Mobilisation of indigenous and local knowledge as a source of useable evidence for conservation partnerships

PERNILLA MALMER, VANESSA MASTERSON
Swedbio, Stockholm Resilience Centre
BEAU AUSTIN
Charles Darwin University
and
MARIA TENGÖ
Swedbio, Stockholm Resilience Centre

6.1 Introduction

Rapid and interlinked changes in the biosphere, including degradation of the biodiversity and ecosystems that underpin human well-being, are reported with increasing regularity. As such, there is an urgent need for conservation initiatives that are capable of countering the speed and veracity of change, while meeting the needs of human societies on a crowded planet. While significant advancements in scientific knowledge in the fields of sustainability and conservation continue to be achieved, the forecasted rate of rapid ecological and social change requires the production of innovative mechanisms for management and policy.

One way of contributing to new solutions in a timely manner is to more effectively mobilise multiple knowledges, values and governance systems that can complement Western approaches to science. Together these can extend the collective knowledge base and contribute to collaboratively designing ways forward for looking after people and the biosphere. Compared with Western-based approaches, indigenous and local knowledge systems represent alternative ways of learning from and with the environment, through close and continuous observation framed by distinct worldviews with particular strengths and limitations (like all knowledge systems). Knowledge is embodied by the actors and in their practices, tools, and technologies, as well as in the institutions that organise the production, transfer and use of knowledge (Cornell et al., 2013). There has recently been more attention

focused on the urgent need for science and policy to recognise and mobilise the knowledge of indigenous people and local communities who steward substantial biodiversity across the globe (Brondizio & Le Tourneau, 2016; Mistry & Berardi, 2016). Collaborative ways for mobilising knowledge and learning across diverse knowledge systems can contribute complementary knowledge, innovations and new solutions. Involvement of multiple actors and knowledges can strengthen usefulness and legitimacy in decision-making and implementation (Sterling et al., 2017a; Gavin et al., 2018).

In this chapter, we draw attention to the potential for mobilising local and indigenous knowledge systems, institutions and actors in ways that allow meaningful use of their knowledge about landscapes and their functions as evidence for conservation. By doing this, we propose that innovative and collaborative mechanisms can be designed and implemented that will create opportunities for long-term sustainable governance and conservation of biodiversity.

We introduce the Multiple Evidence Base (MEB) approach to guide the design and implementation of conservation partnerships that enable engagements with indigenous and local knowledge as evidence as an entry point to promote sustainable governance of interrelated ecosystems and human well-being (Tengö et al., 2014, 2017). The approach was developed to guide inclusive processes for collaborations across knowledge systems, based on equity and usefulness for all actors involved. It emphasises that indigenous, local and scientific knowledge systems are complementary, equally valid and useful for informing sustainable governance of biodiversity and ecosystems. The MEB focuses on the theoretical and practical potential for collaborative knowledge-weaving processes to mobilise indigenous and local actors, institutions and practices to achieve long-term conservation and sustainability targets. We argue that collaborative approaches to conservation must be equitable and fair to be effective in the long term (Brondizio & Le Tourneau, 2016; Sterling et al., 2017a; Gavin et al., 2018).

The utility and value of the MEB approach will be discussed in light of its aim to support more informed and efficient local, national and international policy processes and governance decisions for the integrated benefits of conservation, sustainable use and human well-being. We describe the current and potential role that a MEB approach may have in enhancing the efficacy of conservation science and policy by clarifying and strengthening synergies with indigenous knowledges and practices. To achieve this, we first review the peer-reviewed and grey literature to reflect on the extent of uptake of the MEB and how it has been applied in both science and policy-practice processes. Second, to illustrate the approach and reflect on successes and practical challenges, we take a deeper look at three case studies of piloting a MEB approach. The cases demonstrate the potential for the MEB

approach to be used as both a framing tool for collaborative partnerships and a practical guide to weaving multiple knowledge systems. Lastly, we discuss ways forward to nurture conservation and mobilise partnerships that build on knowledge collaborations. We find that a MEB approach has potential to support the inclusion of a wider range of evidence in conservation practice, strengthen active participation of local actors and improve conservation partnerships through the recognition and revitalisation of local knowledge systems and governance.

6.2 The need for new approaches to collaborative conservation

There is a long history of attempts to reconcile conservation objectives with local livelihoods in integrated development and conservation processes, which have often been framed as 'win–win' opportunities with social–ecological benefits (Adams et al., 2004). In the conservation literature, the importance of involving local people is well established, with mounting evidence that processes that meaningfully engage local people are more likely to succeed in protecting biodiversity (Waylen et al., 2010; Sterling et al., 2017a) and that failure to do so can lead to lack of trust and commitment, project failure, and in the worst case, lingering conflicts (Oldekop et al., 2015). While many indigenous peoples and local communities continue to be evicted from their ancestral lands and experience colonisation in the name of conservation, there is now a move towards recognising their connections to land and endogenous obligations to care for it as synergetic with biodiversity conservation outcomes (Knox, 2017). This provides a foundation for enabling local people and conservation organisations to be strategic allies. Furthermore, there is increasing evidence that involving local actors in monitoring enhances management responses at local spatial scales, and increases the speed of decision-making to tackle environmental challenges at operational levels of resource management (Danielsen et al., 2010; Sterling et al., 2017a).

Despite these generally acknowledged realities about the usefulness of engaging with indigenous peoples and local communities, they are often included as stakeholders in conservation, without recognition of their knowledge and expertise (Danielsen et al., 2010). In the literature much attention is given to the uniqueness and utility of indigenous and local knowledge systems, which is often holistic, providing an understanding of integrated social–ecological systems, biocultural values and belief systems (Sheil et al., 2015; Sterling et al., 2017a). However, in practice, there often exists scepticism about the contemporary existence and/or effectiveness of indigenous and local knowledge as useful evidence in conservation. Similarly, holders of indigenous and local knowledge can be sceptical of the claims generated through western scientific approaches due both to the unfamiliarity of the epistemic practices employed and recent or ongoing experiences of colonisation and disempowerment

(Nadasdy, 1999; Johnson et al., 2015; Kealiikanakaoleohaililani & Giardina, 2016; Mistry & Berardi, 2016).

6.3 The multiple evidence base approach: connecting knowledge systems for the benefit of conservation and human well-being

The need to engage with diverse sources of knowledge for conservation has been recognised in high-level science–policy processes, such as the Convention on Biological Diversity, and the Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES). From the outset, IPBES had the ambition to *recognise and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems* (Díaz et al., 2015). This was used as a window of opportunity to start an open dialogue to explore current divides between indigenous, local and scientific knowledge systems, and to elicit methods for collaborations based on equity, reciprocity and usefulness for all involved (see Tengö et al., 2014). A science–policy–practice dialogue process brought together knowledge-holders and experts from diverse knowledge systems, convened by SwedBio at Stockholm Resilience Centre in collaboration with key partners representing indigenous peoples and local communities, such as the International Indigenous Forum on Biodiversity and the African Biodiversity Network. The active engagement from these networks, representing a diversity of knowledge systems and linking practices on the ground with global policy and science, created legitimacy and recognition of outcomes from the dialogues. The starting point was the pivotal dialogue meeting prior to the establishment of IPBES in the indigenous territory of Guna Yala, Panama, where essential principles for exchange across knowledge systems were identified: *trust*, *respect*, *reciprocity*, *equity*, *transparency* and *free prior and informed consent* (Tengö & Malmer, 2012). Since then, the MEB approach has developed in parallel to the IPBES, while carefully paying attention to other interests and needs of the partners.

The MEB can be understood as a deep approach to collaborative knowledge-sharing that explicitly acknowledges that challenges are fundamentally due to different perspectives and practices concerning human–nature relationships, approaches to knowledge validation, knowledge governance and who qualifies as an 'expert'. Also, it recognises that scientists have tended to dominate the design and implementation of collaborations across knowledge systems both historically and contemporarily (Nadasdy, 1999; Mistry & Berardi, 2016). Another key component of an MEB approach is its emphasis on the need for mobilisation and validation of knowledge within knowledge systems themselves. That is, if scientific methods that often are specific and partial are applied to local knowledge that is practical, multidimensional and holistic, there is a risk of omission, misinterpretation and rejection of critical and useable knowledge.

The MEB approach views different knowledge systems as complementary and emphasises that joint analysis assists in working both with convergence and divergence (e.g. Molnár et al., 2016a; Hohenthal et al., 2018). For example, Molnár et al. (2016a) highlight that when discussing approaches to conservation in the Hungarian steppe, local herders focus on primarily utilitarian purposes, such as how they can manage the behaviour of their grazing animals in order to promote the health and diversity of grass assemblages for production. In comparison, conservationists working in the same landscapes focus almost solely on the protection of the plants themselves, with little regard to the impact on grazing animals. If this difference is ignored, or framed as a problem, it has the potential to create tension when attempting to collaboratively design and implement conservation initiatives in the region. Conversely, these different perspectives can be worked together to provide an enriched picture of exactly what is necessary for maintaining and enhancing biodiversity and social–ecological system function in the steppe.

