

Chapter 2. Conceptualizing the sustainable use of wild species^{1,2}

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Executive Summary

(1) The sustainable use of wild species is conceptualized in multiple shifting ways. It has changed considerably over time and differs strongly across cultures. Nonetheless, common attributes of different conceptualizations emphasize that sustainable use is dynamic and emerges from social-ecological systems that aim to maintain biodiversity and ecosystem functioning in the long term, while contributing to human wellbeing (*well established*) {2.2.2, 2.2.3, 2.2.4}.

(2) In the academic literature, conceptualizations of sustainable use in the different practices have generally broadened along similar pathways but with different timings (*well established*) {2.2.3}. Initial focus was on avoiding excessive harvests or stress on the specific populations being used. Interest in the economic performance of the practice generally followed, as did a growing accommodation of concern for more inclusive ecosystem properties that might be altered by each practice. Social concerns other than revenue and employment in large scale operations were usually a minor or neglected factor in how sustainability was conceptualized until the latter part of the 20th century. These generally appeared first in terms of supporting local employment and livelihoods, and then governance aspects also became part of the discussion, largely in the contexts of inclusiveness and equity in decision-making. Only quite late in the development do matters of culture, identity, community wellbeing and spiritual values appear as elements that are fundamentally interrelated and inseparable from ecological and socio-economic aspects, other than in conceptualizations by indigenous peoples and local communities, where they have long been central.

(3) In the 21st century broad ecological and social aspects of sustainable use dominate academic literature for all practices (*well established*) {2.2.3}. The dominant ecological aspects focus on how commercial harvesting may damage habitats, cause incidental mortalities, and alter relationships in ecological communities. Small-scale livelihoods are a central consideration in sustainable use, with governance issues, including equity and social justice, increasingly prominent in conceptualizations. There is growing focus on a wider range of ecosystem services provided by sustainable use, acknowledgement of the need to co-produce information across diverse knowledge systems when evaluating sustainability or seeking more sustainable practices, and to exercise greater risk aversion in the face of growing awareness of the many sources of uncertainty. The 2015 Sustainable Development Goals are prompting debate among experts regarding appropriate benchmarks for sustainability. Overall, there is high agreement that ecological, socio-economic and socio-cultural factors are central to sustainability, but no census among experts regarding their most appropriate balance.

(4) Indigenous and local worldviews on sustainable use are highly diverse but often share a common focus on reciprocal connections and respect shared between human and non-human "relatives", community well-being, and social responsibilities to care for people and place (*well established*) {2.2.4}. Indigenous and local worldviews, including their associated sustainable use and harvesting practices and knowledge are encoded in cosmologies,

myths, stories, songs, rituals, and numerous other forms of cultural expression. Informed by place-based practices and lifeways that have been developed and refined over centuries and generations, the diversity of indigenous and local worldviews enhances understandings of the natural world.

(5) Customs and norms are critical components of indigenous peoples and local communities' conceptualizations of sustainable use and serve a key role in the stewardship, management, and care for wild species (*well established*) {2.2.4, 2.2.8}. Cultural norms and practices surrounding the sustainable use of wild species are heterogeneous and dynamic across indigenous peoples and local communities but share important commonalities. Sustainable use practices are often guided or informed by intricate and nuanced combinations of spiritual customs and ceremonial practices, regulations, sanctions, and taboos, respect for wild species as kin, sharing across social networks, and maintaining and transmitting indigenous and local knowledge.

(6) International and regional standards, agreements and certification schemes for sustainable use have a common emphasis on not causing serious or irreversible harm to biodiversity and supporting the material and non-material contributions of biodiversity to human wellbeing (*well established*) {2.2.5}. A set of key elements that span themes in five broad categories were identified: ecological impacts, management and monitoring, socio-economic benefits, governance, and education (*well established*) {2.2.6}. These elements encompass ideas from the ecosystem approach and the precautionary approach. Most documents include elements of the first four of these categories, indicating that this arena is consistent with academic literature and indigenous and local knowledge and practices. Within those broad categories, the following concepts are present in sustainable use key elements:

- Respect for laws, policies and institutions;
- Respect for local community rights and access;
- Effective interlinkages among levels of governance;
- Empowerment of local communities;
- Respect for customary law;
- Minimization of ecological impacts;
- Restore and/or improve ecological context;
- Management and monitoring plans are in place;
- Adaptive management;
- Minimization of waste;
- Use of participatory approaches to monitoring and decision-making;
- Integrate science and indigenous and local knowledge;
- Provision of socio-economic benefits;
- Provision of local capacity building;
- Fair and equitable sharing of benefits;
- Support for workers' rights and health;
- Provision of socio-cultural/community wellbeing benefits;
- Raising of understanding and awareness.

Ideas missing or less explicitly represented in the list of key elements, but that represent core dimensions of many indigenous peoples and local communities' conceptualizations, include reciprocity between people and nature, respect for nature as kin, sharing networks, cultural continuity and community health and wellbeing as fundamental, interconnected aspects of sustainable use.

(7) Global policy agreements and policy statements on sustainable use of wild species show substantial uptake of most key elements of sustainable use (*established but incomplete*) {2.2.6, 2.2.7}. There has been lesser uptake of elements related to minimizing waste and support for workers' rights and health. There was similar uptake of elements among organizations and agencies with business/corporate, environmental non-governmental and intergovernmental perspectives. At the regional scale, conventions, policies, and regulations of regional bodies with jurisdictional foci on fishing, hunting, and logging differ in completeness of coverage of the key elements of sustainable use, with much more complete coverage in forestry than the other practices. Binding agreements for fishing display the strongest integration of these seven key elements, although two social key elements (inclusive and participatory decision-making, acknowledgement of rights and equitable distribution of benefits) remain largely absent, as regional fisheries management organizations commonly only have jurisdiction outside national jurisdictions, such that policies on local communities, levels of governance, and customary law are devolved to their member States.

(8) At the national scale, a review of national biodiversity strategies and action plans show that there is substantial consistency between how countries approach the uses of biodiversity within their country and the Addis Ababa Principles for Sustainable Use (*established but incomplete*) {2.2.9}. National uptake of Addis Ababa Principles for adaptive (Principle 4) and participatory (Principle 9) management, for addressing the threats to ecosystem services, structure and functions (Principle 5), and for education and knowledge-sharing (Principle 14) were very high. There has also been high uptake of Addis Ababa Principles relevant to inclusive and participatory governance models for development (Principles 1,3 6) and implementation (Principles 2,7,13) of national policy frameworks for sustainable use of wild species. However, aspects of the corresponding principles that directly focus on roles of indigenous peoples and local communities appear to have had less explicit uptake in the national biodiversity strategies and action plans {2.2.9.3}. Almost all of the national biodiversity strategies and action plans include provisions that policies should take into account current and potential values derived from the use of biodiversity in relation to market forces affecting the values and uses (Principle 10). However, commitments to reduce perverse incentives (Principle 3) and to minimize waste (Principle 11) are much less common. Similarly, it is uncommon to find information on accommodation and valuation methods for non-monetized values of the uses of biodiversity, including spiritual and/or relational values (Principle 10).

(9) The ecological and economic aspects of sustainable use are almost fully embraced in policy commitments at all levels, with almost comparable uptake of macro-economic,

employment, and general quality of livelihoods (*established but incomplete*) {2.2.10}. Uptake in policy does not ensure success at or even adequate resourcing for implementation, but it provides a strong foundation for unified and integrated efforts at achieving and maintaining sustainability. The foundations in national policies for efforts at the more socio-cultural aspects of sustainable use are weaker and less unified.

(10) The Sustainable Development Goals are highly relevant to dialogue on policy and progress for sustainable use of wild species. However, less than half of the associated indicator framework considers the use of wild species at all, and at most a third of the framework expresses sustainable use of wild species strongly (*well established*) {2.3.2}. The relevant indicators in the Sustainable Development Goals Global Indicator Framework are consistently more sensitive than they are specific. The greater sensitivity means that when the sustainability of any or all of the practices in an area change, the changes are likely to be captured by relevant indicator values. However, the low specificity means that changes in the indicator values cannot be attributed to comparable changes of any specific practice, posing challenges to identify specific changes to policies, regulations or customary activities to respond to the indicator. Many of the ecological, economic and governance indicators in global and regional indicator sets have low sensitivity or specificity for the sustainability of individual practices, thus requiring substantial contextual information to be interpreted reliably (*established but incomplete*) {2.3.4}.

(11) As conceptualizations of sustainable use have changed over time, indicators for sustainability have also shifted. Ecological, economic, and social components of sustainable use are present in several global indicator sets. Yet there remain gaps around indicators that convey social-ecological linkages and socio-cultural benefits (*established but incomplete*) {2.3.2, 2.3.3, 2.3.4}. Today, global indicator sets for sustainable use of wild species capture many ecological, economic and social components of sustainable use that are broadly agreed upon in the academic literature, and that are present in global standards and policy agreements for sustainable use, especially for fishing and logging. Global and regional indicator frameworks for gathering, non-extractive practices and terrestrial animal harvesting are largely lacking (*established but incomplete*) {2.3}. Those indicators overlap with some used in indigenous peoples and local communities. However, there are some widely agreed upon aspects of sustainable use of wild species that are poorly represented in global indicator sets. These include indicators that capture social-ecological linkages and those that relate to socio-cultural benefits. Indicators that relate to indigenous peoples and local communities' community rights and access are also poorly represented even though these ideas are well represented in the key elements of global standards for sustainable use of wild species. Little monitoring combines indigenous and local knowledge with scientific monitoring methods. Progress towards addressing these conceptual shortcomings will contribute to reduce inefficiencies and inequity in the management of the use of wild species (*well established*) {2.2.10, 2.3.4}. These targets and indicators will therefore require periodic revision, as knowledge and experience grow and public policy dialogue progresses (*well established*) {2.3.1, 2.3.4}.

(12) Increased and improved collaboration with indigenous peoples and local communities represents an important opportunity for better measuring and monitoring sustainable use across local to global scales (*well established*) {2.3.3, 2.3.4}. Methods for tracking sustainable use have long been used by indigenous peoples and local communities to monitor linkages among ecological and social elements, including community wellbeing and cultural continuity. These approaches can inform development of appropriate global and regional indicators. Likewise, collaborations with indigenous peoples and local communities as well as other communities to co-create local metrics can help adapt global, regional or national indicators to local realities.

(13) Overall, this chapter shows that although there are many broad commonalities, conceptualizations of sustainable use of wild species are also highly dynamic and variable over time and across practices, cultural and social contexts (*well established*) {2.2.10}. Successful adaptation and negotiation require attention to the dynamics of both the social and ecological contexts of uses (*well established*) {2.2.3.7}. The diversity of ways in which sustainability is conceptualized means that there is no “one size fits all” approach to appropriately and effectively characterize, measure and monitor sustainable use. The policy and practical implications of this legitimate diversity of conceptualizations of “sustainable use” will be explored in the rest of this assessment.

2.1 Introduction

This chapter provides context central for the assessment by examining how sustainable use is conceptualized and monitored. It is divided into two themes. The first theme explores how sustainable use of wild species is conceptualized in different contexts and scales – from global to national to local (including indigenous peoples and local communities), and across practices (fishing, gathering, terrestrial animal harvesting, logging and wildlife watching). It reviews broad conceptualization of sustainable use of wild species in the academic literature prior to the 1980s, followed by review of the literature in each practice from the 1980s to 2010, and a detailed review of new ideas and consensuses emerging in the most recent decade. This is followed by a review of conceptualizations of sustainable use by indigenous peoples and local communities. To identify how sustainable use of wild species is conceptualized in global and regional sustainable use agreements, standards and certification schemes, and if it is consistent with the academic literature and with indigenous peoples and local communities' conceptualizations, a review of the key elements in these documents is carried out. The subsequent section then examines if and how the key elements are reflected in policy commitments on sustainable use at the global, regional, and national scales.

The second theme reviews how sustainable use of wild species is measured and monitored. This is addressed by identifying, comparing and contrasting indicators used to measure and monitor sustainable use of wild species across scales, from global to indigenous peoples and local communities, and across practices. The chapter concludes with a crosswalk of the academic literature, global key elements and policies, and indigenous peoples and local communities' conceptualizations with indicators, to identify which ideas about sustainable use are captured in commonly used metrics of sustainable use and which are poorly represented.

2.2 How is sustainable use conceptualized and how has the concept evolved?

2.2.1 Overview of approach

“Sustainable use” can mean very different things to different people, agencies, and institutions (Cooney, 2007). Ideas about sustainable use have also varied greatly over time. The scientific (natural and social) and economic/policy literature on the concept of sustainability and sustainable use reviewed in sections 2.2.2 ad 2.2.3 is dominated by publications from the perspectives of countries from the Global North, particularly prior to the 21st century. With many of the foundational policy documents drafted and negotiated in the late 20th century these perspectives on sustainable use are prominent in the language of international agreements and other policy documents. However, concepts of sustainable relations of humans and nature are found in all cultures, and not solely cultures rooted in the western, largely Judeo-Christian world. By the United Nations Conference on Sustainable Development in 1992, the voices of indigenous peoples and local communities were increasingly prominent, with recognition that their cultural practices and traditional livelihoods have been tied closely to nature, often including values and approaches that are inherently oriented to sustainable uses of nature. This knowledge of indigenous peoples and local communities is recognized by IPBES and increasingly by the international policy world (Hill et al., 2020; Thaman et al., 2013). Section

2.2.4 introduces some of the diversity of conceptualizations and perspectives of indigenous peoples and local communities on the notion of “sustainable use”, together these overviews of evolving perspectives provide a foundation to discuss what differing worldviews, values and resultant conceptualizations may mean for policies and practices on the sustainable use of wild species.

2.2.2 Historical development of the concept of “sustainable use” in the global conservation arena

Ideas and conceptualizations of sustainability have a long and complex history. In this section, the historical background of academic, largely western, conceptualizations of sustainability is presented, focusing mainly on aspects related to the sustainable use of wild species. Following this, the narrower and shorter history of the explicit use of the concept ‘sustainable use of wild species’ is narrated. The historical account presented in this section is based on a literature review of 179 sources. The data management report for this review is available at: [10.5281/zenodo.6472995](https://doi.org/10.5281/zenodo.6472995).

2.2.2.1. Historical background of western conceptualizations of sustainability

The word ‘sustainability’ did not emerge in the English language until the early 1970s (J. A. Simpson et al., 1989), but the German equivalent, *Nachhaltigkeit*, was coined in the mid-eighteenth century (Warde, 2011). However, the historical background of ideas and conceptualizations of sustainability extends beyond explicit use of the term. The survival and well-being of people has always depended on a sustained output of food and other material derived from natural resources. Considerations of sustained yield from the natural environment have existed at least since the agrarian revolution. However, the historical background of the conceptualization of sustainability reflects a societal issue and discourse that comprises more than local concerns over needs and benefits.

Sustainability in this context emerged in early modern Europe (Warde, 2018) and Japan (Caradonna, 2014). The conceptual development was to some degree global, as aspects of it related to the European exploration and colonialism of the period (Grove, 1995). The discourse on sustainability involved many factors related to the political, economic and environmental management of emerging nation-States and their increasingly proactive governance from the sixteenth century (Warde, 2018). As the state came to rely on revenue from the exploitation of natural resources to compete internationally in commerce, war and religion, the natural world increasingly became a political issue and object of the governance by nation states. The earliest discourses about state-governed sustained yield centered around the supply of grain and timber products (Grober & Cunningham, 2012; Scott, 1998; Warde, 2018).

The development of scientific, knowledge-producing networks in early modern Europe also played a central role in emerging discourse on sustainability (Warde, 2018). Many of the active network participants optimistically saw this knowledge generation as part of a larger project to improve states’ and privileged individuals’ wealth by increasing output of natural resources. By the end of the eighteenth century, development of methodologies for survey, measurement and control provided a quantifiable framework that enabled assessment of the degree to which natural resource output was sustained or not. This was particularly well

developed within the emerging field of forestry. Technologies that made nature ‘legible’ to States in a quantified manner, were decisive in framing a particular conceptualization in the developing discourse on sustainability (Höhler and Ziegler 2010; Scott, 1998; Warde, 2018). During the industrial revolution, the limits of natural resources and degradation of environments became gradually clearer, due both to improved knowledge generation and highly visible environmental destruction. As a result, some of the optimism and beliefs in unlimited progress and growth diminished. The optimism was, replaced by a growing concern with sustainability and the realization that development and progress could potentially be unsustainable, and that individuals, the state and the environment might suffer from it (Dresner, 2008; Warde, 2018).

Timber was a valuable natural resource to the emerging nation states of Europe due to its military and industrial uses. As the industrial revolution and growing populations required increasing amounts of wood products, timber scarcity became a problem and issue for governance in many localities (Caradonna, 2014; Warde, 2018). Another factor that might have advanced discourses of sustainability related to timber was the long time horizon compared to other wild species in use; meeting timber demands required planning and governance that spanned human generations. It was in this context that Hans Carl von Carlowitz wrote *Sylvicultura oeconomica*, often viewed as the work that established forestry as a science and management field, and the first to explicitly address sustainable use of a wild species (von Carlowitz, 1713). Von Carlowitz saw the growing scarcity of wood as a threat to further progress of western civilization, and argued that if replanted and cultivated properly forests could produce a significantly higher timber yield that could be sustained over time (Hölzl, 2010; Warde, 2018; Wiersum, 1995; Worster, 1993). John Evelyn, Jean-Baptiste Colbert, Jean-Jacques Rousseau and Thomas Malthus also contributed to the further development of the discourse on sustainable forestry, and sustainability more generally (Caradonna, 2014; Dale, 2018, Du Pisani, 2007). Most western nations established forestry institutions to manage their forests in line with this ideology in the 18th and 19th century.

The pursuit of increased and sustained yield from natural resources that emerged with forestry in the 18th and 19th centuries had repercussions for the understanding and management of other wild species understood to be natural resources. Declining populations of wild terrestrial animals became a concern in the same period, both in Europe and, in particular, in areas under the influence of European colonization (Barrow, 2009; Worster, 1994). In North America, dramatic declines in once numerous species were clearly documented. During the 19th century, in particular, game animals came to be understood as natural resources in a utilitarian, resource conservation perspective inspired by agronomy and forestry (Dunlap, 1988; Scott, 1998). Correspondingly, game management institutions were established in many western nations and tasked with securing a maximized and sustained yield of game animals (Stokland, 2015; Worster, 1994). The eradication of game predators was widely thought to be a prerequisite for fulfilling this task, and became central to ‘sustainability’ of game management (Coleman, 2004; Robinson, 2005; Stokland, 2016).

In the late 19th century, a more ecologically-based and romanticist conservation ideology emerged with growing environmental movements. This ideology was more inclined towards preservation and ecological limitations, and developed in dialogue and tension with the utilitarian conservation ideology (Robinson, 2004; Worster, 1994). These ideological developments are exemplified by the conservation ethos and practices of Americans John Muir

and Gifford Pinchot, respectively (E. W. Johnson & Greenberg, 2018), and the more utilitarian conservation ideology of Aldo Leopold (e.g., Leopold, 1933, 1949). Environmental movements became prominent in the “age of ecology” (1960s and 1970s) playing a central role in this formative phase of the sustainability concept (E. W. Johnson & Greenberg, 2018; Worster, 1994). The issues of pollution and pesticides, as well as ecological limits to growth, received increased attention after publications such as Rachel Carson’s *Silent Spring* (Carson, 1962) and the Club of Rome’s *Limits to Growth* (Meadows, 1972). Drawing public attention to environmental concerns, and emphasizing the science of ecology and a greater sensitivity to the ways in which human socio-economic and biophysical systems interact, the environmental movements prepared the ground for ecological issues to become prominent on governmental, business, and international institutions’ agendas. A crucial step in this development was the linking of human well-being and economic development to ecological systems – familiar now as a central tenet of sustainability – in issues such as pesticides, water pollution, and smog (E. W. Johnson & Greenberg, 2018; Worster, 1994).

In the 1980s, sustainability became an identifiable and publicly discussed concept, growing out of the work of ecologists, economists, systems theorists, energy specialists, environmentalists, biologists and other scientists, and diplomats or appointees within the Organization of Economic Cooperation and Development and the United Nations (Caradonna, 2018). The political context of the 1980s, in which free-market economic logics rose to dominant influence, posed a major challenge to ideas about the limits of growth and ecological concerns. The concept of sustainability, which focused on self-interested movement towards production and development processes with both ecological and economic benefits, found its place on the international stage in this decade through the merger of environment and development concerns (E. W. Johnson & Greenberg, 2018). The United Nations adopted the concept of sustainable development in the 1980s and sponsored a series of conferences and committees notably the 1972 Stockholm conference, the 1980 report *World Conservation Strategy*, the 1982 *World Charter for Nature*, and the World Commission on Environment and Development that produced the report *Our Common Future* (*ibid*). The latter popularized the notion that sustainability is about meeting current needs without jeopardizing the ability of future generations to satisfy their own needs.

Through initiatives such as the 1992 Rio Earth Summit, the 2005 Millennium Development Goals, and the 2015 Sustainable Development Goals, sustainability has become a mainstream concern. Now a standard feature of public and political discourse, most major institutions in the industrialized world have either a department or office of sustainability, and almost any business of a certain size has identified Sustainable Development Goals to which it contributes (Caradonna, 2018). The sustainability concept is seen by many as a critical reappraisal of the values of industrialism and growth-based capitalism, but has also received much criticism. A common critique of the concept, and particularly of the ‘sustainable development’ variant with its explicit focus on development, is that it represents little more than business-as-usual economic development that does not value the idea of living within biophysical limits (Caradonna, 2018; Purvis et al., 2019; Robinson, 2004; Worster, 1993).

The tensions and critiques that have at times riddled the sustainability concept have a historical context. The sustainability concept has roots in ideologies of both economic growth and ecological limitations, intertwined in discourses on the maximization of natural resources

use, the progress of nation states, environmental preservation, pollution and human health, ecological science, international collaboration and more, and has developed across multiple and shifting governance contexts and academic disciplines. As a consequence, sustainability has been conceptualized in multiple and shifting ways by different actors over time, including different understandings of the concept that stand in internal tension (Borowy, 2018; Caradonna, 2014; Mensah, 2019; Purvis et al., 2019; Robinson, 2004; Warde, 2018). As such, there has never been consensus on what constitutes sustainability. However, the objective of avoiding environmental degradation that would lead to a worsening of human conditions in the future has to a large degree been a common denominator of the different conceptualizations. There has been less agreement on how this can be achieved, and whether, or to which degree, it can involve economic growth.

2.2.2.2 The conceptualization of sustainable use of wild species in international agreements

The Stockholm Declaration from the United Nations Conference on the Human Environment in 1972 contains no mention of the terms “sustainable”, “sustainability”, or “sustainable use” (Cooney, 2007). However, it states that natural resources, including fauna, flora and natural ecosystems, should be safeguarded for the benefit of present and future generations (Principle 2), and that the capacity of the earth to produce vital renewable resources should be maintained (Principle 3). Likewise, the Convention on International Trade in Endangered Species of Wild Fauna and Flora and the Ramsar Convention on wetlands, which both came into force in 1975, as well as the Convention on the Conservation of Migratory Species of Wild Animals, which came into force in 1983, were related to use of wild species (overexploitation through international trade, conservation and “wise use” of wetlands, and conservation and management of migratory species, respectively) without expressing it explicitly in terms of sustainability at the time. The United Nations Convention on Law of the Sea (1982) does refer explicitly to “sustainable yield” in both articles 61 and 119, in the context of status of harvested fish stocks, but does not extend the concept explicitly to more general biodiversity properties of the ocean. As is described further down, however, definitions in these conventions were developed in the following decades in parallel with the general development of the conceptualizations of sustainability and sustainable use.

The 1980 World Conservation Strategy, co-authored by the International Union for the Conservation of Nature, the United Nations Environment Program (UNEP) and the World Wildlife Fund, provided an early conceptualization of sustainable use as part of an overall conservation strategy. It recognized the essential role of use of nature and living natural resources in meeting the needs of all humans, and highlighted the importance of ‘sustainable use’ of living natural resources for conservation success. Similarly, the World Charter for Nature, that was adopted by the United Nations in 1982 and proclaimed five “principles of conservation”, included the following conceptualization of sustainable use: “Ecosystems and organisms, as well as the land, marine and atmospheric resources that are utilized by man, shall be managed to achieve and maintain optimum sustainable productivity, but not in such a way as to endanger the integrity of those other ecosystems or species with which they coexist.”

In 1987 the World Commission on Environment and Development (commonly referred

to as the “Brundtland Commission”) established the concept of sustainable development as a central vision and objective in international environmental policy, in *Our Common Future* (World Commission on Environment and Development, 1987). It had wide influence on the further understanding of sustainability in general, and on biodiversity conservation specifically. The sustainable use of wild species was mentioned explicitly in the report, but not thoroughly conceptualized. However, the report firmly established a specific conceptualization of biodiversity conservation related to sustainable use; first, it highlighted the importance of biodiversity for sustainable development, and second, it advocated the need to move beyond the “historical approach of establishing national parks that are somehow isolated from the greater society” (World Commission on Environment and Development, 1987: Part II, 6, V, 39), and address how development patterns affect biodiversity. Thus, the report emphasized the interdependency between biodiversity conservation and sustainable development.

In parallel with the development of the report from the Brundtland Commission, the Ramsar Convention’s definition of wise use of wetlands was updated in 1987, as “their sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem” (Ramsar Recommendation 3.3). The new definition reflected a similar understanding of the interactions between biodiversity conservation and use as the former report. Further, the 1980 World Conservation Strategy was updated in 1991, reiterating the importance of sustainable use of living natural resources for their conservation.

The sustainable use concept and its operationalization was given increasing attention within the International Union for the Conservation of Nature in the 1990s. A specific endorsement of the role of sustainable use in conservation strategies was made by the International Union for the Conservation of Nature General Assembly in Perth in 1990. Specifically, the International Union for the Conservation of Nature here endorsed the idea that under appropriate circumstances, use of living resources could itself contribute to their conservation. However, the specific meaning of sustainable use proved challenging to operationalize into recommendations at the time, because of the complexity of the issue and the balancing of environmental, social and economic aspects of sustainability (Cooney, 2007). The International Union for the Conservation of Nature sought to resolve these issues by the 1995 Sustainable use initiative and the formation of the sustainable use specialist group, as well as later efforts to identify the factors that influence the sustainability of use (Zaccagnini et al., 2001).

The Rio Declaration adopted at the United Nations Conference on Environment and Development in 1992 further developed the concept of sustainable development from the Brundtland Commission’s report, and included reference to “sustainable production and consumption”, but did not make specific reference to sustainable use of wild species. However, the Convention on Biological Diversity was also an outcome of this conference, and sustainable use of biodiversity was granted a central position in it. Specifically, it constituted one of the three objectives of the Convention on Biological Diversity, which are the conservation of biological diversity (Article 1), the sustainable use of its components (Article 2), and the fair and equitable sharing of benefits from the use of genetic resources (Article 3). It was defined as follows: “Sustainable use means the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations” (Article 2).

In 1994 the Convention on International Trade in Endangered Species of Wild Fauna and Flora adopted at its 13th Conference of the Parties Resolution 8.3: Recognition of the benefits of trade in wildlife. This constituted a recognition of some of the basic tenets of sustainable use, recognizing potential benefits of commercial trade to the conservation of species and/or ecosystems, and the potential of incentives for sustainable use of wild animals and plants to avoid conversion of wild landscapes to alternative land uses (Cooney, 2007). The resolution has been understood as a compromise, following intense debates over the position that the Convention on International Trade in Endangered Species of Wild Fauna and Flora should adopt in relation to sustainable use (Favre, 1993; Garrison, 1994).

In 1995 the Convention on Biological Diversity adopted the ecosystem approach as the “primary framework” of action to be taken under the convention (Decision II/8). The ecosystem approach was defined as “a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way” (Decision V/6). The approach directed attention to the structure, processes, functions and interactions within an ecosystem, rather than exclusively on specific elements such as single species or populations. This meant that the sustainable use of biodiversity is also considered from an ecosystem perspective, rather than understood narrowly as the maintenance of single species (Cooney, 2007).

At the second World Conservation Congress in 2000, the International Union for the Conservation of Nature adopted a Policy Statement on Sustainable Use of Wild Living Resources, as well as recommendation 2.92 on indigenous peoples, sustainable use of natural resources, and international trade. In 2001, the International Union for the Conservation of Nature presented the White Oak Principles of Sustainable Use, a short document establishing a definition, seven axioms and eight principles for sustainable use. The following definition was adopted for sustainable use: “Sustainable use, both extractive and non-extractive, is a dynamic process toward which one strives in order to maintain biodiversity and enhance ecological and socio-economic services, recognizing that the greater the equity and degree of participation in governance, the greater the likelihood of achieving these objectives for present and future generations”. Thus, the conceptualization of sustainable use within the International Union for the Conservation of Nature was progressing towards the inclusion of social and economic aspects, emphasizing equity and participation in governance.

The Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity (see supplementary materials S2.1) were adopted in 2004, at the 7th Conference of the Parties to the Convention on Biological Diversity (Decision VII/12). They comprise a set of 14 “practical principles”, each with associated operational guidelines. The conceptualization of sustainable use incorporated in these principles and guidelines indicate a progression towards inclusion of social and economic aspects similar to that within the International Union for the Conservation of Nature, and include topics such as supportive legislative and policy arrangements, empowerment of local resource users, removal of perverse incentives, adaptive management, and avoidance of impacts on nature’s contributions to people.

A similar conceptualization of sustainable use was incorporated in the Aichi Biodiversity Targets, adopted in 2010 as part of the Convention on Biological Diversity's Strategic Plan for Biodiversity 2011-2020. The targets addressed five strategic goals identified in the strategy, of which Strategic Goal B: Reduce the direct pressures on biodiversity and promote sustainable

use, was directly related to the sustainable use of wild species. Aichi Biodiversity Target 6 addressed sustainable use and management of marine biodiversity (fish, invertebrate stocks and aquatic plants) in order to avoiding overfishing and other negative impacts on biodiversity. Target 3 addressed the removal of negative incentives, and development and application of positive incentives for conservation and sustainable use of biodiversity, while Target 18 addressed the integration in legislation and relevant international obligations of traditional knowledge, innovations and practices of indigenous and local communities relevant for ecosystem services and the conservation and sustainable use of biodiversity.

2.2.3 Current academic conceptualization of sustainable use by practice

2.2.3.1 Introduction

Although the history of expert research publications on the sustainable use of nature dates back a couple of centuries (section 2.2.2), publications with new interpretations of what constitutes sustainable use continue in all fields. Reviewing these evolving or new aspects of how sustainable use is conceptualized within each practice, and examining the commonalities and differences of these developments among the practices, is a crucial part of this chapter. It largely delineates the academic context within which the evaluations in the following chapters will be conducted, with implications for application of the conceptualizations as well.

This literature review summarizes widely agreed upon ideas of sustainable use up until 2010, and then reviews the post 2010 literature to identify new and emerging ideas. The review faced several challenges, related to the scope and size of the review; and the different publication rates among practices and between ecological and social aspects of sustainable use within practices. Those challenges are described, along with the review methodology that was designed to overcome them, in the data management report available at <https://doi.org/10.5281/zenodo.6472995>. As per IPBES protocol, the systematic reviews were focused on English language journals. Although these reviews include papers by authors from across the globe, trends reported here may not be representative across all regions and disciplines.

A challenge not discussed explicitly in the data management report was the many scales and value systems within which sustainable use may be conceptualized. Historically the research community has not been strongly focused on research on small-scale uses of nature. Nevertheless, it was important to this literature review (and this assessment) to capture developments in those areas. The academic literature has an intrinsic over-representation of reports from scientific types of knowledge, so thinking from other knowledge systems is under-represented. To deal with potential differences of coverage of various scales, the screening of “hits” was directed to be vigilant for papers with a focus on small-scale uses of nature, to ensure they would be well-represented in the papers evaluated in this review. Interpreting the findings of this literature review should be done with an awareness of these potential shortcomings in the academic literature, and should be complemented by information on the indigenous peoples and local communities’ conceptualizations of sustainable use (section 2.2.4). The academic literature reviews for the five practices follow in sections 2.2.3.2-2.2.3.6. The outcomes of the literature review for each practice are presented separately, with the main findings summarized.

Then a final subsection (2.2.3.7) highlights emergent patterns and messages that cut across all practices, as well as implications of any major differences that are present in the current academic literature on each practice.

