ particles ind.}^{-1}$ (Aphragmophora).

The findings of this study document the relationship between localities and the distribution and spread of microplastics and can therefore serve as a benchmark and lay

a strong foundation for future studies on the spread of microplastic pollution in the marine environment, particularly within zooplankton communities. This study initially aimed to determine microplastic pollution levels in the selected area, but the presence of a marine reserve within the study area necessitated inquiries into the effects of microplastics on biodiversity in Biosphere Reserves. In terms of the impossibility of preventing microplastics from moving to these marine reserves, it is necessary for us to know the current situation of the levels of microplastic pollution and to work seriously to find applicable sustainable solutions.

The results of this research also have implications for the emerging Aqaba Marine Reserve in Jordan and indicate the need for work on monitoring the state of microplastic pollution and its impact on biodiversity in this reserve over time. Indeed, consultations are currently being conducted in order to develop a microplastic monitoring programme in the reserve that will move towards a qualitative analysis of microplastics studies in the region.

Barnes, Isaac Yaw: Use of machine learning and intensity analysis to evaluate the impacts of conservation measures on changes in land cover and land use in a forest biosphere

Isaac Yaw Barnes (1), Benjamin Ghansah (2), and Maxwell Boateng-Gyimah (3)

The Bia Biosphere Reserve in Ghana was established in the 1980s and has the following key features:

- a core area of 29,364.33 hectares that consists of the Bia Conservation area (Bia National Park and Bia Resource Reserve) and the Apaaso sacred grove, which is considered a holy location and is entirely protected for prayer and sacrifice,
- a buffer zone of 429.86 hectares with nearby degraded forest reserves organised into community resource management zones and villages, and
- a transitional zone of 27,551.15 hectares that is home to about 30 villages.

A key challenge in the Bia Biosphere Reserve area relates to quantifying the levels of human–environment interactions in terms of changes to land use and land cover (LULC) as a means of understanding local spatio-temporal conditions in the context of established conservation measures.

By using a combination of machine learning algorithms and ArcGIS/QGIS, the gathered data – including local narratives from selected communities, satellite imagery, and drone footage of the area – were analysed. Results reveal that after the declaration and demarcation of the area as a Biosphere Reserve in the 1980s and up to the year 2002, the transitional zone saw an increase in human activities, which led to a 2.1 % decrease in woodlands and a 56.3 % decrease in forests in favour of farmland. However, by 2016, the situation had reversed, with farmlands having decreased by 20 % in favour of woodland (which had increased by 26 %). Over roughly the same period (i.e. between the 1980 and 2016), the canopy cover in the core area increased by a significant factor of 88 %.

One factor that has contributed to the successful co-existence of communities in the Bia transitional zone relates to the introduction of livelihood adaptation interventions in the community resource management areas (CREMA). These interventions have helped ease the pressure on natural resources in the transitional areas and have incentivised communities to support the conservation of these resources.

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There is a call to increase education, create awareness, and intensify support for livelihood adaptation interventions for community members within the Bia Biosphere Reserve. Moreover, there is a need to intensify research studies that use the Nexus Approach (e.g. climate change, Biosphere Reserves, and livelihood). The complexity of human–nature interactions in Biosphere Reserves requires advanced and dynamic geo-spatial technology to monitor, analyse, and forecast important LULC elements, including monitoring ecosystem evaluation, managing natural resources, and adapting to climate change.

Bourhane, Zeina: Microbial diversity alteration reveals biomarkers of contamination in soil-river-lake continuum

Zeina Bourhane (1), Anders Lanzén (2), Christine Cagnon (1), Olfa Ben Said (3), Ezzedine Mahmoudi (3), Frederic Coulon (4), Emmanuel Atai (4), Angel Borga (2), Cristiana Cravo-Laureau (1), Robert Duran (1)

Biosphere Reserves (BRs) are widespread around the world. According to the World Network of Biosphere Reserves, there are 727 BRs in 131 countries. These BRs include terrestrial, marine, and coastal ecosystems. As we know, most human activities are concentrated around aquatic environments – such as coastal areas, lakes, and lagoons – due to the important ecosystemic services that the areas include, such as fisheries. Thus, these aquatic environments – including many BRs and their surroundings – are being threatened by chemical pollution from urbanisation, agriculture, and industrial activities. Once in the environment, many contaminants – including hydrocarbons, pesticides, and heavy metals – persist for long periods of time and result in chronic pollution. Careful monitoring is therefore required to evaluate the ecological status of Biosphere Reserves. Several studies have proposed solutions to biomonitoring ecosystems, but we still lack information on the quality of BRs in arid and semi-arid areas.

Microbial ecology approaches provide useful information for developing microbial monitoring tools that report on the effect of environmental stressors. Our study determined a relevant set of microbial bioindicators based on chemical and molecular approaches that can be used to assess the ecological status of soil and river ecosystems around the BR of Ichkeul Lake, Tunisia. The study

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revealed a spatio-temporal set of microbial bioindicators that report the effects of a pollutant type on the structure and composition of the microbial communities. This study highlights the microbial community coalescence within a soil–river–lake continuum, identifies specialist bioindicators that are specifically associated with pollutant types, and determines the functional capabilities of these bioindicators, which are involved in biodegradation/transformation processes. This work additionally provides new insights that can be used to develop novel biomonitoring tools for assessing environmental pollution in BRs. During our work, we encountered many difficulties related to administrative agreements with the agencies that manage Lake Ichkeul. Moreover, problems related to travel procedures and funding arose. As part of this work, we published findings in a high-ranking journal, participated in international conferences, and collaborated with international colleagues. In summary, microbial indicators might be useful as accurate biomonitoring tools for managing and restoring complex coastal aquatic systems in BRs. It is therefore necessary for the international biosphere network to conduct further studies and provide additional funding in order to further assess and protect the environmental health of BRs worldwide.

Cusens, Jarrod: Participatory mapping reveals biocultural and nature values in the shared landscape of a Nordic UNESCO Biosphere Reserve

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Nature contributes to our well-being in countless ways, including through tangible benefits, such as food, as well as less tangible benefits, such as mental health. However, our activities have reduced Nature's ability to support us and other species. Addressing this challenge means that we need to re-think our relationship with Nature and truly value the contributions it makes to our lives. We studied the diverse ways in which people value Nature in the UNESCO Nordhordland Biosphere Reserve (NBR) in Norway.

We engaged with local stakeholders using a public participation geographic information systems survey and asked them to map places within NBR where they value Nature. We asked three main questions: (1) Are there hot-spots where people find particularly high value in Na-

ture? (2) How is Nature valued in the different Biosphere Reserve zones? (3) Do certain values co-occur in the same places, and why?

The stakeholders mapped both a greater number of places that they value and a greater variety of values close to human settlements. Individuals have strong non-material cultural connections to Nature through outdoor recreation and cultural heritage. They also highly value biodiversity for its own sake and not just for its material benefits, thereby highlighting the importance of Nature close to home for our well-being. We found that some values often co-occur where agricultural and cultural heritage values are largely inseparable, which reflects the strong agricultural heritage of the region.

The BR framework provided several benefits to our research, although there were also some challenges. The main challenge related to the very recent designation (2019) of the BR. Many residents were unaware that the BR existed or that they lived within a BR and needed substantial background information on the BR and what it meant for them. Additionally, we found – at least in the initial stages of our project – that there were mismatches between our research objectives and some of the BR's interests. This was an excellent learning opportunity for both sides and led to more fruitful work moving forward. The major benefit of the BRs framework was their role as a bridge between us and society, including municipalities and other organisations, such as the agricultural advisory. This role strengthened our transdisciplinary position. From a purely research perspective, the BR framing of our work gave it a unique angle and an element of novelty that should prove interesting to our readers.

Our study represents the future of accounting for how Nature contributes to our lives beyond traditional economics. It adds to the growing body of evidence that we need to connect academia with stakeholders in order to generate knowledge collaboratively so that we can find solutions for both a sustainable now and a sustainable future.

Duguma, Mezgebu Senbeto: Trends in land use, ecosystem services, and biodiversity conservation in Yayo Coffee Forest Biosphere Reserve, Oromia, Ethiopia

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(The agricultural practices of different farming systems – including their productivity and production, their biodiversity, their environment, their natural resources,

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and their related ecosystem service issues that are geared towards the progress of human well-being, human needs, and sustainable development – pose a challenge to Biosphere Reserves. Humans' basic needs are mostly dependent on the services provided by biospheres and their ecosystems, and trends in different agricultural practices within various farming systems can positively or negatively affect these regions and their ecosystem functions. With the ongoing decline of the majority of ecosystem services, the depletion of biodiversity, the increased demand for food and drink, and the challenging future ahead, it is clear that we need to find more resilient, locally accepted ways of managing our ecosystems. Our study was conducted in the Yayo Coffee Forest Biosphere Reserve (BR), where two districts that encompass large areas of the BR were purposely selected due to their proximity to the BR. The study aimed to assess the level of biodiversity in major farming systems, trends in ecosystem services, and the conservation status of the BR. Interviews, focus group discussions, assessments of species diversity, satellite image analysis, secondary information, and personal observations were used to collect data.

Four major farming systems were found to be dominant in the BR: (1) home gardens (HGs), (2) plantation coffee (PC), (3) semi-forest coffee (SFC), and (4) annual crop production (CP). Diversity and evenness indices were highest in the HG system ($H' = 3.14$, $E = 0.8$) and lowest in the CP system ($H' = 0.71$, $E = 0.18$). Woodlots, living fences, and coffee plantations were used as a replacement for natural forest services and to address local communities' needs.

Our study concluded that humans have been modifying the natural landscape and ecosystem function in order to intensify certain provisioning services – such as the food supply – at the expense of other ecosystem service, regardless of the sustainability of these practices, thereby resulting in a lower level of biodiversity and consequently in a decline in ecosystem services in the BR. Further research is needed to analyse and model synergies and trade-offs between humans and the environment.

Gajardo, Lea Janine: Cultural values of ecosystem services from coastal marine areas. The case of Taytay Bay, Palawan, the Philippines

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The Philippine coastal marine ecosystem is a region in which coastal communities are closely dependent on the sea and that provides many ecosystem services (ESs). Direct and visible ESs are often prioritised in management interventions and in deliberations between resource managers and users, which causes other, less obvious ESs to be neglected. Previous ES studies have focused mainly on biophysical and economic assessments, while limited studies have been conducted on cultural ecosystem services (CESs). In our study, we sought knowledge from coastal communities in Taytay, Palawan, the Philippines, in order to understand the CESs that are provided by the coastal marine ecosystem. The study's specific objectives were to identify CESs from the coastal marine ecosystem of Taytay Bay, to identify areas where CESs are being provided, to identify areas where CESs are threatened, to quantify CES values based on importance, and to quantify threat values based on intensity. Data collection involved semi-structured interviews with participatory mapping activities designed to facilitate the (1) verbal articulation, (2) spatial identification, and (2) quantification of values. Our findings revealed that the coastal marine ecosystem of Taytay Bay offers various CESs that are an integral part of the local communities' lives. Both the sense of place as well as intergenerational and recreational services were perceived to be most important to the community. On the other hand, the educational services for children that are associated with the coastal marine ecosystem were perceived to have the lowest value due to their infrequency. This result can be useful when it comes to addressing the need for more learning activities in the coastal marine setting to be incorporated in children's formal education. Links within CESs make it possible to benefit from several services at once. Additionally, CESs cannot be clearly separated from monetary or economic values. Though instructed to identify ESs apart from income generation, people generally associated CESs with provisioning services, particularly livelihood. The capacity of the bay to provide these services may be challenged mainly by anthropogenic factors. Destructive fishing practices, agrochemicals from aquaculture farms, and the privatisation of islands were perceived as the top threats. The co-occurrence of CES values with provisioning values suggests that a holistic approach to ecosystem valuation is needed because the loss of one ES is likely to represent a loss in multiple other services and because protecting key service-providing habitats leads to multiple benefits. Taking community perception into account would greatly contribute to better decision-making and management planning. More importantly, by understanding the points of view of the people whose lives are closely interlinked with the coastal environment and its resources, decision-makers can adopt a better approach to gaining community acceptance of policies and community participation in both implementation and conservation efforts.

Ghoraba, Somaya: Applying the IUCN Red List of Ecosystems to assess the conservation status of natural ecosystems. Case studies from Egypt

Case study: Burullus Wetland Protected Area in Egypt
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As sustaining ecosystems both maintains and enhances nature's contribution to humans and is fundamental to policy frameworks and international legislation on the environment, the IUCN developed the Red List of Ecosystems (RLE) framework. This framework applies standard criteria and categories in order to assess the conservation status of ecosystems based on environmental changes and human activities using five main criteria that measure changes in the area and integrity of the ecosystems. The RLE was applied to wetland, sand plain, and salt marsh ecosystems in the Burullus Protected Area (BPA) as a potential Biosphere Reserve (BR).

The main research question involved assessing the conservation status of the BPA ecosystems. In order to address this issue, it was necessary to first answer questions about changes in ecosystem function, interactions among species, key variables responsible for ecosystem collapse, and changes among common species. For the spatial analysis of the RLE, remotely sensed data were acquired at different dates in order to tackle the changes that had appeared in the study area over time. Regarding the ecological assessment, long-term biotic and abiotic data were collected for the selected variables in order to estimate the relative severity of ecosystem degradation using standard calculations.

The RLE assessment enabled us to identify the risk status of the assessed ecosystems. Both sand plains and salt marshes were identified as being critically endangered, and the wetland ecosystem was categorised as endangered. The assessment also yielded some valuable outcomes, including a complete description of key ecosystem processes and interactions, a diagnostic model, and metadata of spatial and ecological variables.

The greatest challenge to conducting the RLE assessment was the lack of data that could be used to understand the processes and interactions that occur within the terrestrial ecosystems. The benefits of carrying out the research included receiving a UNESCO MAB award in support of the research; cooperating with the IUCN RLE thematic group, which provided resources and tools to conduct the assessment; and receiving logistic support from the protected area managers.

The metadata associated with the assessment can support future research in BRs by guiding legal frameworks and conservation plans when designating new BRs. These outcomes support creating a link between ecosystem health on the one hand and ecosystem services and the

security of livelihoods on the other hand, and they additionally highlight best practices for achieving sustainability. Assessment outcomes can be used in testing and evaluating policies for achieving sustainable development and in guiding the implementation of national and international conservation strategies.

Gohr, Charlotte: Biosphere Reserves from space: Assessing their ecological effectiveness using Earth Engine

Charlotte Gohr, Biosphere Reserves Institute, Eberswalde University for Sustainable Development, Germany

Establishing protected areas is a prevalent measure for mitigating the loss of biodiversity and the effects of climate change. Within the global network of protected areas, the World Network of Biosphere Reserves (WNBR) aims at "conserving biodiversity, restoring and enhancing ecosystem services, [...] and empowering people to mitigate and adapt to climate change and other aspects of global environmental change" (UNESCO MAB Strategy 2015). Although substantial resources have gone into establishing, promoting, and monitoring the WNBR and many studies have examined these issues, their ecological effectiveness as referred to in the literature on ecosystem functioning is less well understood. Our study therefore aims to assess the measurability of the ecological effectiveness of Biosphere Reserves by developing a remote-sensing-based method on a global scale using ecosystem functioning indicators (Pettoirelli et al. 2018). Advances in cloud computing are beneficial in assessing ecosystem functions via satellite imagery. Quantifying land surface temperature extremes is one proposed indicator for assessing the cooling function of different land cover types (Gohr et al. 2021). By using a multi-indicator approach in our global ecological analyses, we hope to address certain challenges, such as the integration of diverse regional parameters, biome-specific variables, and anthropogenic factors. Our methodology and results should be applicable to other global monitoring approaches and could contribute to the evaluation of measures that are considered to be ecosystem-based adaptations to climate change.

Koigny, Kouadio Juslin Hervé: Analysis of factors that have led to the degradation of the fishery resources of Buyo Lake in the Taï Biosphere Reserve in Ivory Coast

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Buyo Lake in Ivory Coast is an artificial lake, part of which is occupied by the N'zo Partial Faunal Reserve in the northern Taï National Park. The lake is exploited by local populations for fish production; however, the fishery resources of Buyo Lake are decreasing due to the unsustainable management of fishing. This situation may be an impediment to achieving the MAB's Strategic Objective 1 for 2015–2025 – namely to "conserve biodiversity, restore and enhance ecosystem services, and foster the sustainable use of natural resources".

