

The Evolution of the World Network of Mountain Biosphere Reserves (WNMBR) – Bridging Science and Practice for Sustainable Mountain Management

Günter Köck, Roberto Aquerreta, Natalia Castro, María Rosa Cárdenas Tomažič, Jorge Sánchez-Cruzado & Xu Weihua

Keywords: mountains, biosphere reserves, network, knowledge-sharing

Abstract

The World Network of Mountain Biosphere Reserves (WNMBR) was established in December 2021, making it one of the newest of the six thematic networks of UNESCO's Man and the Biosphere (MAB) program. The aim of the network, which currently consists of just over 80 mountain biosphere reserves, is continuously to support biosphere reserves in mountain regions through research, strategic partnerships and cooperation, innovative management practices and knowledge-sharing. The WNMBR is coordinated by the MAB Secretariat at UNESCO Headquarters in Paris and a joint technical secretariat run by the Research Centre for Eco-Environmental Sciences of the Chinese Academy of Sciences (China) and the Valles de Omaña y Luna Biosphere Reserve (Spain).

Background

The history of the World Network of Mountain Biosphere Reserves (WNMBR) is intertwined with efforts to integrate biodiversity conservation, sustainable development and scientific research in mountain areas around the world. Since the establishment of UNESCO's Man and the Biosphere (MAB) programme in 1971, interdisciplinary research on mountain ecosystems and the ecosystem services they provide has been one of the programme's priorities, resulting in several international projects and initiatives (Price et al. 2024). The reason for the growing interest in mountain regions is obvious: mountain regions cover around 22% of the earth's surface, are home to around 15% of the world's population (currently around 915 million people) and are rich in cultural and biological diversity. About half of the world's biodiversity hotspots are found in mountain areas (Payne et al. 2020; WNMBR 2025).

At the time of its inception, the MAB programme focused on 14 research themes to achieve the programme's goals of exploring and protecting the world's most important ecosystems. One of these research themes was the MAB-6 project, which focused on monitoring the impact of human activities on mountain and tundra ecosystems, with strong roots in international interdisciplinary mountain research (Köck & Grabherr 2014; Price et al. 2021). MAB-6 quickly attracted attention, became one of the priorities of the MAB programme and served as a catalyst for research initiatives, knowledge exchange and collaboration on mountain issues. One of the most important sub-projects of MAB-6 was the MAB meta-project Obergurgl, which was dedicated to the study of the ecosystem of the municipality of Obergurgl (Tyrol, Austria) in all its ecological and socio-economic components from 1973 to 1980 (Moser 1975, 1987; Köck & Grabherr 2014; Köck & Arnberger 2017; Scheurer 2020; Price et al. 2021).

Two other important projects took place in the 2000s, which provided, so to speak, the model for the founding of the WNMBR, namely GLOCHAMORE (Global Change in Mountain Regions 2003–2005) and its successor project GLOCHAMOST (Global Change in Mountain Sites 2009–2011).

GLOCHAMORE, which was probably the first research project of the MAB programme to deal with global change in biosphere reserves (BRs), produced the *GLOCHAMORE Research Strategy* as an outstanding result, in which 10 key areas for research were highlighted to steer the sustainable management of these areas. In the follow-up project GLOCHAMOST, this research strategy was to be put into practice. The key areas addressed were implemented in a total of nine mountain BRs (M-BRs) (Price et al. 2021, 2024; Schaaf 2009). The research strategy has been used in subsequent years for work in BRs and has also led to further initiatives and projects. However, its existence / importance has been somewhat forgotten in the last decade, although the demand for scientific support for the management of M-BRs and a better exchange of information and experience has steadily increased.

Spurred on by the ever-increasing challenges of global change for the managers of M-BRs, a small group of scientists and BR experts, led by M. Price (UHI Perth), together with the MAB Secretariat in Paris, developed the idea of establishing a network for M-BRs, based on the achievements of GLOCHAMORE and GLOCHAMOST, but adapted to the current challenges. If it were possible to bring together as many BRs as possible in a network to share experiences and conduct research on specific mountain issues, such a network could improve the role of M-BRs and represent an important strategic tool for UNESCO to promote cooperation between Member States and support them in implementing the UN Sustainable Development Goals (SDGs) and the International Environmental agreements on biodiversity and climate change.