2.2.3.2 *Conceptualizations of sustainable fishing in the academic literature*

The literature on sustainable fishing is particularly large. Consequently, even a high-level review of literature prior to 2010 has a relatively large number of influential references. Moreover, there is a policy benchmark in 2010 with Aichi Biodiversity Target 6, that gives a foundation presenting what the Parties to the Convention on Biological Diversity agreed as comprising sustainable use of fish stocks and the ecosystems in which they are found. Similarly, the very large number of post-2010 publications also influence the approach to both screening papers down to a feasible number to review, and allows the findings to be presented in a tabular as well as narrative format.

2.2.3.2.1 Conceptualization of fishing in academic and technical literature up until 2010

In fishing a parameterized conceptualization of sustainable use began as early as the 1950s, when benchmarks of sustainable or “optimal” use of the target species were identified (Beverton & Holt, 1957; Ricker, 1955). The biologically defined benchmarks such as Bmsy (the biomass producing maximum sustainable yield) were quickly adapted to reflect that economic aspects of fishing, such as cost per unit of fishing effort, were part of sustainability, with the benchmark of Bmey (biomass producing the maximum economic yield, Clark, 1973; Clark & Munro, 1975; Roedel, 1975). As the importance of precaution in uses of natural resources (Garcia, 1994; Richards & Maguire, 1998) gained traction, many papers subsequently challenged details of these benchmarks (Butterworth & Punt, 2003; Grafton et al., 2007; Mace, 1994; Schnute & Richards, 1998). However, the conceptualization of sustainable use in fishing never abandoned the properties of both keeping biomass at or above a level producing a high yield (taking into account the productivity of a stock), and ensuring that macro-economically the costs of harvesting would be less than the revenues from the yield (Apkalu, 2009; Harris et al., 2002; Holt, 2009; Martinet et al., 2007). The latter resulted in early criticisms of subsidies as promoting unsustainable levels of fishing capacity; a criticism addressed with Aichi Biodiversity Target 3.

By the 1980s, fisheries management was challenged to include the ways that fishing impacted the food webs and habitats in which it occurred (K. P. Andersen & Ursin, 1977). This prompted development of analytical tools and models to assess the degree to which fishing on lower trophic levels might deplete the food supply of higher predators (Gislason & Rice, 1998; Hollwed et al., 2000; Pope, 1991; Pope et al., 2006; Sissenwine & Daan, 1991; Yodzis, 1994). or result in trophic cascades if populations of higher predators were depleted, allowing lower trophic levels to increase unchecked (Baum & Worm, 2009; Fogarty & Murawski, 1998; Gjosaeter, 1995; Sala et al., 1998). The conceptualization of sustainable fishing correspondingly expanded to require consideration of both types of outcomes, and any other large or expanding alterations of trophic relationships (Fowler, 1999; Larkin, 1996).

Bycatches that depleted non-target species were also identified as a potential unsustainable consequence of fishing, and limiting bycatches to levels that did not deplete the populations of non-targeted species also became a standard for sustainable fishing by the 1990s (Alverson et al., 1994). There was particular emphasis on minimizing, if not avoiding completely, the bycatches of marine mammals, seabirds, and other marine taxa with long life expectancies and low productivity (Dillingham & Fletcher, 2008; Niel & Lebreton, 2005; S. Zhou, 2008; Zydalis et al., 2009). In parallel, the impacts of fishing, particularly with mobile bottom-contacting gears, on seafloor habitats and benthic species received substantial attention in the literature (Lindeboom & Groot, 1998; Rijnsdorp et al., 1998).

Expert groups of the International Council for the Exploration of the Sea and other regional centres consolidated the burgeoning literature and developed standards and guidance for keeping such impacts within sustainable bounds (FAO, 1999; S. Zhou & Griffiths, 2008). Debate continued about whether the standards and benchmarks were set in the correct levels (Frid et al., 1999; Furness, 2002; Kaiser et al., 2000; J. C. Rice & Legacé, 2007; S. Turner et al., 1999; J. L. Young et al., 2006). However, there was no dispute within the expert literature that, as with trophic impacts of fishing, bycatches and habitat impacts had to be taken into account in evaluating the sustainability of fishing (FAO, 2009; Garcia & Cochrane, 2005).

By the later 1990s and 2000s, some contributions to a growing debate in the academic literature about ecosystem effects of fishing became strident and even adversarial, as disagreements about specific benchmarks, and the effectiveness of measures taken to achieve them, were debated (Corbin, 2002; Daan et al., 2011; Jaenike, 2007; Mora et al., 2009; Verweij et al., 2010; Wilberg & Miller, 2007; Worm et al., 2007; Worm & Myers, 2004). However, no fundamentally new ecological concepts were added to the conceptualization of sustainability of fishing. Rather, there was widespread interest in bringing the individual bio-ecological aspects of fishing together in what became known as the ecosystem approach to fishing (Bianchi & Skjoldal, 2008; Commission of the European Communities, 2008; European Union, 2008; Garcia et al., 2003). This did change the dialogue regarding fishing sustainability from the presence or absence of individual properties in the fishery and its impacts to a dialogue about planning and conducting all the fishing in an area in coherent and compatible ways. This, too, became a part of the conceptualization of sustainable fishing (McLeod et al., 2005; Ruckelshaus et al., 2008). These conceptual advances were tracked and taken up by developments in fishing policy and practices, as reported in Chapter 6, section 6.4.1.

As the ecosystem approach to fisheries developed, there were important developments in global policy regarding social justice. The United Nations Conference on Environment and Development in 1992 (<http://www.ciesin.org/docs/008-585/unced-home.html>) and the World Summit on Sustainable Development (2002) (<https://sustainabledevelopment.un.org/milestones/wssd>) brought the uses of wild species in planning development and poverty reduction to central places on the research and the policy stages (Berkes & Folke, 1998; Ostrom, 2009). In fishing, the developing ecosystem approach provided a ready setting for expanding the dialogue on the boundaries of an “ecosystem approach” to include social equity and community well-being as a part of any dialogue on the full “ecosystem” (Allison & Ellis, 2001; Andrew et al., 2007; Berkes, 2003; C. de Young et al., 2008; Schumann & Macinko, 2007). Guidance documents such as the Food and Agriculture Organization of the United Nations (FAO) Code of Conduct for Responsible Fisheries in 1995

were found to give insufficient attention to social aspects of the sustainability of fishing. Publications such as Berkes et al., 2001; Kurien, 2007; contributed to the guidelines on small-scale fisheries (FAO, 2015). Nevertheless, there continued to be calls for more input from experts on the social aspects of fishing outcomes and greater use of knowledge of indigenous peoples and local communities (Béné et al., 2010; C. de Young et al., 2008).

This was the landscape of points of general agreement in 2010 with regard to how sustainable use was conceptualized for fishing. This is affirmed in the very specific language of Aichi Biodiversity Target 6, in 2010. Among the first targets to be adopted at the 10th Conference of the Parties, it states: “by 2020 all fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.”

It confirms in policy that sustainable fishing considers harvesting rate, provision for recovery of depleted stocks, bycatches and habitat impacts, particularly for species and habitats of special concern, and that the combinations of management measures and provisions can be integrated in an ecosystem approach; all themes which the expert literature had stressed as important. The benchmarks: “no serious adverse impacts” and “within safe ecological limits” came from earlier agreements, respectively the United Nations Sustainable Fisheries Resolution 61/105, which required bottom-contacting fishing gears to cause “no serious adverse impacts” on “vulnerable marine ecosystems” (<https://undocs.org/A/RES/61/105>), and the Marine Strategy Framework Directive of the European Union (https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm), which required impacts of uses of marine resources in waters of the European Union to be within “safe ecological limits”. These benchmarks reflect the availability of evidence-based guidance on what comprised a serious adverse impact (FAO, 2013; J. C. Rice et al., 2015), and “safe ecological limits” in general (European Commission et al., 2011) and specifically for exploited species (Piet et al., 2010), seafloor habitat and benthic species (J. Rice et al., 2010), ecosystem processes (Rogers et al., 2010) and biodiversity including threatened species (S. K. J. Cochrane et al., 2010). Subsidies and other economic harmful incentives were not mentioned in Aichi Biodiversity Target 6, but were addressed directly for all uses of biodiversity in Target 3.

Conspicuously absent in the Aichi Biodiversity Target 6 was reference to social outcomes as part of sustainable fishing. Those aspects were all covered in a single Aichi Biodiversity Target 14, with general language for all uses of biodiversity that “by 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable”. The implications of actions to promote implementation of Article 8j of the Convention on Biological Diversity were a topic of debate throughout the 10th Conference of the Parties, such that consensus on the necessity of specific social outcomes was not reached.

2.2.3.2.2 Post-2010

The methods for the review of post 2010 literature is available at [10.5281/zenodo.6472995](https://zenodo.org/record/6472995). Table 2.1 presents the occurrence of the four traditional aspects of sustainable use in fishing in the over 400 papers considered for this analysis: the *target species* of the fishery, the *ecosystem context* in which the fishery occurred, the *economic context* and revenues from the fishery, and the *social context* in which the fishery occurred, supported livelihoods and distributed benefits. Comparable numbers of papers considered both the target species or species complex (126) and the ecosystem context in which the fishery occurred (117). Somewhat fewer papers considered the social context of the fishery (101) and fewer yet the economic context of fisheries (70).

Despite being the most common theme addressed, relatively little genuinely new thinking was presented about sustainable outcomes for the target species and species being incidentally harvested. Nearly half the papers presented new or revised methods for estimating the standard benchmarks for sustainable harvesting rates and/or sustainable levels of the populations being harvesting (Barneche et al., 2018; Jusufovski & Kuparinen, 2020; Kindsvater et al., 2020; Lassen et al., 2013; Pilling et al., 2016; Vasilakopoulos et al., 2016; S. J. Zhou et al., 2020).

The ecosystem context for the sustainability of fishing had a lower proportion of papers (<30%) simply elaborating alternative benchmarks for sustainable impacts, whereas a comparable proportion expanded the notion of “sustainable use” to broader ecosystem properties. Some of these are related to the harvest strategies, such as balanced harvesting of all sizes of fish and invertebrates in a community in proportion to their relative abundances (Garcia et al., 2016; Law et al., 2012, 2015; Plank et al., 2017). Many were about the need to set harvesting benchmarks in the contexts of environmental dynamics, bringing climate change considerations directly into sustainable fishing. Only 15% of papers discussing sustainability of fishing in an ecosystem context addressed the social or economic aspects of fishing at the same time, with most of those dealing with ways to take into account the displacement of fisheries when applying spatial tools to protect some parts of the ecosystem from the impacts of fishing (Arkema et al., 2015; Cinner et al., 2019; Giron-Nava et al., 2019; Lowerre-Barbieri et al., 2019).

Fewer than 15% of all papers reviewed focused directly or indirectly on the economic context of fishing. Again, the single most frequently explored idea was simply alternative ways to estimate sustainability benchmarks for the economic performance of fisheries (e.g., Briton et al., 2019; Brodziak et al., 2015; Forrest et al., 2018; Pascoe et al., 2016; U. R. Sumaila & Hannesson, 2010) without actually reformulating economic sustainability. The detrimental aspects of subsidies are no longer a major point of debate suggesting that the intent of Aichi Biodiversity Target 3 has broad conceptual support, and the challenges now are on effective methods to reduce capacity-enhancing subsidies rather than debates about the benefits of doing so. However, papers on the potential benefits and possible negative social effects of formal eco-certification schemes as incentives for sustainable fishery activities showed a marked increase (Gutierrez et al., 2016; Militz et al., 2017), whereas eco-certification was still considered a feature restricted to economically elite fisheries prior to the 20-teens (Parkes et al., 2010).

Nearly 20% of all papers reviewed looked directly at the social context of sustainability of fishing. This is a marked increase from 2010. Interactions of the social context of fisheries

with environmental and economic considerations and the fishery itself all received attention, in contexts such as the role of socially well-adapted fishing in perpetuating particular ecosystem configurations (Caswell et al., 2020; Tregidgo et al., 2017) and the social status of fisher harvesters and traders in communities (K. L. Cochrane et al., 2011; Pihlajamaki et al., 2020; Twist et al., 2016).

However, the importance of small-scale fisheries' contribution to community identity, livelihoods and overall wellbeing received the most focused attention (e.g., Asche et al., 2018; Cinner et al., 2016, 2019; Galland, 2017; Voyer et al., 2017). These ideas were being discussed in the decades before the 20-teens (FAO, 2015) but in the 20-teens they have taken a central place in discussing sustainability of fishing. Correspondingly, fully 20% of the papers presenting new or adapted ideas of the social aspects of sustainable fishing deal directly with governance and or the use of alternative knowledge systems in sustainability of small-scale fisheries (Al-Humaidhi et al., 2013; Groeneveld, 2011; Maravelias et al., 2018; McClenahan et al., 2014; O. R. Young et al., 2018). Primarily concerns in governance issues are how increasingly concentrated wealth and power can result in a small number of voices and perspectives having a disproportionate influence over governance processes (Cinner et al., 2016; Hilborn et al., 2020; Nielsen et al., 2018; Osterblom et al., 2017; Schultz et al., 2015).

Prior to 2010, governance was conceptualized as an external factor that influences the sustainability of fishing in various ways whereas governance is now understood as an inherent aspect of sustainable fishing. Inclusiveness, equity and small-scale self-governance are widely argued to be essential to sustainability, which is a major development in the 20-teens. However, taking climate change directly into account in the prosecution and management of fisheries is still infrequent, with only 14 explicit mentions. It ranks well behind governance as an expanding concept in the conceptualization of sustainable fishing. Experts still primarily seem to consider climate change an external factor that needs to be taken into account in prosecuting and managing fisheries sustainably.

The identification and formal use of harvest control rules and quantitative or semi-quantitative benchmarks for the exploited stocks, species taken as bycatch, and impacts on seabed habitats has gained significant momentum through the 2010s, appearing in nearly 10% of all papers reviewed. The use of multiple knowledge systems is also being called for although not as a feature of how sustainability of fishing is conceptualized but rather, as a superior approach to evaluate any and all aspects of sustainability of uses.

Marine protected areas or their cognates are another frequent topic of literature on sustainable fishing in the 20-teens literature. Although highly protected marine protected areas by definition do not include fishing within their boundaries, proponents of high marine protected areas coverage argue that they are essential for conservation and the spill-over benefits from marine protected areas can be an important component of sustainability in fishing (Gjerde et al., 2016; Laffoley et al., 2021; Rochette et al., 2014). Other experts argue that marine protected areas are simply one of many tools available to deliver sustainable outcomes from fishing. That tool needs to be planned and located with substantial care to deliver desired outcomes, particularly because marine protected areas often incur significant social and or economic costs, which frequently are distributed in very inequitable ways (Kockel et al., 2020; Li et al., 2020; Mizrahi et al., 2020). Consensus is lacking on whether highly protected marine

areas are sufficient or necessary to produce sustainable fishing, and their role in conceptualization of sustainable fishing is still unresolved.

Table 2.1 Literature for fishing. Each paper was scored first on whether it addressed primarily the target species (population), the ecosystem impacts or sensitivity of a fishery (ecological), the value and financial incentives of the fishery (economic), or the social context in which the fishery operates (social). Then each paper was scored for which aspects of the other factors and whether the primary thrust of the paper was the performance and/or participation in the fishery itself (fishery), analytical methods (analytical), the role of governance (governance), a review of a relatively long historical time series (history), or the use of additional knowledge systems in evaluating the factor (knowledge).

“Traditional” aspects of sustainable fishing	Population	Ecological	Economic	Social
Aspects of sustainable fishing in current literature				
Population	24	10	5	3
Ecological	8	35	5	13
Economic	13	5	11	13
Social	5	12	14	20
Fishery	3	17	4	15
Analytical	59	33	20	17
Governance	3	3	8	17
History	9	1	1	0
Knowledge system	2	1	2	3
Total number of papers	126	117	70	101

2.2.3.3 *Conceptualizations of sustainable gathering in the academic literature*

2.2.3.3.1 Introduction

Gathering encompasses a wide range of species (see Chapter 1), including plants and fungi, as well as animals such as frogs, turtles and crocodilians. Each of these is studied in disparate academic fields. The framing of gathering that has gained most attention in the academic literature is that of “non-timber forest products” or “non-wood products”. This review focuses largely, but not exclusively, on the literature in this framing since it forms the bulk of published research on the topic. The data management report for this review is available at <https://doi.org/10.5281/zenodo.6472995>.

Discussions about the sustainability of gathering in the academic literature emerged in the late 1980s. Prior to this, there was a long history of research on the ecology, harvest, processing and trade of species that are gathered, but little mention of sustainability. When it did come up, ideas centered around tragedy of the commons (Sills et al., 2011).

In the late 1980s the gathering of plants, algae and fungi began to be widely promoted in global conservation circles as a conservation strategy. It was considered an alternative to logging and livestock ranching – major causes of deforestation at the time – that could support local livelihoods while leaving the forest standing. As both governments and non-governmental organizations-initiated programs to promote plants, algae and fungi commercialization, academic discussions about the sustainability of gathering ensued. At first these discussions focused only on economic criteria, because the widely held assumption was that the ecological impacts of gathering were minimal (Sills et al., 2011). Ideas and heated debates about sustainability centered on the economic contributions of gathering to rural livelihoods, including for subsistence, cash income and as safety-nets (Arnold & Perez, 2001; Belcher & Schreckenberg, 2007).

By 2010 however, the conceptualization of sustainable gathering had evolved to include economic, ecological and social components, with governance and management understood to be key components of the latter (Arnold & Perez, 2001; Belcher & Schreckenberg, 2007; Sills et al., 2011; Ticktin, 2004). These components included supportive national policies, resource tenure to ensure benefits captured by those managing the resource, and strong institutions governing resource use including organization among producers, as well as equitable access and benefit sharing. In terms of management, effective inventory and monitoring, including strong community or local involvement in decision-making for management and monitoring, including co-management, adaptable resource management practices, and inclusion of traditional ecological knowledge in management plans were widely conceived to be critical aspects of sustainable use. Finally, transparency and integration along the value chain among producers, and inclusion of women were also recognized as key conditions for sustainable use (Arnold & Perez, 2001; Belcher & Schreckenberg, 2007; Sills et al., 2011).

On the ecological side, most research conceptualized sustainability in terms of the maintenance of forest cover and/or the persistence of the harvested species. However, considerations of the effects of gathering on the broader ecological community, including of ecologically-related species and on measures of biodiversity and ecosystem processes were also discussed, if rarely measured (Ticktin, 2004).

The broad consensus however, which holds still today, was that given the vast array of species, life-histories, and types of use, and the widely different roles these play in local livelihoods, there is no one size fits all (Sills et al., 2011).

2.2.3.3.2 Post-2010

- **Dynamic social-ecological systems**

Conceptualizations of sustainable gathering have shifted in the past 10 years in multiple ways. First, sustainable harvesting is now frequently conceptualized in terms of dynamic social-ecological systems (Pezzuti et al., 2018; Shackleton et al., 2015), where ecological, economic, political and socio-cultural dimensions of gathering are both interdependent and inseparable (de Mello et al., 2020). Similarly, sustainability is increasingly envisioned as a spatially and temporally dynamic phenomenon where harvest systems are in constant flux, with changes occurring at multiple levels and spatial scales and across the various components of the social-

ecological system simultaneously (Pezzuti et al., 2018). As such, conceptualizations of sustainability have shifted towards being context and scale-specific (Shackleton et al., 2015).

- **Sustainability of multiple practices**

In the social-ecological system framing, the sustainability of gathering is no longer considered in isolation from that of other land and resources uses with which gathering co-occurs. For example, scholars argue that sustainability of gathering cannot be conceptualized in isolation of the sustainability of logging and hunting, due to the feedback loops among these practices across many landscapes (Shackleton et al., 2015; Ticktin, 2015). Similarly, sustainability of gathering is now frequently conceptualized in combination with that of interacting agricultural practices, including grazing and foraging of livestock, and associated fire regimes (Groenendijk et al., 2012; Lybbert et al., 2011; Sampaio et al., 2012; Ticktin et al., 2012, 2014). Consideration of feedbacks between gathering and invasive species has also emerged as a consideration for determining if a use is sustainable (Darabant et al., 2016).

- **Sustainable use and ecosystem services**

The effects of gathering on the provision of ecosystem services is now increasingly conceptualized as a component of sustainable use. This is usually framed as trade-offs across services, such as provisioning of plants, algae, fungi, timber, and carbon services (Granath et al., 2018; Strengbom et al., 2018; Triviño et al., 2017), and the cost of production (Lambini et al., 2018). Other authors argue that sustainable gathering could also include consideration of ecosystem services that have not been considered to date, for example the provision of services to other species, including food, shelter and resources used as medicine by non-humans (Shackleton et al., 2018).

- **Socio-cultural dimensions**

While the majority of studies on gathering that conceptualize sustainability from a social and economic science perspective emphasize economic and ecological trade-offs, more recent ideas about the sustainability of gathering include socio-cultural dimensions (de Mello et al., 2020; Pezzuti et al., 2018). Consistent with conceptualizations of sustainable use in indigenous peoples and local communities (see sections 2.2.4 and 2.2.8), the maintenance of social networks, including sharing networks and inter-community linkages, and social institutions are increasingly recognized in the academic literature as core elements of sustainable gathering. The relationship between gathering and health and wellbeing has also emerged as a critical element of social sustainability (Sills et al., 2011). Wellbeing can be generated in multiple ways, including through: the physical and spiritual act of gathering, connection to place, cultural symbolism, and consumption of the products gathered (e.g., de Mello et al., 2020; Rapinski et al., 2018; Shackleton et al., 2018). Although the contribution of gathering to community health and nutrition has been well recognized for some time, especially as nutritional safety nets of both foods and medicines, these considerations are more frequently being conceptualized as considerations for sustainable use (e.g., Morsello et al., 2014). Both food justice and sovereignty

and health justice are viewed as aspects of sustainable gathering in indigenous peoples and local communities as well as in urban settings (Poe et al., 2013).

- **Coproduction**

Finally, as discussed above, co-management approaches that include the integration of traditional and/or local ecological knowledge and science, have been recognized for some time as important for the sustainable gathering of commercialized species. However, sustainable gathering in changing contexts is now increasingly understood to depend not on the integration of knowledge systems, as was previously conceptualized, but rather on the coproduction of new knowledge (e.g., Davidson-Hunt et al., 2013). The latter is understood to require institutional arrangements that provide community control, meaningful collaboration and partnerships, and significant benefit sharing.

2.2.3.4 *Conceptualizations of sustainable terrestrial animal harvesting (focus on hunting) in the academic literature*

2.2.3.4.1 Pre-2010 conceptualizations of hunting

Hunting is defined as the act of searching, pursuing, collecting or killing wild animals (Lindsey et al., 2006). Hunting is one of the earliest forms of interaction between humans and the environment (Kittenberger, 1929). Reasons for hunting range from subsistence to management, recreation, sport (trophy hunting) and cultural heritage or a combination of these (Lindsey et al., 2006). Hunting can also be conducted for the purpose of trade of animal derivatives for making jewellery and sometimes for medicinal purposes under various contexts.

Prior to 2010, hunting was conceptualized in the literature as reflecting utilitarian and economic values (Eltringham, 1994; Sinclair, 1991), which could provide incentives for wild species conservation (Robinson & Bodmer, 1999). Conceptualizations of hunting identified in the literature prior to 2010 are in line with international conventions and guidelines like the Convention on Biological Diversity and the Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity, which confirm the right and the need for the sustainable use of natural resources (IUCN, 2006). The literature in this time period generally argued that sustainable use of wild species should contribute to both human needs and to the conservation of biological diversity (Baldus, 2008; McMichael et al., 2003; Robertson, 1991). Well-managed hunting with efficient legislative mechanisms and scientific input, such as the case of American hunting, were viewed as sustainable while also providing many incentives for conservation of species and landscapes. It was also argued that hunting is an important conservation tool because the social and economic benefits derived from it provide incentives for people to conserve the sources of those benefits (IUCN, 2006). This concept was instrumental in stimulating several conservation initiatives, particularly initiatives where indigenous people and local community engagement, equity and community benefits are crucial. Hunting was regarded as having the potential to support sustainable utilization of wild species, particularly if management took into account harvested species' impacts on other species and on vegetation and was conducted in line with ecological principles applied across their natural ranges (IUCN, 2006).

- **Hunting and wild species population management**

Prior 2010, hunting was described as an important animal population control tool which played a crucial role in maintaining animal populations at sizes that prevent stress on the rangelands supporting them (Williams, 1996). The occurrence of hunting around strict preservation areas such as national parks was accepted in terms of its ability to prevent the ballooning of wild species populations through the source sink relationship which occur between the hunting areas and non hunting areas. In addition, Allendorf & Hard (2009) also highlighted that the targeting of older animals past prime breeding age during hunting contributes to reducing pressure on resources leading to sustainable wild species habitats. The importance of hunting in controlling the population of animals such as elephants which may have significant undesirable impacts on habitats when their populations continuously grow, was generally accepted. In this regard, hunting was seen to have potential to contribute towards the conservation of several other species.

- **Hunting, economic development and tourism**

The call for wild species to pay for their existence was present in early conservation narratives (Eltringham, 1994). Trophy hunting was presented as a wild species-based enterprise generating significant revenues for stakeholders and national economies (Lindsey et al., 2006). Trophy hunting was viewed as an important foreign currency generating venture, contributing significantly to tourism revenues and gross domestic product for nations, and creating incentives for conservation where nature-based tourism was not viable (Freeman et al., 2005). Hunting was presented as a lucrative wild species business with the potential to generate extraordinarily high revenues with minimal off take of individual game animals. Hunting tourism was considered to present opportunities to develop into an economic and social force of considerable impact in remote rural and agriculturally marginal areas (IUCN, 2006). However, tourism in remote and peripheral areas can be rather volatile because it depends heavily on transportation and accessibility. The literature generally supported viewing hunting tourism as a tool to diversify local economies, but not a replacement for other sources of income (Hall & Boyd, 2005). In addition, many papers documented that hunting activity can be a useful mechanism for financing preservation of natural ecosystems, in a context of wise use in line with key elements of sustainable use (Foote & Wenzel, 2007).

- **Community-based conservation, incentives and hunting**

The role of hunting in community development and poverty alleviation was discussed by a number of authors as a key benefit of trophy hunting, creating incentives for conservation among rural communities. Contributions of hunting towards community development were reported in African countries such as Tanzania and Zimbabwe, where it formed the backbone of community based natural resource management programs (Lindsey et al., 2006). By contributing towards community development, hunting formed an important feature of models for sustainable wild species management linking trophy hunting, wild species conservation and community sustainability in rural areas (Freeman et al., 2005). The social and economic incentives from hunting promoted meaningful involvement of indigenous and local

communities in wild species conservation, via incentives created by sustainable use for rural populations (Nilsen & Solberg, 2006). The social and economic benefits of trophy hunting also were acknowledged as cornerstones for incentive driven conservation practices (Hutton & Leader-Williams, 2003).

- **Hunting, ethics and rights in sustainable use**

By 2010, the previously asserted conservation values of hunting were deeply contested. Polarized debates emerged as conservationists differed in opinion as to whether trophy hunting is an ethically legitimate conservation tool (Lindsey et al., 2006). Other polarized discussions hinged on whether strict protection strategies based on exclusion of extractive methods are sustainable (Council of Europe, 2007; Kaltenborn et al., 2005; Kiringe et al., 2007). It was also argued that the sustainability of hunting is susceptible to abuse and malpractices, with hunting tourism inherently vulnerable to corruption, fraud, overshooting of best practices in quotas, bad management, and loss of wild species numbers and biodiversity. It was argued that community benefit from hunting revenues in community-based natural resource management programs where hunting is listed as a key use strategy, was also grossly affected by these misgovernance issues (Balint & Mashinya, 2008; F. A. Johnson et al., 1997).

- **Hunting, trade and sustainability**

A shift in the narratives about hunting and wild species trade reframed them as threatening the conservation of wild species (Darimont et al., 2009; Zapata-Ríos et al., 2009). The limitations of monitoring and control on wild species trade were highlighted as among the reasons commercial trade of wild species could be regarded as unsustainable. The contemporary and prehistoric extinction of thousands of wild species was attributed to hunting, including prominent species such as the quagga, woolly mammoth, sabre toothed cat and West African black rhinoceros. Populations of amphibian species have also declined as a result of collection and trade (Halliday, 2001; Kuzmin, 1996). Economic incentives such as the establishment of quotas without a scientific basis were observed to lead to unsustainable utilization patterns (Zhang et al., 2008). The motives for quota setting in trophy hunting were argued to be dominantly political and economic at the expense of conservation, with far-reaching consequences on the sustainable use of wild species (Rodrigues, 2004). Persistence of wild species markets was also cited as a major hindrance to efforts to stop poaching (Darimont et al., 2009). Other negative impacts of commercial wild species trade such as the spread of invasive species and zoonotic diseases as a result of live animal sales were also highlighted by some authors (e.g., Smith et al., 2009). Several authors suggested that there was need for conservationists and policy makers to find ways to reduce the magnitude of international wild species trade in order to save species from extinction (K. F. Smith et al., 2009; Vercauteren & Hygnstrom, 1998). Approaches that were proposed to address the issue of wild species trade include awareness among governments to take proactive measures to address the impacts and risks of wild species trade (Nijman, 2010).

- **Effects of hunting on species populations and distribution**

Simultaneously, the harvesting or removal of wild species through hunting was observed to have undesirable impacts on populations and the functioning and integrity of some ecosystems (Vermeulen et al., 2009). Hunting, especially wild meat hunting, was often discussed as one of the major contributors to animal species population decline (Brashares et al., 2004). Breeding was argued to be negatively affected as a result of the selection during hunts which harvest males at a faster rate than females (Fischer & Keith, 1974). Negative impacts of hunting were reported on small mammals (Nixon et al., 1975), amphibian and reptile species such as crocodile and turtle (da Nóbrega Alves et al., 2008; Powell et al., 2000), and several bird species in the 19th century (Madsen & Fox, 1995).

Hunting was also identified as a threat to tropical forests (Bonaudo et al., 2005). Citing evidence from Malaysia, Robinson & Bodmer (1999) argued that hunting could lead to the loss of wild species that are pivotal in the maintenance of ecosystem processes such as pollination and seed dispersal. Forms of hunting such as trophy hunting were argued to negatively impact species due to lack of proper research and science-based decisions, which create an opportunity for unsustainable harvests and threatens wild species (Salvatori et al., 2002). In contrast, Stork (2007) described the importance of hunting as a habitat protection tool, which benefits tree dwelling insects and leads to stable insect populations. Most studies which had been conducted on coastal and wetland areas showed that hunting activities can greatly affect bird behavior and distribution as birds move to safer zones and alter known breeding, roosting or wintering sites (Barri et al., 2008; Pack et al., 1999; Robinson & Redford, 1994; Small et al., 1991). In addition, Casas et al. (2009) suggested that human predation alters animal behavior as the former come to be recognized as a threat. However, other articles emphasised the benefits of hunting for non-target species. For example, Mateo-Tomas & Olea (2010) highlighted the importance of carcass meat for raptor and other carnivorous bird species success. In addition, the removal of individuals through hunting was argued to favor selection, thus maintaining balance and integrity of the ecosystem (Stenseth & Dunlop, 2009). Restrictive hunting regulations were credited with contributing to the stability and increase in survival rates of mallard duck populations in Canada and the United States of America, and goose populations in Europe as well as large scale habitat restoration by hunters (G. W. Smith & Reynolds, 1992). Thus, it was argued that populations can thrive under well monitored and effectively managed hunting systems (Burnham et al., 1984; Casas et al., 2009). Thus, the literature includes good illustrations of the success of hunting as a management tool. However, the measures contributing to successes in conservation of species and habitats were recognized to be context specific and should not have a blanket application across populations.

The development of assessment tools to measure the sustainability of hunting over the years was highlighted and the role of research acknowledged in a number of articles (Bennett et al., 2002). There are many cases documenting the value of information from hunting in evaluating the status and trends of harvested populations (Robinson, 1971; Scillitani et al., 2010; Struebig et al., 2007; Tuttle, 1979), particularly if using information from both hunters' activities and removals (Alvard, 1995; Tallis et al., 2008).

