Cebrián-Piqueras, M. A., I. Palomo, V. B. Lo, M. D. López-Rodríguez, A. Filyushkina, M. Fischborn, C. M. Raymond, and T. Plieninger. 2023. Leverage points and levers of inclusive conservation in protected areas. Ecology and Society 28(4):7. https://doi.org/10.5751/ES-14366-280407

Research

Leverage points and levers of inclusive conservation in protected areas

Miguel A. Cebrián-Piqueras [1,2], Ignacio Palomo [3], Veronica B. Lo [4], María D. López-Rodríguez [5,6], Anna Filyushkina [7], Marie Fischborn [8], Christopher M. Raymond [9,10,11] and Tobias Plieninger [1,12]

ABSTRACT. Inclusive conservation approaches that effectively conserve biodiversity while improving human well-being are gaining traction in the face of the sixth mass extinction of biodiversity. Despite much theorization on the governance of inclusive conservation, empirical research on its practical implementation is urgently needed. Here, using a correlation network analysis and drawing on empirical results from 263 sites described on the web platform of the PANORAMA initiative (IUCN), we inductively identified global clusters of conservation outcomes in protected and conserved areas. These clusters represent five conservation foci or archetypes, namely (i) community-based conservation, (ii) sustainable management, (iii) conflict resolution, (iv) multi-level and co-governance, and (v) environmental protection and nature's contribution to people. Our empirical approach further revealed that some dimensions of inclusive conservation are crucial as leverage points to manage protected areas related to these clusters successfully, namely improvements in the socio-cultural context and social cohesion, enhancing the status and participation of youth, women, and minorities, improved human health, empowerment of local communities, or reestablishment of dialogue and trust. We highlight inclusive interventions such as education and capacity building, development of alliances and partnerships, and enabling sustainable livelihoods, or governance arrangements led by Indigenous peoples and local communities or private actors, as levers to promote positive transformations in the social-ecological systems of protected areas. We argue that although some of the leverage points we identified are less targeted in current protected area management, they can represent powerful areas of intervention to enhance social and ecological outcomes in protected areas.

Key Words: *community-based conservation; conservation archetypes; conservation outcomes; correlation network analysis; protected area management; social-ecological systems; social impacts; transformative change*

INTRODUCTION

The current global network of protected areas is the most ambitious management strategy to conserve biodiversity (Watson et al. 2014). Yet, the persistent loss of species, ecosystems, and genetic diversity is still a major global threat driven, among other factors, by the inter-connected effects of land degradation, climate change, excessive human consumption, and anthropogenic pressures within and outside protected areas (Geldmann et al. 2019, IPBES 2019). Compelling collective actions are urgently needed for this decade to halt biodiversity loss, promote climate change adaptation and mitigation, and reduce poverty, requiring multi-sectoral and coordinated initiatives (Xu et al. 2021). Such action needs to include new and legally binding policy responses and standards for making voluntary commitments (Kok et al. 2018) and more resources for biodiversity conservation within protected areas (Silva et al. 2021). It also requires new scientific approaches for integrating a wide diversity of Indigenous, local, and scientific knowledge types and effective engagement of multiple stakeholders in the implementation of biodiversity targets (Tengö et al. 2014, Hill et al. 2020, 2021).

Inclusive conservation approaches are currently discussed to identify, assess, and manage a plurality of perspectives and values associated with protected area management that may not always be compatible (Mace 2014, Tallis and Lubchenco 2014). There is increasing evidence that protected area management interventions are more effective at achieving both conservation and socioeconomic outcomes when integrating the perspectives of local people and diverse stakeholder groups (Oldekop et al. 2016, Zafra-Calvo et al. 2019). For instance, a multi-actor approach can help to empower local people, reduce economic inequalities, and maintain cultural values and local livelihoods while preserving ecological outcomes (McKinnon et al. 2016, Oldekop et al. 2016, Di Franco et al. 2020). Inclusive approaches to conservation are increasingly taken up in global policy discourses around sustainable development and biodiversity targets.

The Kunming-Montreal Global Biodiversity Framework (GBF; CBD 2022) highlights the importance of considering Indigenous and local knowledge and integrating equity and justice considerations within conservation targets. Article 7 (section C) calls for a whole-of-society approach, urging for more robust representation, participation, and inclusion of actors beyond national governments, such as Indigenous Peoples and Local Communities, women's and youth groups, scientists, citizens at large, or other stakeholders (CBD 2022). Discussions on increasing social inclusivity in societal values and visions are also

[1]Department of Agricultural Economics and Rural Development, University of Göttingen, Germany, [2]Social-Ecological Systems Institute, Leuphana University of Lüneburg, Germany, [3]Université Grenoble Alpes, IRD, CNRS, INRAE, Grenoble INP, IGE, France, [4]Department of Forest & Conservation Sciences, Faculty of Forestry, University of British Columbia, Canada, [5]Internet Interdisciplinary Institute (IN3), Universitat Oberta de Catalunya (UOC), Barcelona, Spain, [6]Andalusian Centre for the Assessment and Monitoring of Global Change (CAESCG), Department of Biology and Geology, University of Almeria, Spain, [7]Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam, the Netherlands, [8]International Union for Conservation of Nature and Natural Resources (IUCN), [9]Helsinki Institute for Sustainability Science, University of Helsinki, Finland, [10]Ecosystems and Environment Research Program, Faculty of Biological and Environmental Sciences, University of Helsinki, Finland, [11]Department of Economics and Management, Faculty of Agriculture and Forestry, University of Helsinki, Finland, [12]Faculty of Organic Agricultural Sciences, University of Kassel, Witzenhausen, Germany

carried out in fields such as environmental planning (Zafra-Calvo et al. 2020) and knowledge co-production for sustainability transformation (Norström et al. 2020).

Despite the current momentum for more inclusivity in conservation science, policy, and practice, little is known about the operationalization of inclusive conservation approaches in protected area management. Some features of inclusive conservation have long been introduced into conservation practice, such as co-management and community-based conservation (Berkes 2007, Brooks et al. 2013), or Indigenous and Community Conserved Areas (ICCAs; Farvar et al. 2018). However, the practical implementation of inclusive conservation approaches in protected area management and planning remains understudied (Raymond et al. 2022).

Despite multiple benefits, inclusive conservation presents various tensions and challenges, such as whether and how to combine values across different scales; how to surface and manage issues of consensus and dissensus; and how to build trust and partnerships between actors who live in and outside of protected areas. Such emerging tensions should first be acknowledged, then softened and sometimes reframed to find effective pathways for nature conservation, equity, and well-being (Raymond et al. 2022). Inclusive conservation has also been criticized from political ecology perspectives as its intrinsic search for consensus might jeopardize values and knowledge of historically underrepresented groups of society (Matulis and Moyer 2017). Protected areas are diverse in many aspects, such as IUCN protected area categories I-VI, governance, or biogeographical and socioeconomic contexts, and thus face different challenges and opportunities. This highlights the need for interlinked context-based and multi-scale approaches to address the extent to which participation, equity, and inclusion can effectively be implemented in conservation strategies (Oteros-Rozas et al. 2015, Palomo et al. 2017, López-Rodríguez et al. 2020)

Meadows (1997) created the leverage points concept by introducing a hierarchy of places to intervene to transform systems. She distinguished between shallow and deep leverage points along a gradient depending on their capacity to transform the systems. Recent research clusters these initial leverage points in four realms of Material, Feedbacks, Design, and Intent, following an increasing transformative capacity (Abson et al. 2017, Fischer and Riechers 2019). These works have identified leverage points in social-ecological systems to drive transformative change toward sustainability and how they are derived from theory or perceived in practice (Abson et al. 2017, Fischer and Riechers 2019, Chan et al. 2020). They include values in action, visions of a good life, education and inequalities, and technology and innovation. Recent research in transformative change and nature-based solutions has identified human-nature values, diverse knowledge types, and participation as critical for enabling sustainable pathways in mountainous social-ecological systems (Palomo et al. 2021). In addition to the leverage points concept, levers have been conceptualized as the means of realizing these changes, such as governance approaches and interventions (Chan et al. 2020). Inclusive conservation has indeed been identified as a separate leverage point by Chan et al. (2020), which includes creating spaces for diverse actors to become part of conservation initiatives (Gould et al. 2018, Zafra-Calvo et al. 2020) and large-scale involvement of Indigenous People and Local Communities (IPLCs) in governance and management of protected areas (Naidoo et al. 2019, Hill et al. 2020). However, the different leverage points and levers of inclusive conservation in protected areas have not yet been identified nor analyzed. In addition, recent calls for operationalizing transformative change to reverse unsustainable trajectories urge for more research combining empirical and theoretical frameworks to understand the dynamics of complex social-ecological systems (Riechers et al. 2022). We take these assumptions up and ask what dimensions of inclusive conservation can leverage conservation outcomes and transform the social-ecological system in protected areas.

Our research is guided by the following objectives: (1) to identify and cluster successful and recurrent patterns of conservation outcomes globally; and (2) to analyze how dimensions of inclusive conservation underpin these clusters as leverage points and levers.

METHODS

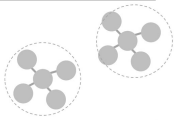
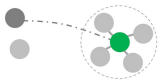
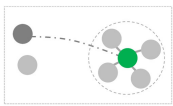
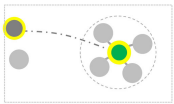
Our analysis is based on a correlation network analysis of conservation outcomes characterizing case studies from the PANORAMA web platform. PANORAMA is a learning and knowledge initiative based on case studies of replicable success stories—solutions—in conservation and sustainable development. It is managed by the International Union for Conservation of Nature (IUCN) and other partners and built on theories of resilience and peer learning (Mattsson et al. 2019). PANORAMA aims to support the replication of successful approaches by fostering knowledge uptake enabling cross-sectoral learning and inspiration. Such initiatives are submitted by practitioners and conservation professionals around the globe who identify different building blocks, namely key components or interventions critical to the successful implementation of their initiative. Building blocks, in theory, can be recombined and replicated in other contexts by other practitioners. Independent experts review solutions before being published in the database. By "solutions" we refer to initiatives and interventions described in the PANORAMA case studies. In Figure 1 we show the key methodological steps conducted in this approach. In Table 1 we provide definitions of specific concepts used in the current approach.

Preparatory work

Data filtering: We filtered all "full solutions," which include a complete description of the solution applied (e.g., region, ecosystems, addressed challenges), the process of applying it (especially its intervention types), as well as its benefits and beneficiaries. We included solutions published prior to 5 February 2021. We excluded "snapshot solutions," which capture only a short description. Additionally, a quality check was performed to exclude solutions with missing data, resulting in 263 solutions analyzed (Fig. 2). This study includes solutions relating to protected areas and conserved areas defined by IUCN (IUCN-WCPA 2019).

Dataset preparation: We first built a dataset characterizing the presence or absence data (1, 0, respectively) of the following dimensions of protected areas and related initiatives from the PANORAMA database: (i) management features and interventions such as governance type and categories of solution interventions (building blocks); (ii) solution benefits and

Fig. 1. Key methodological steps conducted in this approach.

Methodological step	Links to research objective	Methods employed	Nomenclature used in the database PANORAMA	Pictogram
Preparatory work.	Objective 1	Content analysis of protected and conserved areas for identification of conservation outcomes	Beneficiaries and positive impacts (benefits)	
STEP1: Identification of clusters of conservation outcomes – beneficiaries and benefits -	Objective 1	Correlation Network Analysis with Modularity Algorithm (Clusters or Modules detection)	Beneficiaries and positive impacts (benefits)	
STEP2: Identification of leverage points within clusters of conservation outcomes	Objective 2	Correlation Network Analysis with Centrality Measures	Beneficiaries and positive impacts (benefits)	
STEP3: Identification of levers linked to leverage points	Objective 2	Pairwise correlations	Solution building blocks (interventions); Governance types; and Scale of management	
STEP4: Identification of bio-geographic contexts associated with clusters of conservation outcomes	Objective 2	Pairwise correlations	Ecosystem type and Region	
STEP 5: Identification of inclusive conservation dimensions acting as leverage points and levers	Objective 2	Identification of factors, outcomes or processes aiming at enabling the social inclusion within the identified levers and leverage points	Beneficiaries, benefits (positive impacts); Solution building blocks (interventions); governance types; and scale of management	

beneficiaries (conservation outcomes); and (iii) biogeographical context, i.e., ecosystem type and region. If two different interventions belonging to the same category occurred, the solution was assigned with a "2" and so on, highlighting the increasing importance of that intervention category in the given solution (DeVellis and Thorpe 2021).