Figure 1 – Participants of the first face-to-face WNMBR meeting in the Valles de Omaña y Luna BR (Spain). From left to right: Yi Zhiyun, María Rosa Cárdenas Tomažič, Xu Weihua, Jorge Sánchez-Cruzado, Francisco José Cantos Mengs, Günter Köck, Claudia Köck, Carolina Adler, Roberto Aquerreta, Guillermo Castiñeira, Natalia Castro, Thomas Schaaf, Paola Fontanella Pisa, Natalia Beltrán, Wenlu Cheng, Zhiyun Ouyang

Even in the initial discussions, it was agreed that this network should have a strong scientific component to support management, facilitate science-based decision-making and generate a significant impact in the territory through projects and activities. To achieve this, it was deemed essential to have a technical secretariat to serve as both the driving force and an information hub. Additionally, securing a budget to fund activities and projects was identified as a key requirement. The administration of the future network was therefore envisioned to follow the successful model of the World Network of Island and Coastal BRs (WNICBR) coordinated by the MAB Programme in collaboration with two technical secretariats funded by the Republic of Korea and Spain (Jeju Island and Menorca Island respectively).

In June 2021, the MAB Secretariat invited all interested UNESCO Member States to submit applications for the position of Technical Secretariat. These applications were reviewed by the MAB Bureau, which ultimately selected the proposals submitted by the People's Republic of China and Spain.

During the meeting of the Bureau members, Austria recommended accepting both applications for strategic reasons. This would have the advantage that the proposed candidates together would include a greater variety of working languages (Chinese, English and Spanish), different mountain chains in different regional groups (Asia-Pacific, Europe and Latin America and the Caribbean) and open cooperation with several existing regional MAB networks (e.g. EuroMAB, IberoMAB, East Asia Biosphere Reserve Network [EABRN]). In addition, the two candidates would represent two main pillars of the MAB community, namely Academia and BRs (UNESCO 2021). Austria's proposal to nominate the Research Centre for Eco-Environmental Sciences of the Chinese Academy of Sciences and the Valles de Omaña y Luna BR for the joint coordination of the Technical Secretariat in co-



Figure 2 – Group photo from the 1st Workshop of the World Network of Mountain Biosphere Reserves in Dujiangyan (China).

operation with the MAB Secretariat was unanimously accepted by the Bureau members (UNESCO 2021).

The official launch of the WNMBR took place on 9 December 2021 during a webinar on *Sustainable Tourism in Mountain Biosphere Reserves* organized by UNESCO's MAB Programme and the Mountains Research Initiative (MRI) as part of the International Mountain Day celebrations (MRI 2021).

At this point, it should be noted that many MAB documents and media articles referred to the process as a relaunch, which does not quite reflect the reality. Although GLOCHAMORE, for example, involved over 140 scientists from all over the world in addition to UNESCO and 11 research institutions (Price et al. 2024), the project was not a genuine thematic network, but *only* a research collaboration, albeit a global one. Although the WNMBR builds on the results and spirit of GLOCHAMORE and GLOCHMOST, its establishment should therefore de facto be regarded as a new foundation.

Shaping the working structures

In January 2022, the first online meeting of the WNMBR Secretariats and its advisory board made up of experts on BRs and mountain regions discussed the creation of an initial roadmap for the implementation of the network.

Although communication between the stakeholders was considerably impaired by the Covid situation at the time, the establishment of the structures progressed quite quickly. Even before the tender for the Technical Secretariat, a list of members of the World Network of Biosphere Reserves (WNBR) provided by the MAB Secretariat was used to determine the proportion of M-BRs in the World Network of Biosphere Reserves.

Two problems immediately became apparent. One of these was that the geographical coordinates of the respective BRs had been entered incorrectly in some cases, presumably due to frequent editing by different editors, so that the BRs were sometimes incorrectly positioned by several hundred kilometres in a map produced by the Institute of Interdisciplinary Mountain

Research of the Austrian Academy of Sciences, which necessitated a time-consuming revision of the list.

The main challenge, however, was that no clear definition of an M-BR existed then or now for membership of the network. Deciding whether a BR on the World Network of Biosphere Reserves list also counted as an M-BR was therefore very difficult in several cases.