- **Multispecies hunting, wild meat consumption and perceived disease risk**

The pre-2010 literature reported widespread wild meat hunting as one of the major threats to

many mammals and birds in Africa, such as buffalo, kudu, and impala (Golden, 2009; Magige et al., 2009; Rao et al., 2005). According to Golden (2009), this was particularly the case for illegal hunting for wild meat and rampant collection and harvesting of birds, amphibians, reptiles and edible insects. Kumpel et al. (2009) pointed out that hunters are the critical link between demand and supply of wild meat. Although wild meat hunting was acknowledged to present a potential threat to species conservation, demand for wild meat was also highlighted as continuously increasing (Barnes, 2002; Robinson & Bennett, 2004). There were also some articles that discussed negative impacts of wild meat hunting on both wild species populations through harvests of threatened species and people`s livelihoods through the transmission of zoonotic diseases which may have serious consequences for exposed people and their communities (LeBreton et al., 2006; Monroe & Willcox, 2006; Wilkie, 2006).

2.2.3.4.2 Post-2010 conceptualization of hunting

The post 2010 literature review identified 222 papers which were coded according to different aspects of sustainable use that fell into the broad groupings of ecological, socio-economic, governance, and socio-cultural. The data management report for this review is available at <https://doi.org/10.5281/zenodo.6472995>. In these papers, ecological aspects are the most represented and socio-economic aspects the least represented (Figure 2.1).

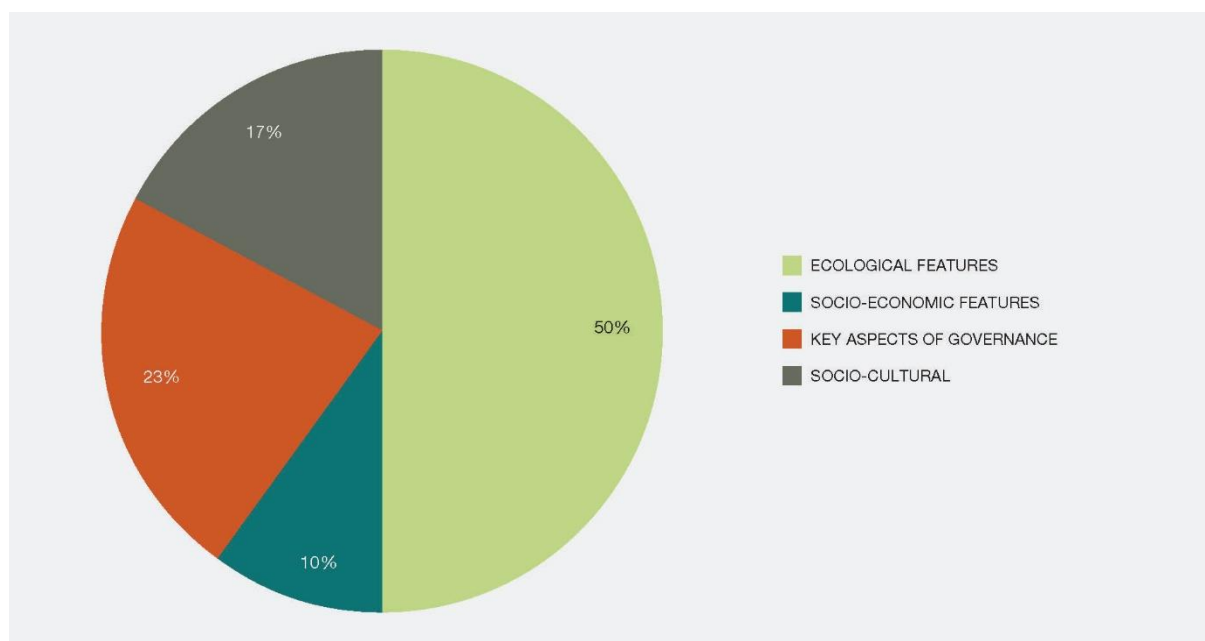


Figure 2.1 Distribution of average scores per group of aspects of sustainable hunting, presented in percentages.

Similar findings emerge when evaluating individual aspects of sustainable use. Among the ten most common aspects, half were ecological, followed by governance and socio-cultural aspects (Table 2.2). The most common aspect is an ecological focus at the population level, which was covered in 98% of all analyzed documents, followed by contributions to subsistence or culturally established livelihoods, which was discussed in 27% of the articles.

Table 2.2 Most represented aspects of sustainable use among 222 analyzed documents.

Rank	Aspect	Category	% of papers that address issue
1	Populations used directly and intentionally, whether harvested in whole or part	Ecological	98
2	Contribution to subsistence or culturally established livelihoods	Socio-economic or socio-cultural	27
3	Impacts on Endangered, threatened, or protected species or habitats	Ecological	25
4	Aggregate spatial features (e.g., portion of area impacted by use)	Ecological	25
5	Adaptive management	Governance	25
6	Aggregate biotic community properties (e.g., biodiversity)	Ecological	23
7	Community wellbeing	Socio-cultural	22
8	Market value of intended product(s) harvested	Socio-economic	19
9	Monitoring, Evaluation and Review	Governance	18
10	Structural habitat features	Ecological	14
10	Contribution to stability of economy at local scale	Socio-economic	14
10	Inclusion of multiple knowledge systems in management plans or policies	Governance	14

Close to one third of the analyzed papers covered aspects from more than one broad grouping. Of the papers that focused on ecological aspects, approximately one quarter also included aspects from another category, usually socio-economic.

About 40% of analyzed documents considered “sustainable hunting” within the framework of the ecological aspects, which is narrowly in accordance with the understanding of “sustainable use” in article 2 of the Convention of Biological Diversity. However, such understanding of the concept of sustainable use of wild species through hunting is limited from the perspective of Addis Ababa Principles and Guidelines for the sustainable use of biodiversity or Guidelines on Sustainable Hunting in Europe (IUCN, 2006). A bit more than half of other sources considered sustainable hunting to go beyond ecological characteristics and impacts, although only 15% of all analyzed documents included features from all groups (ecological, socio-economic, governance and socio-cultural).

Hunting continues to be most frequently conceptualized by considerations of direct impacts on populations, biodiversity, and on endangered or threatened species and protected habitats over a portion of area. Adaptive management, frequent monitoring and evaluation, contributions to subsistence or culturally established livelihoods, and market value to support community wellbeing are other frequently discussed concepts (see Table 2 at

10.5281/zenodo.6472995).

Within each broad category of sustainable use, the following ideas emerge as most prevalent:

- Ecological: direct impacts of use on wild species populations within a certain area, which takes into consideration preservation of habitat and endangered species, as well maintenance of biodiversity and structural habitat features.
- Socio-economic: hunter's bag has a market value, contributes to subsistence or culturally established livelihoods and supports household economy, and/or the local and national economy.
- Governance: implementation of adaptive management is supported with monitoring, evaluation and review of used populations. Indigenous peoples and local communities' customary rights and access to hunting are respected under management plans or policies, which incorporate multiple knowledge systems and allow transparent decision-making.
- Socio-cultural: sustainable hunting ensures community wellbeing, respects traditions and supports education.

In addition to the above, the following aspects of the conceptualization of sustainable hunting also emerged from review.

- **Hunting as a threat**

Many papers address hunting as a threat, but usually do not go beyond considering the environmental impact of hunting. However, within the context of environmental impacts, sustainability of hunting is considered from diverse perspectives, including direct and indirect pressures on wild species populations and habitats. These include a focus on:

- Impacts on wild species: hunting is viewed as a limiting factor which affects wild species population numbers or abundance through harvest (Chamberlain et al., 2012; Ciuti et al., 2015; Proffitt et al., 2010; Ramos et al., 2016; Tagg et al., 2020; Van Vliet & Nasi, 2019; White et al., 2010). This conceptualization is present in a large majority of portion of the papers but usually does not go beyond ecological aspects. Hunting is considered to be sustainable as long it does not result in high pressure on wild species populations and does not threaten species survival.
- Trophy hunting: many papers also analyze hunting impacts on game species, especially charismatic or flagship species, and includes impacts on sex ratio, population age class structure or evolutionary disturbances, and discussion of efforts to make trophy hunting more sustainable (Brink et al., 2016; Coulson et al., 2018; Festa-Bianchet et al., 2014; Miller et al., 2016; Wanger et al., 2017). Papers on this topic overlap with the group above, but are more likely to include additional aspects of sustainable use (e.g., X. Zhou et al., 2020).
- Lead ammunition: the damaging consequences of lead ammunition use on environment, wild species and their habitats is addressed by multiple papers (Cartró-Sabaté et al., 2019; Flint & Schamber, 2010; Kanstrup et al., 2018).
- Hunting as a management tool: some papers take into consideration hunting as an instrument in wild species management in order to achieve sustainability (Crum et al.,

2017; Forti et al., 2017; Simard et al., 2013; Stien & Hausner, 2018). Hunting is conceptualized as useful in control of invasive species, zoonosis or overabundant populations.

- **Wild meat hunting**

Use of wild species for subsistence or trade is a common topic in the post 2010 literature. This topic is addressed from the perspectives of sustainable or unsustainable hunting, the latter arguing that hunting threatens the existence of large mammal species and undermines conservation efforts (Hegerl et al., 2017; Kamgaing et al., 2019; Kouassi et al., 2019; Pangau-Adam et al., 2012; Spira et al., 2019; van Velden et al., 2020; Van Vliet et al., 2015). Papers that address wild meat hunting usually go beyond ecological aspects and involve socio-economic and socio-cultural aspects, especially those related to contributions to subsistence or culturally established livelihoods and community wellbeing. Another common theme argues that placing market value on wild species is an unsustainable practice, which threatens species conservation. Literature on hunting for meat is mostly focused on Sub-Saharan Africa or Amazonia, whereas studies from other parts of the world are poorly represented.

- **Human dimensions of hunting**

Social components of sustainable hunting are significantly less covered in comparison to the two previous categories. Studies that focus on human dimensions of hunting commonly address two subtopics:

- **Hunters:** papers address hunters as stakeholders important for contributing to the implementation of sustainable hunting. This research mostly addresses the role of hunters in various wild species management practices and their impact in environmental protection, but also studies their recruitment and retention (O. Andersen et al., 2014; Breisjøberget et al., 2017; Carvalho et al., 2015; Gude et al., 2012; Jacques et al., 2011; Paulson, 2012; Schorr et al., 2014). Research on trends in hunters' numbers are especially common among scientists from the North America, since the purchase of hunting licenses is linked with financial support to wild species management and conservation. Papers that address this topic also often address other various wild species management or conservation issues (e.g., Schraml, 2012).
- **Human-wildlife conflict:** an important focus is on conflict between local communities and wild animals, usually predators, and its impact on carnivores' conservation. These papers usually involve ecological aspects but also involve other aspects of sustainable use that are discussed separately here (e.g., Austin et al., 2010; Goldman et al., 2013; Hiller et al., 2015; Thorn et al., 2015).

- **Economic dimensions of hunting**

A number of papers address the financial contributions of hunting to local or national economies, and market value of harvested products through different activities, for example hunting tourism or trade. This topic overlaps with wild meat hunting, or and trophy hunting, but goes further in considering both economic and ecological aspects of hunting (e.g., Arroyo

et al., 2016; Buckley & Mossaz, 2015; Deere, 2011; Soliño et al., 2017).

- **Hunting and other land use activities**

Few papers address hunting in the context of other land use activities. The topic was covered by reports and book chapters (Ehrhart et al., 2020; Reimoser et al., 2013), and focuses on the possibility of harmonizing hunting activities with other land uses such as agriculture, forestry or recreation. However too few papers were found for general themes to emerge.

- **Conclusions**

Sustainable hunting is conceptualized as a multidisciplinary and complex issue and is being approached from different perspectives. Nevertheless, the majority of analyzed papers consider sustainable hunting within an ecological and wild species management framework. They find it feasible to keep hunting sustainable, but only with effective management approaches and measures, and adequate enforcement by coherent communities or appropriate authorities. However, papers challenging the ethical basis for hunting are increasing in the literature, as are papers arguing that weak implementation of policies and measures result in widespread unsustainable hunting. Sustainable hunting is evaluated in terms of population removal and natural replacement, levels of disturbance of population parameters (sex ratio, age classes, market suitability and trophy quality) and impacts on protected species and habitats. The market value of hunting products is recognized as an important component of sustainable use, especially the contributions towards income, gross domestic product and economic stability. Socio-economic features such as the contribution of sustainable wild species use towards community wellbeing are emphasized as an important aspect in their own right, but often framed as instrumental to creating incentives for biodiversity conservation. Governance issues are occasionally but increasingly mentioned and discussed as part of sustainable hunting, especially issues such as inclusiveness and distribution of power. There is some mention of monitoring, evaluation and review mechanisms of resource use, which is often emphasized as critical for the sustainable use of biodiversity. Additionally, adaptive management is sometimes emphasized as an essential management strategy key for sustainable utilization of wild species.

Issues related to the costs of hunting are infrequently discussed in the review articles. There was also very little mention or discussion of the viability of local communities in areas where hunting occurs, for example, protection of local communities from gentrification of area uses, ability to keep workforce etc. Finally, governance aspects regarding power and transparency in decision making were missing in most of the review articles, as was the issue of indigenous peoples and local communities' customary rights and access to resources.

2.2.3.5 Conceptualizations of sustainable logging in the academic literature

This assessment defines logging as a practice that removes whole trees or woody parts of trees from their habitat, often resulting in the death of the trees except for cases such as coppicing (see Chapter 1). Because trees and forests are inseparable in nature, there is a strong link between logging and forest management. However, logging is only a subcomponent of forest management that pursues other services and values, such as biodiversity, ecosystem services,

income, livelihoods, and aesthetic and cultural values. Although this review acknowledges this practical difference between the two, it relies largely, but not exclusively, on forestry literature and treats the term “timber” and “forest” almost equally. This is because conceptualizations of sustainable logging developed as part of the efforts towards sustainability in forest management. Thus, the aim is not to define “sustainable logging” as a novel concept but to describe its dimensions under the conceptualization of sustainability in forest management.

2.2.3.5.1 Pre-2010 conceptualization of logging

Forestry is considered the first science to introduce the concept of sustainability in the western world. According to Glacken (1976), books representing the starting point of forestry science published in the mid-seventeenth century already discussed the importance of safeguarding finite timber resources for future generations. The term *Nachhaltigkeit* (“sustainability”) first appeared in the early eighteenth century in a German book by Hans von Carlowitz. He advocated that no more wood should be felled than can grow back (von Carlowitz, 1713). Since then, sustainability in forestry science has generally maintained a strong focus on achieving a sustained timber yield (Innes, 2017b; Wiersum, 1995), and the views of forest experts who typically focused on the allocation of management resources for the maintenance of productivity dominated the discussion (Hahn & Knoke, 2010). Similar approaches to logging also emerged independently in Japan in the same era, where people managed the harvest of Japanese cypress (*Chamaecyparis obtusa*) based on inventory and production planning (Iwamoto, 2002). In the early ages of forestry science, timber production was set as the primary goal, and other forest values and services were often ignored (Hahn & Knoke, 2010). These timber-centric approaches to forestry are referred to as sustainable timber management, sustainable yield forestry, or other related terms (Hahn & Knoke, 2010; Figure 2.2).

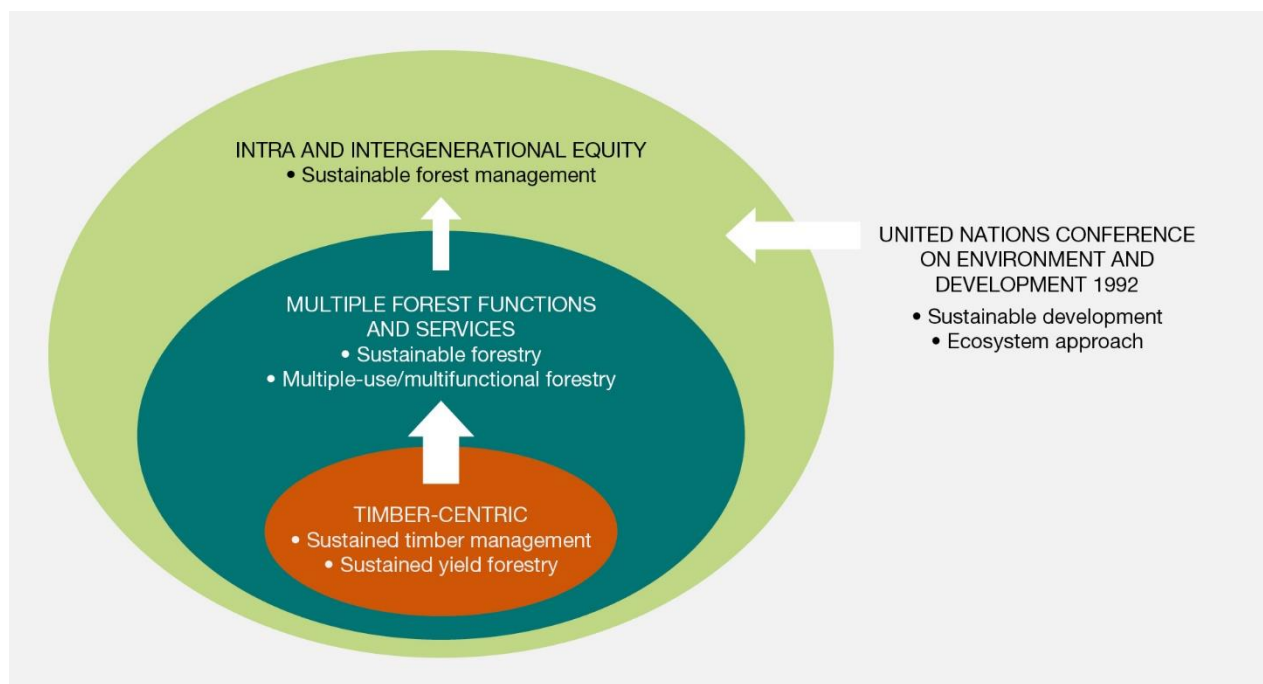


Figure 2.2 Conceptual development of terms related to sustainability in forestry. The width of the arrows qualitatively reflects the impact of the former on the following stages leading to the emergence of sustainable forest management. Modified from Hahn & Knoke, 2010. CC-BY-NC - License number 5275361479074.

In response to the environmental impacts caused by logging, forestry started to incorporate other uses and values of forests with the term “forest function” since the mid-nineteenth century (Bader & Riegert, 2011; Bončina et al., 2019). The seminal work by George P. Marsh (1864), which is considered as the origin of the concept of ecosystem services (Mooney & Ehrlich, 1997), acknowledged functions like regulation of water and climate, soil conservation, decomposition, and pest control. Viktor Dieterich (1953) defined forest function as societal demand on forests, and the term has become common in forestry (Bader & Riegert, 2011). Acknowledgment of forest function was a reflection of growing public interests, but participatory methods in decision-making were not conceptually applied at this point (Hahn & Knoke, 2010), except for community-based participatory forestry that dates back to the 1970s in the tropics (FAO, 1992). This management approach that incorporates multiple forest functions and services is referred to as sustainable forestry, multiple-use forestry, or multifunctional forestry (Hahn & Knoke, 2010; Figure 2.2). In the United States of America, forest uses other than timber were acknowledged by the Organic Act in 1897, and equal weight was given to all types of uses by the Multiple-Use and Sustained-Yield Act in 1960 (Bowes & Krutilla, 1989; Hoogstra-Klein et al., 2017). Similar shifts in the scope of forest management occurred in Europe (Bončina et al., 2019) and the tropics (e.g., Wadsworth, 1952) since the 1950s.

The turning point of conceptualizing sustainable logging was reached in the 1990s when the concept of “sustainable forest management” emerged (Hahn & Knoke, 2010; Innes, 2017b). The notions of “sustainable development” and the outcomes of the United Nations Conference on Environmental Development held in 1992 prompted forest management to consider ecological sustainability, social values, and intra- and intergenerational equity (Hahn & Knoke, 2010). Participation of various stakeholders beyond conventional shareholders - the fundamental component of sustainable development - has become the indispensable attribute of sustainable forest management (FAO, 2003; Hahn & Knoke, 2010). Additionally, the “ecosystem approach” endorsed at the 5th Conference of the Parties to the Convention on Biological Diversity in 2000 also introduced new approaches to forest management. These included adaptive management, conservation of biodiversity and ecosystem services, and considering forests as part of the larger landscape (FAO, 2003; Hahn & Knoke, 2010; Innes, 2017b). Sustainable forest management can be viewed as an application of the ecosystem approach (or ecosystem management) in forest landscapes, and the two are often used interchangeably (FAO, 2003; Hahn & Knoke, 2010; Innes, 2017b). Over time, the goal of forest management has shifted from maximizing yield and profit from timber to balancing various needs and values of forests by incorporating public participation (Figure 2.2).

After the emergence of sustainable forest management, the academic conceptualization of sustainability in logging increasingly became transdisciplinary, covering ecological, economic, and social components (Wang, 2004). By 2010, ecological aspects of sustainable logging attracted the most attention in terms of the number of publications (Dobbertin & Nobis,

2010). The environmental sustainability of harvesting methods, such as reduced impact logging, has been a popular topic in the tropics since the 1990s (Boltz et al., 2003; Putz et al., 2008; Wang, 2004). In Europe and Asia, discourse on ecosystem management, including forest conservation and evaluation of ecosystem services, became common (Schober et al., 2018). Topics related to forest stand management (e.g., harvest, regeneration, and growth) have been popular in the temperate and boreal regions and South America (Schober et al., 2018).

The economic discourse of sustainable logging had shifted from being timber-centric to considering various needs and values of forests and woodlands, including the gathering of non-timber forest products and hunting (García-Fernández et al., 2008; Panayotou & Ashton, 1992). The contribution of forests and trees to rural livelihoods and poverty alleviation has become widely acknowledged across the tropics (Shackleton et al., 2007; Sunderlin et al., 2005). Ecological economics has brought new developments in evaluating forests in different forms of capital assets, including their flow, stock, and trade-offs (Wang, 2004). New forest markets for ecosystem services known as payment for environmental/ecosystem services schemes were developed to compensate service providers for the cost of maintaining healthy forest ecosystems (García-Fernández et al., 2008). At the macro-scale, economic theories have been applied to explain the underlying mechanism of a country's transition from net forest loss to net forest gain (known as "forest transition") (Meyfroidt & Lambin, 2011; Rudel et al., 2005).

The introduction of participatory approaches brought the most extensive changes in discussions on the social dimension. The empowerment of forest communities was often examined under community forestry and related schemes testing whether they brought ecological and/or community benefits (Charnley & Poe, 2007; García-Fernández et al., 2008). Topics included decentralization and devolution of forest management, participation in decision-making, tenure security over forest land and resources, equitable access and benefit-sharing, and customary institutions. Increased transparency and adaptability of forest management have been sought by developing criteria and indicators at two different scales. National criteria and indicators of sustainable forest management have been developed by several international and regional processes, such as the International Tropical Timber Organization, the Montreal Process, and the Pan-European Process, since the 1990s. These initiatives promoted supportive forest policies and monitoring and inventory at the national scale (Innes, 2017a; Linser et al., 2018). Pushed by green consumerism, forest certifications developed ecological and socio-economic criteria and indicators applicable at the scale of forest management unit and to the chain of custody (Auld et al., 2008; Rametsteiner & Simula, 2003). Forest certifications function as means of participation to respond to greater consumer awareness on the environmental impacts imposed on overseas forests (Hahn & Knoke, 2010).

2.2.3.5.2 Post-2010 conceptualization of logging

The conceptualization of sustainable logging during the past ten years has continued to build on the notions of sustainable forest management. Topics have slightly shifted over the years in response to societal needs and have shown regional variation.

Among the 72 papers reviewed (see data the data management report for this review is available at <https://doi.org/10.5281/zenodo.6472995>), the sustainability of timber resources was discussed in about 70 % of the articles, with higher frequency observed in the boreal

regions. Timber production was the main topic, but a considerable number of papers also discussed the maintenance of standing forest stock, which supports a wide variety of ecosystem services. Ecosystem services (including ‘forest functions,’ the synonymous term in forestry), such as climate regulation, water sequestration and purification, nutrient cycling, and sediment control, attracted equal attention. Many papers examined the sustainability of logging, gathering, and other ecosystem services simultaneously (e.g., Nambiar, 2019; Piabuo et al., 2018; Sheppard et al., 2020), suggesting a certain degree of conceptual overlap between the sustainability of logging and gathering. About half of the reviewed papers discussed the conservation of biodiversity. These trends indicate that the sustainability of logging is increasingly conceptualized with the diversified values of forests and woodlands entailing complex trade-offs and synergies among them (Chhatre & Agrawal, 2008; Luysaert et al., 2018; Timko et al., 2018; Visseren-Hamakers et al., 2012; Wagner et al., 2014).

- **Sustaining the productivity of timber**

The single-dimensional discourse on timber production has continued to explore conditions of sustainable harvest. Despite being a rather conventional topic, the relationship between soil impacts and forest productivity has caught great attention in boreal and temperate regions. Increasing use of heavier machinery in industrial forestry has raised concerns over soil compaction and erosion, loss of soil carbon, and soil surface disturbance, leading to reduced forest regeneration and productivity (N. Clarke et al., 2015; Nave et al., 2010; Picchio et al., 2020).

- **The resilience of forests as social-ecological systems**

Greater uncertainty and rapid changes in biophysical and socio-economic conditions surrounding forest management have driven the adoption of social-ecological systems theory (Messier et al., 2016). The concept of resilience connected different narratives. Some discussions emphasized the ecological notion of resilience, i.e., the role of biodiversity for service provisioning and ecosystem stability against disturbances, including climate change (Thompson et al., 2013; Wagner et al., 2014). Other studies have highlighted biocultural approaches to socio-cultural resilience, including the role of traditional ecological knowledge, governance systems of indigenous peoples and local communities, and sense of place (DeRoy et al., 2019).

- **Sustainability of wood-based bioenergy supply chain**

In Europe and North America, the rising demand for wood-based bioenergy for achieving climate mitigation targets has called for the need to assess the sustainability of wood supply chains (Cavalett & Cherubini, 2018; Santos et al., 2019). According to the review by Santos et al. (2019), most assessment and optimization studies have focused on the economic (i.e., overall costs of the supply chain) and/or the environmental (i.e., greenhouse gas emissions) dimensions, while the social component has been largely overlooked. Other ecological impacts included forest cover loss (Ceccherini et al., 2020) and soil nutrient deficiencies (Pare & Thiffault, 2016)

caused by increased biomass removal. Enabling environments for the transition to a sustainable bio-based economy have been explored concerning forest governance systems (Johansson, 2018) and natural resource legislation (Borgstrom, 2018) of producer countries.

- **Multiple dimensions of sustainable use revisited under REDD+**

The emergence of REDD+³ (Reducing Emissions from Deforestation and forest Degradation) since the mid-2000s has introduced results-based carbon payment mechanisms to sustainable forest management and forest conservation in the tropics. Before REDD+, climate mitigation measures in the forest sector focused on the role of forest plantations by promoting afforestation and reforestation under the Kyoto Protocol. REDD+ came in as an alternative approach spotlighting the value of natural forests for carbon sequestration and storage functions. However, valuation of forests through the single lens of carbon provoked active discussions for the need to account for multiple values and perspectives and to ensure environmentally and socially appropriate approaches to forest management (Corbera, 2012; J. Gupta, 2012; Hein & van der Meer, 2012; Visseren-Hamakers et al., 2012). The expected non-carbon benefits of REDD+ consist of biodiversity, ecosystem services, and social livelihoods, all of which require careful cross-sectoral planning and implementation for delivery (Visseren-Hamakers et al., 2012; Wallbott et al., 2019). Social benefits of REDD+ include social justice, equity, equitable sharing of benefits, and improvement of community well-being, which are enabling factors of REDD+ at the same time (Adam & Eltayeb, 2016; Kenfack Essougong et al., 2019; Mwangi et al., 2011; Nambiar, 2019; Palmer et al., 2020; Pokorny et al., 2013). In addition, REDD+ brought forests under renewed and often re-centralized forms of government control (J. Gupta, 2012). In response to this governance reform, scholars have actively discussed the importance of devolution of forest management to local institutions (Adam & Eltayeb, 2016; Chhatre & Agrawal, 2008; Wright et al., 2016), respect to customary rights and practices (Pokorny et al., 2013; Walker et al., 2020), and participation of indigenous peoples and local communities (Palmer et al., 2020). The multiple dimensions of sustainability discussed under REDD+ are not new and largely overlap with the discussions when sustainable forest management emerged.

- **Human health and forest management**

The health and safety of forest occupations have been classic but common topics concerning forest certifications and supply chain assessments (Santos et al., 2019; Yovi & Nurrochmat, 2018). In areas with weak social security systems, forest producer organizations might play essential roles in providing healthcare and health insurance to forest workers (Tirivayi et al., 2018). The health-related conceptualization extends to forest communities not employed by the forest sector. Forests support the food security and nutrition of the local communities directly through the provision of food and indirectly through ecosystem services, such as crop pollination (Timko et al., 2018). Traditional medicine collected in forests are means of primary healthcare, especially where public health services are absent (Nambiar, 2019; Timko et al.,

³ Formally defined as “reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries”.

2018). Furthermore, forest conservation programs and community forestry schemes have started to acknowledge access to healthcare as an indispensable component of community well-being (Duguma et al., 2018; Palmer et al., 2020; Piabuo et al., 2018). A recent study has demonstrated that a healthcare intervention can simultaneously reduce illegal logging and improve the local health status (Jones et al., 2020).

2.2.3.6 *Conceptualizations of sustainable non-extractive practices (focus on wildlife watching)*

2.2.3.6.1 Introduction

This section focuses on wildlife watching as a non-extractive practice in principle. Understanding sustainability in the context of wildlife watching is a relatively new field of academic research compared to the traditional extractive activities of fishing, gathering, hunting, or logging. Wildlife watching has emerged as a significant niche tourism activity starting from around the 1980s and has rapidly increased, up until the recent travel restrictions due to the COVID-19 pandemic.

Conceptualizations of sustainability in wildlife watching practice have undergone several transformations during the recent decades. Initially wildlife watching practice was framed as an inherently sustainable alternative to extractive practices. This coincided with the ‘golden era’ of tourism after the World War II, where tourists were viewed in an overwhelmingly positive light. Over the years, better understanding of the larger context of the unfulfilled promises of a growth-oriented green economy called attention to a wide range of both positive and negative impacts related to wildlife watching practice, in the broader perspective gave rise to more critical views of the sustainability of this practice. Along with this, understandings of sustainability of wildlife watching have been largely framed in terms of minimization of negative environmental impacts on wild species and maximization of economic opportunities for the local population. Social sustainability has been largely represented fairly narrowly in terms of education opportunities provided to wider audiences thorough participating in wildlife watching practice.

In addition, over this period the research field focusing on tourism and outdoor recreation has matured and become more institutionalized. Together these trends of broader understanding and more focused expert study resulted in a transition to a greater awareness of complexities surrounding wildlife watching practice, and a shift away from simplistic conceptualization of sustainability as management of a handful of key impacts. Nevertheless, the research of wildlife watching practice is still dominated by discrete case studies, which makes generalizations challenging. In addition, absence of global and regional regulating authorities results in weak top-down governance of this practice. These and other insights are discussed in more detail in the review of academic literature below. The data management report for this review is available at <https://doi.org/10.5281/zenodo.6472995>.

2.2.3.6.2 Pre-2010

Systematic research attention to sustainability in the context of wildlife tourism and tourism in general started to become noticeable with the emergence of the global sustainability agenda in

the last decades of the 20th century. Early literature on wildlife watching was dominated by a largely optimistic outlook on the role of tourism in species conservation, emphasizing the supposedly ‘win-win-win’ model of tourism industry, which simultaneously delivers benefits to the tourists themselves, local communities, and conservation goals (Mowforth & Munt, 2009). This is present, for example, in the rhetoric of the United Nations International Year of Ecotourism 2002 (Butcher, 2006). Wildlife watching and the tourism industry in general, were positioned as non-extractive, “light”, “clean” and relatively harmless alternatives to extractive heavy industries (Ateljevic et al., 2007; Mowforth & Munt, 2009).

Despite the wide-spread adoption of the “triple bottom line” model of sustainability in tourism, in practice it was primarily conceptualized by authors in the natural sciences in terms of management of environmental impacts, such as minimizing negative impacts on wild species populations in question (Green & Higginbottom, 2000; Higham & Bejder, 2008; Lambert et al., 2010; Tremblay, 2001). The other two pillars of sustainability remained weakly addressed, with the social dimension receiving the least attention. Mowforth & Munt (2009, p.18) for example, explicitly state that “... sustainability, a notion that at its most basic encapsulates the growing concern for the environment and natural resources, though sustainability has also had increasing resonance in social and economic issues.” In addition, consistent with the relative theoretical and methodological immaturity of the tourism studies field prior to the 2000s, the literature was dominated by discrete case studies, making generalizations challenging. Nevertheless, some key elements of sustainability emerged. First, the importance of educational activities, appropriate training and capacity building are widely stressed as a key element of sustainability in wildlife watching. Education has been directly identified as “the most important wildlife management strategy” (Newsome et al., 2005, p. 209), as ignorance is identified as one of the key barriers to sustainability (*ibid.*). This includes provision of both formal and informal education to tourists, local guides, local communities and larger public in general, often formulated in codes of conduct for tourists. However, minimal attention was paid to the inclusion of multiple knowledge systems and indigenous knowledge into educational activities. Interpretation can be conceptualized as aiming to “stimulate interest, promote learning, guide visitors in appropriate behavior for sustainable tourism and encourage enjoyment and satisfaction” (Moscardo et al., 2004, p.231). The intent is for interpretation to add emotional and experiential dimensions to education, making it more memorable and impactful.