It is this observation that led to the present study, whose aim was to identify the causes of the degradation of Buyo Lake fishery resources and the resulting ecological and social consequences. The methodological approach consisted of conducting individual structured and semi-structured interviews with the various stakeholders in the management of Buyo Lake – namely fishing communities and institutional stakeholders. The interviews focused on knowledge about the causes and impacts of the degradation of fishery resources and on the measures adopted by each stakeholder for sustainably managing Buyo Lake. Direct observations were also carried out on the water in order to identify fishing practices.

Results revealed that the main causes of the degradation of Buyo Lake fishery resources are related to bad fishing practices, the decrease in the water level since the Soubré Hydroelectric Power Station was commissioned in 2017, the large number of fishers on the lake, and the poor enforcement of fishery regulations by fishery services. Other sources of the degradation of Buyo Lake fishery resources include conflicts between fishers, the cutting of tree trunks below the water in the lake, and the decreased level of rainfall on and around the lake. All of these factors have resulted in the degradation of spawning areas and in a decrease in the lake's fish stock, which has led to a decrease in the quantity of catches, to a reduction in the size of catches, to the disappearance of certain species of fish, and to an increase in the effort needed to catch fish.

The decrease in the number of catches inevitably leads to a decrease in fishers' income, to poverty, and to an increase in the market price of fish for the consumer. It is thus critical to sustainably manage Buyo Lake's fishery resources in light of the lake's socio-economic importance for the development of the local population's activities. It is therefore necessary to strengthen the monitoring and legal enforcement of fishing tools throughout Buyo Lake. Furthermore, our study revealed that N'zo Partial Faunal Reserve has the ecological and biological characteristics necessary for designation as an internationally important wetland. The reserve meets a number of criteria for inclusion in the Ramsar list as defined by the Ramsar Convention. Receiving a Ramsar designation would contribute to strengthening the governance, conservation, and wise use of the fishery resources of Buyo Lake through the adoption of new sustainable management measures.

Unfortunately, our observations were not carried out on the entire extent of the lake and are thus limited in terms of their potential for analysis. Future studies should be conducted on the other fishing sections of Buyo Lake in order to identify management problems by involving all stakeholders. These actions should make it possible to address the problem of the degradation of Buyo Lake's resources as a whole. In addition, a sociological study should be conducted in order to better understand the social factors that are used to justify the use of bad fishing practices by fishers on Buyo Lake.

Reimov Mamanbek: Geoinformation analysis and mapping of ecosystems and their services in the protected natural areas of the Southern Aral Sea region

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Introduction: Today, protected areas in the Aral Sea region are on the brink of disaster due to two primary issues: Firstly, the growing water scarcity in the lower part of the Amu Darya River is leading to the degradation of both Tugay forests and biodiversity, thereby increasing both the rate of desertification and the salinity of the territory. Secondly, human activities – such as farming and the production of building materials – have had a strong negative impact on the region and have led to the degradation of both the soil and the landscape of the reserve. Quantifying and mapping ecosystem services in the Aral Sea region is one way of controlling existing services and enables us to identify where high levels of these services are needed in order to protect or manage the region and to reduce the negative impact on its ecosystem.

Research aim: To improve the application of geographic information systems in the study of ecosystems and services in protected natural areas of the Southern Aral Sea region.

Objectives:

1. To optimise and improve ecosystem services in the Lower Amudarya State Biosphere Reserve zone using spatial analysis,
2. to develop a method of mapping ecosystem services and creating maps of the Lower Amudarya State Biosphere Reserve, and
3. to create an ecological landscape map and provide a geo-ecological analysis of the complex landscape of the Saigachiy Reserve using remote sensing data and specialised spectral indices.

Key results: We created

1. an ecosystem service for the Lower Amudarya State Biosphere Reserve,
2. ecosystem service maps, and
3. results of spectral index data change for the complex landscape of the Saigachiy Reserve.

Conclusion:

We developed a method of mapping ecosystem services that takes into account the location of the regional ecosystem services based on the zoning of natural areas adjacent to agricultural landscapes in addition to the protected, buffer, economic, and agricultural zones.

Moreover, for the first time, a map of ecosystem services of the Lower Amudarya State Biosphere Reserve was developed that takes into account the provision, regulation, habitat, and cultural services of protected areas near agricultural landscapes (at a scale of 1:500,000).

Additionally and for the first time, a map of landscape ecology was created that takes into account the spectral indices of humidity, vegetation, and the salinity of surfaces for the complex landscape of the Saigachiy Reserve (at scale of 1:250,000).

Isaac, Roman: Understanding the pathways of natural and anthropogenic forms of capital in the co-production of Nature's Contributions to People

Jana Kachler (1), (2), (3), Roman Isaac (4)

Nature's Contributions to People (NCP)– including ecosystem services – strengthen humanity's quality of life and are co-produced through the interplay between natural and anthropogenic forms of capital (Palomo et al. 2016). Similar to NCPs, these forms of capital are affected by governance and institutions (Díaz et al. 2015). We employed a mixed-methods approach in order to understand the co-production of NCP and the multi-level governance of this co-production in forests and grasslands in Germany. First, we used a systematic literature review to assess existing empirical evidence on NCP co-production and the governance of the anthropogenic forms of capital involved. Second, we conducted a policy document analysis in order to understand the effects of multi-level governance on the anthropogenic forms of capital involved in the co-production of grassland and forest NCPs. Third, we used a structural equation modelling framework to test significant linkages between land use, plant diversity, NCP regulations, and forage production in 150 grasslands plots as part of the large-scale Biodiversity Exploratories research project. Fourth, we analysed stakeholder interviews (i.e. farmers, foresters,

nature protection agencies, tourists) through multiple linear regression and cluster analyses in order to identify how stakeholders set priorities in the use and management of NCPs in the national park and two biosphere reserves of the Biodiversity Exploratories. Fifth, we used a social network analysis to determine which actors influence the co-production of NCPs in these three regions. Our findings reveal that empirical evidence on NCP co-production is scarce and that many gaps in knowledge and methodologies persist. Most research that focusses on NCP co-production is conducted on material and non-material NCPs; however, we found that non-material NCPs are predominantly affected by hierarchical governance, for example, in the form of laws, whereas material NCPs are linked to the governing of strategic behaviour, such as payments for ecosystem services. The first results of our analysis on NCPs in grasslands indicate that relationships between land use, plant diversity, pollination, and forage production in semi-protected areas (e.g. landscape protection areas in biosphere reserves) appear to differ from these relationships in both highly protected areas and non-protected areas. Several challenges arose during fieldwork. First, the COVID-19 pandemic made it difficult to plan fieldwork and find potential interviewees. Second, the peculiarities of the German federal system complicated collaborations across universities. In contrast, the administrations of both biosphere reserves – that is, the national park and the Biodiversity Exploratories – were highly supportive in giving interviews, providing material, and contacting other stakeholders. Based on our forthcoming interview analysis, we expect to find that NCP priorities differ between stakeholders as well as between biosphere reserves and the national park (1) because landscapes differ between the regions (e.g. in terms of forest and grassland composition) and (2) because the two landscape conservation concepts imply different expectations and governance approaches.

Sajorne, Recca: Micro- and macro-plastic pollution along sandy beaches in Puerto Princesa, Palawan Island, the Philippines

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Plastic pollution is now considered a global threat to biodiversity, especially in marine environments. Recent

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reports from news and social media have revealed the concern for the worsening problem of marine plastic pollution in Palawan and its capital, Puerto Princesa City. However, a systematic study that documents the extent of plastic pollution in Palawan is lacking. Therefore, our study was conducted in order to investigate the occurrence of microplastics and pollution and to determine the clean-coast index (CCI) of residential and non-residential sites on the coasts of Puerto Princesa, Palawan. Specifically, our study aimed to (1) determine the density of the plastic pollution on residential and non-residential beaches, (2) identify the types and classification of plastic pollution, (3) determine the clean-coast index (CCI) of the beaches on the east and west coasts, and (4) determine the presence of microplastics in the beach sediments of Puerto Princesa City, Palawan. To the best of our knowledge, ours is the first study on marine plastic pollution on the island of Palawan. Plastic pollution was sampled from 21 coastal barangays (i.e. municipality sub-divisions) by delineating a 50-m-long transect line with three 4-m-x-4-m quadrats. The plastic pollution samples were counted and sorted into categories. On the same quadrat, a sand sample from a depth of about 1 cm from the surface was also obtained in order to extract microplastics and pollution debris.

Results revealed that 17 sites were contaminated with plastic pollution. In terms of plastic density in residen-

tial and non-residential sites, the east coast has three times as much plastic (i.e. 2.61 items/m² and 1.26 items/m², respectively) compared with west coast (with only 1.57 items/m² and 0.14 items/m², respectively). The sampled plastics were predominantly fishing line (nylon), food packaging, and fragments. The calculated CCI revealed that 76% of the sampled sites should be categorised as dirty and extremely dirty. On the other hand, 15 sites showed the presence of microplastics, which included mainly fibre, fragments, film, and filament that ranged in colour from blue, red, and green to transparent, yellow, and white.

The challenges that our study encountered included undertaking data collection during the COVID-19 pandemic and dealing with the aftermath of sharing our results with the public. Overall, the study serves as baseline research in the province of Palawan and should help policy-makers create and implement an integrated approach to the problem of solid waste management. The government should also create information, communication, and education (IEC) materials for use in local coastal communities.



Examples of Best-Practice Research Management

■ GROUP 1: ACADEMIA – UNIVERSITIES AND INSTITUTES

Ahamadou, Bocar: Soil biota and biodiversity as key drivers of sustainable Biosphere Reserve management: A case study from Mali with notes on a project concept

Today, multiple issues involving soils and their biota are at stake for the scientific community on both local and global scales. In such a context, gaining a greater understanding of how cross- and extra-disciplinary research is evolving is critical when it comes to identifying and implementing appropriate Biosphere Reserve management strategies. The central aim of our study is to discuss the key issues associated with designing and implementing a multi-dimensional research project in order to contribute to a sound and sustainable strategic management plan for the Boucle du Baoulé Biosphere Reserve in Mali.

When supporting or integrating cross- and extra-disciplinary research, special concern should be given not only to the unknown relationship between soil biodiversity and ecosystem functioning, but also to whether

scientists could use rigorous experiments to predict how future changes might impact human interactions with soils and their biota. Focus should thus be placed on key issues or drivers that help increase the effectiveness of the project managers and their teams and that can make the ecosystem more productive and sustainable. These main drivers include (1) the team structure and maturity, (2) inclusiveness and stakeholder engagement, (3) the skills and experiences of the research project team members, (4) the research ecosystem or environment, (5) the capacities of the institutional and operational management, (6) the effectiveness of the monitoring evaluation and learning (MEL) system, and (7) the project's ability to develop synergies and to pool resources.

In terms of challenges, some research questions and opportunities or gaps that link soil biota to the function, service provision, and land productivity of Biosphere Reserves include (1) integrating spatial variability research according to the zoning of the biosphere, (2) using a selective functional group approach to study soil biota and function, (3) determining the role of remote sensing in detecting the condition and composition of vegetation in order to understand soil microbiological communities on a landscape scale, (4) ensuring the correct design of soil-quality monitoring systems based on microbial indicators or indices that inform land users in the Biosphere

Reserve about the delivery of sound soil health systems in order to aid in policy- and decision-making, and (5) determining the role of soil biota and their diversity in climate-change-mitigation strategies. Regarding administration and institutions, strictly applying laws and regulations is a sine qua non condition of success in the management of Biosphere Reserves.

The key factors that have been beneficial in supporting and strengthening research include

- the existence of vigorous national forms of legislation and regulations,
- the leadership and commitment of Biosphere Reserve managers,
- an advocated participatory and empowering approach,
- support based on the mutual commitment of communities and reserve managers,
- an adapted and flexible monitoring evaluation and learning system, and
- management based on diversified modalities.

Despite insecurities and some other socio-technical issues, the sustainable management of Biosphere Reserves can be improved by taking into account the role and proper functioning of soil biota.

Albarracín Lluncor, Gabriela: Work experience in the Oxapampa–Asháninka–Yánesha Biosphere Reserve in Oxapampa, Peru: Commemorating the reserve's 10th anniversary with a celebration of its achievements, local experiences, and testimonies in order to derive lessons for improving the area's management and development

Gabriela Albarracín-Lluncor, Christian R. Vogl, University of Natural Resources and Life Sciences, Vienna, Austria

The AGROBIO-K_NOW project – which was funded by the UNESCO National Committee MAB-AUSTRIA and the Austrian Academy of Sciences (ÖAW) – was implemented between November 2017 and November 2020. The BIOAY in Peru displays unexpected links with Austria because it hosts the largest Austrian-Tyrolean colony in the world. The underlying objective of the project was to intensify Austrian–Peruvian interaction and to support the governance of the BIOAY. The main guiding assumptions focused on not conducting our own new empirical scientific research in the field because a great deal of scientific research had already been performed in the study area, but the results are not yet accessible to the local public. Moreover, research results collected and published thus far are not yet fully available to the Biosphere Reserve management. We thus proposed creating an overview of previous research projects that had been completed together with the local stakeholders by making research results more visible and accessible.

As a result, we elaborated a repository of publications that contains over 400 documents for use in the BIOAY administration and on the new BR website. Similarly, we communicated selected research results in two radio programmes for local people in accessible languages and with clear content. Finally, an open access book that commemorates the 10th anniversary of the BIOAY was edited. The book was implemented with and for the people of the BIOAY and involved the participation of about 60 authors and co-authors in its 29 chapters. The free open access publication contains testimonies, experiences, opinions, and scientific research results that reflect the biocultural diversity of the BIOAY – that is, its natural, social, economic, and cultural environment. Some of the main challenges in editing the book were (1) the unexpectedly large amount of time needed for following up on the many suggestions, ideas, and potential resources, (2) keeping in touch with authors who live in remote areas or who have a busy agenda, (3) communicating deadlines, (4) dealing with the delay in responding to concerns about imprecise data, and (5) dealing with the delay in correcting texts.

The COVID-19 pandemic forced us to shift our work on the project to WhatsApp, telephone calls, and email. When conducting any research, it is important to consider the cultural and historical background of the area and especially the regional interest in using such research to develop a unique BR identity. In order to encourage acceptance by inhabitants and to enhance their willingness to contribute to the agenda of the BIOAY and related research, it is critical to make the research agenda and processes transparent as well as to make results available and locally understandable. The project created an opportunity to engage in further discussions about existing research findings, to better manage future research projects (within the BIOAY), and to increase the visibility of the Biosphere Reserve beyond its boundaries.

Auinger, Monika: Science_Link Nockberge research cooperation

Connecting a Biosphere Region and the scholarly world

Monika Auinger, Carinthia University of Applied Sciences, Austria

Biosphere Reserves (BRs) as recognised as model regions for sustainable development are supposed to maintain permanent access to scientific findings, innovation, new technologies, and scholarly discussions. SCIENCE_LINK^{Nockberge} is an institutionalised cooperation between the Carinthian part of the UNESCO Salzburger Lungau and Kärntner Nockberge Biosphere Reserve on the one hand and between the Alpen-Adria-University Klagenfurt (AAU) and Carinthia University of Applied Sciences (CUAS) research institutions on the other hand. The long-term cooperation between the BR and AAU has existed

since 2013. In 2020, the UNESCO Chair on Sustainable Management of Conservation Areas (headquartered in CUAS) joined the partnership. The four main aims of the cooperation are (1) to build a bridge between excellent international research and everyday life in the BR, (2) to stimulate, trigger, and scientifically supervise technical, economic, ecological, and social innovations in the BR, (3) to provide access to international developments and trends as well as to the scientific community, and (4) to raise public awareness of the importance and potentials of the BR [1].

The BR is characterised by its rural area, ageing population, migration, and brain drain. The beginning of the cooperation was marked by numerous challenges in unifying the institutional and administrative annual cycles of all institutions. Extensive information campaigns were necessary to define the BR as well as its tasks and goals in order to provide all participants with a common understanding. The cooperation uses an annual work plan and activity reports, which are complemented by quarterly work meetings. One of the core activities is the development of student works (bachelor's and master's theses as well as doctoral dissertations) on current issues from everyday life in the BR. The BR management supports the implementation of these student works by providing technical and logistical solutions, and the universities offer scientific guidance and the supervision of thesis development. The cooperation uses two main tools:

1. a catalogue of research questions that contains more than 50 research topics from different disciplines that are relevant to BRs (e.g. economic, health, legal, natural, and social sciences; conservation technologies; UNESCO and World Network of Biosphere Reserves) and
2. the Nockothek online database, which is a publicly accessible literature database (<https://oremo.e-c-o.at/>) that contains more than 400 entries with relevant publications, documents, completed theses, and grey literature on the BR region [2].