In order to build evidence – whether new knowledge or existing – that is legitimate and useful for all actors in such collaborations for conservation, there is a need to engage with local knowledge systems and knowledge-holders from the outset, co-defining a common problem and facilitating equitable engagement through all activities, including mobilising and assessing knowledge. This process is outlined in the three phases of the MEB approach (Figure 6.1a). Collaboratively analysing and interpreting the complementary evidence from diverse sources is a way to triangulate information, strengthen legitimacy and relevance of existing knowledge and build a base for further learning.

As guidance for how to implement an MEB approach, five tasks were identified as critical (Figure 6.1b; Tengö et al., 2017). First, to *mobilise* knowledge – to ensure that the knowledge is articulated, validated internally and free to be shared with others. Second, to *translate* knowledge, reciprocally, so that all actors can comprehend each others' knowledge and where it is derived from. Third, to *negotiate*, to jointly address convergence and divergence between knowledge systems, and the extent to which the latter can be resolved, for example by understanding differences in underlying assumptions and values (Gagnon & Berteaux, 2009; Molnár et al., 2016a). Fourth, to *synthesise.* Here we emphasise synthesis based on a joint process that does not require that all knowledge is validated by one knowledge system (e.g. empirical validation by science). Lastly, to *apply* – and this is where we iterate the need to recognise the different needs and interests by different actors. Knowledge collaborations need to be designed in a way that is is perceived as useful and leads to constructive outcomes for all involved. The bridging of knowledge systems therefore requires the creation of settings for exchange of multiple
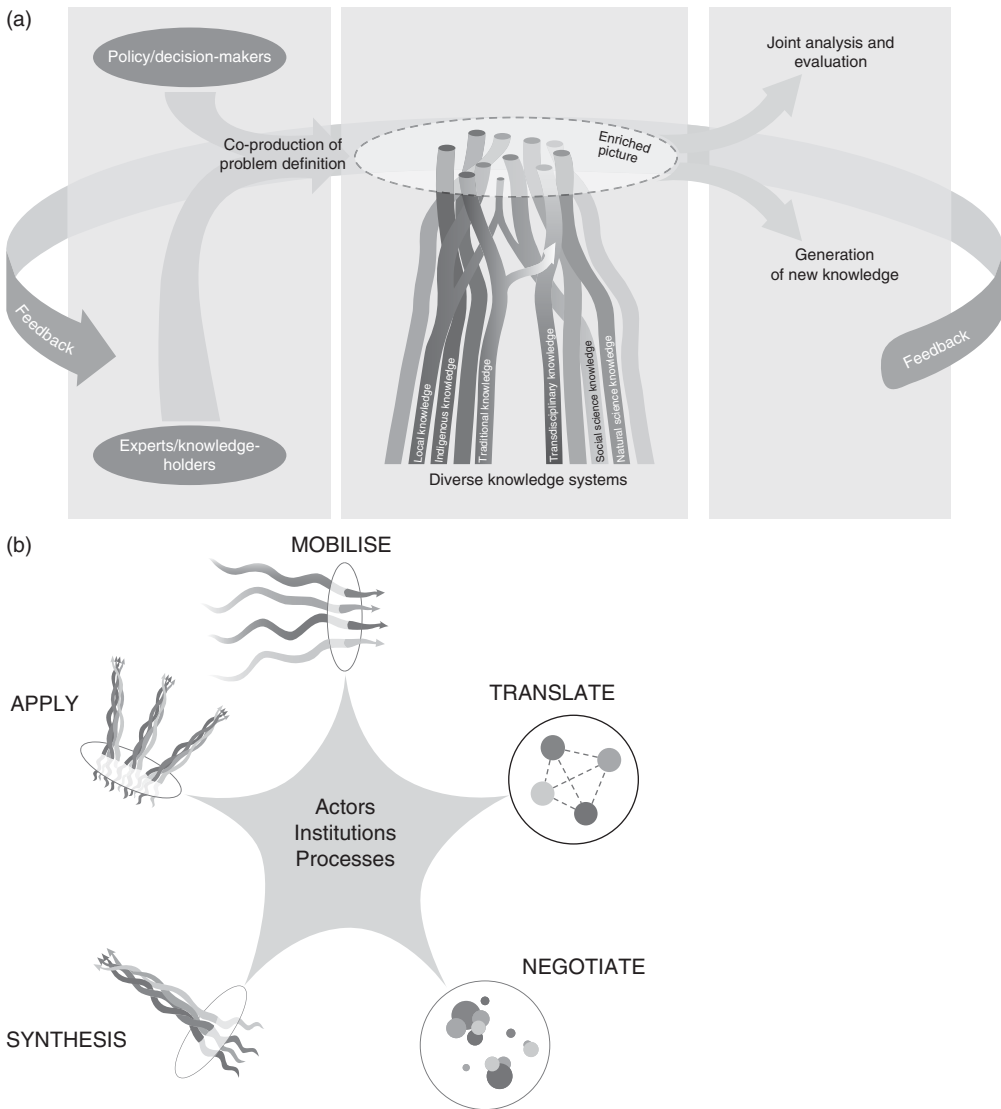
(a)

Policy/decision-makers

Joint analysis and
evaluation

Co-production of
problem definition

Enriched
picture

Feedback

Generation
of new knowledge

Feedback

Local knowledge

Indigenous knowledge

Traditional knowledge

Transdisciplinary knowledge

Social science knowledge

Natural science knowledge

Experts/knowledge-
holders

Diverse knowledge systems

(b)

MOBILISE

APPLY

TRANSLATE

Actors
Institutions
Processes

NEGOTIATE

SYNTHESIS

Figure 6.1 The Multiple Evidence Base approach in action. (a) The three phases of
a MEB approach: joint problem formulation, generating an enriched picture with
contribution from multiple sources of evidence and joint analysis and evaluation of
knowledge (Tengö et al., 2014). (b) Actors, institutions and processes are at the core of
the five tasks required for successful collaboration across diverse knowledge systems.
The different colours of the lines and dots in parts (a) and (b) represent different
knowledge systems, or streams of knowledge within knowledge systems (Tengö et al.,
2017). (A black and white version of this figure will appear in some formats. For the
colour version, please refer to the plate section.)

forms of knowledge and learning across key aspects of the system (Figure 6.1b). We view the outcome as *weaving* – knowledge collaborations that respect the integrity of each knowledge system while working them together for practical collaboration (Johnson et al., 2016; Tengö et al., 2017). In the next section, we use literature and our own experience to evaluate and discuss implementation of the MEB approach, with a specific focus on describing the outcomes in terms of evidence applied in conservation partnerships.

6.4 Reviewing the impact of the MEB in conservation and sustainability

The literature on knowledge collaborations for conservation and sustainability is wide-ranging. To focus on collaborations across knowledge systems (indigenous, local and scientific knowledge systems) and to generate further insights into the application, challenges and usefulness of a MEB approach, we reviewed articles that cite Tengö et al. (2014) or that mention 'Multiple Evidence Base' in the academic literature, represented by Scopus (123 articles), and the grey literature (219 results), represented by Google Scholar (as of 2018–02-01).

The results of this review demonstrate that the MEB approach has contributed to a general move towards broader participation of knowledge-holders in multi-level ecosystem assessments (Díaz et al., 2015; Nesshöver et al., 2016), as well as citizen science, the importance of the plurality of knowledge systems in conservation (Prado & Murrieta, 2015) and knowledge application in public policy and resource management (Bruckmeier, 2016). This is part of a 'shift that has occurred in the science–policy–society interface with a move towards greater inclusivity, and efforts to transcend traditional reductionist approaches' (Jabbour & Flachsland, 2017, p. 196).

The MEB approach is finding traction in diverse discussions including citizen science (Buytaert et al., 2014) and community-based monitoring (Johnson et al., 2015; Lyver et al., 2017), collaborative management and decision-making (Mathevet et al., 2016), community-based conservation (Nkambule et al., 2016; Sterling et al., 2017a), measuring resilience (Quinlan et al., 2016; Sterling et al., 2017b), approaches to modelling global change processes (Verburg et al., 2016), indigenous autonomy and cultural revitalisation (Gonzales, 2015), value pluralism in ecological economics (Martín-López & Montes, 2015; Kenter, 2016; Pascual et al., 2017), biocultural values and diversity (Gavin et al., 2015; Sterling et al., 2017b) and political ecology, law and environmental justice (Gambon & Rist, 2018; Hohenthal et al., 2018).