Early approaches to sustainability of wildlife watching were widely conceptualized in terms of impact management, with the goal of minimizing negative impacts (primarily environmental) and maximizing positive ones (primarily economic). Negative impacts acknowledged included direct injury or death to animals, disruption of their normal activities and increased stress, as well as habitat alteration, whereas positive impacts included financial flows from tourism, economic incentives to conservation, and education of visitors (Green & Higginbottom, 2000). Contributions from natural sciences in assessment of negative impacts were dominating such research efforts (e.g., Green & Higginbottom, 2000; Higham & Lück, 2007; Lambert et al., 2010; Roe et al., 1997; Tremblay, 2001).

In the context of economic impacts, provision of income to the local communities as well as provision of financial support to conservation projects are prioritized (e.g., Glowinski, 2008; Green & Higginbottom, 2000; Newsome et al., 2005). Articles addressing aspects of social sustainability in the context of wildlife watching are scarce (Moore & Rodger, 2010).

although these perspectives can be found in comprehensive books on wildlife watching (Green & Higginbottom, 2000; Higham & Lück, 2007; Newsome et al., 2005). Aspects of social sustainability are much more elaborated in the literature on nature-based tourism and tourism in general, than in the literature focused specifically on wildlife watching tourism (Mowforth & Munt, 2009). Overall, prior to 2010 research literature on sustainable wildlife watching prioritized improvement of education and scientific knowledge regarding possible negative tourism impacts on wild species populations, while simultaneously increasing and appropriately distributing financial flows generated from tourism.

2.2.3.6.3 Post-2010

In the literature after the 2010 the optimistic era of sustainable development, green growth and ecological modernization, dominating scientific and public discourses since the 1980s, is declining (Gómez-Baggethun, 2020; Mowforth & Munt, 2009). Expectations for the “marriage” of growth-oriented neoliberal economics and environmental agendas as a way to attain sustainability, have largely not been met. However, wildlife tourism has been argued to contribute directly to global challenges such as biodiversity decline, climate change and transformation of the environment (Higgins-Desbiolles et al., 2019).

Overall, over the last decade the research literature on tourism demonstrates increasing awareness as well as concerns over the sustainability of wildlife watching. Literature on nature-based tourism and wildlife watching becomes more in-depth, mature and diversified, placing tourism and wildlife watching within the context of a complex set of global transformations, i.e., Anthropocene (Fredman & Margaryan, 2020; Hall, 2016). There also is an explosion of publications with more species-focused, detailed, sophisticated, fine-tuned, and critical approaches to a wide multiplicity of topics in wildlife watching. Several key themes in conceptualizations of sustainability in this context are discussed below.

- **Socio-cultural aspects**

Importance of knowledge-related themes remains key for sustainability of wildlife watching. This includes importance of scientific research for adequate understanding and assessment of watching impacts on wild species. The lack of reliable scientific evidence, particularly the lack of baseline data and longitudinal studies (D’Lima et al., 2018; Newsome et al., 2012; Steven et al., 2011), is presented as one of the main hindrances for sustainability of this practice (Burgin & Hardiman, 2015; DeLorenzo & Techera, 2019; D’Lima et al., 2018; Higham & Shelton, 2011; Kubo et al., 2019; Muntifering et al., 2019; Newsome et al., 2012).

- **Education and awareness raising for the local communities**

Many articles stress the need for education and awareness raising among the local communities on how to engage in wildlife watching tourism business on their own terms, benefit from it and contribute to conservation (Buultjens et al., 2016; D’Lima et al., 2018; Markwell, 2015; Newsome et al., 2012). Shortcomings highlighted in the literature include that traditionally tourism is perceived as a low entry barrier industry, yet employment nevertheless often lacks necessary competence. There are many reports of local and indigenous communities, often

disenfranchised from the tourism industry due to lack of other skills, such as language, marketing or management of tourist expectations, despite having vast knowledge related to wild species. Importance of skilled guides, who face the challenging task of balancing minimization of negative impacts of wild species with facilitation of satisfactory tourist experiences, has been repeatedly emphasized in tourism studies (D’Lima et al., 2018; Margaryan & Wall-Reinius, 2017; Muntifering et al., 2019; Newsome et al., 2012; Patroni et al., 2018; Tarver et al., 2019). Importance of skilled staff to enable facilitation of nature and wild species as experience, promotion of experiential education of nature to encourage sustainable behavior, has been one of the key themes in tourism studies in general (Fredman & Margaryan, 2020).

- **Education and awareness raising for the tourists**

Providing environmental education to the tourist has historically been one of the main missions of wildlife watching practice, especially clearly spelled out in ecotourism ethics. There are many cases showing that through educational wildlife watching experience tourists may raise their awareness of nature and potentially adopt more sustainable behaviors (Apps et al., 2018; Bentz et al., 2013; Markwell, 2015; Patroni et al., 2018; Tarver et al., 2019). Proliferation of information technology and social media has also given a new “twist” to the wildlife watching, as wild species can now be watched vicariously. This greater presence of wildlife watching in social media can both raise awareness and increase ethical reflexivity. Recent controversial killings of Cecil the lion, Marius the Giraffe, and Harambe the Gorilla have received global media attention and raised public debates about people’s relationships with wild species, including that in the tourist context (Mkono & Holder, 2019).

The growing awareness of wild species stemming from tourism, education, and social media, has increased attention towards the diversity of human-animal interactions. Nevertheless, there is still a comparative lack of attention towards integration of traditional and indigenous knowledge into scientific and educational enterprises (Markwell, 2015). Wondirad et al., (2020, p. 159) for example, state that “further empirical studies can explore how modern scientific knowledge that is advocated by non-governmental organizations can be better integrated with antique indigenous knowledge so that the foundations of ecotourism can be strengthened”.

- **Governance**

Monitoring, evaluation, review and adaptive management.

Current challenges stressed in the literature include absence of global governance and regulatory authorities of wildlife watching even for highly migratory species, such as whales (Bentz et al., 2013; D’cruze et al., 2017; Decker et al., 2017). Significant effort in this research is dedicated to understanding negative impacts on wild species, such as behavior change, direct harm to animals or habitat alteration, and management outlook of these impacts (Buultjens et al., 2016; Dimmock et al., 2014; D’Lima et al., 2018; Higham & Shelton, 2011; Markwell, 2015; Newsome et al., 2012). Additionally, ethical concerns regarding sustainable management of wild species for watching are of growing importance, focusing on the issues of rights and well-being of animals (Bertella, 2019; Carr & Young, 2018; Markwell, 2015).

Growing importance of social dimensions

Importance of social sciences and qualitative perspectives has significantly increased in the last decade even though truly interdisciplinary contributions are still rather rare. Research is increasingly giving attention to social aspects, such as inclusivity in decision-making and meaningful participation of local communities in sustainable wildlife watching practice (Decker et al., 2017; Mayer et al., 2018; Mutanga et al., 2015; Spenceley et al., 2019; Spenceley & Snyman, 2017; Wondirad et al., 2020). Decker et al. (2017) emphasize that application of these governance elements contributes to sustainable use because mutual understanding and respect among various interests is more probable if all such interests are engaged in an inclusive discourse about goals of wild species conservation. Growing attention also is paid to the importance of cross-sectorial collaboration as well as inclusivity of a wide range of stakeholders in governance processes (Dimmock et al., 2014; Spenceley & Snyman, 2017; Wondirad et al., 2020).

- **Socio-economic aspects**

Income generation as the main positive impact.

The role of wildlife watching as a source of economic income supporting both the sustainability of local livelihoods and conservation projects has been one of the central themes in wildlife watching research. Alternative income generation through wildlife watching is being framed as the key positive impact of this practice and raison d'être of many wildlife watching enterprises (Burgin & Hardiman, 2015; Kubo et al., 2019; Mayer et al., 2018; Mutanga et al., 2015; Spenceley et al., 2019; Tarver et al., 2019). At the same time, there is a persistent criticism of prioritizing the economic “pillar” of sustainability at the expense of the other two (Hall, 2016).

Equity

Although the aforementioned economic narrative has been very strong since the dawn of tourism research, more recent literature incorporates critical perspectives on the role of wildlife watching in local economies, especially when it comes to the equity of income distribution as well as revenue and other benefit sharing. There have been many cases where communities have been offered limited involvement in wild species conservation, and see a minimal share of the benefits of tourism, yet bear the costs of living with wild species, resulting in conflict and low levels of sustainability (Ahebwa et al., 2012; Spenceley et al., 2019). Despite this, it has been pointed out extensively that the problem is not with tourism revenue sharing as a concept per se, but with the difficulties in implementing it into real-world practice (Spenceley et al., 2019). Growing demand for innovative arrangements in this context has been quite visible (Ahebwa et al., 2012; Spenceley et al., 2019).

- **Conclusions**

Overall, the following conclusions can be made regarding conceptualizations of sustainable wildlife watching practice in the scientific literature. First of all, understanding of sustainability has moved away from simplistic understanding of minimization of negative environmental impacts and maximization of the positive economic ones. Complexities around implementation

of these key elements together with the importance of social sustainability is being addressed more deeply and thoroughly than before. A growing acceptance of wildlife watching as a part of larger socio-cultural and environmental transformations, i.e., the Anthropocene, is rather noticeable. At the same time, there is still comparative lack of attention towards social sustainability when it comes to wildlife watching. It is especially noticeable given the tremendous progress that has been visible in this area in tourism literature in general (Fredman & Margaryan, 2020). In addition, there is still relatively little attention to the issues of indigenous peoples and local communities' rights and indigenous knowledge. At the same time, there is a widespread agreement on the importance of wildlife watching practice for education and stimulation of sustainable behavior. However, approaches to strengthen these benefits currently relies almost exclusively on scientific knowledge, underutilizing the knowledge of indigenous people and local communities. Wildlife watching research also faces a tremendous challenge of keeping up with the ever-expanding number of wild species and local communities being integrated into tourism enterprises. New trends pose new sustainability challenges, such as proliferation of social media and high demand for “selfies” with wild species (see Chapter 3, section 3.3.5.2.3). The lack of reliable and longitudinal scientific data is a major threat to designing sustainable management approaches. Finally, one sees increasingly critical perspectives on wildlife watching as a “benign”, “soft” or “non-consumptive” practice of commercializing wild species, as more evidence is accumulated on the detrimental impacts of tourism on biodiversity (Hall, 2016).

2.2.3.7 Summary: conceptualization of sustainable use over time and across practices

Ideas and conceptualizations of sustainability have a long and complex history, developing across multiple governance contexts and diverse academic disciplines. Consequently, sustainability has been conceptualized in multiple and shifting ways by different actors over time. Nevertheless, the objective of avoiding environmental degradation that would lead to a worsening of human conditions in the future has been a common thread. Thus, conceptualizations of sustainable use reflect an increasing understanding over time of the interconnectedness of human societies and natural environments.

The individual practices differ in when an expert literature proposing conceptualizations of sustainable use began to develop, with literature on sustainable logging appearing by the 17th century, and literature on sustainable wildlife watching only appearing in the latter part of the 20th century. However, for the most part, the literature on sustainability broadened along similar pathways for each practice. Initial focus was on avoiding excessive harvests or stress on the specific populations being harvested, expanding next to avoiding excessive pressures on other species also affected by the practice, generally through incidental mortality but occasionally through changes to ecosystem processes and habitat suitability. Interest in the economic performance of the practice generally followed, as did a growing accommodation of concern for more inclusive ecosystem properties that might be altered. Social concerns were usually a minor or neglected factor in how sustainability was conceptualized until the latter part of the 20th century. These social concerns generally appeared first in terms of supporting employment and livelihoods, and as these factors became included in “sustainability” of the practice,

typically governance aspects also became part of the discussion, largely in the contexts of inclusiveness and equity in decision-making. Only quite late in the development do the more fundamental matters of culture, identity, community wellbeing and spiritual values appear outside the indigenous peoples and local communities' context, where they have always been central.

In the 21st century social and broad ecological aspects of sustainable use dominate literature on what comprises sustainability for all practices. Ecological aspects of sustainability still dominate over other considerations in the aggregate literature on sustainability of each practice, although the focus is often on just the need to improve performance on the various ecological aspects, and not on expanded (or more restricted) conceptualizations of ecological sustainability. Small-scale fisheries and logging are very active parts of the expert dialogue on sustainability, with comparable priority given to the dependence of local community well-being and culture in sustainability. This has occurred in parallel with a marked shift in attention of literature away from classical economic performance features such as profit and efficiency of obtaining economic returns on investments. The issues of governance and socio-cultural aspects of sustainability are becoming more common in the broader literature, but are not yet fully mainstreamed. Generally, uptake of new ideas spreads across practices more swiftly than in earlier times.

At present, the literature in each practice is giving substantial attention to the interplay of the multiple aspects of sustainable use, and the need to take these interdependencies into account when plans are made to improve sustainability of any of the practices. With the social aspects of sustainability increasingly a focus of attention in all practices, small-scale commercial and community livelihoods are becoming a central consideration in sustainable use. This in turn has made governance issues, including equity and social justice, more prominent in conceptualizations of sustainable use. Another increasing trend in the literature is to both critically re-examine previously accepted benchmarks for single aspects of sustainability of uses, in light of these more holistic views of what constitutes sustainability of the practices, and acknowledge the need to integrate information across diverse knowledge systems. The influence of the 2015 Sustainable Development Goals on the benchmarks and the integration across the aspects of sustainability is beginning to appear in the literature on each practice. There is high agreement in the literature that these factors are central to sustainability of each practice, but vigorous debate among experts of where the correct answer lies.

Overall, across practices, sustainable use of wild species is increasingly understood as a dynamic, social-ecological process, with socio-cultural aspects of sustainable use - including community identity, wellbeing and health - representing elements of sustainable use that are fundamentally interrelated and inseparable from the ecological and social aspects of sustainable use that have long been recognized.

2.2.4 Diversity of indigenous and local conceptualizations and perspectives on sustainable use

The following section highlights a suite of diverse conceptualizations and perspectives held by indigenous peoples and local communities around the world. Indigenous peoples and local communities' worldviews, including those that relate to interactions with wild species, are encoded in cosmologies, myths, stories, songs, rituals, and numerous other forms of cultural

expression (IPBES, 2019a, 2019b). These worldviews and their accompanying indigenous and local knowledge are situated in place-based practices and lifeways that have been developed and refined over centuries and generations. Together they carry key insights to enhance the way people understand the natural world and the ways people conduct meaningful research and resource management (Ban et al., 2018). Accordingly, this section draws from peer-reviewed academic literature together with other forms of knowledge expression as identified by contributing authors. The method for this section is presented in the data management report available at <https://doi.org/10.5281/zenodo.6049358>.

- **Perspectives on the global marine environment**

Viewed as totemic ancestors (P. A. Clarke, 2001; Hickey, 2006; Leblic & Teulières-Preston, 1987; Morphy, 1991) or spirits of nature (Lewthwaite, 2017; Martínez Mauri, 2019; Rambelli, 2018), certain aquatic species are indeed pivotal in the distribution of watery spaces. Their role, decisive in maintaining social equilibrium, has even been used to justify their qualification as “keystone cultural species” (Dounias & Mesnil, 2007; Garibaldi & Turner, 2004). Fishing, as practiced by indigenous peoples and local communities, can never be separated from this socializing network that links them to non-humans. These privileged relationships between indigenous peoples and local communities and aquatic species can be expressed in many ways. For example, the Baniwa, who live in the Brazilian Amazon rainforest and who have a vigorous ichthyological cosmology, believe that fish share with humans a set of distinctive cultural traits. Like the Baniwa, the fish learnt to dance and build large communal houses (*malocas*) alongside the first original beings of Baniwa culture (Albuquerque & Garnelo, 2018). For the Moken in Burma, all important customary figures (shamans or performers) have a maritime double, often a cetacean or dolphin, whose shape they occasionally adopt. These close ties with aquatic beings considered original relations (turtles are considered by the Moken as mythical sisters; see Ivanoff, 1992), do not preclude their fishing but it does lead to numerous precautions and prohibitions when these species are targeted.

- **Perspectives from Mexico**

For the Mayan communities of the Yucatan peninsula in Mexico, the sustainable use of plants and animals is nurtured and reproduced by a cosmivision of nature as part of a sacred universe, with no clear separation between the wild and the domesticated (*milpa*), as these interrelate in the cosmogonical and survival space. For the Mayan and peasant communities of the Yucatan, mountains and water bodies, along with the wild animals that inhabit them, and that serve as food or medicine for the communities, have owners. These forest owners - or masters- are spiritual beings who can punish in case of overuse of wild species, e.g., if they are over-harvested for market sale or if the species' habitats are destroyed. These beings are inanimate deities known as Yum K'ax (Quintanilla, 2000). Forest owners and a multitude of other beings, such as the *aluxes* or forest helpers, are thought to inhabit the forest and Mayan communities perceive this space as belonging to the supernatural world and not to the humans. For the ancient Maya, the entire universe comes from sacred, invisible and impalpable energies, and these are capable of manifesting themselves in natural beings and phenomena (De la Garza Camino & Nájera Coronado, 2012). To date, these symbolic representations of the sacred in nature have

allowed peasants and Mayan communities to continue practicing rituals, such as the chá-chaac ritual for asking rain, and other rituals of thanksgiving for a bumper harvest and for a successful hunt. To maintain harmonious relationships with the wild species and with the crops of the *milpa*, a principle of asking for permission and making appropriate use guide Mayan communities hunting and gathering practices, as well as the access and visits to the forest and the cenotes (pits or sinkholes). Mayan communities continue to make offerings to give thanks for the harvest, as well as entrusting the owners of the forest to collect wild plants that are used as medicine, as it is believed that if one enters the forest without asking for permission one can get lost and never be able to find the way out of the forest. Although there is no clear separation between the wild and the domesticated, it is notorious that wild animals can be sent as messengers or punishment for bad behavior, for example, pests that destroy crops such as stilts and gophers. However, when offerings are made and permission is asked for to the *aluxes* and the owners of the animals, Mayan communities think pests can be chase away from the *milpa*. These rituals that authorize and allow Mayan communities to get closer and even penetrate the sacred dimension of the forests have important implications for the preservation of the forest by mediating the contradiction between the need to conserve and the need to consume natural resources (Quintanilla, 2000).

- **Perspectives from the Brazilian Amazon**

The wild harvest of palm tree products (e.g., edible, protein-rich fruits and other natural materials - such as leaves for construction and wood for fabrication) is an important component of nutritional, material and spiritual well-being for Amazonian indigenous communities. Several palm species are also spiritually significant - often regarded as guardians of other forest resources, animals and plants (Virtanen, 2011b, 2011a, 2015), and are associated with power and protection. Among the Arawakan-speaking Apurinã and Manchineri in the Purus River Basin (Brazil), various species of palm trees are thought to have powerful master (owner) spirits, associated with ancestors. For the Apurinã people (*Pupÿkarywakury*), moriche palms, acai (*Euterpe oleracea*), and patauá (*Jessenia bataua*), are especially valued; while for the Manchineri, the most important include the peach palm (*Bactris gasipaes*), uricuri (*Attalea phalerata*), and jarina (*Phytelephas macrocarpa*). Many of these species appear in their origin stories and some species even have dedicated ceremonial songs that are performed during important communal festivities (Virtanen, 2011b, 2011a, 2015, 2016).

- **Perspectives from the Andes**

Wild species play a key role in the daily lives of Andean quechua- and aymara-speaking people. In addition to being directly used as food, medicine, fodder, or construction material, wild plants and animals are prominently featured in cultural expressions such as traditional textiles and in rituals to the *Pachamama* (“Mother Earth”) and other entities of the spiritual and natural worlds. Andean people’s complex knowledge systems about wild species is transmitted from generation to generation, and is constantly enriched by external sources (Mathez-Stiefel & Vandebroek, 2012).

Andean people establish a relational rather than an instrumental interaction with their natural environment, which is characterized by respect, love, and the fundamental principle of

reciprocity, or *ayni* (Mathez-Stiefel et al., 2007; Walshe & Argumedo, 2016). The *Pachamama*, as source of plant and animal life, is considered to be herself alive (Mamani-Bernabé, 2015)⁴. For instance, activities such as sowing, harvesting, gathering or hunting are always accompanied by rituals of *q'owa* and *ch'alla* (“feeding” and “giving to drink to” the *Pachamama*, respectively) (Mathez-Stiefel et al., 2007) (see photo below). The *Pachamama*, in turn responds through climatic and biological signs – such as the phenology of plants and the behavior of animals - that enable Andean people to forecast the weather and guide agricultural decisions (Mamani-Bernabé, 2015).

The Andean worldview is characterized by a deep interconnection between the human, spiritual, and natural spheres of life. The local world (*pacha*) is understood as a “living landscape” inhabited by a community - or extended family - of human, spiritual, and natural entities (Rist & Dahdouh-Guebas, 2007; Walshe & Argumedo, 2016). As expressed by Santo Vilca Cayo, an elder from the Aymara community of Aynacha Wat'asani (district of Tilali, Puno, Bolivia): “For us, all those of us who live in this pacha (...) are persons: the stone, the soil, the plant, the water, the hail, the wind, the diseases, the sun, the moon, the stars, we all are a family. To live together we help each other. We are always in continuous conversation and harmony” (Ishizawa, 2006).

Andean people make a clear distinction between wild and domesticated species: while the latter are considered the responsibility of people, the former are “sown by the *Pachamama*” and may usually not be used for commercial purposes (Boillat et al., 2013). Community norms regulate thus the use of wild species (Boillat et al., 2013). Interestingly, by “nurturing” the *chacras* (cultivated fields) through agricultural practices and rituals, Andean people do not only maintain a diversity of cultivated crops such as Andean grains and tubers, but also of their wild relatives and other related species (Ishizawa, 2006). Andean worldview, knowledge systems and practices thus directly contribute to the conservation of biodiversity in these living landscapes (Boillat et al., 2013).

⁴ This understanding of the *Pachamama* as a living being is translated into the legal recognition of its rights in Bolivia and Ecuador (Humphreys, 2017).



Photo: Offering of coca leaves (*Erythroxylum coca*) and flowers to the *Pachamama*; Pitumarca district, Cusco, Peru. © Sarah-Lan Mathez-Stiefel. CC-BY

- **Perspectives from indigenous/aboriginal Australia**

For indigenous/aboriginal Australians, ancestral beings, animals, and plants, are essential connections to territories of life. Wild harvest values are nested in the “biophysical, human and supernatural worlds” (J. T. Johnson & Murton, 2007) where plants, animals, ancestral beings and humans are part of the interconnected web of relationships that comprise an indigenous world (Battiste, 2007). Ways of knowing are bound to connections to country, which is more than a “named geography; it is a totality of emotive, physical, intellectual and metaphorical connections that has its own agency and influences” (*Tebrakunna* country; see Lee, 2017). Country is created as a world in which people live concurrently with their ancestors and ancestral beings. Ancestral beings then mediate the relationships between themselves, as ancestors, and us, as the carers of them and their law (Munn, 1970). Many of their ancestral beings are the plants and animals that are understood to reside in both biophysical and supernatural worlds. In this worldview, plants and animals can be thought of as kin: they are brothers and sisters, parents, grandparents, and extended family. In this view, there are no “wild species”. Instead, plants and animals hold a place in relation to ourselves and are articulated as “belonging to country”.

- **Perspectives from French Polynesia**

Across Oceania, the wild harvest of terrestrial and marine food species is an important

mechanism for *in situ* biodiversity conservation (Glamann et al., 2017). While subsistence is a key motivation, the sustainable use of wild species takes many forms in the region, for instance, in Hawai‘i upland harvesting of non-tree species for diverse cultural practices (C. K. Blair-Stahn, 2010; Kamelamela, 2019; Wichman, 2012) and the gathering of marine medicinals (Friedlander et al., 2013; Titcomb et al., 1978), or in Papua New Guinea the collection of bird plumage for culturally-salient performances of status and personhood in the highlands (Nugi & Whitmore, 2020; Supuma, 2018) and the collection of a wide variety of marine molluscs for purposes of craft and daily use (Kinch, 2003). French Polynesia has a long history of resource extraction of wild marine molluscs, including the management, and governance of *Pinctada margaritifera*, for shell and pearl resources. French Polynesia’s black pearl industry accounts for 90% of the world production of black pearls and is managed in coordination with the national government, industry leaders, and local farmers. The pearl sector in French Polynesia, which is currently undergoing a significant transformation to re-center on the sustainable well being of both the ecological and social setting, provides significant insights on the relationships between the well being of local communities and the sustainable development of malacological marine resources with respect to indigenous and local communities’ culturally specific engagement and global economic forces (Rapaport, 1996; Rey-Valette et al., 2016). Accordingly, the environmental and social impact assessment of resource extraction or farming of black pearls and *Pinctada* shell nacre has become a lever for sustainable development as a tool of public policy, linking social and environmental issues for transformation towards sustainability (Mazé et al., 2019).

- **Perspectives from Hawai‘i**

Several studies describe place, practice, or plant-focused Native Hawaiian plant gathering practices led or informed by indigenous and local community members (C. G. Blair-Stahn, 2014; Matsuoka et al., 1994; McGregor, 1995a, 1995b, 2007; Ticktin, Fraiola, et al., 2006; Ticktin, Whitehead, et al., 2006). These studies emphasize a strong cultural connection to gathering wild resources for use. The relationship between humans and wild species are of high importance, for instance among hunters and wild boars (Luat-Hu‘eū et al., 2021) and among gatherers and non-timber forest products like plants used in cultural practices (Kamelamela, 2019). Individuals who engage in wild harvesting and gathering practices in Hawai‘i describe values and motivations surrounding strengthened personal identity, continuation of practices and traditions, and a sense of cultural responsibility for the harvested resources. Harvester perspectives on the sustainable use of wild species continue to be impactful for policy engagement, in particular their knowledge of resource availability and demand, and are an important source of information for future management of wild resources (plant, animal, minerals).

Native Hawaiian cosmology also plays an important role in the sustainable use of wild species by codifying relationships between human and non-human relatives. For example, the Native Hawaiian creation and origin chant “ ‘O Wākea” is well-known for describing the birth of the Hawaiian Islands through the union of Papahānaumoku, Earth Mother, and Wākea, Sky Father. However, the same chant has a lesser-known second half which continues on to describe the first taro plant, Hāloanakalaupakalili, as the older sibling of the first Hawaiians. The

inextricable genealogical connections between celestial, plant, and human relatives codified in this worldview provide important context for present-day environmental decision-making, for example when significant public backlash in Hawai‘i derailed plans for patenting and genetic modifications to taro. Although oral transmission continues to play a central role in the perpetuation, transmission, and present-day interpretation of Native Hawaiian knowledge, the Hawaiian language text of this creation chant is provided below, expanding upon an original excerpt published by seminal Native Hawaiian scholar David Malo in 1903.

‘O Wākea (A Native Hawaiian creation chant, expanded from Malo, 1903)

‘O Wākea noho iā Papahānaumoku
Hānau ‘o Hawai‘i he moku
Hānau ‘o Maui he moku
Ho‘i a‘e ‘o Wākea, noho iā Ho‘ohōkūkalani
Hānau ‘o Moloka‘i he moku
Hānau ‘o Lāna‘ikaula he moku
Lili‘ōpū punalua ‘o Papa iā Ho‘ohōkūkalani
Ho‘i hou ‘o Papa noho iā Wākea
Hānau ‘o O‘ahu he moku
Hānau ‘o Kaua‘i he moku
Hānau ‘o Ni‘ihau he moku
He ‘ula a ‘o Kaho‘olawe
Noho hou ‘o Wākea iā Ho‘ohōkūkalani
Ua hānau kā Wākea keiki mua
He keiki alualu, ‘o Hāloanaka ka inoa
A make ua keiki alualu la
Kanu ‘ia ihola ma waho o kala o ka hale
I lalo i ka lepo, ma hope iho
Ulu mai ua keiki la, kalo nō
‘O ka lau o ua kalo la, ua kapa ‘ia ‘o Laukapalili
‘O ka hā o ua kalo la, ua kapa ‘ia ‘o Hāloa
Hanau mai he keiki hou
Kapa lākou i kona inoa ma ka hā o ua Kalo la ‘o Hāloa
Nāna mai ko ke ao nei a pau
‘O Hāloa ho‘i. Hā.

- **Perspectives from China**

There are 55 officially recognized ethnic minority groups in China in addition to the Han majority. While the Han majority is in large guided by the orthodox Confucianism, the ethnic minorities in contrast embrace a vast variety of religious, spiritual and traditional beliefs, including Buddhism, shamanism, polytheism, and/or a synergy of the above-mentioned. These diverse worldviews are usually reflections of and intricately intertwined with the relationship between ethnic minorities and their surrounding nature environments.

Given the high conservation value of being a biodiversity hotspot, Yunnan province in southwest China has received significant international attention. It is also home to 26 ethnic groups including Han, different ethnic groups regard many landscapes as sacred (Pei & Luo, 2000). For example, the Dai people in Xishuangbanna, believe gods reside on the forested holy hills known in the Dai language as *Nong* (Liu et al., 2002; Pei, 1985). All the plants and animals that inhabit these hills are either companions of the gods or sacred living things within the gardens of the gods. In addition, the Dai believe that the spirits of great and revered chieftains reside in the holy hills. Holy hills are therefore a key component of local ecosystems, and studies have found that a high concentration of endemic and endangered species in the holy hill forests, which include 15 species listed in the Plant Red Data List of China, such as *Magnolia henryi*, *Homalium laoticum*, and *Antiaris toxicaria* (Liu et al., 2002; Xu et al., 2006).

Aside from having sacred landscapes, many ethnic minorities in Yunnan practice animal worships and plant worships, which are usually documented and reflected in their own ancient historical records. Taking Yi people as an example, in their traditional folklore of *Mei Ge*, the universe was made from tiger (the head of the tiger formed sky, the belly skin of the tiger formed the land, the left eye formed the sun, and the right eye formed the moon and so on) and everything on the earth planet thrived from there. Tiger is considered as the ancestor of the Yi and until nowadays, it is still highly respected and protected in Yi culture. Moreover, ancient historical record of *Quan Shan Jing* (Good Behaviors) also guides the Yi people to live with wild species in harmony, never take more than needed. This kind of behavior or guidance is also imbedded in everyday life of Akha people, who are farmers residing in the mountainous regions and having a long tradition of beekeeping (see photo below). Even with the commercialization of honey, Akha people still follow the traditional ways of ‘never take too much and always leave some for the bees’, they believe in practicing such sustainability, the bees (wild *Apis cerana*) would not attack people when harvesting the honey.

The many different beliefs in ethnic minorities leading to the peaceful co-existing with the nature are on the edge of being comprised by policy interventions, technology development, the rise of market economy, and cultural assimilation.



- **Perspectives from India**

The high cultural, geographic and ethnic diversity of India reveals both anthropocentric and ecocentric worldviews with regard to the sustainable use of wild species by indigenous and local communities. Anthropocentric worldviews are apparent in local communities' interactions with wild species, especially plants. The diversity in wild edible species foraged from forests and agricultural lands, their nutritive and curative values, and associated traditional knowledge, all reveal utilitarian, practical and instrumental values. However, more ecocentric worldviews emerge when scaling up from individual wild species to their habitats and to interactions at the ecosystem level. Such worldviews are grounded in various cosmological and ontological frameworks, in which dominant religions in the Indian context may play a role, as in Hinduism many species are considered sacred because of their association with gods and goddesses and in Buddhism, the Bodhi tree *Ficus religiosa* under which the Buddha attained enlightenment is held sacred and considered the tree of life (N. Gupta et al., 2016). Research have shown that ritual obligations and related daily practices and interactions with wild species may lead to a control over harvest of algae, fungi and plants and various species of animals, fishes and insects, thus leading to a sustainable use of these species (Behera & Patel, 2008). Ecocentric worldviews are also evident in community interactions with faunal species, for example religious and customary values are attached to fish conservation (N. Gupta et al., 2016). Studies of people's attitudes towards snow leopards and wolves in Ladakh India, show that even though religion solely by itself is not an indicator of an individual's attitude toward large carnivores, the extent to which they practiced it (i.e., religiosity) had a positive correlation with pro-carnivore attitudes in Buddhist communities (Bhatia et al., 2017). In the Indian subcontinent, sacred groves are also recognized as playing a role in conserving and making available key medicinal and edible plant species for local populations (Boraiah et al., 2003; Ormsby & Bhagwat, 2010), while this observation cannot be generalized (Uchiyamada, 2008), partly because of a fast-changing context which increases pressure on such sites (Rath & Ormsby, 2020).