Despite almost ten years of cooperation, no systematic review or evaluation has yet been carried out. Nevertheless, the cooperation has contributed significantly to improving the national and international visibility of the BR. The activities of the research cooperation demonstrate sustainable success in the long-term development of the research, education, protection, and development mission of the BR management.

References

- [1] H. Egner, J. Falkner, M., Jungmeier, & Zollner, D. 2017: Institutionalizing cooperation between biosphere reserves and universities – the example of SCIENCE_LINKnockberge. In *Eco.mont* – Volume 9, Number 2, July 2017, 77–80.
- [2] J. Falkner & Rauch, F. 2020: SCIENCE_LINKnockberge – kooperativ Forschen, Lehren und Lernen. In: Borsdorf A.,

Jungmeier M., Braun V., Heinrich K. (ed.), 2020: *Biosphäre 4.0. – UNESCO Biosphere Reserves als Modellregionen einer nachhaltigen Entwicklung*. Springer Spektrum, 161–170.

Belčáková, Ingrid and Slámová, Martina: Role of the Natura 2000 network and the management of prioritised habitats in the integrated landscape protection of selected Biosphere Reserves in Slovakia

Slovak Karst National Park, Biosphere Reserve and World Heritage Site, Slovakia

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Our project is based on ongoing research projects in the Tatry, Polana, and Slovak Karst Biosphere Reserves (BRs) in Slovakia. Our research focuses on the implementation of a prioritised action framework (PAF) for Natura 2000 in Slovakia for the 2021–2027 period. The implementation of the PAF is the project's main objective and has the goal of contributing to improving the conservation status of some specific and prioritised species and habitat types. The PAF also covers broader actions in the field of green infrastructure and thereby strengthens the Natura 2000 network at regional, national, and cross-border levels. The project results are presented as part of a case study on the Slovak Karst National Park (NP) BR and World Heritage Site.

The caves of the Slovak and Aggteleg Karst are part of the UNESCO World Heritage List, and the territory of the NP overlaps the Slovak Karst BR. The character of the agricultural landscape has historically been shaped by grazing activity, which is currently insufficient. The natural factor that limits grazing is the lack of water on Karst plains. The case study reflects one of the main goals of the MAB programme for 2015–2025: namely to support and develop sustainable, healthy societies and economies as well as prosperous human settlements that exist in harmony with nature. In line with this goal, the following research methodology was proposed: 1. Analyse and evaluate land-use change, 2. identify farms that carry out extensive grazing, 3. identify and evaluate the use of extensive pastures in the context of nature- and landscape protection, specifically within the NATURA 2000 network, 4. perform a multi-criteria analysis and evaluation of the BR's potential for eco-agrotourism and compare the results with the real situation, and 5. design an integrated landscape management conception.

The project aims to spread its findings (in terms of new environmental management styles and new techniques, such as agroforestry) and approach to monitoring- and effectiveness assessments by focusing not only on com-

mon biological and socio-economic factors, but also on the introduction of “best-practice” actions. Nature and biodiversity protection might be able to be more tightly bounded with a new strategic agricultural plan. The implementation of specific conservational actions and the development of new managerial approaches might be performed through integrated land management that covers additional biotopes and species in the future.

Our contribution was made with the financial support of both the Scientific Grant Agency of the Ministry of Education, Science, Research and Sports of the Slovak Republic and the Slovak Academy of Sciences within the project VEGA1/0736/21 “Identification and evaluation of important landscape structures for social practice”.

Benfekih, Leila: Gaining wildlife knowledge in Chréa National Park in the context of global change

A comprehensive literature review of fauna biodiversity databases: Implications for management and species conservation within Chréa Biosphere Reserve, Algeria

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The establishment of databases has been one of the most significant developments in terms of making biodiversity knowledge available to academics, decision-makers, and stakeholders alike. There is growing concern in Algeria over habitat loss, especially in critical forests and wetlands, and the conservation of wildlife species in these major biodiversity zones necessitates the conservation and protection of their habitats in protected areas. Chréa National Park (Chr a Biosphere Reserve; CBR) – a 26,000 hectare mountainous area in northern Algeria – is bioecologically characteristic of extreme ecosystem biodiversity, with a large number of endemic and endangered species having been identified, including 816 plants and 394 animals, 49 of which are protected. Human activities and the heavy use of the site are two of the most pressing challenges that park administrators must address by developing safe, long-term solutions.

Although the flora in Ch a Biosphere Reserve has received greater attention, data on wildlife remain sparse, and the extent of invertebrate and vertebrate biodiversity within these BR ecosystems has yet to be assessed. In this setting, expanding our understanding of wildlife ecology in the CBR is critical to implementing effective conservation and best-practice initiatives. The current research management aims to strengthen the knowledge of terrestrial fauna biodiversity and the protection of these species in order to assess the ecological, economic,

and social impacts of observed changes in the CBR. Within the framework of the University of Blida's doctoral research in ecology and the environment as an institutional project that began in 2021, we conducted an up-to-date review by means of an integrative approach and qualitative analysis of the literature on the CBR from the past decade (2011–2021) in collaboration with academic staff and CBR engineers and veterinarians. Different data sources that matched with management plans, projects analyses, and research investigations with published data in CBR ecosystems were consulted in order to establish an up-to-date database on fauna biodiversity habitat utilisation and seasonal activity.

Early investigations indicate that scientific output has increased in the past decade through the identification of new species. The project's goal since 2021 has been to necessitate the participation of an interdisciplinary research team that promotes local community study and interaction in order to gain a better understanding of the CBR fauna and its preservation while taking the most beneficial human activities in and around the park into consideration.

Dichte, Angela: Network booster – #Biosphere platforms: Supporting communication and dataflow

Angela Dichte, Centre for Econics and Ecosystem Management, Eberswalde University for Sustainable Development, Germany

The Centre for Econics and Ecosystem Management (CEEM) has maintained contacts with Biosphere Reserves (BRs) in Ukraine for over 15 years. This collaboration has been strengthened through joint projects and has expanded through further partnerships with universities and other BRs. An important component of these partnerships is represented by projects that have been funded by the German Academic Exchange Service (DAAD) since 2016 as part of the East–West Dialogue funding programme. These past seven years of continuous funding has fostered trust and helped build steady relationships. Furthermore, within the framework of another project with three Ukrainian BRs on climate change adaptation and the empowerment of BRs, the group of partners again grew, which led to the implementation of a small project on transboundary cooperation between a Ukrainian and a Russian BR in 2020.

Due to the enormous challenges that the COVID-19 pandemic has posed, especially for international projects, we moved our project activities more into the digital realm. In the latter project, in particular, it became necessary to create a multilingual forum platform that would facilitate exchange between project partners and that could also support exchange with civil society and other stakeholders in the longer term. In parallel, in another project at the CEEM with BR partners in the Balkans, a

new platform was developed as a YouTube channel – #BiosphereShare, for which videos are created that present the BR concept. Furthermore, videos on projects in and with BRs as well as presentation videos of BRs have been collected and made available. Based on these videos, the idea emerged to develop a series of #Biosphere platforms that cover different aspects of the work and needs of BRs and of individuals who work with BRs.

Within the project with the Ukrainian and Russian partners, the #BiosphereDialogue platform was developed, which enabled information exchange on topics that had been identified by the two BRs as the most relevant from the Lima Action Plan and that are supported by an automatic translation application that currently enables the input and output of texts in English, German, Russian, and Spanish. In 2021, based on an idea for a student research project (which was presented in another talk during this conference), the idea emerged for a further platform (#BiosphereResearch) that supports data analysis and the creation of a data pool, which will be filled by subsequent students over the years and will thus create the possibility for analysing time series and for providing comparisons.

Unfortunately, we have not yet succeeded in bringing the forum platform to life. Additionally, the platform for the research data has not yet been completed due in large part to the consequences of Russia's war on Ukraine and the effects of the war on our Ukrainian programmer. We strongly believe that in times of multiple enormous global challenges, BRs can and should be places that can find new ways (or resume former ways) of responding more resiliently to environmental and social challenges through their international networks and transformative character. However, this requires courage, flexibility, and perseverance. Tools for collaborative exchange and thus for supporting resilience can help, but they need to become more relevant and attractive to use. One of our aims during the conference was to reflect with participants on how we can achieve this goal.

Grabsch, Leonhard Georg Mehriz: #Biosphere Research – Edge effects between clearcutting areas and natural protected forests

Bachstein, Nadine; Driftmann, Julius; Grabsch, Leonhard, Centre for Ecomics and Ecosystem Management, Eberswalde University for Sustainable Development, Germany

Based on the mandatory international internship that is demanded by the curriculum of the “International Forest Ecosystem Management” undergraduate programme at Eberswalde University for Sustainable Development (HNEE), a transboundary research- and exchange project was initiated and established in 2021. The project is embedded within the DAAD East–West Dialogue programme and is located in the Roztochya Biosphere Reserve (Uk-

raine) and the Plaiul Fagului Natural Reserve (Moldova). Students and scientific staff from HNEE (Germany), the Ukrainian National Forestry University in Lviv (UNFU), and the Moldova State University (MDA) participated in the project. The research management comprised ten components: (1) creating the team, (2) conducting literature research, (3) organising funding, (4) formulating guiding research questions, (5) pre-selecting study sites, (6) organising material, (7) installing plots, (8) conducting work on the sites, (9) analysing and interpreting data, and (10) evaluating work. Research support was provided by carrying out the work within an already-established cooperation between the universities and biosphere reserves as well as by accessing funding via the DAAD T. E.–W. Dialogue programme. German students were supported by the Erasmus+ traineeship programme. The underlying research approach was based on previous microclimate-related forest ecology studies and the concept of adaptive management because both are major concepts that are applied at the CEEM. The lack of further indicators for microclimate regulative capacity was identified as a key research gap in the project. Overall, the project faces an uncertain future due to Russia's ongoing war against Ukraine. A variety of challenges appeared in the fields of time management, logistics and visa organisation, and working with unfamiliar equipment. In addition, legislative challenges were faced in terms of the policies of the BR and the natural reserve as well as related to the topic of gathering students who were interested in ecology-related projects. The BRR provided possibilities for exchanging data and knowledge in different areas. In order to allow the exchange of results and to make these results accessible to interested researchers, a web platform was conceptualised and is currently being created by a software developer from Ukraine. As the project was designed to be long-term, many young researchers are expected to be able to conduct research and profit from the biosphere reserves as sites where they can learn how to implement sustainable development. The preliminary observation of possible sites in the field by all active researchers and the long-term consideration of the organisation of measurement devices were concluded to positively affect the scientific outcome. In order to increase Ukrainian and Moldovan students' willingness and ability to participate, grants should be provided that ensure financial stability during students' active participation in the project. In addition, integrative research opportunities within in the project should be provided in order to help overcome language barriers and increase the project's attractiveness to students at partner universities.

Heitepriem, Nico: The Ginkoo Project – Innovative solutions for sustainable cultural landscape development in the Spreewald

Nico Heitepriem, Spreewald Biosphere Reserve (State Office for Environment | Brandenburg), Germany

The Ginkoo Project was a transdisciplinary research project that examined innovation processes at the Spree-wald Biosphere Reserve between 2014 and 2020 by (1) analysing the requirements for successful innovation project management and (2) building on that knowledge to develop concepts and concrete management tools (e.g. for improving stakeholders' interaction) in order to support complex innovation management processes at the level of the cultural landscape.

Taking into account the specific problem of land abandonment on marginal wet grasslands with high environmental and cultural value, all involved stakeholders worked together to re-design the management cycle of the wetland meadows by focusing on the entire value chain. The main objective was to valorise the threatened peat-soil grassland ecosystems. Therefore, different on-site solutions and lighthouse projects were introduced. The research process began with two overall research questions:

1. How can innovation processes for sustainable cultural landscape management be organised and coordinated?
2. What is the leading on-site concept behind innovation activities for sustainable cultural landscape management?

In order to find answers to these questions, we began with a joint situation analysis that took into account a multitude of valid data, information, and on-site knowledge (e.g. stakeholder workshops, excursions, etc.). What became clear very quickly during the analysis was the common regional understanding that mineral- and peat-soil grasslands are landscape elements of high value for both nature conservation and cultural identity and are therefore worth being maintained.

One solution to the problem of abandoning marginal grassland sites was a special oven technology that produces heat from biomass that originates from marginal sites. During the innovation process, research was carried out on various innovation aspects, such as acceptance and participation, cooperation, marketing, and knowledge management. The new furnace solution was found to provide a successful form of innovation that was able to be implemented using research. The research itself used practical knowledge and developed an innovation management model (IMM) (including a toolbox) to support innovations in sustainable land management. Eventually, scientists and even the practitioners concluded that working together as a multi- and transdisciplinary team was a fruitful process and represented a win-win situation for both sides.

However, it became very clear that real-life innovation processes can be a dead end or be delayed due to (un)foreseeable obstacles (in the present example, due to the insolvency of the original furnace manufacturer). Regional innovation management can be challenging and full

of tasks that at first glance are not obvious to involved stakeholders (invisible work). Bringing together movers and shakers and necessary resources is not only a key challenge, but also a great opportunity for successful sustainable land management.

Mammadova, Aida: University network for intergenerational learning within UNESCO Biosphere Reserves

Kanazawa University, Japan

Most UNESCO-designated sites (Biosphere Reserves, geoparks, and World Heritage Sites) in Japan are protected territories and are located in remote areas that face issues of de-population, aging, the lack of young followers, the loss of employment opportunities, and the loss of traditional culture and knowledge. Forty out of 47 prefectures in Japan are currently facing population decreases. Without the involvement of the youth, these areas will not be able to contribute to UNESCO's concept of sustainable development (SD). The elderly within Japanese local communities thus feel both isolated from the modern world and powerless and lack the necessary motivation to face external challenges, whereas the youth have less interest in rural areas and feel no sense of responsibility for the issues within the communities located there. It is therefore urgently necessary to create an intergenerational alliance (i.e., between the elderly and the youth) within these sites in order to secure SD at local, national, and global levels.

At Kanazawa University in Japan, we created the Interdisciplinary and Intergenerational Studies course together with Biosphere Reserves, geoparks, NPOs, local governments, and villagers in order to develop human resources target towards sustainable regional development. Since 2015, we have conducted training courses inside the BRs, with more than 500 international students from more than 24 countries having participated in our courses. In 2021, in order to connect with more young people in Japan, we created the Japanese Inter-University Network within UNESCO's Man and the Biosphere (MAB) programme (JU-MAB), which consists of six Japanese universities: Kyoto University, Yokohama National University, Ehime University, Tsukuba University, Miyazaki University, and Kanazawa University. Together with the JU-MAB and with strong collaboration from the Japanese Biosphere Reserves Network, geoparks, the Kazakhstan National Committee for the Man and the Biosphere programme, and the ASEAN University Network, we have conducted five training courses with Central Asia (Kazakhstan, Uzbekistan, Kyrgyzstan, and Tajikistan), Europe (Norway, Latvia, and Estonia), and South-East Asia. In 2021, more than 250 students participated in our online training courses. We found significant differences in the awareness and motivation levels between young people from European, Central Asian, and South-East Asian countries that

were related to the different educational and historical backgrounds, living environments, and communication skills of the participants.

Our intergenerational education at the local and global level has demonstrated that UNESCO-designated sites can be used as platforms for linking the elderly and the youth and for motivating both groups to participate in mutually beneficial activities. The engagement of different universities and local authorities with the educational curriculum generates more actionable knowledge and thus has an impact on SD, raises awareness of environmental protection and community welfare, stimulates changes in attitudes and behaviour among the youth towards remote communities, and increases motivation among the elderly to take action on regional issues.

Måren, Inger Elisabeth: Working together for a better biosphere

Inger Elisabeth Måren, University of Bergen, Norway

In the current epoch known as the Anthropocene, we face a multitude of challenges, including the nature crisis, the climate crisis, and now, the pandemic crisis. Despite decades of clear scientific evidence indicating that current levels of human impact are unsustainable and are leading to irreversible and costly losses of biodiversity, of ecosystem functions, and of planetary regulatory mechanisms, we as a society are still far behind the scale of action necessary for a sustainability transformation.

