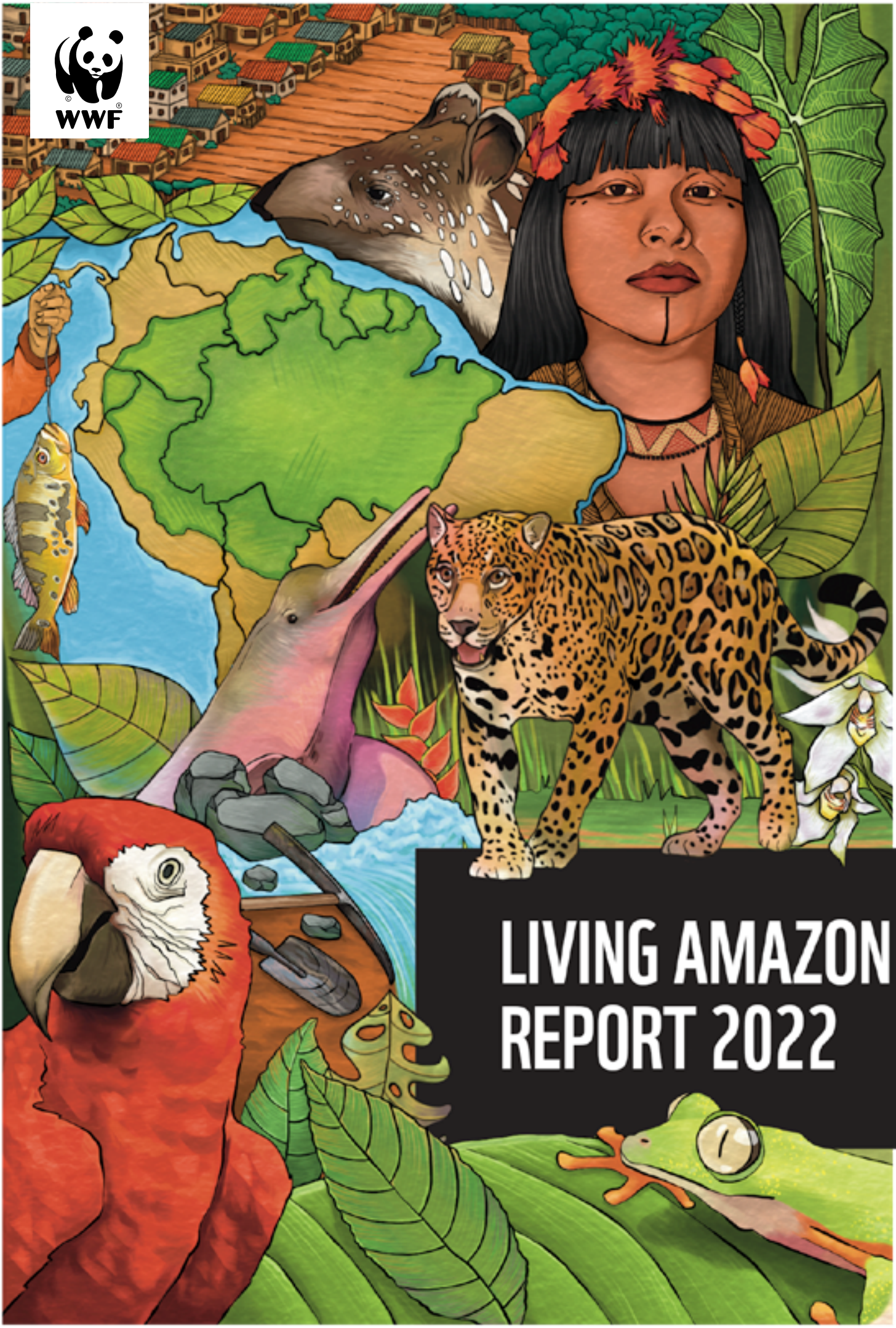
WWF
LIVING AMAZON
REPORT 2022

WWF is an independent conservation organization, with more than 35 million followers and global network active through local leadership in over 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and build a future in which humans live in harmony with nature by conserving the world's biological diversity, ensuring the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

The designation of geographical entities and the presentation of the following information do not imply the expression of any opinion whatsoever on the part of WWF concerning the legal status of any country, territory or area, its authorities, or the delimitation of frontiers or boundaries.

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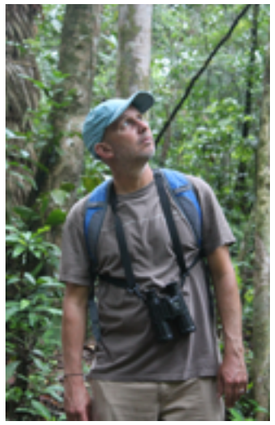


A myriad of words and images evoke the Amazon: incredible, diverse, ancestral, endangered, critical, fascinating, wild, enormous, green, important. I will try to evoke it with a personal anecdote. Here goes. I was walking along a trail with a boy no more than 10 years old. We were both visiting, hoping to see an eagle's nest. I noticed that every so often, the boy would pick up a twig, a leaf, a berry. I preferred not to ask. We arrived at the nest, saw the eagle and returned. When we got back, the boy looked for his mother and with a proud smile showed her the booty. "Look mom, copaiba (*Copaifera*) for wounds, jergón sacha (*Dracontium Spruceanum*) for snake bites, pájaro bobo (*Tessaria integrifolia*) for toothache." And so on and so forth. For me it was a revelation. How much usefulness that I was unaware of. How much knowledge in that little boy. How like so many other children around the world, looking to make his mother proud, but in such a unique way. What great diversity in such a short journey. This image, of a child, some plants, an eagle, a wealth of knowledge, is the Amazon. Yet this same Amazon is also a complex space filled with contrasts. As well as lush forests and rivers, indigenous territories, and local communities, the Amazon is also home to cities, highways and industry. In the Amazon are juxtaposed all kinds of economic activities that have multiple environmental, social and economic impacts, some of them positive and others harmful.

The Living Amazon Report 2022 is based on the conviction that the fate of humanity is inseparable from the fate of the Amazon and that humanity has within its grasp the means to guarantee a prosperous life for all without destroying the natural wealth of the biome on which our collective well-being depends. WWF's vision for the Amazon region, with which we hope to inspire a collectvie effort to keep it alive, is: "To ensure an ecologically healthy Amazon biome and basin that maintains its environmental and cultural value for local peoples, the countries of the region and the world, within a framework of social equity, inclusive economic development and global responsibility". This report outlines the current status of the Amazon biome and basin, summarizes key pressures and drivers of change, and outlines a conservation strategy for this decade that would enable the vision of a Living Amazon to become a reality going forward.

The report also accompanies WWF's global Living Planet Report, with a spotlight on the Amazon biome, available in Spanish and Portuguese (local languages), as well as in English. We hope it will showcase the work of scientists and conservation organizations and bring us closer to the voices of indigenous and Amazonian peoples. And, of course, you'll also find some of the solutions we're working on there - enjoy!

Kurt Holle
Director of WWF Peru and WWF Amazon Coordination Unit

EXECUTIVE SUMMARY

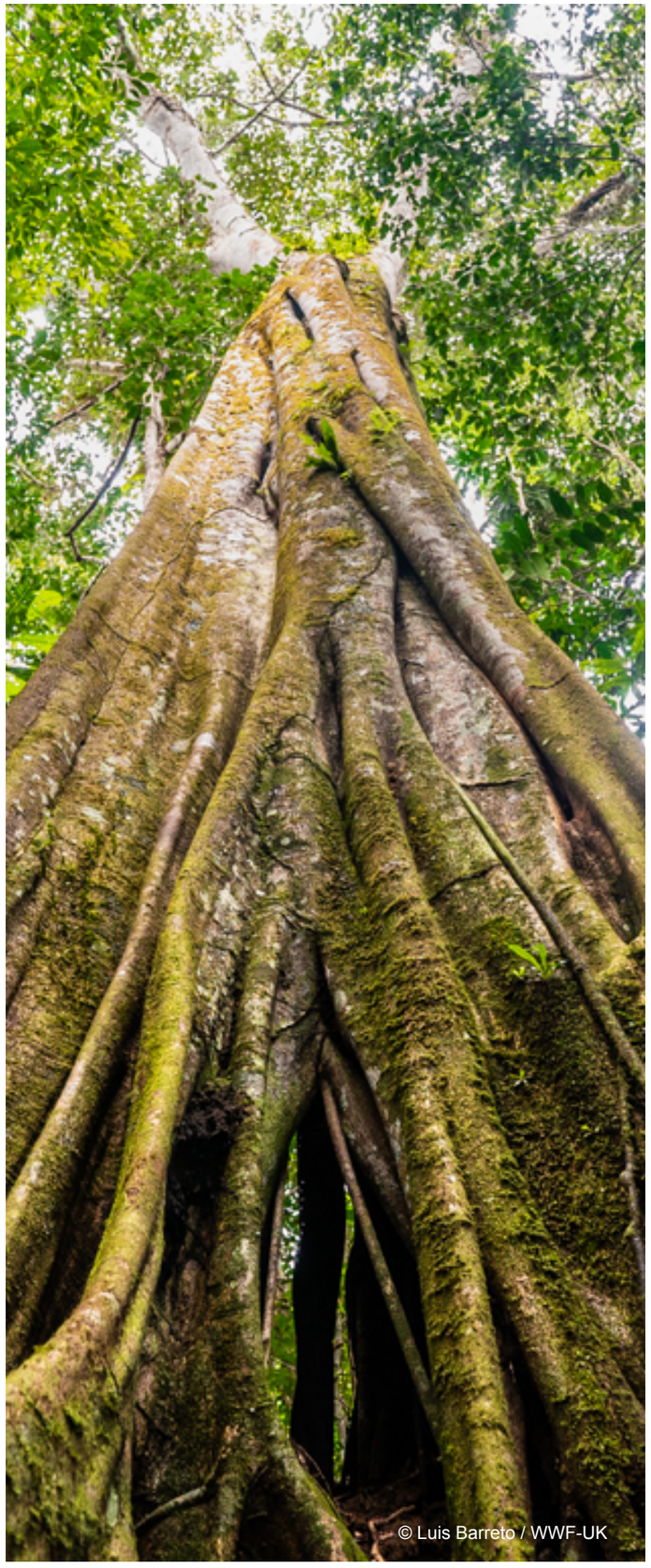
With inmense forests and rivers filled with unique natural environments that support a remarkable cultural diversity across 7 million square kilometers, the Amazon is extraordinarily important to South America and the entire planet.

Spanning eight countries and one overseas territory, this huge portion of the Earth's biosphere is home to a population of 47 million people, more than 2 million of whom are indigenous peoples from more than 500 distinct groups. The Amazon's ecosystems provide environmental benefits to the region and the entire planet, including climate regulation. For these reasons and more, its conservation must be holistically approached, with a regional vision and a global commitment.

The Amazon is currently in a critical situation, facing a variety of pressures and threats both to its biodiversity and to the traditional peoples and communities that live there. The region faces a complex political context in which there are stark barriers to the full participation of civil society in decision-making related to environmental protection and the pursuit of sustainable development; certain economic priorities conflict with conservation; and there is insufficient government capacity to address environmental issues.

In addition, the ongoing advance of deforestation is jeopardizing the health and long-term survival of the biome, constituting its greatest threat. The main drivers of deforestation are the expansion of agriculture and cattle ranching, as well as land grabbing and speculation. But forest loss is also associated with other phenomena that contribute to degradation and deforestation including unsustainable and illegal logging, uncontrolled forest fires, and poorly planned infrastructure. The illegal trade of wildlife is a serious problem: species such as the jaguar are indiscriminately and illegally hunted for the sale of their parts, and overfishing is depleting fish stocks in Amazonian rivers.

The Amazon is home to 20 percent of the world's liquid freshwater, but Amazonian rivers and their associated resources are also at risk. One of the greatest threats stems from dams that disrupt connectivity, alter water quality, and reduce the amount of sediment carrying nutrients throughout the system and ultimately feed mangrove and wetland areas at the river's estuary on the Atlantic. The release of mercury emitted from illegal and informal gold mining also poses a significant threat, poisoning water, air and soil, and moving up the food chain from fish to humans. Other legal and illegal extractive activities are also placing the Amazon at risk.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More than 15 percent of the total Amazon area is under concession for mining and oil operations that have significant environmental impacts and potentially open the door to other forms of encroachment. Finally, climate change is a looming global threat that increases the vulnerability of Amazonian biodiversity and accelerates degradation driven by other pressures. There is a very real risk that the Amazon biome will reach a tipping point after which it will shift away from its extraordinary forests toward different, heavily degraded ecosystems. Protected areas and indigenous territories are an important counter to these pressures, but they too face severe threats.

Over the last four decades, several successful conservation and sustainable management strategies have been developed that seek to keep the Amazon standing and protect its ecosystems, while supporting culturally appropriate sustainable development initiatives for local communities and countries in the region. These strategies depart from the imperative to maintain or increase the area under effective conservation and management in protected areas and indigenous territories, and to halt deforestation and forest degradation through greater environmental regulation, private and financial sector commitments, and integrated landscapes management approaches that combine protection with sustainable management and restoration. This would be achieved by incorporating a range of options from maintaining landscapes and value chains free of deforestation and conversion, through to the sustainable management of forests and legal trade. Strengthening protected areas and indigenous territories is critical as they serve as the biome's green infrastructure and provide long-term resilience against the multiple threats outlined above.

Dedicated efforts are also essential to the protection of key species such as the jaguar, whose status reflects overall ecosystem health. Strategies for the conservation and sustainable management of the Amazon also require targeted measures to maintain healthy rivers, which entails ensuring sufficient connectivity along stretches of high-priority aquatic corridors, halting mercury contamination, and implementing conservation measures for freshwater umbrella species such as river dolphins.

Protection strategies for the Amazon require multiple stakeholder participation - which must necessarily include indigenous peoples and local communities - as well as the execution of crosscutting solutions associated with the implementation of sound public policies, the generation of additional scientific information and knowledge, the transformation of the formal education system, and the promotion of education programs that foster knowledge of the ecological processes and connectivity of the Amazon biome. All of this must be done in conjunction with appropriate communication of the Amazon's importance, the threats it faces and strategies for its protection.

1. AN AMAZONIAN VISION

INTRODUCTION

The Amazon is a biome, which is to say, one of the planet's large regions that together comprise the biosphere, the part of the planet that contains life.

These are large portions of the Earth's surface, seas and atmosphere classified in terms of their biological composition and ecological characteristics. Deserts, savannas, tropical forests, and mountains are all examples of biomes.

When we speak of the Amazon, we refer simultaneously to this biome, as well as to the basin of the great river from which it is named. The correspondence between the Amazon basin (hydrological) and the Amazon biome (ecological), although very close, is not exact. The biome refers to **the tropical rainforest and other connected ecosystems such as savannas, grasslands, and swamps**. The paramo on the eastern foothills of the tropical Andes, for example, is part of the basin but not the biome. The basin refers to **the water catchment area of all the rivers that lead into the Amazon River**. In this case, the eastern foothills of the tropical Andes are part of the Amazon basin (Map 1).

Map 1: Location

Elaboration: WWF-Brasil.

The Amazon can therefore be considered a single ecological entity, with an infinite number of connections between its different species, ecosystems, and mechanisms.

The rainforests of the Guianas are not in the Amazon basin but are continuous with its forests. In this publication we include both the 6.7 million square kilometers of the biome and the basin that includes the headwaters of the Amazonian tributaries in the Andes, which extends beyond the southern border of the Amazon biome but excludes a significant part of the Guiana Shield in the north.

The Amazon can therefore be considered a single ecological entity, with an infinite number of connections between its different species, ecosystems, and mechanisms. What happens in one part of the biome affects the other parts. This interdependence beetween the different components necessitates a biome-level approach: the conservation of the Amazon must be considered from a regional perspective to ensure its long-term viability.

Under this immense environmental umbrella, each Amazonian country has its own distinct realities, priorities and approaches born of a development trajectory that - although they have general points of overlap such as ecological commonalities, a colonial history and multiculturalism - have nevertheless followed distinct paths that make for remarkable heterogeneity. Cultures, languages, political systems, and history are remarkably varied, making cohesion around a common vision for the biome difficult.

But this does not entail that **a regional strategy for the conservation of the amazon that takes these differences as a starting point and integrates them in the search for a common good** is inconceivable. In recognition of the fact that each country's Amazon region depends on the overall health of the biome, any such tool needs to be based on ensuring that the actions of one country do not harm others. The whole is more than the sum of its parts at the biome level; uncoordinated national-level initiatives will not achieve the changes sought at the regional level.

In addition to **coordination, integrated interventions** that contribute to the sustainable development of the whole region are required. An approach must be developed that combines conservation with socioeconomic development needs through a combination of protection, sustainable management, and restoration; that incorporates the visions and needs of multiple stakeholders, starting with the livelihoods and priorities of indigenous peoples and local communities; and which involves other stakeholders inside and outside the biome whose interests affect and are affected by it. The goal should **be the long-term preservation of an ecologically secure biome that enhances human well-being and is compatible with the development needs of the region's countries.**

THE AMAZON: A BIOME OF GLOBAL IMPORTANCE FOR PEOPLE, NATURE, AND THE PLANET

97 percent of the Amazon's surface area (6.5 million square kilometers) is covered by forests. It is the largest continuous system of tropical forests and rivers in the world, covering large portions of eight countries and one overseas territory [1,2].

Brazil contains three-fifths of the biome, followed in order of land area by Peru, Colombia, Venezuela, Bolivia, Guyana, Suriname, Ecuador, and French Guiana [2].

The Amazon biome is composed of multiple interdependent terrestrial and aquatic ecosystems, with extraordinary, unique, and irreplaceable biodiversity, as well as a complex set of biogeophysical interactions. These ecosystems act in concert with the atmosphere and form a continental-scale climate regulation mechanism; a fundamental part of the earth's climate system [* 2] [Cap. 5]. This interconnection means that degradation ocurring in one part affects the system as a whole.

[*] Throughout the report there are entries linking to corresponding chapters in the Assessment Report (2021) from the Science Panel for the Amazon. Entries of this type, in square brackets, indicate the corresponding chapter of the Assessment Report.

The Amazon offers multiple ecosystem services, defined as the benefits provided to us by nature.


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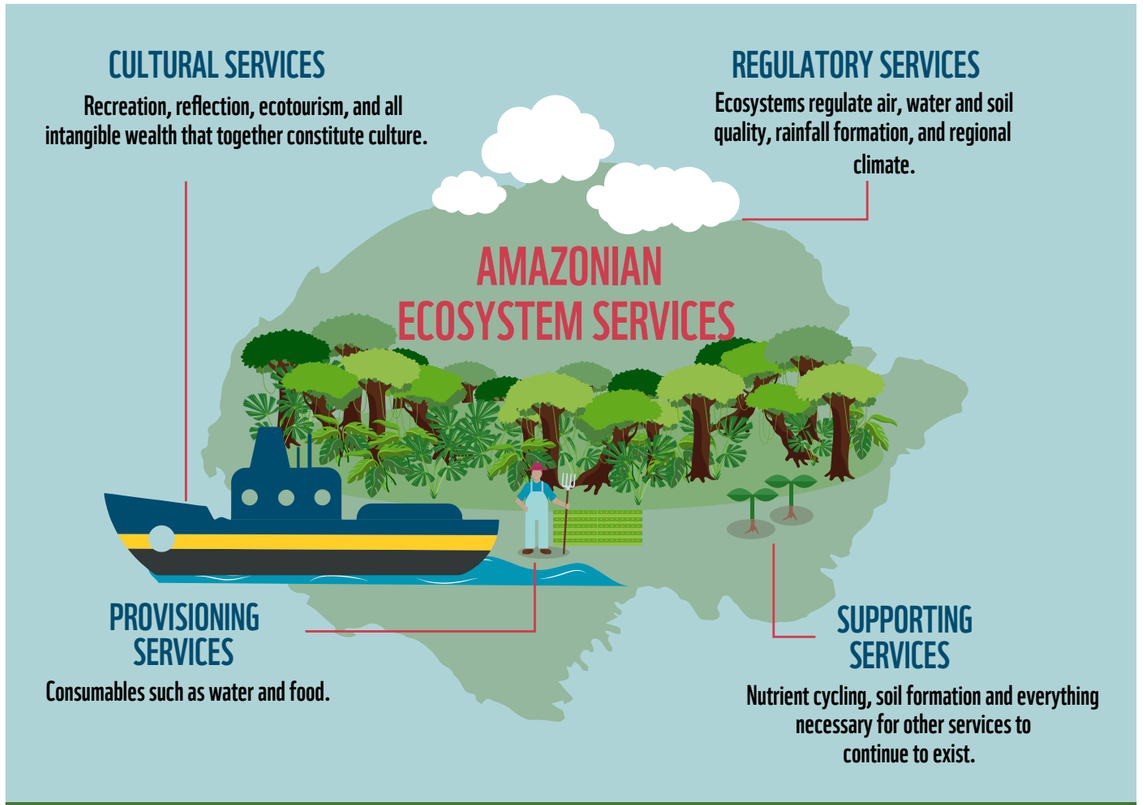

ECOSYSTEM SERVICES SUPPORT ALL LIFE AND ARE VITAL FOR OUR SURVIVAL. THESE ARE PARTICULARLY IMPORTANT [1,2]:

CARBON SEQUESTRATION:

200 billion

Tons are stored in the Amazon's soils and vegetation [14] [Cap.2, Cap.5].

WATER RECYCLING:
between

50 AND 75 percent

Of annual rainfall in the Amazon is recycled.

FOOD PROVISION:
in addition to plant-based food, the Amazon provides

511.000 tons of fish

More than 4 percent of total freshwater catch comes from this region[4].

PROVIDES FRESHWATER AND NUTRIENTS TO THE OCEAN:

the Amazon accounts for between

15 AND 20 percent

of total freshwater discharge into the Atlantic [5].

[*] According to the glossary presented by WWF Colombia's www.wwf.org.co.

Though occupying less than one percent of the Earth's land surface, the Amazon contains almost 10 percent of the Earth's biodiversity [Cap. 2]. It is home to 18 percent of vascular plant species, 14 percent of birds, 9 percent of mammals, 8 percent of amphibians, and 18 percent of tropical fish [6, 7, 8]. It is estimated that a single gram of Amazonian soil could contain more than a thousand species of fungi [9, 10] [Cap. 3]. As much as 90 percent of the biodiversity remains unidentified in some parts of the biome: a native Amazonian species that is new to science is discovered every two days.

Amazonian biodiversity also has very high levels of endemism: 34 percent of mammals [11, 12] and 20 percent of birds are not found elsewhere in the world [6, 13]. The diversity and endemism of fish is also remarkable: 13 percent of all freshwater fish species are found in the Amazon, 58 percent of them endemic [8] [Cap. 2].

Amazon contains almost 10 percent of the Earth's biodiversity.

Safeguarding the integrity of the Amazon is fundamental for the survival of the indigenous peoples living there, as well as for the sustainable development of Amazonian countries and the rest of the world.

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Agriculture is deeply dependent on favorable environmental conditions; this has a lot to do with the Amazon.

