Amazon Assessment Report 2021

Chapter 33

Connecting and sharing diverse knowledge systems to support sustainable pathways in the Amazon

Manifestação dos Povos Indígenas, Largo São Sebastião, Manaus, Brazil (Foto: Alberto César Araújo/Amazônia Real)

THE AMAZON WE WANT
Science Panel for the Amazon

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

About the Science Panel for the Amazon (SPA)

The Science Panel for the Amazon is an unprecedented initiative convened under the auspices of the United Nations Sustainable Development Solutions Network (SDSN). The SPA is composed of over 200 preeminent scientists and researchers from the eight Amazonian countries, French Guiana, and global partners. These experts came together to debate, analyze, and assemble the accumulated knowledge of the scientific community, Indigenous peoples, and other stakeholders that live and work in the Amazon.

The Panel is inspired by the Leticia Pact for the Amazon. This is a first-of-its-kind Report which provides a comprehensive, objective, open, transparent, systematic, and rigorous scientific assessment of the state of the Amazon's ecosystems, current trends, and their implications for the long-term well-being of the region, as well as opportunities and policy relevant options for conservation and sustainable development.

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Graphical Abstract

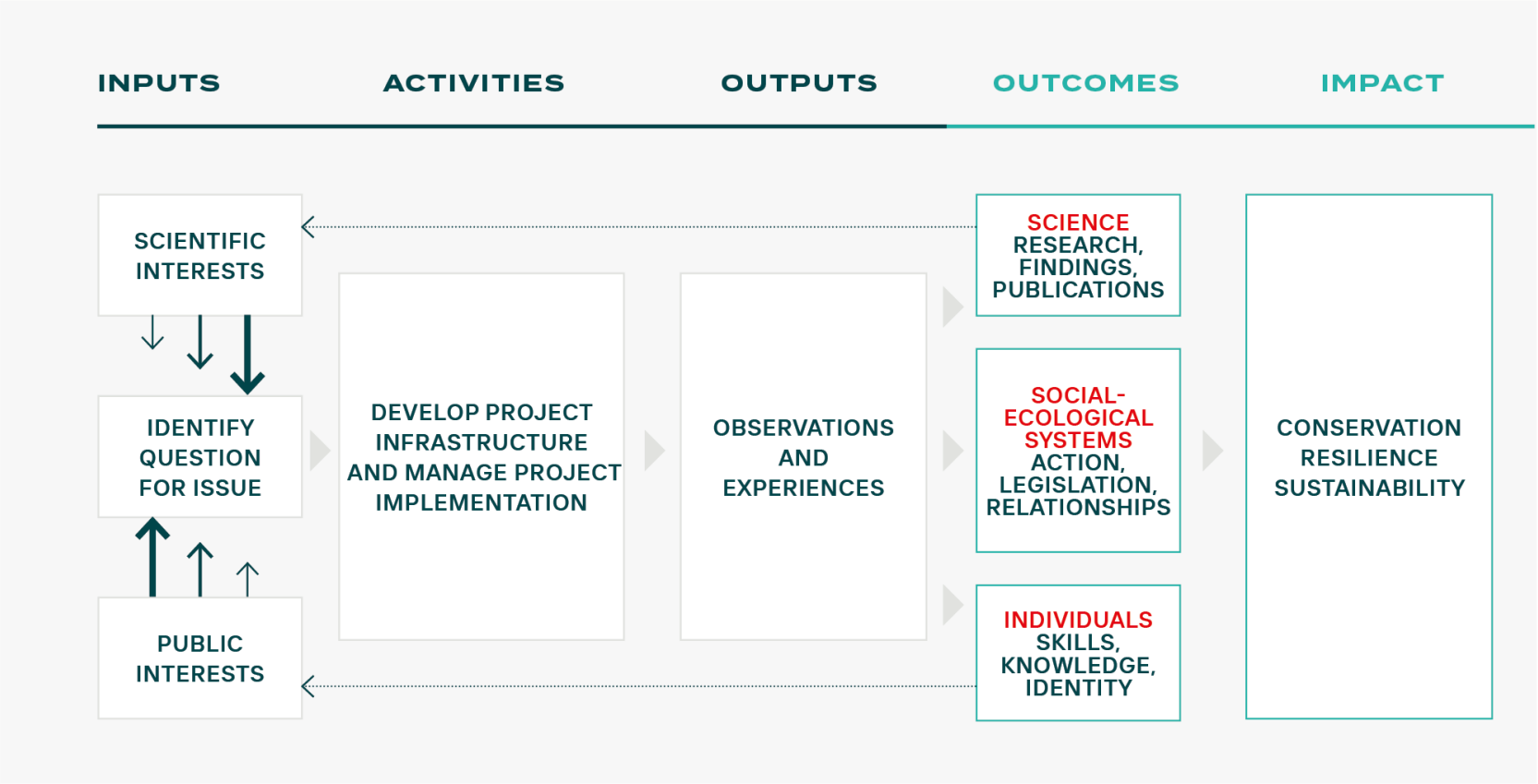

Figure 33.A Graphical Abstract

Connecting and Sharing Diverse Knowledge Towards Sustainable Pathways in The Amazon

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Key Messages

- Indigenous and local knowledge (ILK) has been critical for conservation and sustainable development across the Amazon. However, ILK systems, best practices and lessons that can inspire sustainable pathways for the Amazon are often unrecognized and overlooked in decision and policy-making.
- Many inspiring solutions to the problem of unequal knowledge production, sharing, and articulation in decision-making exist at the local scale; these solutions must be scaled up while combined with policy recommendations and guidelines stemming from global experiences.
- To most effectively align different social actors in knowledge production, sharing, and informed decision-making, a critical first condition involves recognizing and guaranteeing fundamental rights of people and nature, and recognizing ILK. Then, it is urgent to strengthen knowledge dialogues and to enact open and collaborative knowledge principles, through policies, agreements and protocols for each step of the knowledge sharing process. These should be the product of multi-stakeholder collaboration, defined in specific terms and adapted to diverse contexts, objectives and needs.
- The proposed efforts should build on progress made by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) partnerships, emblematic platforms, and should involve the leadership of the IPLCs, grassroots organizations, academia, civil society, and national science councils or ministries.

Abstract

Although Indigenous and Local Knowledge (ILK) held by Indigenous peoples and local communities (IPLC) has been critical in conservation and sustainable development efforts across the Amazon, there is lack of appropriate recognition and internalization of lessons offered, hindering just and inclusive knowledge production, and participatory and effective decision-making at local, national, and international scales. Many inspiring solutions to the problem of inequitable knowledge production, sharing, and inclusion in

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decision-making exist across the Amazon. In this chapter, we use the conceptual framework of public participation in scientific research and an appreciative inquiry approach to review and synthesize a range of illustrative initiatives in the Amazon which align scientific (academic), technical, and Indigenous and local knowledge systems in conservation and development initiatives. We also consider recent policy recommendations and guidelines by local and global professional associations as well as civil society organizations. In order to most effectively align different social actors in knowledge production, sharing, and informed decision-making, a critical first condition involves recognizing and guaranteeing fundamental rights of people and nature, and recognizing ILK. To achieve this goal, it is urgent to strengthen knowledge dialogues, and to enact open and collaborative knowledge principles, through policies, agreements and protocols for each step of the knowledge sharing process. These should be the product of multi-stakeholder collaboration, defined in specific terms and adapted to diverse contexts, objectives and needs. Based on this, we recommend interventions at various scales, including strengthening and scaling up intercultural knowledge dialogue platforms; promoting structural change and training of the institutions that currently make decisions, in order to enable IPLC engagement and strengthen public participation in decision-making; ensuring transparency and accountability of the process; and creating and strengthening intercultural, multi-stakeholder networks to devise collaborative solutions for reconciling the conservation of Amazon ecosystems and the well-being of its peoples.

Keywords: knowledge dialogues, intercultural platforms, public engagement in science, public participation in scientific research, open science, collaborative networks, epistemic justice, Indigenous knowledge, local knowledge, citizen science.

33.1 Introduction

Different worldviews and knowledge systems coexist in the Amazon, often in contrasting conceptualizations of well-being and sustainable development (Arruda and Arruda 2015; Inoue and Moreira 2016; Jacobi *et al.* 2017). Despite the enormous diversity of knowledge systems connected to Amazon cultural and biological diversity (Chapter 10), there are limited investigations into how these systems generate, transmit, use knowledge, and, above all, how they might be better integrated into decision-making processes at different scales toward just and sustainable futures (Bradshaw and Borchers 2000; Cash *et al.* 2003; Lahsen and Nobre 2007; Jacobi *et al.* 2017). Lahsen and Nobre (2007) highlight that this research gap is particularly important in less developed countries, which host a significant part of the world's cultural and biological diversity. Strengthening the dialogue between different knowledge systems, as well as public participation in knowledge production and use, is of prime importance to improve conservation and sustainable development, but these approaches have not yet become a priority for public policies (Congretel and Pinton 2020).

Over the past 30 years, different stakeholders, from civil society to government agencies, have increasingly acknowledged the contribution of Indigenous and Local Knowledge (ILK) to Amazon conservation and sustainable development. It is evident that the number of documented contributions of ILK to decision-making in Amazonian countries has increased year to year. A search in the full collection of the Web of Science[o] resulted in over 14,000 peer-reviewed articles between 1951 and March 2021, in a clearly increasing trend, with over 1,400 articles published in 2020 (see also McElwee et al. 2020 for an extensive global review of ILK in large-scale ecological assessments). However, an Amazon-wide specific review on this topic is still necessary. For example, less than 15 papers of the 214 papers published since 2018 under the Web of Sci-ence

[o] For this exploratory search, we used the following combination of key words: ((TOPIC: knowledge* AND dialogue*) OR (TOPIC: dialogo* de saberes) AND (TOPIC: amazon*)), and a time frame from 1951 to 2021.

category "Environmental Sciences and Ecology" actually pertained to the Amazon, despite the addition of the "Topic" term "amazon*".

ILK is based on long-term, place-based co-evolution with ecosystems and biodiversity, and as such, has the potential to facilitate dialogue between IPLC, and academia and government (Whyte 2013), as well as to contribute to Amazon sustainable development (Athayde et al. 2016; Jacobi et al. 2017; Lahsen and Nobre 2007). Similarly, there is a vast experience of participatory science and monitoring in Latin America and specifically in Amazonian countries, applied to natural resource and territorial management initiatives, in defense of human and environmental rights, and in advancing scientific research (Conrad and Hilchey 2011; Lopes et al. 2021; Piland et al. 2020). Also, the importance of increased public engagement in science and collaborative knowledge production and sharing has received global recognition and attention, not only for their value to science, but also for their contribution to democratizing knowledge and societies and for fostering the implementation of effective solutions to socio-environmental, economic and health problems, climate change, and contributing to the United Nations Sustainable Development Goals (Shirk et al. 2012; McKinley et al. 2017; Fritz et al. 2019; Benyei et al. 2020; Fraisl et al. 2020; Cooper et al. 2017;).

However, except for a few successful experiences, there is much need for improving knowledge generation and sharing between multiple stakeholders with diverse interests and levels of power to inform solution pathways toward sustainable development (SD) in the Amazon, i.e., inform and engage in management and policy decisions at multiple scales. Often, knowledge exists in silos, failing to be effectively aligned or connected across the region, across disciplines, and across stakeholders (Pretty et al. 2009; Nobre et al. 2016). On the one hand, knowledge seems to be insufficient, or sufficient but not readily accessible for decision-makers (from community managers to government agencies). On the other hand, ILK and participatory science and monitoring (under many designations) have a long tradition of producing valuable knowledge, but this knowledge has not been sufficiently acknowledged and internalized by others in power, including academia, government, and civil society organizations (see for instance Cooper et al. 2014; and DuBay et al. 2020 in Box 33.1). Therefore, in part because of this lack of acknowledgment and also because of colonial legacies and epistemic violence tied to institutions, policies, and politics (see Chapter 31, Liboiron 2021, David-Chavez and Gavin 2018), valuable knowledge to inform just and sustainable pathways for the Amazon remains mostly local in reach and poorly integrated into decision-making across Amazonian countries (Jacobi et al. 2017; Doria et al. 2018; Athayde et al. 2019; Matuk et al. 2020; McElwee et al. 2020). Moreover, in some instances, Indigenous and local communities' knowledge is being lost owing to transculturation, inefficient inter-generational transmission, and other external pressures. Changes in climate phenomena and land use have exposed many communities to situations that are new or for which their knowledge may seem not applicable (Benyei et al. 2020; see also Chapter 31 for a case study in which Indigenous peoples contributed to climate change policies).