There is thus a pressing need for a fundamental paradigm shift in both our vision and our approaches to using, managing, studying, and governing critical features of the Earth system. We need to move away from sectorial and divisive approaches that treat nature as a “special interest” among many competing societal priorities and towards a new and integrated “nature-and-people” paradigm in which knowledge is available at scales relevant to decision-makers. This deep transformation must be echoed in academia in how we both deal with the challenges of the Anthropocene and move away from traditional academic silos.

The UNESCO Chair programme can function as a link between academia and society by using Biosphere Reserves (BRs) as particularly suitable and strategic areas for learning about, supporting, and investing in a better biosphere. Thus, in my presentation, I explored how BRs can successfully contribute to alleviating pressing sustainability challenges and can initiate transformational change towards sustainability. Moreover, I tackled how we as researchers can contribute to this transformation in the best ways possible.

By using a transdisciplinary approach, we include BR stakeholders in knowledge co-production processes

for sustainability. Both transdisciplinary knowledge co-creation and the integration of academic and local/Indigenous knowledge are considered particularly suitable areas for creating actionable knowledge that catalyses the implementation of the UN’s Sustainable Development Goals. Challenges include activating stakeholders and engaging policy-makers by using a clear and simple framework and decoding academic “tribal language”. Moreover, using the right methodology for the investigated topics and themes may pose a challenge in itself.

Young stakeholders, in particular, are key to sustainability transformations both as active participants who push these transformations forward and as actors who are vulnerable to being left behind. Research activities that integrate human–nature perspectives in BRs should take this understanding into consideration. Challenges mainly involve how to include the youth as active participants because these youth may not be able to be reached through conventional methods.

As elsewhere in society, minority or marginalised groups are often underrepresented in BR collaborations. These groups may be difficult to activate or motivate, or they may need to be reached and engaged in different or new ways than is the case for other stakeholders.

Research gaps include finding ways to bridge the gap between researchers’ tools and aims, with the goal of having a variety of stakeholders and actors, including youth and minority groups for sustainable development within BRs and beyond. Activating the WNBR to a greater extent may be one way forward.

Müller, Eduard and Moreno, Tania: Biosphere reserves: An opportunity to demonstrate that regenerative development is possible, scalable, and feasible

Eduard Müller and Tania Moreno, University for International Cooperation, Costa Rica, and the Regenerate Costa Rica initiative. UNESCO Chair of Biosphere Reserves and Natural and Mixed World Heritage Sites. www.uci.ac.cr

The United Nations Secretary General has called the latest IPCC Assessment Report a “code red for humanity”.¹ While addressing the Convention of Biological Diversity, he also stated that “[w]e are losing our suicidal war against nature”.² Although we have more data, information, and knowledge than ever before, we appear to have forgotten how to turn these items into wisdom and then into action. We are currently bearing witness to the best

¹ <https://www.un.org/press/en/2021/sghsm20847.doc.htm#:~:text=Today's%20IPCC%20Working%20Group%201,of%20people%20at%20immediate%20risk>

² <https://www.un.org/press/en/2021/sghsm20959.doc.htm>





scientifically documented planetary extinction event in recorded history, but all this science has not been able to reverse humanity's negative tendencies since the Rio Convention 30 years ago.

As Buckminster Fuller stated, “[y]ou never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.” In line with this observation, we launched the Regenerate Costa Rica initiative at the University for International Cooperation. By applying our conceptual framework for regenerative development, which consists of holistically integrating nature, spirituality, economics, society, culture, and politics and originated from our work in biosphere reserves, we demonstrate that bio-regional-scale regeneration is indeed possible.

Due to the complexity of the initiative, we will be reporting on a few strategic areas that can help reverse the transgression of the planetary boundaries that Costa Rica has caused and that can thus be used to actively contribute to reversing climate change and biodiversity loss while putting people at the service of life.

■ GROUP 2: ORGANISATIONS AND INSTITUTIONS

Ashong, Sheila Nana: Cooperation for greater impact: The Biosphere Learning Laboratory Lake Bosomtwe (BL3B) project, Ghana

Sheila Nana Akua Ashong, Ghana MAB National Secretariat, Environmental Protection Agency, Accra, Ghana

Stakeholder collaboration and international cooperation are becoming increasingly relevant to natural resource management everywhere because plant and animal species know neither local nor national boundaries. Hence, site-specific management strategies are inadequate for natural resource management or for achieving the UN's Sustainable Development Goals (SDGs). UNESCO Biosphere Reserves (BRs) are recognised as learning laboratories for sustainable development because they provide a common platform for stakeholders to learn about sustainability and because they foster local and national collaboration as well as international collaboration across all disciplines. BRs also serve as research laboratories for exploring innovative approaches to solving resource management problems.

The Biosphere Learning Laboratory Lake Bosomtwe (BL3B) showcases the opportunities and best practices of collaboration that were designed to achieve the Sustainable Development Goals. Through collaboration in terms of research and education among universities and other BR stakeholders in Germany and Ghana, various activities are being implemented with the goal of fur-

thering Outcome A4 of the Lima Action Plan for the World Network of Biosphere Reserves, which involves “[r]esearch, practical learning and training opportunities that support [the] management and sustainable development of biosphere reserves”. The BL3B project capitalises on BR twinning arrangements and existing stakeholder relationships. The research collaboration enhances awareness and builds local capacities while also improving stakeholder support for the effective management and functioning of the BR. Achievements chalked under the project include a study tour of four BRs in Germany and Denmark, the provision of research equipment for the BR, annual exchange visits by researchers, revision of university curricula in order to integrate the BR concept, and the publication of an awareness-creation booklet for local communities. Lessons learned may be emulated in other collaboration networks, learning laboratories, and protected areas.

Hà, Nguyen Thi Thanh: Funding for research on biodiversity conservation and sustainable development in BRs in Vietnam

Nguyen Thi Thanh Hà, Vietnam Man and the Biosphere programme, Ministry of Science and Technology of Vietnam Department of Human, Social and Natural Science

Introduction: My talk covered state funding for research in BRs in Vietnam. The Ministry of Science and Technology is the main funding agency, which provides a budget for such research projects. Since 2015, about 15 research projects that address the issues of biodiversity conservation in Biosphere Reserves (BRs) in Vietnam have been funded.

Description of the research management conducted in my project: Vietnam joined UNESCO in 1977 and fully participates in UNESCO's natural science programmes, such as the MAB, IOC, IHP, IGGP, and GeoPark programmes. In 2000, Can Gio Forest was approved as the first World Biosphere Reserve in Vietnam. Over the past 20 years, Vietnam has had a total of 11 BRs, with the two newest BRs having been approved in 2020. Vietnam ranks second in ASEAN after Indonesia in terms of its number of BRs. The country was a member of MAB-ICC between 2017 and 2021. Before 2015, the Ministry of Science and Technology of Vietnam had funded general topics on sustainable development, biodiversity conservation, the rational use of natural resources, etc. Since 2015, after being assigned the Head of the Science Commission under National Committee for UNESCO by Vietnam's Prime Minister, the Ministry of Science and Technology began to support research on the biosphere reserves network in Vietnam.

Elements of research support: The research projects were selected through competition. Scientists at universities and institutes applied for grants. There were scientific panels for assessing proposals through peer review.

Each chosen project was provided with a budget of about 200,000 USD for a period of three years. Nine projects were selected between 2015 and 2019, and six additional projects were selected between 2019 and 2022. The topics of these projects include biodiversity conservation and community livelihood, ecotourism, cultural conservation, ecosystem restoration, the ecolabelling of services and products, and the sustainable development of BRs. Moreover, the projects also address management issues, such as strategies for developing BR networks in Vietnam, the capacity-building of sustainable development for BRs, etc.

Outlook and identified research gaps: The Ministry of Science and Technology's support of research in the BRs has drawn scientific attention to the UNESCO sites and particularly to the BRs themselves. Scientists have focused on the UNESCO sites; however, their research projects have lacked international cooperation. Digital transformation in BRs – such as applying technologies like AI and IoT to biodiversity monitoring – has not yet been addressed. **Challenges:** Although there have been demands for research on BRs, due to the shortage of the state budget, the number of projects has been limited. Some scientists are not familiar with the UNESCO sites. Additionally, the capacity of local authorities to obtain research results has been constrained, and the legal management framework for the BRs has not yet been fully developed. The benefits of carrying out research in BRs have included helping raise awareness of the community, the BR management boards, and local authorities. The projects have served as good examples for practicing capacity building for BRs.

Conclusion: Scientific projects have made a positive impact on BRs. The Ministry of Science and Technology will thus continue to support research on BRs in order to promote the value of the UNESCO sites, thereby helping local people to conserve biodiversity while promoting socio-economic development and contributing to achieving the SDGs.

Harcha, Claudia I.: Sustainable development of the Biosphere Reserve Yungay (Chile)

Claudia I. Harcha, José A. Morales, Miguel L. Martinez, Paulo E. Suárez, and Leonardo E. Tapia, Ilustre Municipalidad de Yungay, Chile

In both Latin America and the world, poverty is a multifactorial issue. However, among the main causes of poverty are climate change and effects derived from current national economic model. As a result, the city of Yungay, Chile, is a model territory for sustainable development.

Yungay is located in the Ñuble Region of Southern Chile (37°07' S, 72°01'W). Despite having the second-highest rate of poverty in the country, the city is characterised by natural tourism resources (e.g. a net of waterfalls) and an

extensive territory of 823 km², 26% of which belongs to the Nevados de Chillán–Laguna Laja Biological Corridor UNESCO Biosphere Reserve (UBR) (declaration year: 2011).

Yungay's vision of sustainable local development has ranged from enhancing cultural and geological heritage to developing economic activities (e.g. agro-tourism and agriculture) along with ecosystem protection (environmental education and work with civil society) due to the explicit requirements of the area's local communities. One example of such economic activity the system that has been developed around the Itata River waterfall, which has become a tourist destination not only for its scenic beauty, but also for its cultural heritage and for the contribution it makes to local sustainable development because it is overseen by 16 families from Ranchillos zone.

At the global level, our work mainly addresses the gap between the concept of biosphere reserves and their actual effectiveness. At the local level, our mountain zone must be protected and sustainably managed in order for current and future communities to survive. This mountain zone contains a rich ecosystem with rivers, ancient forests, and endemic plants and animals that can only be found in our UBR.

In Chile, another challenge to managing biosphere reserves involves linking the state administration (which is responsible for public policies and economic distribution), researchers, and civil society. Efforts in this direction have been carried out mainly by universities; however, political-administrative commitment is required to manage biosphere reserves.

Our UBR management plan – which is based on the UNESCO sustainability principles – has been beneficial in supporting, strengthening, and prioritising the needs of the communities that live in the UBR in terms of providing basic infrastructure, road and digital connectivity, biodiversity conservation, river protection, natural and cultural heritage, and entrepreneurship (based on agro-tourism and agriculture).

Biosphere reserves can be model governance areas in which conservation and sustainable development are carried out. In such areas, it is possible to eschew traditional economic models, which have not managed to solve poverty problems in underdeveloped countries, such as Chile.

Hien, Vu Thuc: Biosphere Reserves in Vietnam – A case study of Dong Nai Biosphere Reserve

Vu Thuc Hien, Vietnam Man and Biosphere National Committee, Vietnam

The Vietnam Biosphere Reserve Network consists of 11 Biosphere Reserves (BRs), including 2 new BRs that were recognised by the 33rd MAB ICC. Research activities play

a vital role in BR management bodies as they build information and provide solutions that are necessary for decision-makers and management officers to efficiently manage the sites.

In recent years, a great deal of research has been conducted in, for, and with BRs in Vietnam; however, most of this research has focussed on forest protection and development, biodiversity conservation, and tourism, with only a few studies having prioritised issues such as community livelihood, gender, and climate change mitigation and adaptation. Moreover, almost no research has established these BRs as target research locations because the main research sites are protected areas that are known as “core BR areas”. Therefore, there is a lack of research results in the buffer zone and transition area, except in social and economic databases that are monitored by the central and local government.

In 2016, the Ministry of Science and Technology began funding some national research projects in the field of BRs, which has resulted in not only raising public awareness of BRs, but also in increasing the amount of domestic research on BRs. In our case study on Dong Nai BR, using a periodic review (2011–2021), we found that among the 19 research projects that had been implemented during the period, 18 focused on biodiversity conservation, forest protection, and development, while 1 project focused on building the Cat Tien National Park Nature Museum.

Research on biodiversity conservation, forest protection, and development has also demonstrated a lack of systematicity. Indeed, most studies have focussed on solving outstanding issues in order to meet the urgent needs of core area-management agencies. These studies generally include research, for example, on the biological characteristics of specific animals or plants, breeding and culture possibilities, the conservation and development of specific species, and the monitoring and evaluation of endemic and rare species and of biological indicator species. However, there is a lack of comprehensive studies on biodiversity, with existing biodiversity reports having been compiled based on different single studies that have used different methods and timespans. As a result, most studies on Dong Nai BR lack consistent, updated, and synchronised data on biodiversity.

A similar situation exists with other Biosphere Reserves in Vietnam, which indicates a lack of research in areas such as ecosystem service assessment; linkages and interactions between important ecosystems in the area; cultural values; traditional knowledge; Indigenous customs; the relationship between people and the environment; the impact of the Biosphere Reserve model on economic, social, and environmental aspects of the locality; local communities’ perceptions of the value of the Biosphere Reserve; potential green economic models, such as Biosphere Reserve ecolabels; and cost-benefit

analyses that take into account nature conservation and socio-economic development.

We recommend that more general and comprehensive Biosphere Reserve research be carried out in the future not only in the field of biodiversity, but also in the fields of socio-economics and culture, in order to enable the value of this model to be assessed while simultaneously increasing public awareness and providing better support for the decision-making process.

Matsuda, Hiroyuki: Lessons learned from Yakushima and the challenges at Lake Malawi

Hiroyuki Matsuda, Yokohama National University, Japan

Background: Sika deer (*Cervus nippon yakushimae*) were once overhunted in Yakushima and are thus now carefully protected. However, deer and monkeys are currently overabundant and cause serious damage to agriculture. Although the deer population at the Shiretoko World Heritage Site is being kept under control, controversy continues in Yakushima about the possibility of naturally regulating the deer population, as is also done in Yellowstone National Park.

Project: We proposed a draft management plan based on a mathematical model of population management. Kagoshima Prefecture created a management plan in 2012 that aimed to prevent damage to agriculture and forestry caused by deer.

Research support: It is important to note that we scientists did not find a solution to the problem in Yakushima; instead, we presented multiple options to stakeholders. We clarified that the island-wide deer population could not be reduced without significantly increasing the number of deer captured (from 300 to > 3,000). We explained that the deer captured could only come from the southern transition area and that the western area – where the core population is located – would have to be left alone because the area’s natural vegetation had already been heavily damaged according to a survey of the distribution of endemic plants.

Outlook and identified research gaps: World Heritage (WH) Sites require UNESCO member states to take responsibility for protecting nature. Measures against agricultural damage caused by deer and monkeys are not covered by WH Sites, and BRs can thus coordinate such conflicts through cooperation between nature conservation and human activities.

Challenges to Lake Malawi: Based on the experiences of Shiretoko and Yakushima, we made a proposal to researchers from the University of Malawi, the conservation officer of World Heritage, and local stakeholders that core areas of Lake Malawi BR be registered as a World Heritage Site.

Benefits: We consider options for resolving conflicts between protection and local development that World Heritage Sites and core areas face. We define “ecological distancing” between wildlife and people and provide options for coordinating both nature conservation and local development. The importance of advice organisations per BR and networks between BRs will be recognised. We additionally plan to launch a UNESCO Chair on Education in BRs for Sustainable Societies at Yokohama National University.

Conclusion: In World Heritage Sites, it is important to work on nature conservation that is compatible with local development through a participatory approach. This approach also applies to OECMs, which are separate from protected areas. We plan to establish a global network for new ideas for resolving the human–wildlife conflict as a part of the MAB programme. Instead of separating human activities from protected areas and treating wildlife like pets, we should look directly at the “ecological distancing” between humans and wildlife and at how wildlife and humans rely on one another to co-exist.

Klock, Melanie and Winter, Christina: Analysis of youth participation in German Biosphere Reserves, the 2021 MAB Youth Forum, and other projects

Melanie Klock and Christina Winter; MAB Youth, Nationale Naturlandschaften e. V., Germany

The 2021 MAB Youth Forum project included (1) an analysis of youth participation in Biosphere Reserves, (2) a four-day event for young adults called the MAB Youth Forum, and (3) subsequent small projects implemented by participants of the forum in a Biosphere Reserve on the topic of participation.