Mountains and mountain regions were and are difficult to define, which is why numerous definitions exist today. Currently, the most used approaches to define mountains are those found in Kapos et al. 2000, Körner et al. 2011, 2021 and Karagulle et al. 2017. These approaches use combinations of geomorphometric parameters such as elevation, slope and ruggedness or relief, which are nowadays derived from digital elevation models, and attribute thresholds to decide which terrain is mountainous and which is not (Körner et al. 2021). In addition, consultation with some BR management teams revealed that a BR's self-perception also plays a decisive role in determining its membership in the WNMBR, that is, whether it considers itself as a mountain area or not. One example of this is the Austrian BR Wienerwald. The region is located in the north-eastern spurs of the Alps, is part of the Alpine network of the Alpine Convention and could therefore be considered to be a member of the WNMBR (Köck et al. 2009). However, due to its proximity to Vienna and the associated challenges, its management considers it more of an urban BR than an M-BR and therefore has not joined the WNMBR (A. Weiss, Wienerwald BR-Management, personal communication).

After discussion among experts, it was decided provisionally to use the self-description of the respective BR in its official registration, along with a minimum elevation of 1,000 m asl, to create a provisional list of M-BRs.

To improve public relations and communication within the network, the new WNMBR website was published in three languages (English, Spanish and Chinese) in September 2022. Three months later, the first biannual WNMBR newsletter was published.

Finally, after the end of the Covid pandemic and about two years after the launch of the network, the first face-to-face meeting of the Technical Secretariats and the Advisory Group took place in the Valles de Omaña y Luna BR (Spain) from 7 to 11 March 2023 (Figure 1). The participants drew up a work plan for the next two years, focusing on tackling global issues such as biodiversity loss and climate change to support the implementation of the 2030 Agenda for Sustainable Development.

The meeting participants agreed that tackling these significant global problems increasingly requires bridging the gap between policy, scientific research and indigenous and local knowledge.

In this session, the foundations and mission of the WNMBR were analysed in detail, as well as the way



Figure 3 – Group photo from the 2nd Workshop of the World Network of Mountain Biosphere Reserves in the Ordino BR (Andorra).

in which the work of the WNMBR should be structured. For the roadmap three main areas of work were identified:

- Research for actionable knowledge,
- empowerment and participation,
- support for adaptive management.

To realize these points, six initiatives were decided upon, to be launched immediately:

- Sharing small, affordable and creative initiatives to address global change at the local level.
- Exchanging tools for monitoring biodiversity and socio-economic dynamics.
- A communication platform for M-BR managers.
- A capacity building programme (for WNMBR members).
- A youth education and engagement programme.
- A catalogue of participatory approaches.

Furthermore, three working groups made up of WNMBR members were set up to work on three very important topics for M-BRs:

- Adaptation to climate change and resilience,
- biodiversity,
- participation and socio-economic aspects.

The new 2023–2025 roadmap was presented at the third WNMBR online meeting on 24 May 2023, where it was unanimously adopted by over 120 participants from at least 15 countries from all five continents.

A major milestone for the network was the first face-to-face meeting of the WNMBR held from 18 to 22 September 2023 in Dujiangyan (China). The event brought together around 60 participants, including representatives from M-BRs, related organizations, experts and academics from 17 countries. Key agenda items were the refinement of the new roadmap, first working group meetings and the presentation of a proposal for an exchange programme for BR staff, as well as an international internship programme for young researchers within the network.

Furthermore, several workshops were organized on the three main areas of work in the road map. The aim was to develop a methodology to identify best practices and their replicability and scalability within

the network. In addition, 10 best practice examples selected from a total of 50 projects implemented in M-BRs were presented.

To strengthen the cohesion and functionality of the network, an annual calendar of formal meetings has been agreed upon, consisting of one face-to-face meeting and two online meetings, along with those convened by the working groups. This ensures continuous communication between members and enhances cooperation between M-BRs.

From 24 to 27 September 2024, the second WNMBR face-to-face meeting took place in the Ordino BR (Andorra). This very fruitful event gathered around 50 participants from 22 countries, focusing on strengthening the network, refining the 2025 roadmap, reviewing progress from the past year and defining new lines of action for the future. Prior to the meeting, a questionnaire was sent to all WNMBR members to gather information on the current state of the network and suggestions for improvement. The results provided valuable information on the needs and challenges of the network, which were integrated into the strategic planning.