The Amazon Basin also presents a context of inequalities in terms of communication and power relations among diverse stakeholders (Newig and Moss 2017), and a history in which science and research policies and investments in the Amazon have been insufficient and inadequate (Lahsen and Nobre 2007; Nobre *et al.* 2016; Athayde *et al.* 2019 and others) to address the challenges of a dynamic system threatened by several drivers and processes (see Parts I and II for further detail on historical processes and the state of the Amazon; Chapter 31 for a discussion on the impacts on education; Dorninger *et al.* 2021 for an analysis of resource inequity). As a result, public engagement in decision and policymaking, and especially engagement of Indigenous and local peoples in policymaking, is still limited and inequitable in the Amazon. Although significant progress has been made in this regard in various Indigenous territories and community lands (see Chapter 31), barriers for

Box 33.1 Who Gets to Name Species?
Natalia Piland

The Amazon Basin is home to 10–30% of the world's species (Yale 2020, Mongabay 2020). From a western science perspective, we can provide this statistic, used in various calls to action and conservation (for example, WWF 2013, Rusu 2019), thanks to the process of species description. Species descriptions "elevate" the observation of an individual bird to the abstraction of a species (DuBay, Palmer, and Piland 2020), and the statistics resulting from information on species are used to justify decisions made regarding conservation action/inaction (for some methodologies, Guisan et al. 2013, Nicholson et al. 2013). At the same time, these species descriptions have broader implications: they confer authority and professional opportunities on the authors of these species descriptions (for an example in inequity in citation practices, see Meneghini et al. 2008), and honor Western individuals by using their given and/or family names as honorifics in the Linnean taxonomy. While seemingly innocuous, strict authorship practices mean that the individuals that reap the benefits of the species descriptions may not be the original holders of knowledge or cohabitants of the area the species is from, and honoring Western individuals may actively exclude or signify the exclusion of racialized, gendered, or ethnicized groups.

In a recent paper, we found that even though 95% of bird species described in the last 70 years were from the global South (with three countries in the Amazon basin: Perú, Brazil, and Colombia), names of birds disproportionately honored individuals from the global North (DuBay, Palmer, and Piland 2020). Additionally, the majority of primary authors of these eponyms were from the global North. The implications of local author inclusion were clear—if there was at least one local author (i.e, an author that was from the country the bird was from), it was 62% more likely that the bird would be named after someone local. However, this research did not capture what we anecdotally know: while these species descriptions are often written by researchers based outside of the country, they would not be possible without the indigenous and local knowledge that those authors obtained through conversation or hiring of local labor. Therefore, species descriptions and the surrounding research practice have tangibly been implicated in the erasure of indigenous and local knowledge while becoming by-lines in researchers' curriculum vitaes and further honoring non-local scientists.

In the United States, we have seen a movement, led primarily by younger birders, to change birds' names, at least the common names. For example, McCown's Longspur was named after John P. McCown, who shot the type specimen and sent it to an ornithologist friend to describe and ten years later joined the Confederate army during the United States Civil War, which fought to defend slavery (Elbein 2020). The group Bird Names for Birds organized a successful formal petition with 180 signatories to deliver to the American Ornithological Society's North American Classification Committee to change the common name to one that is descriptive of the species (Roach 2020). The naming of a bird after a Confederate general signifies the long history of exclusion and violence of the birdwatching and environmental communities in the United States, and changing the name signifies commitment to addressing and repairing the harm done by these communities. It is worth noting that this change came after the widespread protests against police brutality following the murder of George Floyd—As recently as 2018, the AOS's NACC had denied a request to change the name (Roach 2020, Elbein 2020).

Beyond changing the names of species that honor racist individuals, initiatives to address the epistemic inequalities in our fields should go hand-in-hand with a reflection of power dynamics and dialogues that facilitate a respectful exchange of ideas and knowledge. Considerations in these initiatives can include questions such as: Is authorship a valuable signifier of authority, and, if so, are all the people who hold and create knowledge, even when not in the form of writing, acknowledged (whether this is through citation or authorship)? Is collective authorship an option in the places where you publish? Is participation informed, voluntary, and consensual? Who leads the research and what power dynamics are implicated? Are there differential expectations for different groups (for example, the expectation of communicating in English gives an implicit advantage to those who are from English-speaking countries, countries who invest in wide-range English education, or from socio-economic backgrounds that allow access to English education from an early age)? Can those expectations be changed (for example, scholarship and degree-granting programs to be offered in local and indigenous languages)? Is the indigenous and local knowledge being valued as is or is such knowledge valued only when it conforms to Western values? Who is the research and the species descriptor for?

participation in decision and policy making are common, especially outside these jurisdictions and at larger scales. It is still necessary to further understand and make visible these barriers, especially systemic and structural ones, such as systemic racism. Also, the larger the scale, the greater the inequalities in terms of the possibility of citizens, communities, and grassroots organizations to effectively engage in generating, sharing, and using knowledge for decision and policy making (for a review on size and political participation, see McDonnell 2020).

At the root of the problem in scaling up successful approaches for knowledge dialogues and public participation in decision-making, as well as in knowledge generation and sharing, lie power relations rooted in formal institutions and regulations that determine whose knowledge is more valid or valuable, who is the expert and who is not (Athayde et al. 2019; Arruda and Arruda 2015; Barthel and Banzhaf 2016; Jacobi *et al.* 2017;; Chambers 1995).

To further promote the sharing and alignment of diverse knowledges for sustainable development, McElwee *et al.* 2020's review recommends the following:

"The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment (GA) demonstrated the importance of Indigenous peoples and local communities (IPLC) to global biodiversity conservation and ecosystem management. (...) Successfully bringing ILK into assessment processes and policy arenas requires a deliberate framework and approach from the start that facilitates recognition of different knowledge systems, identifies questions relevant at various scales, mobilizes funding and recognizes time required and engages networks of stakeholders with diverse worldviews." (p. 1667)

In addition, we propose that stakeholders involved in this process ask critical questions, such as: For whom, by whom, and for what purpose should science investments and policies be promoted in the Amazon? What conditions are needed for a thriving science and knowledge-sharing environment in the Amazon? How can barriers be broken for genuine knowledge dialogue that recognizes, credits and legitimizes ILK and other non-academic contributions (Tress et al. 2005), and recognizes IPLCs as political subjects for informing decisions and policies? What conditions are needed for effective and equitable knowledge sharing among multiple stakeholders and across multiple scales in the Amazon? What can be done to ensure that knowledge about the Amazon is effectively accessible and disseminated in the region and among Amazon peoples, rather than remaining accessible

only to those who can afford access to peer-reviewed journals, publications in English, or university libraries? Answers to these questions are context-based and the product of negotiation between involved stakeholders; ideally through a transparent, just, and equitable process.

Specific challenges in this process involve, for instance, ensuring appropriate credit to IPLCs and non-academic contributions to knowledge generation and sharing, and avoiding co-opting, technifying, or de-contextualizing ILK (Athayde *et al.* 2017; 2016) in research, conservation, and development initiatives. Also, although there is global consensus that science is a common good (UNESCO 2017), the principle of 'situated open access' needs to be carefully implemented in contexts such as the Amazon, where Indigenous Peoples, and, in many instances, local communities, are right holders, rather than stakeholders. This concept applies Donna Haraway's notion of "situated knowledge" to the practices of open access—understanding the context, power relations, and structures that relate the humans and institutions that would produce and/or use knowledge would allow open access to be implemented in a just way (Haraway 1988; OCSDNet 2015).

As with open access, public participation by other stakeholders (e.g., students, volunteers, activists, urban grassroots organizations, professional associations) in the process of knowledge generation, sharing, and use still has a long way to go. The negotiation process to determine what knowledge is 'better' than others needs to take place on more equal terms than what is currently in place. The UNESCO-led process to build a global consensus and adoption of a UNESCO Recommendation on Open Science, scheduled for September 2021, discusses several of these challenges (UNESCO 2020, Wehn et al. 2020) and the comments received by civil society organizations (especially by the Global Citizen Science Partnership and the Open Science Community of Practice) provide effective guidance on how to address these challenges.

It is important to emphasize that at the community and local scales, significant progress has been made in addressing these problems. Solution pathways to generating and sharing knowledge for informing decisions and policies towards sustainable development in the Amazon should build on these experiences, and also on on Indigenous and other civil society organizations' needs, interests, and political agendas. For instance, the Declaration of Belém+30 that calls for, among others, recognition and respect for the right of self-determination of IPLCs and all other human rights, free prior informed consent, benefit sharing from research, prevention of inadequate access or misuse of—and access to—raw data, documentation, information, and artifacts obtained through research in their territories or sacred areas (International Society of Ethnobiology 2018). Also, global and regional professional associations and Indigenous researchers have recently issued best practices, policy recommendations, and ethical considerations for projects that involve IPLCs and public participation (see Bowser *et al.* 2020; Carroll *et al.* 2021; Liboiron 2021). There is still much to do to systematize and disseminate this growing body of knowledge and experience, to harvest lessons and best practices, and to foster their application and adoption in multiple contexts and at larger scales. Platforms for knowledge dialogue between academia and government agencies are also missing or incipient (McElwee *et al.* 2020). Legal frameworks in Amazonian countries continue to present weaknesses in terms of recognizing intellectual property rights tied to Indigenous and local contexts, which increases barriers to establishing inclusive, ethical, and transparent dialogue platforms between them, academia, and government agencies. Similarly, legislation on open science and public engagement in science is still not adequate in several countries of the region. Third, private and public investments in science, research, and technology in the Amazon are still limited and insufficient, more so if these are for and by Amazon peoples (Nobre *et al.* 2016).

The authors of this chapter use an appreciative inquiry approach (Preskill and Catsambas 2006) to

build from success stories, best practices, and lessons learned, acknowledging and expanding them, with an Amazon constituency that fosters a knowledge-based sustainable development paradigm for the Amazon. The chapter is informed by a stakeholder engagement process that identified core elements of a future Amazon vision (see Annex 1; also Chapter 25 for a proposed Living Amazon vision). These core elements are built on two foundational pillars: (1) acknowledgment and respect of fundamental human rights and the rights of nature, specifically the right to land, and (2) acknowledgment and incorporation of ILK and IPLCs in decision-making about the future of the Amazon (see also Preskill and Catsambas 2006, p.1). Based on these pillars, the other four core elements of a vision for the Amazon include the incorporation of ILK in natural resource management public policies and planning; strengthening territorial governance (see also Chapter 31); the conservation of the Amazon's forest and aquatic ecosystems and the services they provide, such as climate regulation, rainfall regimes, and biodiversity maintenance (Chapter 27); and addressing forest and aquatic ecosystems destruction and degradation (Chapters 19–21) and other threats to biodiversity. Therefore, we propose a path forward that starts by reviewing, systematizing, and disseminating lessons learned and best practices, and then applying these learnings to create relevant, just, and effective platforms, ethical procedures, policies, and legal frameworks, and to creatively address the lack of financial and technical resources for connecting diverse ways of knowledge generation and sharing in the Amazon, while calling for greater investments in these initiatives.

Specifically, this chapter takes a first step forward in this process by presenting a set of illustrative experiences of collaborative research that provide concrete examples of knowledge dialogues, public engagement in science, and knowledge sharing for decision-making (Section 2). These experiences showcase how knowledge dialogues and public engagement in science have worked, and how ILK has contributed to sustainability, and provide lessons and guidance for solution pathways in both knowledge dialogues (in Spanish, "diálogo de saberes") and decision-making. These cases were compiled from the experience of the authors of this chapter and those that we were able to synthesize as part of the Science Panel for the Amazon. They are not meant to be exhaustive, and, in fact, we believe that a first recommendation should be the conduction of a comprehensive review of ILK and public (non-academic) knowledge contributions in the Amazon.

Building on these experiences, we then provide a set of recommendations on pathways to move forward (Section 3). The recommendations outlined in this chapter focus on the creation of conditions that promote just and inclusive dialogue between knowledge systems, including: investment in infrastructure (research and technological); creation of normative frameworks for data sharing and ownership, participation, and collaboration; strengthening and expanding intercultural platforms with a long-term commitment; structural change that allows for transparency and effective public participation in decision-making at various spatial scales; and intercultural training for decision-makers in various organizations.

33.2 Inspiring experiences and pathways

Existing experiences and programs offer success stories and lessons learned on generating, connecting, and sharing knowledge to inform and guide decisions and policies. For each case, we attempted to provide information about the process, context, and actors, as well as insights to consider when creating other experiences.

We propose a framework to guide the reflection on public participation (including Indigenous peoples and local communities, civil society organizations and individuals) in knowledge generation and sharing. This framework builds on Shirk et al. (2012, p. 29), who proposes the following:

"Projects must balance inputs from scientific interests and public interests, but each project negotiates that balance differently (as represented by

input arrows of different sizes). Projects also exhibit different outcomes for science, individuals (researchers or volunteers), and social–ecological systems, which may relate to the particular balance of inputs. Note feedback arrows: certain outcomes may reinforce certain interests—and therefore particular design emphases—as initiatives evolve over time. Quality public participation depends upon sufficient attention to public interests in the input stage, to identify questions and structure activities most likely to yield outcomes relevant to those interests." (see Figure 1).