The analysis was conducted nationwide with the goal of evaluating the topic of youth participation in Biosphere Reserves. Surveys and interviews with relevant Biosphere Reserve staff were used to identify concrete opportunities for youth participation as well as examples of best practices. Furthermore, knowledge was gained on how to best address and reach the target group. Success factors, challenges, and obstacles regarding youth participation in Biosphere Reserves were identified. Development goals and ideas on the part of Biosphere Reserves regarding youth participation were also recorded.

The second MAB Youth Forum took place in Germany from 24–27 September 2021 in the Schwäbische Alb Biosphere Reserve. Thirty-five young people from Germany, Austria, and Luxembourg participated in the event, whose main focus was on youth participation. The programme included panel discussions, workshops, excursions, short film shootings, and the creation of a parti*fest (i.e. a combination of the words “participation” and “mani-

fest” that represents the participants’ demands and wishes for enhancing participation in Biosphere Reserves). Three project ideas for the youth that had been inspired by the MAB Youth Forum were developed in the Mittel- elbe, Pfälzerwald-Nordvogesen, and Schwäbische Alb Biosphere Reserves.

The 2021 MAB Youth Forum project was supported by the Federal Agency for Nature Conservation, with funds from the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety, and Consumer Protection. The project was coordinated by Nationale Naturlandschaften e. V. (a registered association of the National Natural Landscapes of Germany) in cooperation with the Schwäbische Alb Biosphere Reserve together with a volunteer team of nine former participants in the 2019 Forum.

In the future, further work on the topic of youth participation in national natural landscapes is necessary. A workshop on youth participation that is designed to educate staff in these national natural landscapes is already planned. The parti*fest will be implemented in the Biosphere Reserves. The third MAB Youth Forum is scheduled for 2023 and will focus on networking between the youth and Biosphere Reserve administrations based on identified research gaps regarding how to contact the youth and inform them about events as well as how to engage the youth in Biosphere Reserves long-term. The main challenge for youth participation is the lack of capacity in Biosphere Reserve administrations. Continuous support and activities are thus needed to keep youth networks and engagement alive.

Manriquez Angulo, Pablo Andrés: Managing functions in the territory and maritortory of a marine and coastal Biosphere Reserve

Pablo Manríquez Angulo, Ilustre Municipalidad de Juan Fernández, Chile

Established in 1977 with 9,500 ha, the Juan Fernández Biosphere Reserve (BR) was the second BR in Chile to be accepted by UNESCO at the national level. Initially, the BR included only a national park, which had been created in 1935; however, in 2018, the BR was expanded to just over 1.7 M hectares. At that time, the BR incorporated developmental and logistical support. The recently created Marine Coastal Protected Area of Multiple Uses (MCPA-MU) – together with its 5 marine parks, which total more than 2.4 M hectares – have now also become part of the BR. Currently, the BR is accepted by the local community; however, initially, there was a period of time in which the community had certain doubts about the BR and preferred not to join. Therefore, we believe that the local population lacked information about BRs, and we saw the need for joint work (public–private) in order to resolve this issue.

Our island town has been maintained thanks to the sustainable management of the extraction of its marine resources for more than a century. This mainly includes self-imposed (bottom-up) control measures for its main activity – that is, fishing for the Juan Fernández rock lobster (*Jasus frontalis*) – that include setting a minimum legal size for catches, prohibiting the capture of egg-bearing females, enforcing temporary fishing closures, allowing trapping as the only means of capture, and closing fishery registrations.

Whenever such measures have been implemented over the past decades on the islands of the Eastern South Pacific with an intrinsic motivation to foster the sustainability of human activities, it has been difficult to implement public policies that are imposed with a continental perspective and that have not been previously discussed with the community. Of course, the creation of a strictly restricted area for a national park in 1935 garnered strong discontent in the community due to the spatial use of the territory, where the livestock and agricultural activities of the islands had made the community autonomous to a certain extent. When the Juan Fernández BR was created within the same limits of the national park, it did nothing more than to remind residents of their negative feelings towards the national park and was rejected by part of the population, thereby simply remaining an idea on paper only that indicated the importance of the endemism of the ecosystem of the island. In day-to-day practice, the BR has not been relevant to the residents of the commune where it is located.

Our challenges as local governance are

- to highlight our BR among the people of the archipelago,
- to incorporate the Mar de Juan Fernández into the soul of the archipelago's population,
- to assume the saturation of the carrying capacity of the islands,
- to meet the responsibilities associated with community development and the strengthening of community organisation in the face of environmental issues in a territory that is rich in natural resources, that consists of a diverse community, and that is viewed as a special sustainable territory in social, economic, and environmental terms,
- to seek greater autonomy in meeting food and energy needs,
- to promote the local economy, and finally,
- to promote the recognition, enhancement, and conservation of the BR's natural and cultural heritage.

Melipillán Figueroa, Valeria: Biosphere reserves from a municipal perspective: The case of the city of Quilpué, Chile

Valeria Andrea Melipillán Figueroa, Illustrious Municipality of Quilpué, Valparaíso Region, Chile

The city of Quilpué represents a local manifestation of the wider neoliberal movement in Chile, where the market reigns supreme as a conduit for national, regional, and local development. During the last 30 years, unprecedented growth in the housing and construction sectors has consolidated industrial cores along the neighbouring cities of Viña del Mar and Valparaíso, thereby relegating Quilpué a “commuter town”. In this regard, Quilpué's urban regulation planning – which was in effect between 1971 and 2019 – threatened and endangered hallmarks of local identity that had emerged from interterritorial biological systems and modes of production, such as farming, micro-scale economies, and industrial production. Between 2017 and 2019, Quilpué's urban regulation planning underwent a reform process with strong pressure from civil society organisations, such as social and political movements, which strongly rejected the proposed “cement-and-shovel” development strategy. Civil society put at the forefront of the public debate the necessity of incorporating new values, objectives, plans, and programmes that safeguard the environment and the intrinsic value of the surrounding ecosystems of Quilpué's urban centre, which – in turn – was the most affected locality due to exponential real-estate growth. In this context, a new local development strategy emerged from the community that creating the necessary conditions for engaging with other historically overlooked social demands, such as the dutiful promotion and protection of human-, economic, social, and cultural rights. In 2021, a horrific wildfire wrought unprecedented damage on the southern zones of Quilpué, thereby signalling the need for institutional change in order to develop and carry out a new local development strategy.

As such, UNESCO's Man and the Biosphere programme – together with the expansion of the core zone of the La Campana-Peñuelas Biosphere Reserve into the city's urban zone – is leading to reforms to territorial planning instruments and to new internal structures within the municipality that form part of a new, minimum baseline for municipal public policies in Quilpué. This new public policy baseline is complimentary to the ongoing and permanent efforts to leverage the importance of the La Campana-Peñuelas Biosphere Reserve Sustainable Development Objectives as part of the framework of the Agenda 2030 within public discourses and spaces. From this perspective, the municipality of Quilpué – as one of eleven local governments in which biosphere reserves are located within the country – highlights and stresses the essential value, meaning, and importance that the La Campana-Peñuelas Biosphere Reserve holds for the local populace. As such, the Quilpué municipality actively engages in bringing about a series of institutional changes and the design of a new, innovative, territorial management model with the main objective of preventing and mitigating various threats. These threats have been continually growing in intensity due to the dramatic effects caused by climate change.

The municipality's Environmental Management Directorate has undergone reforms that have created two new offices: 1) the Office for Biodiversity and Environmental Local Management and 2) the Office for Climate Change and Sustainable Development. The directorate is focused – inter alia – on implementing a new “zero-net-waste” policy that focuses on bio-economy in tandem with social economy within a framework of solidarity. Additionally, current efforts are also being directed towards the design of a local energy policy and a food security sovereignty strategy that has green infrastructure at its core.

For the rural areas of Quilpué, a strategy for adapting to climate change has begun its implementation phase and focuses on nature-based solutions and adaptations that foster the restoration and conservation of ecosystems in harmony with local communities. Furthermore, this strategy includes the design of model farms that aim to restore soils and native vegetation by consuming less water and that add value to non-timber forest products from native forests. The projected outcomes will generate greater livelihoods that are both sustainable and climate-resilient. Finally, this strategy will boost niche- and responsible tourism – and especially educational and scientific tourism – which should add further value to the biosphere reserve in pursuit of significant and simultaneously sustainable progress in local development efforts.

Meuer, Kirsten: Possibilities for NGOs to foster research in Biosphere Reserves, examples of research supported by the Michael Succow Foundation

Kirsten Meuer, Michael Succow Foundation, Germany

The Michael Succow Foundation (MSF) in Germany supports preparing, designating, and implementing Biosphere Reserves (BRs) in several countries. In partnership with the Nationale Naturlandschaften e.V. (NNL) and the Eberswalde University for Sustainable Development, the MSF founded a biosphere centre that also strives to enhance applied research in Biosphere Reserves. The MSF is currently cooperating with the Right Livelihood College on a PhD project on human–environmental interactions in the proposed Three Alazani Rivers BR in Georgia.

Within the framework of an ecosystem-based adaptation (EbA) project in the Lower Amu Darya BR in Uzbekistan, the MSF commissioned a study by Gritsina et al. 2019 on the human–wildlife conflict. The growing population of native Bukahara deer is exceeding the ecosystem's carrying capacity, thereby negatively impacting farmers' fields and the natural regeneration of riparian forests. The aim of the study was thus to address hotspots, to test different farm-protection approaches, and to analyse the root causes of the human–wildlife conflict. As a result, management recommendations for the BR ad-

ministration and guidelines for the target group were elaborated. Keys to the project's success included the involvement of native ecologists and a local NGO that is skilled in participatory processes as well as the support and interest of the BR's scientific staff. Workshops on topic and aim of research with local communities were also important in this endeavour. Although analysing root causes of the human–wildlife conflict was important for local communities due to the strong effect that this conflict has on inhabitants' livelihood, the inhabitants did not always appreciate the open and transparent assessment. There were also challenges in trust building between the local NGO, officials, and local people. A study tour helped to change perspectives and enabled exchange with international counterparts. To conclude, trust-building measures, sufficient time for securing a strong foundation of cooperation with the BR administration, and a solid understanding of administrative processes, unwritten laws, and personal commitments were found to be of the highest priority for successful research cooperation in the BR.

An interesting example of participatory research that would prove highly suitable to BRs and that should thus be promoted more is practiced by the grassroots Sustainable Agriculture Tanzania (SAT) NGO. SAT is currently fostering an agro-ecological transition in the Uluguru mountains by providing training and support to farmer groups that work in organic production. Within its farmer-centred research programme, the NGO regularly organises and facilitates participatory research-design workshops that bring together farmers, students, and lecturers from the nearby Sokoine University of Agriculture on specific problems in organic production. At the workshops, farmers present their problems, which include pests, productivity, and suitable plant varieties for organic production. The lecturers help in translating these practical problems into research questions. BSc and MSc students conduct participatory research together with farmers and report their results back to these farmers, which is a highly effective and inclusive way of promoting applied research that meets BR stakeholders' needs. BR administrations and NGOs should thus regularly organise workshops that bring together local communities and researchers around specific local problems.

Momberg, Frank: The role of biosphere reserves in resolving conflicts in Myanmar

Frank Momberg, Ngwe Lwin, Su San Win Pe, Zaw Min Oo, Maximillian Graefen, Fauna and Flora International, the United Kingdom

The Indawgyi Biosphere Reserve (BR) – the second BR in Myanmar – received its designation in 2017. The BR consists of 133,715 ha and comprises Indawgyi Lake, the surrounding wetlands, and a largely intact watershed. The watershed is covered with subtropical moist



broadleaf forests. The BR protects globally threatened, endemic, and rare species by providing significant ecosystem services and by supporting lake fisheries and paddy fields that are essential to the livelihoods of the indigenous Kachin and Red Shan people. Indawgyi's biodiversity and ecosystem integrity have been threatened by illegal logging, unsustainable firewood extraction, agricultural run-off, mining tailings, and household waste disposal. Research partnerships with national and international universities and partnerships with German BRs have contributed to threat assessments, socio-economic baseline surveys, and monitoring by providing knowledge for participatory zoning, management planning, and the design of conservation-and-development interventions. Prior to the BR designation, Indawgyi Wildlife Sanctuary (IDGWS) had been managed as any other protected area in Myanmar through a top-down, "fence-and-fine" approach by the previous military government. Pronounced petty corruption among the IDGWS and forest department staff had resulted in the impunity of large-scale commercial interests in illegal forest exploitation and in injustices towards local subsistence forest users. Low patrol efforts and ineffective law enforcement had additionally contributed to high levels of illegal activities and negative attitudes towards the wildlife sanctuary. The relationship between local communities and the wildlife sanctuary had been characterised by resource-

use conflicts between indigenous people and the forest department.

Democratisation in 2011 provided the opportunity to designate Indawgyi as a BR, thereby introducing participatory approaches to protected area management. The Indawgyi BR has benefited from comprehensive research, which has enabled nomination, zoning, and management planning. A participatory approach based on the principles of free, prior, and informed consent of local communities has (1) helped to overcome Myanmar's "fence-and-fine" approach to protected area management, (2) improved local communities' ability to legally access natural resources, (3) enhanced law enforcement, and (4) resolved natural-resource conflicts. Participatory, science-based zoning, management planning, and threat-based interventions have resulted in improved governance and law enforcement. Threat-based livelihood interventions have additionally reduced threats and contributed to improved community well-being. Governance and law enforcement have also become more fair, transparent, and effective. The BR development has furthermore resulted in reduced resource-use conflicts and in increased resilience towards political conflicts caused by the recent military coup.

Systematic analyses of community-based SMART patrol data as well as surveys on "pre- and post-project com-



munity well-being” and “knowledge, attitudes, and behaviour” have provided evidence of the success of the science-based participatory approach to BR management and have highlighted the increased resilience of local conservation constituencies in the face of the COVID-19 pandemic and the military coup.

Romera, Mari-Carmen: UNESCO MED Center: Promoting research in Mediterranean biosphere reserves

Mari-Carmen Romera, UNESCO MED Center – CTFC, Spain

The International Center for the Mediterranean Biosphere Reserves (UNESCO MED) – located in Barcelona, Spain – is a Category II Center (C2C) within the United Nations system. Since its inauguration in 2014, UNESCO MED has served as an example for public-private partnerships by combining public commitment with private funding support. One of the main strategic lines of UNESCO MED is to promote and develop interdisciplinary applied research on social, economic, and environmental aspects of Mediterranean biosphere reserves (BRs).

In recent years, UNESCO MED has collaborated on several international and national research projects and has supervised several master’s and PhD students through its International University Campus for Mediterranean Bio-

sphere Reserves. Two remarkable project examples are the EduBioMed Erasmus+ Project, which aims to enhance the academic curricula of Mediterranean universities concerning BRs, and a PhD research project on inclusive socio-environmental governance in a Moroccan BR. In our experience, networking, collaborative projects, and knowledge transfer between academia, BR managers, and local actors have proven to be effective mechanisms of supporting applied research that is meaningful to BR stakeholders.

UNESCO MED aims to become an international reference point for BR research, training, transfer, and monitoring in the Mediterranean region. The UNESCO MED Center’s three main areas of research are (1) binomial protected areas and human health from a multi-disciplinary scientific perspective, (2) the mechanisms and strategies required to consolidate inclusive socio-environmental governance in Mediterranean BRs, and (3) the study of biodiversity and ecosystems within Mediterranean BRs with the goal of developing management and conservation tools that are transferable to other areas.

Differential and fragile national contexts across the Mediterranean that impact BR members of our MedMAB Network are among the most significant challenges we face together with climate change and recent geopolitical and

pandemic-related effects on health, mobility, and economies within and surrounding Mediterranean BRs.

For UNESCOED, public-private partnerships are a significant factor that strengthens our commitment to fostering meaningful applied research in Mediterranean BRs. Through the consolidation of the MedMAB Network, the UNESCOED Center fosters interdisciplinary research on social, economic, and environmental aspects in terms of cooperation and transferability across Mediterranean BRs.

The UNESCOED Center offers a unique platform for researching, networking with, transferring knowledge between, and monitoring BRs in the Mediterranean that is scalable beyond these Mediterranean BRs.