- **Perspectives from Poland**

For local communities in Poland, wild harvest practices like gathering berries and mushrooms helped to supplement the rural economy. Gathering practices, which are primarily conducted by Polish farmers, often coincided with the Catholic church calendar and dates of patron saints. For example, in some rural communities the 2nd of July was called “*Matka Boska Jagodna* (lit. Virgin Mary of Berries)” and marked the appropriate time to collect bilberries (*V. myrtillus*). It is believed that harvesting no sooner than this date allowed the berries to properly mature. A similar tradition existed on the 8th of September called “*Matka Boska Siewna* (lit. Virgin Mary of Sowing)”. This date marked the appropriate time to collect hazel nuts (*Corylus colurna*). On that day, groups of boys and men went to the woods together to harvest the nuts. This was thought to ensure the equitable collection of mature nuts and prevented the collection of immature fruits (Ogrodowska, 2004; Łuczaj, unpublished data).

- **Perspectives from Kyrgyzstan**

Wild harvest worldviews and perceptions can be shared via diverse forms of expression. For instance, among the Kyrgyz of Central Asia, the epic legend of Kojash encodes local and cultural worldviews on hunting. The legend, which is a popular story for children, is studied in schools and is often depicted by artists in Kyrgyzstan. It describes the downfall of a skilled and successful hunter (named Kojash) who succumbs to greedy and wasteful harvest practices. The legend outlines the consequences of Kojash's wrong-doing, but ultimately ends with reconciliation of nature and people (Aitpaeva, 2006).

- **Perspectives from East Africa**

The pastoralist Barabaig of Hanang District (Tanzania) have deep and sophisticated relationship with their environment guided by a complex web of rules and knowledge which avoid the depletion of pastoral resources (Lane, 1993). For example, they practice grazing cycles established through strict regulation of access to land, water and other pastoral resources. These regulations are based on deep traditional knowledge of soil types, topography and groundwater in each area of their territory, and the location and condition of the vegetation that these factors imply at every moment of the year. This is accompanied by a cultural belief that territory is not owned, but carries a right of usufruct inherited from ancestors that must be preserved for following generations. The Pokot of Baringo County (Kenya) have neighboring councils (*Kokwo*) for decision-making, including for decisions regarding access to common resources, such as grazing lands (Bollig et al., 2014). They are located in traditional places, usually under particular large trees, and they are composed of all initiated men living in the area at that moment, under the control of a few prestigious elders. Similar temporary grazing exclusion reserves (*Milaga*) exist among the Gogo agro-pastoralists of Dodoma region, Tanzania (Mwamidi & Dominguez, 2019). Pastoral governance practices also extend beyond the care for the herd. For instance, in the Daasanch community (northern Kenya), elders protect indigenous trees by all possible means because they conceive of both humans and trees as all belonging to one family - the Daasanch community. A curse will fall upon anyone who destroys trees that are used to cure diseases among their people. In their worldview, cutting a tree is like killing a person, because the medicine the trees provide saves the lives of the sick. These are just a few examples of cultural representations and community practices that aim to sustain local ecosystems through a relational ethos.

- **Perspectives from Eastern Europe**

The communistic political regime of Eastern Europe caused considerable erosion to the customary norms, practices, and traditional knowledge of indigenous peoples and local communities. Despite this significant obstacle, many elements of sustainable use practices and knowledge survived in remote local areas. Whereas in the western part of Eastern Europe the Cartesian dichotomy strictly demarcating nature from culture is prominent, the Eastern part often has animistic worldviews where plants and animals possess a soul (Descola, 2013). While nuanced across communities in the Eastern Europe region, this juxtaposition in worldviews manifests in several ways. For example, understanding of sustainable grazing by traditional Hungarian steppe herders is different from the view of nature conservationists (Molnár, 2014; Molnár et al., 2016), because the indicators used to determine impact of grazing are different

(resprouting ability of dominant forage grasses vs. survival of sensitive threatened species). Knowledge of local species is also critical in supporting sustainable use, for instance among the Csángó people in the Eastern Carpathians who depend on summer forage grass and winter hay fodder as resources. Csángó peoples' in-depth knowledge of >240 folk plant taxa and >140 folk habitat types (Babai & Molnár, 2014) enable sustainable harvest, while creating and maintaining one of the most diverse meadow systems of European importance (Csergő et al., 2013). Worldviews can also have unique impacts on landscape modifications, for instance among the Sakha horse and cattle breeders (northeastern Siberia) who both accept and reject the dichotomization of nature and culture (Mészáros, 2012a). For example, while most meadows and lakes are human like animate entities with unique character traits, forests are opposed to the human realm (Mészáros, 2012b). Consequently, while lakes are closely monitored, deforestation is an important tool to support their pastoral practices.

- **Concluding remarks**

In summary, indigenous and local social-ecological systems, including their associated sustainable use and harvesting practice and knowledge, vary greatly over space and time but also share strong commonalities. The examples provided here demonstrate that reciprocal connections between humans and non-humans and relational values associated with wild harvest are defining characteristics of sustainable use across indigenous peoples and local communities. So, too, is the importance of overall well-being, social networks of sharing, ceremonial and ritual practices, and indigenous and local knowledge of wild harvested species. The ontological foundations of sustainable use can also result in adaptations or refinement over generations of practice, for instance according to lived and experienced knowledge, and in response to evolving social, cultural, environmental and economic pressures. Several other pressures can transform worldviews and values surrounding the ways in which indigenous and local communities understand and relate to wild species. These pressures include post-colonial processes (including land-loss and exploitation), integration into national societies and schooling, along with many other multifaceted pressures (Gadamus & Raymond-Yakoubian, 2015; Gambon & Rist, 2019; Gombay, 2014, 2015; Gómez-Baggethun & Reyes-García, 2013). Although these examples provide a brief glimpse into the peer-reviewed academic literature together with other forms of knowledge expression as identified by the contributing authors, there are many other pertinent perspectives on this topic including those described in section 2.2.10.

2.2.5 Conceptualizations of sustainable use in the international policy arena: Definitions from international conventions

Today many international conventions and agreements that relate to the conservation of wild species also make reference to their sustainable use. Some provide definitions of “sustainable use”, whereas others only refer to it. Although emphases vary, a clear commonality across definitions and vision statements is that the idea of sustainable use refers both to conserving/ not causing serious or irreversible harm to biodiversity as well as to supporting people who depend on it, whether the dependence is in reference to needs, aspirations, socio-economic services or cultural values (Table 2.3).

This table is illustrative. It does not include all existing agreements, and new agreements and amendments to older ones continue to emerge, with shifting definitions.

Table 2.3 Definitions of sustainable use of wild species in some international conventions and agreements

Convention on Biological Diversity (1992)	Definition of “sustainable use”	“use of the components of biodiversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations”
IUCN White Oak Principles (2001)	Definition of “sustainable use”	“a dynamic process toward which one strives in order to maintain biodiversity and enhance ecological and socio-economic services, recognizing that the greater the equity and degree of participation in governance, the greater the likelihood of achieving these objectives for present and future generations”
Ramsar Convention on Wetlands (1975)	Definition of “Wise use”	“the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development”
United Nations Forest Instrument (2007)	Definition of “sustainable forest management”	“.. a dynamic and evolving concept, aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations”.
International Union of Forest Research Organizations (IUFRO) and Collaborative Partnership on Sustainable Wildlife Management (CPW)	Definition of “sustainable hunting”	“the use of wild game species and their habitats in a way and at rate that does not lead to the long-term decline of biodiversity or hinder its restoration. Such use maintains the potential of biodiversity to meet the needs and aspirations of present and future generations, as well as maintaining hunting itself as an accepted social, economic and cultural activity”.
European Charter on Hunting and Biodiversity (2007)	Definition of “wildlife management”	The application of science-based and local knowledge in the stewardship of wild (including game) animal populations and their habitats in a manner beneficial to the environment and society.

European Charter on Hunting and Biodiversity (2007)	Definition of “sustainable hunting”	The use of wild game species and their habitats in a way and at a rate that does not lead to the long-term decline of biodiversity or hinder its restoration. Such use maintains the potential of biodiversity to meet the needs and aspirations of present and future generations, as well as maintaining hunting itself as an accepted social, economic and cultural activity (based on the definition of “sustainable use” in Article 2 of the Convention on Biological Diversity).
Convention on Migratory Species	Vision statement	“Living in harmony with nature – where populations and habitats of migratory species (along with all biodiversity) are valued, conserved, restored and wisely used, thereby contributing to global sustainability
UNESCO World Heritage Convention	Operational guidelines (2015)	World Heritage properties “may support a variety of on-going and proposed uses that are ecologically and culturally sustainable

In addition, many of the agreements suggest that the sustainable use of wild species itself can be a central part of conservation. For example, the Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity state that, “sustainable use is a valuable tool to promote conservation of biological diversity, since in many instances it provides incentives for conservation and restoration because of the social, cultural and economic benefits that people derive from that use”. Similarly, Axiom 4 of the IUCN White Oaks Principles states that “sustainable use is a means of bringing about conservation of species and habitats”. This notion is echoed across practices. For example, the European Charter on Hunting and Biodiversity (2007) states that “sustainably managed hunting can contribute to the conservation of biodiversity, the preservation of rural lifestyles and local economies. In this context hunting can provide strong incentives for conservation through use of biodiversity *sensu* the Convention on Biological Diversity”.

2.2.6 Key elements of sustainable use in global and regional standards, agreements and certification schemes

2.2.6.1 Approach taken

Any picture of conceptions of sustainable use in the global conservation arena requires, among other tasks, identifying the ideas in the principles endorsed in global and regional agreements regarding sustainable use. In sustainable use agreements, a “principle” is commonly formulated around a core concept based on social ethics, values, and tradition as well as on scientific knowledge of outcomes for different degrees of change imposed on nature. Differences in principle can reflect, *inter alia*, differences in the relative value placed on different aspects or elements of sustainable use. An analysis of principles can highlight commonalities as well as differences in the global conceptualization of sustainable use across practices.

2.2.6.2 *Materials and methods*

To identify how sustainable use is conceptualized at the international level, and how it may vary across practices, a search for international or regional agreements, standards and certification schemes for sustainable use (hereafter referred to as “standards” for simplicity) was conducted and a comparison of the ideas in their principles was carried out. The methodology is described in the data management report available at <https://doi.org/10.5281/zenodo.6473133>. Twenty-five standards are included in this analysis (see Table 2.1 in the data management report). This list captures many of the widely-used standards across all practices. Not all standards, guidelines or certification schemes contain principles. For example, multiple international and regional standards for sustainable forest management contain only criteria and indicators, including the Montreal Process, Forest Europe, Amazon International Tropical Timber Organization, the Association of Southeast Asian Nations’ Criteria and Indicators for Sustainable Management of Tropical Forests, the Tehran Process for low forest cover countries, and Programme for the Endorsement of Forest Certification, among others. Consequently, these are not included in this analysis. Indicators are discussed in section 2.3. Also, depending on their placement in an agreement, the principles themselves may not be binding, even if the agreements are.

To identify the different ideas about sustainable use present in the principles, the principles in each standard were sorted into one or more themes or “key elements”. To develop the list of possible key elements, those explicit in the Addis Ababa Principles and Guidelines for Sustainable Use of Biodiversity were used as a starting point and new themes were added for ideas that are not captured in the Addis Ababa Principles and Guidelines, but are present in other standards. Any given principle may capture one or more key element.

A total of 18 key elements were identified from the principles listed across the 25 standards (Figure 2.3). In this assessment, this compiled list is referred to as the “key elements of sustainable use”. It is this aggregated list that is used in the policy analysis in section 2.2.7.

The standards range in terms of their scale (e.g., national level versus management unit), context (subsistence versus recreational versus commercial harvest; resources harvested from commons versus from private property) and purpose (e.g., binding versus voluntary agreements versus certification schemes). Some standards include many key elements whereas others have few (Figure 2.3). In addition, clearly not all key elements are relevant to all standards. Nonetheless, when viewed together, the range of key elements covered across the diverse standards sheds light on how sustainable use of wild species is conceptualized in the international conservation arena, and a broad comparison of key elements provides insight into commonalities and differences in these conceptualizations (Figure 2.3).

The key elements span five broad categories: governance, management and monitoring, ecological impacts, socio-economic benefits, and education. Most standards include elements of the first four of these categories, indicating that in this arena, sustainable use is widely conceptualized to include social, economic and ecological components. Exceptions to this are some of the older legally binding multilateral agreements, which center on monitoring, management and ecological impacts.

For both voluntary agreements and certification schemes, most standards include key elements that refer to the need to: respect existing laws and policies; respect the access and use

rights of local communities; implement adaptive management and monitoring plans; minimize ecological impacts - including those on the species harvested, the surrounding ecosystem and on ecosystem services - and foster socio-economic benefits. Many standards also include key elements related to the need to build capacity among resource users. These appear to be the broadly shared key elements for sustainable use. These key elements encompass (sometimes explicitly stated and other times not), both the ecosystem approach and the precautionary approach. At the other end of the spectrum, few standards include key elements related to minimizing waste.

There are also some differences. For example, almost all of the voluntary standards refer to common-pool resources, and in addition to the themes mentioned above, most also include key elements that relate to: ensuring interlinkages among levels of governance; empowering local communities in the management of wild resources, including through a participatory decision-making process; integrating indigenous and local knowledge and science in the development of sustainable management plans; the fair and equitable distribution of benefits; and raising public understanding and awareness. These concepts are clearly perceived to be important to sustainable use in these voluntary agreements. Many certification schemes, which are aimed largely for commercial operations, include key elements related to respecting local customary law, including indigenous peoples and local communities' access for food, nutritional and livelihood security, and to workers' rights and health.

All standards include key elements related to minimizing ecological impacts, but some voluntary agreements and certification schemes go one step further, by explicitly including the restoration of past damage and/or improvement of ecological status as a key element of sustainable use. Similarly, although most standards include key elements relating to socio-economic benefits, some, in particular those related to watching, include key elements or guidelines that stipulate the need for additional intangible socio-cultural benefits for indigenous peoples and local communities, such as promoting community-solidarity, safety or social-pride. One gathering certification standard included a premium for community social development. Overall, though, there do not appear to be any broad differences across practices in terms of key elements of sustainable use.

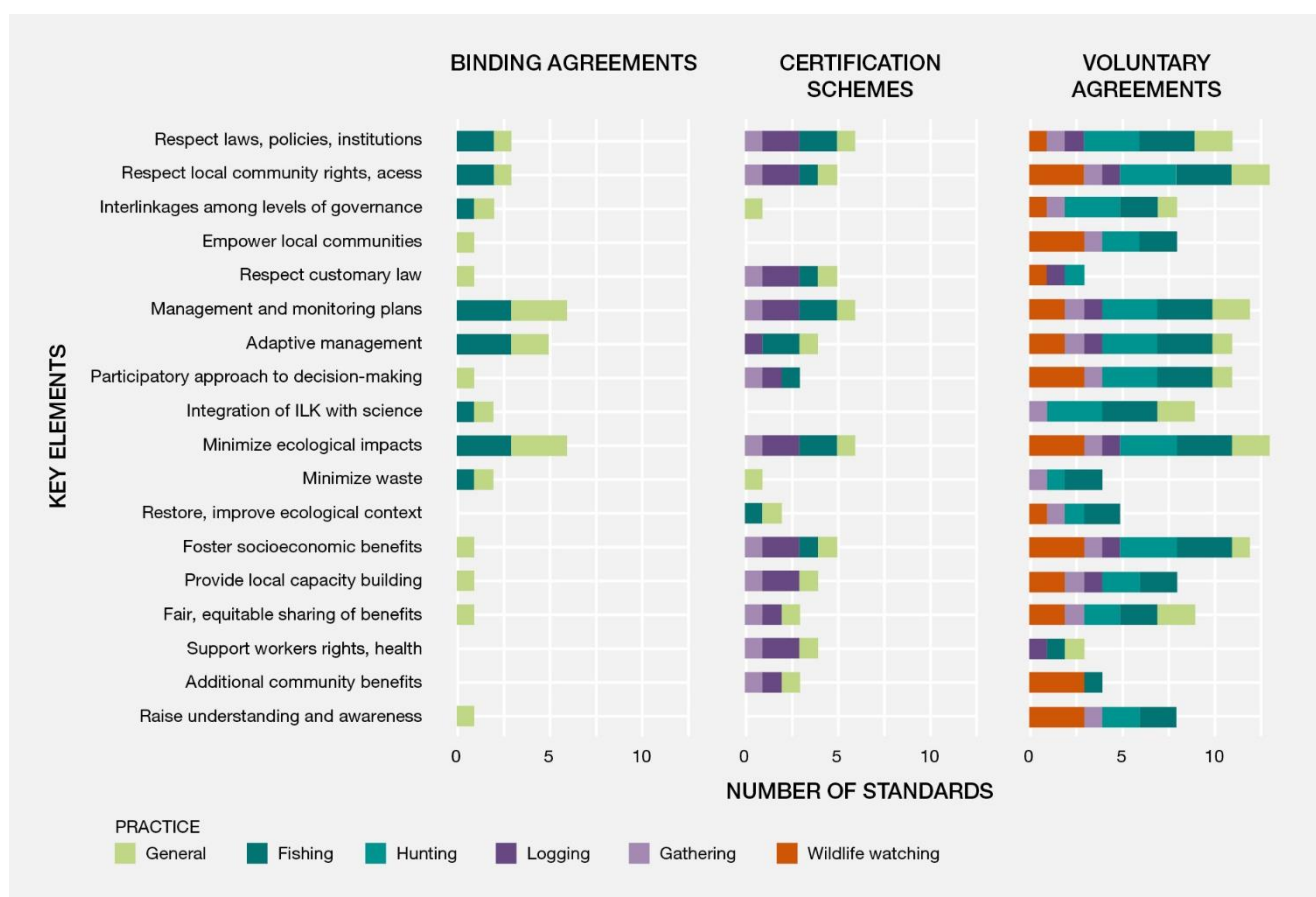


Figure 2.3 Key elements of sustainable use of wild species in international and regional agreements, including binding agreements (n=6), certification schemes (n=6) and voluntary agreements (n=13).

2.2.7 Crosswalk of key elements and policies on sustainable use of wild species

This section identifies the extent to which the key elements of sustainable use identified in section 2.2.6 are captured in formal policy provisions intended to guide practice. Policy provisions articulate commitments or requirements for delivering specific goals or outcomes when a policy is applied in real-world contexts. Provisions can range from aspirational to highly operational, but generally have some evidentiary basis.

2.2.7.1 Global Policies

2.2.7.1.1 Approach taken and rationale

This section focuses on global organizations and agencies that set policies to regulate or guide activities in each of the practices reviewed in the IPBES assessment of the sustainable use of wild species. These organizations and agencies were associated with four different “perspectives” on sustainable use, where “perspective” is a general expression of both the formal mandate of each organization or agency and the background and interests of its professionals, experts, and members: the business or corporate perspective, environmental non-governmental perspective, the intergovernmental organizations perspective, and the indigenous peoples and local community perspective. The fifteen organizations and agencies reviewed here included five organizations or agencies from each of the three perspectives, with a mix

considered representative for each perspective (Table 2.4).

Following a preliminary review, it was determined that the quantitative scoring process applied to the four classes of organizations and agencies identified above would miss core elements and provisions in documents issued by global federations of indigenous peoples and local communities such as the United Nations Permanent Forum for Indigenous Peoples and the International Indigenous Forum on Biodiversity. As a consequence, analysis of key elements and provisions in documents issued by these federations (see supplementary materials S2.2) are presented in sections 2.2.4 and 2.2.8. Those sections of this chapter are an essential complement to the quantitative policy evaluations presented here.

Table 2.4 Organizations whose policy documents were considered for the analysis

Business	Forest Stewardship Council
	International Chambers of Commerce
	Marine Stewardship Council
	Natural Capital Coalition
	World Business Council
Environmental non-governmental organization	FairWild
	International Union for Conservation of Nature
	The Nature Conservancy
	TRAFFIC
	World Wildlife Fund
Intergovernmental organizations	Convention on Biological Diversity (Convention and Annexes)
	The Convention on Biological Diversity Guidance Document on Sustainable Use
	FAO guidance on fisheries
	FAO guidance on forestry
	International Council Game and Wildlife Conservation

This crosswalk of high-level policies with the key elements of sustainable use articulated by global organizations and agencies is not equally straightforward for all practices. For example, in the case of fishing and logging, there are United Nations intergovernmental organizations that national governments have agreed globally to give oversight for development of policy and guidance on acceptable practices. In both cases it is the FAO, although different departments within it. At the other extreme there seems to be no global and in some cases little national policy oversight for some aspects of gathering and/or non-extractive practices, although individual countries may have specific regulations for specified parts of nature.

The five institutions evaluated for each type of organization provide insight into uptake of the emerging global key elements of sustainable use. The analysis also offers an opportunity to look for consistent differences among the perspectives in terms of key elements receiving greater or lesser attention in major policy documents (see Table 2.2. of the data management report here for the list of documents reviewed at <https://doi.org/10.5281/zenodo.6473133>).

2.2.7.1.2 Categories and scoring approach

Policy provisions relevant to each key element were evaluated using a five-category rating system (see supplementary materials S2.3).

Absent – there are no provisions in the policy document that are directly relevant to a specific key element.

Inconsistent – there are individual provisions in the policy document that contradict or are directly in opposition to a specific key element.

Inferred – Although the language of the key element is not present in the individual provision of the policy, it can be reasonably inferred that the *intent* of the element is behind some provisions in the policy.

Partial – Language in the provision of the policy represents clearly the intent of a key element, but only some aspect(s) of the element are captured in the policy provisions.

Complete - The intent of the key element is clearly and fully captured in the provisions of the policy document.

Absent is assigned to a policy-key element combination only, but always, if none of the other categories is relevant for that combination. While unlikely in well-crafted policy documents, inconsistent can apply in combination with inferred, partial or complete. Where a policy document separates the intent of a single key element into multiple policy provisions the aggregate treatment within the document as a whole was scored.

2.2.7.1.3 Policy analysis – global results

The policy documents reviewed display high uptake of the key elements of sustainable use. A median of 15 of the 19 key elements were fully present in all of the policy documents reviewed for each organization or agency. The range from as few as 9 to as many as all 19 key elements completely addressed suggests there are some differences among agencies and organizations in degree of uptake (Figure 2.4). However, when complete and partially present scores are combined, the aggregate uptake score is higher overall, and consistency across agencies and organizations increases substantially.

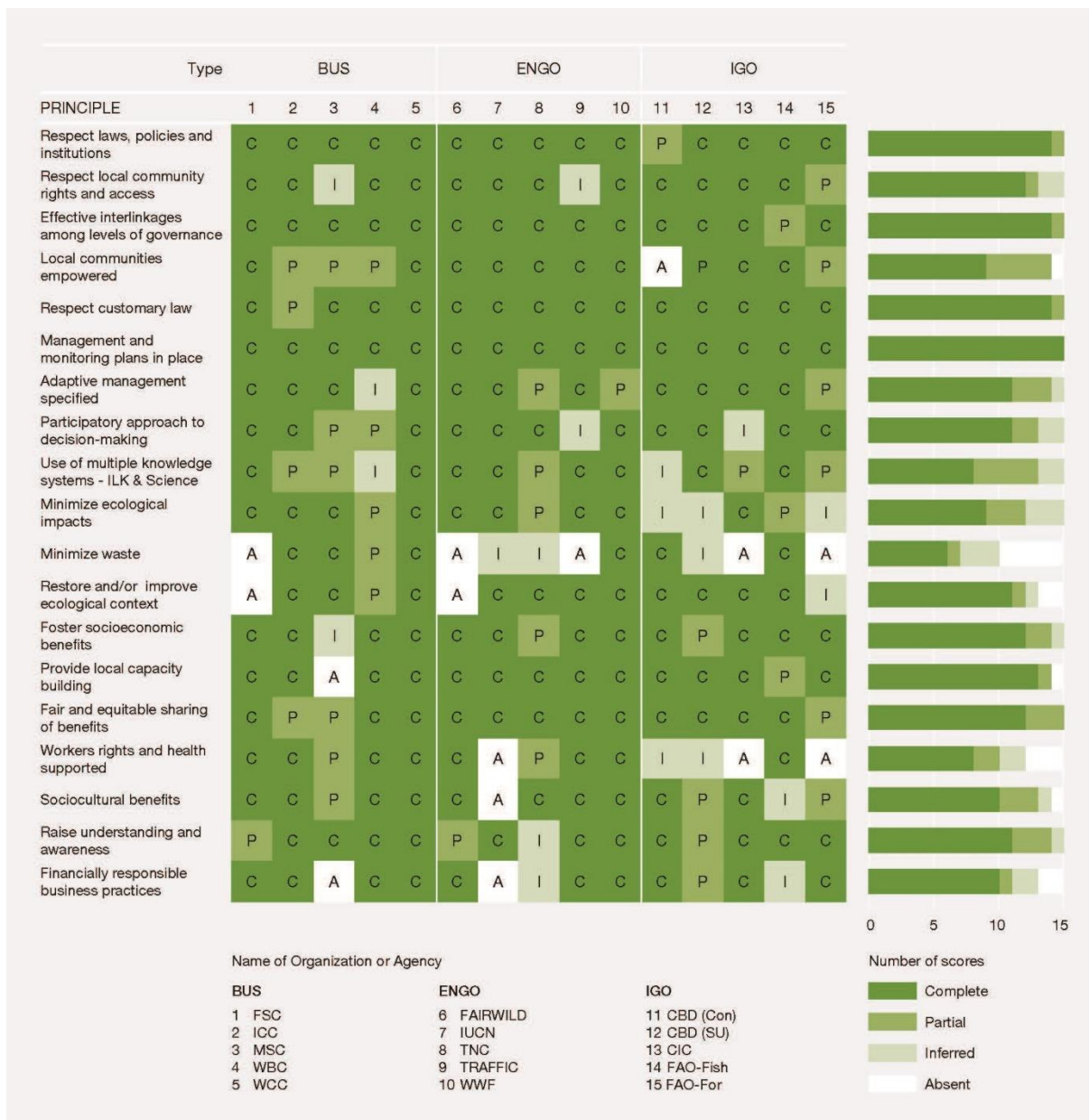


Figure 2.4 Key elements of sustainable use in global policy documents. Stacked bar graphs to the right of each table row display the frequency of occurrence of each score. C = complete; P = partial; I = inferred; A = absent. BUS = business; ENGO = Environmental Non-Governmental Organization; IGO = Intergovernmental Organization. See data management report at <https://doi.org/10.5281/zenodo.6473133>.

The number of key elements found to be absent in an agency’s or organization’s policy documents ranges from 0 to 3, with 0 being the modal value. Only one agency does not address 3 key elements in part or whole. The number of key elements addressed in ways considered inconsistent also ranges between 0 and 3 among agencies and organizations, again with a modal value of 0 key elements. Inconsistent and absent scoring tended to be reciprocal rather than additive. When aggregated, absent and incomplete key elements range between 0 and 4, with a median and mode of 2 per agency or organization.

Uptake of the key elements of sustainable use is high in all the agencies’ and organizations’ policy documents. This is a welcome and somewhat remarkable finding given

that a number of the key elements identified in section 2.2.6 were broadly accepted as core elements after some of the policy documents had been adopted by their respective agencies and organizations. Nevertheless, the fact that uptake is not complete presents scope to explore where there is less than full uptake.

Looking first at the key elements that were scored as absent in Figure 2.4, the overall probability that an element is absent is quite low ($P = .0526$). However, two key elements account for 8 of 15 absent scores, minimize waste (5 absent scores) and support workers' rights and health (3 absent scores). Two other key elements, restore or improve ecological context and apply responsible business practices, were absent in two agencies' or organizations' policies.

Treating a key element inconsistently within or across a series of policy documents also is problematic for an agency or organization. A total of 36 occurrences of either inconsistent or absent key elements were found in the analysis.

When absent and inconsistent scores are aggregated, the same key elements emerge as having less uptake: minimize waste, support workers' rights, restore or improve ecological context, and apply responsible business practices. Minimize ecological impacts also was absent or inconsistent in three cases. There was no statistically significant difference in the likelihood that a key element would be absent or inconsistent in policy documents by perspective (e.g., business organization, environmental non-governmental organization or intergovernmental agency).

Some cautions are in order when interpreting results of the evaluation. The generally low rate of absent or inconsistent treatment of key elements is encouraging. It may be the case, however, that the various perspectives on sustainable use accord lower priority to some key elements. The inclusion of five different agencies or organizations from each perspective was intended to allow the such potential differences to be evaluated. Two additional design factors in the choice of organizations and agencies also are to be kept in mind.

First, although serious efforts were made to evaluate the most prominent policy documents of each agency or organization, some relevant documents may not have been included in the analysis. Second, as previously noted, the perspectives of indigenous peoples and local community perspective are not included in these scorings.

Overall, this evaluation finds that at the global scale, across a range of organizations and agencies with business/corporate, environmental non-governmental organization and intergovernmental perspectives, all have taken on most of the key elements of sustainable use, including:

- Respect laws, policies and institutions;
- Respect local community rights and access;
- Effective interlinkages among levels of governance;
- Local communities empowered;
- Respect customary law;
- Management and monitoring plans in place;
- Adaptive management specified;
- Participatory approach to decision-making;
- Use of multiple knowledge systems;
- Foster / provide socio-economic benefits;

- Provide local capacity building;
- Fair and equitable sharing of benefits;
- Provide socio-cultural benefits;
- Raise understanding and awareness

Collectively these agencies and organizations address many aspects of healthy species and ecosystems, generating and sharing economic benefits, and prosperous stable communities. Aspects of equity, governance, knowledge and capacity-building also are elaborated in their policies. The few key elements not included in this list are still widely taken up and none are frequently overlooked. Together these results indicate that global organizations have been progressing in directions consistent with the evolving consensus on key elements for sustainable use.

2.2.7.2 *Regional Policies*

2.2.7.2.1 Introduction and intent

A number of regional governance bodies also set policies and standards for sustainable use. Serving governance functions between nation states and global agencies and organizations, regional bodies generally are established for one or both of two reasons: (1) harmonization of objectives for species and natural features that cross national boundaries, and (2) coordination of policies and measures for their governance and management (Boyd et al., 2015; Granberg et al., 2019; Prager, 2010).

Regional coordination is pursued and facilitated through diverse governance approaches and arrangements. Some regional arrangements are strictly sectoral, others are multi-sectoral. Some are bilateral while others are multilateral. Some are enabled by binding agreements, others by a variety of mixes of mandatory and voluntary provisions. In the case of fishing the fact that stocks being harvested and biodiversity features impacted extend or are restricted to areas beyond national jurisdiction adds further complexity to their governance. However, the United Nations Convention on the Law of the Sea (1982) and “Fish Stocks Agreement⁵” (1995) enable States to come together to form regional fisheries management organizations, and develop policies and regulations that are binding on its members. Earlier fisheries conventions include the International Commission of the Conservation of Atlantic Tuna.

An exhaustive review of all types of regional arrangements for promoting sustainable use of wild species was beyond the capacity of this assessment. Rather, given the important role of regional arrangements as a link between global and national policies and actions, this section presents a few illustrative examples of how regional governance bodies address the key elements of sustainable use examined in more depth in the global (preceding) and national (following) sections of this chapter.

Five regional intergovernmental organizations were chosen for an exploratory review. The methodology for the analysis is described in the data management report available at [10.5281/zenodo.6473133](https://zenodo.org/record/6473133).