The Amazon contributes to the regulation of the planet's climate. The ecological structure of the biome and its location in the equatorial zone of South Ameerica —between the Atlantic Ocean and the Andes— generate a hydrological engine of favorable climatic conditions across the continent, not only through the water found in rivers and other bodies of water, but also through so-called "flying rivers", those immense aerial flows of water vapor that come from the Atlantic and, nourished by the humidity of the rainforest, transport more water than the Amazon river itself.

The Amazon's hydrological functions are also significant at the global level and its ecosystems contribute to global climate stabilization by storing 150-200 billion tons of carbon in their soils and vegetation, which is equivalent to 367 to 733 GtCO2 (Gigatons of carbon dioxide) stored in the Amazon. The carbon budget that has been estimated for the planet to stay within a level of warming that does not exceed 1.5 degrees Celsius is 360 to 510 GtCO2, which means that losing the Amazon is equivalent to losing the opportunity to reach the climate goal of 1.5° [183, 185, 186] [Cap. 2, Cap. 5]. Of all the estimated biomass in the Amazon region (73 billion tons of carbon), 58 percent is found within indigenous territories and protected areas [187].

Forests can therefore be seen as "giant air conditioners" [Res.1]; their trees functioning as a biological pump that captures water from the soil, raising it up through evapotranspiration, from where it condenses and turns into rain [Cap.5].

In general, agriculture is highly dependent on favorable climatic conditions. Thanks to the humidity generated by its forests and other ecosystems, the Amazon positively influences the climate of the entire continent [15]. Water vapor released from the basin contributes to rainfall far beyond the biome's boundaries, while deforestation leads to drier and warmer conditions locally, regionally, and globally. Moisture from the Amazon travels west and southward into central South America, passing through the Andes, west-central and southern Brazil, the Pantanal and Chaco biomes, and the La Plata River basin; into also influences climatic conditions northward across the continent. Several studies have found that the destruction of the Amazon's forests would reduce rainfall in Central America, North America and even parts of Asia, including countries such as the United States, China and India [16]. In other words, an ecologically healthy Amazon is indispensable for agriculture in the so-called "bread basket" of South America, composed of Brazil, Bolivia, Paraguay and Uruguay, where most of the region's food is produced, as well as for food production systems across the entire American continent and the world [Cap. 7].

Rivers and related freshwater systems (floodplains and temporal lakes) in the Amazon serve multiple functions: they provide habitat for freshwater fish populations that provide food security both for local communities and cities in the region, they deliver sediment downstream, mitigate the impacts of extreme weather events such as droughts or floods, and provide habitat for biodiversity. **Safeguarding healthy, free-flowing rivers is crucial to maintaining these critical ecosystem services over time**.

Humans have lived in the Amazon for at least 12,000 years and the biome was historically a center of cultural and technological innovation [17]. It is presently home to 47 million people including 2.2 million indigenous people from about 511 distinct groups, of which 66 are living in isolation or initial contact [*, 2, 18]. Around 300 different indigenous languages are estimated to be spoken in the Amazon [Res. 1]. More than merely a physical space, indigenous peoples hold both material and immaterial relationships with the territory encompassing culture, ancestral knowledge, rivers, land, and air, which together safeguard their very existence.

However, **most people in the Amazon live in cities**. In general, these cities place serious pressures on ecosystems and typically contain violent urban areas, large informal settlements and high levels of poverty [Cap. 14].

Our planet would not be the same without this incredibly unique place. The Amazon has become part of the collective identity of humanity and, as such, it is our hope that it will continue to provide fundamental benefits to the planet and inspire future generations for a long time to come.

[*] *For more information on the organizational structures of indigenous peoples in the Amazon, visit the website of the Coordinating Committee of Indigenous Organizations of the Amazon Basin.*

The Amazon biome is sensitive to changes in its ecological structure due to deforestation and degradation, which, along with climate change, impact the biome's ability to regulate climate.

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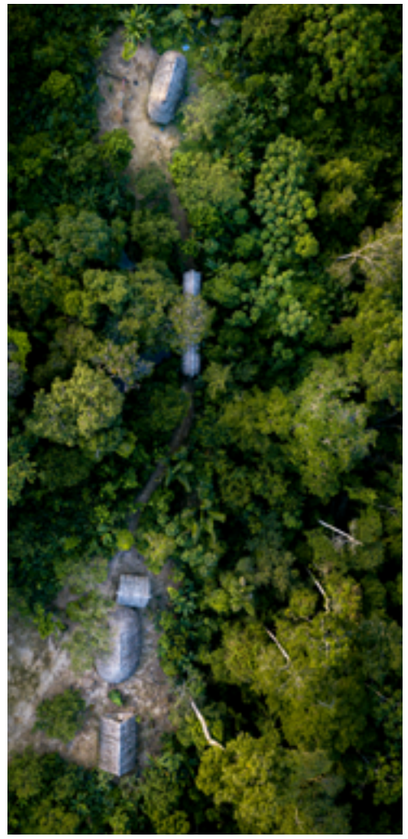

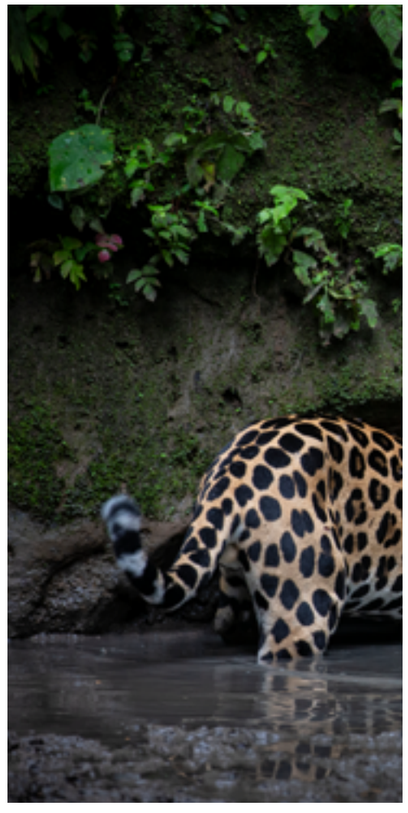

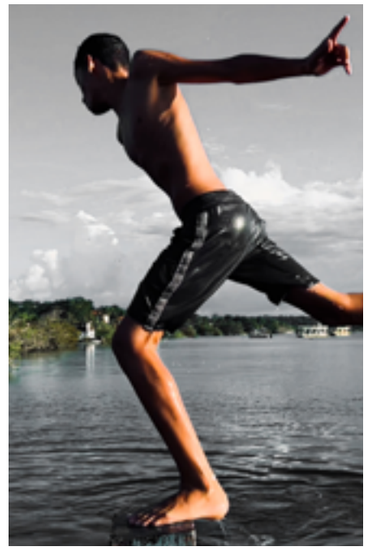

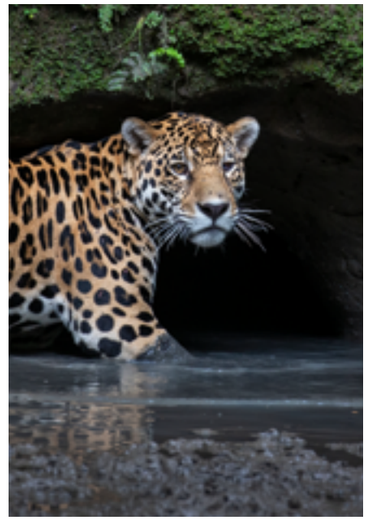

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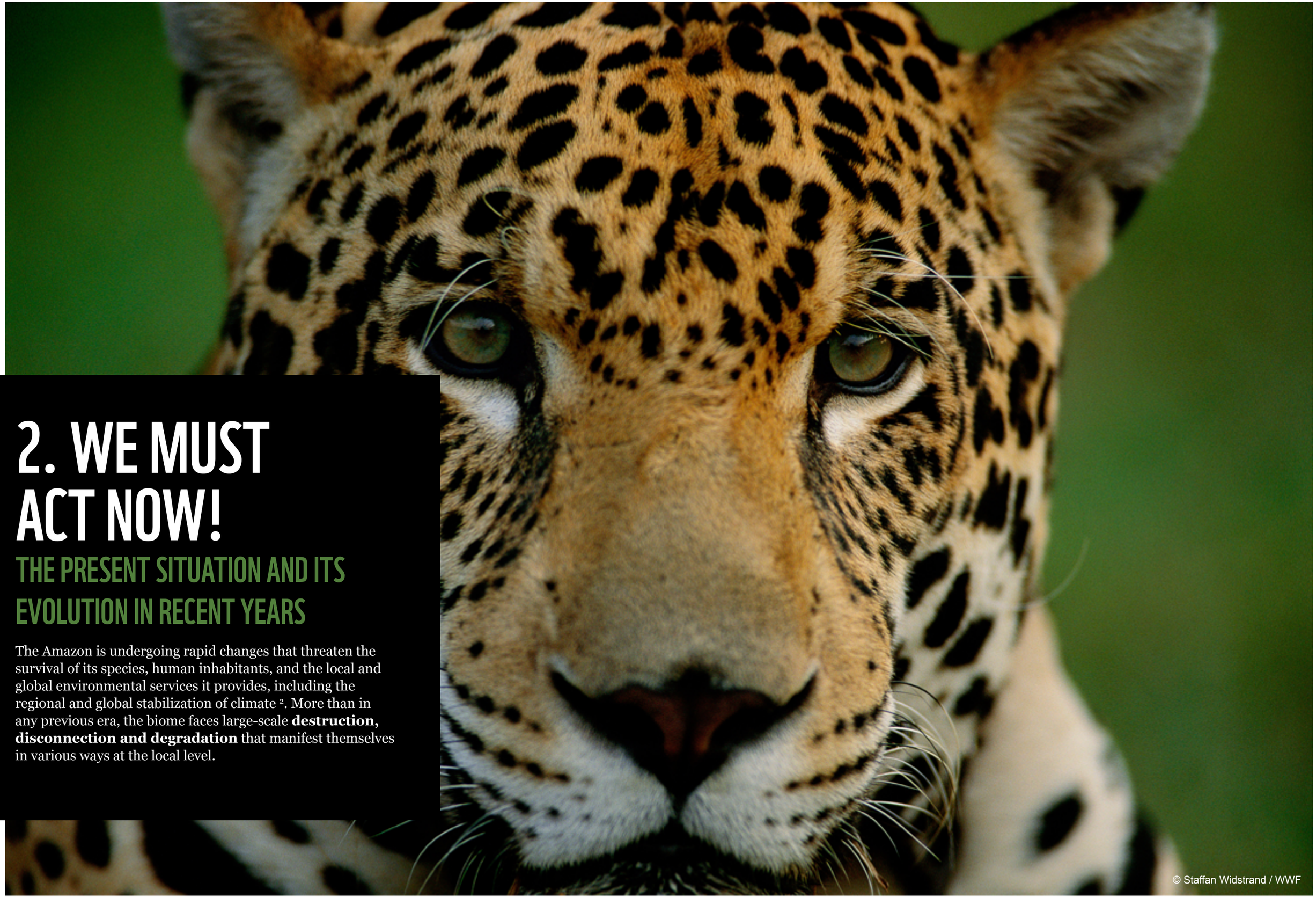
2. WE MUST ACT NOW!

THE PRESENT SITUATION AND ITS EVOLUTION IN RECENT YEARS

The Amazon is undergoing rapid changes that threaten the survival of its species, human inhabitants, and the local and global environmental services it provides, including the regional and global stabilization of climate [2]. More than in any previous era, the biome faces large-scale **destruction, disconnection and degradation** that manifest themselves in various ways at the local level.



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Destruction refers to those **processes that totally transform ecosystems**; that is, when they are entirely converted to other uses such as agriculture and livestock - generally at odds with the suitability of the soils - or are obliterated altogether through catastrophic events such as fires, deforestation, and land use changes. **Disconnection relates to the fact that in a healthy ecosystem, both terrestrial and freshwater elements must be interconnected.** This is particularly true for those species that move around a lot in search of food and mates. Habitat alteration results in the isolation of these elements, leaving many species with no chance of survival. Finally, **degradation represents a series of alterations to the health and integrity of an ecosystem that result in a loss of diversity, coverage, connectivity, and resilience.** It also jeopardizes the livelihoods, and therefore the survival, of indigenous peoples.

More than ever, the Amazon faces destruction, disconnection, and degradation.

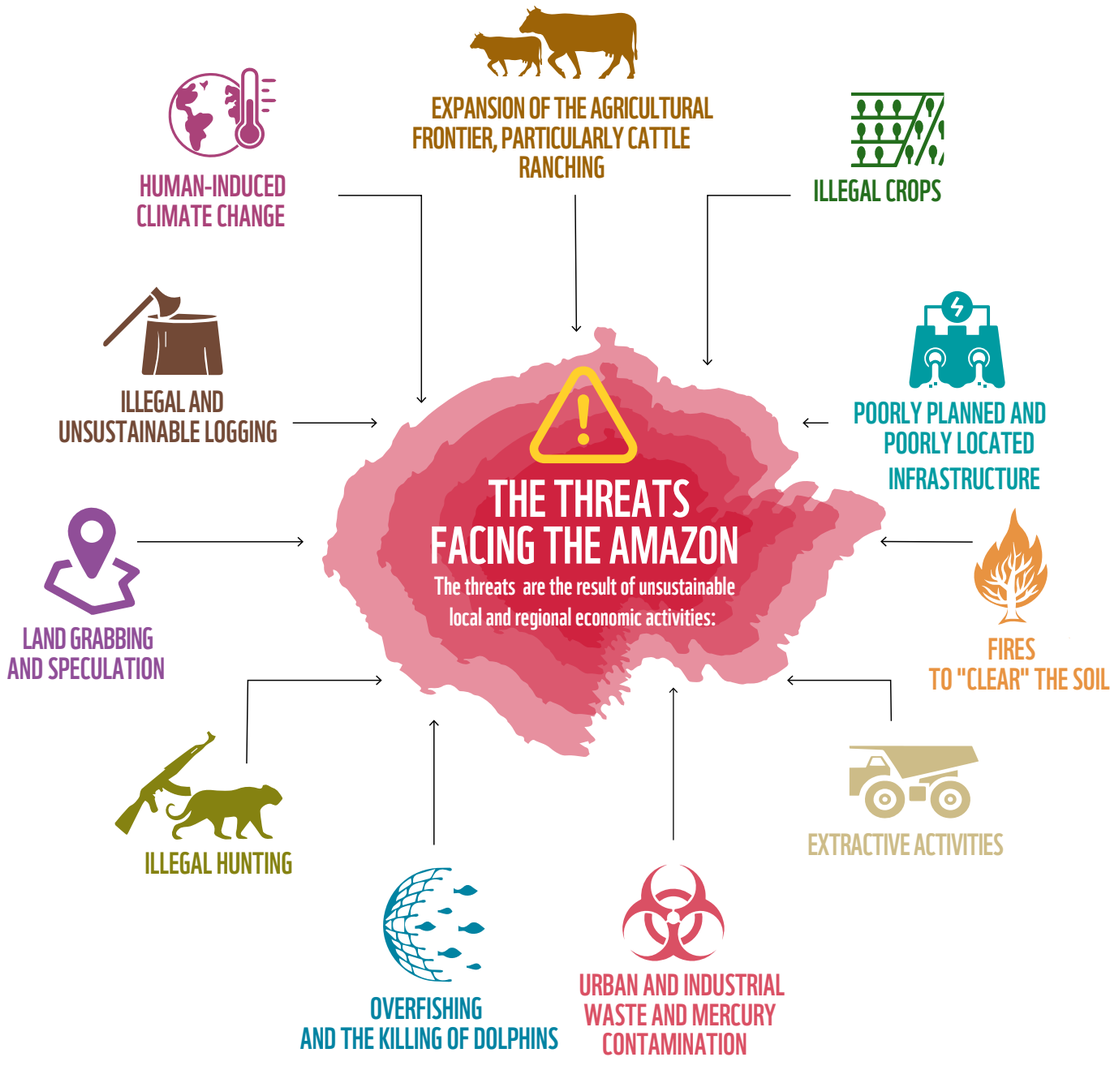
More than ever, the biome faces processes of destruction, disconnection and degradation

An estimated 17 percent of Amazon forests have been converted to other uses and an additional 17 percent degraded

** A previous version stated 18 percent citing the Executive Summary of the Assessment Report of the Science Panel for the Amazon. That figure has been revised by the Panel due to methodological inconsistencies and it is now recommended to use "approximately 17 percent", which is aligned with the RAISG methodology.*

These threats are increasing, leading to the loss of ecosystems, ecosystem services, biodiversity, and cultural diversity. An estimated 17 percent * of Amazon forests have been converted to other uses and an additional 17 percent degraded [Res. 1].

Freshwater biodiversity is in crisis across the globe: almost one third of species are threatened by extinction, and 80 have already been declared extinct [19]. Rivers have been severely disrupted due to economic activities, causing populations of aquatic species to plummet and the ecosystem services they provide to decline [20]. Freshwater ecosystems in the Amazon are also under immense pressure due to fluvial infrastructure works that drive a loss of connectivity, overfishing, the introduction of non-native species, pollution from river transport and human settlements, oil spills, and mercury contamination from illegal and informal mining. Deforestation and road construction are also damaging the biodiversity of rivers. By influencing runoff and sediment discharge and creating barriers to connectivity, they tend to modify the geomorphology and biochemical processes of rivers. In addition, deforestation changes the local and regional dynamics of the hydrological balance by reducing evapotranspiration, which, in turn, lowers rainfall [Cap. 20].



A WWF Brazil study [21] found that desforestation, fires, air, pollution, temperature alteration and ecosystem modifications also affect human health and wellbeing. Approximately 120,000 people are hospitalized each year during the “fire season” in the Brazilian Amazon for asthma, bronchitis, and pneumonia. Periods of intense fire can also increase cardiorespiratory mortality rates and contribute to the development of lung cancer. In addition, deforestation increases the transmission of infectious diseases and promotes the emergence of new diseases, including those transmitted between animals and humans. Deforestation also undermines food security and other aspects of human wellbeing, which, in turn, places greater pressure on protected ecosystems and indigenous territories, fueling conflict and violence.

In addition to all these factors, the Amazon is getting warmer: trends vary according to the database, period and region studied, but the southeast region is experiencing the greatest increase in temperatures [Cap. 22].
“The warming trend is evident from 1980 but intensifies from the year 2000; with three exceptional droughts in 2005, 2010 and 2015/16 [22]. Temperatures were 1.2°C above average in 2015-2016 and 1.1°C above average in 2019-2020; making it the second warmest year in the Amazon since 1960” [Cap. 22].

The increase of extreme weather events, specifically floods and droughts, is altering Amazonian ecosystems and how they function. Dry land forests are increasingly susceptible to droughts and fires, while alluvial plains systems are becoming more vulnerable to changes in flooding patterns. In combination with land use changes, pressures on the Amazon are intensifying and its carbon emissions are growing. Fires in the Amazon contribute to the intensification of global climate change by emitting around 126 Mg of carbon dioxide per hectare during the 30 years following a fire [23] [Cap. 6].

Studies suggest that an ecological tipping point (i.e., a point at which an ecosystem loses its capacity for recovery or resilience) could be reached if an additional 5 percent of forest is lost [24]. WWF therefore advocates for a complete halt to the loss of natural ecosystems in the Amazon.

© Smoke in Rio Branco Acre Brazil / Sep07 / Odair Leal / WWF-Brazil

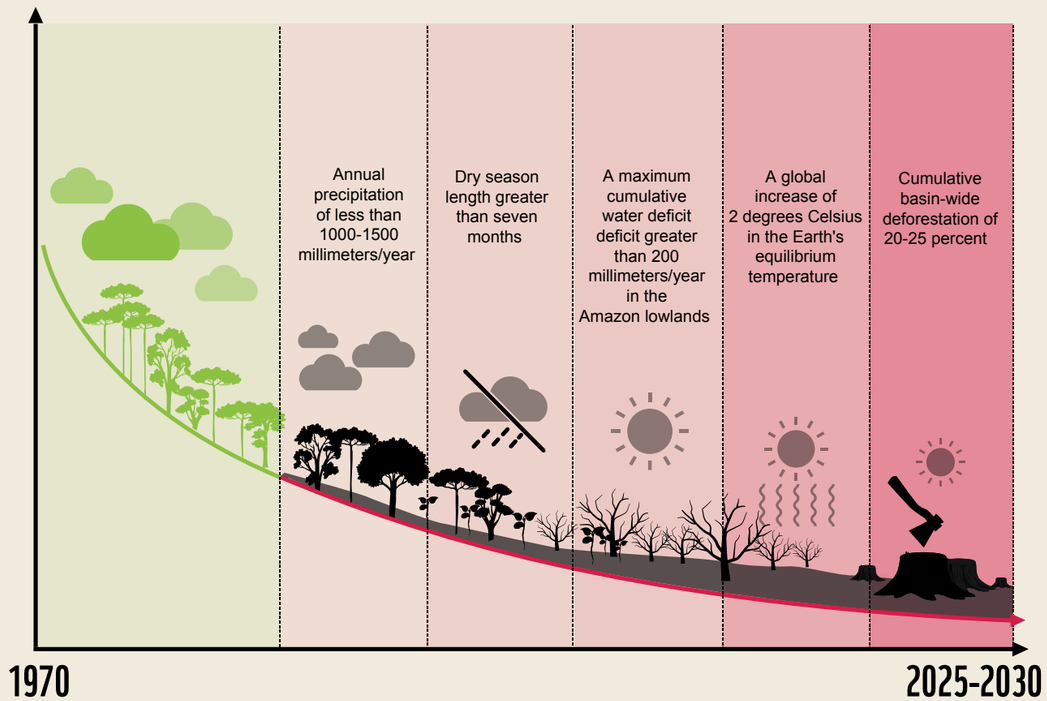
Are we at a tipping point?

The hydrological cycle of the Amazon depends on transpiration from the trees and evaporation from the forest. Up to 75 percent of moisture is recycled when it rains in the Amazon. This cycle can occur up to six times before heading south. This ability to recycle rainwater is reduced when forests are destroyed, disrupting a cycle that is crucial to maintaining life in the Amazon. Research indicates that at current rates of deforestation, and because of negative synergies with climate change, the status of the southern and eastern Amazon could drastically alter [25].

The 2021 Amazon Assessment Report by the Science Panel for the Amazon presents five possible tipping points in the biome that could generate abrupt vegetation change: (1) annual precipitation of less than 1000-1500 millimeters/year, (2) dry season length greater than seven months, (3) a maximun cumulative water deficit greater than 200 millimeters/year in the Amazon lowlands, (4) a global increase of 2 degrees Celsius in the Earth's equilibrium temperature, and (5) cumulative basin-wide deforestation of 20-25 percent [Cap. 24].

In theory, this abrupt change could lead to the loss of the entire forest ecosystem, even if there's only direct forest loss in certain parts of the biome [26].

Tipping points of the Amazon [Cap.24]



Scientific studies identify four states to which Amazonian forests could transition: (i) closed-canopy seasonally dry tropical forest; (ii) native savanna; (iii) degraded open-canopy; and (iv) closed-canopy secondary forest, with the latter two occurring over a greater portion of the biome. In addition, the most recent climate modelling studies indicate the possibility of Amazonian forests reverting to a permanently degraded state as in a pioneer stage due to the effects of regular fire and drought [27]. Further research is needed to more precisely determine the biome's level of resilience to these changes [Cap. 24].