Adapting the framework (Shirk et al. 2012) to the Amazonian context, first, we propose to incorporate the degree to which rights of Indigenous and local peoples over land, resources, and knowledge are acknowledged and respect, which in turn shapes the negotiation between scientific interests and public interests (and rights) to design and implement research projects/initiatives. This process ultimately influences the resulting observations, experiences, and outcomes in terms of science, socio-ecological systems, and communities and individuals (see David-Chavez and Gavin 2018; Liboiron et al. 2018; Carroll et al. 2021; Liboiron 2021). Second, existing institutions (norms), political structures, and civil society's strength and agency of (the organized public) also influence the ability of uptaking knowledge in decisions and, thus, in outcomes and impact resulting from those decisions and/or policies

This framework can be used to analyze not only experiences of public participation in knowledge generation and sharing, but also to design projects, helping to explicitly question and make decisions about citizen engagement or dialogue between diverse knowledge in each step of the process. Core decisions ultimately come down to who participates and who makes the decisions in the different steps of the process, i.e., who has primary authority over the process.

To organize the illustrative experiences shared in this chapter, we use the classification proposed by Shirk et al. (2012), which describes forms of public participation in scientific research without differentiating whether the public are IPLCs, other civil society organizations, or individual citizens. For authors that focus on Indigenous peoples, see David-Chavez and Gavin (2018), who proposed a scale for assessing levels of participation of Indigenous communities in research, and Liboiron et al. (2018), who proposed protocols and methods to reach agreements between researchers and Indigenous communities. Also, Liboiron (2021) proposed specific methods to carry out scientific research in Indigenous lands without reproducing colonial (extractive) relationships between mainstream scientists and Indigenous peoples:

"As director of CLEAR, I identify our space as an anticolonial lab, where anticolonial methods in science are characterized by how they do not reproduce settler and colonial entitlement to Land and Indigenous cultures, concepts, knowledges (including Traditional Knowledge), and lifeworlds. An anticolonial lab does not foreground settler and colonial goals. (...) Anticolonial here is meant to describe the diversity of work, positionalities, and obligations that let us "stand with" one another as we pursue good land relations, broadly defined." (Liboiron 2021, p. 27).

The illustrative experiences included in this chapter, organized using Shirk et al. classification, are summarized in Table 1 (adapted from Shirk et al. 2012). Given the focus of this chapter, all illustrative experiences reflect the most intense forms of public participation in scientific research or monitoring, i.e., collaborative, co-created, and collegiate projects (contractual and contributory experiences were left out of this analysis).

In addition, the illustrative experiences included in this chapter reflect the different types of outcomes that may result from public participation in knowledge generation and sharing (see summaries below and Annex 2 for full descriptions). First, in all cases, there was an increase in the capacities of participating citizens (individuals, communities, associations), as well as improved terms of engagement with government or scientific stakeholders.

Figure 33.1 Illustrative case studies organized by model of public participation in scientific research projects, based on degree of public participation in scientific research.

For instance, the cases "The Matapi History," "Visions of Chiribiquete," "Kukama Indigenous Peoples' Underwater World," "the Jaguars of Yuruparí," and "Biodiversity as a Form of Sexual Education" all qualitatively show an increase in understanding and recognition of ILK of Amazon ecosystems and Indigenous territories by mainstream science and key government agencies. The cases, "Training Indigenous Environmental Agents in the Southern Brazilian Amazon," "Citizen Science as a Tool for Fisheries Monitoring Using the Ictio App in the Madeira River Basin," and "Collaborative Knowledge Production and Coalition Building for Conservation Action through Rapid Biological and Social Inventories" all tell stories of how community-based monitoring and citizen science are contributing to strengthening the negotiation capacities of Indigenous peoples and fisher associations with government agencies and private stakeholders. In these cases, ILK contribution to territorial and natural resource management and conservation is recognized, and common or negotiated visions for the territory are attained or under construction.

Second, in all cases, there were important outcomes attained in terms of science or knowledge generation and sharing. Noteworthy cases include "Piraiba Local Knowledge," which tells the story of how local knowledge resulted in a five-fold increase in the number of prey species of giant Piraiba catfish, and "The Citizen Science for the Amazon Network," which describes how to build a shared fisheries database across the entire Amazon Basin.

Third, some illustrative experiences reflect on the impacts on social-ecological systems. For instance, "The Matapi History" case was critical in informing governance in the Colombian Amazon through the incorporation of a legal figure known as "macro-territories." The case "Peasant Knowledge for Territorial Planning in a Context of Conflict" explains how peasant knowledge was used to inform territorial and land-use planning in Colombia and recede conflicts between agricultural land-use and protected areas. Finally, "The Kukama Indigenous Peoples' "Underwater World" case made cultural river values visible by government agencies and civil society organizations and informed a public review of the environmental impact assessment for a waterway project.

33.2.1 Illustrative experiences of collegial contributions

- *Peasant Knowledge for Territorial Planning in a Context of Conflict (Colombia).* "Colono" settlers arrived in the Amazon piedmont in Caquetá, Colombia, toward the turn of the twentieth century. After conflict arose between their historical use of land for agriculture and the more recent creation of protected areas in the region, peasant knowledge informed and attained revisions of land use planning and conservation policies, overcoming conflict, and promoting conservation (FAO and ANT 2018, Arncop and Incoder 2012).

- *Visions of Chiribiquete from the Shamanic World (Colombia).* With a research grant from Tropenbos, Colombia, traditional knowledge holder Uldarico Matapí documented the Indigenous vision of the Chiribiquete National Park (Matapí Yucuna 2017). He described how Chiribiquete's famous pictographs depict the origin and rules of the world, in which territories, animals, water, plants, and shamanic knowledge were distributed to maintain the order of the rainforest. This knowledge currently informs national park management and promotes conservation.

- *Kukama Indigenous Peoples' Underwater World (Peru).* Leonardo Tello and the Radio Ucamara Civil Society Organization led a 5-year participatory process with Kukama Kukamiria Indigenous communities in the Lower Marañon River (Loreto, Peru) to map and document their ancestral knowledge and vision about sacred places, history, and culture. With support from Wildlife Conservation Society (WCS) and Florida International University (FIU) landscape ecologists, this knowledge was compiled into a story map: Parana Marañún tsawa: The Soul of

the Marañón River. Submerged stories of the Kukama People. The Kukama People and civil society organization have used this story map to inform government agencies about the potential impacts of ill-planned infrastructure on the Kukama's territories and lives.

33.2.2 Illustrative experiences of Co-Created Projects

- *The Territory of the Jaguars of Yuruparí (Colombia).* This publication (ACAIIPI 2021) is a compilation of ILK by dozens of traditional knowledge holders from five Indigenous peoples in the Pirá Paraná River, Vaupés (Colombia) region. The book resulted from a collaboration between the ACAIPI Indigenous organization and the civil society organization Fundación Gaia Amazonas, and an intergenerational and intercultural collaboration between Indigenous wisepersons (sabedores) and youth, and western researchers. It describes the origins, livelihoods, and territorial environmental management vision of these five Indigenous peoples and aims to share and make this knowledge visible to both Indigenous peoples in the Pirá Paraná River (with a sense of pride) and foreigners (so they can understand each other better).

- *Fisherfolks' local knowledge about Piraiba (Colombia).* Biologist Carlos Rodríguez, fisherman Luis Angel Trujillo, and other researchers collaborated to compile and document ILK about Amazon giant catfish in the Lower Caquetá River (Colombia). Trujillo made a significant contribution through the research design and knowledge about the giant Piraiba catfish (Brachyplatystoma capapretum): he identified 93 prey species for this species, whereas prior scientific research had identified only 17. Then, Trujillo, Rodríguez, and Confucio Hernández, a Uitoto Indigenous expert illustrator, collaboratively published the book "Piraiba: Illustrated ecology of the great Amazon catfish" in 2018 (Trujillo et al. 2018), which was awarded the highest Colombian National Research Award.

- *Biodiversity and human health (Colombia).* Indigenous Elder nɨpodɨmakɨ Oscar Romualdo Román-Jitdutjaaño and anthropologist Juan Alvaro Echeverri collaborated in an intercultural study (Jitdutjaaño et al. 2020) of the human condition. They researched the plants from which alkaloid vegetable salts can be extracted. Increased understanding of these plant species and the services they provide to a common objective (e.g., food, tobacco, money, tools) in turn provide guidelines for behavior to develop a human body that is healthy, sociable, and fertile.

33.2.3 Illustrative experiences of Collaborative Projects

- *Training Indigenous Environmental Agents in the Southern Brazilian Amazon (Brazil).* In 2020, 73 Indigenous Environmental Agents (AAIs; acronym in Portuguese) participated in a training program led by the Institute of Education of Brazil (IEB) and the Parintintin, Jiahui, Tenharim, and Apurinã Indigenous Peoples. The program seeks to reflect on concepts, practices, techniques and technologies to support sustainable development and environmental security. Ultimately, the training program aims to increase Indigenous participants' technical and political capacities to face a range of socio-environmental challenges that affect their territories. As a result of this process, AAIs shifted their own and outsiders' perceptions from one where Indigenous peoples are seen as victims or obstacles to national development to one where they are seen as people whose actions are essential for environmental protection and authentic and sustainable development.

- *Citizen Science for Fisheries Monitoring: The Ictio App in the Madeira River Basin (Brazil).* Before this project, the only entity that generated and held fisheries data in Rondônia was a hydroelectric

dam concession holder, limiting access of fisherfolk and government agencies to data and inhibiting their participation in decision-making. However, local scientists and fisherfolk recently agreed to test and implement citizen science approaches and the Ictio App (Ictio.org, see also next experience) to ensure that both state decision-makers and fishers generate and effectively access fisheries data. As a result, community members were empowered to monitor and co-manage fisheries, by uniting formal and traditional governance, and to use their own data to address potential impacts of the two hydroelectric projects operating in the Madeira Basin.

- *The Citizen Science for the Amazon Network (Amazon Basin-wide)* describes the collaboration between over 30 partners from different backgrounds, countries, and interests, to increase the understanding of Amazon migratory fish and foster sustainable fisheries management across the entire Amazon Basin. As of July 2021, using low cost, user-friendly digital tools and transparent knowledge sharing agreements, network partners and 70+ citizen scientist groups (e.g., fisherfolk, IPLCs, students) have generated and shared 55,000+ observations of 20+ migratory and food fish species across the Basin using the Ictio App and shared database (see Ictio.org, World Bank, 2021).

- *Collaborative Knowledge Production and Coalition Building*. Over 20 years of rapid inventories led by the Field Museum has informed conservation recommendations in the region. Rapid inventories have generated integrated, collaborative knowledge and informed conservation actions throughout Andean Amazon countries. Inventories are collaboratively designed and carried out with diverse actors at the local, regional, national, and international scales. Similarly, recommendations are co-created with local people and multiple stakeholders based on the rapid inventories results (Pitman et al. 2021; Wali et al. 2017).

The experiences summarized here offer examples of projects where the terms of collaboration between mainstream scientists, practitioners, government agencies, and IPLCs were negotiated (implicitly or explicitly) and implemented. These offer important inspiration and lessons to address inequities in knowledge generation, sharing, and use, which are presented in the next section.

33.3 Discussion and recommendations

Based on the discussions and illustrative experiences presented in this chapter, and on our combined knowledge, we propose the following recommendations that will contribute to addressing inequities in knowledge generation and sharing for informed decision-making in the Amazon. These recommendations are not exhaustive but rather a starting point to build a sustainable Amazon that values and recognizes the contribution of diverse knowledge and societal engagement in knowledge generation and sharing to inform decisions and policies. Therefore, addressing inequities in terms of knowledge generation, sharing, and access to inform decisions involves:

- Respecting and guaranteeing the fundamental rights of people and nature, recognizing ILK, and guaranteeing IPLC rights to land as a critical first condition (see Annex 1, Liboiron 2021).

- Strengthening the design and enactment of open and collaborative knowledge principles through specific and targeted policies, agreements, and/or protocols appropriate to the Amazonian context.

- Developing open and collaborative knowledge policies, agreements, and ethical protocols are necessary for each step of the knowledge generation, sharing, and informing processes. These should be specific rather than general and should include, for example:

    a) Free prior and informed consent and participation agreements clearly outlining the

risks and benefits of participation and who has the decision-making authority (see David-Chavez and Gavin 2018; Liboiron et al. 2018; Liboiron 2021);
b) Agreement terms for data access and management, including data quality assessment, interoperability, and aggregation of data across scales and countries (see Bowser et al. 2020 on citizen science data; Wilkinson et al. 2016 on FAIR Data Principles; and other global initiatives to improve data management practices and governance) ;
c) Intellectual property rights and licensing agreements;
d) Transparent and effective instruments for equitable and just distribution of risks and benefits associated with knowledge sharing, including crediting contributions (see Liboiron et al. 2017);
e) Investing in and access to innovative technologies that are low-cost, user-friendly, and effective to facilitate public participation, transparency, and scaling-up.

In many cases, these considerations are subject to rapidly evolving fields of study and very dynamic. However, key guidelines and sources of information on how to design and implement them can be found in instruments such as the Principles of Open and Collaborative Science (OCSDNet 2015), UNESCO'S recommendation on Open Science (UNESCO 2020), Research Data Alliance, Citizen Science Association, and European Citizen Science Association.

- Promoting collaborative research among IPLCs, practitioners, and academics. The contribution of ILK, knowledge dialogues, and public engagement in science to devising and implementing solution pathways towards a sustainable Amazon is still not well understood or visible among decision-makers in both Amazon countries and at a global scale. To address this challenge, IPLCs, practitioners, and academics should collaborate to lead compilation and dissemination efforts, with clear research agreements or contracts.