⁵ Agreement for the implementation of the provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the conservation and management of straddling fish stocks and highly migratory fish stocks

- The International Tropical Timber Organization is an intergovernmental organization established in 1983 for developing policies on the economy and trade of tropical timber. Membership is open to all countries producing or importing tropical timber. Current members include 36 producer countries and 38 consumer countries and regions, which represents more than 80% of the world's tropical forests and about 90% of international tropical timber trade.
- The Carpathian Convention was established in 2003 to guarantee protection and sustainable development of the Carpathians. It is the only multilateral agreement addressing multi-level governance in the whole of the Carpathian area and it was, after the Alpine Convention, the second regional treaty-based regime for the protection of a mountain region worldwide. Specific substantive obligations are defined by protocols, which function as means to operationalize the key elements of sustainable use constituted in the Convention. There are five Protocols adopted up to date, including one on biodiversity generally, and one on sustainable forest management.
- The European Federation for Hunting and Conservation was established in 1977, to represent interests of European hunters as an international non-profit-making non-governmental organization. The European Federation for Hunting and Conservation works with its partners on a range of hunting-related matters, from international conservation agreements to local implementation issues with the aim of sustaining hunting across Europe.
- The International Commission for the Conservation of Atlantic Tuna is a formal regional fisheries management organization, first formed in 1966 to manage harvesting of all tuna stocks in the Atlantic, and promote sustainable practices. Membership is open to all interested countries. From the group of 17 original signatories, the Convention has grown to 52 member Parties, among them countries with Atlantic coastlines and countries with distant water fishing fleets.
- The Western and Central Pacific Fisheries Commission was established by the Convention for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean and entered into force on 19 June 2004. The Convention seeks to address problems in the management of high seas fisheries resulting from unregulated fishing, over-capitalization, excessive fleet capacity, vessel re-flagging to escape controls, insufficiently selective gear, unreliable databases and insufficient multilateral cooperation in respect to conservation and management of highly migratory fish stocks. It currently has 26 members, seven participating territories, and nine “cooperating non-members”, with most Pacific small island developing States participating, as well as several countries without borders on the Pacific but with distant water fleets that harvest large pelagic stocks in the region.

2.2.7.2.2 Results and Interpretation

Figure 2.5 contains the results of the scoring of the selected documents for the regional intergovernmental organizations. On initial inspection there appears to be a higher proportion of absent scores for regional organizations than for global organizations. This is an artifact of the analytical approach, however. For the global analyses scores were the aggregate of five

documents evaluated for each agency or organization. Had scores been presented for every individual document, absent scores would have been much more numerous in the global analysis. When the aggregate scores for each regional intergovernmental organization are considered, only 13 absent scores are present in the 114 cells, which is not significantly different to the 15 absent scores among the 285 aggregate scores in Figure 2.4.

The International Tropical Timber Organization stands out among regional and global entities for the number of key elements scored as complete. Every element except socio-cultural benefits received complete treatment in the International Tropical Timber Organization Voluntary Guidelines. Further, community benefits are fully present in other International Tropical Timber Organization guidelines. Complete coverage of every key element made the scorings for the International Tropical Timber Organization significantly different from both the forestry standards in the Carpathian Convention ($P < 0.01$), and standards for logging, hunting and fishing set by all other regional bodies included in the evaluation ($P < 0.01$). In contrast, overall patterns of scores were not significantly different between the pairwise contrasts of hunting ($P > 0.40$) and fishing ($P > 0.10$) regional organizations, or among the five other regional bodies collectively ($P > 0.15$). However, collectively this analysis indicates that complete coverage of the key elements of sustainable use differs substantially among practices and regional bodies ($P < 0.001$), with most complete coverage for logging and least for fishing.

It appears from this examination that regional scale intergovernmental organizations acknowledge the key elements of sustainable use as readily as do global agencies and organizations. However, phrasing of commitments to key elements of sustainable use in most regional intergovernmental organizations' documents tended to be indirect rather than explicit. The fact that the International Tropical Timber Organization consistently included clear and complete acknowledgement of all principles demonstrates that full commitment to the key elements of sustainable use is possible at the regional scale. The fact that the fishing regional bodies reviewed had the lowest rates of complete coverage does not necessarily reflect a lesser overall commitment to sustainable use. The responsibilities of regional fisheries management organizations for waters outside national jurisdictions, where the United Nations Convention on the Law of the Sea constrains policies of Parties and regional organizations, may mean that some key elements (e.g., integration of indigenous and local knowledge with scientific assessments) may not be within their competencies. The small sample renders any inferences from these findings speculative. However, these exploratory analyses demonstrate the potential for regional intergovernmental organizations to promote and facilitate sustainable use of wild species.

Supplementary material S2.4 contains additional interpretation and information about fishing, hunting and logging regional organizations, and their policy contexts.



Figure 2.5 Key elements of sustainable use in regional policy documents. C/c = complete; P/p = partial; I/i = inferred; A/a = absent (uppercase shows the overall score of each organization, while lowercase indicates the scores of individual documents). See data management report at <https://doi.org/10.5281/zenodo.6473133>.

2.2.8 Local and customary norms and rules

While sections 2.2.6 and 2.2.7 cross-walked key elements and policies for sustainable use in the global conservation arena, this section reviews a range of primarily place-based customary rules and regulations used to govern access to and use of wild species. The methodology is presented in the data management report document available at [10.5281/zenodo.6049358](https://doi.org/10.5281/zenodo.6049358). Based on the review of the available literature and key takeaways from the IPBES Indigenous and Local Knowledge Dialogue Reports (IPBES, 2019b, 2019a), results focus on customs and norms surrounding harvest, waste, sharing, stewardship, spirituality, taboos and rest periods, sanctions, social status/significance, physical access, and

gender roles.

2.2.8.1 Results

Findings from the systematic review illustrate that sustainable use cultural norms and practices in indigenous peoples and local communities are heterogenous and dynamic in nature - encompassing socio-cultural, spatial, and temporal variation, and including mechanisms to support adaptation strategies and actions when necessary (Muir et al., 2010; C. K. Turner & Lantz, 2018). Despite this variation, there are also many overarching similarities within and across indigenous peoples and local communities. For instance, spiritual customs and norms play a significant role in shaping sustainable use practices in indigenous peoples and local communities, based on their epistemologies, ontologies, and conceptualizations of relationships between humans and other than human (wild) species (IPBES, 2019b, 2019a; Nadasdy, 2007; Virtanen et al., 2020).

Long-term sustainability of many interactions and relationships with wild species are guided by a complex set of cultural norms involving regulations, sanctions, and taboos. For example, saltwater fishing restrictions/taboo of the Nicobarese and Shompen indigenous tribal communities of Asia are “embedded in a range of belief systems that link fishing in restricted areas with the [limited] success of land-based crops, disease and ill-fortune, etc.” (Patankar et al., 2016). Sanctions and punishments vary by community and include both *de jure* (officially sanctioned) and *de facto* (unofficial) measures. For example, the consequences of felling a tree in culturally protected forests range across five villages in southeast China from “self-criticism in front of the villagers, replanting trees, or paying fines” to taking possession of the offender’s family pig and distributing the meat to the other families in the village (Gao et al., 2018). An increasing number of sustainable use interactions are also codified and mandated via present-day legal tools and mechanisms such as legal personhood and recognized rights of nature (Cano Pecharroman, 2018; Gombay, 2015; Youatt, 2017).

Consistent with what contemporary scholars describe as a strong “sustainability ethos”, indigenous peoples and local communities from geocultural regions around the world place strong emphasis on harvesting or collecting only what is needed. Examples can be found among the Izoceño indigenous peoples of Central America (Noss & Cuellar, 2001), the Buriat of Central Asia (Pratt et al., 2004), the Aotearoa Maori of Oceania and Haida of Coast Salish North America (Stephenson et al., 2014), and many other indigenous peoples and local communities. For example, for the Denésôliné (Chipewyan) community of the Northwest Territories in Canada, wasting caribou meat is considered a “marked show of disrespect to the caribou”, which should be avoided at all costs (Kendrick et al., 2010). Similarly, traditional healers and herbalists of the Nharira community of Zimbabwe harvest a few leaves of the desired medicine rather than uprooting the desired plant or, when tubers or roots are required, they carefully remove a small portion and recover the remaining sections with soil (Mavhura & Mushure, 2019). While many of the customary norms surrounding waste are motivated by the avoidance of social or cultural stigmas, they also serve to ensure the long-term sustainability of wild harvest practices.

Sharing what was harvested or collected is similarly important - exemplified, for example, through ritual and communal feasting practices of the North America Iñupiat (Sakakibara, 2017) and Kluane First Nation (Nadasdy, 2007), through customary gifting “to

create bonds with kin and kith” among the Tsimane' of South America (Reyes-García & Fernández-Llamazares, 2019), and through complex, kinship-based wild meat distribution networks of the Xavante (A'uwẽ) of South America (Welch, 2014).

Customary norms and practices surrounding are also entrenched in spiritual and ritual practices, which extend across several stages and processes involved in maintaining long-term sustainable use ranging from advanced preparations all the way through properly caring for what remains after use. Among the Nicobarese and Shompen of Asia, ritual plays a strong role in determining the appropriate timing for access to wild harvest target species or the places they inhabit, for example, some reef areas are protected as no take or no go areas except for important cultural festivals (Patankar et al., 2016). In the Quinault Indian Nation of North America, the bones of the first caught salmon are returned to the home river during a ceremony to encourage an abundant harvest the following year (Amberson et al., 2016). Ritual practices surrounding harvest and preparation can also be found in gray literature and cultural texts, for example in Oceania within the Native Hawaiian epic saga of Pele and Hi 'iaka (Emerson, 1997). While this seminal myth is situated in time immemorial, the sustainable harvest rituals contained in the story emphasize the importance of proper protocol and etiquette when handling wild-harvested foods that were gathered for specific guests or special occasions (i.e., when feasting in the presence of a deity) and for the proper disposal of the unconsumed portions of wild harvest species (i.e., burning and burying fish tails, fins, bones, and scales).

When engaging in sustainable use practices, many communities request access or protection from guardian spirits. For example, in the Sebitoli area of Kibale National Park, Uganda it is understood that if hunters ask permission from *Kaliisa* (who is described as a forest hunter spirit), then Kaliissa will provide safe passage (Bortolamiol et al., 2018). For the Nharira of Zimbabwe, accessing the Chirozva and Daramombe hills requires mandatory ritual practices to request permission from *midzimu yevaNjanja* (ancestral spirits of the vaNjanja clan). Failure to follow these ritual practices are thought to result in “huge misfortunes including droughts or long dry spells and reduced crop yields. Given droughts and reduction in crop yields affect the entire community, the villagers do their best to observe the laid down rules and regulation” (Mavhura & Mushure, 2019).

The maintenance and transmission of indigenous and local knowledge and practices associated with sustainable use are an important enabling factor of local and customary norms and rules. For example, among the Karen indigenous community of Thailand, rotational farming practices and daily rituals revolve around a central objective to “maintain and recover the culture, belief, traditional knowledge and spirituality of the community” (Mellegård, 2017). Similarly, in the War Khasi community of Meghalaya, India, in-depth knowledge of fish behavior has informed seven discrete forms of customary fish-harvesting practices: *Buh Kroh*, *Riam Kriah*, *Riam Khohka*, *Riam Kyllong*, *Ring Khashiar*, *Buh Ruh* and *Bia Dohpieh* (Tynsong & Tiwari, 2008). Knowledge of these practices, together with indigenous and local knowledge of fish habitat, reproductive behaviour, food preferences and life cycle, is shared and maintained intergenerationally through oral transmission. In many instances, the indigenous and local knowledge that drives daily norms and rules around sustainable use practices are key components for successful construction of sustainability, biodiversity, and conservation policies across local to global scales (Sterling et al., 2020).

2.2.8.2 Concluding remarks

Cultural norms and practices surrounding the sustainable use of wild species are heterogeneous and dynamic across indigenous peoples and local communities, but they share important commonalities. In many indigenous peoples and local communities, sustainable use practices are often guided or informed by intricate and nuanced combinations of spiritual customs and ceremonial practices, regulations, sanctions, and taboos, respect for wild species as kin, sharing across social networks, and maintaining and transmitting indigenous and local knowledge. As socially situated and living governance systems (Whyte, 2013), the dynamism of the values, practices and associated knowledge of indigenous peoples and local communities can also occur through accommodation and hybridization of new forms of knowledge and by setting aside norms and practices that become less useful in daily life (Gómez-Baggethun et al., 2013; Gómez-Baggethun & Reyes-García, 2013) to suit their own needs (L. R. Simpson, 2004). Although continuity and dynamism of customary management plays a central role in the continued sustainability of harvesting practices, cultural values and their contributions to wild species stewardship can be undermined by accelerated social-ecological changes from global to local scales (Brondízio et al., 2021; Cunha et al., 2021; Fernández-Llamazares et al., 2021; Pardo de Santayana et al., 2012). For example, the erosion of customary institutions, including the loss of the spiritual values underpinning sacred sites, can compromise the effectiveness of traditional norms and regulations (Fernández-Llamazares et al., 2018; Maru et al., 2020; Osei-Tutu, 2017). Many other pervasive pressures, including direct threats to indigenous territories and collective lands from industrial-scale development (Forest Peoples Program et al., 2020), and the expansion of the commodity extraction frontiers (Natcher & Brunet, 2020; Temper et al., 2018) challenge indigenous and local communities' lifeways and access to resources. Many communities look to the integrity of indigenous and local leaders that resist and work to counter these threats (Brondízio et al., 2021; Forest Peoples Program et al., 2020; Scheidel, 2020). Efforts to counter environmental injustices may also result in unanticipated favorable contributions, such as the revitalization of indigenous and local communities' practices, ties to land and non-human relatives, and indigenous and local knowledge systems more generally (Fernández-Llamazares et al., 2021; McGregor et al., 2020). The existence and persistence of local and customary norms and rules are fundamental to conceptualizing sustainable use, and require individual programs to be tailored to local contexts to achieve stewardship, management, and care for wild species across local to global scales (see Chapter 6).

2.2.9 National laws and regulations across practices

2.2.9.1 Introduction and intent for this section

International conceptualizations of sustainable use described in this chapter become more concrete as countries adopt and integrate them into their legal and institutional frameworks. Adoption and integration reflect national circumstances, including the status of biodiversity and ecosystem services, socio-economic status, resources for implementation, existing policy contexts, and the diversity of knowledge and value systems and management approaches within countries. Consequently, the conceptualizations framed in global policy commitments are adapted sometimes substantially to accommodate national cultures and capacities, and

interpreted into national conceptualizations of sustainable use of wild species in relevant national laws, policies, and programs. This diversity of factors potentially influencing national legislation and related regulations and practices makes a consistent and comprehensive review of all national policies challenging. Nevertheless, some global agreements help structure the policies of most countries, notably the Convention on Biological Diversity. Thus, this section reviews conceptions of sustainable use of wild species as expressed in a sample of national biodiversity strategies and action plans relative to provisions of that convention.

As reviewed in section 2.2.7 in this chapter, many global policy documents address sustainable use of wild species from diverse perspectives. Generally, however, they are rooted in a common set of key elements (see section 2.2.6), particularly the Addis Ababa Principles and Guidelines for the Sustainable Use of Biodiversity. In addition, Article 6(a) of the Convention on Biological Diversity requires all Parties to develop national biodiversity strategies and action plans for fulfilling the requirement of Article 6(b) to integrate sustainable use practices into relevant plans, programs and policies. This intent of the national biodiversity strategies and action plans is to draw in diverse, relevant government sectors at national and sub-national levels, and engage all economic private sectors and other stakeholder or rights holder groups who have interest in or impacts on use of wild species.

National biodiversity strategies and action plans are key instruments for countries to coordinate and operationalize sectoral and cross-sectoral sustainable use policies. National biodiversity strategies and action plans developed before the adoption of the Aichi Biodiversity Targets in 2010 did not consistently address sustainable use of biodiversity due to factors such as the lack of sectoral and cross-sectoral policy coordination or engagement (Prip et al., 2010). However, one of the intents of Aichi Biodiversity Target 17 was to reinforce the commitment to informative and effective national biodiversity strategies and action plans, and encourage them to address a common range of issues related to sustainable use (Convention on Biological Diversity Decision X/2 Para. 3(c)). After 2010, national review and revision of national biodiversity strategies and action plans in the context of Aichi Biodiversity Target 17 have both increased the consistency of issues covered in national biodiversity strategies and action plans and strengthened the role of national biodiversity strategies and action plans as key policy instruments for promoting sustainable use practices by each country. These efforts have been augmented by oversight from the Conference of the Parties to the Convention on Biological Diversity, reviewing national biodiversity strategies and action plans for consistency with the Aichi Biodiversity Targets and other high-level commitments. As of June 2019, 155 countries have submitted a national biodiversity strategy or action plan that takes into account the Strategic Plan for Biodiversity 2011-2020, including the Aichi Biodiversity Targets.

In this section, the national biodiversity strategies and action plans are used as the information base for this review and analysis, because they are provided by almost all Parties to the Convention, and consistent with Article 10 of the convention, are specifically mandated to report on sustainable use of biodiversity and have some consistency of thematic coverage as encouraged by Aichi Biodiversity Target 17. The methodology for this analysis is available in the data management report, available at [10.5281/zenodo.6473133](https://zenodo.org/record/6473133).

One to three analytical questions for each Addis Ababa Principle were developed to assess how the elements of sustainable use presented in each of the Addis Ababa Principles are reflected in national actions reported in the national biodiversity strategies and action plans. An

additional question was set to see how many countries explicitly refer to the Addis Ababa Principles and Guidelines for the development of the strategies and action plans. A science-policy interface is not explicit in the Addis Ababa Principles and Guidelines but is important for most policy development, including for sustainable use. Consequently, four additional questions were set to analyze the degree to which a) science – policy interactions have played roles in developing national policies for sustainable use, and b) these interactions are recognized in national biodiversity strategies and action plans.

The questions are all linked to specific Addis Ababa Principles but for purposes of analysis and interpretation of patterns, they were grouped into seven themes. The degree to which each relevant Addis Ababa Principle is addressed in a national biodiversity strategy and action plan was assessed using a series of questions. These questions were grouped into seven themes:

- Governance A (policy and legal frameworks and institutions),
- Governance B (decentralization and empowerment of decision-making),
- Management systems,
- Ecological considerations,
- Socio-economic considerations,
- Education, and
- Science-policy interface.

A complete description of the methodology used for this review is available in the data management report (10.5281/zenodo.6473133). The list of countries whose national biodiversity strategies and action plans were analyzed is available in supplementary materials S2.5.

2.2.9.2 Results

The results of the evaluation of the above-mentioned questions are presented in Figure 2.6 and described in more detail below.

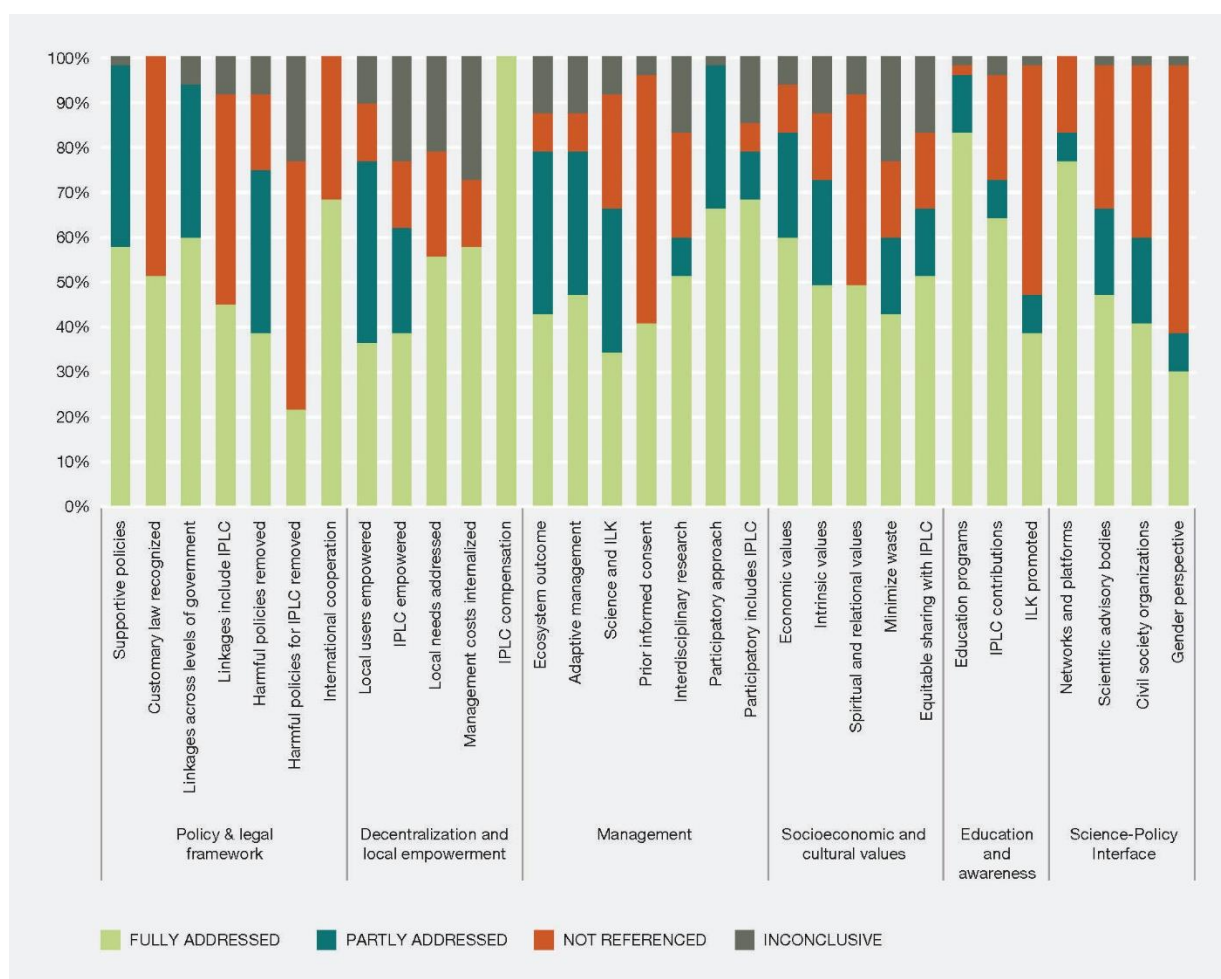


Figure 2.6 Key elements of sustainable use in national biodiversity strategies and action plans. The y axis represents the proportion of national biodiversity strategies and action plans (n=47). IPLC = Indigenous peoples and local communities. The data for this figure are available at 10.5281/zenodo.6473133.

- **Governance A: Policy and legal framework and institution questions**

The evaluation of governance A principles addresses national frameworks through questions following on Addis Ababa Principles 1, 3 and 8 (Box 2.1), with one question about international aspects of the national policies. Sub-questions in each case ask how more local scale practices are at least acknowledged, if not protected, in the higher-level policies, regulations, and related governance aspects.

Box 2.1 The Addis Ababa Principles related to governance A: Policy and legal frameworks and institutions, and corresponding questions include:

Addis Ababa Principle 1: Supportive policies, laws, and institutions are in place at all levels of governance and there are effective linkages between these levels.

Q1-1a. Supportive policies, laws and/or institutions are in place?

Q1-1b Local customs and traditions (customary law) are recognized and described within these policies, laws and/or institutions?

Q1-2a. Different levels of governance and their linkages are addressed in the policies, laws and/or institutions assessed in Q1-1?

Q1-2b. Levels of governance for which linkages are addressed include customary laws, local traditional and customs?

Addis Ababa Principle 3: International, national policies, laws and regulations that distort markets which contribute to habitat degradation or otherwise generate perverse incentives that undermine conservation and sustainable use of biodiversity, should be identified and removed or mitigated.

Q3-1a. Policies, laws and/or regulations that undermine sustainable use of wild species, are identified and (will be) removed or mitigated?

Q3-1b. Laws and regulations that adversely affect sustainable use by indigenous peoples and local communities and therefore need to be removed or mitigated are described in the report (e.g., displacement of indigenous peoples and local communities by Protected Areas development) and/or harmful impacts of biodiversity funding on indigenous peoples and local communities and their lands and territories have been or will be removed or mitigated?

Addis Ababa Principle 8: There should be arrangements for international cooperation where multinational decision-making and coordination are needed.

Q8-1. Bilateral or multilateral coordination for management of transboundary biodiversity resource are in place.

Several patterns emerge from this examination of how well the national biodiversity strategies and action plans that were evaluated address larger-scale governance issues. Q1-1a and Q1-1b addressed supportive policies in place for the national biodiversity strategies and action plans, including acknowledgement of the rights and generally sustainable practices of indigenous peoples and local communities. Over half of the national biodiversity strategies and action plans fully addressed these governance aspects. The national biodiversity strategies and action plans that were evaluated as partially addressing these two questions often were ones focused overall on detailed treatment of selected sectors or types of policies and regulations. Tenser national biodiversity strategies and action plans expressed general and unqualified commitments to address these governance issues. For question 1-2a many cases evaluated as “partially addressed” were cases in which indigenous peoples and local communities were not mentioned explicitly. However, references to citizenry or similar phrasings may be intended to acknowledge indigenous peoples and local communities, especially where such communities make up a large proportion of a nation’s population (e.g., small island developing states). Explicit recognition of the rights and practices of local communities and indigenous peoples is made in half or fewer of the national biodiversity strategies and action plans (Q.1-2b) evaluated. In cases where recognition of the rights of indigenous peoples and local communities are still evolving, several national biodiversity strategies and action plans imply that efforts to negotiate access to and uses of nature may serve as an opportunity for national governments and communities to make progress on these complex governance issues. This was particularly evident in some Asia-Pacific and Latin American and Caribbean national biodiversity strategies

and action plans.

Commitments to review a broad range of policies, regulations and practices for perverse incentives and other potentially negative biodiversity impacts are less common (Q.3-1a and 3-1b). In two-thirds or more of the national biodiversity strategies and action plans examined, expressions of intent to review sectoral and other policies are generic or absent. Explicit acknowledgement of the need to review existing policies and regulations with regard for potentially negative impacts on the contributions of nature to indigenous peoples and local communities' livelihoods and cultures is particularly infrequent.

In the minority of cases when national biodiversity strategies and action plans contained substantial information on plans for individual sectors or practice, these were usually the countries where a yes was recorded for 3-1b, and where many of the “fully addressed” and “partially addressed” evaluations were made for 3-1a. At least two possible interpretations may explain these patterns. Countries may be more willing or able to conduct such policy evaluations for specific sectors (often fishing or forestry) than for the broad spectrum of policies, including economic and social policies. Alternatively, national biodiversity strategies and action plans commonly are prepared by environment ministries in collaboration with ministries responsible for sectors that use biodiversity, such as agriculture, forestry and fishing. Understandably, these ministries may emphasize their own policies and management measures. The information available from the national biodiversity strategies and action plans was insufficient to identify which, if either, of these factors is determinative.

Nearly a third of the national biodiversity strategies and action plans did not explicitly reference bilateral or multilateral agreements (Q8-1), even though every country submitting a national biodiversity strategy or action plan is at least a party to the multilateral Convention on Biological Diversity. However, the text of the national biodiversity strategies and action plans suggested that countries differ greatly in how they view the relationship of their resource management policies and practices to international agreements. Nevertheless, in cases where the resources being managed are themselves transboundary, such as many marine fish stocks, explicit acknowledgement of the importance of international agreements and cooperation was usually present.

- **Governance B: Decentralization and empowerment questions**

Governance B questions (Box 2.2) provide insight into ideas about decentralization, accountability and empowerment in decision-making. Fewer than half of the countries evaluated fully addressed empowering local communities and supporting them through rights to be responsible and accountable for sustainable use (Q2-1). Approximately an additional one third of countries partially addressed the issue by broadly or generally discussing the importance and/or promotion or participation of local communities in decision-making without mention of rights and/or the mechanisms through which communities are or could be empowered. A few countries (7 and 6, respectively), discussed local and community rights and empowerment in the context of particular sectors (e.g., logging, hunting and/or fishing) but not as a general principle applying to all types of uses of wild species. Most discussion of empowering and supporting the rights of indigenous peoples and local communities (Q2-2) in the national biodiversity strategies and action plans centered on protecting and encouraging customary use

of biological resources. Few countries explicitly mentioned legal recognition of customary or traditional rights. As with Governance A, countries differ greatly in how much explicit recognition is given to the identity of indigenous peoples and local communities.

Box 2.2 The Addis Ababa Principles related to Governance B: Decentralization and empowerment of decision-making, and corresponding questions include:

Addis Ababa Principle 2: Recognizing the need for a governing framework consistent with international, national laws, local users of biodiversity components should be sufficiently empowered and supported by rights to be responsible and accountable for use of the resources concerned.

Q2-1. Local users of wild species are empowered and supported through rights to be responsible and accountable?

Q2-2. Indigenous and local communities are empowered and their rights supported?

Addis Ababa Principle 7: The spatial and temporal scale of management should be compatible with the ecological and socio-economic scales of the use and its impact.

Q7-1. Spatial and temporal scale of management addresses the ecological and socio-economic needs of the use?

Addis Ababa Principle 13: The costs of management and conservation of biological diversity should be internalized within the area of management and reflected in the distribution of the benefits from the use.

Q13-1a. The costs of management and conservation of biological diversity are identified and internalized within the area of management?

Q13-1b. State yes if compensation for indigenous peoples and local communities for the socio-cultural costs and impacts arising from the establishment and maintenance of protected areas are described?

The question associated with Addis Ababa Principle 7 (Q7-1), which stipulates that the spatial and temporal scale of management should address the ecological and socio-economic needs of the use, were difficult to evaluate. Slightly over half of the countries addressed this principle in some way, but almost always through general mention of the need for conservation while meeting socio-economic needs and/or of involving stakeholders in the decision-making process. There was little mention of individual sectors, or of approaches or scaling mechanisms to link responsibility and accountability to the spatial and temporal scale of use.

Slightly over half of the national biodiversity strategies and action plans explicitly addressed Addis Ababa Principle 13, which refers to internalizing the costs and the distribution of costs and benefits from biodiversity conservation and management (Q13-1a and Q13-1b). However, their narratives often were relevant to the principle without explicitly addressing it. Almost all discussion in this arena focused on providing economic incentives, especially payments for ecosystem services, with some national biodiversity strategies and action plans also mentioning mechanisms for funding conservation initiatives, entry and license fees, taxes

or fines. In some rare instances, the principle was addressed for the forestry or hunting sectors. Seven countries mentioned compensation for indigenous peoples and local communities for the socio-cultural costs and impacts arising from the establishment and maintenance of protected areas.

- **Management approach questions**

Questions following on Addis Ababa Principles 4, 6 and 9 were used to examine management systems and approaches reported in the national biodiversity strategies and action plans (Box 2.3). The questions are divided between two subjects. The first include aspects of adaptive management and the nature and sources of information to inform adaptive responses. The second centers on the inclusiveness of the actual management of activities (in contrast to the inclusiveness of choosing management strategies and policies addressed in governance B).

Box 2.3 The Addis Ababa Principles related to management and corresponding questions include:

Addis Ababa Principle 4: Adaptive management should be practiced, based on:

1. Science and traditional and local knowledge;
2. Iterative, timely and transparent feedback derived from monitoring the use, environmental, socio-economic impacts, and the status of the resource being used; and
3. Adjusting management based on timely feedback from the monitoring procedures.

Q4-1. Adaptive management of the use is practiced based on feedback from monitoring?

Q4-2a. Adaptive management of the use incorporates not only scientific knowledge but also traditional and local knowledge?

Q4-2b. Process to obtain approval from the knowledge holders (PIC/FPIC) is mentioned (yes/no)?

Addis Ababa Principle 6: Interdisciplinary research into all aspects of the use and conservation of biological diversity should be promoted and supported.

Q6-1. Interdisciplinary research on the use is promoted and supported?

Addis Ababa Principle 9: An interdisciplinary, participatory approach should be applied at the appropriate levels of management and governance related to the use.

Q9-1a. A participatory approach is applied to the management and governance of the use?

Q9-1b. Participation of indigenous and local communities is addressed?

Adaptive management is widespread as a way to maintain or improve sustainability of uses of natural resources (Q4-1). Provisions for adaptive management are present to some degree in more than 90% of national biodiversity strategies and action plans, although in some cases the language may be ambiguous or open to interpretation. Feedback from indigenous peoples and local communities is considered in over two-thirds of the national biodiversity strategies and action plans reviewed, although formal mechanisms for acquiring and using such

information are not explicitly mentioned in the majority of such cases (Q4-2a and Q4-2b). This omission is noteworthy given that nearly half of all national biodiversity strategies and action plans examined reference the need for, and sometimes processes for, acquiring the scientific and technical information needed for management (Q6-1). However, one third of the national biodiversity strategies and action plans, commit to or acknowledge the need to acquire indigenous and local knowledge to inform adaptive management.