The majority of articles reviewed (51 percent) engage with the MEB approach in a relatively superficial manner to illustrate that combining

multiple knowledge systems is a sustainability challenge. The literature is awash with programmatic articles with calls to include, combine and integrate knowledges to find solutions to sustainability problems (e.g. Balvanera et al., 2017; Vasseur et al., 2017). However, still very little attention is paid to exactly how this will be done. Additionally, 20 percent of articles reviewed represent collaborative processes in practice but do not apply a MEB approach. Many articles view actors as stakeholders and talk about 'open participation and open consultation' (e.g. Livoreil et al., 2016) rather than addressing their role as knowledge-holders and experts and the need for equitable platforms for engagement, mobilisation and translation of indigenous and local knowledge.

The MEB approach has also received significant attention in the grey literature and science–policy–practice community. For example, it is called for as a way of ensuring equitable participation for indigenous, local and scientific knowledge in monitoring of the Convention on Biological Diversity. For example the Convention's Aichi target 18 on traditional knowledge, innovation and practices, along with the Community-Based Monitoring and Information Systems, is a bottom-up approach developed by indigenous peoples and local communities to contribute their experiences and observations through monitoring (CBD, 2014; Farhan Ferrari et al., 2015). Further, a MEB approach has been encouraged in traditional knowledge inventories, as well as in the development of safeguards for biodiversity financial mechanisms and Reducing Emissions from Deforestation and Degradation (REDD+) under the United Nations Framework Convention on Climate Change.

To illustrate the implementation of the MEB approach in the literature, we have selected a small set of pertinent case studies. Table 6.1 presents an analysis using key features of the MEB approach – joint problem formulation, validation within knowledge system and the five tasks illustrated in Figure 6.1b.

The cases illustrate that, in different contexts, specific phases of the MEB approach presented by Tengö et al. (2014, 2017) are more or less useful, and are operationalised in different ways. The process of co-defining the problem and questions together with all knowledge-holders appears to be a challenge not taken up in all cases, often with scientists or project proponents defining a problem, and then approaching indigenous and local knowledge-holders and local communities through consultation sessions to join and support the collaboration (e.g. Strangway et al., 2016; Lyver et al., 2017; Smith et al., 2017). However, other papers do emphasise the critical role of joint problem formulation for the success of conservation interventions (Brondizio et al., 2016; Galvin et al., 2016).

Maintaining the integrity of diverse knowledge systems throughout collaborative knowledge processes also appears to be a particular challenge in science-driven processes. Actively thinking about what validation of knowledge within knowledge systems means (rather than using science to validate local knowledge) and how it may be embedded in practice is absent from most papers. There are notable exceptions that explicitly reflect upon this challenge (e.g. Austin et al., 2017) and suggest new approaches, such as peer-to-peer validation by farmers (Smith et al., 2017; Table 6.1). Other papers do not address this explicitly, but still engage with how local knowledge systems evaluate knowledge (e.g. through interactions with internally acknowledged experts and their local institutions) (Molnár et al., 2016; Nguyen et al., 2017; see Table 6.1). Additionally, joint discussion and analysis of data across knowledge systems has sometimes been incorporated through formal consultation structures or committees (e.g. Strangway et al., 2016; Austin et al., 2017; Reed & Abernethy, 2018). The articles also illustrate the progress in development of methods to facilitate the phases and activities defined in Tengö et al. (2014, 2017) to combine and relate multiple data through e.g. participatory scenario planning, focus groups (Danielsen et al., 2014), fuzzy cognitive maps and community monitoring with digital devices (Brammer et al., 2016). The use of art (Rathwell & Armitage, 2016; Polfus et al., 2017), participatory maps (Robinson et al., 2016) or film (Molnár et al., 2016) to mobilise, translate and present knowledge on an equitable platform has facilitated joint analysis and negotiation. Articles also illustrate practical ways of maintaining equity, such as creating research agreements or protocols concerning intellectual property; free, prior and informed consent; the roles and responsibilities of each member of the project team (Robinson et al., 2016); and recognising indigenous and local knowledge-holders as authors on scientific articles (Molnár et al., 2016a; Smith et al., 2017; Table 6.1).

The citations suggest that the mobilisation and translation activities suggested by Tengö et al. (2017) have had particular resonance in the conservation and sustainability literature. There has been consistent progress towards the explicit mobilisation and translation of indigenous knowledge and worldviews (Gonzales, 2015; Vogt et al., 2016; Horstkotte et al., 2017; Timoti et al., 2017). In this way, the mobilisation of multiple knowledge systems contributes to a movement towards environmental justice and pluralism in decision-making (Hohenthal et al., 2018), as well as recognising indigenous peoples' autonomous actions towards dealing with climate change (Gonzales, 2015).

In the next section, we use three in-depth case studies to further explore the value of a MEB approach to contribute to conservation partnership based on diverse sources of knowledge.

Table 6.1 *Articles applying a multiple evidence base in literature*

Article citation	Issue investigated including location	Multiple evidence base	Evidence of joint problem formulation and usefulness for all (Tengö et al., 2014)	Evidence of validation within knowledge systems (Tengö et al., 2014)	Evidence of application of the five tasks for successful collaboration across diverse knowledge systems (Tengö et al., 2017). 1 = mobilise, 2 = translate, 3 = negotiate, 4 = synthesise, 5 = apply
Austin et al., 2017	MEB approach to enable enriched picture of progress of an Indigenous Land and Sea Management programme run by the Wunambal Gaambera people in the Kimberley, Australia	Informing the evidence base of the Wunambal Gaambera Healthy Country Plan using western scientific and local indigenous knowledge. Parallel integration of western and indigenous monitoring data/ information to support co-production of enriched picture of country and management activities by the Uunguu Monitoring and Evaluation (M&E) Committee	Collaborative and multiple evidence-based M&E committee designed the approach to conducting evaluation of progress and assessment of key targets	Yes, each stream of knowledge was internally validated and cross-checked through collaborative self-assessment by Uunguu M&E Committee	1, 2, 3, 4, 5 Local indigenous knowledge was mobilised through the planning process and the M&E committee; translation of information from various sources via monitoring methods; further negotiation and translation occurred within M&E committee; all knowledge streams synthesised through M&E committee meetings and reporting processes; and applied through adaptive management of the Healthy Country Plan

Table 6.1 (*cont.*)

Article citation	Issue investigated including location	Multiple evidence base	Evidence of joint problem formulation and usefulness for all (Tengö et al., 2014)	Evidence of validation within knowledge systems (Tengö et al., 2014)	Evidence of application of the five tasks for successful collaboration across diverse knowledge systems (Tengö et al., 2017). 1 = mobilise, 2 = translate, 3 = negotiate, 4 = synthesise, 5 = apply
Nguyen et al., 2017	Sustainable management of eroding mangrove-dominated muddy coasts in Vam Ray, Hon Dat district, Kien Giang Province, Vietnam	Partnership between government agencies, scientists and local communities. Methods included literature review, semi-structured interviews, participatory community meetings, participatory diagramming and thematic analysis. The introduction and analysis of different knowledge systems are undertaken in participatory community meetings, semi-structured interviews, field visits, photovoice and debriefings	All parties agreed to co-formulate the problems and use local and scientific knowledge to generate and pilot new knowledge for solving them. It was agreed to build local capacity and to utilise as many local resources as possible for developing the fence and nursery construction, to solve serious erosion problems affecting the community	Local knowledge of, e.g. Melaleuca fence construction was validated by local experts based on their experience. However, facing new challenges in the community created interest in other knowledge such as scientific knowledge. The collaboration led to new knowledge about fencing for controlling coastal erosion	1, 2, 5 Local knowledge held by individuals regarding traditional Melaleuca fences, and local contexts were systematically collected and brought together with the relevant scientific knowledge in relation to sedimentation and coastal dynamics in Kien Giang, Vietnam into ecologically based, cost-effective strategies for successfully controlling coastal erosion

| Robinson et al., 2016 | Water management in territories of aboriginal people connected to the Girringun Indigenous Corporation (Girringun) in northern Australia | Participatory maps created in workshops of Girringun support staff, Aboriginal rangers, some Girringun elders who are also artists and some of the authors to determine the values, knowledge and management aspirations of participants for their 'fresh water country'. Second workshop to discuss the values that the participants had for native plants and trees and to identify risks to those values and the attributes of partnerships that support these values | Co-research approach, in which Girringun representatives worked with the researchers to select participants and design the participatory mapping workshops, advising on an appropriate focus, location and design for each workshop | Yes, the integrity of each indigenous knowledge system was maintained throughout process | Girringun representatives and scientists created individual maps to mobilise and translate the knowledge needed for Girringun and its associated tribal groups to assess two distinct issues of concern. Collective watershed maps were also used to negotiate knowledge and although there was some variety in the information shared by different participants, the integrity of each indigenous knowledge system was maintained throughout the process. Synthesis of themes occurred through creation of targeted research 'products', including a one-page summary, that could be used by the research team and the Girringun Indigenous Community to translate the results of the project in a way that was useful to the participants, Girringun and the wider natural resource management community | 1, 2, 3, 4, 5 |

Table 6.1 (*cont.*)