- Addressing imbalances of power with respect to knowledge through creating spaces for ILK in academia, and building bridges for equitable and just collaboration between academia, IPLCs, and non-academic knowledge. Similarly, we propose to open up government agencies to acknowledge and support ILK contributions to solution pathways toward Amazon sustainable development. This includes training courses for academics and government agency staff on intercultural contexts and knowledge dialogues; expanding the practice of allowing students to defend their theses or researchers to present their findings in Indigenous languages, as well as increased education in Indigenous and local languages; creating dialogue and exchange settings; and ensuring that the Amazon is prioritized in national and international science and technology agendas and investments.

- Building and strengthening multiple intercultural platforms for knowledge dialogue among general, technical, and scientific knowledge; arts; and ILK. This process could start by strengthening partnerships with IPBES and with national science and technology agencies and councils, and building effective national and regional platforms for exchanging experiences on ILK. Then, initial knowledge dialogue platforms may start at universities and research centers with the inclusion of ILK holders and local experts as faculty members. Cátedra Amazonas offers a model for multiple disciplines including natural sciences, social sciences, humanities, arts, engineering, and business management. Also, intercultural working groups with the participation of scientists, practitioners, and ILK holders (conocedores locales) could lead thematic seminars to address an agenda of previously agreed-upon priority issues. A specific priority is to maintain a permanent Amazon-wide knowledge dialogue platform involving the Coordinator of Indigenous Organizations of the Amazon River Basin (COICA) and other IPLC organizations,

academia, civil society organizations, and government institutions.

- Organizing an Amazon Congress on ILK. This could be co-led by COICA, the Amazon Cooperation Treaty Organization (OTCA), or other Amazon multilateral organizations, and national-level Indigenous organizations, ministries or councils of science and technology, as well as other civil society organizations, to organize an Amazon Congress on ILK every two years. It is critical to secure continuity of this initiative over time to create and strengthen intercultural networks that involve stakeholders from IPLCs, academia, civil society organizations, and governments to devise joint/collaborative solutions for sustainable development in the Amazon.

- Ensuring that knowledge and evidence are effectively used in decision-making towards Amazon sustainable development. Public engagement in knowledge generation and sharing is critical but not enough; it needs to be complemented by public engagement in management and policy decisions. Representativeness, transparency, and accountability need to be critical elements of knowledge-based organizations and solutions.

- Addressing unequal access to information and communication technologies, connectivity, and critical research infrastructure capacities. The COVID-19 pandemic surfaced weak and unequal access to information and communication technologies, connectivity, and critical research infrastructure capacities (e.g., laboratories, research facilities, training). Therefore, it is urgent to address these gaps in ways that are appropriate to the Amazon context (diverse, multicultural, urbanized, and containing vast rural areas with low population densities).

33.4 Conclusions

Sustainable pathways for the Amazon require, first and foremost, the recognition and respect of the fundamental rights of humans, nature, and ILK. ILK has informed and continues to inform territorial and natural resource management, as well as conservation and sustainable development initiatives, especially those led by IPLCs themselves. However, the lack of appropriate recognition or internalization of ILK and other non-accredited knowledge, still hinders just knowledge production and informed decision-making at national and international scales. Existing solutions to the problem of unequal knowledge production, sharing, and articulation in decision-making must be described, disseminated, scaled up, and mainstreamed. At the same time, local, regional, and global professional associations and organizations are producing critical policy recommendations and guidelines that can inform the pathways forward.

Interventions at various scales are recommended to address these inequities in knowledge production, sharing, and informed decision-making, emphasizing the need to guarantee fundamental human and nature rights; recognizing ILK; and fostering an honest dialogue between different knowledge systems; enabling and promoting public participation in science and knowledge generation and sharing; and adhering to, and operationalizing, the principles of open and collaborative knowledge.

33.5 Recommendations

- Recognize and guarantee the fundamental rights of people and nature, as well as the knowledge systems of Indigenous people and local communities (IPLCs).
- Strengthen the design and implementation of open and collaborative knowledge principles through policies, agreements, and protocols. These should be targeted and adapted to specific contexts, objectives, and needs.

- Promote collaboration between IPLCs, practitioners, and academics to synthesize and disseminate knowledge to increase our collective understanding of the contribution of ILK and public engagement to science and Amazonian solutions.
- Invest in infrastructure for strengthening public participation in knowledge dialogues at various scales.
- Collaboratively create context-specific normative frameworks, agreements, and protocols for open and collaborative knowledge.
- Create, strengthen, and scale up intercultural knowledge platforms.
- Promote structural change and training for decision-making institutions to promote engagement with IPLCs, enhance public participation, and ensure transparency and accountability.
- Build on the progress made by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), regional and global partnerships, and emblematic knowledge dialogue platforms, and involve the leadership of IPLC and grassroots organizations, academia, civil society, and national science councils or ministries.

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ANNEX 33.1. Proposal summary of a conceptual framework for the future of the Amazon

Proposal summary of the Amazon future vision conceptual map

This is a proposal summary of the vision map of the future of the Amazon, prepared in a participatory way during the Virtual Meeting held by WG12 on 2 September 2020, "In search of a more sustainable and just future for the Amazon". The content of this text still needs to be reviewed and validated by the participants of the meeting. A table with the summary of the vision and values is attached.

What is your vision for the future of the Amazon?

Recognition and respect for Indigenous, traditional and local rights and knowledge.[16]

The virtual meeting with representatives of Amazonian peoples and organizations was held on September 2, 2020, within the scope of Working Group 12 (WG12) of the Scientific Panel for the Amazon (SPA)[17], and gathered numerous contributions on the vision of the future for the Amazon. From the set of visions that we were able to compile (see list in the Memory of the Virtual Meeting), it seems there is a collective vision based on two fundamental pillars: (1) the need for recognition and respect for capital rights, among them and, in particular, the right to land and (2) the recognition and inclusion of Indigenous, traditional and local knowledge in decision-making about the future of the region. The group, in general, seems to converge around the opinion that these two pillars are the foundations for maintaining the socio-environmental integrity of the region and human well-being inside an outside the region. If recognition and full respect for Indigenous, traditional and local rights and knowledge are achieved, the result should be an effective incorporation of this knowledge into public policies.

Incorporation of Indigenous, traditional and local knowledge into public policies and planning to manage natural resources.

Assuming the two pillars mentioned above are valid, the incorporation of Indigenous, traditional and local knowledge into decisions and public policies should be effective and influential. Otherwise, there will be no possibility of treading a new path towards a sustainable Amazon for everyone. In this sense, incorporation must be carried out respecting the diverse spirituality present in the region and under the precepts of gender identity[18], generational issues and the inclusion of ancestral values. Only in this way will the focus be effectively intercultural, allowing fair treatment of Indigenous, traditional and local knowledge in processes of construction or improvement of public policies for the Amazon, breaking with the colonialist notion historically present in the region.

Strengthening territorial governance by indigenous peoples and traditional communities.

Respect for rights and the inclusion of Indigenous, traditional and local knowledge in decision-making is one of the most effective ways to achieve full territorial governance by Amazonian peoples, regardless of

[16] We consider traditional knowledge that offered by traditional communities (ribeirinhos, quilombolas, etc.), Indigenous peoples, small farmers and extractivists.

[17] https://www.laamazoniaquequeremos.org

[18] The way in which an individual identifies in society, based on the identification of that individual with a certain gender (male, female or both), regardless of sexual orientation.

their nationality. The result will be a more sustainable Amazon and greater legal certainty regarding the protection of territorial rights. As already mentioned, this governance will only be complete with the autonomous management of the territory, with the due participation of women and young people.

Conserve the Amazon forest and its essential ecosystem services, such as climate regulation, rainfall, and the maintenance of biodiversity

Without effective governance of territories, conservation in the Amazon will not be assured. Forests inside Indigenous lands, for example, have an insignificant rate of forest destruction (<1%) compared to other lands (>30%). This justifies attributing the title of "guardians of the forest" to Indigenous peoples. But such a title will only be genuine if the autonomous management of the territory is ensured, as well as recognition and respect for their cultures and rights, including, in particular, Indigenous peoples in voluntary isolation and initial contact.

Attention to the destruction and degradation of the forest and aquatic ecosystems, and threats to biodiversity (fauna, flora)

Recognition and respect for rights will only be achieved if traditional and local communities and Indigenous peoples continue to conserve the territories inherited from their ancestors. This seems the main way to combat the threats suffered. It is also necessary for each Indigenous people or community to self-determine its way of living and developing and, even if they decide to live or develop in the urban/western way, that they can do so without losing their customs. Thus, it will be possible to continue with the benefits of the conservation of territories and the environmental benefits they provide, in addition to ensuring food and health security, always taking into account ancestral values and knowledge. It will be the means to raise awareness and publicize the importance of the Amazon to the world and develop fair markets guided by sustainability and by fostering a bioeconomy based on biodiversity, knowledge and values/aspirations of the peoples of the region.

What are your personal values or the values of your community? What are the keys to building the future of the Amazon?

Values are important because they define the behaviors expected by society, whether universal or specific to some groups. In this case, participants identified the values needed to foster a sustainable future for the Amazon. These values were identified in writing in the communication before the meeting or during the meeting, and are summarized as follows:

Respect

Specifically, the sustainability and future of the Amazon depends on respect for individual, collective and territorial rights, especially the rights of Indigenous populations, who have their own views and conceptions about the integrity of their territories.

Honesty and Transparency

For fair work towards the future of the Amazon, honesty and transparency are needed, creating collaboration and collectivity. Processes must be clear, and by committing to honesty and transparency, you are also committing to the fight against corruption.

Collaboration and collectivity

When making decisions, you must think about collective values and what affects the common good. Throughout the process, the main actors must also be involved and facilitated, and reflection must be valued.

Solidarity

Valuing solidarity also means creating and valuing love of and passion for working towards a better future for the Amazon. The Amazon's people can advance when they understand, value and respect each other, creating conditions of equity.

Interculturality

The value of interculturality means that not only scientific knowledge, but also Indigenous, traditional and local knowledge is recognized. The knowledge and way of life of Amazonian peoples are valid and valued, promoting a direct and genuine listening to the territory and its people. This intercultural approach also means advocacy and governance where different voices and opinions are considered; promotes participatory democracy and is aware of the different cultures, identities and spiritualities present; and how processes can impact them in different ways. It also means promoting a dialogue of shared knowledge where local solutions are seen as models and, thus, epistemological change is created.

Strengthening Amazonian citizenship

Strengthening Amazonian citizenship is necessary to maintain the integrity of the ecosystem and people's well-being. This means a political formation where the history of the people and the territory is known and, thus, better care can be taken, avoiding predatory actions on the territories and resources of the region. This also means autonomy for the peoples of the Amazon, so that they themselves make decisions that impact their future and can communicate to see the Amazon as a connected ecosystem. Furthermore, the voice of Amazonian citizenship must be projected so that it has its place in national and international instances.

Table 33.A1 Summary of shared visions and values shared in the meeting 02/09/20

VISÃO		VALORES
Recognition and respect for Indigenous, traditional and local rights and knowledge		Historical knowledge, political training, advocacy Preservation and expansion of laws and principles that protect rights
Incorporation of Indigenous, traditional and local knowledge into public policies and natural resource management plans		Gender, intercultural and intergenerational approach Emphasis on local solutions Respect for diverse spirituality Knowledge dialogues and knowledge sharing
Strengthening territorial governance by Indigenous peoples and traditional communities.		Honesty and transparency Consider local protection and conservation technologies Collective ethics with a guide for communities Respect for the common heritage Collaboration and collectivity
Conserve the Amazon and its essential ecosystem services, such as climate regulation, rainfall, and the maintenance of biodiversity		Consider and connect diverse knowledge: scientific, Indigenous, traditional and local Social and environmental safeguards for development programs Prevent deforestation, destruction and degradation of ecosystems and predatory exploitation Mapping the vulnerabilities of Amazonian territories and ecosystems to climate and occupation threats in the region.
Amazonian citizenship		Recognition and respect for capital rights, especially the right to land. Inclusion of Indigenous, traditional and local knowledge in decision-making. Collective construction of the future, based on the exchange and sharing of diverse knowledge (scientific, Indigenous, traditional and local).

ANNEX 33.2. Illustrative experiences

The History of the Matapí: Documentation of local knowledge by their own experts

Country: Colombia
Summary Author: Carlos Rodríguez

The bibliography on Indigenous peoples is dominated by the authorship of social scientists, especially anthropologists, who in one way or another recognize local knowledge and express it in their works, and even mention local experts and highlight their texts under the figure of informants. This process of recognition of local knowledge has led to the increasing involvement of Indigenous people themselves as compilers of their own knowledge and authors of publications of all kinds, from a short history, through primers and articles to complete books, including book series.

Communities approach the process of telling, writing, and sharing their knowledge in diverse ways, depending on their goals. For instance, to strengthen their own cultures and to address concerns that their knowledge is being lost or eroded. Also, to share their knowledge with the outside world, including academia and government agencies, in a way that it can be recognized and taken into account in public policy decision-making.

