

Harnessing the Socio-Ecological Potential of Mountain Biosphere Reserves for Biodiversity Conservation

Introduction

Mountains in the face of the triple planetary crisis

Key points

- *Biodiversity loss is one of the main global environmental problems and is reaching unprecedented rates in human history.*
- *Mountains are the most biodiverse areas on Earth and among the most vulnerable.*
- *There is great room for improvement in mountain conservation, in terms of both protected area (quantity) and protected value (quality).*

The combination of climate change, pollution and biodiversity loss, known as the “triple planetary crisis”, is a real threat to both ecosystems and the well-being of current and future generations (6, 38, 41).

Half of the world’s biodiversity hotspots are found in mountain areas (6, 18), as a result of complex topographic and climatic characteristics (see Fig.1).

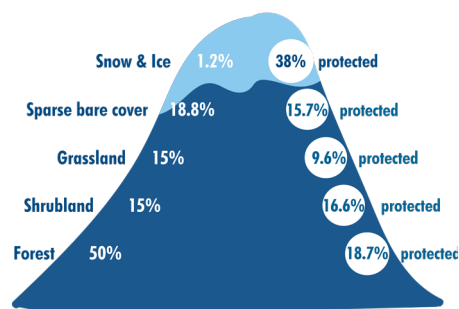


Figure 1. Mountain Biomes: Proportion of each biome in the mountain landscape, globally (central column), and each biome’s Level of Protection (right-most edge), (not including croplands or settlements): (based on Sayre et al. 2020). (Note that the heights of each biome and % protected are not to scale). © Marc Foggin

These vital areas have the highest levels of genetic, species and ecosystem diversity per unit area on Earth (30, 34). However, mountain ecosystems are also among the most threatened globally, particularly from habitat fragmentation and climate change (1, 7).

About 30% of Key Biodiversity Areas (KBA) worldwide are located entirely or partially in mountain areas, and 88% of the Earth’s 821 ecoregions include mountains (18, 36). However, many mountain areas of biodiversity significance lack effective protection: 40% of KBA in mountain areas are not protected at all and 52% are insufficiently protected (16, 18, 32).



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1. Landscape approach: Mountain biosphere reserves in a new era for biodiversity conservation

Key points

- *Despite efforts in recent years, protected areas are not effective in halting biodiversity loss.*
- *A shift towards landscape conservation is needed, integrating both biodiversity conservation and sustainable development objectives.*
- *Biosphere reserves fit perfectly into this new vision and can play a key role as “Other Effective Area-based Conservation Measures” (OECM) under the UN Convention on Biological Diversity.*

Protected areas have so far been the main strategy for biodiversity conservation in the face of ecosystem fragmentation (3, 28), without having fully achieved their intended objectives (17, 28).

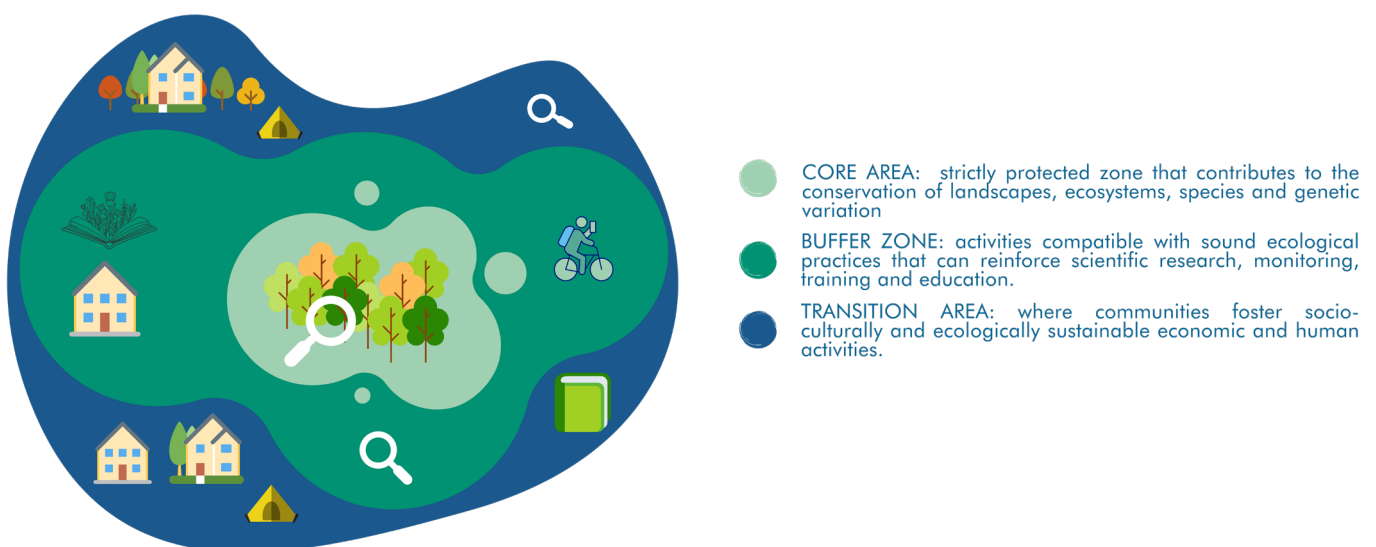
In their conventional sense, protected areas have many limitations, all deriving from the reality that they are linear and static solutions to dynamic, complex and multifactorial challenges (28).