Article citation	Issue investigated including location	Multiple evidence base	Evidence of joint problem formulation and usefulness for all (Tengö et al., 2014)	Evidence of validation within knowledge systems (Tengö et al., 2014)	Evidence of application of the five tasks for successful collaboration across diverse knowledge systems (Tengö et al., 2017). 1 = mobilise, 2 = translate, 3 = negotiate, 4 = synthesise, 5 = apply
Smith et al., 2017	Developing conservation strategies for pollinators in the context of pollinator decline in Orissa, India	Peer-to-peer validation of trends and statements distilled from focus groups including 50 smallholder subsistence farmers, including tribal people, who have personal and procedural knowledge of crop production, and rural advisors; anecdotal network. This was in preparation for integration with scientific knowledge from other regions	The problem (a potential pollinator crisis) was defined by scientists, who recognised the dearth of information on diversity of crops and pollinators and together with farmers and rural advisors collated traditional and local knowledge on the same	Yes. Peer-to-peer validation of indigenous knowledge of trends and statements distilled from focus groups including 50 farmers and rural advisors	1, 2, 4 Traditional knowledge of crop diversity and pollinators was elicited and internally validated, providing a consensus on knowledge which was collated for integration with scientific knowledge

| Molnár et al., 2016a, 2016b | Mitigation of conflicts between cattle herding and conservation management of salt-steppe and wood pastures in Hungary | An inventory of objectives and practices of herders (representing traditional knowledge) and conservationists and ethnobotanists (scientific knowledge) were collected by participatory knowledge co-production in teamwork with the co-authors. Possible resolutions to potential conflicts were suggested. Methods include: (1) participatory observation, (2) semi-structured interviews with herders and conservationists, (3) co-author herders and conservation managers completed and clarified the contents of the tables in two rounds | Herders and ethno-ecologists jointly formulated the problem, and potential solutions were suggested by all parties | Yes. Herder interviews colleagues that explain their observations and experiences and jointly validate the relevance for the issues. Less focus on conservation manager's validation. However, importance of integrity, equity and reciprocity in their knowledge-based interactions highlighted | 1, 2, 3, 4 | Herders' and conservationists' knowledge of practices were elicited in interviews. Herders' perspectives were mobilised and translated through film. Data were negotiated among diverse author group and synthesised for joint publication |

Table 6.1 (*cont.*)

Article citation	Issue investigated including location	Multiple evidence base	Evidence of joint problem formulation and usefulness for all (Tengö et al., 2014)	Evidence of validation within knowledge systems (Tengö et al., 2014)	Evidence of application of the five tasks for successful collaboration across diverse knowledge systems (Tengö et al., 2017). 1 = mobilise, 2 = translate, 3 = negotiate, 4 = synthesise, 5 = apply
Strangway et al., 2016	A registry monitoring an aboriginal subsistence fishery in the Cree community of Waskaganish (Waskaganish Voluntary Anadromous Cisco Catch Registry) within the Environmental Impact Assessment (EIA) Follow-up Phase after diversion of the Rupert River for hydroelectric plant at Nûtimesânân in Northern Quebec, Canada	Collaboration between Hydro-Quebec and the impacted community. Bringing together different monitoring reports of cisco including the Voluntary Catch Registry of the Crees of Waskaganish First Nation, biological monitoring and complementary studies	Unclear. State-owned utility, Hydro-Quebec, proposed a monitoring programme after authorisation of river diversion which would include studies on cisco spawning success, as cisco harvesting is key for Waskaganish First Nation community's cultural identity and subsistence economy. Four community members hired as monitors to collect data on cisco catch	Yes. In the voluntary cisco catch registry programme, compiled data were presented to land users at the end of the fishing season for interpretation and validation. Shared observations regarding the fishing season, fishing success and any other comments, as well as how the data will be presented outside of the community, were discussed and included in the final Registry reports	1, 2, 4, 5 Fishers propose mitigation measures to increase fishing success under new flow rates, and stakeholders assess their potential, with the results of the various cisco monitoring programmes, including the Voluntary Registry, featuring prominently in the decision. Once measures are implemented, the Registry programme is used to evaluate their effectiveness by collecting catch data

Notes: Examples assessing the experience of applying a MEB approach, showing the issue investigated, the location and the multiple evidence base, in literature that either quoted Tengö et al. (2014) or referred to MEB. The review examined evidence of joint problem formulation and usefulness for all stakeholders (defined by Tengö et al., 2014), evidence of internal validation within knowledge systems (defined by Tengö et al., 2014) and evidence of application of each of the five tasks for successful collaboration across diverse knowledge systems (as defined by Tengö et al., 2017).

Table 6.2 *Summary of MEB tasks to guide knowledge collaborations (Tengö et al., 2017) as applied in the three case studies*

MEB phases	Multiple evidence-base case examples		
	4.1. Piloting the MEB: Tharaka's river is running dry	4.2. Mobilising indigenous knowledge systems for saltwater country across the Kimberley, Australia	4.3. Justice and conservation: Global Dialogue on Human Rights and Biodiversity Conservation
1. Mobilise Develop knowledge-based products through a process of innovation and/or engaging with past knowledge and experience	The preparatory process for the eco-cultural mapping, where the elders of the clans start to engage and document their experiences The process of making ecocultural maps and calendars, which mobilised and synthesised knowledge on the landscape and how it has changed over time	Project objectives and research activities identified by an intercultural collaborative Working Group (WG) to ensure focus on local priorities. At the individual community workshop level, each of the indigenous ranger groups designed the specific activities, venue and participants. Focus group discussions and knowledge-holder interviews were selected as appropriate methods for indigenous people to use their knowledge to inform the process. Ranger groups were all equally resourced to facilitate and participate in research activities	Participation occurred before the actual dialogue, through interactions over internet. Preparation of indigenous community representatives to present and mobilise knowledge about ecology as well as human rights among the participants. The contributions from indigenous communities were planned to be presented during walking workshops in the Oigek Community. However, an outbreak of Marburg virus meant the dialogue was moved to Eldoret. The stories were told by community representatives attending the workshop

Table 6.2 (*cont.*)

MEB phases	Multiple evidence-base case examples		
	4.1. Piloting the MEB: Tharaka's river is running dry	4.2. Mobilising indigenous knowledge systems for saltwater country across the Kimberley, Australia	4.3. Justice and conservation: Global Dialogue on Human Rights and Biodiversity Conservation
2. Translate Adapt knowledge products or outcomes into forms appropriate to enable mutual comprehension in the face of differences between actors	Occurred together with mobilisation in the ecocultural mapping event, where representatives from local authorities, regional authorities and national institutions were present Also later in the process, in the documentation of customary laws that were considered along with modern law, and in the gazetting of sacred sites led by the National Museums of Kenya	All research results generated by indigenous workshop participants and knowledge-holders were collated and provided in short, simple reports to relevant indigenous communities for validation. A period of one month was provided to give feedback, make amendments, add anything that was missing or embargo content Once the reports were validated they were presented to the WG who discussed how to analyse and represent results from the perspective of both indigenous people and their non-indigenous partners in collaborative management of saltwater country	The core focus for the dialogue and concerns articulated was what indigenous knowledge, practice and belief systems mean for indigenous peoples, in relation to how it is perceived by scientists and government representatives. But also, what human rights mean if applied to biodiversity conservation decisions. Dialogue was designed to encompass the very diverse ways of expression, experiences and perspectives among the participants

Stage			
3. Negotiate Interact among different knowledge systems to develop mutually respectful and useful representations of knowledge	All actors accepted evidence of the critical situation for the river brought up by the ecocultural mapping, complemented with technical data from research and government institutions provided by regional authorities Negotiation also happened in the development of action plans following the mapping process, where the community and local authorites agreed upon actions to improve the condition of the river	WG and research team had regular contact to ensure a collaborative research approach and facilitate discussions on saltwater research and monitoring at a regional scale WG provided an important conduit between indigenous communities, their staff and the research community WG held a final workshop attended by indigenous people, indigenous rangers, indigenous representative bodies, scientists and federal and state governments to raise awareness and seek final feedback on project outputs	Negotiations included how to interpret biodiversity data from different approaches for management and governance of ecosystems, along with knowledge about human rights principles and legislation, and cultural and socio-economic use of biodiversity
4. Synthesise Shape broadly accepted common knowledge bases for a particular purpose	Synthesis occurred in compiling customary laws and conventional laws together with authorities, when gazetting the sacred sites and in the development of action plans for protecting the river	Indigenous participants engaged in regular synthesis of results, from scoping, defining research questions and conducting fieldwork, to analysing results and communicating outcomes. The use of the MEB approach was a result of the WG's capacity to consider a range of possible tools and processes and choose the ones that work best for the project Indigenous people had the opportunity to continuously monitor to ensure that project frameworks and tools	Agreement in place, based on evidence, that synergies are possible between conservation and human rights. In policy and practice, more efforts are needed to synthesise 'how' this can happen. The dialogue did not aim for a synthesis, that is for a later stage, with policy decisions leading to application. When presenting a summary of evidence, it was considered important to recognise convergence, but also identify and