Sudarmonowati, Enny: Lessons learned from Asia-Pacific Biosphere Reserves: Factors that influence successful research, and the main problems faced

National Research and Innovation Agency (BRIN), Indonesia

The various components of research – including human resources (academics/researchers, students, and supporting personnel in science and technology), infrastructures, funding, and policies – have been given greater attention by governments in the Asia-Pacific region in recent years. This trend has also been reflected in research conducted in, for, and with UNESCO Biosphere Reserves (BRs) via integration of the life sciences, engineering, and the social sciences. The Asia-Pacific region – whose member countries are considered rich in biodiversity, culture, ecosystems, and government structures at various economic development levels – is thus highly interesting to compare and analyse.

In order to obtain an overview of research conducted in, for, and with UNESCO BRs in the Asia-Pacific region, the results of which could be used to improve conditions in the future, especially for research-based policies on developing the region, an analysis was conducted using either a questionnaire or visits made eight BRs in five countries: four BRs in Indonesia (Berbak Sembilang, Karimun Jawa-Jepara-Muria, Takabonerate Kepulauan Selayar, and Cibodas), one in Thailand (the Mae Sa-Kog Ma BR in Chiang Mai), one in Vietnam (the Cat Ba BR), one in the Republic of Korea (the Yeoncheon Imjin River Biosphere Reserve (YIBR)), and one in Australia (the Noosa BR). A total of at least nine aspects were compared – namely (1) the main donor or source of funding, and how it was obtained; (2) the availability of other counterpart funds or other sources of funding, for example, through fundraising galas and campaigns, research partners, philanthropic funding, or grants; (3) successful research that is planned or required in the future; (4) the number of team members and their roles; (5) output; (6) outco-

mes (i.e. carry-over changes that have been made); (7) the level of sustainability; (8) the main problems faced; and (9) additional questions, such as the impression of the researchers or managers of the BR programmes based on their own experiences.

Our analysis found that research topics are varied and mostly focus on wildlife and the conservation or utilisation of local biodiversity or bioprospection, followed by habitat restoration, ecotourism, and sustainable development. Most of the reported research results were not organised or structured to solve problems in the area due to the lack of synergism caused by the fact that the chosen topics depend on the interests of the students, researchers, and supervisors.

A number of research projects have also been conducted in close or adjacent sites to the BRs, especially when funding is very limited. These research results could be used as a reference point or could serve as the basis for developing research in, for, and with BRs. Most funding sources are obtained on a competitive basis from international agencies or from other countries' funding schemes, from partnerships with other institutions/universities/NGOs, from fundraising, and/or from private sectors. Consistent and regular sources of funds come from the county or district/province and the country's foundation or trust.

Researchers and BR managers are mainly supported by 5–11 team members, which affects the quality and the number of programmes and activities, the funding obtained, and the sustainability of the projects. In addition, scientific results – such as data, products/prototypes, international publications, and other output – reveal support for management plans and policies, community empowerment, and a heightened level of awareness. Benefits of the research include more job creation, improved resources, and the improved state of nature. By identifying problems, including mostly research coordination, capacity-building, funding, and the sustainability of the programmes, research gaps and other analysed factors could be improved, excellent collaborations could be established nationally among BRs in the region and among other WNB members, and the quality of research and its impact could be improved.

GROUP 3: BIOSPHERE RESERVES (INITIATIVES)

Baztan, Juan: Zero plastic in biosphere reserves: On-going efforts and transdisciplinary challenges ahead

Zero Plastic in Biosphere Reserves Initiative

The members of the initiative – listed alphabetically – are Ahmed Suliman, Ana Carrasco, Anastasia Barkusova, Antonio Gallardo Campos, Aquilino Miguélez, Bárbara Avaroa, Bethany Jorgensen, Borut Peric, Carol De León, Cristopher A. Gonzalez Baca, Darja Kranjc, Eva Cardona,

Fabien Boileau, Irene Estaun, Jacobo Santander Monsalvo, Jean-Jacques Barreau, Jennifer Dingam, Jeong Dai-Yeun, Jorge Blanco, Josep Aragonès, Joseph Emmanuel Philippe, Juan Baztan, Julio C. Medrano Zavala, Katja Bonnevier, Kwang Sub Jang, Lázaro Márquez, Madrono Cabrestante, Manu Monge- Ganuzas, Maria Murcia, Maria Rosa Cardenas, Mark Heistein, Mattias Holmquist, Mercè Mariano, Nami Kim, Nga Tran, Nicolás García-Borreguero, Paco Cantos, Patrick Poulaine, Peter Duncan, Pilar Pérez, Ricardo Haroun Trabaue, Richard Selmán, Rowan Henthorn, Teodoro Jose S. Matta, Toni Domènech Montaña, and Tuyen Le Thanh.*

**Presenter: Juan Baztan*

Today, 25 biosphere reserves and counting actively participate in the environmental commitment represented by the Zero Plastic initiative, which is a shared effort between the World Network of Island and Coastal Biosphere Reserves and the Marine Sciences For Society network. In alphabetical order, the biospheres are the Archipelago Sea Area (Finland), the Blekinge Archipelago (Sweden), the Cape Winelands (South Africa), the Cat Ba Archipelago (Vietnam), the Commander Islands (Russia), Fuerteventura (Spain), Fundy (Canada), Gran Canaria (Spain), the Islands of Iroise Sea (France), the Isle of Man (the UK), Jeju Island (Republic of Korea), the Karst and Reka River Basin (Slovenia), La Palma (Spain), La Selle (Haiti), Lanzarote (Spain), the Mariñas Coruñesas e Terras do Mandeo (Spain), Menorca (Spain), Ometepe Island (Nicaragua), Palawan (the Philippines), the Península de Guanahacabibes (Cuba), the Sistema Arrecifal Veracruzano (Mexico), the Socotra Archipelago (Yemen), the Terres de l'Ebre (Spain), and Urdaibai (Spain).

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Plastic pollution impacts the whole planet, and the number of observations of this plastic continues to increase, which is giving rise to new fields of investigation. Addressing the increasing plastic threat requires an exponentially expanding base of scientific research, but we need to balance between three distinct challenges:

- (1) identifying and understanding the causalities,
- (2) defining priorities for research and action, and
- (3) making explicit the values that underlie the choices of each active element in research.

The majority of plastic that is produced ends up in the environment (e.g. Geyer et al. 2017), where it impacts ecosystems and species, including human health.

Knowing this, when we ask ourselves whether we want to see an end to plastic pollution, the response is unanimously, "Yes!" Why, then, does plastic production continue to increase?

Judge H. Lee Sarokin gave the answer when addressing tobacco company lobbies: "Who are these persons who knowingly and secretly decide to put the buying public

at risk solely for the purpose of making profits and who believe that the illness and death of consumers is an appropriate cost of their own prosperity!" Power relations with producers/polluters are highly imbalanced, and the values inherent in production and consumption are incompatible with the values of those who call for a reduction in pollution and an increase in the responsibility of the polluters. In this context, we must ask ourselves who it is that should decide on which course of action designed to give rise to the eradication of plastic pollution. We are happy to share our ongoing collective efforts and to open the debate to the public in order to identify priorities for the 2022–2025 period and to answer the question of how we can make true progress on the issue of plastic pollution.

Brossette, Florian: Adapting common resource management to underutilised pastures: The case of common pasture organisations in the Black Forest Biosphere Reserve

Florian Brossette, Black Forest Biosphere Reserve, Germany (project manager), Chair of Societal Transition and Agriculture (430b), University of Hohenheim, Germany (PhD candidate)

In the southern Black Forest (BF) of south-west Germany, common pastures ("Allmende") are an emblematic feature of the traditional landscape, feature high natural value, and are connected to the cultural heritage of common grazing. The recognition of the southern Black Forest as a UNESCO Biosphere Reserve (BR) in 2017 is directly related to the task of preserving common pastures. As the meaning of the "Allmende" in the regional context extends beyond the value of these areas as grazing resources but their preservation depends on adapted grazing practices, the BF Office (BRO) launched the "Allmende 2.0" applied research project in 2019 with the goal of identifying viable pathways for preserving the traditional landscape and farming. A project manager (author) was also added to the BRO's staff. As the research questions of "Allmende 2.0" seemed promising from a scientific perspective, a collaboration was sought between the BF BRO and the Chair of Societal Transition and Agriculture at the University of Hohenheim.

This context brought about the need to unite research support and to deliver results related to practice and academic rigour. In order to meet these needs, (1) a project advisory group comprising farmers, mayors, administration officials, the farmers' association, and scholars was established, (2) the BRO's network was used to facilitate research, and (3) scientific frameworks were chosen that allow for integrating practitioners' perspectives with ecological and social components. For these frameworks, research is rooted in transdisciplinary sustainability sciences. The employed frameworks include the Social-Ecological Systems Framework (Ostrom

2009), Social-Ecological Resilience (Biggs et al. 2015), and Design Principles for common pool resources (Ostrom 1990).

Given that the tasks of supporting and conducting research involve the same staff, the link that research support can provide in facilitating research practices and feeding back results within the BR figures is the strongest point within this configuration. However, since the integration of a doctoral thesis was not part of the initial project plan and had to be formally separated from the project work, it has been particularly challenging to manage the workload. In order to broaden the perspective and to include research support activities that involve the BF BR (which was established in 2016), staff are not (yet) able to provide similar research support for researchers without having a desk within the BRO. In light of the transdisciplinary approach to sustainability that BRs stand for, integrating research into the BRO's activities requires knowledge and contacts that go beyond purely "technical aspects" (e.g. providing research questions, data, and interviewees). In order to facilitate exchange between researchers, staff, and the BR, desk-sharing solutions for researchers during fieldwork phases as well as access to research grants for students that cover their stay within the BR should be made possible.

Gabdullina, Aliya: Scientific research in the Great Altai Transboundary Biosphere Reserve (Kazakhstan and Russia): Challenges, problems, perspectives, and solutions

Aliya Gabdullina, Katon-Karagai State National Nature Park, Kazakhstan

The Great Altai Transboundary Biosphere Reserve (TBR) was included in the UNESCO Biosphere Reserve (BR) World Network in 2017 and is the first TBR in Asia. It includes the Katon-Karagai BR (Kazakhstan) and the Katunsky BR (Russia). In fact, these two protected areas – the Katon-Karagai State National Nature Park (KKNP) and the Katunsky BR – function as independent organisations in two countries but perform all the functions of the TBR. The KKNP was organised in 2001, while the Katunsky BR was created in 1991. In 2004, we initiated joint activities, including scientific activities that involve work on botany, ornithology, and theriology.

One successful international project has been the development of a management plan for the planned Altai TBR (<https://www.centreforeconomics.org/consultancy-and-projects/projects/altai-transboundary-biosphere-reserve>).

Another successful joint scientific project has involved research on the snow leopard. In Kazakhstan, research on the snow leopard within the framework of the scien-

tific programme began in 2011. At that time, we didn't have the proper equipment or financing, and we began to look for ways to solve this problem. In 2013, we received our first camera trap from an NGO from Ust-Kamenogorsk (Kazakhstan). Our employee went to Russia to visit colleagues for the purpose of training and receiving methodological assistance. In 2014, we received 10 camera traps from another NGO from Ust-Kamenogorsk and 10 camera traps from WWF Russia (Moscow). We finally captured our first picture of a snow leopard on a camera trap on 20 November 2014.

Subsequently, we received a grant from WWF Russia for 2015–2016. The UNDP project joined our work and has provided equipment for researchers. We have also received financial assistance from the republican budget and sponsors. We have additionally begun publishing information about the snow leopard on our social networks and in scientific articles.

In the future, we plan to open a checkpoint across the state border in order to strengthen the scientific potential of our TBR, to conduct joint expeditions, and to foster information exchange between specialists. In addition, we plan to contribute our data to the GBIF as well as to conduct further research using the budget of our national park, which may include research on the genetics of the snow leopard, possibly in cooperation with universities and institutes from Russia and Kazakhstan.

In addition to the problem of the lack of specialist knowledge and funding, we have had to face additional problems, such as the pandemic, military actions, protests, and a lack of Internet. We continue to tackle these problems as they arise.

The advantage for us is also that we can continue to publish scientific articles, to develop social networks, and to finance some aspects of our activities from the republican budget. In addition, the cooperation between our protected areas, NGOs, and institutes from Russia and Kazakhstan has also had a positive impact on the development of scientific research in our TBR.

Haddouch, Moha: Arganeraie Biosphere Reserve ecolabels – An instrument for harnessing the power of the circular economy

Moha Haddouch, Argan Biosphere Reserve Ecolabel Moroccan Association (ABR EMA), Morocco

Reversing the trend of environmental degradation by rebuilding natural capital is a new option that is being investigated by the Moroccan government in the Arganeraie Biosphere Reserve. The project entitled "A Circular Economy Approach to Agro-Biodiversity Conservation in the Souss-Massa Draa Region of Morocco" has been implemented under the Integrated Nature Resources Manage-

ment in the Middle East and North Africa Region UNDP Programme over the last seven years for this purpose.

The project focuses on the Inzerki pilot area, which is a site of ecological and biodiversity importance (SEBI) where one of the largest traditional apiaries was established in order to foster a connection between the Saharan yellow bee – an endemic species of North Africa deserts – and its melliferous natural habitat.

The approach uses systems thinking and embeds (1) regenerative practices through payment for ecosystem services, (2) social and solidarity economy enhanced by the ecolabel governance body (ABR EMA), (3) the efficient use of resources empowered by the ecolabel standard (4), commitments to zero net waste, including greenhouse emissions, (5) a virtualising value chain through digital marketing, and (6) teaming up with universities in order to advance the science of sustainability and resilience.

In order to manage the new ABR ecolabel according to the above-mentioned principles, the Argan Biosphere Reserve Ecolabel Moroccan Association (ABR EMA) was founded in 2019 with the goal of certifying local entities that are biodiversity-friendly and meet food-safety requirements. The ultimate goal of the ABR EMA is therefore to establish a sustainable production and consumption standard in the ABR that could be progressively expanded to national biosphere reserves and eventually to the whole MAB/UNESCO World Network of Biosphere Reserves.

The ABR EMA standard covers all domestic products and services, including argan oil, honey, aromatic and medicinal plants, and tourism. The board of directors is composed of 15 elected members, and the executive board is managed by 7 members (www.ecolabelrba.com).

In order to strengthen the ecolabel standard, a process that verifies a practice's positive impact on sustainability was initiated with support from VERRA, an accredited certification body.

In sum, the ABR ecolabel is an effective instrument for fostering public-private joint forest management in which PES schemes should be complementary and mutually reinforced through

- publicly developed PES regarding compensation for grazing set-asides and
- the ABR eco-certification associated for PES.

Hoffman, Clarissa: Forests of the future: Identifying climate-change-resilient trees in the Fundy Biosphere

Clarissa Hoffman, Fundy Biosphere Region, Canada

Introduction

As climate change progresses and landscape conditions change, the Fundy Biosphere Region (FBR) – along with

our community partners – identified a need to understand how these changes affect forest composition. In order to achieve this understanding, the FBR partnered with researchers from Mount Allison University to assess forest resiliency in the biosphere and to identify tree species that should survive well under climate change conditions.

Research management and support

The FBR was able to undertake most of the research management for this project, including granting applications, acquiring permits, dispensing funds, and handling all communications. Staff were also able to offer support on many aspects of the project, including data collection, site assessment, and the climate-envelope analysis.

Outlook and identified research gaps

Since the completion of the project, there have been many public-education events, tree plantings, and media-outreach events, all of which have allowed the FBR to share its findings throughout the region. A smaller follow-up study was also conducted in order to evaluate the same species list as the first, but with a few extra urban-related criteria.

Challenges

Developing a strong connection to research institutions has been a challenge in the FBR for a few reasons, which generally coalesce around the value proposition of the biosphere to institutions. In Canada, biosphere regions are supported entirely through project-based grants, for which research institutions are also eligible, and we thus cannot offer any additional funding. The FBR is also a small organisation, and our capacity is therefore limited. The project was made possible because an employee with both personal connections and expertise had graduated out of the partner lab. Without this link, we would have been struggling to create long-term partnerships with research institutions.

Benefits

The major benefits to conducting research in the biosphere include our connections to communities and local organisations as well as the fast speed at which the research can be put into use in the landscape. Through our partnerships, we have been able to identify the need for this information and to collaborate with these partners in order to obtain the answers. The FBR has also been able to share this information quickly and widely, which has led to real impacts in the landscape.