There is no scientific consensus on the exact probability of reaching a point of no return because we do not know enough about some complex ecosystem factors. It is known, however, that the probability increases with greater deforestation, degradation and climate change [Cap. 24].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A COMPLEX POLITICAL CONTEXT AL THE GLOBAL, REGIONAL, NATIONAL AND LOCAL LEVELS

The region has been reshaped by the dramatic expansion of large-scale economic activities such as cattle ranching and soybean cultivation —a product of global agribusiness in partnership with local players—, extractive and infrastructure projects, and illegal activities such as informal and illegal gold mining and drug trafficking.

Far from bringing sustainable and equitable development, these transformations have increased conflict in the region an failed to translate into economic benefits for local communities and indigenous peoples [Cap. 17].

Threats facing the Amazon biome have undergone important changes over the last decade related to greater investment in mining and infrastructure projects (from several countries, notably China) and increased international demand for soybean and meat (particularly from Asia) as well as other products for global and national markets [Cap. 14]. These changes have occurred with minimal environmental standards under increasingly permissive governments.

There is widespread instability in the Amazonian countries at the governmental level beyond any specific political trend.

This is all taking place in the complex political, ideological, and institutional contexts of each Amazonian country. Despite all being democratic, there is widespread instability at the governmental level beyond any specific political trend. A common tension stems from the complex confluence of economic interests, high internactional dependence on the export of raw materials in the region, an international commercial system based on resources from the region, asymmetrical power relations, social inequality, poverty, violence, corruption, and impunity.

Development and conservation initiatives in the Amazon have been plagued by instability [Cap. 14] . This is evident both in the fluctuating priority afforded to environmental problems and in the institutional capacity to deal with them. At present, the greatest challenges for the region concern [28]:

Institutional weakness and precariousness across all levels of government

Authoritarianism

Lack of environmental regulation and implementation capacity

Organized crime

Corruption

The reduction of civic space, i.e., the possibility of civil society intervention and decision-making in the face of deregulation and limited state action

Export dependence and a lack of diversification in the productive matrix

Changes in Brazil's environmental policy between 2018 and 2022 are of particular concern. For example, the November 2019 revocation of the decree preventing the cultivation of sugarcane in areas of natural vegetation jeopardizes not only the protection of the Amazon and Pantanal in Brazil, but also existing protected areas, especially in the Cerrado.

The combination of the above-outlined political context, an abundance of natural resources, and the socioeconomic realities of poverty and inequality, gives rise to an extractivist development model that corresponds to high levels of environmental conflict: 492 of the 2,832 environmental conflicts reported worldwide, or 17 percent, occur in Amazonian countries and relate to mining, oil extraction, drug cultivation and trafficking, and infrastructure construction within the biome [29]. Environmental crimes related to wildlife trafficking, illegal logging and mining are also common in the region.

Several governments in the Amazon region have a history of severely suppressing social movements struggling for land rights, security, autonomy, and sustainable development and, in doing so, have contributed to increasing the vulnerability of indigenous peoples. In a number of cases, governments have denied rights to ancestral territories and even ignored threats to the lives of environmental defenders. The level of impunity for the murder of indigenous leaders in the Amazon at the hands of land speculators, loggers, illegal miners, and members of drug trafficking groups is extremely high [30].

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According to a report by Civicus (a global alliance of organizations and activists dedicated to strengthening citizen action and civil society around the world), the majority of Latin American and Caribbean countries do not adequately respect the rights of civil society, **resulting in an encumbered, stifled and diminished civic space**. Countries in the Amazon are no exception. Recent years have witnessed heightened scrutiny and surveillance, greater legal and administrative barriers to registration and operation, forced closures, campaigns to discredit organizations and, in general, an increase in crackdowns on protest as well as the criminalization and menacing of human rights defenders [31].

The last 15 years have witnessed **an increase in financing from countries that do not comply with the strictest environmental standards in the extractive and infrastructure sectors,** which has exacerbated the situation in Venezuela, Brazil, and Ecuador in particular.

The shrinking of civic space has detrimental consequences for environmental protection because it restricts the capacity of civil society actors to participate in public debate on an equal footing with those in the private sector and government. This frequently results in unjust social and environmental outcomes, weak and/or biased legal protection, a decline in indigenous lands and protected areas, diminished transparency and social oversight of environmental licensing mechanisms, reduced investment in environmental programs, and the expansion of illegal logging, mining, and the agricultural frontier.

According to a report by the British organization Global Witness, 212 environmental defenders were killed worldwide in 2019, of which more than two thirds occurred in Latin America, with 64 in Colombia alone [32].

The infringement of the collective rights of indigenous populations seems to be a recurrent issue across the biome

The infringement of the collective rights of indigenous populations seems to be a recurrent issue across the Amazon and is evident in their lack of effective participation in decision-making mechanisms related to their territorial spaces. The major area of non-compliance is the lack of guarantees concerning their rights to exercise self-determination; that is, the possibility of determining territorial management in accordance with traditional forms of government. Even in cases where there is a certain degree of participation, it does not extend to decision-making on territorial design and planning, which has a bearing on access to, and the control of, biodiverse resources.

One clear example is the repeated lack of compliance with Article 32(2) of ILO Convention 169, which specifies: “States shall consult and cooperate in good faith with the relevant indigenous peoples through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands or territories and other resources, particularly in connection with the development, utilization or exploitation of mineral, water and other resources”.

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Indigenous peoples' organizations in the Amazon

In response to civic space restrictions and an environment in which rights are violated, indigenous peoples in the Amazon have formed their own organizations that afford them greater recognition as strategic actors and more effective participation in decision-making spaces at the subnational, national and international levels. The Coordinating Committee of Indigenous Organizations of the Amazon Basin (COICA), currently the largest international indigenous organization on the planet [33], is made up of nine national organizations, one from each Amazonian country and French Guiana. Its mission is to develop policies, proposals and actions at the local, national and international levels for Amazonian indigenous peoples, nationalities and organizations, through coordination, dialogue, consultation and strategic alliances with public and private actors and international cooperation for equitable and differentiated development in the Amazon. Over the years, COICA has strengthened the representation of Amazonian indigenous peoples in multilateral and international advocacy spaces such as the United Nations Conferences of the Parties conventions. One recent example is the "Amazon for Life: Protect 80 percent by 2025" declaration, a motion led by COICA and its nine grassroots organizations, with the support of civil society actors and the scientific community, which was approved during the World Conservation Congress organized by the IUCN in September 2021 [33].

Through representative, legitimate and strong organizations, Amazonian indigenous peoples are making their way into the international political arena to demand the safeguarding of their rights, the protection of their territories, and recognition of their strategic role in environmental conservation.

It is crucial to dispel the widespread idea that Amazonian inhabitants exclusively live in ranches, farms, mining camps, indigenous territories, forests and villages. This biased perception contributes to the establishment of contradictory policies, or to failing to develop them at all. Evidence shows that most people in the Amazon live in towns and cities, some of which are very large, such as Manaus in Brazil, with over two million inhabitants. The perceptions and interests of local populations, both urban and rural, native and migrant, are too often overlooked. Recognizing the diversity of the Amazon's inhabitants is critical to making the necessary changes to the approach and practices of sustainable development in the region [Cap. 14].

Moving beyond the antagonism between "extractivism" and "conservation" as competing development models is also extremely important. **The lack of sustainability of the current model of development in the Amazon** makes it necessary to move towards an alternative path. This new model must ensure forest and river conservation while meeting the self-determined wellbeing objectives of indigenous peoples and local communities, and redefine the rules, incentives and business models of economic activities based upon long-term regional and sustainable cooperation [Cap. 17].


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A BIOME AS VAST AND DIVERSE AS IT IS FRAGILE AND VULNERABLE

The sheer size of the region, its relative inaccessibility, and the enormous diversity of habitats and wealth of species mean that the biodiversity of the Amazon is not yet fully known to science, even among groups such as mammals and birds [34].

Although there is still a lack of information, the alteration and loss of biodiversity in the Amazon biome can be summarized in a single word: deforestation. Although not all human activities severely affect forest cover - or even cause it to disappear at all —deforestation is the end— result of several synergistic activities related to infrastructure construction, the advance of the agricultural frontier, and mining, as well as those directly connected to the extraction of forest resources. Along **with the degradation of terrestrial and freshwater ecosystems** due to other activities, deforestation has a series of consequences, from the local through to the global scale, on the disappearance of biodiversity and its resulting benefits to human beings.

Some 1200 new plant and vertebrate species were discovered between 1999 and 2009 alone, with an additional 441 species discovered between 2010-2013, and 381 between 2014 and 2015. It is estimated that around 180 new species are discovered on average each year [34].

Many Amazonian species are extremely vulnerable, particularly endemic species and those with restricted geographical distribution, and those that inhabit inter-riverine areas. Habitat loss is the principal threat to most endangered species and has accelerated over the last 20 years.

Deforestation and degradation: farewell to forests

Deforestation is the outcome of several pressures including agriculture, cattle ranching, land grabbing, infrastructure development and extractive industries.

Deforestation is the outcome of several pressures including agriculture, cattle ranching, land grabbing, infrastructure development and extractive industries. Certain human activities -such as logging, poaching and fires- as well as climate change, contribute to forest degradation and, to a lesser extent, deforestation, by fueling land-use change and exploitation.

The disappearance of forests has a variety of complex consequences on the Amazon biome, principally biodiversity loss, the release of carbon emissions, erosion, and hydrological and climatic changes. It also affects the provision of ecosystem services from the Amazon to local communities and around the world, which in turn impacts both the livelihoods and wellbeing of the Amazon's urban and rural populations, and the ecological stability of the Earth. Deforestation has negative consequences for Amazonian rivers, altering their characteristics by affecting the exchange of materials between the vegetation and soil surrounding the river, and decreasing surface water evaporation which then modifies hydrological cycles [35].

On the other hand, **degraded forests and ecosystems undergo changes in diversity, microclimate and structure, and subsequently lose their capacity to produce goods and services,** diminishing their ecological value [Cap. 19]. Plant and animal populations drastically change when a forest is degraded, with populations of certain species at risk of being rendered locally extinct [36].

Degradation also increases greenhouse gas emissions from the Amazon: it has been estimated that carbon dioxide emissions from carbon loss due to forest degradation are greater than those from deforestation [37, 38]. As of 2017, it is estimated that about 1 million square kilometers of Amazon forests (17 percent of remaining standing forests) have been degraded, most of them in Brazil [39]. This extremely high percentage highlights the critical importance of halting the drivers of degradation in the biome while simultaneously stopping deforestation [Cap. 19].

WWF therefore advocates a complete halt to deforestation, ecosystem conversion and degradation in the Amazon. In short, ***the loss of forests and other Amazonian ecosystems must stop.***

Degraded forests and ecosystems undergo changes in diversity, microclimate and structure, and subsequently lose their capacity to produce goods and services.

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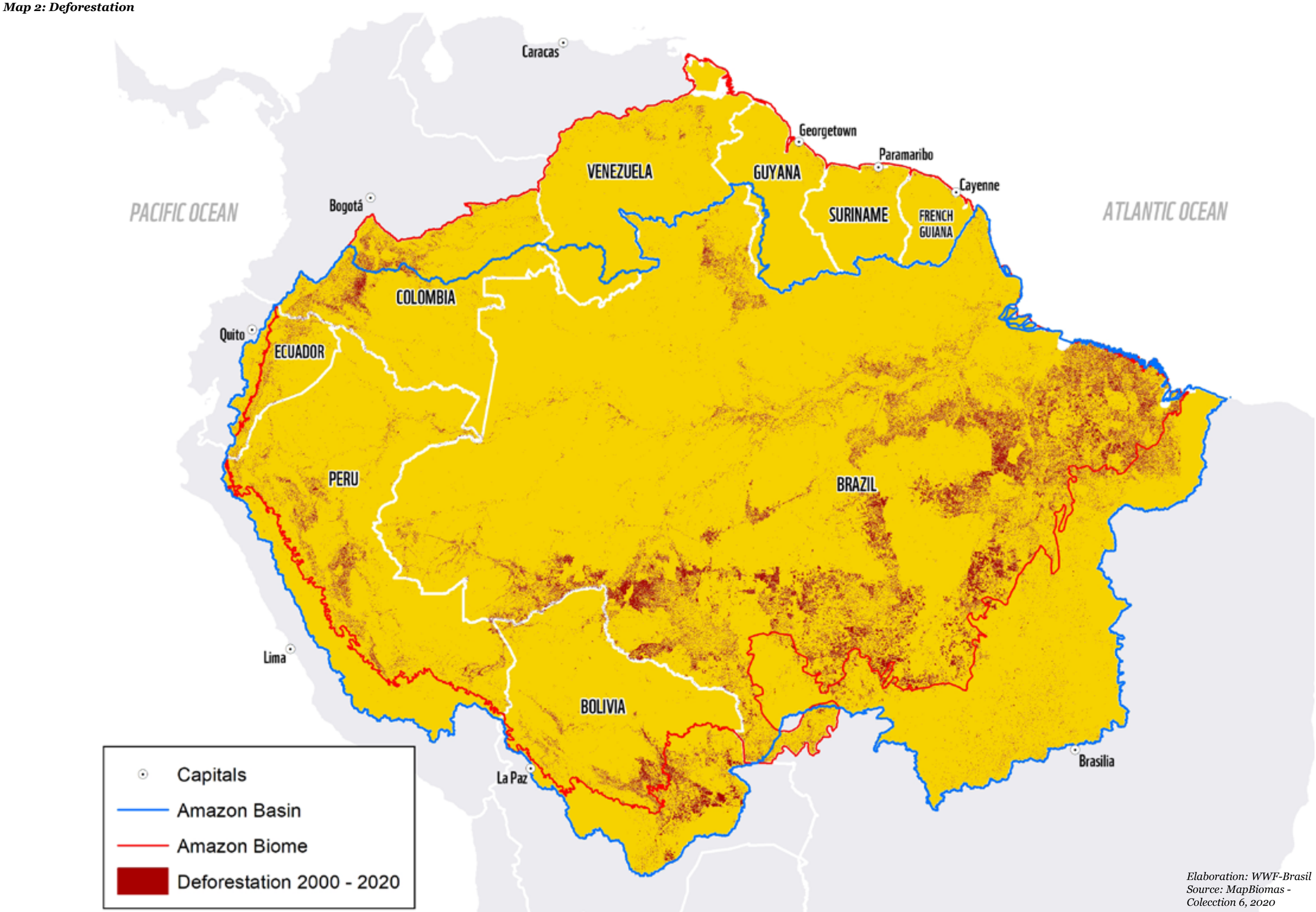
Map 2: Deforestation



Elaboration: WWF-Brasil
Source: MapBiomas - Colecction 6, 2020

Annual canopy loss since 2001 has followed an uneven pattern, with a peak in 2004 followed by another, far higher, in 2016. One study found that deforestation between 2001 and 2014 shifted from being concentrated in the southeastern Amazon in Brazil to the Peruvian Amazon. Although large forest clearings of more than 50 ha decreased during the period, small new clearings of less than one-hectare increased [41]. Brazil's overall annual deforestation was several orders of magnitude greater than the total sum of all other Amazonian countries combined between 2001-2017. Following Brazil, the major contributors to biome deforestation during this period were Bolivia, Peru, and Colombia [42, 43].

Some 870,000 square kilometers have been lost in the Amazon as of 2018 [44]. About 85 percent of deforestation occurred in Brazil, followed by Peru, Ecuador also lost a significant area of its forests; around 13 percent of its Amazon biome (in absolute terms). Only French Guiana, Suriname and Venezuela have maintained more than 97 percent of their original vegetation cover [44, 45].

A complex phenomenon that varies geographically and over time, deforestation is the most serious problem facing the biome. More than 13 percent of the Amazon's forests were lost between 1970 and 2013 [40].

** PRODES is a satellite monitoring project on deforestation in the Brazilian Amazon and is part of the National Institute for Spatial Research (INPE, for its acronym in Portuguese).*

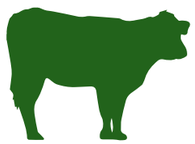
*** Consultado en www.wwf.org.br.*

Deforestation continues to increase at a high rate in the Brazilian Amazon: according to data from PRODES *, almost 12.2 thousand square kilometers of forest were cleared in the Amazon in 2021, an increase of about 18.44 percent over 2020. This is the highest annual deforestation rate since 2008 [46]. Unfortunately, the trend is set to continue in 2022. Data from INPE, the Brazilian agency in charge of monitoring deforestation, shows that deforestation in the first half of 2022 has been the highest on record for that period since 2016, suggesting 2022 will be the fourth consecutive year of record high-levels of deforestation in Brazil **.

Deforestation in Colombia increased after the signing of the peace agreement in 2016. According to IDEAM (the Colombian deforestation monitoring agency), forest loss in Colombia increased from 124,000 hectares in 2015, to 220,000 hectares in 2017, and 197,000 hectares in 2018. In 2019, 62 percent of deforestation occurred in the Amazon; more than two-thirds of forest loss (83,599 hectares) occurred in just three Amazonian departments; Caquetá, Guaviare, and Meta; and an estimated 10,830 hectares were deforested within protected areas [47].

The biome hit a new deforestation high point in 2021, with the fifth highest levels on record, behind 2002, 2004, 2005, and 2017. Total primary forest loss (including deforestation and forest loss from fire) was estimated at 2 million hectares, a slight decrease from the 2.3 million hectares of primary forest lost in 2020. Brazil, Bolivia, Peru, and Colombia account for the largest losses of primary forest in 2021 [48].

Deforestation is also connected to land grabbing and land trafficking for conversion to various productive activities. In the Amazon as elsewhere in the world, land grabbing involves national agencies selling off or assigning areas to other entities or corporations, and an accumulation of land holdings in the hands of a few large landowners, whether for food or biofuel production, the establishment of plantations, or mining or logging concessions on lands already occupied by indigenous peoples or local communities. In some cases, Amazonian lands are transferred on a vast scale to transnational and international corporations for the pursuit of various economic activities [Cap. 15].



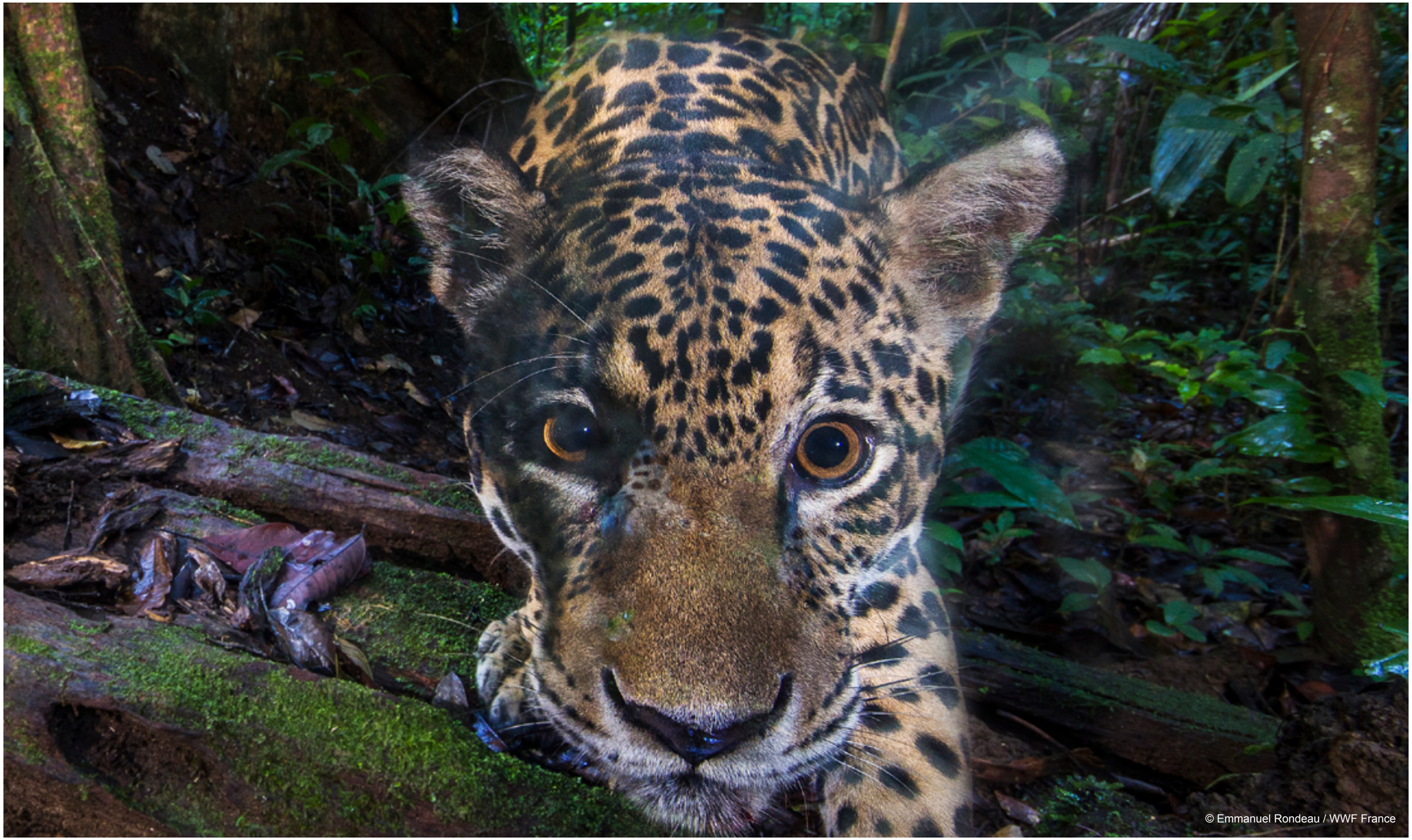
Public policies have actively fostered the expansion of agribusiness (such as soybean and livestock).

Public policies have actively fostered the expansion of agribusiness (such as soybean and livestock) through the construction of infrastructure, economic production incentives, technical assistance and access to credit and land tenure, to the detriment of policies that support the interests of local communities and sustainable and inclusive economic initiatives.

Unless concrete action is taken to halt these trends in the immediate future, **the biome is on track to reach a dangerous tipping point in terms of forest loss**.

Despite these rather discouraging find trends, there is immense potential for the implementation of an alternative model. An example of this is the three Guianas which together cover almost one-fifth of the Guiana Shield * —one of the most biodiverse places on the planet— and contain 38 million hectares of forest. Suriname and Guyana are among the greenest countries on Earth in terms of forest cover as a percentage of total land area and are among the top five producers of freshwater. These countries are classified as two of the 11 High Forest Cover Low Deforestation (HFLD) countries, with more than 85 percent forest cover and less than 0.1 percent deforestation. It is essential to establish development models that will maintain the richness of the Guiana Shield going forward [49].

** The Guiana Shield is a geological structure that almost entirely encompasses Guyana, French Guiana and Suriname, as well as parts of Brazil, Colombia and Venezuela.*



More cows, fewer trees: unsustainable livestock farming, mechanized agriculture, and land speculation

The major drivers of expanding deforestation in the Amazon are cattle ranching, the expansion of mechanized agriculture, and land speculation and grabbing.