In the Colombian Amazon, there are very good contributions authored by traditional knowledge holders who have compiled their own texts for more than 20 years. One of the pioneering cases was the book *The History of the Upichia*, authored by Carlos Matapi and his son Uldarico Matapi, published as a scientific series with an international editorial committee (Matapi 1997). This recognition of Indigenous knowledge was important because it contributed to making visible the knowledge accumulated by the elders and, in this case, to recognize in a broad way that Indigenous peoples have a historical depth of more than 13 generations in their memory. This is an oral history which follows specific codes, languages, and rituals. The history is also written in the forest and consolidates the notion of ancestral territory.

Indigenous authors prepared this publication over several months, transcribing their historical knowledge and drawing maps of the sites occupied by their ancestors in an exercise of their own cartography. This process allowed them to contribute to territorial planning, the designation of Indigenous territories (*Resguardos*), and clarification of the relations between the various Indigenous groups with whom the territory is shared. The process and the publication were a significant contribution to understanding the cultural contexts within the notion of macro-territory, an area shared by 30 different Indigenous peoples and a fundamental concept for the new Indigenous governance in the Colombian Amazon.

The volume became a reference material for academics and for local schools, since the Upichia could include their own views of history and also disprove those who considered that the Indigenous people did not have history. The publication has also encouraged other Indigenous groups to compile their own knowledge; other neighboring Indigenous peoples have carried out similar writing exercises, and currently there are several dozen publications with local Indigenous authorship.

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Peasant knowledge for territorial planning in a context of conflict

Country: Colombia
Summary Author: Visnu Posada

The El Pato-Balsillas region is located in the northwestern part of the Department of Caquetá in what is known as the Amazon piedmont. It is crossed by a national road that connects the city of Neiva (Department of Huila) with San Vicente del Caguán (Department of Caquetá), one of the epicenters of peasant colonization in the Colombian Amazon.

Peasant settlement of this region took place between the end of the nineteenth century and the beginning of the twentieth century and was based on two processes: first, displacement produced by land distribution conflicts, mainly in the Magdalena River valley; second, cyclical "bonanza economies", attracting settlers during booms of quina, timber, furs, rubber, and coca.

The government supported some colonization processes, and agricultural and livestock planning explicitly promoted them. However, these were not coordinated with environmental agencies, at minimum to avoid siting them in areas unsuitable for production and designated as conservation units (mainly National Natural Parks and Forest Reserves). When created, conservation units did not foresee the necessary actions to prevent and address conflicts with peasant settlements. As a result, several conflicts between settlements and conservation units arose in the region. These conflicts were aggravated by the weak governance of the conservation units, which were in turn associated with (a) weak capacities of the National Natural Parks agency and (b) the dynamics of armed conflict present in these frontier areas.

During this situation, peasant settlements achieved high levels of awareness and organization that involved diverse policies and programs for managing their territory, including minimum and maximum land sizes; intervention percentages; permits for the use of natural elements; soil, water, wildlife and forest management; community infrastructure; conflict resolution; and non-intervention sites. These achievements were condensed into Community Action Boards and grassroots organizations with clear territorial jurisdictions but varied levels of organizational strength. These organizations negotiated with government agencies about multiple rural development aspects, but conflict with conservation units and other environmental planning policies were the main contention points.

The Pato-Balsillas Region provides a relevant case study for conflicting territorial dynamics; although conflicts were initially associated with easements for communication infrastructure and lack of governmental support for rural development, land use conflicts quickly surfaced, since conservation units limited the access of peasants to agricultural and livestock services (e.g., land, extension services, credit).

The settlement's economy was mainly based on extractive activities (timber) and illicit crops, which increased tension with local and environmental authorities. In the early 1980s, the Pato-Balsillas settlers organization, Asociación Municipal de Colonos del Pato (Amcop), began to negotiate an agreement with local and environmental authorities, a change in the productive model of two conservation units: the Amazon Forest Reserve and the Cordillera de los Picachos National Natural Park.

The most outstanding elements of the negotiations included halting deforestation, eradicating illicit crops, lifting the Forest Reserve (1984) designation, and agreeing on a new boundary for the National Park (1998) that would exclude most of the peasant families, relocate others, and pay for the most remote lands.

All these elements were agreed upon during years of negotiations with national and subnational government and environmental and other agencies. They were expressed in a new territorial management unit: the Peasant Reserve Zone (ZRC) for the Pato River Basin and the Balsillas valley (1997).

Colombian legislation started including Peasant Reserve Zones in 1994, as a response to the mobilization of peasant communities that demanded territorial recognition, through the promotion of their culture and economy, limitations to small and large holdings, and public investments. The first pilot Peasant Reserve Zone was developed in the region of Pato Balsillas, in Cabrera and Guaviare. It is the result of agreements between government environmental and agricultural agencies, conservation units, and the peasantry, generally located in agricultural frontier areas with relatively low levels of agricultural development. Peasant Reserve Zones aim to ensure the sustainability of both peasant life and ecosystems, and their main management instrument is the Sustainable Development Plan (PDS).

To date, the Peasant Reserve Zone (ZRC) for the Pato River Basin and the Balsillas valley has managed to maintain the Cordillera de los Picachos National Park without human intervention in the area adjacent to it, reduce internal deforestation to less than 1% of its territory per year, and find a productive system that allows peasant life to flourish.

At the end of 2020, the boundaries of the ZRC were updated as a result of the high levels of ecosystem preservation (more than 60% of the ZRC), and 2,730 ha of forest cover were converted into the first Regional Natural Park of the Colombian Amazon (Miraflores and Picachos). At the same time, the Ministry of Environment and Sustainable Development adjusted the limits of the Amazon Forest Reserve, allocating to the ZRC lands that were taken away from settlers in 1984. Also, foundations were laid to manage the expansion of the ZRC towards the Bajo Pato sub-region, after consultation with the neighboring Nasa Indigenous Community of the Altamira Resguardo.

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Chiribiquete: World Natural and Cultural Heritage Site

Country: Colombia

Summary author: Carlos Rodríguez

The Serranía de Chiribiquete National Natural Park, located in the southwestern end of the Guyanese shield in the Colombian Amazon, is one of the largest protected areas in the country, with 4,268,095 hectares. In 2018 it was listed as a site of mixed Cultural and Natural Heritage of Humanity by UNESCO. This area, in addition to having high biodiversity, has more than 70,000 pictographs, which give it an exceptional value in terms of the history of settlement and occupation of the Amazon.

Researchers have studied the area for nearly three decades (Castaño-Uribe 2019), including its geology, geomorphology, soils, water, vegetation, and fauna, together with the archaeological study of the pictographs. Several articles have been published in indexed journals and carefully-edited books. The literature on Chiribiquete mostly represents the perspective of accredited science, but one of the volumes of

the *Revista Colombia Amazónica* includes the contribution of a traditional expert, Uldarico Matapí, who wrote the article "Echoes of Silence", which shows from the very title the magic and poetry of the place and its importance to Indigenous communities (Matapí Yucuna, 2017).

Uldarico Matapí, supported by a research grant from Tropenbos Colombia, has been documenting his vision of Chiribiquete as an area of great importance for shamanism, with the different phases of the origin of the world and its management rules presented in pictographs. Matapí, a shaman of the Upichía group, makes mental tours of the area to describe or tell its history, its role in the creation of the world, and how the mountains, rivers, and geographical features, such as huge round holes ("the echoes of silence"), were formed. In the same way, he has been compiling the shamanic meaning and the explanation or interpretation of the pictographs in which he finds the sequences of origin myths, songs, and rituals that order the world.

As a shamanic space, Chiribequete's pictographs tell stories about the origin of the rules of territorial management, how animals were dispersed to occupy their own territories, how plants and waters were distributed, and most importantly, how shamanic knowledge was distributed to maintain the order of the jungle. In this sense, Matapí contributes elements for governance from the traditional vision, since the area is formalized as a National Park, but its management should include the Indigenous communities for whom Chiribiquete is an ancestral site.

Matapí's compilation contributes to the dialogue of knowledge, to know first hand the traditional visions and not only the scientific research. In this sense, knowing and recognizing the importance of Indigenous knowledge contributes to better management of the area and highlights its role in cultural heritage, locally managed. Traditional knowledge can contribute elsewhere in similar ways, impacting new management and governance schemes for protected areas. It is therefore important to support contributions from traditional knowledge.

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Kukama Indigenous Peoples' underwater world, Peru

Country: Peru

Summary authors: Leonardo Tello and Natalia Piland

In the Lower Marañón River, Loreto, Peru, the Kukama Kukamiria Indigenous people collectively constructed a map that tells the story of these communities, a process that proved to be a powerful tool for reflection if humbly applied. In the face of external processes that threaten the lives of the people, such as logging concessions, oil exploitation, headwater mining, and over-extraction (e.g., fish, palm trees), the map communicates the relationships that are present in the day-to-day life of the communities and the

living dynamics of the river. The river is not a physical entity but rather part of family and memory. This initiative was full of hope, struggle, and strength in defense of rivers, life, and people. Among the relationships that the map reveals are stories of the *pela-cara*, ghost ships, and submerged cities.

The *pela-cara* is a supernatural character with lights, guns, and airplanes. He is very fast and appears to chase fishers and boat drivers. He is a being that cannot be seen from the forest. This story is told mostly when mining and oil companies invade without respecting the space of the native peoples. Thus, the frequency with which this story is told reproduces relationships between communities and external agents, and a history of aggression and violence. The *pela-cara* story and its increased visibilioty can be used to identify where this is happening.

The river also carries the memory of the rubber boom. People see ghost ships in the same places where rubbe, rosewood (*Tipuana tipu*), and other materials exploited at that time were shipped from. When one sees ghost ships, the sighting can also be felt; one can feel the pain of the people through time. We not only remember the violence before, but also the current violence, because the violence of the past is the same violence with which governments, extractivists, and others act today. They contain the same promises and lies. The map shows many things that have happened in the history of the Amazon and the Kukama people.

The river also moves fish and provides drinking water, among other things. But when a person falls into the river and we do not find his or her body, it is because this person now lives inside the river. Thus, the river enters into a relationship with people—the river gives life to everything, and it also contains the lives of our relatives in submerged cities. These cities are the same as the ones we have outside the river. The river also becomes a vehicle of communication with our relatives, and our relationship with the river is also affective and spiritual.

Through these ways of knowing the river, one can understand that the river is alive. In the same way, it is understood that there are various groups of "people" (*"gente"*), not only humans, but also fish, birds, plants, and other living beings. This way of looking at the world makes possible a harmonious relationship that is not possible when power corrupts, makes people consider themselves superior to other people, or when we believe that we can change our surroundings without respecting the relationships we have with other people. Outsiders are ignorant and do not know that the *cochas* (lagoons) have mothers, that there are relationships with animals, and that spirits exist, and so they believe they can enter these lands, destroying everything and taking the people with them.

This map was constructed within the project The Soul of the Marañon River: Submerged Stories of the Kukama People. This project, spanning more than five years, was carried out by Radio Ucamara, an Indigenous media outlet, which collects the individual and collective stories and histories of hundreds of generations. Through an interactive map, visitors can dive into the depths of the river to learn about what cannot be seen with the naked eye: the memory and worldview of an entire culture. Through meetings and workshops with community leaders, religious animators, and other members of the Kukama people, the team gathered the information to map the significant places. Between September 2016 and October 2017, with the support of civil society organizations such as the Wildlife Conservation Society (WCS) Peru, four additional field trips were completed to georeference the elements identified in the maps, which were published within a StoryMap in 2020 (Radio Ucamara 2020).

The information compiled in this map and the location of each element of the cosmovision of the Kukama People shows us the importance rivers have for an entire culture and the tremendous social impact that

the construction of poorly planned infrastructure brings; not only does it change the space where they live, but it could also destroy a part of their memory that can never again be recovered.

The map can also help with outreach to other people suffering similar things. The process of mapping a cosmovision and its political and cultural context can be done in other areas of the Amazon. In collaboration with CONFENIAE, an Indigenous federation in the Ecuadorian Amazon, Radio Ucamara is in the process of forming a network that gives Indigenous peoples the possibility of building policies and communications throughout the Amazon. The COVID-19 pandemic has made it more important to have this kind of alliance with courage. This experience can generate a new way of thinking about political relationships and the relationships of power in both ways. Large networks generate a lot of porosity and fall apart if they are not grounded in local experiences; with a map like this, we can generate local experiences that inspire a much larger movement. In addition to the map, the group is making films, animations, video clips, and recovering self-participating identities. Radio Ucamara is categorized as cultural radio, but is creating a movement that will sustain itself over time, just as the feminist movement is getting stronger.

The map is not just a map. It is full of lived, painful, and violent histories, and there could be a struggle as confrontational as that of the unions and other movements, but no one wants to lose any more lives. The struggle is at the creative level. We must be able to do beautiful things, and this map is just one step in this struggle that moves people through affection, rethinking, and collaboration and synergy. No one can resist a nice thing, and the map is just one of the nice things in this movement of Indigenous knowledge.