Solving this problem requires a transformative paradigm shift for biodiversity conservation (29): a landscape approach that recognises the multifunctionality of a territory and incorporates the visions of its different stakeholders (27), closely aligned with the fulfilment of the UN 2030 Agenda and the 2050 vision of the Convention on Biological Diversity for “Living in Harmony with Nature” (28).

Within this framework, mountain biosphere reserves can play a strategic role for biodiversity conservation in line with the Post-2020 Global Biodiversity Framework, particularly if the biosphere reserve model is recognised as an Other Effective Area-based Conservation Measure (OECM) under the UN Convention on Biological Diversity.

The specific zonation of biosphere reserves (see Fig.2) allows for the holistic integration of conservation objectives together with other compatible social and economic objectives (3, 8). This zonation enables mutually reinforcing feedback loops between the three zones, most importantly by reducing the “edge effect” of the core area, improving its effectiveness, and by involving communities in the governance of the biosphere reserve, a mainstay of long-term effective management following a landscape approach (27, 28).

Figure 2. Zoning and functions of a biosphere reserve



2. Knowledge: Boosting the role of mountain biosphere reserves for applied research

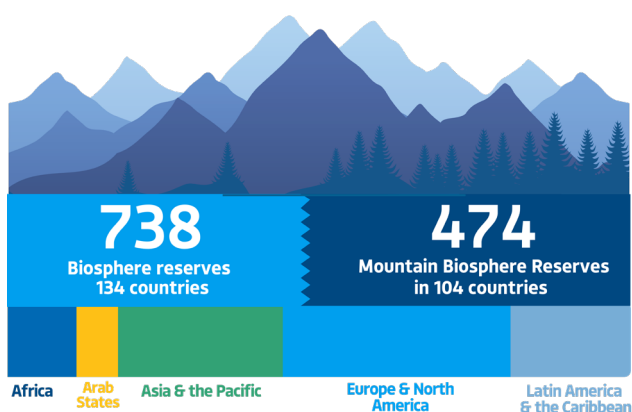
Key points

- *Improving the adaptive management of mountain ecosystems requires detailed understanding of the dynamics of change and how these interact.*
- *The World Network of Biosphere Reserves and its World Network of Mountain Biosphere Reserves (WNMBR) can greatly facilitate the generation and dissemination of knowledge at different scales.*
- *Many biosphere reserves serve as sites of excellence for research, as demonstrated by the GLOCHAMORE and GLOCHAMOST projects (see Box 1). Launched in 2021, the WNMBR offers a conducive framework for scientific collaboration between mountain biosphere reserves.*

Scientific research and the application of Indigenous and local knowledge are fundamental components of UNESCO's Man and the Biosphere (MAB) Programme, which defines biosphere reserves as "sites of excellence for exploring and demonstrating conservation and sustainable development approaches at a regional scale". MAB networks present extensive opportunities for fundamental and applied research related to socio-ecological systems and sustainable natural resource management.

As more than half the world's 738 biosphere reserves are found in mountain areas (see Fig.3), including 13 transboundary mountain biosphere reserves, the WNMBR is an ideal mechanism to foster innovative research and particularly to promote collaboration and the exchange of knowledge. Collaboration at an international level increases the impact and acceptability of research, by allowing for wider mobilisation on common issues and replicability of solutions.