Table 6.2 (*cont.*)

MEB phases	Multiple evidence-base case examples		
	4.1. Piloting the MEB: Tharaka's river is running dry	4.2. Mobilising indigenous knowledge systems for saltwater country across the Kimberley, Australia	4.3. Justice and conservation: Global Dialogue on Human Rights and Biodiversity Conservation
		fitted into the holistic, contextual and current situation in the Kimberly Saltwater Country	recognise where there were still disagreements
5. Apply Use common knowledge bases to make decisions and/or take actions and to reinforce and feed back into the knowledge systems	The process led to applications to improve river conditions at multiple levels: Revitalisation of rituals and enforcement of customary law at sacred sites Government recognition of the custodians as protecting the sites Enforcement of regulations of water extraction and riparian zone protection by regional authorities	The primary outcome: a regional network of indigenous people who have negotiated as regional knowledge brokers with their elders and knowledge-holders Short-term funding secured for the WG to support implementation, modification and compliance of the best-practice approaches developed Tools developed: – Regional saltwater monitoring framework based on indigenous knowledge identified social, cultural, economic and environmental values – Digital research protocol and application systems – Set of guidelines to describe simple processes for knowledge collaborations	The evaluation showed that knowledge for conservationists about Human Rights law and implementation representing a strand of research was considered useful. There was potential for application of insights around equal benefit of conservation and human rights in all the cases brought up in the dialogue

6.5 Exemplifying MEB cases and reflecting on lessons learned

Here we present three case studies that have explicitly implemented a MEB approach (Table 6.2). The first two set out processes to address local conservation and development issues. The third is an international dialogue meeting where the aim was to create a platform to discuss a fundamental crux in conservation globally – how to realise synergies between human rights and biodiversity conservation, and support local people and conservation organisations in becoming strategic allies.

6.5.1 Piloting the MEB approach: Tharaka's river is running dry

6.5.1.1 Context

Drought is a recurring challenge to the livelihoods of the people in Tharaka, Kenya. Kathita River is the main water source and of paramount importance, economically, culturally and spiritually. Fourteen sacred natural sites along the river are protected by the communities for their cultural and spiritual values. In recent years, the government's policy guidelines and regulations for protecting the river have not been upheld and traditional ecological law has not been enforced either. This has led to excessive and often illegal abstraction along the river's course, degradation of the riverine vegetation and destruction of the catchment area. The local people, led by clan-based custodians of the sacred sites, decided to come together to find ways of protecting the river using their indigenous and local knowledge and practices and customary laws. A non-governmental organisation in the area offered to facilitate an eco-cultural mapping process to enhance the eroded local capacity to govern the river.

A preparatory process brought together custodians of the sacred sites along the river. Local community organisations, county leaders and government institutions, including the National Museums of Kenya, were successively engaged in the process. In August 2014, community members jointly developed eco-cultural maps and calendars of the past and present, which illustrated changes in the integrity of their social–ecological system. Based on these, maps of the future envisioning different scenarios were drafted, creating a collective understanding and describing alternative pathways for the future. The maps and insights were shared and discussed with different actors beyond the local community.

A couple of years after the initial process, several of the problems identified with river governance have been addressed: strategies have been formulated for local authorities to reach out to land owners to safeguard riparian reserves. Tree seedlings are raised and distributed to land owners for planting in order to protect the riparian zone. The National Museums of Kenya have, together with the communities, gazetted the sacred sites along Kathita River, which has given them a government-recognised status. Rituals are again carried out at the sacred sites and the customary rules are enforced (Mburu, 2016).

6.5.1.2 *Role of the MEB*

The local non-governmental organisation convening the eco-cultural mapping in Tharaka is a member of a bridging organisation who were engaged in the initial dialogue across knowledge systems and volunteered to pilot a MEB approach. Eco-cultural mapping emerged as a culturally appropriate tool for knowledge mobilisation to enhance ecosystem governance for the society at large, beyond the community benefits expected by the clans that initiated the process. This also led to a greater understanding of the roles that different actors play in the local community and who to approach, how to formulate proposals and the utility of referring to established facts from community-based monitoring of the river.

The process contributed to unifying actors towards an enriched picture of understanding that could be shared and discussed with decision-makers outside the community. The eco-cultural mapping activity focused on how knowledge can be *translated* and *negotiated* to benefit an official process of conservation of sacred sites, and better ecosystem management of the Kathita river at large, through collaboration to protect the landscape (see Table 6.2). For this step, it was important to engage with actors with the authority to act in the customary governance system. Thus, the clans that were managing the sacred sites had a critical role in mobilising other community members.

6.5.1.3 *Challenges and opportunities*

The power imbalance between farmers with resources to extract and use water, and the majority of the community who did not have such resources, but were still exceptionally dependent on Kathita River as a water source, proved a challenge. Community research groups have been formed to solve specific emerging problems defined by the community.

The initiative for the eco-cultural mapping process came from the communities and the local non-governmental organisation, who contacted government and later also the Natural Museums of Kenya in order to catalyse change and ensure impact. The local actors as initiator created a solid base for trustful collaborations across knowledge systems.

6.5.2 Mobilising indigenous knowledge systems for saltwater country across the Kimberley region, Australia

6.5.2.1 *Context*

The Kimberley region in tropical north-western Australia is globally significant for its biodiversity, relatively intact ecosystems and its aesthetic and recreational values. Indigenous peoples comprise almost half of the region's population and have ownership or management rights over most of the land and sea. They are caretakers of a diverse cultural landscape dating back at least 60,000 years. The Australian public places high value on the cultural and natural assets of the Kimberley. The Western Australian Government

concluded in 2011 that to ensure the best possible outcomes of conservation efforts in the Kimberley, a combination of indigenous knowledge and scientific knowledge was needed.

The Kimberley Indigenous Saltwater Science Project (KISSP) was established by a group of indigenous peoples and their organisations, research institutes, corporations and government organisations to investigate ways of co-producing collaborative monitoring, management and research regionally. A working group was established in 2014 with representatives from seven indigenous groups (Balangarra, Bardi Jawi, Dambimangari, Karajarri, Nyul Nyul, Wunambal Gaambera and Yawuru peoples) and key staff from local indigenous organisations. The working group recruited a team of researchers to assist the project. In total, there were 103 indigenous participants in five Traditional Owner workshops and one Knowledge-Holder interview.

6.5.2.2 *Role of the MEB*

Although not intentionally applied at the commencement of the project, the MEB process was followed intuitively by the experienced practitioners involved. Midway through the project, the MEB approach was formally introduced to participants, who immediately recognised its value in describing their practice. The working group agreed to adopt the MEB as an overarching framework for the KISSP project and to design regional frameworks for collaborative knowledge production, monitoring, research and management of Kimberley Saltwater Country (Table 6.2).

6.5.2.3 *Challenges and opportunities*

The biggest challenge faced by the KISSP was to establish engagement with indigenous peoples in the Kimberley. Prior to the formation of the working group, the project struggled for many years to create dialogue with indigenous peoples. Finally, a workshop was held to identify collaborative pathways towards project goals. The intervention of the indigenous-led working group demonstrated the potential for MEB approaches to ensure useful outcomes through intercultural and interdisciplinary projects.

Initially, lack of investment in the capacity of indigenous peoples and their organisations to engage in the research process limited progress. This should not be understood as a lack of knowledge or capacity to care for saltwater country, but rather as a need for support to mobilise their knowledges and practices to contribute to the KISSP as a collaborative, intercultural project. There was a prior assumption that indigenous peoples and their knowledge and practice could easily fit into a regional project that comprised indigenous and scientific knowledge systems side by side. There was no insight of the need for recognition and equity, and for explicit usefulness of the research products for all involved in collaborative practices. For example, there was

consistently a subconscious assumption that flows of knowledge produced throughout the project would be channelled in a unilateral direction to scientists in the regional capital in the form of 'data' to be analysed so as to suitably inform the policy and decision-making processes of the state. The communication of this new information back to indigenous peoples in the Kimberley was more of an afterthought and, presumably, seen more as a bureaucratic demand than a practical mechanism for improving collaborative management of Saltwater Country. This assumption ignored the practical, and fairly reasonable, requirement of local indigenous peoples that any knowledge shared or co-produced through collaborative research and monitoring be made available for informing their own local decision-making and practice for looking after Saltwater Country. The indigenous-led KISSP Working Group made this point patiently and constructively and, thus, ensured that the project could produce several locally useful outputs and outcomes for indigenous peoples in Kimberley Saltwater Country.