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The territory of the yurupari jaguars

Country: Colombia
Summary Author: Carlos Rodríguez

El Territorio de los Jaguares de Yuruparí (ACAIPI 2015) gathers the contributions of dozens of traditional knowledge holders of the Barasana, Eduria, Itana, Macuna, and Tatuyo peoples of the Pirá Paraná River in the Colombian Amazon, also known as the Territory of the Jaguars of Yuruparí. Through a long process of cultural strengthening, these Indigenous peoples captured their knowledge in written form as a way of transmission to young generations and the western or “white” world. In this way, they would better understand their visions of territorial management and their vision of the world.

UNESCO recognized traditional knowledge of the jaguars of the Yurupari as an Intangible Cultural Heritage of Humanity. This recognition entails the implementation of special measures for its protection and dissemination in governmental, academic, and cultural spheres. In this sense, the book makes visible the wealth of Indigenous knowledge about caring for the territory in one of the best-preserved areas of the Amazon.

This book was developed through a dynamic interaction between ACAIPI, the association of captains and traditional Indigenous authorities of the Pirá Paraná River, and the Gaia Amazonas Foundation, through a collaboration between Gaia researchers and several Indigenous youth groups, who also learned skills such as how to use technology for listening, learning, and transcribing Indigenous narratives and knowledge. In this way, they recorded, translated, and transcribed oral histories into Spanish and made

dozens of drawings and maps to accompany the narratives. This process was nurtured by professionals in the natural and social sciences from the Gaia Foundation through an intercultural knowledge dialogue. Researchers and Indigenous groups designed a joint strategy to create research groups, one per Indigenous group, *maloca,* and community. The research groups defined priority research topics and selected the texts that would later be included in the publication.

The final selection of texts by local Indigenous experts does not correspond to a linear discourse, but rather to the integral vision that Indigenous peoples possess. However, for the purpose of publication, these texts were grouped into chapters by theme: Narrations or words of origin, origin of the prayers, the emergence of the people, the territory as a great *maloca*, the sacred places of power, and the ecological calendar. Each chapter includes contributions from different Indigenous experts as authors and highlights their personal stamp in terms of the different ways in which each person tells a story.

Through these written texts, Indigenous youth have valuable reference material for their own educational projects, whereas, for western society, this publication is a first-hand reference on Indigenous visions of the territory and their care for nature, and offers great lessons of environmental ethics that have enabled these Indigenous peoples to secure one of the best-preserved forest areas in the entire Amazon over thousands of years.

The impact of this publication also reaches the political sphere: it strengthened the case for self-government and autonomy of Indigenous peoples in the Colombian Amazon and may inform the design and implementation of public policies that respond to the cultural diversity of the nation. Indigenous and non-Indigenous researchers have made significant efforts to show the Indigenous world vision to subnational and national government authorities and to include this knowledge and practices in the concept of sustainability. In his prologue, the president of Colombia highlighted the agreements recently signed with Brazil to safeguard the immaterial patrimony of Indigenous peoples of the northwestern Amazon Basin.

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Piraiba local knowledge: The fishermen's knowledge

Country: Colombia

Summary Author: Carlos Rodríguez

Scientific research on giant catfish in the Colombian Amazon dates back to the end of the 1970s, with studies from the Araracuara Corporation, a private institution that conducted research about giant catfish fisheries in the middle Caquetá River (Japurá in Brazil), including dorado (*Brachyplatystoma rousseauxii*), lechero or piraiba (*Brachyplatystoma capapretum*), pejenegro (*Zungaro zungaro*), guacamayo (*Phractocephalus hemiliopterus*) and pintadillo (*Pseudoplatystoma sp*). Early research focused on the definition of biological parameters for fisheries, such as catch sizes and sexual maturity sizes, to inform fisheries regulations. These early studies resulted in published articles that guided future research. On behalf of fishing authorities of that time, surveys were also conducted in the lower Caquetá River, very close to the border with

Brazil, and some fisheries regulations were established, including long periods of closure and limitations on the use of fishing nets—the predominantly used gear in the area.

In 1982, Carlos Rodríguez started a ten-year study of commercial fishing of giant catfish species, using information generated locally by fish traders (through fish inventories in commercial refrigerated chambers). This study was published as "Bagres, Malleros y Cuerderos en el Bajo Río Caquetá" (Rodríguez 1992) and presented a first-ever integrated analysis of historical, social, economic, and biological aspects of fisheries in an area of approximately 400 km^2 between the Cahuinarí River and the Brazilian border. Through participatory research methodologies, both fishers and traders refined and improved data collection methods to record information on catch parameters, fishing gear, catch areas, and fishing effort.

Research on biological, reproductive, and fishing aspects of giant catfish species continued over time with undergraduate and doctoral research and investigations by civil society organizations and research institutes (e.g., Instituto SINCHI), contributing to a better understanding of catfish species (Agudelo Córdoba et al., 2000). A popular topic was always feeding relationships of catfish, and many scholars tried to study this subject but found enormous limitations. Biological sciences approach this subject from the perspective of studying stomach contents, but researchers found empty stomachs in more than 95% of sampled catfish. Researchers then proposed to study the stomachs of all captured specimens by fish traders, but found fish arrived to cold chambers already eviscerated and that the research would interfere with the fish traders' processing (e.g., evisceration, gutting, de-salting, and cutting the head).

More than two decades ago, Tropenbos began a participatory research process with Indigenous communities and local people aimed at supporting the exhaustive documentation of Indigenous and local knowledge about the Amazon forest, including plants, terrestrial and aquatic fauna, soils, geology, and social and cultural aspects of Indigenous and local visions of the forest and its resources. As part of this, through grants for local research, researchers supported Luis Angel Trujillo, a second-generation settler, to compile his own knowledge about catfish and their ecological relationships. Trujillo was selected as he often showcased his enormous knowledge and ability to share it with the biologists working in the region.

Trujillo learned the art of fishing as a child and began to master the world of water and fish, especially giant catfish species. At the time, fishing was almost the only source of cash income in the region, and many young people entered this trade. Over time, fishers learn in great detail the behavior of the river, its hydrological periods, its hydrography, the strength of its currents, and its geographic accidents, such as rapids (*correntadas)*, watering places (*regadales*), beaches, shallows, and backwaters. Fishers also learn the seasonal behavior and diurnal and nocturnal cycles of giant catfish, and with practice over time and with persistent advice from experienced fishers, they learn about baits, capturing techniques, and the most successful capturing locations. Fishers are the first ones to check the stomach contents of giant catfish to determine which fish-prey they were consuming at the moment of capture and then look for these species as bait. Over a lifetime, angler fishers accumulate an enormous amount of information about prey–predator relationships and fish behavior.

Throughout his life, Trujillo accumulated expert fishing knowledge that enabled him to effectively gather information about the feeding relationships of each of the giant catfish species. Accompanied by scientific methods and with a simple spreadsheet, he recorded his knowledge about the diets of each of the species and generated extensive lists of prey. Then he consulted with fellow fishers to expand these lists. The expanded prey lists were then used as the base to organize additional information in new columns, such as classification of species as bait or natural prey, the hydrological period in which the relationship occurs,

and notes on whether the predation occurs on the Caquetá River or in its tributaries, providing information on how far upstream giant catfish can swim.

The resulting list of prey for the piraiba reached 93 species, whereas scientific research had only been able to identify 17 prey species, i.e., local knowledge exceeded scientific knowledge five times over. The list of species compiled by Luis Angel Trujillo was later complemented by his descriptions of the methods of capture, the moment in the river's hydrological cycle, the behavior of each prey, and other fish stories he learned from Indigenous peoples. This magnificent material, compiled over 20 years, was edited for publication in collaboration with Confucio Hernández Makuritofe, an Indigenous Uitoto expert in the art of illustration. Under the direction of Trujillo and his family, Makuritofe drew, one by one, the ecological relationships present in the world of water with impressive mastery and detail.

The result was published in a book, *Piraiba: Ecología Ilustrada del Gran Bagre del Amazonas* (Trujillo, Rodríguez, and Hernández 2018). It is the product of extensive dialogue between local knowledge and academic knowledge in the fields of biology, systematic taxonomy, and ecology, complemented with ecological illustration. That same year, the book obtained the Alejandro Angel Escobar National Research Prize, the most important research prize in Colombia. For the first time in Colombian history, local knowledge was recognized with a prize traditionally dominated by academic scientific research. The impact of this collaborative work has also permeated public institutions, and environmental government agencies are beginning to recognize the importance of including local knowledge and community monitoring in the management of fisheries in Colombia.

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Biodiversity as a form of sexual education

Country: Colombia

Summary Authors: Oscar Romualdo Román-Jitdutjaaño and Juan Álvaro Echeverri

Oscar Román-Jitdutjaaño 'Enokakuiodo', a Murui nɨpode elder, and anthropologist Juan Alvaro Echeverri have collaborated on research, and work on salt since 1995. The Murui word *ɨaizaɨ* (salt) refers to alkaline salts of vegetable origin, which are used by the Murui and other neighboring groups as a mixture for tobacco paste (*yera ambil*). However, in a symbolic and spiritual sense, the concept of *ɨaizaɨ* refers to the fertilizing potency present in all living beings and is the basis of the formation of human beings and the management of their relationships (Román-Jitdutjaaño *et al.* 2020).

This was an intercultural work, meaning not so much the combination of different approaches—Indigenous and scientific—on the same object (salt), but rather the recognition of the same (human) condition

through the construction of different objects: an object of the positive sciences, salt; and an object of Indigenous knowledge, the human body. An intercultural project is above all the construction of a social relationship between people with different capacities and knowledge, where an exchange of substances and services is established to achieve some common goal. This relationship is precisely the object of Indigenous knowledge; substances and services—food, tobacco, money, tools—are the salt of the matter. This relationship is comparable to the sexual relationship between a couple, where the exchange of substances leads to fertility, the main focus of this knowledge.

From the perspective of science, the subject of our common research is the salt; from the Indigenous perspective, what matters is the salt of the matter: the project, seen as a human relationship. What interests us is the latter. We want to show how the study of the human condition is carried out through a reading of the plant species used to extract plant salts, which are conceived as coming from the body of the Creator and as an image of the human body.

Plant species conspicuously show bodily processes that are hidden from perception. This reading of natural entities is intended to guide moral behavior and to develop a healthy, sociable, and fertile human body. Unlike the knowledge of objective and empirical sciences, Indigenous knowledge of biodiversity can be conceived as sexual education, understood as "knowledge of the body" (*abɨna onode*); that is, the control and management of bodily humors, affections, and capacities, in order to achieve fertility.

We said above that our concept of "interculturality" goes beyond the combination of different approaches (Indigenous and scientific) on the same object. In the western vision, plant salt (and its different associations) is an object and its different interpretations a matter of cultural difference. From Indigenous knowledge, on the other hand, the fact that each culture is apparently talking about a different object (or objects) is irrelevant, insofar as the objects share a common condition: humanity. Indigenous knowledge about plants is a device for understanding the dangers and risks ("salt-diseases") of the relationship involved in any political or scientific engagement, i.e., sexual education.

There is much to learn from Indigenous and local communities that directly depend on, spiritually value, and fight for their biodiverse ecosystems. These peoples not only value biodiversity for its utility, but also and primarily because these natural entities, objects, and species are their very body.

In 1995, at the very beginning of our study of the salts, Enokakuiodo wrote a text in the Murui language, entitled *Nabairiya* (Agreement), in which he made explicit the objective of our common effort. We translate some lines from it, which may give us an idea of the salt of the matter (Román-Jitdutjaaño *et al.* 2020, 1339):

fitoɨ raidora jenoyena	Seeking fruitfulness in a dangerous frontier.
yɨzidɨno dujuna jenua	Seeking the formation of life.
kaɨe daanori onoiyena feeiredɨno taɨjɨe	To know together what is ours, is a difficult job.
jaɨkɨna maɨrɨe jɨaɨe jibibɨrɨdɨno	A direct power to other *mambeaderos*.

menade nɨɨ ɨairoji jɨaɨ naɨraɨ	Two oceans, two peoples.
daaje Moniya nagɨma Kamani nagɨma	Europe and America.
fakadoga uai kominɨdɨkaɨ uai	Each speaks with its own voice.
kɨona onoga komɨnɨ ɨyano nagɨma	Each one lives according to its origin.
jɨrui uai nɨbaɨde onoñenia iia yote jɨruiñede	Sexuality however is the same; it is dangerous, one must know.
yoneraɨngo nɨɨ yoneraɨma daɨit-adɨma onoiga	The sex education teacher [biodiversity] is the one who knows, for she has already experienced everything.

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Training Indigenous Environmental Agents in the Southern Brazilian Amazon

Country: Brazil

Summary Author: Ney José Brito Maciel (PPI/IEB)

The Continous Training Program for Indigenous Environmental Agents in the south of the Amazon is the result of a consolidated partnership between the Indigenous Peoples Program (PPI) of the Institute of Education of Brazil (IEB) and the Parintintin, Jiahui, Tenharim, and Apurinã Indigenous peoples, with their respective representative organizations. In 2020, 73 Indigenous Environmental Agents (AAIs) participated in this training program, which seeks to reflect on concepts, practices, techniques, and technologies to support sustainable development and environmental security. Ultimately, the training program aims to increase the technical and political capabilities of Indigenous participants for facing a range of socio-environmental challenges that affect their territories.