Quantitative content analysis: Some solution dimensions, such as (i) protected area governance type, the scale of management, solution intervention, or biogeographical context, are characterized with pre-defined categories (i.e., tags) in the PANORAMA platform. However, some dimensions such as (ii) solution beneficiaries or benefits are not represented by pre-defined categories because only text descriptions are provided. We performed a quantitative content analysis (Hsieh and Shannon 2005, Rana et al. 2020) to develop a set of benefit and beneficiaries' dimensions reported in the whole set of solutions. We applied both deductive and inductive reasoning to identify beneficiaries' categories and benefits (Rubin and Babbie 2016). As a first step for facilitating the identification of benefits, we deductively developed a basic typology (e.g., if a challenge was "Lack of technical capacity" and a corresponding impact was "Development of technical capacity," we include this as a benefit). We added to this typology inductively by including other reported benefits not considered in the initial set. Only those solutions reporting one or more benefits or beneficiaries were considered.

To facilitate subsequent analyses, the benefits were categorized into broader groups, i.e., ecological, economic, social, political, and legal, or climate change-related). The coding work for the 263 solutions was divided between five different coders. In the first round, we collectively identified 124 categories of benefits and beneficiaries. To avoid potential biases caused by inter-coder variability and improve consistency, every group of solutions assigned initially to a first coder was double-checked by a second coder, and the inconsistencies were discussed and removed. One final single coder checked all solutions and codes in a third round to ensure consistency in categorization of benefits/beneficiaries. After removing duplicate categories, we arrived at a final number of 68 categories of benefits and 24 for beneficiaries for a total of 92 conservation outcomes.

Correlation network analysis of benefits and beneficiaries: conservation outcomes and identification of leverage points

Adjacency matrix: To address our first objective of identifying recurrent patterns—clusters—of positively linked conservation outcomes—beneficiaries and benefits—(Step 1, Fig.1), we built a correlation matrix (Spearman) based on conservation outcomes using the sample of 263 solutions. Subsequently, the correlation matrix was transformed to an adjacency matrix. As we aimed to identify successful patterns of protected area management, and for clarity, simplicity and further interpretation of results and clusters, only significant and positive correlations ($p < 0.05$) between conservation outcomes were kept. Following this approach, every positive and significant correlation coefficient was considered as one positive link between pairs of conservation outcomes and therefore assigned a "1" through the adjacency matrix transformation, while non-significant values were set to zero. The resulting matrix was unweighted and showed the presence and absence of positive connections (Table A1). In practical terms, a significant positive correlation between two conservation outcomes implies that when one outcome is positively affected, the other is expected to be positively affected, e.g., when women are positively affected by conservation interventions, children will be as well (Table A1).

Centrality measures: This analysis was done to identify central roles of conservation outcomes, namely leverage points (Step 2, Fig. 1). We define leverage points of successful protected area management as the intervention points that positively influence social-ecological systems (Table 1). We employed the Software Cytoscape 2.2, and we ran the plug-in aMatReader (Settle et al. 2018) to import the adjacency matrix. Then we ran the plug-in Centiscape 2.2. (Scardoni et al. 2015) to characterize the role of nodes (here benefits and beneficiaries: conservation outcomes) within the network based on centrality measures such as (i) the number of connections (here significant and positive correlations) leading to a conservation outcome, i.e., degree centrality (DC); (ii) the capacity of a node to connect several sub-networks or highly connected groups of conservation outcomes, i.e., betweenness centrality (BC); and (iii) the degree of influence of a node in the network, i.e., eigenvector centrality (EC), which reports about how well connected a node is to other well-connected nodes (see Negre et al. 2018 for further details).

For example, conservation outcomes with a high degree centrality (Fig. 3a) will be connected to many other conservation outcomes and, therefore, would play a role as leverage point either within a sub-network or the whole network characterizing protected areas (Golbeck 2015); we specifically called them Hub-Connectors (C).

Table 1. Definitions of specific concepts used in the current approach.

Concept	Definition
Dimensions of inclusive conservation	Factors, outcomes, or processes that represent or enable the social inclusion of diverse values and visions for nature to enhance conservation in protected areas and provide multiple well-being benefits for people and nature.
Leverage points of successful protected area management	Intervention points that fundamentally influence positively social-ecological systems through protected area management. They represent beneficiaries and benefits to be targeted because of their positive association and influence on other conservation outcomes. Methodologically, here leverage points are identified by correlation network analysis and represent benefits and beneficiaries with high values for centrality measures.
Levers of successful protected area management	Key interventions, including governance approaches, that drive transformative changes in protected areas by activating leverage points.
Beneficiaries	Social groups, sectors, or collectives positively affected by the implementation of protected area interventions and initiatives.
Benefits	Protected area social, economic, ecological, political, legal, and climate change parameters that are positively affected by the implementation of the protected area solutions
Conservation outcomes	Both beneficiaries and benefits that are positively associated with implementing protected area solutions. Methodologically, they are the nodes of the correlation network analysis employed in this study.
Dimensions of protected areas and related solutions	All parameters, processes or outcomes characterizing protected areas and related solutions, e.g., conservation outcomes, management features, and interventions or biogeographic-context parameters.
Clusters of conservation outcomes: Conservation foci or archetypes	Highly positively correlated parameters in high-dimensional data set of conservation outcomes, i.e., solution beneficiaries and benefits. Methodologically, these clusters are identified with a modularity analysis within a correlation network analysis.
Links between conservation outcomes	Significant positive correlation between conservation outcomes (assigned value of 1). They are usually referring as "edges" in correlation network analysis.

Conservation outcomes with high betweenness centrality (Fig. 3b) will be critical for connecting several sub-networks or clusters and acting as a bridge-like connector between two parts of a network (Lu and Zhang 2013). We called them Bridgers (B). Finally, conservation outcomes with high eigenvector centrality (Fig. 3c) will be connected to other well-connected conservation outcomes, acting as Influencers (I). Dimensions with a low degree, betweenness and eigenvector (Fig. 3c) will have a Peripheral (P) role within the network or sub-networks. We selected conservation outcomes highly relevant within the network of benefits and beneficiaries, i.e., we specifically focused on values of degree, betweenness, and eigenvector equal or higher than the third quartile lower limit from the whole range. These conservation outcomes will refer to benefits and beneficiaries highly connected and therefore acting as leverage points for protected areas management. We also assigned a high peripheral role to those conservation outcomes ranking within the lowest quartile for all the metrics employed.

Modularity: Modularity measures the strength of division of a network into clusters of densely connected nodes, e.g., species, social groups, people, or parameters. To assess the degree of modularity and the number of clusters within the correlation network of conservation outcomes, we used the igraph package (Csardi and Nepusz 2006) with R software (R Core Team 2021). Specifically, we used the function *Module Louvain*. This function is based on a hierarchical approach and implements a multi-level modularity optimization algorithm for finding community structure. Modularity is usually measured on a scale value between -1 (non-modular clustering) and 1 (fully modular clustering; Blondel et al. 2008). Based on the conservation outcomes contained in every cluster, we named and described the clusters accordingly, representing distinct conservation foci.

Linking clusters of conservation outcomes to management features and interventions and the bio-geographic context (levers)

We define levers of successful protected area management as key interventions, including governance approaches that drive transformative changes in protected areas by activating these leverage points. To address Step 3 (Fig. 1), we first selected the leverage points within clusters, i.e., conservation outcomes ranking above the third quartile for at least one centrality measure (degree, betweenness, or eigenvector). Because our focus was to identify successful associations and pathways, we, therefore, assessed to what extent (frequency) they were positively related (based on positive and significant bivariate Spearman rank correlations, $p < 0.05$) to governance types and solution interventions. The most salient values were selected, i.e., those conservation outcomes significantly and positively correlated to a relatively high number of leverage points. Similarly, we selected which biogeographic dimensions, such as region and ecosystem, were highly related to the different clusters of conservation outcomes following the same approach. We expanded our previously developed adjacency matrix to develop our approach containing positive and significant correlations of beneficiaries and benefits by including the rest of the dimensions mentioned above (Table A2).

Identification of dimensions of inclusive conservation

We understand inclusive conservation as a trans-disciplinary approach to acknowledging the diversity of stakeholder visions and related management and conservation tensions to effectively manage protected areas, building on current discussions about social inclusion in conservation (Saberwal 1996, Berkes 2007, Mace 2014, Tallis and Lubchenco 2014, Matulis and Moyer 2017, Berkes 2021, Goodson et al. 2022, Raymond et al. 2022). We define inclusive conservation dimensions as all factors, outcomes, or processes enabling the inclusion of diverse values and visions

Fig. 2. The map shows the global distribution of full solutions for protected and conserved areas included in this work (n = 263). The ordinal numbers refer to the number of solutions per country, which is also indicated by a gradient of intensity of green color.

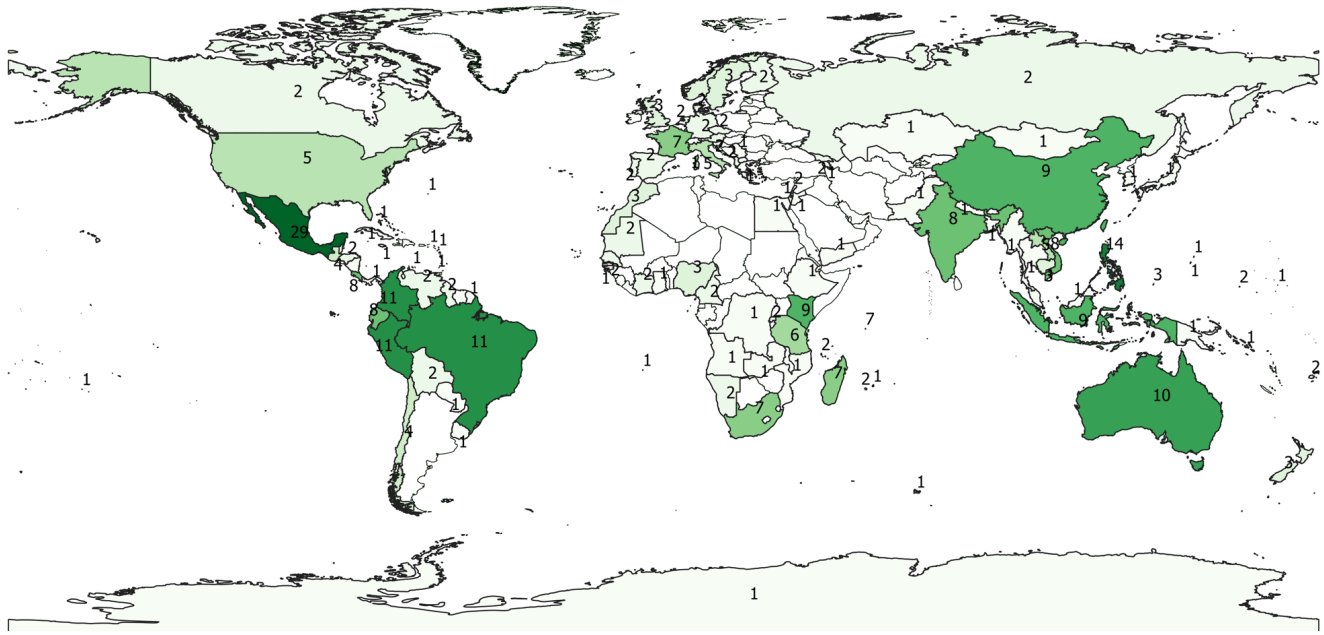
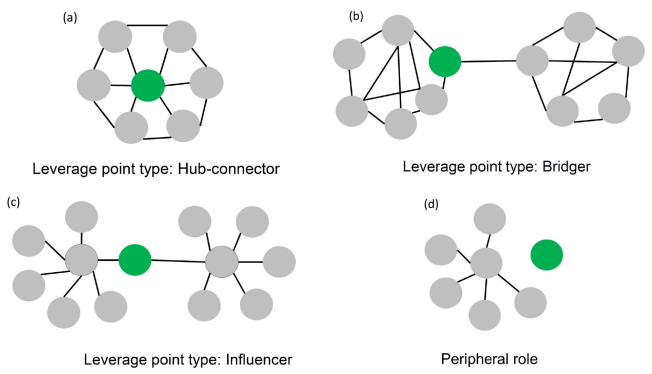