6.5.3 Justice and conservation: Global Dialogue on Human Rights and Biodiversity Conservation

6.5.3.1 Context

The Global Dialogue on Human Rights and Biodiversity Conservation was an international meeting initiated to address the conflicts that have often emerged across the globe between conservation agencies and indigenous peoples with longstanding relationships with their ancestral territories, co-organised by SwedBio at Stockholm Resilience Centre, Forest Peoples Programme, Natural Justice and the Chepkitale Indigenous Peoples Development Project as the local host in Kenya. The organisers represented actors engaged from different scales and perspectives, which created confidence and legitimacy for the dialogue. The dialogue started from the conviction that local people and conservation organisations could be strategic allies. It was attended by conservation agencies, social justice and human rights advocates, biodiversity conservation and sustainable use experts, legal and human rights professionals, members of community-based organisations, government officials, UN organisations and academics. It was designed in a global policy-setting context, while also aiming to contribute to local ways forward. The venue for the dialogue, Eldoret, Kenya, is situated between two biodiversity-rich areas conserved by indigenous peoples as their ancestral lands. The Ogiek people are an indigenous hunter-gatherer community on Mt Elgon, at the border of Uganda, while the Sengwer people are traditionally living with and taking care of the Embobut Forests. Both Ogiek and Sengwer have been faced with repeated attempts of eviction over decades in the name of conservation. In 2011, through a conservation-related mediation method called the Whakatane mechanism, the Ogiek communities in Mt Elgon

reached an initial agreement to live in and govern parts of their ancestral lands. However, the Sengwer have rather experienced increased tensions in later years.

6.5.3.2 *Role of the MEB*

Globally there is an increased recognition that human rights protection can, and should, be complementary to safeguarding biodiversity and ecosystems (Knox, 2017), but there is a need to mainstream *how*, through good case examples and methods in policy and practice. A MEB approach was introduced in the preparatory process before the dialogue as part of the multi-actor dialogue method. The design process started with informal discussions between conservation agencies, indigenous peoples, human rights professionals and the organisers a year before the dialogue took place. The long preparatory process helped mobilise knowledge and confidence as a base for common understanding of the overarching ecological, legal, institutional and political challenges among participating actors. Through the dialogue process, the MEB approach provided guidance to ensure equity, reciprocity and usefulness for all actors. In the evaluation, the community representatives stressed they had never before had experience of being recognised and presenting their stories as evidence on an equal footing with science and governments.

6.5.3.3 *Challenges and opportunities*

Establishing a collaboration among different actors at national level in Kenya representing government, indigenous peoples and conservation agencies that generally do not meet was the greatest challenge. Thanks to the global context of the meeting, the presence of international actors with diverse experiences contributed to a constructive dialogue. Interactions among indigenous peoples and scientists were successful because a common understanding of the MEB approach had been established during the preparation. Persistent barriers between indigenous peoples and governments still exist in local cases, in particular the Sengwer people, and should be resolved through policy and legal processes. However, establishing MEB processes whenever governance of ecosystems and biodiversity can be enhanced through collaborative processes across multiple knowledge systems can be useful for all involved in the meantime.

6.6 Sharing lessons from the three cases

In the first case from Tharaka River, the importance of mobilising indigenous and local knowledge as a solid base for translation and negotiation phases was very clear. This then helped people speak about their knowledge, and also catalysed the revitalisation of eroded institutions and rules that previously served to protect the river, including the recognition and protection of the

sacred sites. As the problem formulation was owned by the community, this enabled articulation of the importance of the sacred sites for understanding previous river governance, and motivated local people to restore the river. Later, they contacted the Natural Museums of Kenya, to provide support in gazetting their biodiversity-rich sacred sites for formal national recognition. This illustrates the important role that values and beliefs in diverse knowledge systems can play for conservation, how they may be identified, and how knowledge and governance capacity is embedded in the belief systems.

In the case from the Kimberley, the use of the MEB and the role of indigenous and local knowledge in collaborative management, created space and enthusiasm for experimenting with new ways of combining knowledge systems for management and governance of Saltwater Country. The KISSP demonstrated that working with multiple knowledge systems and disciplines in the context of unequal power relations requires design, support and monitoring of mechanisms that can maintain constant dialogue (e.g. the KISSP working group). Thinking of the collaboration as 'intercultural' was useful for understanding what capacity development was required for all actors. No single party had capacity deficits, but the collective needed to build joint capacity for weaving knowledge systems in ethical and equitable ways.

In the Global Dialogue on Human Rights and Conservation, reaching synergistic solutions between conservation and human rights once again was about overcoming power imbalances. The dialogue was an opportunity for key actors with different knowledges, experiences, worldviews and power to meet in a neutral context. Diversity of experiences (positive and negative) across scales and a careful mix of actors helped to overcome these imbalances during the dialogue. Mobilisation of indigenous and local knowledge and strengthening confidence among participating community representatives, but also knowledge about human rights and other legal aspects before the dialogue, was critical for deliberations. The recognition of indigenous rights and the value of their knowledge and practices for conservation expressed by researchers contributed to trust followed by constructive proposals. Positive experiences from successful collaborations in conservation of indigenous lands contributed to exploring ways forward in cases where conflicts persist. The learning across different sectors and scales, such as ecologists learning about human rights aspects, was appreciated in the evaluations. It also became clear that the deepest conflicts may not relate to conflicting evidence from different knowledge systems regarding ecology, but to controversial policy, such as the eviction of people from conservation areas.

In all three cases, the main challenge of the collaborative process was to overcome power imbalances and build trust and confidence. The focus on recognising, mobilising and discussing evidence from diverse knowledge systems was an entry point that contributed to the development of strong

collaborative partnerships. Designing a process that was considered useful for all involved was critical to securing successful and sustainable outcomes, new and useful ways to combine and apply knowledge from diverse knowledge systems, and sometimes the generation of new knowledge. In all cases, the aim of creating synergies across knowledge systems for providing evidence on sustainable governance could be realised when all holders of knowledge gained from collaborations. A MEB approach, on whatever level it is conducted, emphasises the importance of collaborative processes that value multiple knowledges and practices needed to sustain the social–ecological landscape to the double benefit of sustainable livelihoods and conservation over the long term. Further, the collaborative relationships of trust developed provide new opportunities to align multiple modes of governance of ecosystems, to ensure decisions and policy are based on all available knowledge.

6.7 Discussion

In this chapter, we review the use of one recent and important approach to combining the knowledge of indigenous peoples, local communities and scientists for sustainability and conservation partnerships. We have focused on the MEB and its potential for building more inclusive understanding of multiple sources of evidence, how it is generated and how it is transmitted among diverse conservation actors. We argue that such an approach is important for better understanding of interlinked social–ecological systems, strengthening conservation partnerships and identifying new evidence-based pathways towards sustainability. Our review and the three case studies show examples of different ways to move forward that recognise the complementarity and integrity of knowledge systems in addressing specific problems (Molnár et al., 2016; Smith et al., 2017), create conditions (and methodologies) for full and open dialogue on how to move ahead, overcome power inequalities and navigate cultural differences (Robinson et al., 2016; Reed & Abernethy, 2018). We demonstrate reciprocal synergies between indigenous and local knowledge and conservation science and rich cases of how cross-fertilisation leads to stronger partnerships and better outcomes. The three case studies also show that the MEB requires partnerships that are underpinned by recognition, respect and understanding of diverse knowledge systems, and that the process for producing and applying common knowledge to problems cannot be viewed separately from the outcomes of partnerships. That is to say, much like the concept of adaptive management in conservation, the diversity and dynamism of knowledge systems dictate that the process of collaboration be taken as seriously as the achievement of conservation outcomes themselves (Gavin et al., 2018).

More work is needed to further elaborate how to implement a MEB approach in different processes and contexts. The IPBES process has struggled

with the tension between open collaboration and the demands for structure set by the scientific knowledge governance. There is yet some way to go to better acknowledge and solve epistemic challenges, such as diverse modes of validation across knowledge systems (Löfmarck & Lidskog, 2017; Obermeister, 2017). There is also a need to continue developing tools and approaches for bridging knowledge systems that are connected to local, cultural, social and ecological conditions. Our review illustrates that indigenous peoples, local communities and scientists have begun to tackle this challenge (Molnár et al., 2016; Robinson et al., 2016; Smith et al., 2017), but further dialogue is required, both horizontally across local scales and vertically through local to global institutions.

We have shown that a MEB approach has been particularly effective in dialogues where there are power imbalances among actors and historical bias concerning the validity or usability of knowledge systems other than western approaches to science (see also Klenk & Meehan, 2015). Building trust and respect is especially pertinent in the context of ongoing and historical injustices and abuse of indigenous rights, and requires the recognition of indigenous peoples as rights-holders and defenders of biodiversity, who maintain management and governance systems of vast ecosystems (Brondizio & Le Tourneau, 2016; Mistry & Berardi, 2016).