Pastures and livestock are mostly used for beef and dairy production, while the principal crops produced are soybeans, palm oil, sugarcane, and corn, particularly for animal feed and biofuels.

The synergy between these deforestation drivers causes significant indirect land use change. For example, the replacement of pasture by soybeans due to high profitability pushes cattle ranching into natural forests, and illegal logging promotes road development, increasing disruption to surrounding areas [50]. The lack of clear land tenure also contributes to the expansion of cattle ranching since one mechanism for claiming land rights is to demonstrate that the land has been put to productive use. In many cases, agricultural expansion and land speculation are preceded by fires that are lit to "clean" and prepare the land for production. This scenario is further compounded by the leniency and lack of political will on the part of governments to enforce legislation. The advance of agriculture and cattle ranching in the Amazon is largely a consequence of today's predominant food production and consumption system that favors unsustainable, extensive, polluting and environmentally destructive production practices *. **Cattle ranching in the Amazon tends to be unproductive, drives deforestation and degrades soils due to poor livestock management.** In addition, the high demand for meat products in developed countries results in an excessive use of resources such as water and soil to produce the food necessary for raising cattle, as witnessed in the immense expanses of land used for soybean cultivation in the Amazon.

** A relatively new phenomenon in the Peruvian and Bolivian Amazon is the increasing occupation of land by Mennonite groups for agricultural activities. As of 2020, these religious groups were responsible for at least 4,800 hectares of deforestation in the Peruvian Amazon alone.*

Inefficiencies also exist at the level of distribution: food produced in South America travels thousands of kilometers to be consumed on other continents, leaving a large water and ecological footprint in its wake. Finally, food waste contributes to this spiral of unsustainable consumption and production practices (one-third of the food produced is never consumed) that destroy native ecosystems and contribute to climate change [51].

Smallholder and family farming practices tend to be more environmentally friendly and have a greater positive social impact. However, this type of agriculture has given way to large agribusiness due to a lack of credit facilities and multiple policies that favor large companies, to the detriment of the environment, equity and sustainable development [Cap. 15].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The trees that must not be felled: unsustainable and illegal logging

Timber extraction —both legal and illegal— occurs most notably around those areas of the biome that can be accessed by river or road, such as the port of Pucallpa in Peru and Santarem in Brazil.

Most of the timber is used locally for construction and fuel, but some, such as mahogany *(Swietenia macrophylla *)*; is exported legally and illegally; a large proportion of timber exports extracted from Amazonian forests is thought to be illegal [52]. In Peru, wood is extracted in large quantities from the impressive shihuahuaco (*Dipteryx alata, D. micrantha and D. odorata*), which reaches 50 meters in height and one meter in diameter at 700 years of age, from where it is exported primarily to China for the construction of floors. Peru's Forestry Supervision Agency (OSINFOR) estimates that about 4000 cubic meters of shihuahuaco were illegally felled in 2018 [53].

** This species is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.*

Unsustainable logging and timber extraction from Amazonian forests contributes to forest degradation; it is estimated that in one quarter of cases it leads to forest conversion to other land uses such as agriculture and cattle ranching. Selective logging has a detrimental impact on biodiversity and is a source of carbon emissions, mainly through damage to surrounding vegetation [2].

Logging jeopardizes the survival of tree species by drawing them ever closer to the point "commercial extinction", where their scarcity makes their commercialization no longer viable, reduces forest carbon stocks, makes sustainable logging practices less competitive, and is also a driving force behind forest degradation and indirect deforestation, by fueling the construction of roads and settlements for timber extraction [Cap. 27].

The scale of illegal logging in the Amazon is estimated to be high. In Brazil, illegal logging supplies more timber to the market than that from legal sources [22]; 47 percent of timber sold in Colombia is illegally sourced, with some originating from Amazonian forests in Peru, before subsequently being legalized in Colombia and then sold in Brazil [54] [Cap. 14].

Illegal logging in the region is the product of structural factors —for example the informality and low competitiveness of the forestry sector— which limit access to formal financing. The same is true of the lack of transparent and regulated systems for the allocation of forestry permits. The ease of "laundering" timber - the process by which illegal timber is fraudulently registered, sold and exported - also plays a significant role. In many cases, the administrative agencies responsible for timber registration do not have the necessary conditions for field verification and the enforcement agencies do not have the capacity to stop illegal operations on the required scale.

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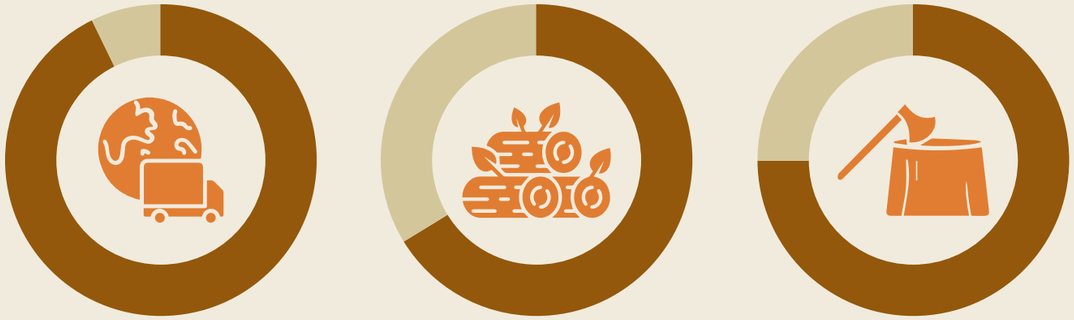
The case of balsa wood logging in Ecuador

Ecuador is the world's leading exporter of balsa wood, supplying 95 percent of global demand, which accounts for 66 percent of the Ecuadorian forestry industry. Ecuadorian balsa exports doubled between 2019 and 2020, to a total of US$550 million. The amount of balsa in certain Amazonian regions of Ecuador decreased by as much as 75 percent in that same period, with logging activities taking place within, or very close to, protected areas, increasing pressure on the natural resources they were designed to protect [55].



95%

OF THE WORLD'S DEMAND FOR BALSA WOOD IS SUPPLIED BY ECUADORIAN EXPORTS

66%

OF ECUADOR'S FORESTRY INDUSTRY CONSISTS OF BALSA WOOD

75%

DECREASE OF BALSA WOOD AVAILABILITY IN CERTAIN AMAZONIAN REGIONS OF ECUADOR BETWEEN 2019 AND 2022

A recent WWF [55] report analyzed the current situation in four sites in the Ecuadorian Amazon involved in the balsa wood industry, mostly indigenous territories, and found that the economic benefits of the recent increase in logging were not proportionally reflected in local economies and that current levels may be exceeding the natural regeneration capacity of the respective plantations and forests. Local social and environmental impacts vary according to the different territorial characteristics and forms of commercial management.

In the framework of the "Alliance for Wildlife and Forests" project, part of the analysis focused on three zones: Shuar territories in the Santiago River Basin (Morona Santiago); Waorani territory on the border between the provinces of Pastaza and Napo; and settler and Kichwa territories in the San Miguel River basin in Sucumbíos [56].

During the worst months of the pandemic, timber exporting companies in Ecuador were selling a cubic meter of balsa for US$760 while local producers received merely US$275. The fragile social organization of some rural Amazonian populations favors the use of intermediaries in the commercial process and there are cases of local producers being cheated by intermediary traders.

The other part of the study, developed with support from the "Strengthening Natural Resource Governance in Ecuador" project, was conducted in Achuar territory in the provinces of Morona Santiago and Pastaza [57].

In this case, the balsa in its natural state from the Pastaza province did not entail the conversion of native forest to other types of, more degraded, vegetation. However, the balsa plantations may still have contributed to deforestation due to the displacement of other land usage practices, such as the search for new for cattle grazing pastures. 45 percent of balsa production costs in the Achuar indigenous nationality's territory were found to relate to internal transport costs and transport to exportation facilities, therefore any initiatives to increase the sectors sustainability in this territory must consider transport requirements and possible alternatives. The study concluded that the implementation of best practices and traceability standards must take the high number of local producers into account and adapt to the local context if they are to be effective.

Greater integration of all actors in the balsa production and commercialization chain could reduce inequality in the distribution of benefits and make illegal activity more difficult. The study notes that the legal harvesting of balsa wood in Ecuador does not involve higher costs than illegally sourced balsa, so it is important that the administrative authorities incentivize legal trade in order to improve the management of forest resources and social outcomes.

In order to reduce the degradation and deforestation associated with the balsa wood sector it is important to promote sustainability and traceability standards, and good business practices amongst export companies and large international buyers of Ecuadorian balsa.

Flames in paradise: fires to clear forested areas

Amazonian forests have not evolved to adapt to fire and under normal conditions are not very flammable due to the high humidity levels * [57] [Cap. 19].

Fires in the Amazon initially destroy forest understory, the vegetation that grows under the trees, and normally advance at a slow pace and burn at a low height (10 to 50 centimeters). However, by destroying small vegetation which subsequently causes the death of large trees, wiping out animals that cannot easily flee and destroying vast areas of habitat, fires can nevertheless have devastating affects [58, 59] along the entire trophic chain and ultimately lead to ecosystem modification. Recovery of Amazonian forests after fire is possible, but slow, and it is unknown to what extent they regain species composition, especially without assisted regeneration [Cap. 19].

Between August and December 2019, fires consumed huge tracts of forest in the Brazilian and Bolivian Amazon as well as in other ecoregions in both Bolivia and Paraguay including the Chiquitano Forest, the Chaco, the Pantanal and the Cerrado. These fires were related to increasing deforestation. Brazil's Amazon Environmental Research Institute (IPAM) reported that the ten urban areas with the highest number of fires corresponded to those with the highest levels of deforestation in the Brazilian Amazon. Although the weather contributed to the spread of fire in Bolivia, climatic conditions in Brazil during that period were not abnormal for the dry season, so the large number of fires in relation to other years cannot be attributed to drought *. In 2020, more than 2500 large fires were recorded in the Amazon, most of them in Brazil (88 percent), followed by Bolivia (8 percent) and Peru (4 percent) [63]. In 2021, fires directly led to the loss of 22 percent, or 436,00 hectares, of remaining primary forest. Though this is a fall in comparison to the severe 2020 season, it nevertheless remains the fourth-highest fire season on record. It should be noted that more than 90 percent of fires impacted only two countries: Brazil and Bolivia [48].

Fires are becoming more intense because of climate change and yet, at the same time, contribute to it, in a vicious circle creating conditions conducive to yet further fire. Fire could surpass deforestation in the future to become the Amazon's main source of carbon emissions [22], with climate and land use changes further expanding the areas prone to fire [Cap. 19].

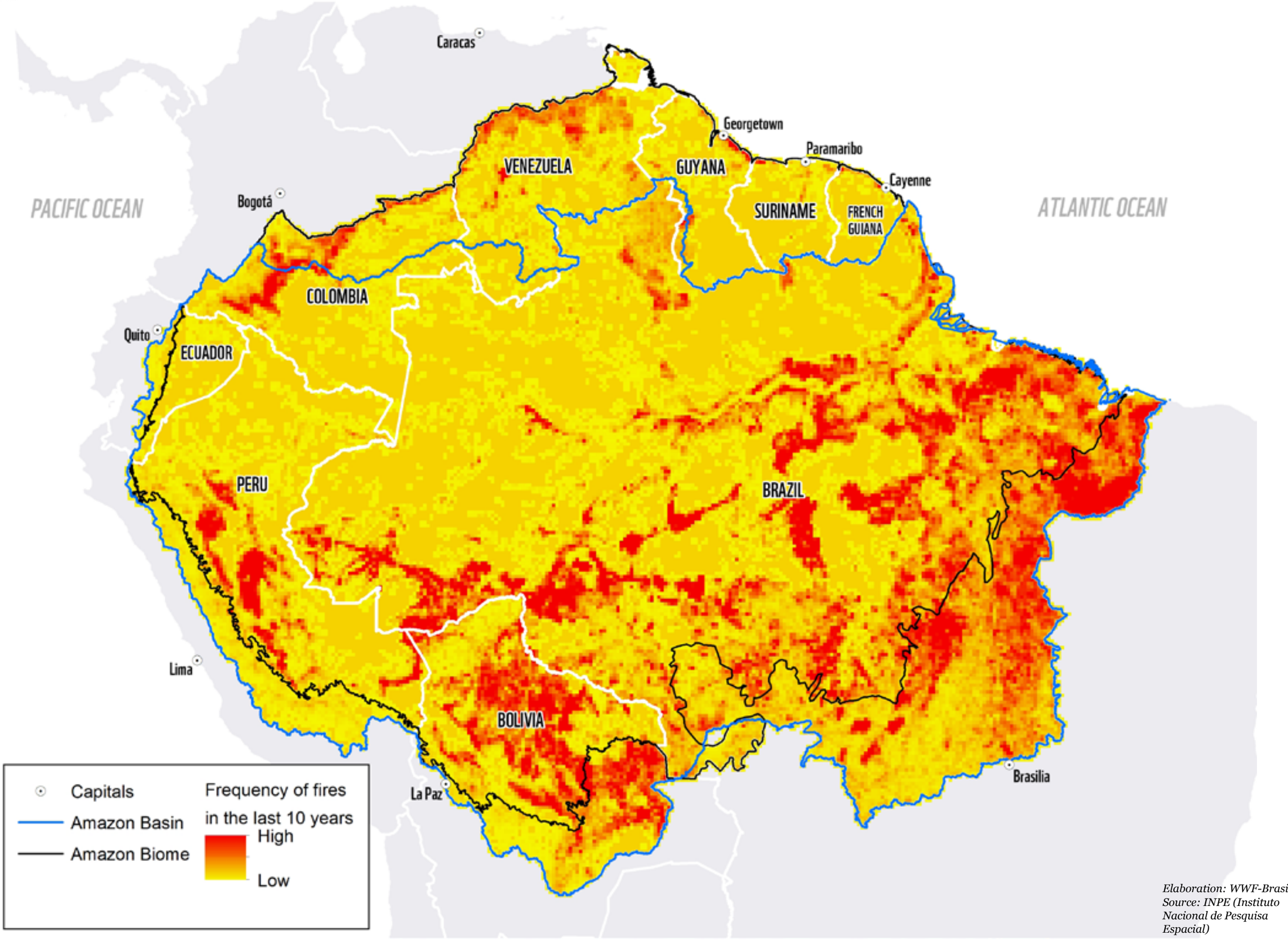
In synergy with climate and land use change, forest degradation also increases their susceptibility to fire. Degradation tends to result in less compact, and therefore drier and more flammable vegetation, so degraded forest is at greater risk from fire than the same type of well-preserved forest.

** Fires affect the Amazon's various ecosystems differently. Savanna ecosystems are much more vulnerable to fire than forests and somewhat paradoxically, floodplain forests are much more flammable than those in dryland areas because these forests' undergrowth has a layer of roots and humus that, during periods of intense drought, spread fire because they are more open and subsequently dry faster. Fires in this type of forest are therefore more intense and can destroy up to 90 percent of tree cover* [60,61,62].

** Search on www.wwf.org.co.*

Forest fires are a well-known technique for clearing already deforested land or standing forest for agricultural purposes and are an ancient technique for restoring soil fertility and minerals. However, this practice can lead to large-scale, uncontrollable fires that destroy thousands of hectares of forest, wipe out countless animals and cause habitat loss which then jeopardizes the future survival of numerous species. Fires of this type also pose significant socioeconomic risk by destroying the livelihoods of local smallholders and indigenous peoples.

Map 3: Fires



Elaboration: WWF-Brasil
Source: INPE (Instituto Nacional de Pesquisa Espacial)

The darker sides of infrastructure

Unsustainable infrastructure development in the Amazon is permanently affecting terrestrial and freshwater ecosystems and related human communities.

Unsustainable infrastructure development in the Amazon is permanently affecting terrestrial and freshwater ecosystems and related human communities. The construction of infrastructure, in combination with climate change, the expansion of the agricultural frontier, cattle ranching, extractive activities and unsustainable timber extraction, is affecting natural resource stocks and the integrity of the Amazon biome [2]. Threats are geographically wide-ranging, long-lasting, and naturally transnational, as in the case of shared basins or overland transport routes for regional integration * [64].

** The Initiative for the Integration of Regional Infrastructure in South America (IIRSA) is an institutional mechanism for the coordination of intergovernmental initiatives for the twelve South American countries; its objective is to build a common agenda to promote projects for the integration of transport, energy and communications infrastructure (www.iirsa.org). It is currently inactive.*

Aside from land-use changes driven by the increased global demand for primary goods, infrastructure development projects account for the majority of the region's negative environmental and social impacts. These same projects are of high interest to Amazonian governments [Cap. 14].

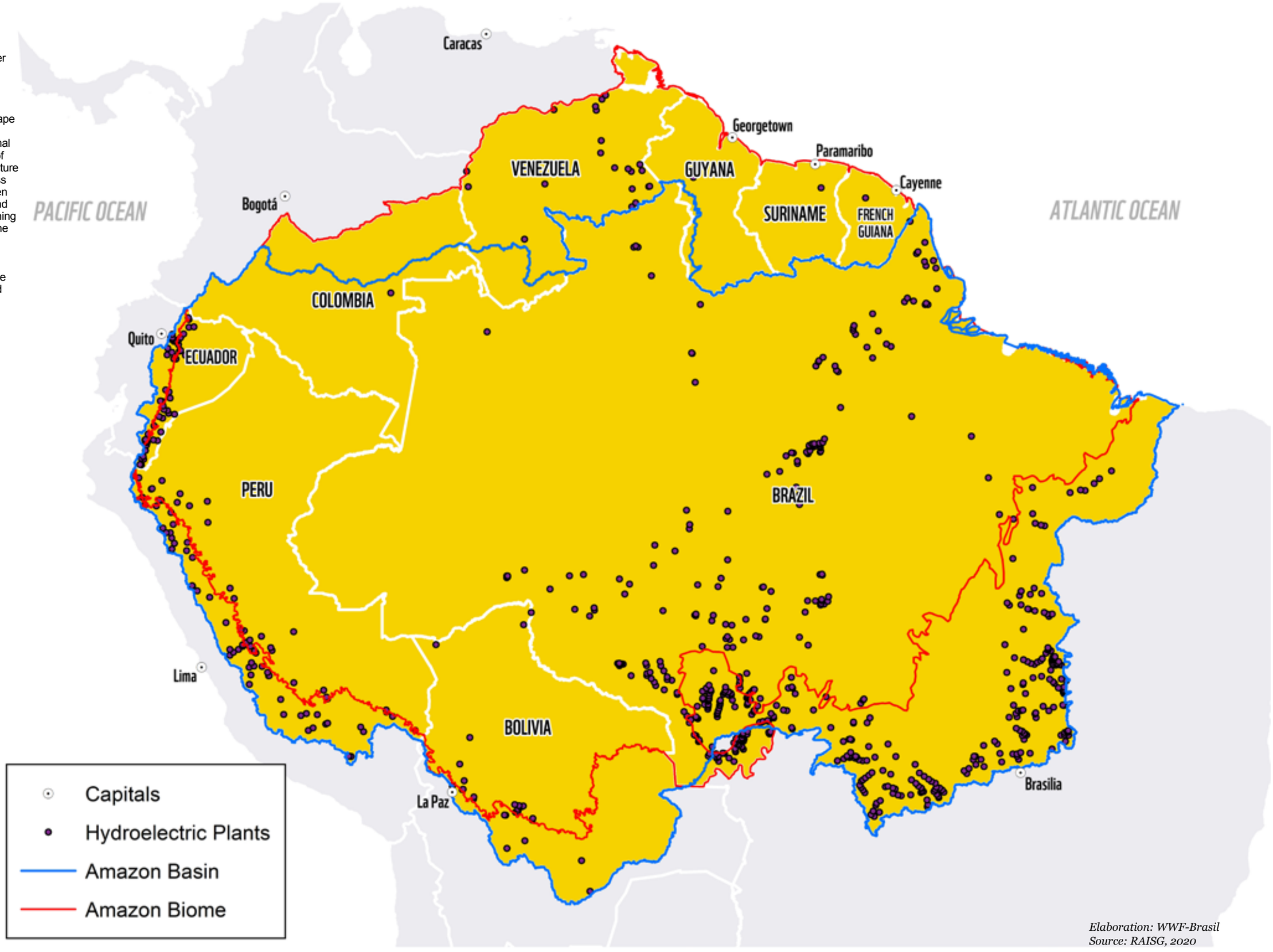
Poorly planned infrastructure contributes to forest loss and disrupts river connectivity, broadly understood as the continuity of surface and groundwater flows, as well as sediment and organisms, in longitudinal, lateral, and transverse terms. Roads (whether official, unofficial, or illegal) are particularly heavily associated with deforestation as they open access to remote areas and encourage new settlements. 75 road projects were found in the region, with a total of 12,000 km of planned routes [65]. Many of these projects entail more costs than benefits and cancelling economically unjustified projects would avoid 1.1 million hectares of deforestation and US$ 7.6 billion in wasted funds for development projects [66].

Roads also directly impact wildlife in the Amazon. They lead to reptiles, amphibians, birds, and mammals being run over, and result in the fragmentation of wildlife habitat. Evidence documents a number of endangered species being run over including the harpy eagle, giant anteater, giant armadillo, giant otter, red-faced spider monkey, lowland tapir, and red-billed toucan [67, 68] [Cap. 19].