Fig. 3. Example of leverage points within the network of conservation outcomes: circles represent conservation outcomes (beneficiaries and benefits), the object of study (usually referred to as nodes in correlation network analysis [CNA]). Lines represent significant correlations between conservation outcomes (edges in CNA). (a) Conservation outcome displaying high degree centrality – Leverage point type: Hub-Connector. (b) Conservation outcome displaying high betweenness centrality – Leverage point type: Bridger. (c) Conservation outcome displaying high eigenvector centrality – Leverage point type: Influencer. (d) Conservation outcome displaying non-links or low level of connectivity to other conservation – Peripheral role (no Leverage point). Both (a), (b), and (c) types of conservation outcomes are considered leverage points of protected area management.



for nature to enhance conservation while providing multiple benefits for people and nature. Some examples of inclusive conservation dimensions are gender mainstreaming (Svarstad et al. 2006, Schmitt 2014), integration and weaving of both Indigenous-local and scientific knowledge systems (Medeiros et al. 2018, Cebrián-Piqueras et al. 2020), processes of building trust and feelings of inclusion (Goodson et al. 2022), or empowerment of local communities and minority groups (Scheyvens 1999, Constantino et al. 2012). Based on these examples, we selected dimensions of inclusive conservation from our array of PANORAMA solutions (Table A3). We specifically selected those solution conservation dimensions involving people and enabling social inclusion in protected and conserved area management. These dimensions could be found in (i) in the solution management features and interventions, i.e., including governance types: local communities governance or shared governance, solution intervention types, e.g., education, training, and other capacity development activities. But we also selected (ii) conservation outcomes representing social inclusion in conservation, i.e., benefits: improvement and preservation of socio-cultural context and heritage; empowerment of local stakeholders and communities or social cohesion. We selected all types of beneficiaries as inclusive conservation dimensions, e.g., women, youth, Indigenous communities, governance institutions, as a comprehensive representation of beneficiaries is inherently inclusive from our perspective (Table A3).

Researchers' profiles and positionality

The researchers from this study are affiliated with research institutions from the Global North, namely Western Europe (MACP, IP, MDLR, AF, CR, TP) and North America (VL). One research team member is affiliated with the IUCN and

PANORAMA solutions initiative (MF). Four researchers (CR. TP, IP, AF) have been / are authors of chapters in the Values, Nexus, and Transformative Change Assessments of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). All researchers are broadly working in social-ecological systems research, sustainability science, and participatory and transdisciplinary approaches to conservation. Half of the research team are women. None of them is a member of any Indigenous group nor affiliated to institutions in the Global South. One self-identifies as a minority. We are aware that our mostly Western academic background, ontologies, and epistemologies could have influenced this work's framing and analysis (Maclean et al. 2022). However, we highlight our commitment and alignment with global strategies spearheaded by IPBES and IUCN, where equity and inclusion of all kinds of minorities and vulnerable local communities and associated worldviews, knowledge systems, and beliefs are a priority to tackle the current biodiversity crisis. To minimize the potential influence of our background, we have used a strong inductive approach accounting for the context-based knowledge and perspectives of practitioners representing protected and conserved areas all around the globe. The case studies used in this approach, from which emerging categories of perceived conservation benefits and beneficiaries are identified, are highly represented by the Global South and Indigenous and local communities' governance systems.

RESULTS

Overview of conservation outcomes: beneficiaries and benefits

We identified 92 distinct conservation outcomes, i.e., 24 beneficiaries and 68 benefits (Table 2). Our approach identified Indigenous and local communities (in 78% of the solutions); Protected area management staff and authorities (43%); and Local producers (e.g., farmers, fishers, and local enterprises; 39%) as most frequently reported beneficiaries. The following beneficiaries were reported as positively affected in 20–40% of the solutions: Private sector (25%); Local government administration (24%); Visitors and tourists (23%); and Citizens from the wider region (living in nearby cities and settlements; 22%). Seventeen conservation outcomes were reported in less than 20% of the solutions. Some beneficiary groups were rarely reported or not directly reported at all: Women (10% of the solutions); Young people and children (10%); NGOs (acting at local, regional, or national scales; 8%); Education sector (e.g. students, teachers; 7%); Minority groups (ethnic groups, Indigenous minorities, dependent/disabled people, religious groups, sexual orientation minorities; 5%); International NGOs (4%); Private landowners (3%); Community-based organizations (1%); Volunteers (1%); and Older adults (0%).

The most frequently reported benefits were (Table 2): Raising public and decision makers' conservation awareness and environmental education (Social benefit; 63.9%); Increasing biodiversity and ecosystems conservation and regeneration (Ecological benefit; 58.9%), and Alternative income opportunities for stakeholders and maintained/enhanced livelihoods (Economic benefit; 56.7%). Other inclusive benefits were reported less frequently, such as Reduced social conflict and civil unrest (4.2%); Improved gender-responsiveness (1.9%); Equity and equal distribution of conservation outcomes (e.g., Benefits sharing; 1.1%), and Work-life balance for local communities (0.8%).

Inclusive conservation within clusters of conservation outcomes

The modularity analysis identified six clusters of conservation outcomes (Fig. 4). The modularity value obtained was 0.4., reflecting a moderate value. This means that the network is relatively modular, but connections between clusters still exist, so they are not isolated. The network has 92 nodes (i.e., 92 conservation outcomes; Table 2). One of the clusters is represented by only three conservation outcomes (see cluster 6 in Table 2), offering too little information for a consistent interpretation. The five identified clusters represent five different conservation foci or archetypes for managing protected and conserved areas.

Cluster 1 focuses on Indigenous communities and vulnerable minorities including women, Indigenous people, and hunters as beneficiaries. This cluster has a strong focus on community-based conservation and is represented almost entirely by benefits representing social inclusion in protected areas, such as reducing poverty, social cohesion, subjective well-being and quality of life, work-life balance for local communities, local and traditional knowledge and biocultural values, protection of customary rights, or improved gender-responsiveness. Cluster 2 focuses on sustainable management, including sustainable local production and economic perspectives, emphasizing local producers, private landowners, or the private sector as beneficiaries. A wide range of beneficiaries is identified in this cluster. This cluster aggregates multiple socially inclusive benefits: empowerment of local stakeholders and communities, alternative/assurance of income opportunities for stakeholders, and livelihoods, improving people-nature connection, knowledge co-produced and social learning. Improved tourism opportunities or sustainable use of natural resources are also emphasized in this cluster. Cluster 3 focuses on minimizing negative impacts and reducing conflicts, improving policies, laws, and management, poaching, and land-use transformations. Within this cluster, multiple and diverse inclusive benefits are emphasized, such as improved dialogue, communication, and trust between stakeholders, building collaborative partnerships and technical capacity, accessing to long-term funding, and improving governance and participation. Cluster 4 is centered on multi-level governance and co-governance, because governance institutions at different scales are directly involved in the management of the protected areas and non-governmental organizations are included. Cluster 5 relates to nature and environmental protection with a focus on biodiversity and ecosystem conservation and restoration. It is also related to mitigation and adaptation of climate-changed related impacts, soil preservation, and nature's contributions to people. We did not identify any beneficiary assigned to this cluster.

Inclusive conservation dimensions as leverage points within the network of conservation outcomes

Our analysis identified central roles of conservation outcomes, namely leverage points acting specifically as hub-connectors, bridgers, or influencers. Leverage points were identified in all five clusters (Table 3). Four of the five clusters contained some leverage points with remarkably transformative change potential as they were at the same time hub-connectors, bridgers, and influencers (e.g., improvement of the socio-cultural context, improved social cohesion, empowerment of local stakeholders and communities, or adaptation/mitigation of land and forest degradation). Other leverage points were assigned to the influencer type of leverage point (e.g., socio-cultural associations

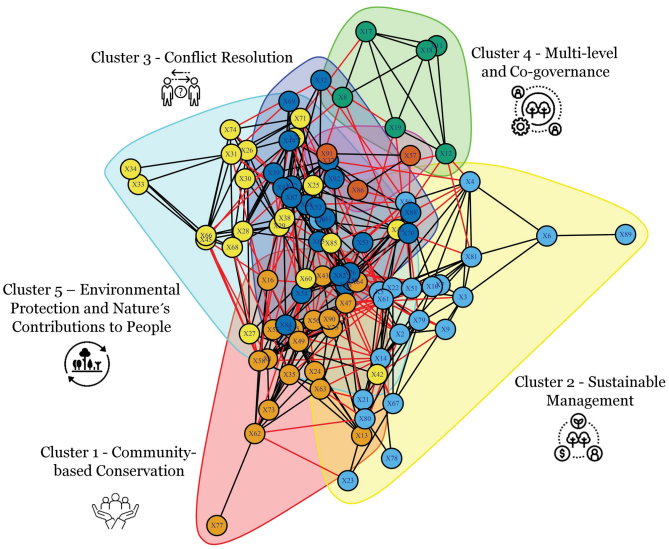
Table 2. Identified conservation foci based on conservation outcomes. Frequencies of reported conservation outcomes within the sample of 263 protected and conserved areas are shown.