Participants addressed important topics such as the internal organization of the network, the expansion of membership and ongoing or planned cooperation initiatives.

Status quo of the WNMBR and next steps

Some important conclusions were drawn from the intensive discussions at the WNMBR meeting in Andorra, which will be incorporated into the 2024–2025 roadmap and should now be implemented or tackled immediately.

Strategic roadmap

Clear priorities for the 2024–2025 period have been identified, including defining the network's mission, vision and values and creating a five-year strategic plan. The need to develop impact indicators that demonstrate the contribution of M-BRs to conservation, sustainability and socio-economic development was also emphasized.

Consolidation of the network and definition of mountain biosphere reserves

The network currently comprises 83 BRs in 37 countries in Africa, Arab States, Asia/Pacific, Europe, North America and Latin America/Caribbean. The WNMBR is thus clearly on the way to greater internal cohesion and geographical diversification. However, attracting more M-BRs from under-represented regions to join the network is still a priority. Strength is expressed in numbers! The more members, the stronger the external representation of the network, the greater the wealth of knowledge and experience within.

Furthermore, there is an urgent need to establish a clear and comprehensive definition of an M-BR for

network membership and for further analysis. To address this, the MAB Programme Secretariat has been working on a broader and more inclusive definition, moving beyond altitude as the sole criterion. This effort takes into account various existing definitions of mountains, as proposed in Kapos et al. 2000, Körner et al. 2011, 2017, Karagulle et al. 2017, and Snethlage et al. 2022.

Strengthening communication and cooperation

The opportunities for internal communication such as newsletters, digital platforms and regular webinars are to be expanded and improved. This should facilitate knowledge transfer and improve the visibility of the WNMBR in international forums.

Participation in international events

Right from the start, the network began to increase its participation in international events relevant to M-BRs, such as the First Southern African Mountain Conference 2022 in South Africa (Köck et al. 2022), the International Mountain Conference 2022 in Innsbruck (Austria) (Fontanella Pisa et al. 2022) and the World Biosphere Reserve and Global Geopark Sustainable Development Conference 2024 in Changbaishan (China). For example, a workshop on *Climate change and mountain regions* was organized as part of the EUROMAB Conference 2024 in Wittenberg (Germany), in which experiences from M-BRs were exchanged (Strasser & Köck 2024).

The World Congress of Biosphere Reserves 2025, which will take place in Hangzhou (China) in the third week of September 2025, is an important event for UNESCO's MAB programme, as it will lay the foundation for the programme's new 10-year strategy. The World Congress represents an important strategic opportunity for the WNMBR to position the network as a reference for sustainable mountain management. The network will therefore use this space to make its influence visible and strengthen international partnerships.

Innovative and cooperative projects

Several projects have been discussed and prepared in the last two years. These are intended not only to promote the creation and exchange of knowledge, but also to strengthen local and regional capacities to tackle global challenges.

Launch of a GLOMOS-WNMBR internship programme

This programme will connect young researchers with M-BRs, facilitating the integration of scientific knowledge into biosphere reserve management. The project will be launched in 2025 in collaboration with EURAC Research (Bolzano, Italy) and The United Nations University as part of the GLOMOS (Global Mountain Safeguard Research) programme.

Launch of an exchange programme for mountain biosphere reserve staff

The aim is to facilitate knowledge exchange between M-BRs and to promote collaboration, innovation and capacity building. The programme is intended to start in summer 2025 as a pilot project with the exchange of technicians and/or managers between the Nockberge (Austria) and Ordino (Andorra) BRs.

Contribution of mountain biosphere reserves to biodiversity conservation

The Research Center for Eco-Environmental Studies of the Chinese Academy of Sciences is working on a project to measure the contribution of World Network of BR to biodiversity conservation, sustainable development and climate change mitigation. For example, a set of key indicators and a baseline will be defined to facilitate subsequent measurement and monitoring. Data is currently being collected from all BRs in China, but the project will be expanded to cover the entire globe in the future.

Glacier monitoring and conservation project

This project aims to inventory glaciers in the M-BRs and encourage citizen participation in their conservation using a citizen science tool. It will define a baseline for the presence of glaciers in the WNMBR and collect testimonies on the biocultural relationship of people and local and indigenous communities with glaciers, whether they are present or have disappeared. The project shall contribute to the United Nations International Year of Glacier Conservation 2025 and the Decade of Cryosphere Research 2025–2035.