Figure 3. Mountain biosphere reserves | 2022



Box 1. From GLOCHAMORE (2003) to the World Network of Mountain Biosphere Reserves (2021)

Two pioneering projects on global change in mountain areas set an example for international scientific collaboration between biosphere reserves. GLOCHAMORE (2003-2005) and GLOCHAMOST (2009-2011) involved more than 300 researchers, 28 mountain biosphere reserves and global research networks such as the Mountain Research Initiative (MRI). The projects generated valuable knowledge to assess the state of mountain ecosystems in the face of global change and improve their adaptive capacity (11, 38).

The success of these initiatives led the MAB Programme to identify an opportunity to establish a dedicated network for mountain biosphere reserves. At the institutional level, this network would consolidate and stimulate long-term scientific collaboration, and allow Member States to pool resources to address common challenges.

In 2016, the 4th World Congress of Biosphere Reserves adopted the Lima Action Plan. This plan laid the groundwork to increase research in mountain biosphere reserves, and also to create a thematic network, complementing existing research networks. On 9 December 2021, in the context of its 50th anniversary, the MAB Programme inaugurated the World Network of Mountain Biosphere Reserves and its official partnership with MRI, thus creating a bespoke framework for scientific collaboration between more than half of the world's biosphere reserves.

3. Community: Enhancing livelihoods that benefit from biodiversity and highly functional ecosystems

Key points

- *Mountain areas harbour a wealth of cultural diversity that is historically rooted in thriving ecosystems, as recognised in the governance and management of biosphere reserves.*
- *Mountain communities and traditional agro-silvo-pastoral practices play key roles as socio-cultural repositories of agrobiodiversity, which is vital to food security and resilience to global change.*
- *Ensuring the interrelated resilience of both mountain ecosystems and mountain communities requires the recognition of the services these ecosystems provide, and more open and inclusive governance systems.*

Mountains are home to more than a billion people. They are witness to a vast diversity of cultures whose ways of life, knowledge and spiritual values have played a crucial role in conserving and increasing biodiversity through a holistic and inclusive view of nature (21, 36). In several mountain biosphere reserves, the management of communal lands, traditional cultivation practices and the existence of sacred sites provide examples of sustainable resource management adapted to the particularities of mountain ecosystems (14, 22, 31).

In developing countries, approximately 648 million people live in rural mountain areas. It is estimated that over half face the risks of hunger and malnutrition, a trend that has been growing steadily over the last 20 years (30, 39).

The gradual loss of traditional practices, the simplification of crops (13) and increases in extreme climatic events, combined with a reduced functionality of ecosystems, are having direct consequences on biodiversity, particularly in the most vulnerable mountain regions (1, 13, 15). In these areas, the functionality of mountain ecosystems and their provision of environmental services depend to a large extent on the maintenance of traditional governance systems, specific ways of life and appropriate agro-silvo-pastoral practices (35, 39).

Recognising these key elements and building resilience to global change from a socio-cultural point of view are vital steps for conserving and increasing biodiversity (35). Mountain biosphere reserves provide a framework that embeds the synergies between community and ecosystem into its management plan and the representation of communities in its governance model.

Integrating local perspectives and knowledge in site management helps to reduce the vulnerability of ecosystem-community links. Inclusive and non-discriminatory governance systems, with special attention to Indigenous peoples, women and youth, also enable progress towards adaptive co-management, facilitating the resilience and management of these complex mountain socio-ecological systems (5, 15).

Overall, the active participation of communities in conservation increases its effectiveness (see Box 2), as well as reducing social conflict. Biodiversity protection transcends multiple scales and requires consensus and collective action.

Box 2. Case study: Jobs for Carbon, Gouritz Biosphere Reserve Cluster (South Africa)

The Gouritz Cluster Biosphere Reserve is promoting several initiatives to mobilise its community, two of which stand out.

The “Jobs for Carbon” project, launched in 2014, aims to recover habitats degraded by erosion and overgrazing through reforestation using native species, especially the speakboom (*Portulacaria afra*), which is effective at capturing and storing carbon. The initiative has led to the creation of 27 jobs in environmental restoration, recovering 653 ha with more than 600,000 speakboom plants, and generating additional income through potted plant sales and increased ecotourism.