Cluster membership	Conservation outcome	ID	Type	Frequency (% of cases)
1. Community-based conservation	Indigenous and local communities	X1	Beneficiary	78
	Women	X13	Beneficiary	10
	Minority groups	X15	Beneficiary	5
	Socio-cultural associations	X16	Beneficiary	0.4
	Hunters	X24	Beneficiary	1
	Adaptation or mitigation of vector and water-borne diseases	X35	Climate change benefit	0.4
	Sustainable practices and landscape management	X43	Ecological benefit	35
	Alternative/assurance of income opportunities for stakeholders and livelihoods	X47	Economic benefit	57
	Improvement and preservation of socio-cultural context and heritage	X49	Social benefit	18
	Improvement of food security	X55	Social benefit	8
	Reducing unemployment / poverty	X56	Social benefit	17
	Health improved	X58	Social benefit	7
	Social cohesion	X62	Social benefit	9
	Subjective well-being and quality of life, i.e., happiness, self-esteem	X63	Social benefit	6
	Work-life balance for local communities	X64	Social benefit	1
	Local and traditional knowledge and biocultural values used and protected	X73	Social benefit	10
	Protection of customary rights, e.g., Indigenous rights, land tenure	X75	Social benefit	8
	Recovery of historical heritage	X77	Social benefit	1
	Improved gender-responsiveness	X90	Social benefit	2
2. Sustainable management	Local producers, i.e., farmers, fishers, and local entrepreneurship	X2	Beneficiary	39
	Visitors and tourists	X3	Beneficiary	23
	Protected area management authorities (including rangers and staff)	X4	Beneficiary	43
	Conservationism, i.e., associations and institutions	X5	Beneficiary	11
	Research institutions	X6	Beneficiary	13
	Region citizens from nearby cities and settlements	X7	Beneficiary	22
	Private sector, e.g., tourism private sector, energy, agriculture	X9	Beneficiary	25
	Private landowners	X10	Beneficiary	3
	Youth people and children	X14	Beneficiary	10
	Environment, nature, plants, and animals	X20	Beneficiary	5
	Volunteers	X21	Beneficiary	1
	Education sector (students, teachers)	X22	Beneficiary	7
	Community-based organizations	X23	Beneficiary	2
	Building technical capacity	X50	Social benefit	29
	Raising public and decision maker's conservation awareness and environmental education	X51	Social benefit	64
	Empowerment of local stakeholders and communities (educators, conservation staff)	X61	Social benefit	19
	Tourism opportunities improved, e.g., sustainable tourism	X67	Economic benefit	23
	Changing negative behaviors and attitudes to positive	X78	Social benefit	11
	Volunteer participation/engagement with nature conservation	X79	Social benefit	13
	Improving people-nature connection, e.g., relational values	X80	Social benefit	11
	Knowledge co-produced and social learning	X81	Social benefit	13
	Promoting research for conservation/evidence-based conservation practice	X89	Social benefit	13
3. Conflict resolution	Adaptation or mitigation of salinization	X32	Climate change benefit	1
	Solving land-use and water conservation conflicts	X37	Ecological benefit	15
	Ecosystems and species increase, conservation and regeneration	X39	Ecological benefit	59
	Poaching and illegal uses of biodiversity reduction; illegal timber logging	X41	Ecological benefit	14
	Efficient management of financial and economic resources	X44	Economic benefit	8
	Access to long-term funding	X46	Economic benefit	17
	Minimizing conservation impacts and negative impacts of resource extraction	X48	Ecological benefit	14
	Improvement of monitoring and enforcement	X52	Social benefit	27
	Improvement of governance and participation	X53	Social benefit	48
	Reduction of social conflict and civil unrest	X54	Social benefit	4
	Equity and equal distribution of conservation outcomes, e.g., benefits sharing	X59	Social benefit	1
	Action is taken (for nature conservation and transformative change)	X65	Social benefit	3
	Effective implementation and management of conservation targets and milestones	X69	Policy and management benefits	32
	Collaborative partnership promoted between several sectors and organizations	X70	Social benefit	44
	Biodiversity stewardship (private landowners)	X72	All-domains benefits	3
	Dialogue, trust, and collaboration re-establishment or improved between communities and authorities	X76	Social benefit	7
	Awards, best practices, acknowledgment	X82	Social benefit	4
	Political and legal support, amendments, reforms in conservation policies	X83	Policy and management benefits	18
	Pilot cases/demonstrative examples related to protected areas sustainability	X84	Policy and management benefits	3
	Communication facilitated/improved across stakeholders' groups	X87	Social benefit	7
	Increased management effectiveness	X88	Policy and management benefits	5
	Ceasing land-use changes, e.g., urbanization processes, intensive agriculture	X92	Ecological benefit	1
4. Multi-level and co-governance	Country population/society/civil society	X8	Beneficiary	7

(con'd)

	International NGOs	X11	Beneficiary	4
	NGOs (local, regional, national)	X12	Beneficiary	8
	National government administration	X17	Beneficiary	13
	Regional government administration	X18	Beneficiary	11
	Local government administration	X19	Beneficiary	24
5. Environmental protection and nature's contributions to people	Adaptation or mitigation of desertification	X25	Climate change benefit	1
	Adaptation or mitigation of drought	X26	Climate change benefit	2
	Adaptation or mitigation of floods	X27	Climate change benefit	1
	Adaptation or mitigation of increasing temperatures	X28	Climate change benefit	1
	Adaptation or mitigation of land and forest degradation	X29	Climate change benefit	27
	Adaptation or mitigation of loss of biodiversity	X30	Climate change benefit	42
	Adaptation or mitigation of ocean warming and acidification	X31	Climate change benefit	2
	Adaptation or mitigation of sea level rise	X33	Climate change benefit	2
	Adaptation or mitigation of storm surges	X34	Climate change benefit	2
	Adaptation or mitigation of wildfires	X36	Climate change benefit	3
	Erosion prevention	X38	Ecological benefit	5
	Invasive species reduction	X40	Ecological benefit	4
	Pollution reduction (incl. eutrophication and litter, waste)	X42	Ecological benefit	6
	Improvement of infrastructure development, e.g., low impact, green infrastructure, schools	X45	Economic benefit	11
	Compensations, incentives, and/or direct payments	X60	Economic benefit	9
	Water asset protected or maintained	X66	Ecological benefit	11
	Nature's contributions to people improved, e.g., regulation, non-material, and material	X68	Social benefit	16
	Adaptation and/or mitigation to/of climate change (in general)	X71	Climate change benefit	13
	Soil asset protected or maintained	X74	Ecological benefit	3
	Reduction/Offsetting of greenhouse gas	X85	Climate change benefit	3
6. Indeterminate cluster	Broader scope of management	X57	Ecological benefit	9
	Reduction of energy cost	X86	Economic benefit	1
	Improvement of coordination efforts between conservation authorities or public administrations	X91	Policy and management benefit	1

Fig. 4. Graphical representation of correlation network of conservation outcomes. Every node (circles) represents one of the 92 conservation outcomes, which are clustered based on the algorithm Louvain run in R. Every clustered is visually represented by different colors. Black lines represent positive links between conservation outcomes from same cluster. Red lines represent positive links between conservation outcomes assigned to different clusters.



or women), and might be positively associated to other key conservation outcomes. Bridger leverage points such as NGOs (conflict resolution cluster) might be essential on bridging clusters of conservation. Although some inclusive conservation dimensions are less frequently reported in conservation interventions (Table 2), they work as leverage points in clusters of conservation outcomes. This is the case for beneficiaries such as women or young people and children, which both were not reported frequently (10%) but might play an essential role in conservation foci like the ones associated with Cluster 1 and Cluster 2 (Table 3).

Nevertheless, this is also the case for some benefits such as improved gender-responsiveness (1.9%; Leverage point in Cluster 1) or reducing social conflict and civil unrest (4.2%; Leverage point in Cluster 3). Some inclusive conservation dimensions, such as raising public and decision makers' conservation awareness (64%) or improvement of monitoring and enforcement (26%) are frequently reported in solutions for protected areas but our analysis did not identify these as leverage points (Table 2, Table 3). This comparison highlights that despite being frequently targeted, some dimensions might not be relevant for positively affecting or being affected by other conservation outcomes. Table A4 in Appendix 1 displays the list of 92 dimensions with their values for centrality measures (Degree centrality; Betweenness centrality; Eigenvector centrality).

Levers linked to leverage points of conservation outcomes and the biogeographical context

Here we summarize the results of the key levers, namely management features and interventions such as protected area governance type; intervention type; and scale of management, linked to the leverage points of conservation outcomes clusters (Table 4). According to our results, management interventions aiming at enhancing sustainable livelihoods appear in 4 of the 5 clusters. The role of governance types in empowering local communities and the private sector are also prominent, appearing in 3 of the 5 clusters. Moreover, we identify the biogeographic contexts associated with clusters (Table A5). For instance, community-based focus (cluster 1) is salient in South America, North Europe, East and South Africa, and Asia within agro-

Table 3. The table displays cluster memberships for the benefits and beneficiaries (conservation outcomes) within the network (Network size: 92 [68 benefits and 24 beneficiaries]). Only conservation outcomes playing a central role (positively and frequently related to other conservation outcomes) are shown based on correlation network analysis, and they are the leverage point types: Hub-Connectors (High degree centrality [DC]: conservation outcomes highly connected to other conservation outcomes); Bridgers (High betweenness centrality [BC]: Conservation outcomes bridging different groups); Influencers (High eigenvector centrality [EC]: Conservation outcomes highly connected to other conservation outcomes which are highly connected as well). Some conservation outcomes displayed high values (i.e., top 25th percentile) for all the three centrality measures and therefore are highly relevant within the network of conservation outcomes. These are highly relevant leverage points. Inclusive conservation dimensions are highlighted in the last column.

Conservation focus	Key conservation outcomes working as leverage points	ID	Frequency (% of cases)	Type of conservation outcome	Leverage point Hub-Connector (DC)	Leverage point Bridger (BC)	Leverage point Influencer (EC)	Socially inclusive conservation dimension
1. Community-based conservation	Indigenous and local communities	X1	78	Beneficiary			x	x
	Women	X13	10	Beneficiary			x	x
	Socio-cultural associations	X16	0.4	Beneficiary			x	x
	Improvement and preservation of socio-cultural context and heritage	X49	18	Social benefit	x	x	x	x
	Improvement of food security	X55	8	Social benefit	x		x	x
	Reduction of unemployment and poverty	X56	17	Social benefit			x	x
	Social cohesion improved	X62	9	Social benefit	x	x	x	x
	Enhanced subjective well-being and quality of life improved, i.e., happiness, self-esteem	X63	6	Social benefit	x		x	x
	Alternative/assurance of income opportunities for stakeholders and livelihoods	X47	57	Economic benefit	x	x	x	x
	Health improved	X58	7	Social benefit	x	x	x	x
	Improved gender-responsiveness	X90	2	Social benefit	x		x	x
2. Sustainable management	Local producers, i.e., farmers, fishers, and local entrepreneurships	X2	39	Beneficiary	x	x		x
	Youth and children	X14	10	Beneficiary	x	x	x	x
	Built technical capacity	X50	29	Social benefit	x	x		x
	Empowerment of local stakeholders and communities	X61	19	Social benefit	x	x	x	x
	Protected area management authorities and staff	X4	43	Beneficiary	x	x		x
	Co-produced knowledge and social learning achieved	X81	13	Social benefit	x	x		x
3. Conflicts resolution	Solved land-use and water conservation conflicts	X37	15	Social benefit	x	x	x	x
	Efficient management of financial and economic resources	X44	8	Economic benefit		x		
	Minimized conservation impacts and negative impacts of resource extraction	X48	14	Ecological benefit	x	x	x	
	Ecosystems and species conserved and restored, e.g., habitats and connectivity improved	X39	59	Ecological benefit	x	x	x	
	Improved governance and participation, e.g., co-management	X53	48	Social benefit			x	x
	Reduced social conflict and civil unrest	X54	4	Social benefit	x	x	x	x
	Re-established and improved dialogue, trust and collaboration between communities and authorities	X76	7	Social benefit	x	x	x	x
	Communication facilitated/improved across stakeholders groups	X87	7	Social benefit	x	x	x	x
4. Multi-level and co-governance	NGOs (local, regional, national)	X12	8	Beneficiary		x		x
5. Environmental protection and nature's contributions to people	Adaptation or mitigation of land and forest degradation	X29	27	Climate change benefit	x	x	x	
	Adaptation or mitigation of ocean warming and acidification	X31	2	Climate change benefit		x		
	Erosion prevented	X38	5	Ecological benefit	x	x		
	Improvement of infrastructure development, i.e., low impact, green infrastructure, schools, facilities	X45	11	Economic benefit	x	x		
	Adaptation and/or mitigation to/of climate change (in general)	X71	13	Climate change benefit	x	x		

ecosystems, agroforestry systems, and tropical dry forests. The conflict resolution focus (cluster 3) is salient in several regions of Africa (West, Central, and North), Europe (South, Western, and Eastern), and Asia and related to forest ecosystems. Multi-level and co-governance focus (cluster 4) is salient in marine and coastal ecosystems or large forest-protected areas, mainly in Asia. The environmental protection and nature's contributions to people focus (cluster 5) is salient in forestry areas and in several regions of Africa (East and South, West and Central), South America and Caribbean, and Oceania.

DISCUSSION

The overarching aim of this paper was to examine the transformative potential of inclusive conservation within major conservation foci as represented and understood by protected and conserved area managers and professionals worldwide. Drawing upon solutions uploaded to the PANORAMA platform, we derived two major results. First, based on global data and a comprehensive representation of conservation outcomes—beneficiaries and social, ecological, economic, political, and climate-related benefits—we identified the existence of at least five, non-exclusive, conservation

Table 4. Overview of most salient management features and interventions acting as levers and therefore positively linked to leverage points for conservation foci.