Tengo et al. (2017) suggest five tasks that can guide processes that build trust and agency (see Figure 6.1b), while at the same time building a stronger evidence base for action. We find in our review that the mobilisation task is often neglected, or that documentation of indigenous and local knowledge is not fully recognised. More research is needed, but mobilisation of knowledge and empowerment of knowledge-holders may be critical steps for successful knowledge collaborations that also contribute to strengthening collaborative governance capacity. We also find that explicit joint problem formulation and analysis across knowledge systems is absent from many processes and is clearly a challenge in regional and global assessments with rigid scientific formats (Livoreil et al., 2016; Nesshöver et al., 2016; Oubenal et al., 2017). Our case examples clearly show the importance of creating the right conditions for joint problem formulation.

It should be acknowledged that the implementation of a MEB approach is demanding, in terms of time and other resources, and requires strong commitment from all parties. However, we reiterate that there is mounting evidence of the potential positive outcomes in terms of novel indicators, more efficient responses to and implementation of findings, as well as for synergies between conservation and human well-being, including human rights (Danielsen et al., 2010; Johnson et al., 2015; Sterling et al., 2017b, 2017c). As found by the participants in our third case example on reconciling conservation and human rights, conservation initiatives can

play a positive role by engaging with communities and increasing their recognition as actors and partners who hold important and useful knowledge.

Our experiences derive mainly from dialogues and collaborations with indigenous and local knowledge-holders who have deep connections, obligations to care for and a duty to fight for their rights to actively govern their ancestral territories. We are aware that in many other contexts, local knowledge-holders may be less empowered and traditional governance systems and cultural connections may be displaced and eroded. However, we believe that insights about dialogue and partnership between indigenous peoples, local communities and scientists can also be applied in western, urban and developing settings, where local knowledge and experience may be less evident but remains critical for nurturing effective stewardship of biodiversity and ecosystems. Ultimately, the MEB approach contributes to a much-needed conceptual mind shift to mobilise all knowledge that is useful for maintaining the life-supporting ecosystems in our world.

References

Adams, W. M., Aveling, R., Brockington, D., et al. 2004. Biodiversity conservation and the eradication of poverty. *Science (New York, N.Y.)*, 306(5699), 1146–1149. doi:10.1126/science.1097920

Austin, B. J., Vigilante, T., Cowell, S., et al. 2017. The Uunguu Monitoring and Evaluation Committee: intercultural governance of a land and sea management programme in the Kimberley, Australia. *Ecological Management and Restoration*, 18(2), 124–133. doi:10.1111/emr.12257

Balvanera, P., Calderón-Contreras, R., Castro, A. J., et al. 2017. Interconnected place-based social–ecological research can inform global sustainability. *Current Opinion in Environmental Sustainability*, 29, 1–7. doi:10.1016/j.cosust.2017.09.005

Brammer, J. R., Brunet, N. D., Burton, A. C., et al. 2016. The role of digital data entry in participatory environmental monitoring. *Conservation Biology*, 30(6), 1277–1287. doi:10.1111/cobi.12727

Brondizio, E. S., Foufoula-Georgiou, E., Szabo, S., et al. 2016. Catalyzing action towards the sustainability of deltas. *Current Opinion in Environmental Sustainability*, 19, 182–194. doi:10.1016/j.cosust.2016.05.001

Brondizio, E. S. & Le Tourneau, F.-M. 2016. Environmental governance for all. *Science (New York, N.Y.)*, 352(6291), 1272–1273. doi:10.1126/science.aaf5122

Bruckmeier, K. 2016. *Social–Ecological Transformation Reconnecting Society and Nature*. London: Palgrave McMillan.

Buytaert, W., Zulkafli, Z., Grainger, S., et al. 2014. Citizen science in hydrology and water resources: opportunities for knowledge generation, ecosystem service management, and sustainable development. *Frontiers in Earth Science*, 2 (October), 1–21. doi:10.3389/feart.2014.00026

Convention on Biological Diversity (CBD). 2014. Decision XII/12. Article 8(j) and related provisions.

Cornell, S., Berkhout, F., Tuinstra, W., et al. 2013. Opening up knowledge systems for better responses to global environmental change. *Environmental Science & Policy*, 28, 60–70. doi:10.1016/j.envsci.2012.11.008

Danielsen, F., Burgess, N. D., Jensen, P. M., et al. 2010. Environmental monitoring: the scale

and speed of implementation varies according to the degree of peoples involvement. *Journal of Applied Ecology*, 47, 1166–1168. doi:10.1111/j.1365-2664.2010.01874.x

Danielsen, F., Jensen, P. M., Burgess, N. D., et al. 2014. Testing focus groups as a tool for connecting indigenous and local knowledge on abundance of natural resources with science-based land management systems. *Conservation Letters*, 7, 380–389. doi:10.1111/conl.12100

Díaz, S., Demissew, S., Carabias, J., et al. 2015. The IPBES Conceptual Framework – connecting nature and people. *Current Opinion in Environmental Sustainability*, 14, 1–16. doi:10.1016/j.cosust.2014.11.002

Díaz, S., Pascual, U., Stenseke, M., et al. 2018. Assessing nature's contributions to people. *Science*, 359 (6373), 270–272. doi:10.1126/science.aap8826

Farhan Ferrari, M., de Jong, C. & Belohrad, V. S. 2015. Community-based monitoring and information systems (CBMIS) in the context of the Convention on Biological Diversity (CBD). *Biodiversity*, 16(2–3), 57–67. doi:10.1080/14888386.2015.1074111

Gagnon, C. A. & Berteaux, D. 2009. Integrating traditional ecological knowledge and ecological science: a question of scale. *Ecology and Society*, 14(2), 19.

Galvin, K. A., Reid, R. S., Fernández-Giménez, M. E., et al. 2016. Co-design of transformative research for rangeland sustainability. *Current Opinion in Environmental Sustainability*, 20, 8–14. doi:10.1016/j.cosust.2016.03.003

Gambon, H. & Rist, S. 2018. Moving territories: strategic selection of boundary concepts by indigenous people in the Bolivian Amazon – an element of constitutionality? *Human Ecology*, 46, 27–40. doi:10.1007/s10745-017-9960-z

Gavin, M. C., McCarter, J., Mead, A., et al. 2015. Defining biocultural approaches to conservation. *Trends in Ecology & Evolution*, 30, 140–145. doi:10.1016/j.tree.2014.12.005

Gavin, M., McCarter, J., Berkes, F., et al. 2018. Effective biodiversity conservation requires dynamic, pluralistic, partnership-based approaches. *Sustainability*, 10, 1846. doi:10.3390/su10061846

Gonzales, T. 2015. An indigenous autonomous community-based model for knowledge production in the Peruvian Andes. *Latin American and Caribbean Ethnic Studies*, 10, 107–133. doi:10.1080/17442222.2015.1034433

Hohenthal, J., Räsänen, M. & Minoia, P. 2018. Political ecology of asymmetric ecological knowledges: diverging views on the eucalyptus–water nexus in the Taita Hills, Kenya. *Journal of Political Ecology*, 25, 1–19.

Horstkotte, T., Utsi, T. A., Larsson-Blind, Å., et al. 2017. Human–animal agency in reindeer management: Sámi herders' perspectives on vegetation dynamics under climate change. *Ecosphere*, 8(9), e01931. doi:10.1002/ecs2.1931

Jabbour, J. & Flachsland, C. 2017. 40 years of global environmental assessments: A retrospective analysis. *Environmental Science & Policy*, 77, 193–202. doi:10.1016/j.envsci.2017.05.001

Johnson, J. T., Howitt, R., Cajete, G., et al. 2016. Weaving Indigenous and sustainability sciences to diversify our methods. *Sustainability Science*, 11, 1–11. doi:10.1007/s11625-015-0349-x

Johnson, N., Alessa, L., Behe, C., et al. 2015. The contributions of community-based monitoring and traditional knowledge to Arctic observing networks: reflections on

the state of the field. *Arctic*, 68(5), 1–13. doi:10.14430/arctic4447

Kealiikanakaoleohaililani, K. & Giardina, C. P. 2016. Embracing the sacred: an indigenous framework for tomorrow's sustainability science. *Sustainability Science*, 11(1), 57–67. doi:10.1007/s11625-015-0343-3

Kenter, J. O. 2016. Editorial: Shared, plural and cultural values. *Ecosystem Services*, 21(October), 175–183. doi:10.1016/j.ecoser.2016.10.010

Klenk, N. & Meehan, K. 2015. Climate change and transdisciplinary science: problematizing the integration imperative. *Environmental Science & Policy*, 54, 160–167. doi:10.1016/j.envsci.2015.05.017

Knox, J. 2017. Report of the Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment. UN OHCHR A/HRC/34/49.