The courses provide complementary spaces for dialogue and debate between diverse Indigenous and non-Indigenous concepts and practices, with the premise of developing a more equitable and balanced dialogue between Indigenous and non-Indigenous knowledge, particularly mainstream scientific knowledge. Courses aim to build a productive collaborative relationship between communities that have distinct worldviews, and yet share the same planet. The result is new ideas, new commitments, and new co-produced intercultural practices.

An essential part of this continuing education program is to carry out activities "on the ground" in the villages where AAIs live. These activities include natural resource management and conservation, political articulation with their communities, surveillance and inspection actions, research, mapping, and production of GIS maps, surveys, diagnoses, and inventories of natural resources and/or agro-forestry, as well as other interventions based on the opinions and demands gathered directly from the residents.

The training, followed by continued activity by AAIs in their villages and in political spaces, is part of a broader process that involves many other Indigenous peoples in Brazil, and is recognized as one of the most important components in the field of Brazilian environmental indigenism. This recognition stems from the very effectiveness and practical results that they demonstrate in the effective environmental and territorial management of their territories. In this sense, AAIs are considered central social actors in the effort to place Indigenous peoples on another level, where they are no longer attributed the role of victims or obstacles to national development, but rather as collectives whose actions are essential for the environmental protection of Brazilian biomes and for authentic sustainable development.

Financial support for this continuing education comes from various sources, almost always from various international cooperation projects. Specifically, to support the training of the 73 AAI mentioned here, resources are being provided by USAID, which supports the Our Land Project: Support for Territorial Management in southern Amazonas; and resources from the Amazon Fund, which supports the Sulam Indigenous Project: Indigenous Territorial Management in southern Amazonas. Both are aimed at improving and enhancing the environmental and territorial management of the Indigenous lands of the above mentioned peoples.

To learn more about these and other partnerships between the PPI/IEB and the Indigenous peoples of the southern Amazon, go to https://iieb.org.br/projetos-e-programas/povos-indigenas-2 or visit https://www.youtube.com/c/canaldoieb/videos.

Citizen science as a tool for fisheries monitoring using the Ictio App in the Madeira River Basin

Country: Brazil
Summary Author: Carolina R C Doria

Continental fisheries are less regulated in developing countries than in other regions of the world, and fishing statistics on fish landings are underrepresented or non-existent. The lack of robust data in Brazil is recognized as a threat to the management and conservation of stocks. A large and diverse population of small-scale fisherfolk undertake fishing activities in freshwater ecosystems, often in remote, undefined places. Catches are seasonal and species composition highly variable. Most catches do not enter a formal market but go directly to domestic consumption. These factors make it even more difficult to monitor fisheries and assess stocks.

This situation is even more aggravated in the state of Rondônia because the only fisheries monitoring in the region is done by hydroelectric dam construction and operation companies. Therefore, government fisheries managers can only access data with difficulty, and access is essentially impossible for fishers. As a result, these actors cannot participate in fisheries assessments and managing fisheries in the region is very difficult.

Between July and December 2018, the ECOPORÉ non-governmental organization and the Ichthyology and Fisheries Laboratory of the Federal University of Rondônia tested the Ictio application as a tool to solve

gaps in small-scale fisheries monitoring. This was part of an Amazon-wide collaborative project that supported training of a technician and a local intern, and the exchange of experiences with other projects across the Basin.

The project encouraged the participation of fishers in data collection and interpretation to answer their own questions about fishing. Fishers were invited through community meetings and also at fish landing sites. Project team members and participating fishers communicated via community meetings and Whatsapp groups and discussed the situation of exploited fishing resources; the impacts of hydroelectric dams on fish, particularly on migratory fish; and other topics of interest to fishers.

Field testing results demonstrated that it is possible to use smartphones to collect data on small-scale fishing landings. Using citizen science protocols and the Ictio App on smartphones, fishers collected data on small-scale fish landings. At the same time, community members were empowered to monitor and co-manage fisheries, uniting formal and traditional governance. This is particularly important in the Madeira Basin, given the recent implementation of two hydroelectric plants in the system, and the numerous problems caused by fishers' lack of access to data collected by hydroelectric companies, inhibiting their participation in decision-making.

As long as fisherfolk have access to the internet through smartphones, the Ictio App can be a powerful tool, allowing greater ownership when participating in data collection and also the creation of a support network between users.

The network created between the technical team and the fishermen makes it possible to continue the project by encouraging fishermen to keep daily records. In addition, the Citizen Science for the Amazon Network that emerged in this process seeks to replicate it throughout the entire Amazon Basin. To this end, next steps involve disseminating the results obtained so far and raising awareness about the Ictio App and the Network among as many fisherfolk as possible. We expect that the number of (sporting and professional) fisherfolk that use the application will increase in the coming years and that the information generated will be used to increase understanding of fisheries stocks so that fisherfolk can propose management and mitigation measures to address impacts of the hydroelectric dams and overfishing on fisheries in the Madeira Basin. For more information see https://ecopore.org.br/novo/o-que-os-cientistas-cidadaos-estao-registrando-no-ictio-neste-2020.

The Citizen Science for the Amazon Network: An Amazon-wide multi-scale collaboration to understand large-scale fish migrations

Countries: Bolivia, Brazil, Colombia, Ecuador, Peru
Summary autor: Mariana Varese

The Citizen Science for the Amazon Network is a knowledge network that seeks to create and share knowledge in an accessible, trustworthy, and timely way, with the ultimate goal of informing management and policy decisions at scale in the Amazon Basin. As of April 2021, the network included over 30 partners of different backgrounds from 7 different countries, all working on Amazon freshwater systems from their own perspective and interests. Partners have their own area of influence and lead collaborations with 70+ citizen scientist groups; thus, the Citizen Science for the Amazon Network is in fact a regional network of local networks (Figure 1).

Figure 33.A2.1 As of September 2021, there are over 30 partners of the Citizen Science for the Amazon Network, including universities, research institutes, non-governmental organizations, grassroots organizations, and individuals from 7 different countries, including Bolivia, Brazil, Colombia, Ecuador, France, Peru, and the United States of America.

The Citizen Science for the Amazon Network focuses on Amazon freshwater systems and started with migratory fish because fish are sentinels of the Basin's connectivity, critical for the livelihoods of rural and urban people, and connect people with the ecosystem (see following Figure). In the Amazon's extremely diverse and complex context, network partners create connections without forcing partners to meet standards or protocols that may become a barriers for participating organizations and IPLCs. First, through a collaborative process that started in 2017 and continues today, partners jointly defined a common question general enough to gather multiple stakeholders, and able to weave in other questions at smaller scales. *Where and when do fish migrate in the Amazon Basin and what environmental factors influence these migrations?*

Having a clear common framework, the Network also builds from the knowledge, capacities, and experience of partners and others. Partners design, test, and adapt innovative solutions catered to the Amazon context, constantly learning in this process. Over time, partners have agreed on guiding principles, varia-

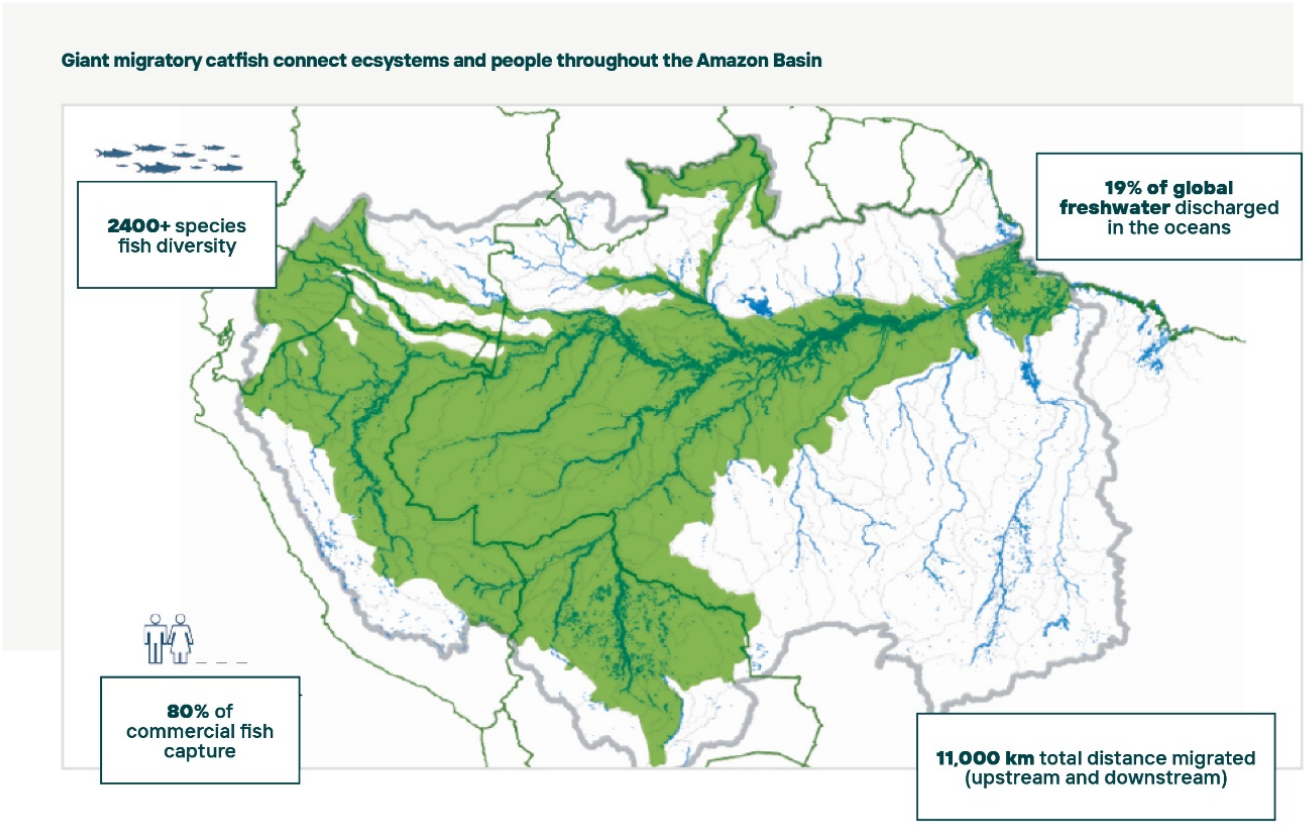

Figure 33.A2.2 Green represents the areas important for continental and large-scale migratory fish life cycles. © WCS, based on Venticinque et al. (2016), Goulding et al. (2019).

bles, protocols, free prior informed consent, terms of use, credit, and protection of privacy guidelines. These are periodically reviewed, assessed, and adjusted with an adaptive management approach.

A major achievement is Ictio.org, a shared database and app to generate, manage, and share data on observations of the most important migratory and food fish in the Amazon. Ictio.org was developed by the Cornell Lab of Ornithology in collaboration with Wildlife Conservation Society and Network partners. As of June 2021, Ictio's shared database included over 55,000 fish observations in 75% of the total 198 Amazon Level 4 sub-basins (as per Venticinque et al. 2016) (Figure 3). A lot more data is needed to make robust inferences at scale, and both Ictio and the Network are prepared to foster such large-scale, multi-stakeholder, multi-scale collaborations. To address challenges associated with the high-level of diversity and complexity of fisheries in the Amazon Basin, Ictio embraces diverse sources of data on fish observations (uploading data to the app, recording in notebooks, government data, researcher-based monitoring frameworks), and partners follow careful procedures to ensure proposed activities are presented, consulted, co-designed, and implemented with participating citizens, IPLCs, and organizations in a collaborative way, where objectives and decisions about access and use of the generated information are transparently and horizontally agreed upon.