Conservation focus	Management interventions and feature types	Management interventions and features as levers	No. links from levers to leverage points within clusters	Socially inclusive conservation dimension
1. Community-based conservation	Interventions	Enabling sustainable livelihoods	7	x
		Development of alliance and partnership	3	x
	Governance type	Governance by Indigenous peoples and local communities	5	x
	Scale of management	Subnational	1	
2. Sustainable management	Interventions	Enabling sustainable livelihoods	2	x
		Enabling sustainable financing	1	
		Collection of baseline and monitoring data and knowledge	1	
		Developing technical methods and tools	1	
		Processes of reviewing interventions	1	
		Enforcement and prosecution	1	
	Governance type	Governance by private actors	2	x
	Scale of management	NA		
3. Conflicts resolution	Interventions	Enhancement of governance and decision making	3	x
		Education, training, and other capacity development activities	2	x
		Enforcement and prosecution	2	
	Governance type	NA		
	Scale of management	Subnational	2	
		National	1	
		Multi-national	1	
4. Multi-level and co-governance	Interventions	NA		
	Governance type	NA		
	Scale of management	NA		
5. Environmental protection and nature's contributions to people	Interventions	Enabling sustainable livelihoods	1	x
		Developing technical interventions and infrastructure	1	
		Promoting stakeholder dialogue	1	x
	Governance type	Governance by indigenous peoples and local communities	1	x
		Governance by private actors	1	x
	Scale of management	NA		

foci or archetypes perceived as successful: (i) community-based conservation, (ii) sustainable management, (iii) conflict resolution, (iv) multi-level and co-governance, and (v) environmental protection and nature's contributions to people. During the last decades, conservation research and practice have been trying to soften the divide between nature and culture and embrace the potential of inclusive approaches for effectively managing protected areas and enhancing equity (Andrade and Rhodes 2012, Palomo et al. 2014, Tallis and Lubchenco 2014, Oldekop et al. 2016, Bennett et al. 2017, Büscher and Fletcher 2019, Armitage et al. 2020). In response to these calls and efforts, we elicit major successful archetypes of conservation in protected areas understood as five complementary lenses on how to design more inclusive protected area management approaches. To the best of our knowledge, this is the first attempt, based on a large sample of case studies, to globally present archetypes of conservation foci. This approach can help to understand recurrent patterns in variables and processes that positively shape social-ecological systems in protected areas and can help to bridge the gap between global narratives and local realities (Oberlack et al. 2016). We propose these conservation foci as a guideline for oncoming conservation strategies aligning with current calls for promoting diverse values of nature, equity, and the inclusion of local knowledge systems in biodiversity governance (IPBES 2022, Raymond et al. 2022).

Second, we expand the potential of empirical and theoretical works on leverage points and inclusive conservation and propose a complementary approach based on correlation network analysis and content analysis of local knowledge to support successful transformative change in protected areas. We respond to recent calls on leverage points conceptualizations, suggesting that a combination of methods might help to achieve a more comprehensive understanding of systems dynamics and that special attention should be given to possible interactions between leverage points within a given system to design more effective interventions (Riechers et al. 2022). Our empirical analysis based on 263 case studies of protected and conserved areas revealed that inclusive dimensions play a fundamental role within the identified major conservation foci or archetypes and, therefore, should be prioritized in protected area management. These key roles are characterized by their ability to cluster positively conservation outcomes in different but non-exclusive ways (as influencer, hub-connector or bridger). Based on previous works in transformative change for sustainability, we highlight the potential of targeting these dimensions as leverage points, to intervene to affect and positively change social-ecological systems in protected areas. We show that these key conservation outcomes sometimes are less obvious or less addressed in protected area management but are potentially far more powerful areas of intervention (Abson et al. 2017). These results also offer insights into the inclusive processes, namely intervention and governance and management features,

linked to operationalizing inclusive conservation effectively. These are considered as levers to enable change, such as governance approaches and interventions (Fischer and Riechers 2019, Chan et al. 2020, West et al. 2020). We also highlight potential biogeographical contexts where conservation foci and related inclusive conservation approaches could be implemented in conservation. In the following discussion, we reflect on the specific leverage points and levers of inclusive conservation for each of the identified conservation foci, so we confront our main insights with current efforts from the researcher and practitioners' conservation communities.

Leverage points and levers of community-based conservation in protected areas

Community-based conservation should focus more on IPLC, women, and socio-cultural associations, because they act as leverage point influencers, and they might enable and influence a wide variety of conservation outcomes while aligning with human rights-based approaches. These results align with previous literature showing that protected Indigenous areas reduced deforestation in comparison to other protected area types (Sze et al. 2022). Previous studies have also emphasized the lack of inclusion of women in conservation science and practice despite being recognized as agents of change in conservation. Thus, their agency and engagement in conservation projects should be prioritized (Kaeser and Willcox 2018, Armitage et al. 2020, Fernández-Giménez et al. 2022).

Regarding the different types of benefits within this foci, social benefits are the most prominent, followed by economic benefits linked to alternative income opportunities. Aligned with previous work (Corrigan et al. 2018), we revealed that social cohesion and preservation of the socio-cultural context are critical elements of community-based conservation and might positively relate to other conservation foci because these dimensions also showed a strong bridging role. In this vein, previous work in Mexico on successful community-based conservation projects emphasized increased sensitivity of local cultural norms as an enabling factor for recognizing local communities and their capacity to communicate with external actors (Guibrunet et al. 2021).

Attention to dimensions like food security, poverty, and alternative income opportunities is relevant as these represent key leverage points to affect multiple conservation outcomes positively, and they could reduce the opportunity costs that local communities sometimes incur through protected areas (Green et al. 2018). These results align with current Targets 9 and 14 of the GBF (CBD 2022). Poverty alleviation has been highlighted in a recent global review (Dawson et al. 2021), specifically focused on IPLCs where material aspects represent 30% of the variety of identified human well-being dimensions. Nevertheless, and in line with our results, previous research highlights synergistic effects between non-material and material aspects of well-being (Dawson et al. 2021). For instance, subjective well-being measures related to values, beliefs, and norms can be linked to successful community-based conservation strategies. Targeting the previously highlighted leverage points in protected area management might eventually benefit the preservation of biocultural diversity (Gavin et al. 2015) and enable and preserve local and traditional knowledge and customary rights (Berkes 2007, Armitage et al. 2020, Berkes 2021). According to our results, some priorities for management and interventions, such as levers, positively affecting conservation outcomes, could contribute toward sustainable livelihood, building partnerships and alliances between several stakeholder groups, and favoring community-based governance. As our results suggest, these strategies might be well represented or more applicable in regions like South America, Central Asia, the Middle East, and Northern Europe, and more applicable in agroecosystems, agroforestry systems, or dry tropical forest ecosystems. Decolonial perspectives on conservation aiming at empowering local communities, Indigenous communities, and related worldviews and local knowledge may prioritize the key dimensions highlighted above that operate at local and regional levels. However, we also acknowledge that, in parallel, community-based conservation efforts could acknowledge political power bases, such as investors and government officers, which represent key drivers of change in local social-ecological systems (Büscher and Fletcher 2019, Lanjouw 2021). This is also highlighted in recent theoretical frames, which emphasize worldwide and distant coupled effects affecting conservation efforts at the local level (Carmenta et al. 2023).

Leverage points and levers of sustainable management of protected areas

In this conservation focus, beneficiaries such as youth and local producers were identified as leverage points. There is growing awareness of the need to include youth perspectives, values, and motivations in conservation (Powell et al. 2018, Chen et al. 2019, Kamat 2019, Poudel 2021), as also emphasized in Target 21 of the Kunming-Montreal GBF (CBD 2022). Consideration of youth perspectives can lead to valuable insights on historical and contextual motivations for supporting, or not supporting, conservation practices (Kamat 2019). We found that youth were seldom reported as direct beneficiaries in the protected areas analyzed, although this group might work as a leverage point in strategies emphasizing sustainable management of protected areas. This suggests that more targeted interventions for youth in protected areas should be adopted. Examples of engagement include youth workshops (Poudel 2021), or youth councils and strengthened educational opportunities (Chen et al. 2019). Another area to consider is livelihoods and financing opportunities for stakeholders by working with local producers, e.g., fishers, farmers, and entrepreneurs, within and surrounding protected areas as leverage points within strategies aiming for sustainable management in protected areas. This is clearly expressed in the current Target 9 of the current GBF and has been raised by multiple empirical and theoretical works on protected areas and aligns, for instance, with IUCN category VI (sustainable use) and biosphere reserves (UNESCO). From social-ecological systems perspectives, there is a clear emphasis on expanding protected area management philosophies to balance local livelihoods and biodiversity conservation (Wei et al. 2018). Co-occurrence of socioeconomic benefits, e.g., enhanced livelihoods and empowerment of local stakeholders, and conservation outcomes, is more likely to arise when protected areas are managed to promote sustainable resource use rather than enforcing stricter protection of biodiversity (Oldekop et al. 2016). Our results support previous research showing that effective empowerment and capacity building of local producers and communities, with special care of youth and women, and the

introduction of knowledge co-production and social learning processes might also favor sustainable use of protected areas (Braga et al. 2017, Engen et al. 2021). In this vein, in the global review of Oldekop et al. (2016), the empowerment of local stakeholders is also highlighted as a critical element in protected areas' social and ecological success. Our results suggest that successful examples of sustainable use of protected areas may be levered by privately managed conservation areas and the assurance of which ensure sustainable livelihoods.

Leverage points and levers of conflict resolution in protected areas

Within this conservation focus a wide variety of social, economic, and ecological benefits as leverage points are identified. Our results suggest that inclusive perspectives should establish dialogue, trust, and collaboration between communities, management authorities, and government institutions within protected areas experiencing ongoing conflicts and the threats of land use transformation. These are shown to be essential leverage points to navigate and revert negative trends (Goodson et al. 2022) and have been revealed as essential aspects of successful co-management for preventing the escalation of conflicts and attaining sustainable conflict management in protected areas (Soliku and Schraml 2020). These results align with insights from current research in areas where feelings of exclusion from local communities and ongoing conflicts and negative impacts remain latent (van Riper et al. 2021). Redpath et al. (2013) also highlight, among others, the importance of improving transparency, dialogue, and trust, and the recognizing of problems as shared ones and discussing them collaboratively in protected area management. We show that protected areas experiencing conflicts can benefit substantially from improved participation to diminish social conflict and civil unrest. Similarly, Andrade and Rhodes (2012) found that local community participation in the protected area decision-making process was the only variable significantly related to compliance with protected area polices in areas prone to experiencing conservation conflicts and tensions. Despite these insights, improved participation has rarely been reported in the context of protected areas. In light of our results, this conservation focus should prioritize mechanisms and tools for achieving effective governance and improving decision making. Education, training programs, and mechanisms for effective enforcement and prosecution should also be facilitated because they can represent successful levers in protected areas experiencing recurrent conflicts. According to our results, this conservation focus was more salient in multiple African regions (North, Central, and West), in Western, Southern, and Eastern Europe, and East Asia, and primarily in forest ecosystems.