Cultural giants

This initiative seeks to document and promote traditional cultural expressions in M-BRs through digital and printed publications. So far, 16 cultural expressions from six countries have been collected.

Conclusion

Since its creation, the WNMBR has rapidly evolved into a key global player in the conservation and sustainable development of mountain ecosystems. Important reasons for the rapid progress since its creation have undoubtedly been the engagement of its technical secretariat and the establishment of a highly committed advisory group. Another factor could also be the fact that all face-to-face meetings are led by the same experienced facilitator who knows the network and its stakeholders very well.

In the future, it would be desirable for the Technical Secretariat to count on its own budget to cover structural costs, as well as to finance network-wide projects and activities. Furthermore, efforts must be made to accelerate the process of recruiting new members, especially from previously under-represented regions. In addition, a clear definition of an M-BR for member-

ship of the network must be established as soon as possible.

Building on the success of previous initiatives such as GLOCHAMORE, the World Network of Biosphere Reserves will continue to forge partnerships, share knowledge and promote strategies that secure the future of mountains and the people who depend on them. With new initiatives, the network will help M-BRs adapt to the challenges of the future, including climate change, while ensuring that M-BRs and their societies remain vibrant, sustainable and resilient to future uncertainties.

References

- Fontanella Pisa, P., J. Thornton, S. Schneiderbauer, C. Adler, M. Cardenas, M. Price, T. Schaaf, T., G. Köck & S. Boret Penmellen 2022. UNESCO MAB World Network of Mountain Biosphere Reserves. *International Mountain Conference*, 11–15 September 2022. Innsbruck.
- Kapos, V., J. Rhind, M. Edwards, M.F. Price & C. Ravilious 2000. Developing a map of the world's mountain forests. In: Price, M.F. & N. Butt (eds), *Forests in sustainable mountain development report for 2000*: 4–9. CAB International, Wallingford.
- Karagulle D., C. Frye, R. Sayre, S. Breyer, P. Aniello, R. Vaughan & D. Wright 2017. Modeling global Hammond landform regions from 250-m elevation data. *Trans GIS* 21: 1040–1060.
- Köck, G., G. Koch & C. Diry 2009. The UNESCO Biosphere Reserve 'Biosphärenpark Wienerwald' (Vienna Woods) – a long history of conservation. *eco.mont - Journal of protected mountain areas research and management* 1(1): 51–56.
- Köck, G. & G. Grabherr 2014. Forty years of the UNESCO Man and the Biosphere Programme in Austria – a success story of ecologic basic research evolving into a flagship of transdisciplinarity. *eco.mont - Journal of protected mountain areas research and management* 6(1): 57–62.
- Köck, G. & A. Arnberger 2017. The Austrian Biosphere Reserves in the light of changing MAB strategies. *eco.mont - Journal of protected mountain areas research and management* 9 (Special issue): 85–92.
- Körner, C., J. Paulsen & E.M. Spehn 2011. A definition of mountains and their bioclimatic belts for global comparison of biodiversity data. *Alp Botany* 121: 73–78.
- Körner, C., D. Urbach & J. Paulsen 2021. Mountain definitions and their consequences. *Alp Botany* 131: 213–217. <https://doi.org/10.1007/s00035-021-00265-8>
- Moser, W. 1975. *MAB-6 Obergurgl (Austria)*. Report 1975.
- Moser, W. 1987. Chronik von MaB-Projekt Obergurgl. In: Patzelt, G. (ed.), *MaB-Projekt Obergurgl, Veröffentlichungen des österreichischen MaB-Programms*: 7–24. Innsbruck.

MRI 2021. Launch of the World Network of Mountain Biosphere Reserves. Available at: <https://mountainresearchinitiative.org/events/launch-of-the-world-network-of-mountain-biosphere-reserves/> (accessed 20/01/2025).

Payne, D., E.M. Spehn, G.W. Prescott, J. Geschke, M.A. Snethlage & M. Fischer 2020. Mountain biodiversity is central to sustainable development in mountains and beyond, *One Earth* 3(5): 530–533.