A trend towards greater inclusiveness in knowledge systems and participation in management at the national and sub-national scales is further evidenced by reports in two thirds of national biodiversity strategies and action plans' reports that management is largely participatory, with the remaining third reporting that it is partially participatory (Q9-1a). The inclusion of indigenous peoples and local communities in these participatory processes is explicitly or implicitly acknowledged in all but three of the national biodiversity strategies and action plans evaluated (Q9-1b). Regional differences were not apparent in any of these patterns, indicating that participatory management has broad uptake globally. When individual sectors were mentioned in the national biodiversity strategies and action plans, it was usually for fishing or logging, and sectoral reports were positive with regard to inclusive management.

- **Socio-economic and cultural values questions**

The questions in Box 2.4 were used to evaluate how the Addis Ababa Principles associated with accommodating social and economic outcomes desired by the countries (principles 10, 11 and 12), were reflected in national biodiversity strategies and action plans.

Box 2.4 The Addis Ababa Principles related to socio-economic and cultural values, incentives and benefit sharing, and corresponding questions include:

Addis Ababa Principle 10: International, national policies should take into account:

1. Current and potential values derived from the use of biological diversity
2. Intrinsic and other non-economic values of biological diversity and
3. Market forces affecting the values and use.

Q10-1. Policies take into account current and potential values derived from the use in relation to market forces affecting the values and use?

Q10-2a. Policies take into account intrinsic and other non-economic values associated with the use?

Q10-2b. Spiritual and/or relational values are described (y/n)?

Addis Ababa Principle 11: Users of biodiversity components should seek to minimize waste and adverse environmental impact and optimize benefits from uses.

Q11-1. Policies that seek to minimize waste and adverse environmental impacts and optimize benefits from uses are addressed?

Assis Ababa Principle 12: The needs of indigenous and local communities who live with and are affected by the use and conservation of biological diversity, along with their

contributions to its conservation and sustainable use, should be reflected in the equitable distribution of the benefits from the use of those resources.

Q12-1. Indigenous and local communities are identified as stakeholders and mechanisms that ensure equitable sharing of benefits are in place.

The questions primarily addressed how a range of values were taken into account in policies and programs within the country. Additional questions asked about the efficiencies of policies and programs to deliver benefits and avoid waste, and to distribute benefits equitably throughout society and particularly to indigenous peoples and local communities.

Nearly 90% of countries evaluated were considered to fully or partially address the expectation that policies should take into account current and potential values derived from the use in relation to market forces affecting the values and uses (Q10-1). These countries acknowledge the economic values of the use of biodiversity and wild species and have implemented or are in the process of implementing mechanisms for economic valuation and ecosystem services approaches in national policies. Of the countries that only partially address Q10-1, use values are appreciated but descriptions are not provided on how these are going to be taken into account in policies. More than three-quarters of the national biodiversity strategies and action plans acknowledged that policies would take into account intrinsic and other non-economic values associated with the use (Q10-2a), but fewer than half stated how this would be accomplished. This is in contrast to a more complete specification of the mechanisms and valuation methods specified for economic and use values. Approximately half of the countries evaluated explicitly acknowledge spiritual and/or relational values, or their role in uses of biodiversity (Q10-2b).

About 40% of the national biodiversity strategies and action plans include an intent to develop and implement policies that actually see to minimize waste and adverse environmental impacts and optimize benefits from uses (Q11-1), leaving open how fully these considerations will influence policies. On the other hand, over two-thirds of the national biodiversity strategies and action plans examined explicitly or implicitly acknowledge the special role of indigenous peoples and local communities and include commitments to have mechanisms in place that ensure equitable sharing of benefits (Q12-1). For all questions in this group, sector-specific provisions were most likely to be provided for logging and fishing, especially by countries for which those uses of biodiversity are important, in general, and/or for indigenous peoples and local communities, in particular.

- **Ecosystem outcomes questions**

Addis Ababa Principle 5 directly addresses ecosystem status and outcomes from uses of biodiversity, in particular the need to avoid or minimize adverse impacts on ecosystem services, structure and functions. Of the national biodiversity strategies and action plans evaluated, close to three quarters fully and/or partially addressed threats to ecosystem services, structure and functions (Q5-1). Key issues specified in this regard included invasive species, effects of tourism on biodiversity, impact of climate change, and human-induced impacts on ecological systems. To a larger extent than for many of the other questions, sector-specific information

was provided. Again, fishing and logging were the sectors most frequently addressed, and generally full or partial commitments to deliver outcomes consistent with Principle 5 were present.

- **Education and awareness-raising questions**

These questions explore the provisions in the national biodiversity strategies and action plans that are intended to increase public awareness of the importance of biodiversity to human well-being, and ways that the pressures on biodiversity can be reduced (Addis Ababa Principle 14; Box 2.5). This is one of the best represented themes in the national biodiversity strategies and action plans. All but one of the countries in the sample have paid significant attention to the importance of education and public awareness programs (Q14-1). There is, however, a difference when it comes to the importance of two components of this question: “conservation” and “sustainable use”. The lion’s share of attention goes to education and awareness raising about biodiversity and its conservation in general, as well as inventories, monitoring, production and distribution of knowledge about particular species. Comparatively less attention is paid to education and public awareness of sustainable use. Conservation and sustainable use, are of course, connected and it is possible that sustainable use is included in the aforementioned programs, but there are concrete examples focusing explicitly on sustainable use.

Box 2.5 The Addis Ababa Principles related to education and awareness-raising, and corresponding questions include:

Addis Ababa Principle 14: Education and public awareness programmes on conservation and sustainable use should be implemented and more effective methods of communications should be developed between and among stakeholders and managers.

Q14-1. Education and public awareness programmes (including promotion of communication among stakeholders and managers) on conservation and sustainable use are in place?

Q14-2 Initiatives to increase awareness of the contributions of knowledge, practices and innovations of indigenous and local communities for the sustainable use of biological diversity are in place (y/n)?

Q14-3 The use and revitalization of indigenous languages and traditional knowledge are promoted (y/n)?

There is general acceptance that indigenous and local knowledge is important when it comes to biodiversity conservation (Q14-2) and a substantial majority of the countries evaluated included a statement stressing this. However, there are few examples of concrete initiatives to raise awareness of the practices and innovations of indigenous and local communities, and nearly a quarter of the national biodiversity strategies and action plans do not explicitly mention the importance of indigenous or local knowledge.

Use and revitalization of indigenous languages and traditional knowledge is one of the most underrepresented points in the national biodiversity strategies and action plans (Q14-3). None of the countries have included revitalization of indigenous languages as an objective in their national biodiversity strategy or action plan. National biodiversity strategies and action

plans usually acknowledge the importance of traditional knowledge but lack concrete examples of activities targeted at revitalizing it.

- **Scientific and policy interface questions**

The intent of these questions was to investigate the extent to which there were commitments and structured processes to facilitate the inclusion of expert knowledge as inputs to development and implementation of national and subnational policies on sustainable use of wild species as articulated in Addis Ababa Principles 15 and 16 (Box 2.6). The three parts of Question 15 investigate commitments to networks or other vehicles for bringing knowledge from outside policy-making agencies into their dialogues (Q15-1); specifically, processes for engaging scientific and technical expert knowledge (Q15-2) and for community-based knowledge, particularly of indigenous peoples and local communities (Q15-3). Q16-1 asked specifically about acknowledgement of gender considerations in the knowledge being sought and the impacts of the policies being developed. These questions were particularly hard to score as “complete” or “partial”. It can always be argued that there is scope for greater inclusiveness and structure in advisory processes and for accountability of policymakers to their advisory processes. Thus, for Q15-1 and Q15-2 a score of fully addressed was awarded whenever there was explicit commitment to such networks and processes and some indication, they were either in place or under development. A score of partially addressed was awarded if it was implicit that such advisory pathways were functioning or assumed, but specific acknowledgement of their existence and value was lacking.

Box 2.6 The Addis Ababa Principles related to scientific and policy interface and corresponding questions include:

Q15-1. Structured groups, networks or platforms for the sustainable use of biodiversity are mentioned and/or described (e.g., National biodiversity platforms or networks).

Q15-2. Scientific advisory bodies (or persons) to the Government are mentioned and/or described.

Q15-3. Indigenous and local communities and civil society organizations (e.g., networks, syndicates, confederations, associations) that play a role in the governance and sustainable use of biodiversity are mentioned and/or described.

Q16-1 Mechanisms, instruments and/or strategies to incorporate a gender perspective are described.

A majority of countries recognize the need for mechanisms to bring external expert knowledge into policy-making processes and have made explicit commitments to either establish and strengthen such mechanisms or to ensure their existing ones are supported and used. The few national biodiversity strategies and action plans missing such acknowledgements tended to be short and focused more on outcomes than processes and mechanisms. When it came to the nature of such advisory processes and mechanisms, however, the documents more often were vague about the types of mechanisms to be established and knowledge that would have input into policy making. Countries that explicitly or partially addressed scientific advisory mechanisms also tended to address indigenous peoples and local communities and

civil society advisory mechanism more often than would be expected if these two aspects of the knowledge – policy interface were treated independently. This suggests that when countries think about how to bring external advice into the policy-making processes they think broadly about what types of knowledge input to seek. An equal number (9) of countries scored yes (or partial) on 15-2 and no, and no or yes (and partial) on 15-3, respectively, suggesting there is no bias towards either scientific experts or towards indigenous peoples and local communities and civil society if countries are only considering one of those sources of input.

Less than a third of countries explicitly included gender issues in their national biodiversity strategy or action plan. However, eleven of the thirteen that did were countries classified as economies in transition. Countries classified as fully developed countries were significantly less likely to include gender issues in their national biodiversity strategy and action plans.

2.2.9.3 Conclusions on representation of Addis Ababa Principles for Sustainable Use in national biodiversity strategies and action plans

Overall, the review of national biodiversity strategies and action plans indicated that at the national level there is substantial consistency between how countries are approaching the uses of biodiversity within their country and the Addis Ababa Principles for Sustainable Use, although some principles have greater uptake than others. Management that is adaptive (Principle 4) and participatory (Principle 9) and education and knowledge-sharing (Principle 14) have seen particularly high uptake by nations, and the reported interpretations of these principles has often reflected the negotiated language of the principles, as reflected by the frequency of “fully addressed” scores in this evaluation.

Uptake of the relevant Addis Ababa Principles regarding governance models for development (Principles 1, 3 and 6) and implementation (Principles 2, 7 and 13) of national policy frameworks has been nearly comparable to that for management and education. However, interpretation of these frameworks has been broader, as reflected in the more frequent evaluations of “partially addressed” or “inconclusive”. Aspects of the Addis Ababa Principles that directly focus on indigenous peoples and local communities appear to have the least explicit uptake in national biodiversity strategies and action plans.

The pattern was much the same in the evaluation of questions related to Addis Ababa Principles reflecting the socio-cultural and economic aspects of sustainable use (Principles 10, 11 and 12). Many of the comments accompanying the evaluations highlighted that countries were found to differ greatly in how they acknowledged indigenous peoples and local communities in their overall governance, some as an explicit and distinct component of their national population, some as being undifferentiated from the full citizenry of the countries, and some nearly silent on any explicit status for indigenous peoples and local communities. Differences in scorings across all the governance and the socio-economic questions often followed those differences in the degree of explicit acknowledgement of indigenous peoples and local communities in the national biodiversity strategies and action plans as a whole.

Only questions related to ecological outcomes (Principle 5) could be scored by practice (e.g., fishing, gathering, logging). The fact that “fully addressed” scores were particularly frequent is welcome, but should be interpreted cautiously. It could not be determined if countries were selectively reporting practices for which policies and management were

particularly effective at promoting sustainability, or calling for more effective sectoral policies and management because current ones were not delivering sustainable ecological outcomes. Both would be positive developments, the former showing successful outcomes on this consideration and the latter showing a willingness of countries to address unsustainable uses of wild species. Nevertheless, the ambiguous interpretation here highlights the importance of Chapters 3 and 4 of the present assessment.

Further, when specific practices were discussed in the national biodiversity strategies and action plans, logging and fishing were most frequently cited, with hunting and wildlife watching mentioned in a few cases. Almost none of the national biodiversity strategies and action plans reviewed contained any practice-specific information on gathering, despite its importance to subsistence, local livelihoods and well-being (see Chapters 1 and 3) and despite specific principles on the sustainable harvest of plants being part of the Convention on Biological Diversity's Global Strategy for Plant Conservation.

The preliminary finding of this review is that the conceptualizations of sustainable use contained in the national biodiversity strategies and action plans of a representative sample of countries are broadly consistent with the Addis Ababa Principles for Sustainable Use, but are not fully comprehensive in addressing all principles. No striking differences were found among United Nations economic groupings of countries or uses of biodiversity. The national biodiversity strategies and action plans are by name and nature only plans. However, much they reflect the Addis Ababa Principles for Sustainable Use, implementation of national biodiversity strategies and action plans could be incomplete for many reasons. This evaluation cannot address national implementation of these plans, making the information in the rest of the assessment of great importance.

2.2.10 Synthesis of conceptualizations of sustainable use of wild species

The review of academic literature found that the conceptualizations of sustainable use of wild species have been changing and expanding both overall and for each practice, over the course of decades (sections 2.2.2, 2.2.3). Key elements of sustainable use in global and regional standards can vary greatly depending in their purpose and scope, but taken together, they largely capture these ideas in the literature (section 2.2.6). Some of the more recent, widely accepted ideas in the literature, including that of sustainable use of wild species as a dynamic, social-ecological system, where ecological, social/governance and cultural components are interconnected, are present in the key elements and also consistent with some aspects of indigenous peoples and local communities' conceptualizations. However, some of the broad commonalities across indigenous peoples and local communities' conceptualizations of sustainable use are either absent or poorly represented in the key elements of global and regional standards. These include the foundational concept of reciprocal relationships among people and nature, and the conceptualizations of sharing across social networks, cultural continuity and community health and wellbeing as fundamental, interconnected aspects of sustainable use (sections 2.2.4, 2.2.8).

At the global level there was very high uptake of all key elements in the overarching policy and guidance documents of a range of intergovernmental organizations and bodies with both business and conservationist orientations. As with the key elements themselves, uptake was slightly less complete for elements about working conditions, full recognition and

empowerment of indigenous peoples and local communities in governance, and rehabilitating degraded ecosystems and species. However, there were no differences among the different types of global policy bodies with regard to degrees of uptake of aspects of key elements of sustainable use, nor among types of agencies. Nevertheless, the commitments in policy and the guidance in the relevant guidance documents were in generally high level and general language with broad scope for interpretation.

At the regional level, comparisons among regional bodies were possible for fishing, hunting and logging, but multiple regional agencies with fully comparable broad policy and guidance documents were not located for gathering or non-extractive uses. At the regional level uptake of the key elements was again very high; comparable to uptake by global agencies and generally with the same key elements showing less complete an uptake. The important feature at the regional scale was the larger number of bodies and organizations who were considered to have only partial or implied uptake of the key elements, compared to complete uptake globally. This did not appear as more apparently weaker commitments being made, but as much more carefully crafted language particularly in guidance documents and families of regulations for implementation of the policy commitments. This reflected the effort in those documents to walk a very fine line of both interpreting the generally abstract commitments in the global policy documents more concretely in the context of the resources, cultures and economies of the various regions, while respecting the sovereignty and diverse legal and statutory bases of governance of the individual States within the region.

This pattern appeared even more strongly at the national policy level with the analyses of national biodiversity strategies and action plans. It was at the national scale where some of the key elements were found not be taken up in a minority, but still a noteworthy number, of national policy frameworks. The key elements most likely to be missing in the national policy frameworks were explicit commitments regarding empowering indigenous peoples and local communities in governance, integrating diverse knowledge systems, and considering non-monetized values of the uses of biodiversity in policy, including spiritual and/or relational values. This is consistent with a pattern seen elsewhere in the chapter and assessment as a whole – that the ecological aspects of sustainable use (with the important exception of minimizing waste) are quite fully embraced in policy commitments at all level, with almost comparable uptake of macro-economic, employment, and general quality of livelihoods. Uptake in policy does not ensure success at or even adequate resourcing for implementation, but it provides a strong foundation for unified and integrated efforts at achieving and maintaining sustainability. The foundations in national policies for efforts at the more socio-cultural aspects of sustainable use are weaker and less unified, even if the aspirational commitments to the relevant key elements have been made globally.

2.3 How is sustainable use of wild species measured and monitored?

Criteria and indicators translate concepts and ideas about sustainability into factors that can then be measured and monitored (Linser et al., 2018). Therefore, the types of indicators used can reflect conceptualizations of sustainable use and of the relative importance placed on different aspects or elements of sustainable use. As ideas, understanding, and societal risk tolerances

change about the elements of sustainable use, criteria and indicators are continually updated. For example, criteria and indicators in sustainable forest use standards have changed as perceptions of forests change, with more emphasis on economic and social values in recent versions (Linser et al., 2018). Because indicator sets may influence the development of policies on sustainable use of wild resources, differences in the conception, measuring and monitoring of indicators may translate into differences in policies with potentially different outcomes for nature and people (Linser et al., 2018; Sterling, Filardi, et al., 2017; Sterling et al., 2020). The use of criteria and indicators can be expressed in policies for sustainable use in multiple ways, including as reporting tools for description and diagnosis; as a means of providing a framework for policy making or to identify enabling conditions, including financial and technical resources, to implement management; as a reference framework for the development of policies; and as assessment tools for evaluating the effectiveness of programs and measures (Linser et al., 2018).

This section examines how sustainable use is measured and monitored, with a focus on indicators used across practices and scales, from global to local. First, a review of indicator choice is presented. Then, given the relevance of the Sustainable Development Goals commitments to the future dialogue on policy and progress for sustainable use of wild species, this is followed by an evaluation of the relevance of each indicator to the sustainable use of wild species. To identify how conceptualizations of sustainable use of wild species are reflected in approaches to measure and monitor use, a review of global indicator sets and indicators in indigenous peoples and local communities are presented. Finally, a crosswalk of the academic literature, global principles and policies, and indigenous peoples and local communities' conceptualizations was carried out with the indicators, to identify which ideas about sustainable use are captured in commonly used metrics of sustainable use and which are poorly represented.

2.3.1 Indicator choice and interpretation for assessing sustainable use of wild species

2.3.1.1 Context and literature review of criteria used in indicator selection

Indicators are important to contemporary governance processes. They can serve functions as diverse but vital as expert assessments of status and trends of components of the natural world, their uses, and well-being of people; informing decision-making processes with regard to needs for actions and effectiveness of measures or programs in place, and facilitating communication among experts, decision-makers, stakeholders, rights-holders, civil society and media (Lakhani et al., 2005; Lyytimäki et al., 2013). All of these functions can be important to sustainable use of wild species, individually or in combination.

Even for single aspects of biodiversity or human well-being, a single indicator rarely serves all of these functions robustly, so use of suites of multiple indicators is common, with different members of the suite having different strengths and vulnerabilities. Correspondingly, reviews have found thousands of indicators have been proposed, and the number has more than doubled between reviews by Gudmundsson et al. (2010) and by Pires et al. (2020). This has resulted in a proliferation of not only indicators, but even criteria and processes for selecting appropriate suites of indicators.

The recent review of Pires et al. (2020) found that approximately 350 criteria have been advocated in various expert applications, and even after overlaps and redundancies among

criteria were taken into account and removed, 60 different criteria for selecting indicators were identified. This demonstrates that choices are necessary in selecting even the criteria and standards for choosing indicators. Using more selection criteria may increase the quality of the assessment by allowing multiple perspectives on sustainability to be accommodated (Niemeijer & Groot, 2008). Nevertheless, as the number of selection criteria increases the complexity and cost of even choosing the indicators, let alone using them in an assessment, also increases.

The findings of the Pires et al. (2020) review, and earlier ones approaching the problem of indicator selection for sustainable practices from various perspectives (e.g., Cloquell-Ballester et al., 2006; James et al., 2012) are important for the the IPBES assessment of the sustainable use of wild species, where indicators have several roles (see Chapter 1). Interpretation throughout the assessment of both findings from its own summaries of information and findings taken from publications and other sources often are in the form of indicator values and trends, and the indicators need to interpreted with appropriate caution and confidence.

Reviews considered typically were consistent with the approach of Pires et al. (2020), even if they used different terminology in presenting their findings. In fact, as Pires et al. (2020) note, there is no consensus among experts on the terms to be used for specific properties of indicators or their criteria, so substantial inference is needed to identify similarities of concepts presented in different words. There is also no consensus on the best processes for selecting suites of indicators, among options as diverse as modeling, expert opinion, participatory processes with users and stakeholders, empirical validation with reference data sets, and efforts at mathematical optimization of indicator coverage. Moreover, indicator selection processes can be conducted as top-down or bottom-up exercises, and in highly structured ways, such as formal Delphi methods for consultation, or very informally, seeking broad buy-in of experts, stakeholders, rights-holders, and decision-makers to a final suite of indicators, even though no single perspective may have confidence in all members of the set.

In their recent and very thorough review of articles specific about criteria for selecting indicators, Pires et al. (2020) identify two different sets of criteria. One set of criteria is based on prioritizing scientific and expert perspectives on valuable criteria for indicator selection, the other based on prioritizing criteria associated with the end uses of the indicators. The criteria mentioned of each type, mentioned in at least five different review papers meta-reviewed by Pires et al. (2020) are presented in Table 2.5 ranked by frequency of explicit mention.

Table 2.5 Categories of criteria identified in Pires et al. (2020) for use in selection indicators for biodiversity, its uses, and human well-being

Scientific perspective	End-usage perspective
Strong scientific foundations for the indicator reflecting the underlying property	Data availability for calculating the indicator values
Reliability of the indicator values across different users	Relevance of the indicator to the decisions or dialogue on the underlying property
Measurability of the property represented by the indicator	Comprehensibility of the indicator in the same way by diverse perspectives
Sensitivity of the indicator to changes of the	Usefulness of the indicator to the user

property of the ecosystem or its use	audiences
Accuracy with which the property can be measured	Target-oriented where thresholds have been or could be set for the indicator
Specificity of the indicator value to the specific property of concern	Operational simplicity in providing indicator values
Timeliness of indicator response relative to changes in the ecosystem or usage property	Compatibility with Indicators used by other jurisdictions for similar properties
Representativeness relative to larger property which the indicator is supposed to reflect	Linkage of an indicator to specified management actions
Data quality of the available information sources	Retrospectivity of the indicator in capturing past trends in the property
Space-bound in having a clearly defined spatial scope	Resource demands to collect the information needed for the indicator
Anticipatory in giving early warning of changes in the property	Sustainability of the commitment to the indicator, given the governance of the system
Spatial and temporal scales appropriate for the desired interpretations of the underlying property	

These criteria still need to be applied in a systematic process. Again, many such processes have been proposed. Although the exact language varies among the sources (e.g., (Becker, 2010; GAO, 2004; Reed et al., 2005; Spangenberg, 2008), most can be fit into the steps outlined in J. C. Rice & Rochet (2005).

2.3.1.2 Review of recent literature on criteria for selecting indicators directly relevant to the IPBES assessment of the sustainable use of wild species

A literature review was performed based on the findings of Pires et al. (2020). The data management report is available at: [10.5281/zenodo.6452576](https://zenodo.org/record/6452576). The review presented few surprises. The coverage of multiple aspects of sustainable use was clearly an important feature when choosing indicators for sustainable use of biodiversity. It was mentioned explicitly in more than half the papers reviewed for both proposing criteria for selection and specifying desired performance features of indicators and suites of indicators. The literature clearly supported mathematical algorithms for choosing suites of indicators, but this could be biased by the dominance of academic and government institutional bases for the authors of the papers that were reviewed, such that they might have been more comfortable with such algorithmic approaches than if more stakeholder and civil society sources of selection criteria could have been included.

Many of the types of properties proposed for use in selecting suites of indicators were properties which would have increased the likelihood of good performance as perceived by user communities – uptake by decision-makers, civil society, etc. It was initially a concern that uptake by various audiences was very rarely mentioned explicitly as desirable properties when selecting indicators, and in Table 2.6 uptake is represented by a star (*) rather than a count of

papers mentioning the properties explicitly in some way (which would have consistently been a misleadingly low number). However, it is likely that the papers specifying desirable properties for indicators considered factors like uptake by various audiences to be the outcome produced by good choices of indicators, rather than as a property of the indicators themselves.

Given the lack of standardization in terminology when discussing desirable properties of indicators, it was not possible to provide finer breakdowns of priority given to operational features such as sensitivity, specificity, and responsiveness, nor to apply the scaling factors identified by Pires et al. (2020) as important considerations. Nevertheless, the high compatibility between the findings of that the Pires et al. study, which encompassed a very broad literature on environmental properties and human well-being, and this review that focused specifically on literature about sustainable use of wild species, suggests that the broader considerations are applicable in the the IPBES assessment of the sustainable use of wild species. This means when indicators are presented or reported through the assessment, it will be important to consider both their scientific/expert soundness and end-usage appropriateness when interpreting their messages. Weaknesses in scientific features like sensitivity, specificity, and responsiveness or their space or time scales, or in their actual relevance in the necessary dialogue and linkage to appropriate policy or management responses, all can weaken conclusions about their messages on sustainable use of wild species.

Table 2.6 Tabulation of results of review of 2010-2010 literature on approaches to selection of indicators for sustainable use of wild species

Property of the indicator or Suite	Performance	Criteria
Relevance to multiple sustainable use dimensions	22	26
Output by analytical optimization algorithms	11	8
Ability in statistical trend detection	16	7
User satisfaction	8	3
Confirmation with independent data	9	6
Data availability and cost	5	9
Uptake in Decision-making	*	14
Consistency with Legal frameworks and Objectives	*	15
Uptake in public awareness	*	16
Respect for indigenous knowledge and values	*	2
Breadth of use already established	*	2
Respect for multiple values	*	14
Ability to use in projection models	*	4
Confidence of experts	*	11**

** The confidence of experts was implicit in many more of the articles than the ones which mentioned it explicitly.

* The language used in articles on the performance of various criteria for selecting of indicators did not use these types of terms. However, in many cases, such as with uptake in decision-making, consistency with legal frameworks and objectives, and uptake in public awareness, these were the desired performance outcomes, so their inclusion as properties of good indicators

would have been circular. Hence the table presents the values as a star (*) rather than 0 hits.

2.3.2 Indicators and approaches used at international level

2.3.2.1 *Sensitivity and specificity of the Sustainable Development Goals indicators for sustainable use of wild species*

2.3.2.1.1 Introduction - the Sustainable Development Goals Global Indicator Framework

United Nations Resolution A/RES/71/313 has endorsed a Global Indicator Framework for the Sustainable Development Goals and Targets of the 2030 Agenda for Sustainable Development (<https://undocs.org/ru/A/RES/71/313>; see also Chapter 1, section 1.6). This indicator framework was evaluated as part of the overview of indicators as they relate to the conceptualization of sustainable use. This is not straightforward because the Sustainable Development Goals are not designed around specific practices. Almost all of the Goals are aspirational outcomes to which any or all of the practices many make important contributions under some circumstances, whereas under other circumstances they might have little relevance. Nevertheless, given the potential importance of the Sustainable Development Goals to policy development, it is important to improve understanding of how effectively the Sustainable Development Goals Global Indicator Framework will reflect improvements in sustainability of each of the practices, and how improvements in the sustainability of the practices contribute to improved performance as measured by the Global Indicator Framework.

Because the majority of the indicators in the Sustainable Development Goals Global Indicator Framework are not yet in near-global application, there is no database of past performance on which they can be evaluated. Moreover, cell scores in a matrix of the five practices and the individual Sustainable Development Goals indicators would be context specific, and scale-dependent. However, a high-level scoping of the relevance of each practice for each indicator might be “conceptualizing” what interpretations could be applied to the individual members of the Global Indicator Framework. Consequently, this evaluation consists of an evaluation of the relevance of each indicator in the framework, evaluating the potential sensitivity and specificity (section 2.3.1) of each indicator for each practice. The scorings are qualitative and often subjective, but major overall patterns in the results are expected to be robust to the subjectivity of the scores. The data management report is available at [10.5281/zenodo.6452576](https://doi.org/10.5281/zenodo.6452576).

2.3.2.1.2 Results

The scores of the sensitivity and specificity of each possibly relevant indicator in the Sustainable Development Goals Global Indicator Framework for each practice are summarized in Table 2.7.

Table 2.7 Number of indicators in the Sustainable Development Goals Global Indicator Framework scored as having little or no (0), small (1), modest (2), or strong (3) sensitivity and specificity relative to fishing (F), logging (L), hunting (H) and gathering (G). Note that 93 of the Global Indicator Framework indicators were not scored because they were considered not

be related to the uses of wild species.

Score	Sensitivity				Specificity			
	F	L	H	G	F	L	H	G
0	57	49	75	110	88	70	87	126
1	55	44	51	38	42	42	53	36
2	37	55	34	25	30	44	24	11
3	24	25	13	0	13	17	9	0

The results suggest that the majority of Sustainable Development Goals indicators are not strongly or even moderately sensitive to any of the practices. Logging is the practice to have modest or high influence on the largest proportion of the Sustainable Development Goals indicators (30%), but only 10% of the indicators are thought to be highly sensitive to sustainability of logging. Fishing is the practice showing modest to high influence on the next largest proportion of Sustainable Development Goals indicators (23%), with a comparable 10% of the Sustainable Development Goals indicators highly sensitive to sustainability of fishing. An even lower proportion of Sustainable Development Goals indicators are modestly or highly sensitive to sustainability of hunting (23%), with a much lower proportion of Sustainable Development Goals indicators (5%) highly sensitive. Gathering has the fewest indicators modestly or highly sensitive to its sustainability (9%) and none are highly sensitive to gathering.

Although only a third or fewer of the 173 Sustainable Development Goals indicators were considered modestly or highly sensitive to the four practices considered, those that were had a strong tendency to be sensitive across all or most of the practices. In fact, 53 of the indicators had non-zero scores for at least three of the four practices, and scores of 2 or 3 on at least two of them, with gathering the least likely to be included in the list of practices for which the indicator was considered sensitive. This has a likelihood less than 1×10^{-6} (binomial test) if the sensitivity of the respective indicators was wholly independent among practices.

Looking from the perspective of specificity, where changes in an indicator value were considered to be reasonably attributed at least in part to changes in sustainability of a specific practice, scorings were generally lower, with significantly more zero scores for specificity than sensitivity for all practices (fishing $P < 1 \times 10^{-5}$; logging $P < 0.0004$; hunting $P < 0.038$; gathering $P < 0.026$; binomial tests). However, patterns were generally similar between sensitivity and specificity. Logging had the most moderate or high scores for specificity (36%), followed by fishing (25%), suggesting more of the Sustainable Development Goals indicators are informative about changes in the sustainability of these practices than for the others.

Substantially fewer indicators showed modest or high specificity for hunting (20%) with again many fewer indicators having such levels of specificity for gathering (6%). Likewise, however, the indicators scored as having modest or high specificity for one of the practices were significantly likely to have a similar level of specificity for other practices. Gathering was outside this group, but 24 of the indicators had non-zero scores for specificity with regard to fishing, timber-harvesting and hunting, and scores of 2 or 3 on two or all three of them ($P < 1 \times 10^{-6}$).

2.3.2.1.3 Interpretation

The major emergent finding from this analysis is the Global Indicator Framework for the Sustainable Development Goals is not focused specifically on the sustainability of how people use nature, or even on how they use parts of biodiversity and then distribute the benefits from those uses. It certainly does not ignore the sustainable use of wild species, but these considerations are present in less than half of the total indicator framework, and expressed strongly in at most a third of the framework. As is common with indicators (see section 2.3.1), the relevant indicators in the Sustainable Development Goals Global Indicator Framework are consistently more sensitive than they are specific. The greater sensitivity means changes in the indicator values may reflect changes in the sustainability of any or all of the practices in an area. However, the low specificity means that changes in the indicator values cannot be interpreted as reflecting comparable changes in the sustainability of any specific practice. In this context, it may seem counter-intuitive that this assessment's evaluation found that experts can consider a single indicator to be modestly to highly informative about the sustainability of multiple practices at once. However, this could be both a credit to the Sustainable Development Goals Global Indicator Framework, and a strong warning about how it can be interpreted when in use. There could be a benefit in having indicators that actually are integrative of all the practices in a place – an attribute of assessments and policies that has been widely advocated (see Chapter 1, sections 1.3.1, 1.3.5). The warnings are also important however. When the values of the indicators in the Sustainable Development Goals Global Indicator Framework are being interpreted, the interpretation can only be meaningful if accompanied by a well-informed understanding of the context in which the Framework is being applied each time. Only then can changes in the indicator values be attributed to the proper causes, and appropriate policies and programs to build on progress and address shortcomings be developed. Also, more generally, at best only a minority of the Sustainable Development Goals Global Indicator Framework is going to be informative about specific or even general trends in sustainable use of wild species. If the Sustainable Development Goals are going to be central to the policy and program efforts of all United Nations and regional agencies, and to States, then the indicators that are informative about the sustainable use of wild species need to be highlighted and strongly supported in reporting, for the well-being of both nature and people to develop in harmony.