Data is then made open to the public and shared through a three-tiered system that seeks to protect the privacy and rights of participating citizens and their communities or organizations (especially IPLCs),

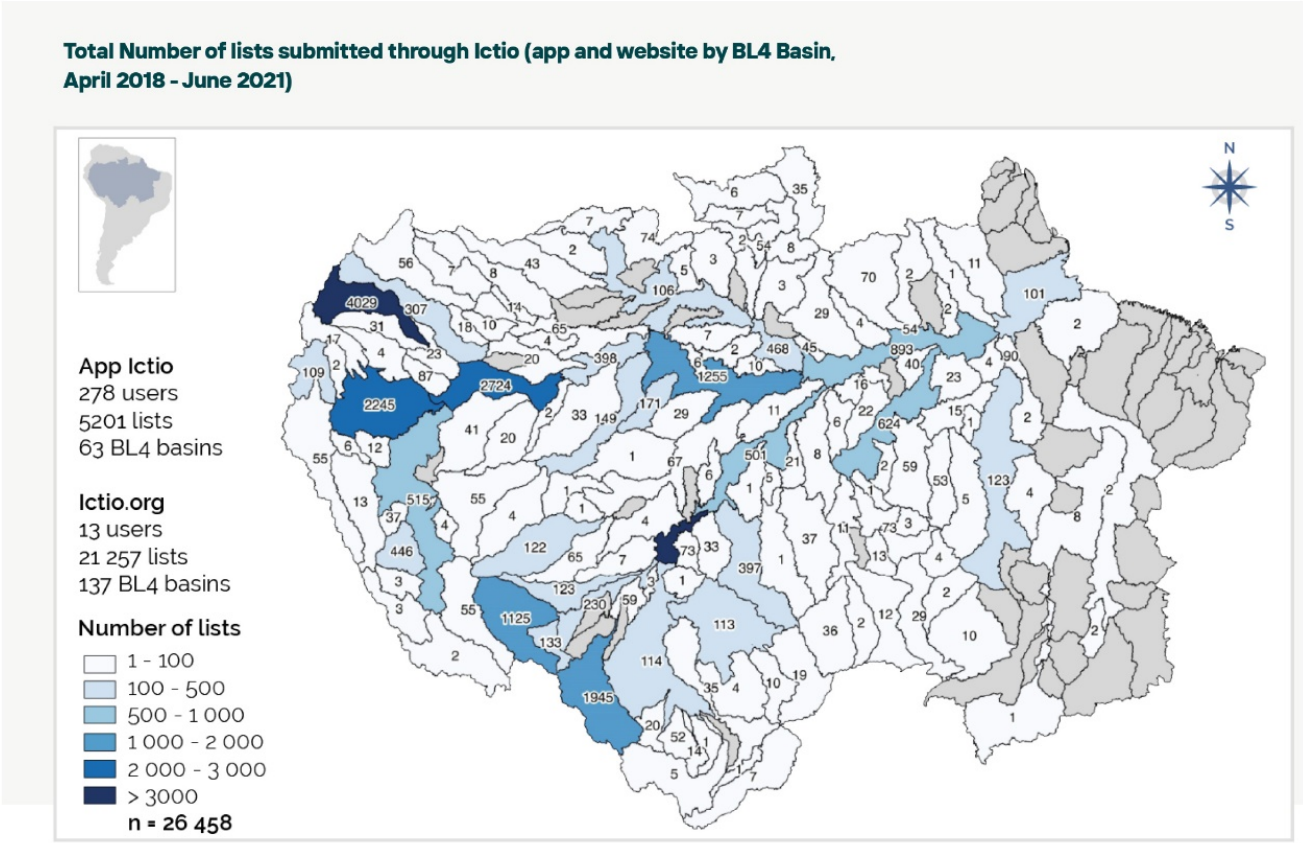

Figure 33.A2.3 Between April 2018 and June 2021, a total of 26,458 lists (observation events) were uploaded to the Ictio shared database, through the Ictio App and/or the online platform (ictio.org). These lists represent a total of 57,372 observations of 126 fish taxa (including 12 giant migratory catfish species), across 149 BL4 sub-basins of the Amazon that represent 75% of the 198 BL4 level sub-basins (as per basin classification by Venticinque et al. 2016).

while following the principles of open science and open access (see OCDKN 2015). Individual citizen scientists (users may be a person, a community, or a fisherfolk association) have complete access to the full data set they generate. Network partners have access to a data set that does not include personal identifiers but includes precise location names or coordinates. This is important for partners to address locally-relevant questions (e.g., at the level of a watershed or river tract). Finally, data is available to the public via the Ictio.org website, but this dataset does not include personal identifiers such as names and contact information, nor precise location names or coordinates. Instead, this dataset only includes the Basin Level 4 watershed for location (between 10,000 and 100,000 km^2 as per Venticinque *et al.* 2016). This system enables citizens, IPLC organizations, managers, and researchers to use the data for multiple purposes at different scales—from recording individual fishing/selling statistics, to informing community-based fisheries management plans, to understanding impacts of infrastructure projects such as dams on fish migrations, to learning about continental-level giant catfish migratory patterns.

The Citizen Science for the Amazon Network still faces important challenges on its quest to increase our collective understanding of the connectivity and integrity of freshwater systems, but a strong foundation of transparency, collaboration, adaptive management, and innovation has been laid out (see also World

Bank 2021, p. 297). In the coming years, Network partners will focus on increasing the fish database, connecting it with other similar or complementary efforts, and gathering best practices and lessons to continue fostering public participation in knowledge generation and sharing to inform decisions and policies across the Amazon. All this, while managing potential tensions associated with the Network's commitment to scale (this is what brings partners together), while embracing diversity of sources of knowledge (especially ILK), and respect and enforcement of the fundamental rights of IPLCs. For instance, reaching Basin-wide scale requires some level of homogenization, while community-based monitoring or science generally involves multiple forms of knowledge, associated with specific environmental, social, and cultural contexts. This diversity makes it difficult to agree on common criteria, parameters, and thresholds for aggregation. Also, it sometimes forces us to negotiate among conflicting views of the world. Authorship, intellectual property rights, and appropriate credit given to non-mainstream scientists continues to be an unresolved challenge, although important progress has been made in recent years.

As Network partners deal with these tensions and address these challenges, a fundamental guideline is to follow the precautionary principle and that local partners take the lead on identifying together with citizen scientists (e.g,. fisherfolk associations, Indigenous communities, or students) what local questions to answer, how to analyze and use the data, if and how to share information, what decisions to inform, and what audiences to target.

The rapidly evolving fields of citizen science, open science, and open access offer globally-important lessons and best practices that can contribute to sustainable pathways for the Amazon, in a way that places its peoples at the center of conversations. The Citizen Science for the Amazon Network provides a model of an Amazon-Basin-wide network that connects diverse and distributed communities to generate and share knowledge and co-create solutions through a decentralized, transparent, and innovative governance model. For more information visit https://www.amazoniacienciaciudadana.org/english/ .

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Collaborative Knowledge Production and Coalition Building for Conservation Action through Rapid Biological and Social Inventories

Countries: Andean Amazon (Bolivia, Colombia, Ecuador and Peru)
Summary authors: Christopher Jarrett and Diana Alvira Reyes

Since 1999, the Field Museum has led 31 rapid biological and social inventories in areas of high biodiversity and uniqueness, and 24 of these have been conducted in the Amazon: 14 in Peru, 3 in Bolivia, 3 in Ecuador, 2 in Colombia, and 2 binational (Ecuador–Peru and Peru–Colombia). Rapid inventories leverage the Field Museum's scientific expertise and collections of over 40 million specimens to collaboratively produce knowledge that supports conservation action. Our vision of conservation is one in which environmental health is intimately linked with local peoples' well-being, so we design inventories to bring together diverse groups and with the shared goal of sustained stewardship of these unique and important landscapes (Wali et al. 2017).

Rapid Inventories

PROTECTED		HECTÁREAS	ACRES
01	Bolivia: Tahuamanu	1,427,400	3,527,105
02	Perú: Cordillera Azul	1,353,190	3,343,732
03	Ecuador: Cofán-Bermejo	55,451	137,019
06	Bolivia: Bruno Racua	74,054	182,991
11	Perú: Tamshiyacu-Tahuayo	322,979	798,098
12	Perú: Ampiyacu-Apayacu	433,099	1,070,211
15	Perú: Megantoni	216,005	533,748
16	Perú: Matsés	420,635	1,039,413
17	Perú: Sierra del Divisor	1,478,311	3,652,906
18	Perú: Nanay-Pintayacu-Chambira	953,001	2,354,916
20	Perú: Güeppí-Sekime	203,629	503,177
20	Perú: Huimeki	141,234	348,998
20	Perú: Airo Pai	247,888	612,544
21	Ecuador: Territorio Ancestral Cofan	30,700	75,861
21	Ecuador: Cofanes-Chingual	89,272	220,596
22	Perú: Maijuna-Kichwa	391,040	996,280
23	Perú: Yaguas	868,927	2,147,118
Total Protegido / Protected		8,706,815	21,544,713

REINFORCED		HECTÁREAS	ACRES
04	China: Yunnan	405,549	1,002,133
07	Cuba: Zapata	432,000	1,067,495
08	Cuba: Cubitas	35,810	88,488
09	Cuba: Pico Mogote	14,900	36,819
10	Cuba: Siboney-Juticí	2,075	5,127
13	Cuba: Bayamesa	24,100	59,552
14	Cuba: Humboldt	70,680	174,654
20	Ecuador: Cuyabeno	603,380	1,490,984
24	Peru: Kampankis (Santiago-Comaina)	398,449	984,590
31	Colombia: Reserva Forestal Tarapacá	425,471	1,051,362
31	Colombia: Amacayacu	293,500	725,254
31	Colombia: Rios Cotuhé y Putumayo	255,146	630,479
Total Fortalecido / Reinforced		2,961,060	7,316,937

PROPOSED		HECTÁREAS	ACRES
05	Bolivia: Madre de Dios	51,112	126,298
06	Bolivia: Federico Román	202,342	499,987
11	Perú: Yavarí	777,021	1,920,019
19	Ecuador: Dureno	9,469	23,398
23,31	Perú: Bajo Putumayo	347,699	859,164
25	Perú: Ere-Campuya-Algodón	900,172	2,224,325
26	Perú: Cordillera Escalera-Loreto	130,925	323,516
27	Perú: Tapiche-Blanco	308,463	762,212
28	Perú: Medio Putumayo-Algodón	416,600	1,029,419
29	Colombia: Lindosa, Capricho, Cerritos	54,000	133,434
30	Colombia: Bajo Caguán-Caquetá	779,857	1,927,027
Total Propuesto / Proposed		3,977,660	9,828,798

TOTAL	HECTÁREAS	ACRES
Protegido / Protected	8,706,815	21,544,713
Fortalecido / Reinforced	2,961,060	7,316,937
Propuesto / Proposed	3,977,660	9,828,798
TOTAL HECTÁREAS / ACRES	15,645,535	38,660,117

Figure 33.A2.4. Locations of rapid inventories conducted in the Amazon

While the whole inventory process typically lasts a year or more, the main fieldwork portion is completed within a few short weeks. A multidisciplinary team of local, national, and international experts—biologists, social scientists, and representatives from civil society and government—work with local people to learn as much as possible about a landscape and what is needed to protect it. For the biological portion of the inventory, the team surveys plants, fish, amphibians, reptiles, birds, and mammals—organisms that indicate habitat type and condition and that can be surveyed quickly and accurately. They identify species, natural resources, and landscape features with high conservation value (at global, national, or local scales), assess their status, and document threats to these natural assets. For the social portion of the inventory, the team uses a variety of social science methods—participant observation, interviews, focus groups, participatory mapping, and others—to quickly identify the assets and aspirations of local people, as well as the challenges they face. Such knowledge informs recommendations for conservation action (Pitman et al. 2021) to ensure that they align with local peoples' strengths and visions for their quality of life.

As soon as fieldwork is complete, the team presents preliminary findings to local people and in-country decision-makers. Then, practical recommendations for long-term conservation are developed, which often include establishing a new protected area and strengthening environmental governance in the region by mitigating threats and supporting sustainable natural resource use. In the months and years following the inventory, we share the recommendations, reports, and other inventory products with decision-makers, who in turn take action. We also produce a written report that we return to local people and make available in digital form for free online (http://fm2.fieldmuseum.org/rbi/results.asp).

Rapid inventories are participatory knowledge production processes. During fieldwork, in-country and international scientists collaborate with local people to understand the environments surveyed through a synthesis of scientific and local knowledge. The process makes visible the intimate understanding local populations have of the landscapes they call home and the ways in which their long-term stewardship has conserved these places over time. At the same time, it provides local people access to scientific knowledge that allows them to better manage their resources and protect their territories from threats such as deforestation and contamination from mineral extraction, which are typically driven by outsiders.

Rapid inventories are also structured to create diverse coalitions that drive conservation action. Since the first rapid inventory, we have worked with thousands of people, hundreds of local communities, dozens of in-country organizations, and more than 20 different Indigenous peoples. We deliberately build a consensus vision for conservation across a wide cross-section of stakeholders, while acknowledging and respecting the differences among the actors involved. The vision explicitly puts local people at the forefront to ensure that conservation actions are just, equitable, and sustainable. The rapid inventory process has allowed local people to gain greater recognition of, and formalize, their sustainable management practices. It has also helped in-country government agencies better understand the sociocultural, political, and biological contexts in the areas they are tasked with protecting. This consensus-based approach ensures that the vision is seen as broadly legitimate and thus attractive to decision-makers. It also ensures more effective protection by incorporating the knowledge and needs of local people into conservation.

Finally, rapid inventories have laid the groundwork for new participatory knowledge construction and data management tools. For instance, after inventories are complete, we develop field guides based on the observations and collections during fieldwork, and these guides are subsequently made available to in-country researchers and local communities for educational and research purposes (See Field Guides here: https://fieldguides.fieldmuseum.org). We have also recently partnered with Yale University's Map of Life

project (https://mol.org) to develop "Biodiversity Dashboards" (https://mol.org/places), an online tool for easily accessing biodiversity data. The Biodiversity Dashboards provide regularly updated species lists by country, territorial designation (province, region, or department), protected area, watershed, or Indigenous territory. This information is currently available for Colombia, Ecuador, and Peru, and we hope to expand to other countries and regions in the future.

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