The “Gouritz Ecological Corridors Project”, launched in 2019, aims to restore the functionality of ecological corridors through environmental rehabilitation and the promotion of sustainable practices, with special emphasis on wetlands and peatlands due to their vulnerability and critical role in water purification and carbon sequestration. The initiative already involves 37 private landowners in designing and implementing sustainable management strategies, covering more than 100,000 ha.

In addition to the intrinsic environmental value of both initiatives, they have exhibited a great capacity to boost local economies and mobilise local businesses for environmental outcomes. These initiatives, both developed in the Cape Floristic Region – one of six floral kingdoms in the world and a Key Biodiversity Area – demonstrate the capacity of biosphere reserves to address conservation, as well as the needs and interests of local communities at a landscape scale.



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Policy recommendations



1. *Intergovernmental, international and regional levels*

- Support the adoption of high standards in the design and implementation of the Post-2020 Global Biodiversity Framework, recognising mountains as reservoirs of biodiversity and sources of key ecosystem services, and the socio-ecological potential of mountain biosphere reserves for biodiversity conservation.
- Support the classification of biosphere reserves as “Other Effective Area-based Conservation Measures” (OECM) under the UN Convention on Biological Diversity, recognising them as effective and bespoke frameworks for integrated biodiversity conservation, and enabling Member States to meet targets for increasing protected areas.
- Support mountain biosphere reserves and the WNMBR in leading research on the added value of the biosphere reserve model in the implementation of the Post-2020 Global Biodiversity Framework and their classification as OECM under the UN Convention on Biological Diversity.
- Foster transboundary cooperation and networking on biodiversity conservation in mountain areas, notably between transboundary mountain biosphere reserves and through nominations of new transboundary sites.
- Normalise the application and open exchange of scientific, local and Indigenous knowledge in the management of mountain landscapes, particularly in Key Biodiversity Areas (KBA) and biosphere reserves.
- Support the membership of mountain biosphere reserves to the WNMBR and the activities of the WNMBR in fostering international science collaboration, knowledge exchanges and knowledge-based management in, with and for mountain areas, and in disseminating good practices and environmental education materials.





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2. *National and sub-national levels*

- Increase significantly the proportion of mountain areas with formal protection status, alongside the nomination and extension of mountain biosphere reserves, particularly in KBA, defining SMART (Specific, Measurable, Achievable, Relevant and Time-Bound) targets for 2030 and 2050, in line with the Post-2020 Global Biodiversity Framework.
- Allocate specific funding to boost research in mountain areas and support mountain biosphere reserves in strengthening collaboration and cooperation between institutions, science networks and research centres, incorporating biodiversity conservation and highly functioning ecosystems as cross-cutting research themes and management goals.
- Recognise and protect the roles and rights of local and Indigenous mountain communities, notably through the effective governance of mountain biosphere reserves, with particular regard for inclusiveness and participation for Indigenous peoples, women and youth.
- Recognise and protect the livelihoods and traditional agro-silvo-pastoral cultures of mountain communities, notably through the effective management of mountain biosphere reserves, with particular regard for their vital role in conserving and increasing biodiversity, resilience and food security in mountain areas.
- Integrate management tools enhancing the interrelated resilience of mountain communities and ecosystems, such as Payment for Environmental Services, Ecosystem-based Adaptation and Nature-based Solutions, notably through the effective management of mountain biosphere reserves, in coordination with other frameworks in downstream areas.
- Integrate local adaptation and mitigation strategies to global change in mountain areas, notably through the effective management of mountain biosphere reserves, with emphasis on the role of key mountain ecosystems, such as peatlands and grasslands, in carbon sequestration, and developing early warning systems to reduce the vulnerability of mountain communities.