Conclusion

The Forests of the Future project is a unique example of how research can be conducted in biosphere reserves. The biosphere framework can offer some great research benefits, such as a connection to community and partners as well as the ability to identify key areas of new research. However, it can be highly difficult to

build the necessary relationships, especially for smaller organisations. In order to expand research in biosphere reserves, we all might benefit by creating education opportunities for biosphere staff to learn more about building these relationships and articulating their value proposition.

Maldonado Osorio, Sandro Esteban: Lauca Biosphere Reserve – Using applied research to change the management paradigm

Sandro Maldonado, Corporación Nacional Forestal, Arica, Chile

Through an applied research-and-management programme, it was possible to improve the management of the Lauca Biosphere Reserve (BR), which had been running the risk of losing its designation. Since 1998, UNESCO has required Biosphere Reserves to demonstrate progress in three basic principles: (1) adequate zoning, (2) a management committee, and (3) a management plan. However, the Lauca BR did not meet any of these requirements until 2019. Thanks to a project by the Global Environment Facility (GEF) that was executed by the World Bank, a new application was submitted that included an expansion of the Lauca BR, which made it possible to comply with the requirements of the statutory framework of the MAB network. The World Bank has environmental and social requirements for implementing its projects. With an original surface area of 358,312 hectares, the Lauca BR was designated as a pilot intervention area for the Sustainable Land Management (SLM) project, which required a process of dialogue and Indigenous participation.

This designation made it possible to implement a series of pilot initiatives that created development instruments aimed at mitigating and adapting to climate change. Through these environmental initiatives, the local community plays a role as an agent in development and seeks to generate human well-being. The most important element in the design of the research was the participation of the local Indigenous communities as this participation prioritises actions in response to specific problems. In the case of the BR, participatory processes were created that prioritised work in the following areas:

- propagating and planting native flora with conservation problems (genus *Polylepis*),
- managing wetlands with the goal of restoring them by using traditional techniques and environmental monitoring to observe the effects of the interventions, and
- supporting and researching llama herding with the goal of mitigating conflicts with wildlife and avoiding overgrazing.

By researching and implementing these pilot initiatives, we were able to define them as instruments that support the communities within the BR, thereby changing the pa-

radigm in Chile from a “top-down” form of management to a participatory form of management that addresses issues that are relevant to local communities. This change generated a positive effect in Indigenous communities outside the limits of the BR, and these communities requested to participate in the project. As a result, a public-private committee was formed, 54% of which is composed of Indigenous organisations and authorities, which – in turn – promote the idea of expanding the BR to more than 1,000,000 hectares. This shift finally allowed for adequate zoning and governance principles that meet UNESCO's requirements, which were positively sanctioned at the MAB programme's 27th meeting in 2021.

Masubelele, Mmoto Leonard: Climate risk and local early-adaptation co-planning and development

Masubelele, M.L., Samuels, M.I.; Cupido, C.; Lynes, L.; van Oordosol, K.; Phophe, P.A.; Foster, J.; De Wet, G.; and Links, A., SANParks, ARC, TRI, and the Richtersveld World Heritage Site, South Africa

Climate change is leading to a variety of severe problems for Indigenous Peoples around the world, who are at risk because they live off of natural resources. Although Indigenous Peoples have developed sophisticated knowledge of how to cope with and adapt to a changing climate and are known to be highly resilient, extreme climate events are now occurring at a faster rate than these communities can naturally adapt to. Moreover, the negative effects of social and economic challenges faced by many Indigenous People make adapting to climate change more complex. Issues such as a lack of services, extreme poverty, and social issues have all contributed to the barriers that prevent Indigenous Peoples from coping with and adapting to climate change. All the struggles they face have also been exacerbated by pandemics, including SARS-COVID-19.

Although it is a UNESCO WHS, the Richtersveld Cultural and Botanical Landscape World Heritage Site (RCBLWHS) is currently adopting the Biosphere Reserve concept in line with the modern conception of landscape management because the site seeks to balance ecological requirements with the economic needs of people living in these areas. Implementation is difficult due to the challenge of reconciling different land uses in the area, and conservation authorities commonly falsely perceive the RCBLWHS as merely another type of protected natural space. In order to cope with and adapt to climate change, it is important for communities to assess the effects of climate-related hazards. Furthermore, managing these risks is central to both Indigenous People and pastoral practices.

Our study assessed climate vulnerability and the risks that Indigenous Nama households face in the arid zone of South Africa. In addition, the study examined the rela-

tionships between the dimensions of vulnerability, exposure, and climate-change impacts as well as how interactions among these dimensions affect the well-being of Nama households with regard to access to resources both outside and inside an adjacent protected area. The next phase used stakeholder-engagement workshops. A co-developed local early-adaptation plan (LEAP) was also explored for application in a partnership between protected areas and Indigenous Peoples. Integrating the vulnerability- and LEAP approaches allowed an entire adaptation journey to be mapped out; however, the implementation of the agreed-upon adaptation actions was limited to short-term activities. Taking up these agreed-upon actions in the WHS's Integrated Management Plan will ensure that implementation takes place within the next 10 years.

This pathway model can be used to achieve the SDGs and will be promoted at the UNFCCC IPP platform for Indigenous Peoples, thereby aiding in the development of sustainable Indigenous communities in the arid zone. This partnership between SANParks, ARC (RSA), and The Resilience Institute (Canada) fully engaged in working in multiple time zones and revealed the tremendous effort needed just to stay in touch with international partners. Communication, trust, good will, understanding cultural differences, and having a sense of camaraderie were essential in making this project work during the 2–3 years when all partners and stakeholders were fully engaged.

Murcia, Maria: The World Network of Island and Coastal Biosphere Reserves (WNICBR) – An assessment of island resilience through a comparative analysis of indicators

Murcia, M.; Martín-Rosa, M.A.; Carreras, D.; Cardona, E.; Mendes, J., Menorca Biosphere Reserve, Lanzarote Biosphere Reserve, Spain

The WNICBR was launched by the UNESCO MAB programme in 2009 as a thematic network aimed at fostering sustainability and climate change adaptation strategies in designated island and coastal areas. The network is a platform for cooperation and knowledge exchange on themes that are of critical concern to islands and coasts. In our contribution below, we highlight a comparative analysis of four Spanish islands via a set of indicators as a germinal study for making a broader assessment of resilience in island contexts within the WNICBR framework. By making use of the collaboration agreement for research and monitoring between the Cabildo of Lanzarote and the Socio-Environmental Observatory of Menorca, a comparative analysis that assessed sustainability in four islands was undertaken through the development of a system of joint indicators that were first explored in 2018 for Menorca and Lanzarote and that were later extended to two additional Spanish islands: Fuerteventura and Ibiza. The main objective was to carry out a dynamic

comparison of the four islands by analysing their evolution via a series of sustainability indicators (up to 98 indicators distributed within 7 thematic blocks) that were framed in the context of the SDGs.

The existence of operative centres for BR monitoring, research, and data analysis was crucial in developing our study as these centres provided the study with the large time-series, homogeneous, and comparable datasets needed to undertake the comparative analysis. Although the study explored many aspects of the islands' sustainability, further aspects that might be more difficult to measure and compare due to their qualitative nature could be explored and integrated into the assessment in the future.

In order to extend this study to other territories, it is important to have systematised and comparable data, to be able to work with different operational contexts, and to provide a model so that the comparative analysis can be applied and extended. In this context, having the support of research frameworks and funding mechanisms is crucial to being able to deepen the analysis and extract policy recommendations for management.

A key factor that supported and strengthened our research was the close cooperation of a network of BR managers and researchers who had the potential to exchange experiences and data and to disseminate results. These activities relied on the support and funding of the MAB UNESCO, the MAB Korea, and the MAB Spain.

Islands play an important role as permanent observatories of global change and may be relevant learning sites for developing strategies and public policies on sustainability, for creating adaptations to changes, and for facing current critical socio-environmental pressures. The WNICBR as a platform for cooperation and transfer appears to be the ideal place to disseminate findings and to broaden the scope of our analysis because it can facilitate the creation of a robust research-management structure that can be used to continue to provide the appropriate research framework for studies like ours.

Nixon, Raven: Indigenous engagement in the Canadian context – Opportunities and challenges: Relations with biosphere reserves

Raven Nixon, Fundy Biosphere Region, Canada

The Fundy Biosphere Region consists of over 400,000 hectares located in the traditional territory of the Wabanaki people. The Wabanaki Confederacy is comprised of the Mi'kmaq, Maliseet, Passamaquoddy, Penobscot, and Abenaki peoples. Designated in 2003, the Fundy Biosphere Region has since worked with local indigenous groups and individuals towards collaboration and reconciliation. The Fundy Biosphere Reserve changed

its name in 2021 due to the implications of the word “re-serve” in North America. In 2018, members of the Fundy Biosphere Region attended a conference in Ottawa with representatives from biospheres across Canada as well as with indigenous individuals and partners with the aim of forming an indigenous circle. This collaboration allowed members of the Canadian Biosphere Reserve Association (CBRA) and the indigenous circle to come together in true conversation and to acknowledge our goals for further work in reconciliation. Gatherings such as this conference are key to globally sharing issues that impact us all. Real truth and reconciliation are not a project, but rather an everyday conscious effort of understanding, implementation, and conversation. Forests of the Future has been a successful project in partnering with indigenous communities in working towards language revitalisation and indigenous awareness. The revitalisation of native tree species is essential to many aspects of life both environmentally and culturally. This project represents a key demonstration as to how both the political and environmental climate in which we all live, work, and play can be better understood. The Fundy Biosphere Region created the Forests of the Future tool, which can be used by anyone from nature hobbyists to experts for researching and planting native and climate-resilient tree species. The tool shows images of each tree as well as an abundance of other information on the specific species. This region uniquely showcases initiatives designed both to preserve outstanding natural and cultural heritage and to share ideas and research on biodiversity conservation, climate action, the development of a quality sustainable tourism infrastructure, the delivery of educational programmes, and the responsible human development. Collaborating with local education, municipalities, and individuals opens up conversation, revitalises language and culture, and inspires connection with one another and with nature both now and for generations to come. The Fort Folly First Nation is a 56-hectare first nation reserve in New Brunswick, Canada, and is the only indigenous reserve that exists within the Fundy Biosphere Region. Over the years, collaborations have occurred; however, the size, capacity, and turnover of most Canadian biospheres is limited. Meaningfully collaborating with indigenous groups takes time. Reconciliation is about the past, present, and future and is not a framework that can simply be integrated; rather, it must be understood and constitutes a way of life. An everyday conscious effort must be made to understand people, their stories, and their culture with respect. Through collaboration, we can achieve true environmental and cultural harmony.

Perret, Carolina Alexandra: Systematising and analysing research results for better management practices in the Oxapampa–Asháninka–Yánesha Biosphere Reserve (Oxapampa, Perú)

Carolina Alexandra Perret, Federico Rizo Patrón, Florencia Trama, Mireya Bravo Frey, Rolando Becerra Manosalva,

Elisa Romero Simons, Esteban Navarro Espinoza, Javier Gonzales Arteaga; Oxapampa–Asháninka–Yánesha Biosphere Reserve Research Working Group, Peru

The governance structure of the Oxapampa–Asháninka–Yánesha Biosphere Reserve (BIOAY) includes ten working groups (grupos técnicos de interés/stakeholders), which are specialised bodies that support the Biosphere Reserve management in selected topics. Both the establishment of these working groups and the specialised topics that they research were and are influenced by the demands of both civil society and diverse local organisations, and the groups thus serve as open spaces for participation (i.e. the first Biosphere Reserve participatory scheme in Perú).

The BIOAY Research Working Group (formally recognised by the local authority in 2019) pursues the following objectives: (1) to guide and facilitate research, (2) to analyse and systematise existing research for further use in local education, (3) to develop and manage activities, and (4) to make research that is conducted in the BIOAY both available and accessible. The BIOAY is the only biosphere reserve in Peru that has its own law. It is Law 30206 that declares the conservation, restoration, maintenance, and improved conditions for the sustainable development of the BIOAY to be of public interest. This law is a model not only for organising and managing the role that diverse actors play, but also for regulating governance mechanisms.

In 2019, a participatory process (2017–2018) was developed that updated the BIOAY Action Plan. As a result, five strategic objectives were prioritised, including those related to education, research, and traditional knowledge. In this context, the Research Working Group (RWG) functions as an open space for participation since its members are not only linked to research institutions but also individuals are part of the group. Additionally, the Research Working Group’s work plans are linked to the strategic objectives of the Action Plan, and its work is accompanied (monitored) by the Technical Secretariat of the BIOAY (i.e. a part of the governance body of the BIOAY that provides administrative support).

Since the BIOAY occupies the entire territory of Oxapampa Province, some challenges exist when it comes to effectively involving all the districts of the BIOAY due to distance, a lack of communication, and the incentive to participate. Over time, we have learned that the commitment of individuals is key to the work performed in the BIOAY, but we also know that this commitment can be limited if there are no resources that support activities. Despite these limitations, the RWG has been able to organise activities and to contribute to the process through the implementation of the BIOAY Action Plan.

The work of each of the technical groups of the BIOAY has been fuelled by the pro-active leadership of the

Technical Secretariat, the political support of the local government, and the active participation of members from international cooperations and academies. Given both the legal framework that supports the BIOAY and the organisation of its governance structure, there is great potential for achieving not only the biosphere reserve goals, but also the objectives that guide the BIOAY Action Plan. In this sense, the commitment of the individuals who accompany the management of the BIOAY must be supported by resources (financial, technical, and logistic) in order to achieve common goals.

Weiss Aparicio, Alexander: Are research conferences an appropriate tool for Biosphere Reserve administrations? Key findings from a regional conference designed to promote research and monitoring in a Biosphere Reserve

Alexander Weiss Aparicio, Elbe River Landscape Biosphere Reserve (Brandenburg), Germany

One of the key tasks of UNESCO Biosphere Reserves is to conduct research and monitoring. In order to prevent repeating research and to promote cooperation between researchers and monitoring actors, it is essential to ensure a periodic exchange of information between all actors involved. In most Biosphere Reserves, the administration is the only agent that is aware of all ongoing research and monitoring within its reserve and is thus the most well-suited actor for promoting cooperation and data exchange. Moreover, administrations that strive for evidence-based conservation need to base their management decisions on the most up-to-date science, especially in dynamic times caused by climate change and other human influences on the ecosystem. A research conference combines all these needs and potentials in one event.

This year, for the first time, we organised a two-day regional research conference and invited all professionals involved in research and monitoring within our Biosphere Reserve or within similar regions. The roughly 40 participants included scientists, monitoring actors (e.g. rangers), self-employed environmental surveyors, citizen scientists, and managers from similar Biosphere Reserves. The agenda consisted of (1) presenting accumulated monitoring data and current monitoring programmes to scientists, (2) allowing these scientists to present their current research projects, (3) providing networking opportunities, and (4) fostering group workshop discussions on the future direction of research and monitoring within the Biosphere Reserve.

As we are not experienced event managers, it was challenging to organise such an event. However, we are firmly convinced it was worth the effort. Indeed, we received highly positive feedback from the participants, and the workshops resulted in the following valuable recommendations for our own work:

Administrations need to use three main tools in order to ensure that adequate networking and cooperation are possible: (1) a research conference for presenting the newest developments every two to three years; (2) an up-to-date website/document that lists all past, current, and future research and monitoring projects as well as surveying work; and (3) a database that includes all data, reports, publications, etc. that have been conducted in the Biosphere Reserve. While the first two tools are the responsibility of each Biosphere Reserve, the database would be less time-intensive and much more effective if all Biosphere Reserve administrations within a country could rely on a shared database and only have to input data.

Additionally, we discussed specific future research topics for our own Biosphere Reserve, including conducting a thorough analysis of the carbon emissions (and equivalents) within the Biosphere Reserve as a first step towards taking measures to become a climate-neutral region.

In conclusion, research conferences are a great tool for networking, exchanging new ideas, and discovering possibilities for cooperation that benefit researchers and administrations alike. We thus urge every Biosphere Reserve to organise such conferences. Hosting a research conference periodically is a great way for the administration to stay in close contact with all the professionals involved in the region and to promote the Biosphere Reserve as an attractive region for conducting research and monitoring activities.

» Being at this conference and getting to know and exchange ideas with researchers from all over the world is certainly a benefit.