Livoreil, B., Geijzendorffer, I., Pullin, A. S., et al. 2016. Biodiversity knowledge synthesis at the European scale: actors and steps. *Biodiversity and Conservation*, 25, 1269–1284. doi:10.1007/s10531-016-1143-5

Löfmarck, E. & Lidskog, R. 2017. Bumping against the boundary: IPBES and the knowledge divide. *Environmental Science & Policy*, 69, 22–28. doi:10.1016/j.envsci.2016.12.008

Lyver, P. O. B., Timoti, P., Jones, C. J., et al. 2017. An indigenous community-based monitoring system for assessing forest health in New Zealand. *Biodiversity and Conservation*, 26, 3183–3212. doi:10.1007/s10531-016-1142-6

Martín-López, B. & Montes, C. 2015. Restoring the human capacity for conserving biodiversity: a social–ecological approach. *Sustainability*

Science, 10, 699–706. doi:10.1007/s11625-014-0283-3

Mathevet, R., Thompson, J. D., Folke, C., et al. 2016. Protected areas and their surrounding territory: social–ecological systems in the context of ecological solidarity. *Ecological Applications*, 26, 5–16. doi:10.1890/14-0421

Mburu, G. 2016. *Reviving Indigenous and Local Knowledge for Restoration of Degraded Ecosystems in Kenya A. Contribution to the Piloting of the Multiple Evidence Base Approach*. Report. Stockhom: SwedBio, Stockholm Resilience Centre.

Mistry, B. J. & Berardi, A. 2016. Bridging indigenous and scientific knowledge. *Science*, 352, 1274–5.

Molnár, Z., Kis, J., Vadász, C., et al. 2016a. Common and conflicting objectives and practices of herders and conservation managers: the need for a conservation herder. *Ecosystem Health and Sustainability*, 2(4), e01215. doi:10.1002/ehs2.1215

Molnár, Z., Sáfián, L., Máté, J., et al. 2016b. "It does matter who leans on the stick": Hungarian herders' perspectives on biodiversity, ecosystem services and their drivers. In Roué, M. & Molnár, Z., editors, *Indigenous and Local Knowledge of Biodiversity and Ecosystem Services in Europe and Central Asia* (pp. 42–56). Paris: UNESCO.

Nadasdy, P. 1999. The politics of TEK: power and the 'integration' of knowledge. *Arctic Anthropology*, 36 (1–2), 1–18. doi:10.2307/40316502

Nesshöver, C., Vandewalle, M., Wittmer, H., et al. 2016. The Network of Knowledge approach: improving the science and society dialogue on biodiversity and ecosystem services in Europe. *Biodiversity and Conservation*,

25(7), 1215–1233. doi:10.1007/s10531-016-1127-5

Nguyen, T. P., Luom, T. T. & Parnell, K. E. 2017. Developing a framework for integrating local and scientific knowledge in internationally funded environment management projects: case studies from Kien Giang Province, Vietnam. *Local Environment*, 22, 1298–1310. doi:10.1080/13549839.2017.1342617

Nkambule, S. S., Buthelezi, H. Z. & Munien, S. 2016. Oppportunities and constraints for community-based conservation: the case of the KwaZulu-Natal Sandstone Sourveld grassland, South Africa. *Bothalia*, 46(2), 1–8. doi:10.4102/abc.v46i2.2120

Obermeister, N. 2017. From dichotomy to duality: addressing interdisciplinary epistemological barriers to inclusive knowledge governance in global environmental assessments. *Environmental Science & Policy*, 68, 80–86. doi:10.1016/j.envsci.2016.11.010

Oldekop, J. A., Holmes, G., Harris, W. E., et al. 2015. A global assessment of the social and conservation outcomes of protected areas. *Conservation Biology*, 30, 133–141. doi:10.1111/cobi.12568

Oubenal, M., Hrabanski, M. & Pesche, D. 2017. IPBES, an inclusive institution? Challenging the integration of stakeholders in a science–policy interface. *Ecology and Society*, 22(1), art11. doi:10.5751/ES-08961-220111

Pascual, U., Balvanera, P., Diaz, S., et al. 2017. Valuing nature's contributions to people: the IPBES approach. *Current Opinion in Environmental Sustainability*, 26–27, 7–16. doi:10.1016/j.cosust.2016.12.006

Polfus, J. L., Simmons, D., Neyelle, M., et al. 2017. Creative convergence: exploring biocultural diversity through art. *Ecology and Society*, 22(2), Art4. doi:10.5751/ES-08711-220204

Prado, H. M. & Murrieta, R. S. S. 2015. Ethnoecology in perspective: the origins, interfaces and current trends of a growing field. *Ambiente & Sociedade*, 18(4), 133–154. doi:10.1590/1809-4422ASOC986V1842015

Quinlan, A. E., Berbes-Blazquez, M., Haider, L. J., et al. 2016. Measuring and assessing resilience: broadening understanding through multiple disciplinary perspectives. *Journal of Applied Ecology*, 53, 677–687. doi:10.1111/1365-2664.12550

Rathwell, K. J. & Armitage, D. 2016. Art and artistic processes bridge knowledge systems about social–ecological change: an empirical examination with Inuit artists from Nunavut, Canada. *Ecology and Society*, 21(2), art21. doi:10.5751/ES-08369-210221

Reed, M. G. & Abernethy, P. 2018. Facilitating co-production of transdisciplinary knowledge for sustainability: working with Canadian Biosphere Reserve practitioners. *Society and Natural Resources*, 31, 39–56. doi:10.1080/08941920.2017.1383545

Robinson, C. J., Maclean, K., Hill, R., et al. 2016. Participatory mapping to negotiate indigenous knowledge used to assess environmental risk. *Sustainability Science*, 11, 115–126. doi:10.1007/s11625-015-0292-x

Sheil, D., Boissière, M. & Beaudoin, G. 2015. Unseen sentinels: local monitoring and control in conservation's blind spots. *Ecology and Society*, 20(2), art39. doi:10.5751/ES-07625-200239

Smith, B. M., Basu, P. C., Chatterjee, A., et al. 2017. Collating and validating indigenous and local knowledge to apply multiple knowledge systems to an environmental challenge: a case-study of pollinators in India. *Biological Conservation*, 211(Part A), 20–28. doi:10.1016/j.biocon.2017.04.032

Sterling, E. J., Betley, E., Sigouin, A., et al. 2017a. Assessing the evidence for stakeholder engagement in biodiversity conservation. *Biological Conservation*, 209, 159–171. doi:10.1016/j.biocon.2017.02.008

Sterling, E. J., Filardi, C., Toomey, A., et al. 2017c. Biocultural approaches to well-being and sustainability indicators

across scales. *Nature Ecology and Evolution*, 1, 1798–1806. doi:10.1038/s41559-017-0349-6

Sterling, E., Ticktin, T., Kipa Kepa Morgan, T., et al. 2017b. Culturally grounded indicators of resilience in social–ecological systems. *Environment and Society*, 8, 63–95. doi:10.3167/ares.2017.080104

Strangway, R. E., Dunn, M. & Erless, R. 2016. Monitoring Nûtimesânân following the diversion of our river: a community-led registry in Eeyou Istchee, Northern Québec. *Journal of Environmental Assessment Policy and Management*, 18, 1–21. doi:10.1142/S1464333216500010

Tengö, M., Brondizio, E. S., Elmqvist, T., et al. 2014. Connecting diverse knowledge systems for enhanced ecosystem governance: the multiple evidence base approach. *Ambio*, 43, 579–591. doi:10.1007/s13280-014-0501-3

Tengö, M., Hill, R., Malmer, P., et al. 2017. Weaving knowledge systems in IPBES, CBD and beyond – lessons learned for sustainability. *Current Opinion in Environmental Sustainability*, 26–27, 17–25. doi:10.1016/j.cosust.2016.12.005

Tengö, M. & Malmer, P. 2012. Dialogue workshop on 'Knowledge for the 21st Century: Indigenous knowledge, traditional knowledge, science and connecting diverse knowledge systems'. Usdub, Guna Yala, Panama, 10–13 April, 2012. Workshop Report. SwedBio at Stockholm Resilience Centre.

Timoti, P., Lyver, P. O., Matamua, R., et al. 2017. A representation of a Tuawhenua worldview guides environmental conservation. *Ecology and Society*, 22(4), 20. doi:10.5751/ES-09768-220420

Vasseur, L., Horning, D., Thornbush, M., et al. 2017. Complex problems and unchallenged solutions: bringing ecosystem governance to the forefront of the UN sustainable development goals. *Ambio*, 46, 731–742. doi:10.1007/s13280-017-0918-6

Verburg, P. H., Dearing, J. A., Dyke, J. G., et al. 2016. Methods and approaches to modelling the Anthropocene. *Global Environmental Change*, 39, 328–340. doi:10.1016/j.gloenvcha.2015.08.007

Vogt, N., Pinedo-Vasquez, M., Brondízio, E. S., et al. 2016. Local ecological knowledge and incremental adaptation to changing flood patterns in the Amazon delta. *Sustainability Science*, 11, 611–623. doi:10.1007/s11625-015-0352-2

Waylen, K. A., Fischer, A., McGowan, P. J. K., et al. 2010. Effect of local cultural context on the success of community-based conservation interventions. *Conservation Biology*, 24, 1119–1129. doi:10.1111/j.1523-1739.2010.01446.x