Bibliography

- 1 Adler, C., Wester, P., Bhatt, I.D., Huggel, C. (2022): Cross-Chapter Paper 5: Mountains. In: Climate Change 2022: *Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (H.O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Raba (eds.)). Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2273-2318, doi: 10.1017/9781009325844.022
- 2 Antonelli, A. et al. (2018): *Geological and climatic influences on mountain biodiversity*. Nature Geoscience, Vol. 11, October 2018, pp. 718-725
- 3 Aschenbrand, E., Michler, T. (2021): *Why Do UNESCO Biosphere Reserves Get Less Recognition than National Parks? A Landscape Research Perspective on Protected Area Narratives in Germany*. Sustainability, December 2021, 13, 13647. <https://doi.org/10.3390/su132413647>
- 4 Barraclough, A.D. (2021): *Recognise the 727 UNESCO Biosphere Reserves for COP15*. Nature, Vol 598 (14 October 2021), pp. 257
- 5 Barraclough, A.D., Schultz, L., Måren, I.E. (2021): *Voices of young biosphere stewards on the strengths, weaknesses, and ways forward for 74 UNESCO Biosphere Reserves across 83 countries*. Global Environmental Change 68 (2021) 102273
- 6 Basel Convention Secretariat, GRID-Arendal, UNEP & UIAA (2022). Policy brief: *Keeping our mountains plastic waste free*. September 2022.
- 7 Bhawana K.C. (2010): *Mountain Biodiversity: Reason Behind its High Diversity and its Change with Time*. The Initiation (January 2010), pp. 102-113
- 8 Borsdorf, A., Moreira-Muñoz, A., Casale, J. (2014): *Reservas de la Biosfera como Laboratorios para la Sustentabilidad: Paisajes de Conservación y Ordenamiento Territorial*. En: A. Moreira-Muñoz & A. Borsdorf (eds) Reservas de la Biosfera de Chile: Laboratorios para la Sustentabilidad. Academia de Ciencias Austriaca, Pontificia Universidad Católica de Chile, Instituto de Geografía, Santiago, serie Geolibros 17, pp. 272-293
- 9 Fabricius, C., Currie, B. (2015): *Adaptive Co-Management*, in C.R. Allen & A.S. Garmestani (Eds). Adaptive Management of Social-Ecological Systems, Springer Netherlands, pp. 147-179
- 10 Fargette, M., Loireau, M., Libourel, T. (2019): The relationship between Man and his environment: A Systemic Approach of the viability of "System Earth". In *Coviability of social and ecological systems: reconnecting mankind with biosphere in an era of global change. Vol. 1: The Foundations of a New Paradigm*. Springer Nature, 2019, pp. 1-28
- 11 Ferreira, A.F. (2020): *Managing Social-Ecological Systems for People and Nature: Insights from the World Network of Biosphere Reserves (Phd Thesis)*. Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia
- 12 GLOCHAMORE Consortium (2005): *GLOCHAMORE- Global Change and Mountain Regions Research Strategy*. Project financed by the European Commission (FP&, Contract No. 506679. Global Change and Mountain Regions: An Integrated Assessment of Causes and Consequences. Nov 03 - Oct 05), UNESCO Man and the Biosphere (MAB) Programme, and the UNESCO International Hydrological Program (IHP)
- 13 Ilieva, L. (Ed.), 2029: *Evidencias sobre Adaptación basada en Ecosistemas en América Latina y el Caribe. Diez casos de estudio*. Comunidad AbE, ONU Medio Ambiente
- 14 International Institute for Environment and Development (IIED), (2021), Briefing: *Indigenous knowledge and values: key for nature conservation*, IIED, Mountain Partnership, INMIP, Association for Nature and Sustainable Development, FSN, KEFRI, August 2014
- 15 IUCN (2014). Policy Brief: *Las montañas como torres de agua del mundo: Protegiendo el agua y los servicios ecosistémicos de montaña ante el cambio climático*. Egan, P.A., Price, M.F. (IUCN Comisión para la Gestión de Ecosistemas), Programa Hidrológico Internacional (PHI), Programa El Hombre y la Biosfera (MAB), (December 2014)
- 16 IUCN (2022). Policy Brief: *Post-2020 Global Biodiversity Framework*. (March 2022)
- 17 IUCN co-authored study: Press release (7 October 2020): *Nations fall short on biodiversity despite protected area growth*
- 18 IUCN-WCPA Mountains Specialist Group (2022): *Mountain Protected Areas Update*, September 2022, #115
- 19 IUCN, WCPA, CEESP, International Indigenous Forum on Biodiversity, ICCA Consortium: Story (01 April, 2022): *Targets for effective area-based conservation under the 30x30 ambitions: What Counts? Who Counts?*. Side event #4250 Geneva, CBD meetings of the SBSTTA, SBI & OEWG, 25 March 2022
- 20 Key Biodiversity Areas Partnership (2021): *KBA Programme Annual Report, 2021*
- 21 MacKinnon, K. (IUCN-WCPA), 2020: *Other Effective Area-Based Conservation Measures (OECMs)*. Presentation. https://www.cbd.int/protected/partnership/vilm/presentations/15_oecm_mackinnon.pdf