Price, M.F., T. Schaaf & M.R. Cárdenas Tomažič 2021. Mountain research in UNESCO's Man and the Biosphere Programme: the first five decades. *eco.mont - Journal of protected mountain areas research and management* 9 (Special issue): 93–101.

Price, M., T. Schaaf, M.-R. Cárdenas, P. Fontanella Pisa & G. Köck 2024. The World Network of Mountain Biosphere Reserves. In: Schneiderbauer, S., P. Fontanella Pisa, J. F. Shroder & J. Szarzynski (eds), *Safeguarding mountain ecosystems: A global challenge*: 169–174. Amsterdam. <https://doi.org/10.1016/C2019-0-04671-7>

Schaaf, T. 2009. Mountain Biosphere Reserves – A people-centred approach that also links global knowledge. *Sustainable Mountain Development* 55: 13–15.

Scheurer, T. 2020. Das MAB-6-Projekt der UNESCO: Von der Ökosystemforschung zum MAB-Biosphärenreservat. In: A. Borsdorf, V. Braun, K. Heinrich & M. Jungmeier (eds), *Biosphere 4.0. – UNESCO-Biosphärenparks als Modellregionen einer nachhaltigen Entwicklung*: 87–100. Berlin/Heidelberg.

Snethlage, M.A., J. Geschke, A. Ranipeta, W. Jetz, N.G. Yoccoz, C. Körner, E.M. Spehn, M. Fischer & D. Urbach 2022. A hierarchical inventory of the world's mountains for global comparative mountain science. *Sci Data* 9: 149. <https://doi.org/10.1038/s41597-022-01256-y>

Strasser, S. & G. Köck 2024. Workshop – Addressing climate change in mountain regions: science, local action and collaboration. Sharing experiences from the World Network of Mountain Biosphere Reserves (WNMBR). In: German Commission for UNESCO, *Report of the EuroMAB Conference 2024: Climate for Change – UNESCO Biosphere Reserves for Sustainable Futures*, 3–7 June 2024. Lutherstadt Wittenberg/Bonn.

UNESCO 2021. *Report of the fourth online meeting (in 2021) of the Bureau of the International Coordinating Council of the Man and the Biosphere (MAB) Programme*, December 2, 2021.

WNMBR 2025. Homepage of the World Network of Mountain Biosphere Reserves. Available at: <https://www.mountainbiosphere.org/en/> (accessed 20/01/2025)

Authors

Günter Köck

was Secretary-General of the Austrian MAB National Committee, is a former Vice-Chair of the UNE-

SCO MAB Programme and was the Austrian delegate to the MAB International Coordinating Council. Since his retirement, he has also been active in UNESCO's Earth Network. He has been involved in the founding of the WNMBR from the very beginning. Institute for Interdisciplinary Mountain Research, Austrian Academy of Sciences

Roberto Aquerreto

has a long experience in the design and implementation of initiatives linked to conservation and sustainable development in protected areas, especially in mountain areas and, for several years, in the framework of BRs. He has been an active part in the process of creating the WNMBR and currently forms part of its technical secretariat at the Valles de Omaña y Luna BR.

Natalia Castro

is manager of the Valles de Omaña y Luna BR, focusing her experience on public participation processes and the creation of learning communities in rural mountain environments. She is currently working in the joint technical secretariat of the WNMBR.

María Rosa Cárdenas Tomažič

is a geographer from the Pontifical Catholic University of Chile and holds a Master's degree in Sustainable Development from the University of Sussex (United Kingdom). She joined UNESCO in 2004, first working with the World Water Assessment Programme and, later, on projects related to the management of UNESCO sites (Biosphere Reserves and World Heritage) using space technologies. Since 2012, she has been working in the Secretariat of UNESCO's Man and the Biosphere (MAB) Programme in Paris, where she coordinates the activities of the WNMBR and the Ibero-American and Caribbean Biosphere Reserve Network (IberoMAB).

Jorge Sánchez-Cruzado

has been working with BRs and networks for a long time, mainly on issues related to governance and community participation. In his role as a professional facilitator and consultant with the cooperative *Altekio*, he has been involved in the creation of the WNMBR since its first meetings.

Xu Weihua

is a professor in the Research Center for Eco-Environmental Sciences, Chinese Academy of Science. His research interests are in biodiversity conservation and protected areas planning and management. He currently serves on the joint technical secretariat for the WNMBR.