Annex

Programme

Monday (May 16th), seminar rooms (conference map no. 2)

| | |
|-------|--|
| 09:00 | Breakfast or arrival |
| 11:00 | Opening: Welcoming remarks (HNEE) and introduction |
| 11:15 | Plenary presentation "Science and Research in, for and with UNESCO Biosphere Reserves: Benefits and Challenges" (UNESCO MAB Youth Spokespersons: Alicia May Donnellan Barraclough + Rebecca Yego Laibich) |
| 11:45 | Panel discussion "Indigenous Knowledge in, for and with Biosphere Regions" (Rebecca Cherop Kwalia + Rebecca Yego Laibich) |
| 12:15 | Organisational announcements |
| 12:30 | Lunch break |
| 13:30 | Thematic sessions: Presentation of current research projects (international early career scientists) |
| 15:00 | Coffee Break |
| 15:30 | Practical input "Verbal science communication: How to make your presentation clear, creative, compelling" (Dr. Volker Hahn, Head of Media and Communications, German Centre for Integrative Biodiversity Research) |
| 16:30 | Thematic sessions: Presentation of current research projects (international early career scientists) |
| 18:00 | Dinner |
| 20:00 | Get together |

Tuesday (May 17th), seminar rooms (conference map no. 2)

| | |
|-------|---|
| 07:30 | Breakfast |
| 09:00 | Thematic sessions: Presentation of current research projects (international early career scientists) |
| 10:30 | Coffee break |
| 11:00 | Thematic sessions: Presentation of current research projects (international early career scientists) |
| 12:30 | Lunch break |
| 13:30 | Plenary: Key learnings of each thematic session |
| 14:30 | Group work on how to foster research in BR <ul style="list-style-type: none"> • Improving the concept & management of BRs to foster research • Improving international research cooperation on BRs • Improving transfer of research results • Improving BR research opportunities |
| 16:30 | Coffee break |
| 17:00 | Preparing statements and output to be presented on Wednesday |

Opening ceremony, big conference room (conference map no. 1)

| | |
|-------|--|
| 18:00 | Setting the scene (Prof Dr Matthias Barth, Eberswalde University for Sustainable Development) |
| 18:10 | Welcoming remarks (Dr Bettina Hoffmann, Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection) |
| 18:25 | Welcoming remarks (Dr Lutz Möller on behalf of Dr Stefan Lütke, German MAB National Committee) |
| 18:35 | "Research and Science in, for and with UNESCO Biosphere Reserves – a framing" (Dr. Noëline Raondry Rakotoarisoa, UNESCO MAB Secretariat) |
| 18:50 | "The Global ecosystem crisis, UNESCO Biosphere Reserves and research. Time for a wake-up call?" (Prof Dr Pierre Ibisch, Eberswalde University for Sustainable Development) |
| 19:20 | Award of the Madga Staudinger Prize (German Commission for UNESCO) |
| 19:45 | Ceremonial sharing (Larry Mc Dermott + Rebecca Cherop Kwalia) |
| 19:50 | Celebratory reception |
| 21:00 | Joint evening |

Wednesday (May 18th), big conference room (conference map no. 1)

| | |
|-------|--|
| 07:30 | Breakfast |
| 09:00 | Joint feedback session: Welcome (Prof Erik Aschenbrand) |
| 09:10 | Lecture on “Research for Sustainability and Biosphere Reserves” (Prof Emeritus Dr Martin Price + Prof Dr Maureen Reed) |
| 09:40 | Presentation: Key learnings of the first conference part and proposals to strengthen research in biosphere reserves |
| 10:30 | Coffee break and exchange |
| 11:00 | Presentation of the biosphere reserve and welcome to Schorfheide-Chorin (Dr Martin Flade) |
| 11:20 | Organisational remarks |
| 12:00 | Joint excursions in the Schorfheide-Chorin Biosphere Reserve (including joint group work) |
| 19:00 | Dinner |

Thursday (May 19th), big conference room (conference map no. 1)

| | |
|-------|---|
| 07:30 | Breakfast |
| 09:00 | Setting the scene: Wrap-up and outlook (Prof Emeritus Dr Martin Price + Uli Gräbener) |
| 09:10 | Lecture on “Lessons and learning opportunities that biosphere reserves offer to sustainability science” (Dr Lisen Schultz, Stockholm Resilience Center) |
| 09:40 | Situation analysis of research management related to Biosphere Reserves • Universities and institutes (Prof Inger Elisabeth Måren, UNESCO Chair on Sustainable Heritage and Environmental Management, University of Bergen) • (Administrative) organisations (Dr Birthe Thormann, Federal Agency for Nature Conservation Germany) • Biosphere reserves (Dr. Martha-Marie Vogel, MAB UNESCO) |
| 11:00 | Break and exchange then change of location to seminar rooms (conference map no. 2) |
| 11:20 | Organisational announcements |
| 11:30 | Presentations on best practice of research management, support and implementation (international representatives of organisations, institutions and biosphere reserves) |
| 13:00 | Lunch break |
| 14:00 | Presentations on best practice of research management, support and implementation (international representatives of organisations, institutions and biosphere reserves) |
| 15:40 | Coffee break |
| 16:10 | Presentations on best practice of research management, support and implementation (international representatives of organisations, institutions and biosphere reserves) |
| 18:00 | Dinner |

Friday (May 20th), seminar rooms (conference map no. 2)

| | |
|-------|---|
| 07:30 | Breakfast |
| 09:00 | Presentations on best practice of research management, support and implementation (international representatives of organisations, institutions and biosphere reserves) |
| 10:00 | Distilling key learnings of the presentations |
| 10:15 | Best practice related to research in the BR network (outcomes of presentations) |
| 10:45 | Group work: What can we do to foster research in BRs? |
| 11:30 | Coffee break |
| 12:00 | Plenary: Results of the group work |
| 12:40 | Presentation and adoption of the final document |
| 13:30 | Lunch break |
| | Departure or free time |
| 18:00 | Dinner |

Benefits and challenges of research in, for, and with UNESCO Biosphere Reserves

The following benefits and challenges of conducting research in, for, and with Biosphere Reserves were discussed by early career scientists during the first part of the conference. Corresponding proposals are included in a condensed form in the Eberswalde Declaration.

BENEFITS:

- Different approaches and research tools ranging from geo-information to participatory mapping and interviews can be integrated.
- BRs have well-established relations with local communities.
- BRs support research: Research ideas/needs are provided/formulated by the BRs.
- BRs give the research a unique angle.
- BRs support upscaling, best practices, and standardisation.
- BRs support capacity-building research and communities as well as (local) knowledge production.
- BRs have multi-scale approaches to governance.
- BRs can be enablers of institutional exchange on different scales and levels.
- The framework of the MAB Programme and the BRs can make social issues, challenges, inequalities, and conflicts visible.
- BRs are platforms that enable collaboration and cooperation between various different stakeholder groups.
- BRs foster a sense of belonging / a sense of place and can impact communities.
- Ethnographical and participatory research designs are effective at minimising the risk of oversimplification.
- Results can be validated with local researchers and key stakeholders; networking and the adopted ethics and values can foster trust and enhanced data quality.

Benefits for BRs:

- BRs can gain new methods of monitoring and management (management implications).
- BRs can gain monitoring data or even first data (benchmark data).
- BRs can hold workshops (communication of research results).
- BRs can gain increased awareness.

Benefits for researchers:

- Researchers can make data available (which is a common challenge).
- Researchers can network with other researchers who work in the BR.
- Researchers can foster an international network and can collaborate with others.
- The BR is a global concept.
- The BR status can lead to in-depth research into various social items.
- BRs present opportunities for applied science and citizen science approaches.
- Researchers can work in interdisciplinary teams and conduct transdisciplinary work.
- Research institutions and BRs can form (long-lasting) partnerships.
- The MAB network can enable large-scale studies.
- Researchers have access to Indigenous knowledge.
- Funding comes from the UNESCO MAB programme, for example, through the MAB Young Scientist Grant.
- Being at this conference and getting to know and exchange ideas with researchers from all over the world is certainly a benefit.

CHALLENGES:

Science communication:

What is a Biosphere Reserve?

- We need a good explanation (maybe a metaphor).

Where is the Biosphere Reserve?

- We need better maps that correspond with the BR on the ground (especially outside of Europe).

Data access/availability is problematic in most cases:

- Data are often heterogeneous or poorly documented/archived (we need metadata!).

Lack of communication:

- Partners' work is not always communicated or shared with other companies, which limits the possibilities for collaborating or developing activities.
- The lack of communication and difficulties in information exchange are omnipresent; → we need better databases/storage systems.
- Communication networks are not well established in BRs and lack awareness of local issues.
- It is not clear how to communicate the results of research to political decision-makers in an appropriate way for long-term improvement.
- It is not clear how to communicate sensitive scientific research without risking the safety and scientific

freedom of ›whistle-blowers‹, especially if there are intense conflicts.

- It is not clear how to ensure confidentiality or the anonymity or safety of change-makers.

Knowledge–Transfer gap

Knowing–Doing gap

for example, the fear of evaluations:

- Major obstacles to using evaluations for learning include the limited margin for reporting problems and unexpected results as well as the existing bias towards reporting numbers over process analysis.
- We need more adaptive management.
- Concept–Reality gap:
- Reforestation reports can sometimes contain information that is different from what was actually done in the field.
- Innovations may not be detected because they are different from what is expected.

Administrative obstacles:

- It can be difficult to obtain funding.
- Long-term cooperation with research institutes can be challenging.
- Changes in admin officer/staff can occur.
- Research permits and communication are required; in some cases, research permits have to be paid!
- The lack of capacities can be a major issue.
- Bureaucratic obstacles must be tackled and overcome.
- A mismatch between research objectives and BR objectives can exist.
- Large-scale studies are challenging because BRs are a highly heterogeneous group.
- Small-scale studies are challenging because various administrative systems (official and unofficial) are often present in one BR.
- Researchers often still rely on informal contacts.
- There is often limited representation of Indigenous knowledge.
- Trust issues exist towards researchers (from the side of both BR administrations and the local communities).
- Challenges are present in terms of language, cultural context, endogenous dynamics, national and international bureaucracy, timing, and logistics; → we need training programmes and workshops for researchers.
- There is a need for agroecological transitions in BR areas; → research on this topic must be developed in order to support territories in their transitions.
- Community participation is sometimes reported to be weak.

- The dominance of the Western-centric perspective in the frameworks of the MAB and the BRs presents a structural issue.

Conclusions regarding how to conduct research in, with, and for Biosphere Reserves:

- How can the biosphere network and collaboration be activated?
- Better research communication is needed.
- More knowledge transfer is needed.
- Man and the Biosphere = human–nature interaction = ecosystem services.
- BRs should provide information on needed research.
- Greater investment should be made in education, awareness, research, and equipment.
- BR biodiversity hotspots have a high risk of biodiversity loss, and of stresses resulting from climate change, of fast output, and of daily struggles with deteriorating conditions.
- There needs to be a transition from the concept of ecosystem services to the concept of nature's contributions to people.
- Should the IUCN Red List of Ecosystems be implemented and supported by the WNBR?

Excursions

EXCURSION 1

The agricultural landscape around Brodowin

Keywords: glacial landscape formation; agricultural landscape; nature tourism; visitor guidance; large-scale organic farming; local production; nature conservation on farmland; steppe grassland, kettle hole ponds, and lakes

This excursion took us to the ›eco-village‹ of Brodowin, a rural village that entirely switched to organic farming (Demeter) in 1991. A large-scale organic farm and several smaller family enterprises work here in the heart of Schorfheide-Chorin BR. We learned about target conflicts between nature conservation and large-scale modern organic farming and about how to solve them as well as about a visitor-guidance system in the landscape and about nature conservation in the young moraine agricultural landscape. This excursion included a visit to the biggest farm and the surrounding countryside.

With: Susanne Winter and Frank Gottwald, Ökodorf Brodowin e. V., and Ludolf von Maltzan, farm manager



EXCURSION 2

Peatlands in the central biosphere reserve, and Sernitz spring mire restoration

Keywords: natural and drained mires; peatland ecosystems; mire restoration; farming on wet organic soils

We visited different types of near-natural mires in the central Biosphere Reserve and the peatlands of the Sernitz catchment near Greiffenberg. Here, the largest restoration of a spring and percolation mire in northern Germany has just been completed. A guided tour took us along different mire ecosystems, which were re-vitalised as part of the EU LIFE project ›Lesser Spotted Eagle‹. We also learned about extensive grazing as conservation-oriented land use on wet organic soils.

With: Benjamin Herold, Biosphere Reserve administration, and Vera Luthardt, HNEE

EXCURSION 3

Ancient beech forests of the Schorfheide-Chorin Biosphere Reserve

Keywords: old-growth lowland beech forests; science-based integration of conservation targets into beech forest management; cooperation of Biosphere Reserve and forest administrations; marteloscopes

This excursion led us to various lowland beech forest tracts – including the Grumsin forest – as part of the UNESCO World Natural Heritage Site ›Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe‹. We had the opportunity to exchange infor-

mation with foresters. In order to learn more about nature conservation and the integrated management of beech forests, we visited managed forests and the ›Fauler Ort‹ BR core zone as well as a forest marteloscope, which is an innovative tool for simulating forest management.

With: Martin Flade, Director of Schorfheide-Chorin BR, and Dietrich Mehl, Director of the Reiersdorf state forest district

EXCURSION 4

Journey with the Solar Explorer (Werbellinsee) and experimental aquatic research (Wuckersee)

Keywords: renewable energies; climate-change mitigation; environmental education; experimental research on calcareous clear-water lakes; fishery management; tourism pressure

Participants in this excursion travelled on the solar-powered research vessel ›Solar Explorer‹. During the trip, we talked about the importance, condition, and protection of clear-water lakes. In this context, we also learned about innovative environmental education and sustainable fishing. We were additionally introduced to the EU LIFE project ZENAPA, which focuses on climate protection in large protected areas, and we visited a lake where experimental research on clearwater lake ecosystems is performed.

With: Uwe Graumann and Rüdiger Michels, Biosphere Reserve administration, and Rüdiger Mauersberger, Manager of the Chara Lakes Research Project



Sustainable and diverse – the Biosphere Reserves Institute's guiding principles

Sustainability

We are aware that organising a large international conference exerts some form of pressure on the environment. We aimed to minimise this impact as much as possible. In order to create a sustainable research conference, the following measures were implemented:

Regional and organic food: The meals during the conference were regional, organic, and mostly vegetarian. This ensured that the food was produced with low environmental impact and with respect for animal welfare.

CO2 compensation: The calculated greenhouse gas emissions of 183 t CO₂eq that resulted from the conference were compensated for via the Kakamega Stove Project by Ivakale e. V. This project in Kenya compensates for emissions by installing efficient clay cookware stoves (Upesi stoves) at beneficiary households. We received an official Gold Standard certificate proving this compensation.

Democracy, Diversity, and Tolerance

In universities, different people from different countries realise their right to personal development and education. Therefore, at our institution and our events, people are valued and respected, regardless of their race, class, gender, sexual orientation, or abilities. Brandenburg's higher-education institutions are committed to democracy, diversity, and tolerance through a joint position paper. Accordingly, a diversity concept and an anti-racism concept have been established in 2017 in order to help guide the university's activities.

Goals of our diversity concept

We aim to:

- refrain from discrimination and to improve the integration of people from diverse cultures;
- notice the differences of all people without prejudice, accept these differences, and above all, appreciate this diversity;
- guarantee social justice and equal opportunities for all status groups;
- benefit from the potential of diversity (e.g. by making optimal usage of the different competencies, experiences, and qualifications of all people); and
- increase diversity (e.g. by having more international students and employees, more women in technical fields, and more female professors).

Goals of our anti-racism concept

We aim to establish systematic protection against discrimination. The measures of our anti-racism concept are intended to raise awareness of (unconscious) everyday racism and to promote critical thinking and actions.

All people should be confident that they are protected from racist discrimination and that they will receive the best possible support and solidarity in the event of incidents.

All people should be strengthened through networking as well as through racism- and discrimination-critical educational offers in order to defend against the feeling of powerlessness and a lack of voice and to expand their own scope of action.

Based on these goals, when selecting the participants, we aimed to achieve a balanced composition in terms of world region and gender.

93 Contributing Participants - 46 Countries

AFRICA: 13 COUNTRIES

28 % Participation

NORTH & SOUTH AMERICA: 8 COUNTRIES

15 % Participation

EUROPE: 12 COUNTRIES

26 % Participation

AUSTRALIA: 1 COUNTRY

2 % Participation

ASIA: 11 COUNTRIES

26 % Participation