Leverage points and levers of multi-level and co-governance of protected areas

Our results align with previous works that identified synergies between multi-level and co-governance of protected areas with NGOs and that found these to be particularly relevant and necessary in cross-boundary contexts, and extensive marine protected areas (Gruby and Basurto 2013, Kozar et al. 2019). It is predominantly governments that have supported and enabled inclusive conservation practices in protected areas management. As conservation authorities responsible for proposing, designating, and managing protected areas, they have traditionally implemented different formal and informal mechanisms to facilitate, to a greater or lesser extent, stakeholders' participation in decision making (Borrini-Feyerabend et al. 2013). We found that this practice can be successfully delegated to NGOs that work as leverage points. For instance, implementing mosaic governance in urban green infrastructure has benefited from the crucial role of citizen groups and NGOs (Buijs et al. 2019). NGOs have played a complementary and mutually supportive role in bridging a wide diversity of local communities and institutions to cooperate for conservation governance. Whereas significant efforts have been made by multi-level and multi-stakeholder governance models to connect and engage local communities in protected areas management, more resources, skills, and capacity building seem to be needed to progress in this direction (Gruby and Basurto 2013, López-Rodríguez et al. 2020). In our analysis, these governance aspects were more commonly associated with coastal areas or forest ecosystems in North and Central Asia. This conservation focus must be linked to vast and transboundary areas and strategies that require strong coordination at all governance levels, i.e., multi-level or co-governance, such as those working with maritime, coastal areas and islands, or with international transboundary vast forest areas (Jentoft et al. 2007, O'Leary et al. 2018, Liu et al. 2020)

Leverage points and levers of environmental protection and nature's contributions to people in protected areas

Our results revealed that conservation strategies focusing on biodiversity conservation and minimizing the negative impacts of climate change contribute to a wide variety of nature's contributions to people (IPBES 2022). This conservation focus was salient in areas with many ecological and climate change-related challenges and increased risk of habitat loss and ecosystem degradation. Our findings point to connecting biodiversity and environmental protection and nature's contributions to people, reinforcing the importance of spatial and landscape planning policies that consider the interplay between healthy ecosystems and human well-being and good quality of life (Sandifer et al. 2015, IPBES 2022). Finally, our results revealed that some inclusive management interventions aiming to improve sustainable livelihoods or stakeholder dialogue are critical as levers to trigger benefits on multiple conservation outcomes, particularly within this conservation focus. The importance of governance types empowering and engaging both IPLCs, and the private sector are also highlighted. Overall, our findings for this conservation focus align with previous works highlighting the positive links and pathways between nature's contributions to people and increasing participation of local communities in protected area management (Naidoo et al. 2019, Chan et al. 2020), which is supported by several targets of the adopted GBF (CBD 2022).

LIMITATIONS AND FUTURE DIRECTIONS

Further standardization of the parameters characterizing protected area solutions in the PANORAMA database are needed. This includes clear definitions of concepts and parameters to avoid "double counting" and encourage consistent application of terms. We also identified a bias toward the Global South in terms of countries and continents represented by the protected area solutions in the PANORAMA database, encouraging submissions from countries including the Global North would enable more representative analyses.

Expanding the set of parameters characterizing the context where protected areas and solutions are embedded could further explain patterns and processes, e.g., socioeconomic indicators or temporal factors. Finally, we acknowledge that this work focuses on practitioners' perceptions of what constitutes a successful "solution," and that these are submitted by practitioners directly linked to the initiatives, so we expect some bias in results even with a third party reviewing the data. Further research should explore negative relations and associations, trade-offs, between dimensions of protected areas and related solutions and conservation outcomes. This would allow to draw causal relationships on what works and how in conservation (Ferraro and Hanauer 2014, Ferraro et al. 2018). Though the analysis based on modularity of conservation outcomes allows the identification of salient clusters of conservation outcomes, we acknowledge the existence of multiple cross-cluster relations, indicating that a given dimension might not only be valid in a single conservation focus.

CONCLUSIONS

Based on an empirical analysis of 263 case studies in protected areas globally, we demonstrate that key inclusive conservation dimensions work as leverage points, representing points to intervene to influence protected area management practices and outcomes. These leverage points include, among others, improvements in the socio-cultural context and social cohesion, enhancing the status and participation of youth, women, and minorities, improved human health, empowerment of local communities, or reestablishment of dialogue and trust. We also identified protected area management features and interventions that might work as levers, representing the fundamental processes on how these changes can be realized, such as governance approaches and management interventions. Examples of these levers are interventions to enhance livelihood sustainability, alliance and partnership development, or protected areas managed and governed by local and Indigenous people or private actors. Although leverage points are sometimes less obvious or less addressed in current protected area management, they can represent potentially more powerful areas of intervention. We also revealed potential conservation foci as conservation archetypes where the specific leverage points and levers might be more effective: community-based conservation, sustainable management, conflict resolution, multi-level and co-governance, and environmental protection and nature's contributions to people. Our findings are particularly relevant to ongoing discussions about global biodiversity targets and the sustainable development agenda, which increasingly show the need to include multiple social dimensions within biodiversity conservation strategies for effective and equitable outcomes.

Acknowledgments:

This manuscript is an outcome of the ENVISION project, funded through the 2017–2018 Belmont Forum and BiodivERsA joint call for research proposals, under the BiodivScen ERA-Net COFUND program, and with the support of the following national funders: German Federal Ministry of Education and Research, Grant Number: 01LC18064; Swedish National Science Foundation under Grant No. 1854767; the Swedish Research Council for Sustainable Development (FORMAS, 2018 -02429); the Netherlands Organization for Scientific Research (NWO); Grant PCI2018-092958 funded by MCIN/AEI/ 10.13039/501100011033. We also want to thank the valuable support of the PANORAMA web developers and the data providers for the solutions, and Peter Verburg, Marc Metzger, and Ciska Ulug for their comments on the manuscript in the latest phase.

Data Availability:

The data supporting this study's findings are available online in an open repository (ZENODO-OpenAIRE project): https://zenodo.org/records/10031797. These data were derived, after content analysis and coding, from the following resources available in the public domain: https://panorama.solutions/es.

LITERATURE CITED

Abson, D. J., J. Fischer, J. Leventon, J. Newig, T. Schomerus, U. Vilsmaier, H. von Wehrden, P. Abernethy, C. D. Ives, N. W. Jager, and D. J. Lang. 2017. Leverage points for sustainability transformation. Ambio 46:30-39. https://doi.org/10.1007/s13280-016-0800-y

Andrade, G. S. M., and J. R. Rhodes. 2012. Protected areas and local communities: an inevitable partnership toward successful conservation strategies? Ecology and Society 17(4):14. https://doi.org/10.5751/ES-05216-170414

Armitage, D., P. Mbatha, E.-K. Muhl, W. Rice, and M. Sowman. 2020. Governance principles for community-centered conservation in the post-2020 global biodiversity framework. Conservation Science and Practice 2(2):e160. https://doi.org/10.1111/csp2.160

Bennett, N. J., R. Roth, S. C. Klain, K. M. A. Chan, D. A. Clark, G. Cullman, G. Epstein, M. P. Nelson, R. Stedman, T. L. Teel, R. E. W. Thomas, C. Wyborn, D. Curran, A. Greenberg, J. Sandlos, and D. Veríssimo. 2017. Mainstreaming the social sciences in conservation. Conservation Biology 31(1):56-66. https://doi.org/10.1111/cobi.12788

Berkes, F. 2007. Community-based conservation in a globalized world. Proceedings of the National Academy of Sciences of the United States of America 104(39):15188-15193. https://doi.org/10.1073/pnas.0702098104

Berkes, F. 2021. Advanced introduction to community-based conservation. Edward Elgar Publishing, Cheltenham, UK.

Blondel, V. D., J. L. Guillaume, R. Lambiotte, and E. Lefebvre. 2008. Fast unfolding of communities in large networks. Journal of Statistical Mechanics: Theory and Experiment P10008. https://doi.org/10.1088/1742-5468/2008/10/P10008

Borrini-Feyerabend, G., N. Dudley, T. Jaeger, B. Lassen, N. Pathak Broome, A. Phillips, and T. Sandwith. 2013. Governance of protected areas: from understanding to action. International Union for Conservation of Nature, Gland, Switzerland.

Braga, H. O., U. M. Azeiteiro, H. M. F. Oliveira, and M. A. Pardal. 2017. Evaluating fishermen's conservation attitudes and local ecological knowledge of the European sardine (*Sardina pilchardus*), Peniche, Portugal. Journal of Ethnobiology and Ethnomedicine 13 (1):25. https://doi.org/10.1186/s13002-017-0154-y

Brooks, J., K. A. Waylen, and M. B. Mulder. 2013. Assessing community-based conservation projects: a systematic review and multilevel analysis of attitudinal, behavioral, ecological, and economic outcomes. Environmental Evidence 2:2. https://doi.org/10.1186/2047-2382-2-2

Buijs, A., R. Hansen, S. Van der Jagt, B. Ambrose-Oji, B. Elands, E. Lorance Rall, T. Mattijssen, S. Pauleit, H. Runhaar, A. Stahl Olafsson, and M. Steen Møller. 2019. Mosaic governance for urban green infrastructure: upscaling active citizenship from a local government perspective. Urban Forestry & Urban Greening 40:53-62. https://doi.org/10.1016/j.ufug.2018.06.011

Büscher, B., and R. Fletcher. 2019. Towards convivial conservation. Conservation and Society 17(3):283-296. https://doi.org/10.4103/cs.cs_19_75

Carmenta, R., J. Barlow, M. G. B. Lima, E. Berenguer, S. Choiruzzad, N. Estrada-Carmona, F. França, G. Kallis, E. Killick, A. Lees, et al. 2023. Connected conservation: rethinking conservation for a telecoupled world. Biological Conservation 282:110047. https://doi.org/10.1016/j.biocon.2023.110047

Cebrián-Piqueras, M. A., A. Filyushkina, D. N. Johnson, V. B. Lo, M. D. López-Rodríguez, H. March, E. Oteros-Rozas, C. Peppler-Lisbach, C. Quintas-Soriano, C. M. Raymond, I. Ruiz-Mallén, C. J. van Riper, Y. Zinngrebe, and T. Plieninger. 2020. Scientific and local ecological knowledge, shaping perceptions towards protected areas and related ecosystem services. Landscape Ecology 35(11):2549-2567. https://doi.org/10.1007/s10980-020-01107-4

Chan, K. M. A., D. R. Boyd, R. K. Gould, J. Jetzkowitz, J. Liu, B. Muraca, R. Naidoo, P. Olmsted, T. Satterfield, O. Selomane, G. G. Singh, R. Sumaila, H. T. Ngo, A. K. Boedhihartono, J. Agard, A. P. D. Aguiar, D. Armenteras, L. Balint, C. Barrington-Leigh, W. W. L. Cheung, S. Díaz, J. Driscoll, K. Esler, H. Eyster, E. J. Gregr, S. Hashimoto, G. C. Hernández Pedraza, T. Hickler, M. Kok, T. Lazarova, A. A. A. Mohamed, M. Murray-Hudson, P. O'Farrell, I. Palomo, A. K. Saysel, R. Seppelt, J. Settele, B. Strassburg, D. Xue, and E. S. Brondízio. 2020. Levers and leverage points for pathways to sustainability. People and Nature 2 (3):693-717. https://doi.org/10.1002/pan3.10124

Chen, D., A. Garmulewicz, C. Merner, C. Elphinstone, C. Leggott, and H. Dewar. 2019. Encouraging youth engagement in marine protected areas: a survey of best practices in Canada. Aquatic Conservation: Marine and Freshwater Ecosystems 29 (S2):223-232. https://doi.org/10.1002/aqc.3094

Constantino, P. A. L., H. S. A. Carlos, E. E. Ramalho, L. Rostant, C. Marinelli, D. Teles, S. F. Fonseca-Junior, R. B. Fernandes, and J. Valsecchi. 2012. Empowering local people through community-based resource monitoring: a comparison between Brazil and Namibia. Ecology and Society 17(4):22. https://doi.org/10.5751/ES-05164-170422

Convention on Biological Diversity (CBD). 2022. Kunming-Montreal Global Biodiversity Framework. UNEP, Montreal, Quebec, Canada. https://www.cbd.int/doc/decisions/cop-15/cop-15-dec-04-en.pdf

Corrigan, C., C. J. Robinson, N. D. Burgess, N. Kingston, and M. Hockings. 2018. Global review of social indicators used in protected area management evaluation. Conservation Letters 11 (2):e12397 https://doi.org/10.1111/conl.12397

Csardi, G., and T. Nepusz. 2006. The Igraph software package for complex network research. InterJournal Complex Systems 1695(5):1-9.