© Adriano Gambarini / WWF-Brazil

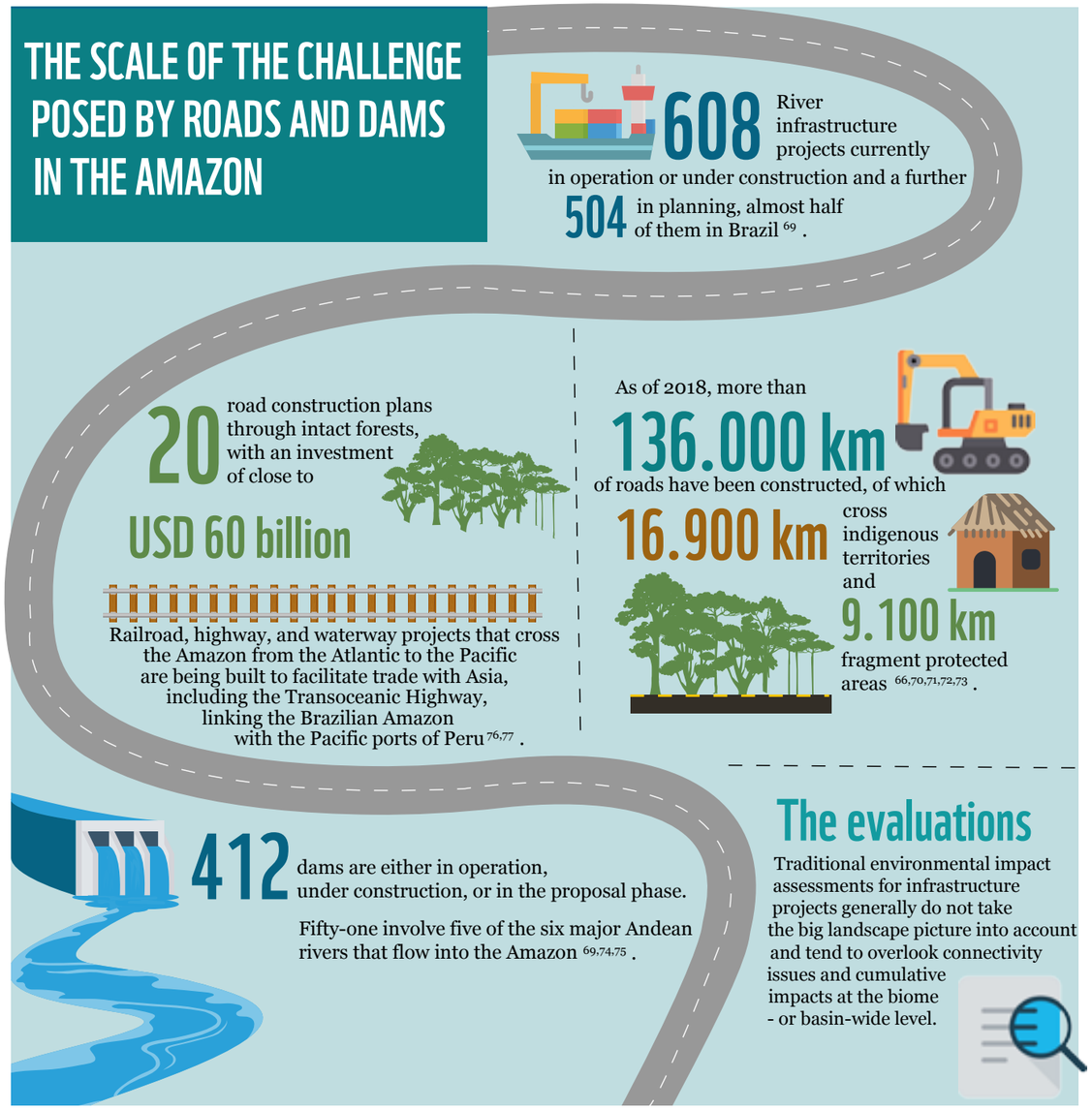
Map 4:
Hydroelectric plants

Dams are typically large constructions dedicated to water storage for irrigation, human consumption, industry, and hydroelectric generation; they have significant impact on various elements of the landscape including the normal flow of rivers and the migration of animal populations. The construction of dams and associated infrastructure drives deforestation and the loss of submerged forests; sites often overlap with protected areas and indigenous territories, undermining environmental protection and the rights of communities. Societal practices such as navigating rivers, tourism and fishing can also be directly affected, and the very survival of settlements and heritage sites put at stake.



Elaboration: WWF-Brasil
Source: RAISG, 2020

The scale of the challenge posed by roads and dams in the Amazon



A recent study by Conservation Strategy Fund, in collaboration with IPAM and the Foundation for Conservation and Sustainable Development (FCDS, for its Spanish acronym), analyzed 75 road projects covering 12,000 kilometers in the Bolivian, Brazilian, Colombian, Ecuadorian and Peruvian Amazon. By calculating the economic return and socio-environmental risks, the study concluded that **45 percent of the projects would have costs that exceed the benefits**. In fact, the economic losses associated with these projects amount to US$7.6 billion, in addition to the associated environmental losses [78].

River ports are another high-impact form of infrastructure development. Nearly 100 such major industrial ports have been built on major rivers in the Brazilian Amazon over the past two decades and dozens more are in the pipeline [79]. Many have been financed and built by international commodities companies with little governmental oversight [80]. By opening it up further to agribusiness and reducing the costs of transporting commodities for export, notably soybeans to China and the rest of the world, these projects have transformed the region. But this boom in port infrastructure comes with high environmental costs and frequently negatively impacts traditional riverine communities [81].

Until now, the development of waterway infrastructure in the Amazon region has taken place primarily in Brazil. However, contracts have recently been signed in Peru to begin work on the Amazon Waterway that would affect the Ucayali, Marañon, Huallaga an Amazon Rivers. Developing waterways entails a series of infrastructure works that change the characteristics of rivers to ensure that they are navigable by large vessels throughout the year. This includes rock removal and channel dredging, which increases the depth of shallow areas and changes the normal flow of the river, its sediments and riverbank vegetation. **These actions can have serious impacts on aquatic biodiversity by modifying, deteriorating, or eliminating the habitat of fish and other species, and can damage the livelihoods of local communities by reducing fish abundance and diversity** [Cap. 20]. Waterways also negatively impact river dolphins by increasing boat traffic, noise pollution and solid waste, sewage, and hydrocarbon discharges from engines, which affect the communication, feeding, reproduction and resting processes of these mammals, as well as their stress levels and the risk of collision [82].

The development of road, energy and extractive infrastructure also has specific and direct consequences on indigenous territories. Indigenous territories in the Amazon frequently face unwanted development pressures. The recent State of the Lands and Territories of Indigenous Peoples and Local Communities 2021 report found that, due to the superior ecological condition of indigenous territories relative to their surroundings, such areas contain high amounts of unexploited natural resources (renewable and non-renewable) which would potentially require the development of significant infrastructure for their extraction and transport, and concluded that 25 percent of indigenous territories worldwide are likely to face severe pressures in the future associated with development models based upon the extraction of raw materials [83].

The power of water: more on dams

The abundance of water in the Amazon has historically attracted the development of hydroelectric plants to meet the region's own demands and those of neighboring countries. However, the restriction of the free flow of rivers and the flooding of large areas of forest in the Amazon, puts huge pressure on biodiversity. In addition, **hydroelectric works often affect indigenous peoples and local communities that suffer the negative impacts but don't receive the benefits**[84].

Hydroelectric plants (and other types of dams) affect flood patterns that are critical to providing environmental cues for species to complete their life cycles and for connecting primary waterways to floodplains. In addition, they result in sediment retention that causes large-scale changes to the landscape and disrupts the flow of nutrients and sediment downstream into floodplains and other habitats. Dams often involve flooding large areas to create water reservoirs. When this occurs, trees that are submerged can die and forests bordering the floodplains are also likely to be affected. Larger dams can inundate extensive areas of upstream habitat. Dams also accelerate the formation of methylmercury, a highly toxic substance, and the production of methane, which contributes to the greenhouse effect. Finally, **hydroelectric plant construction is the most common cause for the downgrading, reduction, or loss of legal protections of protected areas** [85].

Hydroelectric plant construction is the most common cause for the downgrading, reduction, or loss of legal protections of protected areas.

The impact of dams on aquatic biodiversity in the Amazon is of significant concern. By interrupting riverbeds, these infrastructure works impede the normal movement of fish and order animals upstream or downstream, making it difficult for them to complete their life cycles. In addition, they may lead to the formation of islands that can isolate wildlife populations and cause a loss of terrestrial biodiversity [Cap. 19].

The disruption of connectivity affects the survival of certain species such as migratory fish, river turtles, and river dolphins. This is especially serious in the case of migratory fish such as large catfish, or for those that inhabit large expanses of water such as river dolphins. One in-depth case study of goldfish found populations to have drastically reduced in Bolivia following the construction of two hydroelectric dams in Brazil. Dams also affected downstream ecosystems by altering stream flows and flooding regimes, hindering the reproduction of aquatic species, and the further impacting fish species by creating low oxygen conditions at the bottom of reservoirs [Cap. 20].

Disrupted dorado migration

Dorado *(Brachyplatystoma rousseauxii)* undertake long-distance migrations of approximately 400 kilometers during their life cycle: they travel from the headwaters of Amazonian rivers in Bolivia, Colombia, Ecuador and Peru to the mouth of the Amazon and then, after reaching a certain size, return to their place of origin to reproduce. Between 2009 and 2014, two dams, Jirau and Santo Antonio, were built on the Brazilian side of the Madeira River, blocking the passage of adult dorado and their larvae from the river's headwaters in Bolivia to the river's estuary. Since then, population monitoring of the species in the headwaters of the tributaries in Bolivia has yielded very discouraging results. Only 10 percent of the dorado population that existed in 2008 was present as of 2018, and it is estimated that by 2024 the species could become extinct in Bolivia. These barriers also have consequences for dorado populations downstream in Brazil, as populations are unable to reach their breeding areas upstream in Bolivia and Peru. The extent to which they will be able to adapt to this challenge is unknown [86].

Many indigenous peoples and local communities also experience negative impacts on their fishing activities due to dam construction [87]. Population declines and changes to the species composition of Amazonian fish directly harm the diet of Amazonian villagers as well as the economic livelihoods of fishermen, who can be forced to change trade or in some cases even migrate. By modifying sedimentation, nutrient cycles, and floodplains interactions, dams also potentially disrupt downstream agricultural activity, making crops more vulnerable to sudden hydrological change [87]. Disputes over water use or the increased risk of flooding in downstream settlements because of dam construction projects directly affect indigenous peoples and local communities [87]. In extreme cases, dam construction has led to the relocation of entire communities.

A recent study found that the Amazon is the longest free-flowing river in the world and its basin still has many long and very long free-flowing rivers [88]. Currently, two of the three world's longest rivers (over 1000 km) face disruption due to human intervention. Most of those still considered to be free-flowing are in the Amazon, the Arctic, and the Congo Basin. Dams and reservoirs are the major impediments to river connectivity.

Building on that study, further research is being carried out that analyzes more than 340,000 kilometers of rivers in the Amazon basin * to assess the current and future situation regarding proposed dam developments. Nearly 1,000 dams in the river network were mapped, about half of which are still in the planning or development stages, including both hydroelectric dams and those for other purposes such as drinking water and agricultural provision.

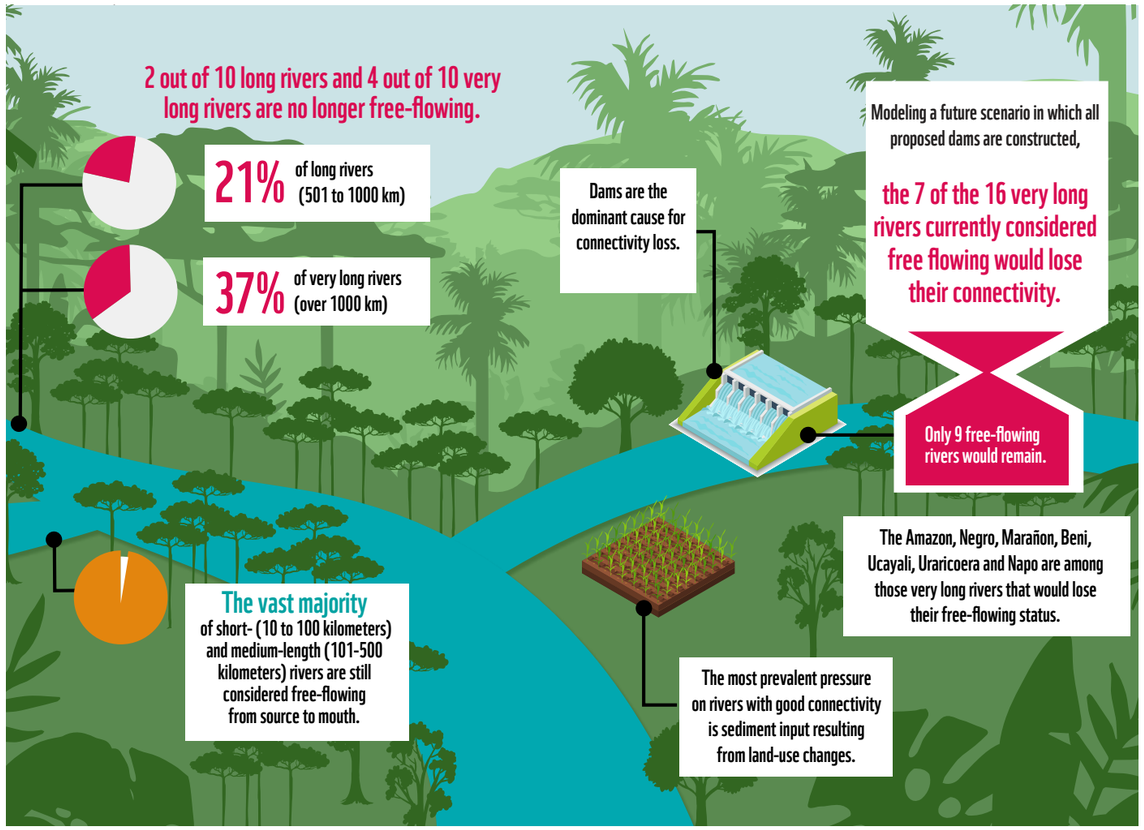
By combining a set of indicators ** on longitudinal, lateral, and vertical aspects of river connectivity, the assessment has identified entire rivers and stretches of the river that are still considered free flowing

Preliminary results of the study indicate [88]:

Currently, two of the three world's longest rivers (over 1000 km) face disruption due to human intervention.

** This work was initiated and is being carried out by TNC, WCS, Fundación Faunagua, Omacha and WWF.*

*** These include the impacts of fragmentation and flow regulation from dams, roads and urban areas as well as the impacts of large-scale water withdrawals and planned waterways.*



If no action is taken, important ecosystem services such as fish stocks will be affected, as documented in the above case of the recent dorado decline in the Madera Basin [86, 89].

The long-term sustainability of hydropower and the need for a change in the energy matrix

Hydroelectric projects are themselves vulnerable to the combined effects of climate change and deforestation which in the future could lead to a significant decrease in precipitation in the region. One study found that, with deforestation projected until 2050, the energy produced by the Belo Monte dam in the Brazilian Amazon could fall to just 25 percent of the plant's peak production and 60 percent of the industry's own projections [90].

In October 2019 the Norte Energia company, in charge of the Belo Monte dam facility, declared a water emergency due to extremely low water levels that meant the dam's own structures were put at risk and its power supply contract with the Brazilian state could not be fulfilled [91].

Before constructing new hydroelectric plants, governments and developers should conduct comprehensive and timely regional assessments that consider future water scenarios and climate projections, environmental and social impacts, potential indirect and cumulative effects, and the needs of local communities [84]. Alternative options to meet energy or water supply needs should be examined, and any necessary infrastructure should be placed in the least damaging locations (see section 3.2.1.).

© Vice-Presidente da República, Hamilton Mourão durante Visita à Usina Hidrelétrica Belo Monte_ by Bruno Batista_ VPR is licensed under CC BY 2.0

Given the many socio-environmental issues posed by hydroelectric plants in the Amazon, they should start to be disincentivized in government planning. The world is beginning to undergo a major shift in energy supply, with renewable energy technologies becoming more financially competitive and policies in many countries promoting the replacement of fossil fuels [92] and hydropower.

The emergent energy transition should be used to encourage policy makers in Amazonian countries to move away from the use of hydropower, oil and gas in the region and instead embrace low-cost, low-carbon and low-impact systems such as solar and wind energy both to meet (inter-) national demand and to provide energy to communities within the biome *.

** Carefully designed, low-impact or off-channel hydropower can still play an important role in supporting power grid stability.*

Biodiversity and ecosystem services are the bedrock of the economy: they provide the environmental inputs and conditions necessary for the productive sector to operate. The conservation of the biome and its ecosystems is therefore not only crucial for local populations, but for the private sector and strategic industries of Amazonian States. The Norte Energia case is an excellent example of how human production systems depend on properly functioning ecosystems. The present production of hydroelectric energy cannot be sustained in the Amazon without healthy rivers and forests.

Gold and mercury: contentious metals

The Amazon also faces a sharp increase in informal and illegal gold mining (IIGM), considered the principal source of human-generated mercury emissions and releases worldwide

The Amazon also faces a sharp increase in informal and illegal gold mining (IIGM), considered the principal source of human-generated mercury emissions and releases worldwide. Since the sustained rise in gold prices beginning in 1979, which rose to 500 percent between 2004 and 2019, IIGM operations have expanded throughout the Amazon biome leading to greater levels of production and the deepening of negative impacts across the basin [93]. It has been estimated that "mining is responsible for about 10 percent of deforestation in the Brazilian Amazon" [94] [Cap. 14].

The gold production process drives deforestation and soil erosion. Mercury is used to separate gold particles from rocky materials and sands, after which the metal is disposed of directly into freshwater ecosystems or released into the air via burning. In 2015, total annual mercury emissions from IIGM averaged 838 tons, meaning that between 24 percent and 27 percent of global emissions come from countries in the Amazon biome. This also suggests that Amazonian countries account for more than 75 percent of total emissions from South America [96].

It is estimated that a significant portion of gold mining in Amazonian countries is illegal.

**A 2021 OECD report examines the risks of corruption, conflict financing and money laundering associated with gold flows from Venezuela.*

IIGM is a prominent source of income for the biome's inhabitants, particularly in Brazil, Colombia, Guyana, Peru, and Suriname. Amazonian countries produce about 400 metric tons of gold per year and satisfy almost 10 percent of global demand for this precious metal (taking both large-scale mining and IIGM into account). **It is estimated that a significant portion of gold mining in Amazonian countries is illegal.** According to the Escolhas Institute, illegal gold mining in Brazil stands at 36 percent, while in Ecuador, Colombia and Venezuela it varies between 77 and 90 percent * [95] [Cap. 14]. IIGM is often associated with other illegal activities such as logging and drug trafficking.

Gold mining is especially prominent in Brazil and Peru, with the scale and consequent impacts of the practice set to substantially increase. In the Brazilian Amazon, most of the numerous applications for mineral prospecting permits are for gold. Alluvial gold mining, such as that conducted by illegal miners known as garimpeiros, releases large amounts of sediment into watercourses [Cap. 20].

According to an Assessment Report (2021) from the Science Panel for the Amazon, gold mining in the basin occurs in the following rivers:

Bolivia:
Madeira, Beni and Iténez [97]

Brazil:
Tapajós, Tocantinas, Madeira, Xingu, Negro, Amapari and Solimões or Alto Amazonas [98, 99]

Colombia:
Putumayo, Caquetá, Guanía, Vaupés and Inirida [100]

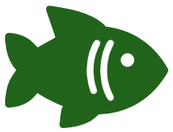
Ecuador:
Nambija and more recently Jatunyacu, Napo, and others [101]

The mercury used to extract gold is a volatile chemical element that does not disintegrate; by contaminating the air and water it threatens not only the ecosystem but also the health and well-being of human populations living in the region. Traces of this metal have been found in predatory species such as the migratory golden catfish, as well as in several species of turtles and birds, and even in jaguar and dolphin tissue.

Today, the use of mercury for mining activities in the Amazon represents a significant threat to public health as it causes serious harm when ingested or inhaled when burned. Sixty-four percent of the mercury entering Amazonian rivers comes from mining [98, 102, 103]. This chemical element flows downstream and is converted into methylmercury, which is ingested by aquatic organisms and, since it cannot be broken down, accumulates in their tissue and moves up to the food chain to larger fish, reptiles, and aquatic mammals (dorado, black caiman, otters, river dolphins, and others).

Its most significant impact occurs when it enters the trophic chain of fish and from there enters the diet of local populations, especially indigenous peoples. The mercury problem in the Amazon highlights the close relationship between biodiversity and the local populations that depend on the resources provided by the forest and river [Cap. 20] .

The World Health Organization classifies mercury as “one of the ten chemicals or groups of chemicals of greatest public health concern” because exposure can lead to a variety of human health disorders. These include effects on the nervous, digestive, immune, cardiovascular, renal,



The most significant impact occurs when it enters the trophic chain of fish and from there enters the diet of local populations.

The World Health Organization classifies mercury as one of the ten chemicals or groups of chemicals of greatest public health concern.

and respiratory systems. Notably, fetuses that have been exposed to mercury may suffer lasting consequences on the development of their nervous systems [104, 105].

A study conducted by the Oswaldo Cruz Foundation (FIOCRUZ) and WWF-Brazil in 2020 [106] analyzed mercury contamination in three villages of the Brazilian indigenous Munduruku peoples in the state of Pará. Alarming mercury levels were found in the 200 inhabitants whose samples were analyzed: six out of 10 participants and nine out of 10 of those living on the banks of contaminated rivers showed values above the maximum safe levels established by health agencies. 15.8 percent of children were found to have neurodevelopmental problems. When analyzing the fish in nearby rivers, which are the main source of protein. for surrounding communities, all specimens examined, encompassing 18 species, were found to contain mercury levels between four and 18 times higher than the maximum safe limits.

Mercury contamination is expanding dramatically not only due to the increasing price of gold but also because of non-compliance with national laws and international regulatory treaties, the lack of effective coordination between countries and in border areas, and the inadequate understanding of its impacts at the local level; all of which takes place in a context of poverty and lack of economic opportunity, providing ideal circumstances for the expansion and intensification of contamination in already degraded areas. This is even more concerning considering the interconnected and transnational nature of freshwater ecosystems and their associated hydrobiological resources which therefore spread mercury contamination across the entire biome.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Other extractive activities

Active mining and fossil fuel concessions cover 15 percent of the Amazon and 30 percent of its protected areas; 37 percent of indigenous territories are affected by mining, oil and gas contracts [2].

More than 100 million hectares of the Amazon are currently under concession for oil and gas exploration and extraction, with 192 concessions currently in operation and a further 33 in the prospecting phase [107, 108].

Extractive activities such as large-scale mining and oil drilling are widespread in the Amazon biome. In total, 45,065 mining concessions are classified as either operational or awaiting approval in the Amazon. Almost half of which coincide with, or potentially impact, protected areas and indigenous territories [107, 108] [Cap. 19].

** Coltan is a metal mineral widely used in the manufacture of cellular phones and other electronic devices.*

The northernmost area of the biome in Venezuela is home to the Orinoco Mining Arc, the most extensive mining concession in the Amazon in an area designated for mining development by President Maduro in 2016. The region contains a wealth of minerals such as gold, coltan *, copper and diamonds, and was expected to attract substantial foreign investment. Investment from reputable companies has been lower than expected, however, there is currently a complex web of criminal and military groups involved in mining operations, indigenous peoples, local communities, and subsistence miners that coexist in this landscape amidst extreme levels of violence and environmental destruction [109].