- 22 Mountain Partnership, ICIMOD (2022). Policy Brief: "2022 International Year of Sustainable Mountain Development".
- 23 Mountain Research Initiative (2022): *Global Change and Mountain Regions (GLOCHAMORE)*. <https://www.mountainresearchinitiative.org/activities/mri-publications/global-change-in-mountain-regions-glochamore>
- 24 Nature (2020): *New biodiversity targets cannot afford to fail*. Nature, Vol. 578, 20 February 2020, pp. 337-338
- 25 Nature (2020): *Set a global target for ecosystems*. Nature, Vol. 578, 20 February 2020, pp. 360-362
- 26 Nature (2022): *Biodiversity faces its make-or-break year*. Nature, Vol. 601, 20 January 2022, pp. 298
- 27 Palliwoda, J. et al. (2021): *Ecosystem service coproduction across the zones of biosphere reserves in Europe*. Ecosystems and People 2021, Vol. 17, No. 1, pp. 491-506
- 28 Palomo, I. et al. (2014): *Incorporating the Social-Ecological Approach in Protected Areas in the Anthropocene*. BioScience Advance Access, 13 February 2014, pp. 1-11
- 29 Post 2020 Biodiversity Framework EU Support (2021): *From conservation to transformative change for biodiversity: On the road to CBD COP15 in Kunming at the European Development Day 2021*. <https://4post2020bd.net/from-conservation-to-transformative-change-for-biodiversity-on-the-road-to-cbd-cop15-in-kunming-at-the-european-development-days-2021/>
- 30 Rahbek, C. et al. (2019): *Humboldt's enigma: What causes global patterns of mountain biodiversity?* Science, No. 365, 13 September 2019, pp. 1108-1113
- 31 Romeo, R., Grita, F., Parisi, F., Russo, L. (2020): *Vulnerability of mountain people to food insecurity: updated and analysis of drivers*. Rome, FAO and UNCCD.
- 32 Secretaría del Convenio sobre la Diversidad Biológica, Programa de las Naciones Unidas para el Medio Ambiente. Comunicado de Prensa (2020): *Naturaleza: La humanidad en una encrucijada, alerta la ONU*, 15 September 2020
- 33 Shore, M., Potter, K. (2018): *Assessing Biosphere Reserves for Qualification as Other Effective Area-Based Conservation Measures (OECMs): A preliminary Analysis*. UNESCO, Canadian Biosphere Reserves Association
- 34 Stoll-Kleemann, S., O'Riordan, T. (2017): *The Challenges of the Anthropocene for Biosphere Reserves*. Parks, 2017, Vol. 23, 1 March 2017, pp.
- 35 Swiderska, K., Argumedo, A., Chavez, E., Wekesa, Ch. Song, Y. (2022): *Traditional mountain landscapes: crucial for meeting biodiversity and climate targets*. International Institute for Environment and Development (IIED), November 2022
- 36 UNEP, GRID Arendal, GMBA and MRI (2020): *Elevating Mountains in the post-2020 Global Biodiversity Framework 2.0*
- 37 UNESCO (2021): *Draft on possible actions/recommendations to include Biosphere Reserves in the implementation of the CBD's post-global biodiversity framework 22/11/2021*, Not published
- 38 United Nations Framework Convention on Climate Change, 1.5 Degrees - A climate action blog (13 April 2022): *What is the Triple Planetary Crisis?*. <https://unfccc.int/blog/what-is-the-triple-planetary-crisis>
- 39 United Nations, General Assembly (2022): "Sustainable mountain development" (15 November 2022), A/c.2/77/L.34/Rev.1, <https://documents-dds-ny.un.org/doc/UNDOC/LTD/N22/696/76/PDF/N2269676.pdf?OpenElement>
- 40 Woodley, S., Rao, M., Dudley, N. (2021): *Speaking a common language on what should count for protecting 30% by 2030?*, Parks, Vol 27, 2 November 2021, pp. 9-14
- 41 WWF (2020): *Informe Planeta Vivo 2022: Hacia una sociedad con la naturaleza en positivo*. Almond, R.E.A.; Grooten, M.; Juffe Bignoli, D.; Petersen, T. (Eds). WWF, Gland, Suiza