Dawson, N. M., B. Coolsaet, E. J. Sterling, R. Loveridge, N. D. Gross-Camp, S. Wongbusarakum, K. K. Sangha, L. M. Scherl, H. Phuong Phan, N. Zafra-Calvo, W. G. Lavey, P. Byakagaba, C. J. Idrobo, A. Chenet, N. J. Bennett, S. Mansourian, and F. J. Rosado-May. 2021. The role of indigenous peoples and local communities in effective and equitable conservation. Ecology and Society 26(3):19. https://doi.org/10.5751/ES-12625-260319

DeVellis, R. F., and C. T. Thorpe. 2021. Scale development: theory and applications. SAGE, Thousands Oaks, California, USA.

Di Franco, A., K. E. Hogg, A. Calò, N. J. Bennett, M. A. Sévin-Allouet, O. Esparza Alaminos, M. Lang, D. Koutsoubas, M. Prvan, L. Santarossa, F. Niccolini, M. Milazzo, and P. Guidetti. 2020. Improving marine protected area governance through collaboration and co-production. Journal of Environmental Management 269:110757. https://doi.org/10.1016/j.jenvman.2020.110757

Engen, S., V. H. Hausner, G. G. Gurney, E. G. Broderstad, R. Keller, A. K. Lundberg, F. J. A. Murguzur, E. Salminen, C. M. Raymond, J. Falk-Andersson, and P. Fauchald. 2021. Blue justice: a survey for eliciting perceptions of environmental justice among coastal planners' and small-scale fishers in Northern-Norway. PLoS ONE 16(5):e0251467. https://doi.org/10.1371/journal.pone.0251467

Farvar, M. T., G. Borrini-Feyerabend, J. Campese, T. Jaeger, H. Jonas, and S. Stevens, 2018. Whose 'inclusive conservation'? Policy Brief of the ICCA Consortium no. 5. The ICCA Consortium and Cenesta, Tehran, Iran.

Fernández-Giménez, M. E., F. Ravera, and E. Oteros-Rozas. 2022. The invisible thread: women as tradition keepers and change agents in Spanish pastoral social-ecological systems. Ecology and Society 27(2):4. https://doi.org/10.5751/ES-12794-270204

Ferraro, P. J., and M. M. Hanauer. 2014. Quantifying causal mechanisms to determine how protected areas affect poverty through changes in ecosystem services and infrastructure. Proceedings of the National Academy of Sciences of the United States of America 111(11):4332-4337. https://doi.org/10.1073/pnas.1307712111

Ferraro, P. J., J. N. Sanchirico, and M. D. Smith. 2018. Causal inference in coupled human and natural systems. Proceedings of the National Academy of Sciences of the United States of America 116(12):5311-5318. https://doi.org/10.1073/pnas.1805563115

Fischer, J., and M. Riechers. 2019. A leverage points perspective on sustainability. People and Nature 1(1):115-120. https://doi.org/10.1002/pan3.13

Gavin, M. C., J. McCarter, A. Mead, F. Berkes, J. R. Stepp, D. Peterson, and R. Tang. 2015. Defining biocultural approaches to conservation. Trends in Ecology & Evolution 30(3):140-145. https://doi.org/10.1016/j.tree.2014.12.005

Geldmann, J., A. Manica, N. D. Burgess, L. Coad, and A. Balmford. 2019. A global-level assessment of the effectiveness of protected areas at resisting anthropogenic pressures. Proceedings of the National Academy of Sciences of the United States of America 116(46):23209-23215. https://doi.org/10.1073/pnas.1908221116

Golbeck, J. 2015. Analysing networks. Pages 221-235 in Introduction to social media investigation. Elsevier, Amsterdam, The Netherlands. https://doi.org/10.1016/B978-0-12-801656-5.00021-4

Goodson, D. J., C. J. van Riper, R. Andrade, M. A. Cebrián-Piqueras, and M. E. Hauber. 2022. Perceived inclusivity and trust in protected area management decisions among stakeholders in Alaska. People and Nature 4(3):758-772. https://doi.org/10.1002/pan3.10312

Gould, R. K., I. Phukan, M. E. Mendoza, N. M. Ardoin, and B. Panikkar. 2018. Seizing opportunities to diversify conservation. Conservation Letters 11(4):e12431. https://doi.org/10.1111/conl.12431

Green, J. M. H., B. Fisher, R. E. Green, J. Makero, P. J. Platts, N. Robert, M. Schaafsma, R. K. Turner, and A. Balmford. 2018. Local costs of conservation exceed those borne by the global majority. Global Ecology and Conservation 14:e00385. https://doi.org/10.1016/j.gecco.2018.e00385

Gruby, R. L., and X. Basurto. 2013. Multi-level governance for large marine commons: politics and polycentricity in Palau's protected area network. Environmental Science & Policy 33:260-272. https://doi.org/10.1016/j.envsci.2013.06.006

Guibrunet, L., P. R. W. Gerritsen, J. A. Sierra-Huelsz, A. C. Flores-Díaz, E. García-Frapolli, E. García-Serrano, U. Pascual, and P. Balvanera. 2021. Beyond participation: how to achieve the recognition of local communities' value-systems in conservation? Some insights from Mexico. People and Nature 3(3):528-541. https://doi.org/10.1002/pan3.10203

Hill, R., Ç. Adem, W. V. Alangui, Z. Molnár, Y. Aumeeruddy-Thomas, P. Bridgewater, M. Tengö, R. Thaman, C. Y. Adou Yao, F. Berkes, J. Carino, M. Carneiro da Cunha, M. C. Diaw, S. Díaz, V. E. Figueroa, J. Fisher, P. Hardison, K. Ichikawa, P. Kariuki, M. Karki, P. O. Lyver, P. Malmer, O. Masardule, A. A. Oteng Yeboah, D. Pacheco, T. Pataridze, E. Perez, M. M. Roué, H. Roba, J. Rubis, O. Saito, and D. Xue. 2020. Working with Indigenous, local and scientific knowledge in assessments of nature and nature's linkages with people. Current Opinion in Environmental Sustainability 43:8-20. https://doi.org/10.1016/j.cosust.2019.12.006

Hill, R., S. Díaz, U. Pascual, M. Stenseke, Z. Molnár, and J. Van Velden. 2021. Nature's contributions to people: weaving plural perspectives. One Earth 4(7):910-915. https://doi.org/10.1016/j.oneear.2021.06.009

Hsieh, H. F., and S. E. Shannon. 2005. Three approaches to qualitative content analysis. Qualitative Health Research 15 (9):1277-1288. https://doi.org/10.1177/1049732305276687

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2019. Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo, editors. IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.3831673

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2022. Summary for policymakers of the methodological assessment report on the diverse values and valuation of nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. U. Pascual, P. Balvanera, M. Christie, B. Baptiste, D. González-Jiménez, C. B. Anderson, S. Athayde, D. N. Barton, R. Chaplin-Kramer, S. Jacobs, E. Kelemen, R. Kumar, E. Lazos, A. Martin, T. H. Mwampamba, B. Nakangu, P. O'Farrell, C. M. Raymond, S. M. Subramanian, M. Termansen, M. Van Noordwijk, A. Vatn, editors. IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.6522392

International Union for Conservation of Nature World Commission on Protected Areas Task Force on OECMs (IUCN-WCPA). 2019. Recognising and reporting other effective area-based conservation measures. IUCN, Gland, Switzerland.

Jentoft, S., T. C. van Son, and M. Bjørkan. 2007. Marine protected areas: a governance system analysis. Human Ecology 35 (5):611-622. https://doi.org/10.1007/s10745-007-9125-6

Kaeser, A., and A. Willcox. 2018. Identifying women's attitudes and barriers to participating in a proposed community-based conservation group in western Belize. Ambio 47:622-633. https://doi.org/10.1007/s13280-017-0986-7

Kamat, V. R. 2019. Dynamite fishing in a marine protected area in Tanzania: why youth perceptions matter. Coastal Management 47(4):387-405. https://doi.org/10.1080/08920753.2019.1619902

Kok, M., A. Rankovic, H. Löwenhardt, P. Pattberg, C. Prip, O. Widerberg, and Y. Laurans. 2018. From Paris to Beijing: insights gained from the UNFCCC Paris Agreement for the Post-2020 Global Biodiversity Framework. PBL Netherlands Environmental Assessment Agency, The Hague, The Netherlands.

Kozar, R., E. Galang, A. Alip, J. Sedhain, S. Subramanian, and O. Saito. 2019. Multi-level networks for sustainability solutions: the case of the International Partnership for the Satoyama Initiative. Current Opinion in Environmental Sustainability 39:123-134. https://doi.org/10.1016/j.cosust.2019.09.002

Lanjouw, A. 2021. De-colonising conservation in a global world. American Journal of Primatology 83(4):e23258. https://doi.org/10.1002/ajp.23258

Liu, J., D. L. Yong, C. Y. Choi, and L. Gibson. 2020. Transboundary frontiers: an emerging priority for biodiversity conservation. Trends in Ecology & Evolution 35(8):679-690. https://doi.org/10.1016/j.tree.2020.03.004

López-Rodríguez, M. D., I. Ruiz-Mallén, E. Oteros-Rozas, H. March, R. Keller, V. B. Lo, M. A. Cebrián-Piqueras, and R. Andrade. 2020. Delineating participation in conservation governance: insights from the Sierra de Guadarrama National Park (Spain). Environmental Science and Policy 114:486-496. https://doi.org/10.1016/j.envsci.2020.09.019

Lu, L., and M. Zhang. 2013. Edge betweenness centrality. Pages 647-648 in W. Dubitzky, O. Wolkenhauer, K.-H. Cho, and H. Yokota, editors. Encyclopedia of systems biology. Springer, New York, New York, USA. https://doi.org/10.1007/978-1-4419-9863-7_874

Mace, G. M. 2014. Whose conservation? Science 345 (6204):1558-1560. https://doi.org/10.1126/science.1254704

Maclean, K., E. Woodward, D. Jarvis, G. Turpin, D. Rowland, and P. Rist. 2022. Decolonising knowledge co-production: examining the role of positionality and partnerships to support Indigenous-led bush product enterprises in northern Australia. Sustainability Science 17(2):333-350. https://doi.org/10.1007/s11625-021-00973-4

Mattsson, B. J., M. Fischborn, M. Brunson, and H. Vacik. 2019. Introducing and evaluating a knowledge transfer approach to support problem solving in and around protected areas. Ambio 48(1):13-24. https://doi.org/10.1007/s13280-018-1048-5

Matulis, B. S., and J. R. Moyer. 2017. Beyond inclusive conservation: the value of pluralism, the need for agonism, and the case for social instrumentalism. Conservation Letters 10 (3):279-287. https://doi.org/10.1111/conl.12281

McKinnon, M. C., S. H. Cheng, S. Dupre, J. Edmond, R. Garside, L. Glew, M. B. Holland, E. Levine, Y. J. Masuda, D. C. Miller, I. Oliveira, J. Revenaz, D. Roe, S. Shamer, D. Wilkie, S. Wongbusarakum, and E. Woodhouse. 2016. What are the effects of nature conservation on human well-being? A systematic map of empirical evidence from developing countries. Environmental Evidence 5(8). https://doi.org/10.1186/s13750-016-0058-7

Meadows, D. 1997. Places to intervene in a system (in increasing order of effectiveness). Whole Earth 91(1):78.