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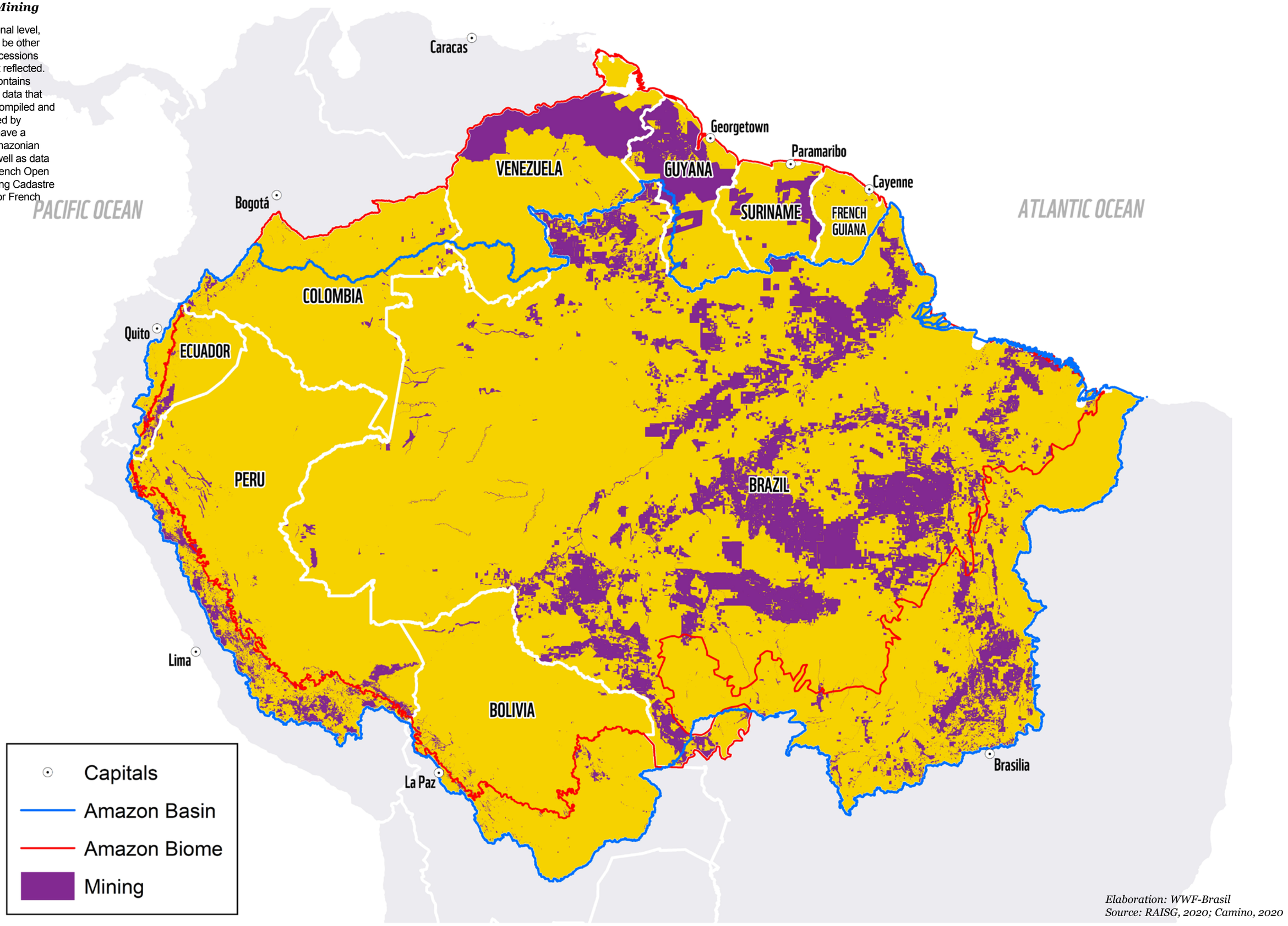
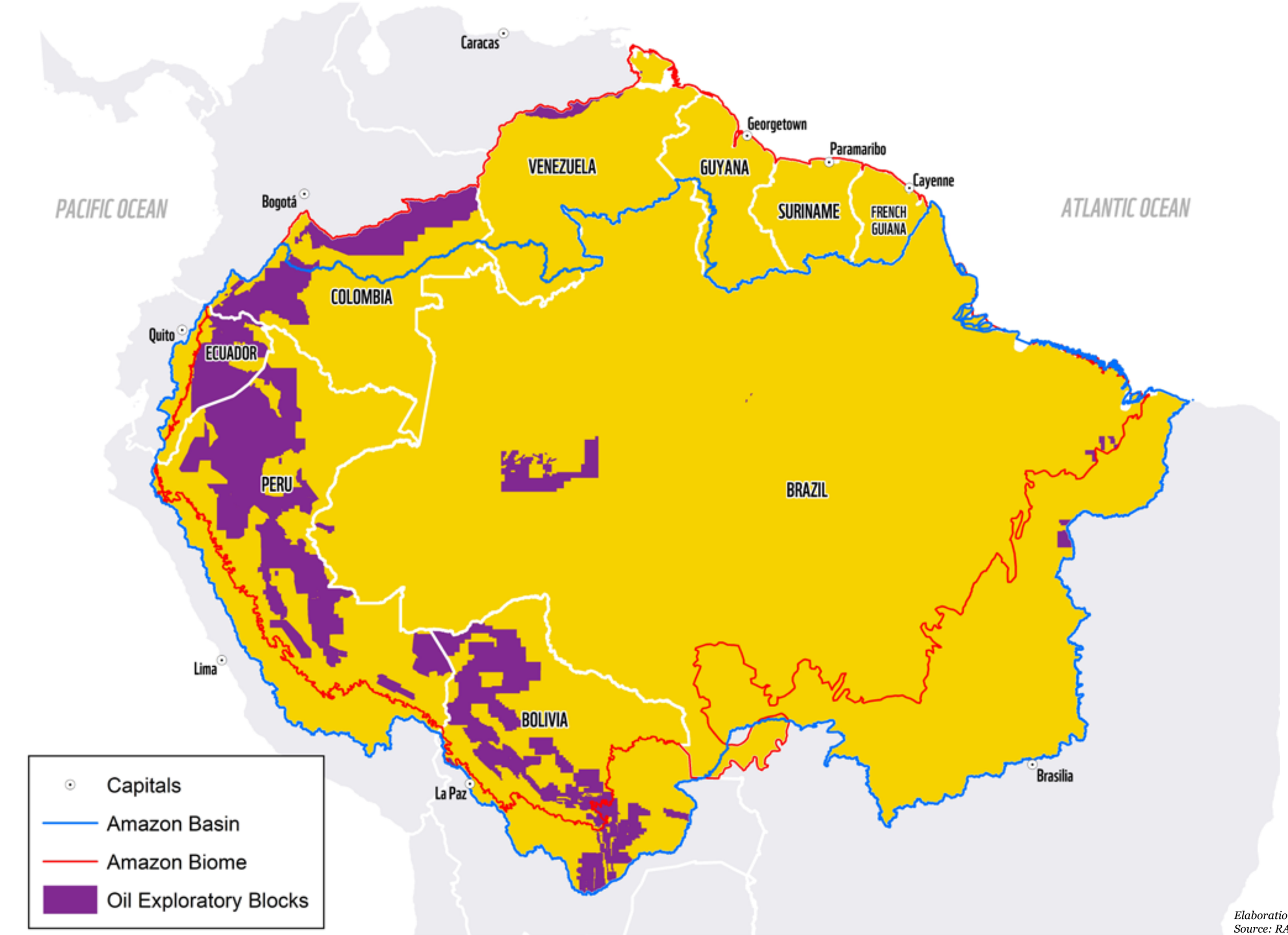
Map 5: Mining

At the national level, there could be other mining concessions that are not reflected. The map contains geographic data that has been compiled and standardized by RAISG to have a regional Amazonian scope, as well as data from the French Open Digital Mining Cadastre (Camino) for French Guiana.



Elaboration: WWF-Brasil
Source: RAISG, 2020; Camino, 2020

Map 6: Oil extraction



Elaboration: WWF-Brasil.
Source: RAISG, 2020

It is important to keep in mind that extractive activities are directly associated with deforestation, habitat fragmentation and road construction, all of which deepen forest degradation and loss. Extractive industries cause different types of pollution, including toxic and flash by-products. A recent study in Peru found dangerous levels of lead in Amazonian wildlife originating from oil extraction operations. This has particularly significant health effects on communities that consume game animals [110].

Most oil extraction in the biome occurs in the western region. Oil was discovered in Andean countries in the mid-20th century and oil industry operations in the Amazon have intensified since the 1970s. The oil industry in the Amazon drives deforestation and has led to numerous oil spills. In Ecuador, a total of 10,000 metric tons of crude oil were spilled in 464 events between 2001 and 2011 [111], the equivalent of a quarter of that leaked in the Exxon Valdez oil spill. Oil contaminates soil and rivers and, although its effects on wildlife still remain largely unknown, it is likely detrimental to lowland tapirs, *pacas*, collared *peccaries*, and deer called *red soches* that consume potentially contaminated soil and water [112] [Cap. 19].

While gold mining is largely illegal in the Amazon, large corporations legally extract minerals such as bauxite, copper, and iron ore [113]. Agriculture causes most of the deforestation in the biome in general, but mining is the primary driver of deforestation in the Guianas and parts of Peru [114, 115]. In Venezuela, the Orinoco Mining Arc coincides with about 70 percent of the country's sources of freshwater and overlaps with the territories of many indigenous communities [109]. The indirect impacts of mining are even greater than the direct impacts, as it promotes migration, human settlements and urbanization, logging, and fuels the expansion of the agricultural frontier [Cap. 15, Cap. 19].

Extractive industries in the Amazon and the rest of Latin America are closely associated with the emergence of social and socio-environmental conflicts. Conflicts nearby extractive activities usually arise when they result in environmental damage or involve human rights violations, or when they have been implemented following inadequate or non-existent processes of prior, free, and informed consultation with local communities and indigenous peoples. Conflicts can result in violence, deepen inequalities, limit opportunities for human development and erode the social fabric of the communities involved. The prevention, mitigation, adequate resolution, and reparation of these conflicts is difficult due to the existing power imbalances between affected communities and corporations, the lack of effective and timely socioeconomic policies and inadequate government intervention [116].

The oil industry in the Amazon drives deforestation and has led to numerous oil spills.

Extractive industries in the Amazon and the rest of Latin America are closely associated with the emergence of social and socio-environmental conflicts.

Hunting, the wildlife trade and overfishing

The trade in wildlife is an important, large-scale economic activity worldwide, with implications for biodiversity conservation.

It occurs on every inhabited continent and involves more than 24 percent the planet's vertebrate species [117]. A significant proportion of international wildlife commerce occurs legally and is regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), supporting the livelihoods of millions of people around the world. **However, many species are illegally and/or unsustainably traded, threatening their survival in the wild and potentially leading to their extinction**.

** CITES stands for The Convention on International Trade in Endangered Species of Wild Fauna and Flora*

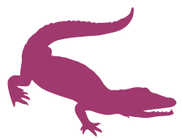
As one of the main repositories of biodiversity on the planet, the Amazon is an important region for both the legal and illegal trade in wildlife. Legal trade in CITES * -listed species from the region includes:

Caiman and peccary skins

Live reptiles for the pet market

Live orchids

Live paiches or pirarucus



Caimans

Paiche meat and queen conch

Spanish cedar

Big-leaf mahogany

The estimated average annual value of exports of these species is $128 million for the period 2005-2014 [118]. Although the legal wildlife trade is sometimes used to "launder" illegal trade, for the most part it is benign if well managed and provides sustainable livelihoods for communities as well as helping to prevent more predatory activities.

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* See: www.iucnredlist.org.

The illegal trafficking of Amazonian wildlife is driven by global demand for wildlife products.

The illegal wildlife trade is more concerning, with overexploitation endangering several Amazonian species, especially those that simultaneously face habitat loss. The illegal wildlife trade is often linked to other illegal activities (mining, drug trafficking, logging, etc.) and affects a diverse array of animals in the Amazon. Parrot exports from Guiana, Peru, and Suriname, for example, amounted to some 250,000 birds between 2000 and 2013 [119]. It is estimated that some 4000 Night Monkeys *(Aotus)* were sold to a biomedical laboratory on the Colombian side of the triple border region in the northwest Amazon [120]. The pet trade has a long history and may have contributed to the regional extinction of species such as the golden parakeet *(Guaruba guarouba)* as far back as the mid-19th century *. Although the pet trade has decreased due to tighter regulation and control, it is still the principal threat to critically endangered species at the regional level, as in the case of the large-billed finch *(Sporophila maximiliani)* [121] [Cap. 20].

The illegal trafficking of Amazonian wildlife is driven by global demand for wildlife products, especially for use in gastronomy and medicine. Other factors include the local and international demand for exotic pets and the tourist demand for unique experiences. In some Peruvian port cities, tourist attractions have been observed where wild animals are kept in very precarious conditions, often with the complicity of tour operators [122].

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The impacts of hunting vary according to the life cycle and location of species. Longer-living species such as primates are more vulnerable to local extinction as their populations regenerate more slowly due to lower reproductive rates [123]. On the other hand, species that inhabit very localized and/or accessible sites are more likely to be hunted. A study in southeast Peru found that local hunting had wiped out species of larger primates and reduced populations of medium-sized primates by 80 percent [124] [Cap. 19]. In addition to hunting, biodiversity loss is also caused by other factors including human-wildlife conflicts due to real or perceived negative impacts on human populations, wildlife populations, or both. Examples include livestock depredation by jaguars and harpy eagles, or crop damage from herbivorous species [Cap. 20]. Such conflicts can provoke hunting either as retaliation or as a protective measure by those affected.

An increase in jaguar part seizures has been detected over the last decade in countries such as Bolivia and Suriname. About 600 jaguar fangs were seized in Bolivia between 2013 and 2020, in addition to other parts such as skins and skulls aside from live animals [125]. Some of the seizures in these and other countries such as Mexico and Peru were destined for foreign markets in Asia, Europe, and North America, indicating a resurgence of international trade in the species which has been banned since its inclusion in CITES Appendix I in 1975 [125]. The trafficking of jaguar parts to China is of particular concern because of the potential connection to the illegal trade in Asian tiger parts and other felids that are highly sought after in traditional Asian medicine and collectibles markets [125]. Despite the significant challenges of obtaining information on international jaguar markets, investigations by journalists and civil society have begun to reveal the existence and modus operandi of organized jaguar trafficking networks with operations and contacts within and beyond the Amazon [126, 127].

In addition to international trade, some recent studies on jaguar trafficking point to the existence of a sizeable domestic market driven to a large extent by opportunistic hunting, negative human-jaguar interactions, and the cultural value of the species throughout its habitat range [125]. Jaguar parts, mainly fangs and skins, are sold in local markets and tourist centers as decorative pieces, medicinal items or for souvenirs, among other uses [125]. Social networks serve as a means of commercializing jaguar parts [125]. Trafficking represents a considerable threat to jaguars due to their low population density and slow reproduction rates, yet further exacerbated by their loss of habitat because of increasing deforestation, agricultural expansion, and forest fires in the Amazon biome.

The illegal trade in Amazonian birds has declined significantly over the last decade. According to a recent TRAFFIC study, the capture of these wild species has dropped considerably thanks to international wildlife trade bans in most Amazonian countries and captive breeding in consumer countries [119].

Illegal domestic trade nevertheless remains a problem in Brazil and Peru, where between 30,000 and 35,000 birds are confiscated each year, as well as in Peru. Illegal cross-border trade between South American countries remains a problem, however, with Peru, for example, both sourcing and supplying various species of wild birds with partners in Chile, Bolivia Brazil, and Ecuador [119].

Overfishing in Amazonian rivers

Overfishing in a major threat to aquatic ecosystems in the Amazon. Both subsistence and commercial fishing for human consumption are exerting unsustainable pressure on several Amazonian species. The *pirarucu* or *paiche (Arapaima gigas)*, which is endangered and on the CITES Appendix II list of protected species, the *tambaqui* or *gamitana (Colossoma macropomum)*, and several species of catfish are all considered overfished species in the Amazon [128, 129, 130, 131, 132].

Overfishing affects both large species, which continue to be the most sought after, and small species, especially around large cities such as Manaus and Iquitos [133, 134, 135, 136, 137, 138]. Migratory fish are the aquatic species most threatened by anthropogenic changes in the biome, and represent the majority of the catch in both commercial fisheries, accounting for more than 90 percent of the catch, and subsistence fisheries [139]. Although there is no conclusive data, it is thought that the capture of fish for the decorative market also exerts pressure on certain Amazonian species. Other aquatic species are also under pressure due to human activities: turtles are illegally captured for human consumption and the meat of river dolphins and caimans is used as bait for fishing catfish called *piracatinga* or *mota* (see more in the section on river dolphins) [140] [Cap. 20].

Overfishing is a major threat to aquatic ecosystems in the Amazon.

Dolphins are a particularly problematic case, with the practice of using their flesh to attract scavenger fish first identified in Brazil. As well as using dolphins that have fallen victim to bycatch, perpetrators also catch dophins specifically for this reason. A moratorium on the killing of dolphins for this purpose was implemented in Brazil in 2015 and 2019, and from 2020 to 2021, which appears to have had positive local impacts; however, the practice has spread to other countries. The *Inia geoffrensis* species was classified as Endangered by the IUCN in June 2018 in part as a response to this threat [82].

Overfishing and unsustainable catches directly affect the survival of several aquatic species and the relationships between the different trophic levels of an aquatic ecosystem. This reduces the sustainability of economic activities linked to fishing an diminishes the food security of communities and indigenous peoples who depend on fish. Overfishing also affects plant diversity and conservation in general, as several Amazonian fish species, especially larger ones, feed on fruit and thereby play an important role in seed dispersal [141] [Cap. 20].

Beautiful Destinations @Beautiful Destinations

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Protected areas and indigenous territories: ever smaller and less protected

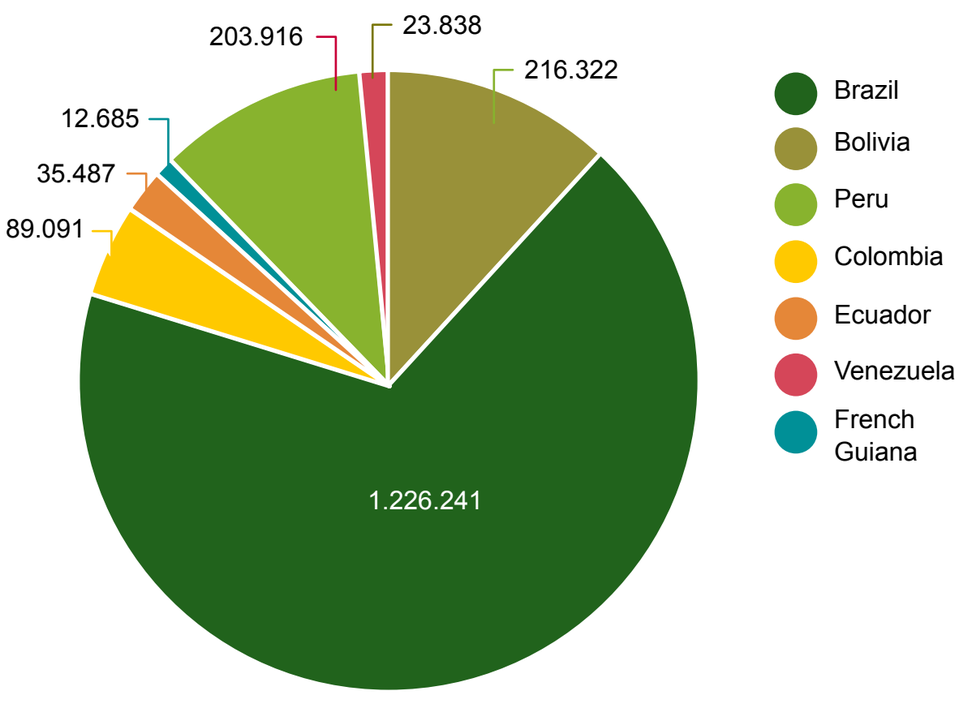
Protected areas and indigenous territories constitute the most important protection network in the biome.

Protected areas and indigenous territories legally protect 25.3 percent and 27 percent of the Amazon basin, respectively [182] [Cap. 16], which is to say, more than half of the Amazon is within one of these conservation entities or reserves. These spaces form a fundamental part of the green infrastructure that sustains the biome's equilibrium and strengthens its resilience in the face of multiple threats.

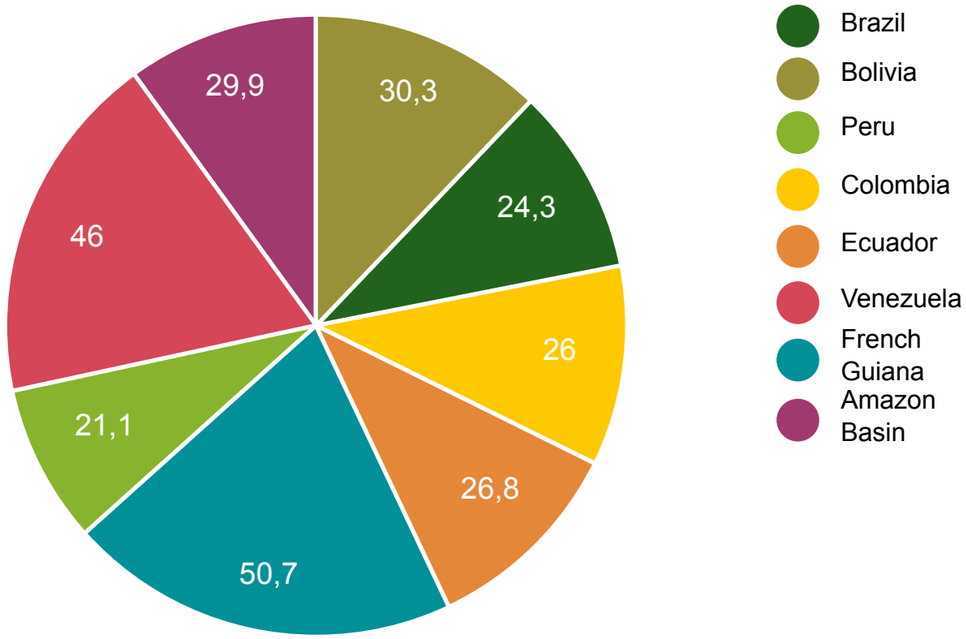
COVERAGE OF PROTECTED NATURAL AREAS IN THE AMAZON BASIN *.

Protected Areas without overlaps (km²)

** Available at: www.theamazonwewant.org.*



Percentage of the Amazon Basin in each country or territory set aside for protection (%)



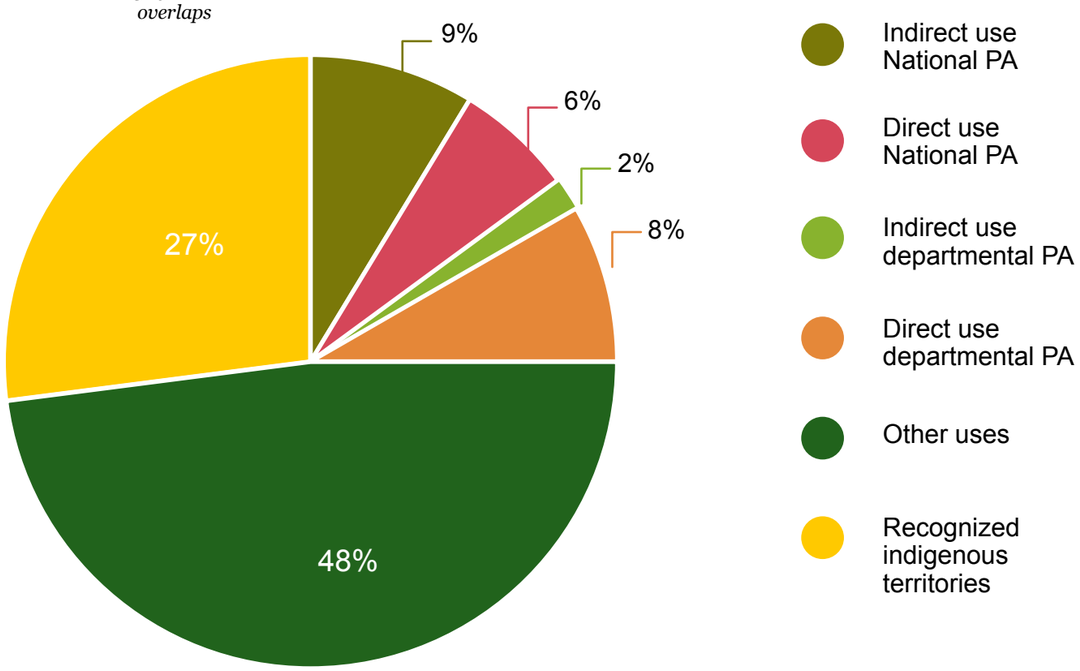
The majority of protected areas in the biome were established between 1990 and 2009, particularly between 2005 and 2009, with categories ranging from strict protection to sustainable production (such as Brazil's extractivist reserves), as well as certain core biosphere reserves that combine different uses and restrictions in the same geographic area. The creation of protected areas in the Amazon has slowed down since 2010, with efforts concentrating on improving the management of those already established so that they can better meet conservation objectives [142].