2.3.2.2 *Global indicators of sustainable use of wild species across practices*

Over the past three decades, numerous international and regional standards for sustainable use and certification schemes (see section 2.2.6 on key elements) have developed criteria and indicators to measure and monitor the sustainable use of wild species. Many indicators are explicitly associated with lists of key elements, and/or specified in specific policies. FAO defines criteria as “the essential elements against which sustainability is assessed. Each criterion relates to a key element of sustainability, and may be described by one or more indicators” (<http://www.fao.org/forestry/ci/en/> accessed June 11 2019). The fulfillment of a criterion is evaluated by using indicators, which may be quantitative, qualitative or descriptive. An indicator that is measured and monitored periodically is used to indicate the direction of change relative to a criterion, and if quantitative or rank-quantitative, the magnitude of change as well.

2.3.2.2.1 Approach

To identify how conceptualizations of sustainable use are reflected in indicators used at the international level, global and regional indicator sets for different practices were compiled. Previous reviews of forestry standards (Holvoet & Muys, 2004; Linser et al., 2018) have compared the number and types of indicators associated with different criteria. This assessment builds on their approach here but groups indicators into the broad themes of sustainable use observed in the key elements analysis (see section 2.2.6) and subsequently analyzed in the policy analysis (see section 2.2.7). This analysis is intended to be illustrative rather than exhaustive. As such, the assessment draws on two widely used international indicator sets per practice as examples, recognizing that there are other global and regional indicator sets that may differ. The data management report for this analysis is available at: [10.5281/zenodo.6452576](https://doi.org/10.5281/zenodo.6452576).

2.3.2.2.2 Results

Figure 2.7 illustrates clearly that the four broad categories of sustainable use that are present in the key elements: ecological, socio-economic, governance and management & monitoring, are also clearly represented in the indicator sets. Thus, these conceptualizations of sustainable use are clearly captured in international level indicators across practices. The category “education”, which encompasses the idea that public awareness of sustainability is a part of sustainable use, was only represented once, and as a secondary category, and was also not frequently found in the key elements. Variation in the number and proportion of indicators within any category can reflect multiple issues, including variation in the size of the indicator set, differences in scale and in purpose of the indicators as well in how broad or multidimensional each category is. As such, specific comparisons are not meaningful here.

A small minority of indicators (for example, an average of <10% per indicator set, median <5%) were scored as representing both an ecological category and a social category (governance, socio-economic benefits) category. A handful of indicators were scored as both ecological and governance. This included indicators such as, “number of countries with policies to secure that [fish] mortalities are accounted for and kept within safe biological limits” or “number of countries with regulations requiring recovered of depleted species”. Only a couple of indicators were scored as both ecological and socio-economic. These included “Marine Stewardship Council Certified catch” and “Share of main groups of species in fish trade in terms of value”. These cross-cutting indicators were found mostly in the fishing indicator sets.

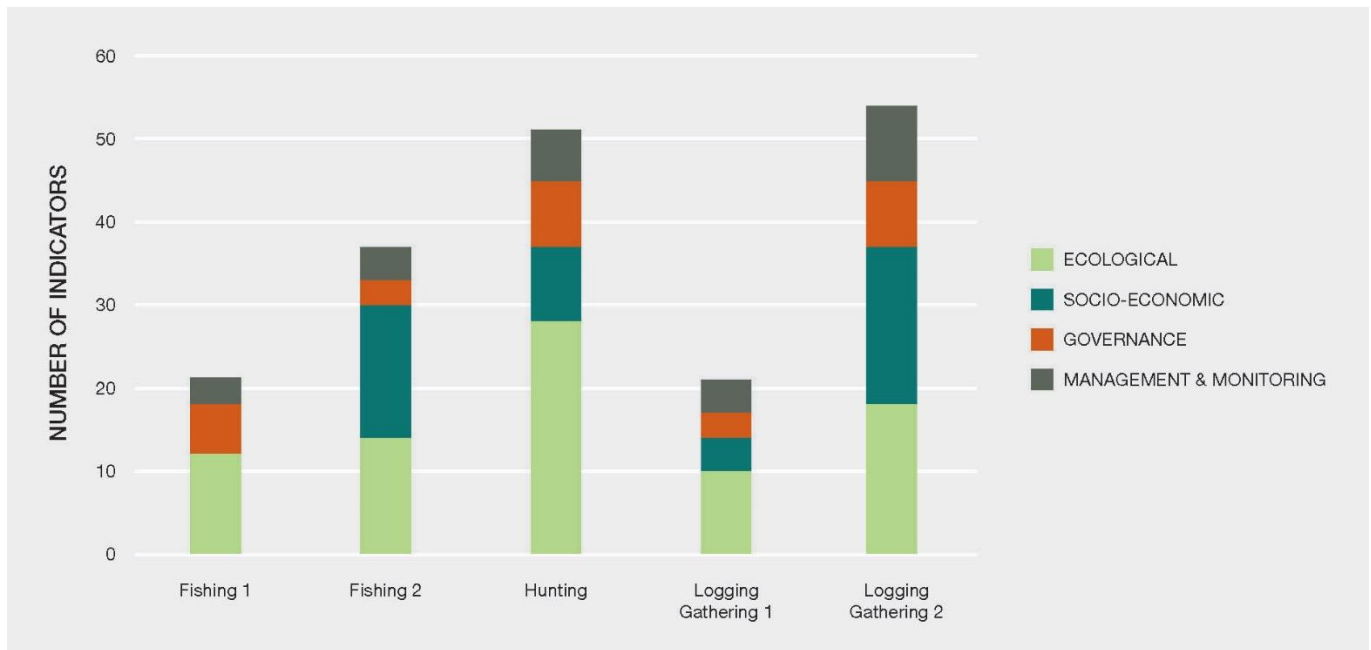


Figure 2.7 Number of indicators in global and regional indicator sets in five broad categories of sustainable use.

See data management report at <https://doi.org/10.5281/zenodo.6452576>.

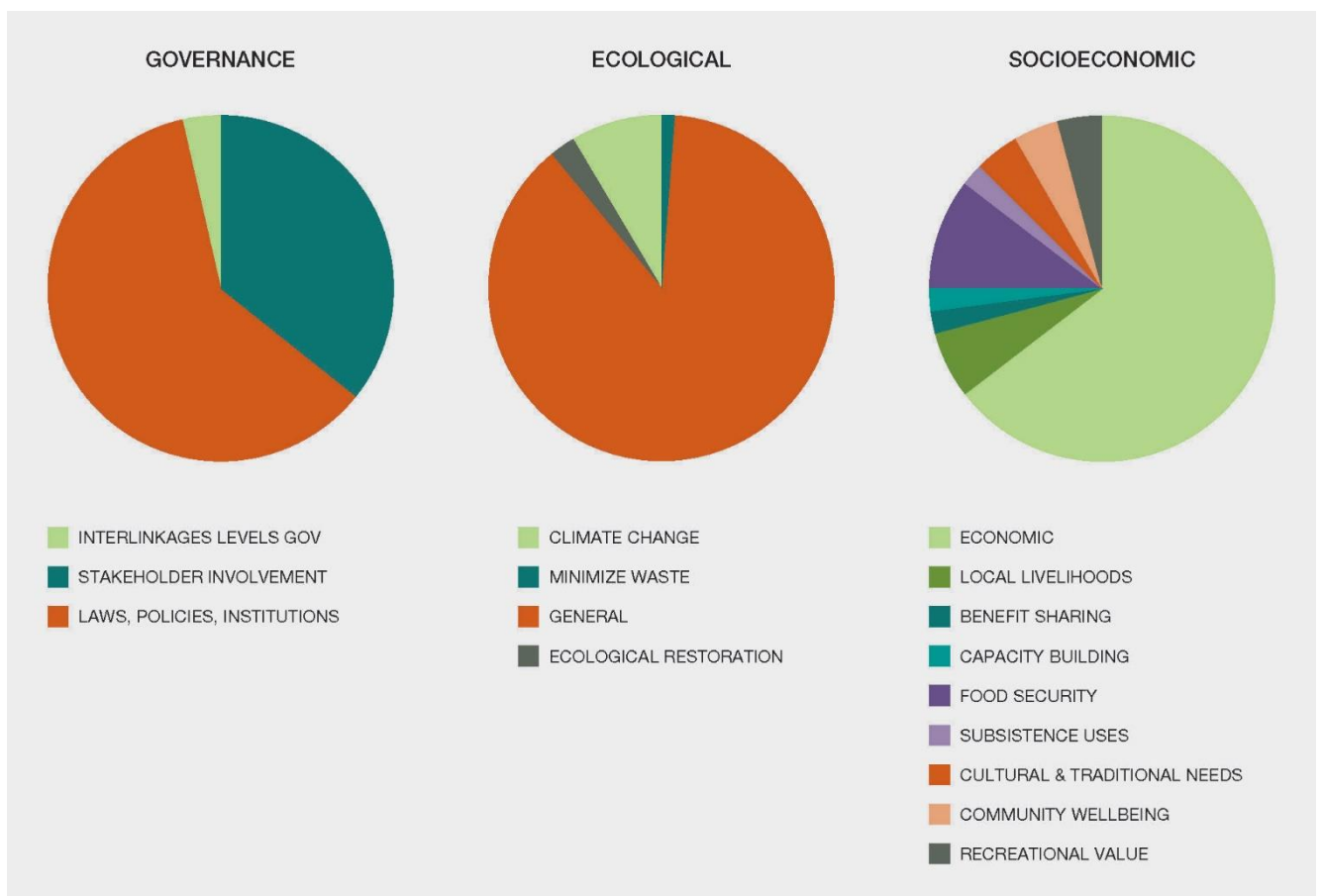


Figure 2.8 Subcategories of ecological, governance and socio-economic indicators in global indicators sets for the sustainable use of wild species.

See data management report at <https://doi.org/10.5281/zenodo.6452576>.

Figure 2.8 illustrates the subcategories of indicators. Most of the ecological indicators fell within the broad areas of minimizing ecological impacts and conserving biodiversity (classified as “general” here). Only one set included indicators related to the measurement of ecological restoration. Similarly, of all the indicators, there was only one that pertained to minimizing waste. These aspects of sustainable use were present but not prevalent in the analysis of key elements. However, there were indicators in nearly each set intended to measure issues related to climate change (whether emissions or mitigation).

In terms of governance, indicators related to respecting laws, policies and institutions, and to measuring local stakeholder involvement in the governance process were both very well represented. These concepts were also well represented in the key elements analyses. Indicators related to community rights and access, and to monitoring that involved the integration of indigenous and local knowledge and science were absent, although these themes were consistent with many key elements. Most of the socio-economic indicators were economic, focusing on measuring financial resources, revenues, or employment. A few indicators measured local livelihoods in particular and two indicator sets had indicators related to food security. Indicators relating to socio-cultural aspects of sustainable use were the least represented, with community wellbeing, cultural and traditional uses, subsistence value and recreational value found in only one indicator set.

In past decades, when social indicators were included in the conservation arena, they tended to focus on measuring the “value” of people being in nature as “instrumental values” (how responders “felt” about their experience with nature), for example pleasure or satisfaction from being in nature, via the recreational or educational value of nature to the individual. As reflected in the review of the academic literature (see sections 2.2.2, 2.2.3), in the 2010s, values reflecting relationships between people and nature (e.g., “relational values”), have been increasingly conceptualized as critical to consider for sustainable use (Chan et al., 2016) The latter include cultural identity, kinship, connection to place, social ties, and stewardship, among other relationships. In the review, only one indicator set included indicators that may capture these kinds of relational values (Table 2.8). Similarly, the same indicator set was the only one that included subsistence use (which might also be a relational value depending on the context) and community resilience. The latter indicator is intended to provide “information on the extent to which communities dependent on forests for their wellbeing, livelihoods, subsistence, quality of life or cultural identity are able to respond and adapt to social and economic change” (USDA, 2011).

Table 2.8 Examples of socio-cultural indicators in global indicator sets

Indicator	Value
<i>The importance of forests to people</i>	Can measure instrumental value
<i>Area and percent of forests managed primarily to protect the range of cultural, social and spiritual needs and</i>	Can measure relational value

<i>values; Recognition and value of forest-management knowledge and skills of local people</i>	
<i>Area and percent of forests used for subsistence purposes</i>	Can measure subsistence value (can also be a relational value)
<i>Resilience of forest-dependent communities</i>	Can measure community well being

2.3.2.3 *Status of wildlife watching indicators*

Analysis of global sustainability indicators in the context of wildlife watching is challenging due to absence of a global or even regional governance authorities focused on this practice. At the same time, there is proliferation of small and micro level measures, focused on specific species, practice and/or geographic area, aimed to increase sustainability of wildlife watching. These are first and foremost, wildlife watching focused codes of conduct, ecolabelling and certification, briefly discussed below.

Although codes of conduct in wildlife watching are too numerous for a comprehensive overview, some common patterns can nevertheless be identified. Reis (2020) identified 22 codes of conduct pertaining to marine wildlife tourism management, Fennell & Yazdanpanah (2020) identified 32 codes for wildlife photography, Garrod & Fennell (2004) talk about 58 codes for whale watching tourism, and Öqvist et al. (2018) mention 35 seal watching codes. It is emphasized, however, that codes of conduct at least need to be accompanied with educational and training activities to have any tangible impact (de Lima & Green, 2017; Garrod & Fennell, 2004; Reis, 2020). In addition, even if voluntary, clear links between codes of conduct and wild species legislation and monitoring organizations need to be established, otherwise “the recommendations will sit on a shelf, along with all the others” (Reis, 2020, p.6). Overall, codes of conduct still continue to multiply without any consolidation on regional or global levels, despite calls for internationally recognized codes of conduct and regulatory bodies have been visible in the research literature for decades (Buckley & Pegas, 2013; Fennell & Yazdanpanah, 2020; Garrod & Fennell, 2004; Öqvist et al., 2018; Reis, 2020).

Patterns observable with codes of conduct in wildlife watching are also present in ecolabelling and certification. First, there are similarly proliferation of ecolabels and certification schemes with relatively low efficiency and international recognition. According to Ecolabel Index there are currently more than 400 ecolabels globally (www.ecolabelindex.com) of which at least 50 focus on tourism (Dziuba, 2016) and their number keeps growing. In fact, only within the first decade of the 21st century 70 new ecolabels were launched within tourism market (Bučar et al., 2019). Although the exact number is unclear, this situation has been referred to as an “ecolabel jungle”, given the high numbers, diversity and lack of quality regulation of these labels (Bučar et al., 2019).

A major challenge hindering efficiency of ecolabelling and certification schemes in tourism in general and wildlife watching in particular remains the nature of overwhelming majority of these businesses. As mentioned above, wildlife watching tourism firms are usually

not small and medium entrepreneurs but rather micro entrepreneurs. Micro-enterprises often lack resources, knowledge, skills and willingness to engage in formalized sustainability schemes (Margaryan & Stensland, 2017; Tippet et al., 2020). This however, does not mean that these businesses are not interested in managing their impacts and pursuing sustainability goals. Quite often the contrary is the case, as many nature-based tourism entrepreneurs are so-called lifestyle entrepreneurs, for whom achieving certain lifestyle goals is prioritized over economic goals and business growth (Jenkins, 2004; Margaryan et al., 2020; Margaryan & Stensland, 2017). Motivations such as “contributing to sustainability”, “educating people about nature” or “using local natural resources” are ranking very high among the motivations to run nature-based tourism business in Sweden and Norway, although adoption of ecolabels remains very low. There is a strong perception that small and micro firms do not need to formalize or legitimize their sustainability efforts, and that ecolabelling and certification schemes favor big players and are a redundant bureaucratic effort overall (Margaryan & Stensland, 2017; Tippet et al., 2020).

Further, similarly to the codes of conduct, the majority of tourist ecolabels focus on local tourism impacts of businesses, leaving the surrounding impacts out of scope, e.g., transportation of tourists, products and other resources to and from the destination. In this context, greenwashing remains a major issue, when an ecolabel is used purely for marketing purposes, without transforming business practices towards sustainability (Buckley & Pegas, 2013; Tippet et al., 2020). (Buckley, 2013) claims that ecocertification schemes can be largely understood as a political game between business and civic interests, because contrary to economic logic, the “market” of ecolabels has become neither more mature nor more solidified around the most successful and high-quality labels over time. Consequently, he argues that ecolabels in tourism have not become more useful to consumers, businesses and regulating authorities, although they have currently more relevance and transparency than they had three decades ago (Buckley, 2013).

The quantity of codes of conduct, ecolabels and certification schemes in tourism continues to increase, although the same cannot be said about their quality and efficiency. The theory and practice of ecolabelling and certification in tourism have not yet converged (Bučar et al., 2019). Calls for two-tiered approaches, i.e., combining abstract and general principles with factors specific to certain species and geographical contexts (e.g., Fennell & Yazdanpanah, 2020) as well as strengthening global wild species governance in general (Decker et al., 2017) have begun to appear in the literature.

2.3.3 Indicators of sustainable use of wild species among indigenous peoples and local communities

The above sections focus on indicators of sustainable use of wild species used at global and regional scales. There is also a diversity of indicators of sustainable use of wild species used at national and local scales. Indigenous peoples and local communities in particular have long used indicators to effectively measure and monitor the status of wild species (e.g., Berkes, 2017; Lyver et al., 2017; Parlee et al., 2005; Sterling, Filardi, et al., 2017; Sterling et al., 2020; Thompson et al., 2019). Consistent with the broad commonalities across many indigenous peoples and local communities’ worldviews (see sections 2.2.4 and 2.2.8), the sustained use

and health of wild-species and their habitats is often conceptualized as fundamentally interconnected to community well-being and cultural continuity. Monitoring, which is often carried out through the act of harvesting and harvest-related activities (e.g., “monitoring through harvesting”), includes interlinked indicators that capture social, ecological, and social-ecological (linkages and feedbacks among social and ecological components) aspects of sustainable use (Berkes, 2017; Lyver et al., 2017; Parlee et al., 2005; Sterling, Filardi, et al., 2017; Sterling et al., 2020; Thompson et al., 2019). Indicators in indigenous peoples and local communities may also take many forms, from evaluations of the quantity and quality of species, habitats and interactions, to those embedded in stories, songs, ceremonies, oral histories and what *ex situ* actors might view as “art” (Sterling, Filardi, et al., 2017; Sterling, Ticktin, et al., 2017). Box 2.6 provides an example of monitoring and indicators for wild species used by the Gitga’at, on the northwest coast of North America.

Box 2.6 “We monitor by living here”: social-ecological approaches to monitoring and indicators by Gitga’at resource users

The Gitga’at are a Tsimshian (Ts’msyen) tribal group whose people have occupied and stewarded their lands and waters on the northwest coast of North America since time immemorial. As has been the case for millennia, hereditary leaders continue oversee the stewardship, allocation and management of resources based on an intimate knowledge of their territories, *adaawx* (oral history), and *ayaalx* (Tsimshian law). Gitga’at territorial management activities now also draws on the methods and technology offered by science (e.g., Keen et al., 2017; Ritts et al., 2016), with advice and technical administration provided by the Gitga’at Oceans and Lands Department, including the Gitga’at Guardians (Gitga’at First Nation, 2011). Despite colonial policies of cultural assimilation and land dispossession, many Gitga’at cultural identity persists and continues to be underpinned by the harvest, consumption, trading, and celebrating of traditional foods on a daily-basis (Fediuk & Reid, 2014).

In 2016, the Gitga’at Oceans and Lands Department invited university researchers to assist in designing and piloting a monitoring program that would focus documenting the observations of Gitga’at harvesters and knowledge holders (Thompson et al., 2019). The monitoring objectives of the program (now known as “We monitor by living here”) were established by harvesters and knowledge holders, and include: tracking changes in Gitga’at territory, including traditional food species, to inform stewardship decisions and adaptation measures; encouraging youth to learn about traditional foods and how the territory is changing; strengthening the case for Gitga’at rights and title; and informing health and wellness programming.

Over the course of two pilot data collection seasons a monitoring framework was co-developed (Thompson, Lantz, et al., 2020). The framework includes the elements and indicators that Gitga’at people monitor through the harvesting and harvest related activities including processing, preserving, cooking and sharing. It made explicit the numerous interlinked social, ecological, and social-ecological elements that are monitored by Gitga’at land- and sea-users including the quality and abundance of food and medicine species, habitat quality, harvest intensity, sharing and trading institutions, accessibility of resources, weather patterns, cultural continuity, and abnormal occurrences in the territory (Table 2.9, Figure 2.8). It is important to

note that the distinction between social and ecological elements of the monitoring framework was not made by Gitga’at participants, as occurrences in the spiritual and social-political world and the natural world are understood as inseparable.

Table 2.9 Non-comprehensive list of concepts and indicators that Gitga’at people described monitoring during harvesting activities (from Thompson, Hill, et al., 2020).

Concepts monitored by Indicators Gitga’at people through harvesting activities	
Abundance of food species	Catch per unit effort Spatial distribution of species Associated species Cyclical patterns of abundance
Quality of food species	Texture Size Smell Color Taste Ease of harvest Signs of illness
Habitat quality	Water clarity Smell Species diversity and abundance Sediment texture General feeling Presence of supernatural beings
Food harvest intensity	Prevalence of traditional management practices Spatial harvest intensity Amount harvested
Sharing and trading institutions	Number of people giving and receiving foods Age of people giving and receiving foods Geographic spread of shared or traded foods
Accessibility	Physical barriers to harvesting Physical barriers to travelling Cost of fuel Availability of time

Weather	<ul style="list-style-type: none"> Wind strength Wind direction Relative number of sunny days Relative number of rain or snow days Air temperature Water temperature
Cultural continuity	<ul style="list-style-type: none"> Knowledge of territory Use of Sm'algyax (traditional language of Tsimshian peoples) Knowledge of harvest protocols Number of young people on the land Prevalence of ceremony
Abnormal species and landscape features	<ul style="list-style-type: none"> Invasive species Strange animal behavior Unusual phenology Landslides

The example of Gitga'at monitoring through land- and sea-based practices is similar to reports from other indigenous communities. For example, Māori communities monitor forest health and community well-being using indicators that include prevalence of certain species, sounds associated with the forest, intensity of weather, and the strength of people's connection to the forest (Lyver et al., 2017). Denésôliné hunters monitor barren ground caribou migrations using physical indicators such as body condition and population size as well as spiritual indicators to explain variability in migration patterns (Parlee et al., 2005).

A recent global review of participation of indigenous peoples and their knowledge in environmental monitoring highlights that in collaborative monitoring efforts, the degree of power and participation of indigenous peoples and local communities influences which monitoring indicators are used (Thompson, Hill, et al., 2020). Initiatives with strong indigenous leadership throughout all phases of monitoring, including initiating and setting monitoring objectives, designing methods and indicators, and ultimately making management decisions, were most likely to monitor a diversity of indicators, including social-ecological, social, and ecological indicators within the same initiative. For example, Inuit people monitoring environmental change paid attention to ecological indicators, such as the body condition of caribou, social-ecological indicators such as hunting success, and social indicators such as the prevalence of knowledge about seasonal cycles in their communities (Berkes et al., 2007). Collaborative initiatives with indigenous participation were most likely to monitor a combination of ecological and social ecological indicators. For example, Kaxinawá people in collaboration with non-profit organizations monitored wild species in their territory using ecological indicators, such as the mean body mass and abundance of preferred harvest species, as well as social-ecological indicators such as the catch-per-unit effort of harvest species (Constantino et al., 2008). Meanwhile, initiatives with less strong indigenous involvement in phases of design and management were most likely to focus solely on monitoring ecological

indicators. Indeed, monitoring initiatives driven by external agencies tended to focus primarily on ecological indicators, while those led by indigenous peoples tended to include a more holistic suite of indicators including social (i.e., human processes such as spirituality, language), ecological (i.e., biological, physical, or chemical), and social-ecological indicators (i.e., interactions between humans and the natural world such as hunting activities) (Figure 2.9).

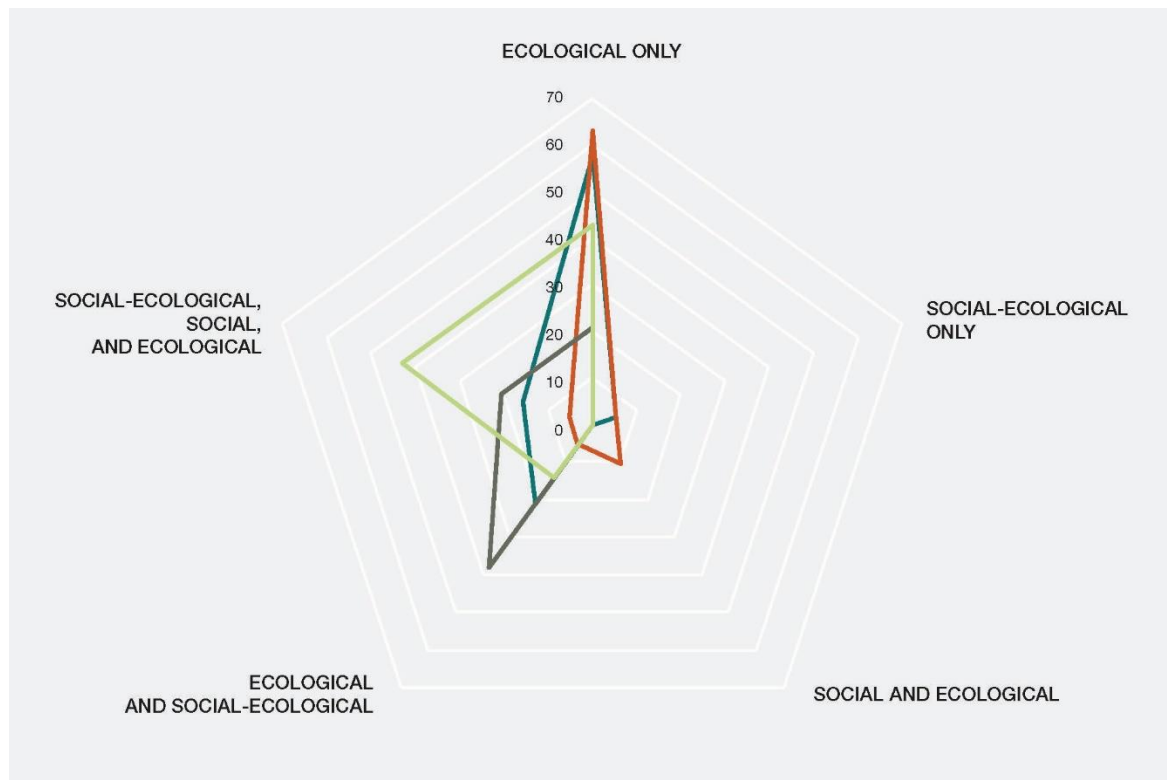


Figure 2.9 Percent of monitoring initiatives displayed according to the type of indicators used. Initiatives are classified according to the degree of participation of indigenous people: the blue dashed line indicates externally driven initiatives with indigenous people as data collectors; orange dotted line indicates collaborative initiatives with indigenous people playing some role in design and execution; grey solid line indicates collaborative initiatives with indigenous people playing a strong role in design, execution and management; and the yellow dashed line indicates autonomous monitoring by indigenous people with some external support. Modified from (Thompson, Lantz, et al., 2020), under [CC BY-NC 4.0](https://creativecommons.org/licenses/by-nc/4.0/). See data management report at <https://doi.org/10.5281/zenodo.6452576>.

2.3.4 Summary of global and local indicators of sustainable use of wild species

How sustainable use of wild species is measured and monitored is shaped by the ways in which it is conceptualized. At the global level, as conceptualizations of sustainable use have changed over time (see section 2.2.2, 2.2.3), indicators for sustainability have also shifted, for example from a fairly narrow focus on ecological aspects towards inclusion of social, especially economic and governance aspects (Linser et al., 2018; see section 2.3.2). Today, global indicator sets clearly capture many of ecological, economic and social components of sustainable use that are broadly agreed upon in the global conservation arena (see section 2.2.6).

They also overlap with some of the indicators used in indigenous peoples and local communities, for example ecological indicators of abundance and distributions in harvested species (see section 2.3.3).

Nonetheless, there are also some widely agreed upon aspects of sustainable use that are poorly represented in global indicator sets. In particular, in the academic literature today, there is widespread agreement that the harvest of wild species is best understood as a social-ecological system, where sustainable use requires understanding and maintaining linkages and feedbacks among and between social and ecological elements (see section 2.2.3). There is also growing recognition of the importance of socio-cultural dimensions of sustainability, including relational values (see section 2.2.3). Similarly, in indigenous peoples and local communities, the sustained use and health of wild-species and their habitats is often conceptualized as fundamentally interconnected to community well-being and cultural continuity (see sections 2.2.4, 2.2.8, 2.3.3). However, indicators that capture these concepts of sustainable use, i.e., social-ecological indicators and socio-cultural indicators, including those that capture relational values, are sparse in global indicator sets (see section 2.3.2). Similarly, despite their representation in key elements of sustainable use of wild species (see section 2.2.6.), indicators that relate to indigenous peoples and local communities' community rights and access, and to monitoring that involves both indigenous and local knowledge and scientific knowledge are poorly represented.

The underrepresentation of these kinds of indicators can have multiple consequences for the sustainable use of wild species. First, regardless of the scale in which they are applied, missing key elements of sustainable use can increase the potential for misdiagnosis and poor design of interventions (Sterling et al., 2020). For example, indicator sets that lack social-ecological linkages may miss important connections and feedback loops that are critical to ensuring sustainable use. This potential for misdiagnosis and subsequent poor design of interventions is aggravated by the strong tendency for indicators of all aspects of sustainability to be more sensitive than specific, calling attention to the need to address a shortcoming in performance without guidance on what practices are actually responsible for the shortcomings

Second, if indicators fail to measure aspects of sustainable use perceived locally to be critical, they will hold little meaning locally, may fail to inspire appropriate action, and in addition, have the potential to cause both environmental and social harm (Sterling et al., 2020; Sterling, Ticktin, et al., 2017). Ultimately the impacts of global goals and indicators are felt at the local level through the direction of financial resources and implementation of programs intended to achieve progress towards these metrics (Sterling et al., 2020).

Designing global indicators is complex (see section 2.3.1) and designing those that capture social-ecological linkages and socio-cultural components poses even more challenges since global processes rely on indicators that are easy to quantify, compare, aggregate and communicate across scales. Nonetheless, there are examples of existing global indicators that encompass these aspects of sustainable use (see section 2.3.2.2), for example, numerous social-ecological indicators in the fishing indicator sets reviewed, and socio-cultural indicators, including relational indicators, in one of the forestry indicator sets reviewed. These and other indicators could be appropriately adapted to other practices and/or contexts.

Moreover, increased and improved collaboration with indigenous peoples and local communities represents a critical opportunity for better measuring and monitoring of

sustainable use at both local and global scales (Figure 2.9). Indicators of sustainable use that have long-been used in indigenous peoples and local communities to monitor the linkages among social and ecological elements, and that link to community wellbeing and cultural continuity, can inform the development of appropriate global indicators. Conversely, collaborations with indigenous peoples and local community knowledge holders and knowledge experts can lead to the co-creation of local indicators that can help localize global, regional or national indicators to local realities (Dacks et al., 2019; Sterling et al., 2020; Sterling, Filardi, et al., 2017; Sterling, Ticktin, et al., 2017; Thompson, Hill, et al., 2020). The Tracking Change project conducted with communities across the Mackenzie, Mekong, and Amazon River basins, as well as community-based observation networks across coastal Arctic communities, are demonstrating this potential by building local monitoring indicators, and networking knowledge gained (Michell et al., 2018; Parlee & Mahoney, 2017). These collaborations are effective when colonial governments recognize the authority of indigenous peoples as managers of their territories and when power is shared between indigenous experts and outside scientists.

In sum, while there are some broad commonalities, conceptualizations of sustainable use of wild species are highly dynamic and variable across practices, and economic, cultural and social contexts. Ultimately, the diversity of ways in which sustainability is conceptualized means that there is no “one size fits all” approach to appropriately and effectively measure and monitor sustainable use.

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