Medeiros, M. C., R. R. D. Barboza, G. Martel, and J. da S. Mourão. 2018. Combining local fishers' and scientific ecological knowledge: implications for comanagement. Ocean and Coastal Management 158:1-10. https://doi.org/10.1016/j.ocecoaman.2018.03.014

Naidoo, R., D. Gerkey, D. Hole, A. Pfaff, A. M. Ellis, C. D. Golden, D. Herrera, K. Johnson, M. Mulligan, T. H. Ricketts, and B. Fisher. 2019. Evaluating the impacts of protected areas on human well-being across the developing world. Science Advances 5(4):eaav3006. https://doi.org/10.1126/sciadv.aav3006

Negre, C. F. A., U. N. Morzan, H. P. Hendrickson, R. Pal, G. P. Lisi, J. P. Loria, I. Rivalta, J. Ho, and V. S. Batista. 2018. Eigenvector centrality for characterisation of protein allosteric pathways. Proceedings of the National Academy of Sciences of the United States of America 115(52):E12201-E12208. https://doi.org/10.1073/pnas.1810452115

Norström, A. V., C. Cvitanovic, M. F. Löf, S. West, C. Wyborn, P. Balvanera, A. T. Bednarek, E. M. Bennett, R. Biggs, A. de Bremond, B. M. Campbell, J. G. Canadell, S. R. Carpenter, C. Folke, E. A. Fulton, O. Gaffney, S. Gelcich, J. B. Jouffray, M. Leach, M. Le Tissier, B. Martín-López, E. Louder, M. F. Loutre, A. M. Meadow, H. Nagendra, D. Payne, G. D. Peterson, B. Reyers, R. Scholes, C. I. Speranza, M. Spierenburg, M. Stafford-Smith, M. Tengö, S. van der Hel, I. van Putten, and H. Österblom. 2020. Principles for knowledge co-production in sustainability research. Nature Sustainability 3:182-190. https://doi.org/10.1038/s41893-019-0448-2

Oberlack, C., L. Tejada, P. Messerli, S. Rist, and M. Giger. 2016. Sustainable livelihoods in the global land rush? Archetypes of livelihood vulnerability and sustainability potentials. Global Environmental Change 41:153-171. https://doi.org/10.1016/j.gloenvcha.2016.10.001

O'Leary, B. C., N. C. Ban, M. Fernandez, A. M. Friedlander, P. García-Borboroglu, Y. Golbuu, P. Guidetti, J. M. Harris, J. P. Hawkins, T. Langlois, D. J. McCauley, E. K. Pikitch, R. H. Richmond, and C. M. Roberts. 2018. Addressing criticisms of large-scale marine protected areas. BioScience 68(5):359-370. https://doi.org/10.1093/biosci/biy021

Oldekop, J. A., G. Holmes, W. E. Harris, and K. L. Evans. 2016. A global assessment of the social and conservation outcomes of protected areas. Conservation Biology 30(1):133-141. https://doi.org/10.1111/cobi.12568

Oteros-Rozas, E., B. Martín-López, T. M. Daw, E. L. Bohensky, J. R. A. Butler, R. Hill, J. Martin-Ortega, A. Quinlan, F. Ravera, I. Ruiz-Mallén, M. Thyresson, J. Mistry, I. Palomo, G. D. Peterson, T. Plieninger, K. A. Waylen, D. M. Beach, I. C. Bohnet, M. Hamann, J. Hanspach, K. Hubacek, S. Lavorel, and S. P. Vilardy. 2015. Participatory scenario planning in place-based social-ecological research: Insights and experiences from 23 case studies. Ecology and Society 20(4):32. https://doi.org/10.5751/ES-07985-200432

Palomo, I., B. Locatelli, I. Otero, M. Colloff, E. Crouzat, A. Cuni-Sanchez, E. Gómez-Baggethun, A. González-García, A. Grêt-Regamey, A. Jiménez-Aceituno, B. Martín-López, U. Pascual, N. Zafra-Calvo, E. Bruley, M. Fischborn, R. Metz, and S. Lavorel. 2021. Assessing nature-based solutions for transformative change. One Earth 4(5):730-741. https://doi.org/10.1016/j.oneear.2021.04.013

Palomo, I., C. Montes, B. Martín-López, J. A. González, M. García-Llorente, P. Alcorlo, M. R. G. Mora. 2014. Incorporating the social-ecological approach in protected areas in the Anthropocene. BioScience 64(3):181-191. https://doi.org/10.1093/biosci/bit033

Palomo, I., M. Múgica, C. Piñeiro, B. Martín-López, J. Atauri, and C. Montes. 2017. Envisioning protected areas through participatory scenario planning: navigating coverage and effectiveness challenges ahead. Parks 23(1):29-44. https://doi.org/10.2305/IUCN.CH.2017.PARKS-23-1IP.en

Poudel, A. 2021. Migration, youth workshops and forestry: case studies from Nepal. Trees, Forests and People 3:100057. https://doi.org/10.1016/j.tfp.2020.100057

Powell, R. B., S. L. Vezeau, M. J. Stern, D. W. D. Moore, and B. A. Wright. 2018. Does interpretation influence elaboration and environmental behaviors? Environmental Education Research 24 (6):875-888. https://doi.org/10.1080/13504622.2017.1339302

R Core Team. 2021. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org

Rana, S., D. Ávila-García, V. Dib, L. Familia, L. C. Gerhardinger, E. Martin, P. I. Martins, J. Pompeu, O. Selomane, J. I. Tauli, D. H. T. Tran, M. Valle, J. von Below, and L. M. Pereira. 2020. The voices of youth in envisioning positive futures for nature and people. Ecosystems and People 16(1):326-344. https://doi.org/10.1080/26395916.2020.1821095

Raymond, C. M., M. A. Cebrián-Piqueras, E. Andersson, R. Andrade, A. A. Schnell, B. Battioni Romanelli, A. Filyushkina, D. J. Goodson, A. Horcea-Milcu, D. N. Johnson, R. Keller, J. J. Kuiper, V. Lo, M. D. López-Rodríguez, H. March, M. Metzger,

E. Oteros-Rozas, E. Salcido, M. Sellberg, W. Stewart, I. Ruiz-Mallén, T. Plieninger, C. J. van Riper, P. H. Verburg, and M. M. Wiedermann. 2022. Inclusive conservation and the Post-2020 Global Biodiversity Framework: tensions and prospects. One Earth 5(3):252-264. https://doi.org/10.1016/j.oneear.2022.02.008

Redpath, S. M., J. Young, A. Evely, W. M. Adams, W. J. Sutherland, A. Whitehouse, A. Amar, R. A. Lambert, J. D. C. Linnell, A. Watt, and R. J. Gutiérrez. 2013. Understanding and managing conservation conflicts. Trends in Ecology & Evolution 28(2):100-109. https://doi.org/10.1016/j.tree.2012.08.021

Riechers, M., J. Fischer, A. O. Manlosa, S. Ortiz-Przychodzka, and J. E. Sala. 2022. Operationalising the leverage points perspective for empirical research. Current Opinion in Environmental Sustainability 57:101206. https://doi.org/10.1016/j.cosust.2022.101206

Rubin, A., and E. R. Babbie. 2016. Essential research methods for social work. Cengage Learning, Boston, Massachusetts, USA.

Saberwal, V. K. 1996. Pastoral politics: Gaddi grazing, degradation, and biodiversity conservation in Himachal Pradesh, India. Conservation Biology 10(3):741-749. https://doi.org/10.1046/j.1523-1739.1996.10030741.x

Sandifer, P. A., A. E. Sutton-Grier, and B. P. Ward. 2015. Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: opportunities to enhance health and biodiversity conservation. Ecosystem Services 12:1-15. https://doi.org/10.1016/j.ecoser.2014.12.007

Scardoni, G., G. Tosadori, M. Faizan, F. Spoto, F. Fabbri, and C. Laudanna. 2015. Biological network analysis with CentiScaPe: centralities and experimental dataset integration. F1000Research 3:139. https://doi.org/10.12688/f1000research.4477.2

Scheyvens, R. 1999. Ecotourism and the empowerment of local communities. Tourism Management 20(2):245-249. https://doi.org/10.1016/S0261-5177(98)00069-7

Schmitt, M. 2014. Gender awareness in European alpine protected-area management: achievements, shortcomings, and the way forward. Mountain Research and Development 34 (3):291-296. https://doi.org/10.1659/MRD-JOURNAL-D-13-00090.1

Settle, B., D. Otasek, J. H. Morris, and B. Demchak. 2018. aMatReader: Importing adjacency matrices via Cytoscape Automation. F1000Research 7:823. https://doi.org/10.12688/f1000research.15146.2

Silva, J. M. C. da, T. C. A. de C. Dias, A. C. da Cunha, and H. F. A. Cunha. 2021. Funding deficits of protected areas in Brazil. Land Use Policy 100:104926. https://doi.org/10.1016/j.landusepol.2020.104926

Soliku, O., and U. Schraml. 2020. From conflict to collaboration: the contribution of comanagement in mitigating conflicts in Mole National Park, Ghana. Oryx 54(4):483-493. https://doi.org/10.1017/S0030605318000285

Svarstad, H., K. Daugstad, O. I. Vistad, and I. Guidvik. 2006. New protected areas in Norway: local participation without gender equality. Mountain Research and Development 26 (1):48-54. https://doi.org/10.1659/0276-4741(2006)026[0048:NPAINL]2.0.CO;2

Sze, J. S., L. R. Carrasco, D. Childs, and D. P. Edwards. 2022. Reduced deforestation and degradation in Indigenous lands pan-tropically. Nature Sustainability 5(2):123-130. https://doi.org/10.1038/s41893-021-00815-2

Tallis, H., and J. Lubchenco. 2014. Working together: a call for inclusive conservation. Nature 515(7525):27-28. https://doi.org/10.1038/515027a

Tengö, M., E. S. Brondizio, T. Elmqvist, P. Malmer, and M. Spierenburg. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. Ambio 43(5):579-591. https://doi.org/10.1007/s13280-014-0501-3

van Riper, C., W. Stewart, R. Andrade, D. Johnson, E. Salcido, D. Goodson, R. Colliani, E. Johnson, A. Craver, R. Keller, B. Battioni, A. Arroyo Schnell, and D. Reynolds. 2021. ENVISION Fact sheet: social learning about protected areas in the Denali Region of Alaska (US). Zenodo. https://doi.org/10.5281/zenodo.5706747

Watson, J. E. M., N. Dudley, D. B. Segan, and M. Hockings. 2014. The performance and potential of protected areas. Nature 515 (7525):67-73. https://doi.org/10.1038/nature13947

Wei, F., S. Wang, B. Fu, L. Zhang, C. Fu, and E. M. Kanga. 2018. Balancing community livelihoods and biodiversity conservation of protected areas in East Africa. Current Opinion in Environmental Sustainability 33:26-33. https://doi.org/10.1016/j.cosust.2018.03.013

West, S., L. J. Haider, S. Stålhammar, and S. Woroniecki. 2020. A relational turn for sustainability science? Relational thinking, leverage points and transformations. Ecosystems and People 16 (1):304-325. https://doi.org/10.1080/26395916.2020.1814417

Xu, H., Y. Cao, D. Yu, M. Cao, Y. He, M. Gill, and H. M. Pereira. 2021. Ensuring effective implementation of the post-2020 global biodiversity targets. Nature Ecology and Evolution 5(4):411-418. https://doi.org/10.1038/s41559-020-01375-y

Zafra-Calvo, N., P. Balvanera, U. Pascual, J. Merçon, B. Martín-López, M. van Noordwijk, T. H. Mwampamba, S. Lele, C. Ifejika Speranza, P. Arias-Arévalo, D. Cabrol, D. M. Cáceres, P. O'Farrell, S. M. Subramanian, S. Devy, S. Krishnan, R. Carmenta, L. Guibrunet, Y. Kraus-Elsin, H. Moersberger, J. Cariño, and S. Díaz. 2020. Plural valuation of nature for equity and sustainability: insights from the Global South. Global Environmental Change 63:102115. https://doi.org/10.1016/j.gloenvcha.2020.102115

Zafra-Calvo, N., E. Garmendia, U. Pascual, I. Palomo, N. Gross-Camp, D. Brockington, J.-A. Cortes-Vazquez, B. Coolsaet, N. D. Burgess. 2019. Progress toward equitably managed protected areas in Aichi Target 11: a global survey. BioScience 69 (3):191-197. https://doi.org/10.1093/biosci/biy143

appendix 1. Appendixes

Please click here to download file 'appendix1.xlsx'.