PROTECTED AREAS IN THE AMAZON BASIN ACCORDING TO ADMINISTRATIVE LEVEL AND MANAGEMENT CLASSIFICATION. PERCENTAGES REFLECT THE AREA OF EACH CATEGORY IN RELATION TO THE BASIN'S TOTAL AREA IN EACH COUNTRY *.

Percentage of the Amazon basin that is in recognized indigenous territories and in different types of protected areas **

** Available at: www.theamazonwewant.org.*

*** The graph assumes that there are no significant overlaps*

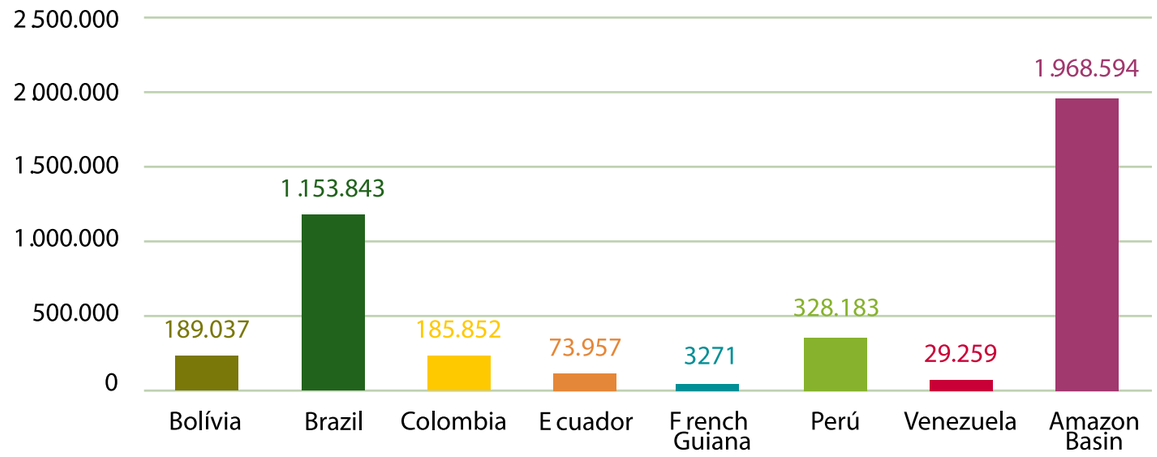


The end of the previous century marked the beginning of territorial recognition for those indigenous peoples that have inhabited territories for centuries and, in some cases, their legalization. **These territories correspond to a different rational to that of protected areas, in this case closely linked to the culture of the peoples that inhabit them/live there. They are not exclusively conservation spaces but reflect a far richer interrelationship with nature in which most native peoples practice traditional ways of life using ancestral/traditional knowledge in a more harmonious coexistence with wildlife.**

INDIGENOUS TERRITORIES (IT) IN THE AMAZON BASIN *.

Extension of indigenous territories in the Amazon Basin (km2)

** Available at: www.theamazonwewant.org.*



*** PADDD is the acronym for "Protected area downgrading, downsizing and degazettement" and refers to legal changes that decrease restrictions on the usages or total area of protected areas, or eliminate legal protections altogether.*

As of 2005, protected areas in the Amazon have increasingly faced downgrading, downsizing, and degazettement (loss of legal protection), collectively known as PADDD events **. PADDD events are now widespread in the Amazon with "75 percent of ecoregions and 21 percent of key biodiversity areas currently or potentially affected" [144].

There were 69 documented PADDD cases in Amazonian protected areas between 2008 and 2016, corresponding to 19 losses of legal protection, 18 classification downgrades, and 32 instances of downsizing. Most PADDD events occurred in Brazil (54), followed by eight in Bolivia, two in Ecuador, two in French Guiana, two in Peru and one in Guyana [145]. In September 2018, Brazil eliminated 11 protected areas in the Amazonian state of Rondônia which had covered 600,000 hectares of forest [146].

PADDD events are often driven by a protected area's high potential for extractive activities and large-scale industrial resource development, which potentially jeopardize biodiversity conservation objectives. Studies show that these events correlate with greater deforestation; but at the same time, high historical rates of deforestation in a protected area are also a *cause* of PADDD in Brazil, meaning that poorly performing protected areas are at greater risk of being downgraded [145].

Although, by definition, indigenous territories are not affected by PADDD events (being a term exclusive to protected areas), they also experience downsizing and loss of recognition by state authorities. Indigenous territories are also vulnerable to various forms of illegal incursion, such as illegal mining and logging, which places individual lives at risk and exposes

the natural resources of Amazonian peoples to unregulated exploitation. These territories are especially vulnerable to natural resource exploitation and infrastructure construction by the region's governments, in many cases without due consultation processes or free, prior, and informed consent, as required by Convention 169 of the International Labor Organization, as well as in violation of the rights established in the United Nations Declaration on the Rights of Indigenous Peoples. In many cases the legal land tenure of indigenous peoples who have ancestrally inhabited a particular area is inadequately upheld by the State, hindering protection mechanisms, and exposing communities to encroachment from other actors with interests in the territory.

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Climate change: A planetary problem

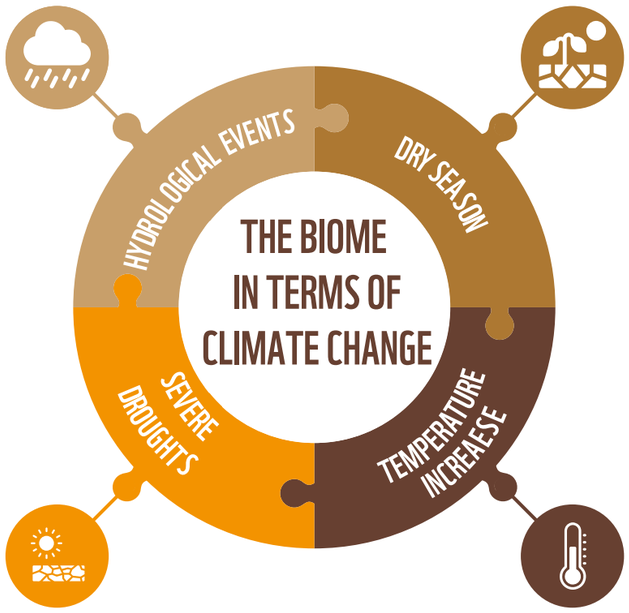
As in much of the world, since 2010 the Amazon has experienced the warmest years on record since the Industrial Revolution.

Climate change affects the biome's terrestrial and aquatic ecosystems and magnifies the impact of other threats such as forest fires.

The 2021 Assessment Report from the Science Panel for the Amazon provides some of the most important data on the current situation of the biome with respect to climate change [Cap. 22]:

Extreme hydrological events have intensified and become more frequent. Floods used to occur every 20 years in the first half of the 20th century but have been occurring every four years during this century.

The dry season has lengthened, and extreme droughts have become more frequent and intense. The dry season has lengthened by about one month in the southern Amazon relative to the 1970s.



Recent severe droughts are linked to the El Niño Phenomenon (ENSO) and temperature anomalies in the Tropical North Atlantic.

There is evidence of temperature increases in the Amazon over the last 40 years. The years 2015, 2016 and 2020 have been among the warmest years in the last three decades. The scale of the warming varies according to the studied periods and areas.

A third of the species in the Amazon will be under threat of local extinction if temperatures rise to extremes.

A Vulnerability Analysis of the Amazon Biome and its Protected Areas by WWF calculated an integrated climate change risk index for the biome based on a regional climate change index and a socio-cultural index, which takes changes in precipitation and temperature, seasonality and future climate predictions for dry and wet seasons into account.

The index shows that the areas at most climatic risk — understood as the biome's potential loss of functionality (its capacity to provide ecosystem services) — are found in the eastern Amazon in the Brazilian state of *Pará*, the southern part of the state of *Rondônia*, and the northern part of the state of *Mato Grosso*, also in Brazil. Other risk hotspots appear in Amazonas (Brazil), *Loreto* (Peru) and northern Guyana. In addition, 35 percent of Protected Areas, covering 18.6 percent of the biome's total protected area, were found to be at high risk from climate change [147].

Another study carried out by WWF on the impact of climate change on Amazonian species shows that a third of species are likely to face local extinction if temperatures rise sharply. Plant species will fare very badly in all areas and amphibians are the animal most likely to suffer, with birds and mammals potentially better able to adapt if the necessary ecological connectivity conditions allow relocation to more temperate zones [148].

Climate change is also causing an annual decrease in the biome's surface water. A recent study by WWF and Imazon found that surface waters in the Brazilian Amazon have decreased since 2010. The consequences on aquatic and terrestrial biodiversity in the Amazon have not yet been thoroughly researched, but the study shows for the first time a clear loss of freshwater habitat in recent years: there was a sustained reduction in surface water between 2010 and 2017 in comparison to the previous three decades, falling from an average of 130,000 square kilometers per year to just 116,811 square kilometers per year over the study period. This reduction coincides with a period of extreme drought and low precipitation, beginning in 2010, suggesting a connection to climate change [149].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Climate change and forest fires: a negative spiral

Climate change exacerbates the risk of forest by causing drought that facilitates the spread of fire. Fires, in turn, exacerbate the climate crisis through emitting carbon when vegetation and organic soil matter is burned. Finally, fire affected areas become more prone to droughts, floods, and other effects of climate change.


© Andre Dib / WWF-Brazil

Another recent WWF study investigated the impacts of various global climate scenarios on the extinction of various species populations in the Amazonian-Guyana priority region [148]. According to the projections, plants and amphibians are again the most vulnerable groups, reptiles are deemed moderately vulnerable, and birds and mammals less so. The ability to move around reduces the vulnerability of species populations. The mobility of certain animals allows them to shift their native ranges to climatically more suitable areas, which is easier for birds and, to a lesser extent, mammals.

In addition, there are specific human health risks in the Amazon region that could potentially result from climate change. Climate change could facilitate the spread of infectious diseases and affect the food security of local populations. **Indigenous peoples are especially vulnerable to climate change due to their strong ties to the territory for their physical and cultural survival**. An investigative report highlighted the effects that climate change is already having on indigenous communities in the Brazilian Amazon: indigenous peoples already confront changing rainfall patterns, reduced river flows, increased forest fires, and a reduction of forest and food resource availability [150].

These effects are prompting community subsistence change. The use of seeds that are more resistant to drought and heat is increasingly common [150], for example, which may lead to the gradual disappearance of certain traditional products in the region. Physical health is also increasingly at risk due to the reappearance of tropical diseases such as yellow fever which were previously under control [150]. More information is needed on the vulnerability of local communities and indigenous peoples in the Amazon to climate change in order to better adapt and mitigate its most harmful effects.

Climate change could facilitate the spread of infectious diseases and affect the food security of local populations.

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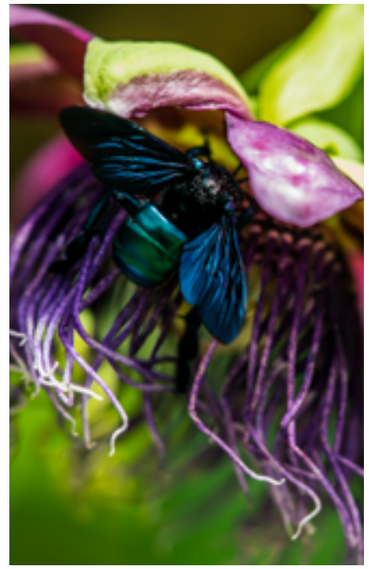

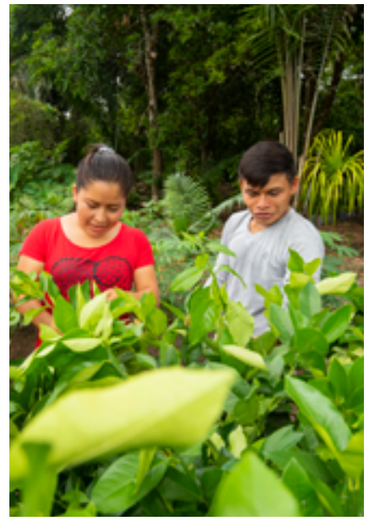

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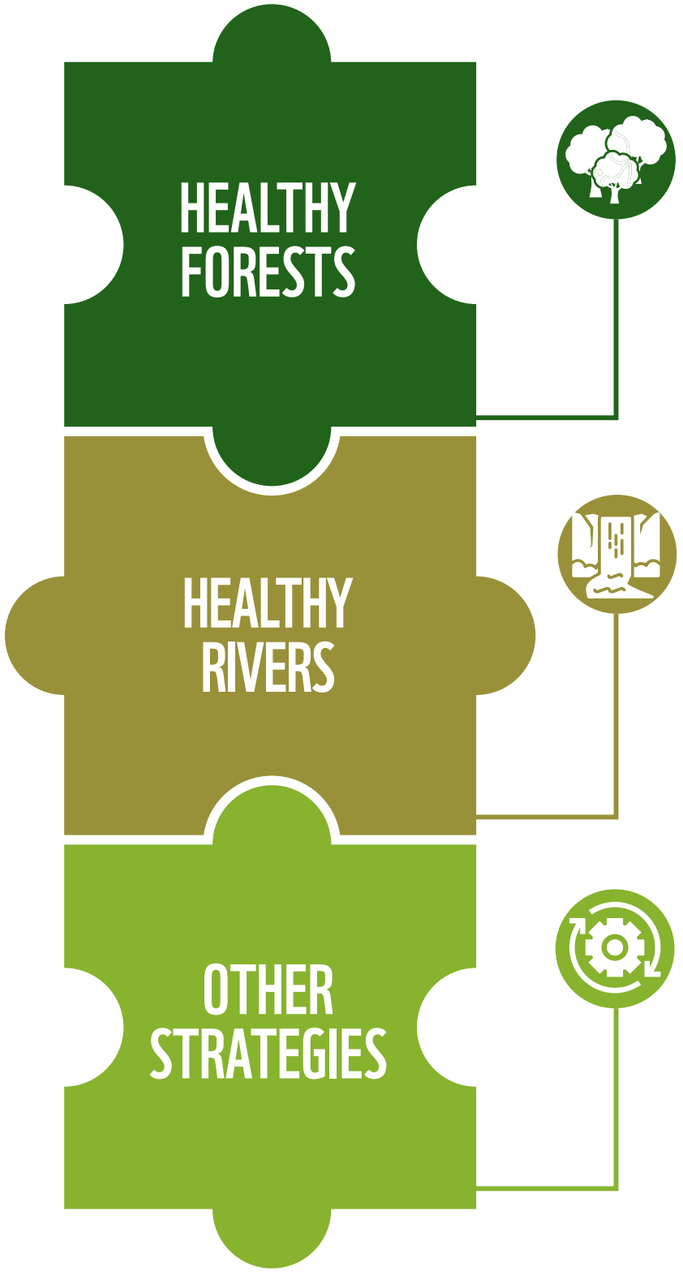
3. WHAT SHOULD BE DONE? WHAT CAN BE DONE?

PRIORITIES AND SOLUTIONS FOR THE AMAZON

The Amazon is made up of the forests, rivers and communities found there, both human as well as wild flora and fauna. Larger towns and cities have complex relationships with the ecosystems on which they exert pressure. In order to create a *Living Amazon*, deforestation and degradation must be halted immediately to avoid reaching a point of no return; degraded ecosystems must be restored; and sustainable, fair, and inclusive economies established in the region.

© Joel Heim / WWF-Ecuador

This section outlines some of the strategies that need to be implemented in an integrated manner in order to protect the Amazon. The first part presents some general considerations related to forests, followed by some others specifically related to rivers. We end with a discussion of some potential cross-cutting strategies. Examples of successful attempts to address specific issues are presented in the boxes throughout the chapter.



- Landscape approaches to the conservation and susteinable development of forests
- Protected areas
- The guardians of the Amazon
- Jaguar Conservation

- Free-flowing Amazon rivers and healthy freshwater ecosystems
- Mercury free gold mining
- The conservation of river dolphins

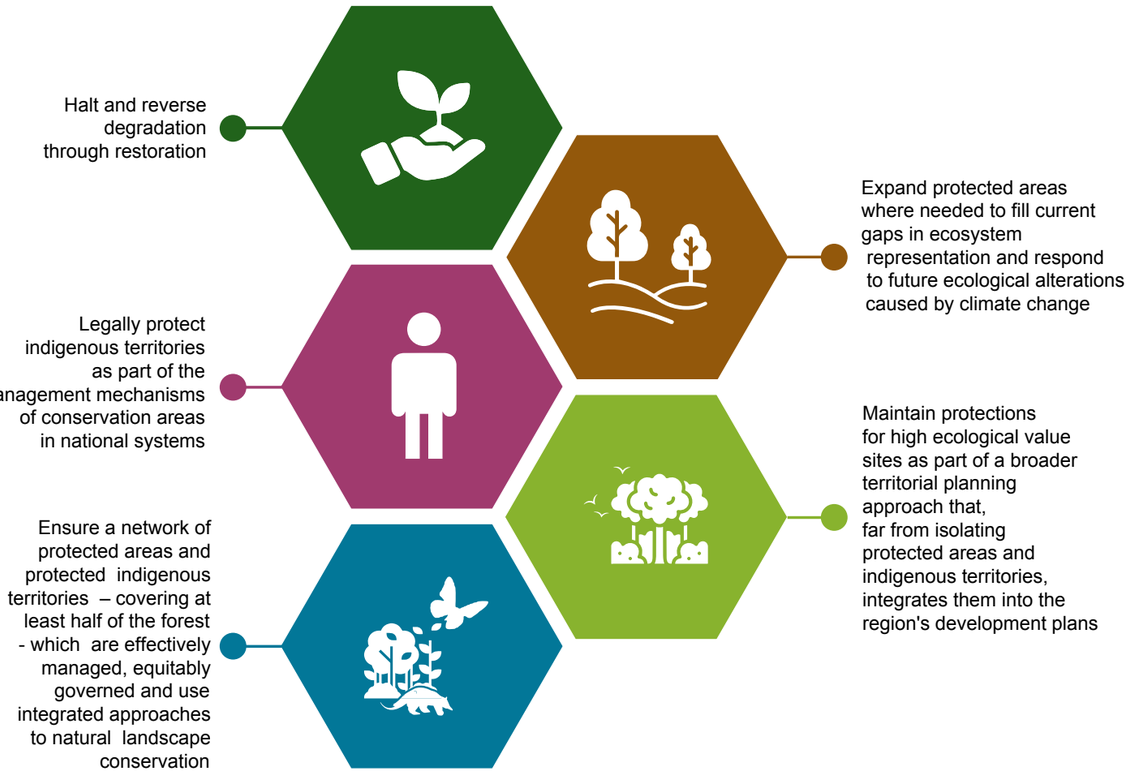
- Amazonian societies and governance

HEALTHY FORESTS

The protection of the Amazon requires a combination of strategies and approaches that combine conservation requirements with the developmental needs of the countries that comprise it.

There is a delicate balance among the Amazon's environmental systems that cannot be maintained if forest loss is not contained as soon as possible.

The long-term survival of the Amazon is heavily dependent on halting deforestation. In order to safeguard the forests, it is necessary to:



All this must be carried out based on a robust vision of sustainability and a development model that does not involve deforestation or conversion, balancing multiple needs with environmental priorities by way of a regional approach to ensure that human populations benefit without jeopardizing the long-term security of the biome.

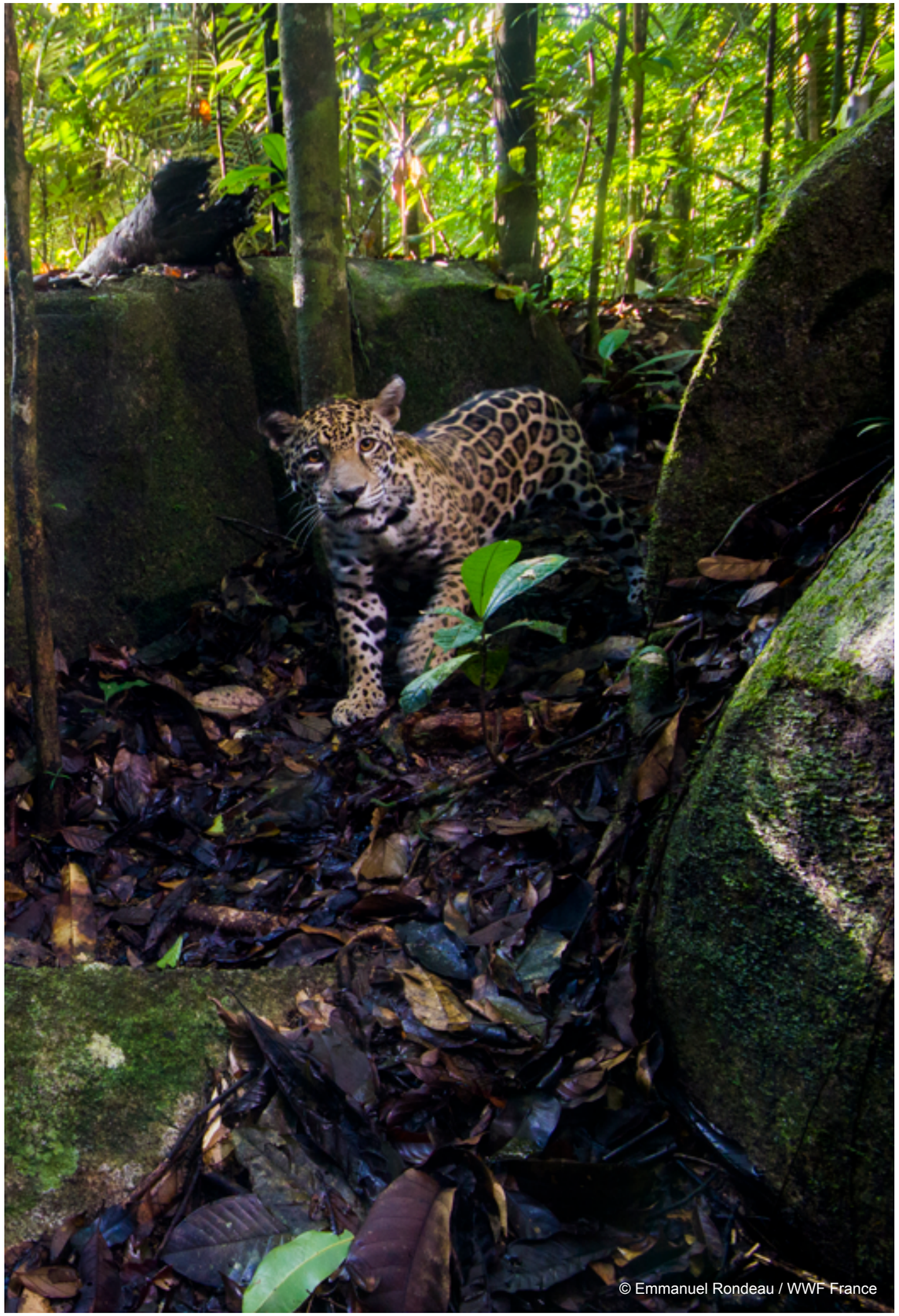
Landscape approaches to conservation and the sustainable development of forests

The protection of key forest areas and their biodiversity in the Amazon entails a combination of conservation and sustainable use that aims to completely avoid the deforestation, conversion and degradation of native vegetation while promoting sustainable development and the establishment of livelihoods in harmony with nature.

In this context, some of the most important strategies for protecting the Amazon's terrestrial ecosystems can be grouped under an *integrated landscape management approach.*

Maintaining resilience in the biome, reducing negative impacts on biodiversity, guaranteeing the rights of indigenous peoples and traditional communities, promoting human well-being, and preserving ecological integrity require a landscape approach and an "integrated conservation model, combining protection, sustainable management and, when necessary, restoration" [2]. Landscape-level conservation strengthens the connectivity between ecosystems to facilitate the movement of species such as the jaguar and river dolphin whose survival depends on large tracts of habitat.

© WWF-Brazil / Adriano Gambarini



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Deforestation- and conversion-free supply chains

Private sector and banking action is key to ensuring that agricultural and forestry commodities can be produced without causing deforestation and ecosystem conversion in the Amazon. Companies involved at different levels of the supply chain must implement management schemes and sustainable practices that increase agricultural productivity while halting or reversing deforestation[151]. Likewise, those that market these products should adopt sustainable procurement, traceability and accountability standards to ensure that there have been no negative impacts on natural ecosystems and local communities in the supply chain.

Governments must establish more robust legal frameworks and promote transparency and verification systems to ensure fair and environmentally responsible trade in both producer and consumer countries. For their part, financial institutions bear responsibility for establishing credit policies that allow them to identify and exclude productive activities that involve deforestation and conversion from their portfolios, and investors must commit to divest from companies associated with deforestation and conversion in the Amazon.

It is essential that civil society continues to promote tools and incentives for producers and investors to facilitate a decoupling between deforestation or conversion and the production of soybeans, livestock and other characteristic industries currently operating in the Amazon. Consumers, the last link in the chain, are responsible for supporting these transformations by changing their consumption patterns and ceasing to buy products that are associated with deforestation and conversion in the Amazon.

The Accountability Framework Initiative provides a comprehensive guide on how to eliminate deforestation and native vegetation conversion from supply chains, specifying the actions that must be taken by different actors involved in these chains; from government, civil society, commercial traders and financial institutions, to producers and processors, manufacturers and retailers *.

** Footnote: WWF is one of the 9 lead organizations behind the Initiative. For more information see here.*

Strategies for an effective integrated landscape management approach for the Amazon include:

CONVERSION-FREE LANDSCAPES:
T**he preservation of existing natural ecosystems** so that they do not undergo land use change. In the case of Amazonian terrestrial ecosystems, this equates to halting deforestation, the conversion of native vegetation, and degradation. This objective requires the appropriation of **strong socio-environmental safeguards** by companies and investors in key economic sectors to encourage deforestation-free sustainable development that is compatible with long-term goals of ecological, energy and food security for Amazonian countries [2]. It also requires the governmental identification and protection of key ecosystems where extractive activities or infrastructure are not permitted. It is essential that the construction of new infrastructure is only approved for projects that have the potential to generate large social and economic benefits with low environmental and social impacts.

SUSTAINABLY MANAGED FORESTS:
The development of **deforestation-free value chains** that use forest products in a sustainable manner and/or incentivize good agricultural practices in local communities. Sustainable forest management also encompasses reforestation and restoration efforts in degraded landscapes or those that have been converted to other uses. The creation of **sustainable economic and commercial models** for local stakeholders entails payment for ecosystem services as a mechanism to compensate local communities and indigenous peoples for the conservation of nature.

LEGAL TRADE:
Illegal logging and the illegal wildlife trade reduce biodiversity and degrade forests, paving the way for further degradation and, ultimately, deforestation. Reducing illegal logging requires **integrated strategies to stem illegal activities and promote legal and sustainable practices** and depends upon governmental cooperation across the region to address the cross-border and global nature of timber trafficking. **The promotion of a legal timber market** through the implementation of traceability technologies * and certification schemes such as FSC ** is crucial to countering the threat from illegal trade. Well-managed timber commerce has the potential to conserve forests while providing sustainable livelihoods to local populations.

On the other hand, the trade in wildlife and wildlife parts does not have a sustainable alternative in most cases ***, so strategies must focus on eliminating the practice through improved legislation and wildlife protection policies in Amazonian countries, capacity building for the detection and control of illegal trade, and cross-border collaboration to combat trafficking between countries, with the goal of preventing the illegal trade of animals and timber.

** Forest clearance and supply chains must be overseen in such a way that the origin of timber can be traced and verified in a clear and transparent manner.*

*** The FSC (Forest Stewardship Council) is a non-profit organization whose mission is to promote environmentally sound, socially beneficial and economically viable management of the world's forests (www.fsc.org).*

**** The alligator trade in Bolivia is one exception.*

ENSURING THE RIGHTS OF INDIGENOUS PEOPLES, LOCAL COMMUNITIES, WOMEN, AND YOUNG PEOPLE:
Build **stronger, forest-related, multi-stakeholder partnerships** to ensure greater compliance with both environmental laws and land tenure rights and incorporate autonomous community decisions into governmental public policy related to the conservation and sustainable use of forests.

These strategies are intended to complement well-managed conservation areas and indigenous territories to form a network of well-conserved landscapes that maintain standing forests and provide spaces for species conservation and sustainable development.


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Changes in climate will affect the fulfilment of landscape approach objectives for forest conservation and sustainable development

Current scientific knowledge suggests that Amazonian forests are becoming increasingly susceptible to forest fires and droughts. The connections between climate change and the functioning of Amazonian ecosystems are significant and need better understood and quantified [Cap. 23]. More comprehensive studies are needed on the connections between biodiversity loss and climate change, as well as on resilience. The consequences of the intensification and lengthening of the dry season on ecosystems also require investigation. Finally, more research is needed on the effect of climate change on protected areas and indigenous territories, and how it may affect their conservation and the environmental services they provide.

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About 17 percent of forests are degraded.

Restoration and remediation are important components of landscape approaches for both terrestrial and freshwater ecosystems in the Amazon and, given that about 17 percent of forests are degraded and various rivers face degradation, they must be prioritized. The restoration of deforested and degraded riparian areas is necessary to reestablish connections between forests and rivers, as well as within forest areas that are important due to the species they harbor or the services they provide, and which are not connected to a river [152]. In addition, remediation is indispensable to aquatic ecosystems that have been affected by pollution or disrupted by infrastructure. Depending on the ecosystem, restoration can be either be induced or conducted passively through natural regeneration, as well as through the use of silvopastoral systems [Cap. 25, Cap. 27, Cap. 28, Cap. 29].

LANDSCAPE APPROACHES TO CONSERVATION AND SUSTAINABLE DEVELOPMENT

WWF promotes a vision of conservation in the Amazon that, **rather than** being divorced from development, actively seeks sustainable and equitable development in the region as a means of ensuring the provision of ecosystem services to local populations, Amazonian countries, and the rest of the world. To this end, WWF's Amazon offices use a series of tools based on an integrated landscape approach which adapt to the specific characteristics and needs of each of the landscapes prioritized at the regional level. Landscape management models have been developed that halt deforestation and degradation while providing sustainable development alternatives and culturally appropriate livelihoods. Local communities and indigenous peoples are recognized as key partners and actors in conservation and sustainable development.

Examples of successful approaches used across the biome include:

DEFORESTATION- AND CONVERSION-FREE VALUE CHAINS:
Businesses have an important role to play in protecting nature, especially in the Amazon. Products from recently deforested areas are flowing into markets around the world. It is critical and urgent that the private sector leverage the deployment of deforestation- and conversion-free supply chains and eliminate the negative impacts of their businesses. The Soy Moratorium in Brazil is an example of how businesses can act to stop deforestation and conversion, but such solutions need to be accelerated across other supply chains. WWF's global presence allows it to work on greening the supply chains of beef and other Amazonian products associated with deforestation in both producer and consumer countries. To this end, WWF is working to influence policies and financial flows in Brazil, the United Kingdom, the United States, China, and members of the European Union [153].

SUSTAINABLE FORESTRY:
The promotion of sustainable forest management as an important strategy for maintaining standing forests and generating community income. This approach seeks to improve awareness of timber and wildlife trafficking problems and promote the legal timber market. WWF has been working with indigenous communities from the *Awajun, Ashaninka, Arahuaca, Yine, Ese Eja* and *Shipibo* ethnic groups in Peru since 2002 to develop their technical and commercial capacities for sustainable forestry and has contributed to the certification of thousands of hectares of forests in the Amazon *. WWF Bolivia has been working in community forest management and forest certification since 1993 **. WWF Ecuador has worked with several Amazonian communities to promote agroforestry cocoa production in alliance with the *Pacari* chocolate brand, which provides fair prices to producers and thus helps develop sustainable livelihoods while avoiding deforestation. Indigenous bio-enterprises related to guayusa leaf production, gastronomy, handicrafts, and tourism have also been supported. Several of WWF's Amazonian offices have developed successful projects built around the sustainable production of rubber, *asaí, copaíba* and Brazil nuts, sustainable fishing, among other products.

** Available at www.wwf.org.pe.*

*** Available at wwf.panda.org.*

TERRITORIAL MANAGEMENT:
Supporting the development of territorial management plans by local Amazonian governments to facilitate the inclusion of environmental and climate change criteria. Through the SNACC project (2014-2016), WWF provided technical assistance to several local governments in priority sites in the *Cordillera Real Oriental* in Colombia, Ecuador, and Peru to include criteria related to climate change and protected areas in their plans.

COMMUNITY MONITORING, REPORTING AND VERIFICATION:
The implementation of monitoring, reporting and verification systems for deforestation and other land-related issues, led by local communities. WWF and the Wai Kaneshen community have successfully implemented a Community Monitoring, Reporting and Verification (CMRV) system in Guyana that enables indigenous communities to participate in REDD strategies within the national low-carbon development strategy. Through this system, WWF is helping 33 indigenous communities (on 22 titled lands) to become active participants in Guyana's low-carbon economy, with the possibility of qualifying for results-based REDD+ funds. WWF works closely with the Guiana Forestry Commission and the North Rupununi District Development Board to ensure that CMRV standards are met, and that data is fully integrated with the National Monitoring, Reporting and Verification System (MRVS). Guyana's MRVS is the world's first country-wide system for reliably monitoring changes in forest cover. It is a powerful mechanism to inform policy debates and has become a cost-effective and reliable model for other countries preparing for REDD+.

RESTORATION AND REFORESTATION:
These important components within an integrated landscape approach address the issue of forest degradation. WWF is working with CINCIA and other partners in Peru to identify the best techniques for restoring degraded areas due to illegal and informal gold mining in Madre de Dios. This initiative has undertaken research of 74 different tree species, planted 45,500 trees and developed a methodology that can be replicated in other sites across the biome *. In addition, WWF is working with the Environmental Control Tribunal and cattle ranching schools to increase the productivity of small cattle ranches through soil restoration and tree cover.

** Available at www.wwf.org.pe.*


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Protected Areas

The management of protected areas strongly affects their capacity to conserve biodiversity. The most successful national protected area systems are effectively and equitably managed, sustainably financed, ecologically representative, and well connected [2].

Protected areas provide many benefits to both nature and people.

The conservation of protected areas in the Amazon is necessary to meet several international commitments, including Objectives 4 and 15 of the 2030 Agenda for Sustainable Development; the objectives set out at the Convention on Biological Diversity, in particular the Work Program on Protected Areas and the targets in the new Global Biodiversity Framework; the Promise of Sydney (2015); the Lima Declaration at the Latin American and Caribbean Protected Areas Congress (2019); and the commitments made by Latin American countries in the REDPARQUES framework, including the Declaration on the Role of Protected Areas and Climate Change (2015).


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Protected areas offer integrated natural solutions for climate change adaptation and mitigation, as well as for strengthening resilience.

Protected areas offer integrated natural solutions for climate change adaptation and mitigation, as well as for strengthening resilience [24]. Carbon stocks in protected areas of the Amazon are larger than in unprotected areas but face significant pressures. Provided they are equitably managed, protected areas can also offer the twin benefits of poverty reduction and sustainable development to surrounding communities.

WWF's Vulnerability Analysis of the Amazon Biome and its Protected Areas found that protected areas buffer the impact of extreme climate events by maintaining high levels of water availability for times of extreme shortage (such as droughts) and exhibit fewer severe flooding events [147]. In addition, protection entities are associated with a more than 21 percent reduction in the climate risk index presented in this analysis.

Although protected areas are supported by a legal framework, they can fall victim to the phenomenon known as PADDD, outlined in the previous chapter, which refers to their downgrading, reduction, or loss of legal protection. This often happens to make way for governmental extractive or infrastructure projects, or due to pressures to expand the agricultural frontier.


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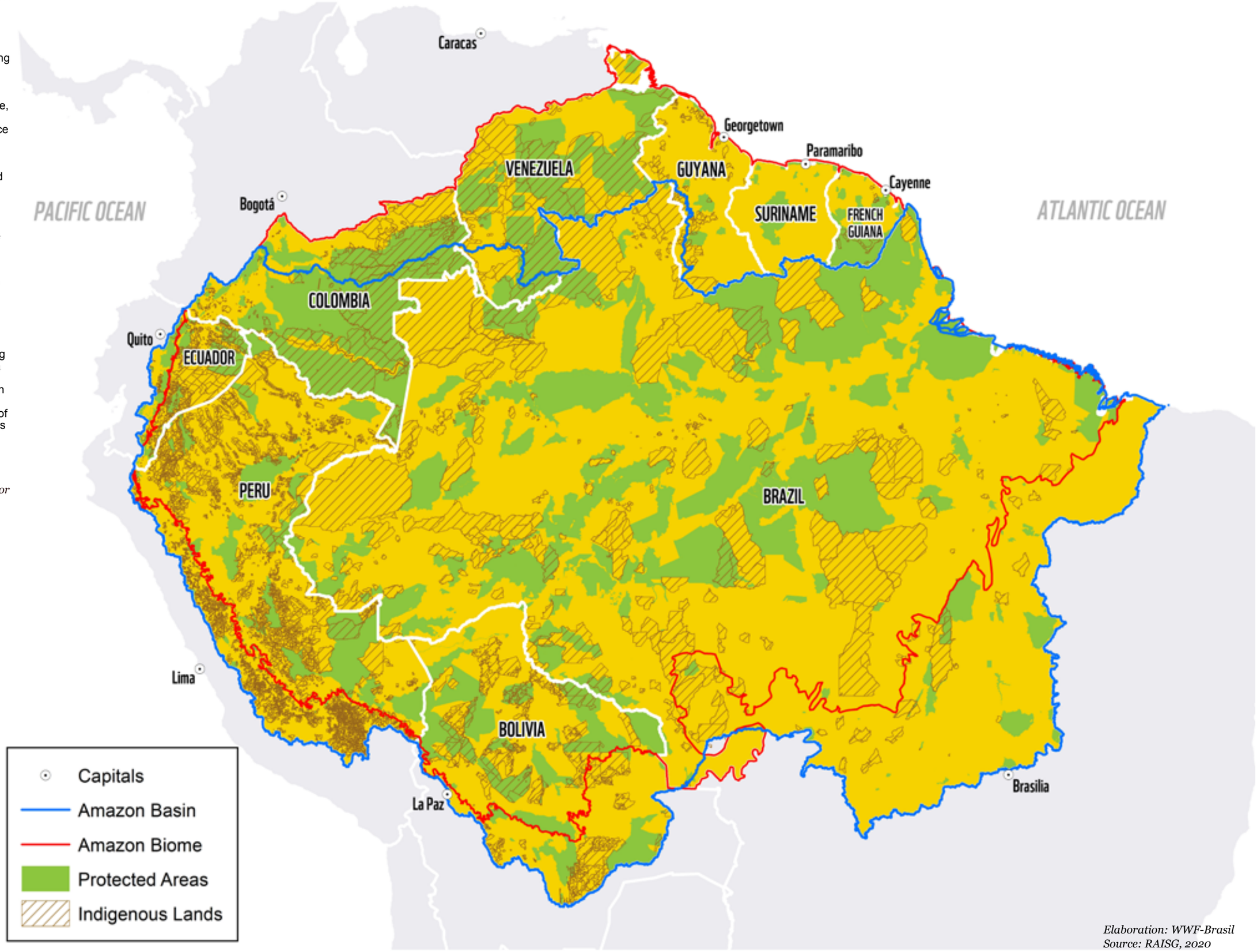
Map 7: Protected areas

Protected areas face pressures from illegal hunting and mining, contamination from extractive industries, the construction and use of poorly planned infrastructure, the presence of invasive species, and may experience the withdrawal of legal protections collectively known as PADD*, a product of pressures related to extractive activities, infrastructure development and the expansion of the agricultural frontier. Effective participation in the management of protected areas and/or their buffer zones by communities is key to reducing these types of threats and ensuring their socio-environmental sustainability. Participatory co-management is one of the most successful approaches to strengthening the management of an area and providing sustainable livelihood opportunities such as ecotourism. Long term governmental prioritization of the protection of these areas is crucial.

**This is described in the previous chapter and covers the downgrading, reduction or withdrawal of legal protections for protected areas.*



Elaboration: WWF-Brasil
Source: RAISG, 2020

With respect to the **design of protected areas**, ecosystem representation at the biome level must be improved and climate change considerations incorporated (to include key ecosystems in the fight against climate change and to preserve ecosystem services in scenarios of ecosystem chance) when creating new areas, expanding, or reconfiguring existing areas, or increasing protection categories * [147]. **The design and management of transnational or bilateral ecological networks is important, especially for key ecosystems, to facilitate coordinated management by distinct countries and/or international organizations,** promote regional collaboration at the Amazonian level through REDPARQUES **, and advocate for the coordinated implementation of the Leticia Pact ***.

Likewise, **the development of research initiatives** should be promoted to better understand the socio-environmental dynamics of the biome and to consolidate a regional conservation vision for the Amazon.

It is crucial to **raise awareness** among the general public, and especially among decision-makers, about the role of protected areas in sustainable development, biodiversity protection and in addressing climate change, as well as about the ecological, economic and social benefits they bring to Amazonian societies [Cap. 26].

It is also essential to use landscape approaches to integrate protected areas into planning and land management instruments, and into development policies at the local, national, regional, and sectoral levels.

The use of various existing tools to improve area management should be strengthened throughout the biome.**Effective management requires building institutional adaptive capacity in national systems, as well as the integration of land management approaches from other authorities and governments, encouraging the recognition of the role other forms of governance can play in conservation.** Among other factors, management programs should strengthen the restoration of priority sites at the landscape scale, and the recuperation and remediation of sites affected by extractive activities, degradation, or deforestation.

Among measures to strengthen protected areas in the Amazon, **priority should be given to strategies that provide benefits to local populations** within a framework of equity. Firstly, new protected areas should not incorporate territories traditionally used by indigenous peoples, even if not currently settled there. Shared governance frameworks, in conjunction with indigenous territories, can form connective corridors to ensure the maintenance of ecosystem services both inside and outside protected areas and broaden the range of effective area-based conservation. Socio-economic benefits related to food security, employment and other income opportunities (through tourism and so forth) for local communities must also be prioritized, and local cooperation agreements established for the sustainable management of fisheries and other resources [Cap. 28, Cap. 29].

** According to the Climate Vulnerability and Risk Analysis of the Amazon Biome and its Protected Areas, the modification of climatic patterns due to climate change could generate alterations in the distribution of species causing key species to lose parts of their current habitat, and existing Protected Areas are inadequate to ensure a reduction of this impact on the species analyzed.*

*** The Latin American Network for Technical Cooperation in National Parks, other Protected Areas and Wildlife (REDPARQUES) is a technical mechanism made up of public and private institutions as well as specialists from member countries in the region that work in the area of protected areas and wildlife. Its objective is to progressively increase technological and management capacity, based on the exchange of experiences and knowledge among members, using their own technical, human and financial resources (www.redparques.com).*

**** The Presidential Summit for the Amazon was held on September 6, 2019 in the city of Leticia, Colombia, after several countries were affected by forest fires in the Amazon. The signing of the Leticia Pact formalized several commitments regarding the preservation and sustainable use of natural resources and biodiversity, the creation of a network to address disasters, as well as the promotion of initiatives for the recovery of ecosystems affected by forest fires and illegal activities, and the creation of financial mechanisms for the implementation of the commitments made.*

To strengthen protected areas in the Amazon, priority should be given to strategies that provide benefits to local populations within a framework of equity.

The future of these areas is threatened by the lack of funds for their protection, therefore **ensuring the financial sustainability** of protected areas in the Amazon is also a challenge and a priority. WWF has played a leading role in the creation of an innovative model called Project Finance for Permanence (PFP) to address this issue in which various governments, public and private donors, NGOs, and other actors work to secure long-term funding to permanently protect and sustainably manage conservation areas. The PFP approach seeks to expand and strengthen protected areas and/or other effective area-based conservation measures by bringing together stakeholders and securing comprehensive commitments of financing, conservation, and community development.

PROJECT FINANCING FOR PERMANENCE (PFP) MODELS IN AMAZONIAN COUNTRIES

The PFP approach supported by WWF has led to the establishment of the world's largest tropical forest protection program in Brazil, the Amazon Protected Areas Program (ARPA). It has achieved 98 percent of the necessary funding to protect 60 million hectares of forest within 114 protected areas [14]. WWF also played a key role in the development of Herencia Colombia, a program that will establish a fund to expand the protected areas system and improve management and good governance of areas in and around protected areas in the Amazon, the Andes, the Orinoco River Basin, and on the Pacific and Caribbean coasts. In Peru, WWF supported the establishment of Patrimonio Natural del Perú, an initiative that will allocate US$140 million to permanently protect 16.6 million hectares in the Peruvian Amazon. In late 2021, the Enduring Earth partnership received funding from the Bezos Earth Fund to enable WWF to assess and strengthen the necessary conditions to lay the groundwork for the prospective development of a PFP in Bolivia and Ecuador.

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PROTECTED AREAS: ONE OF THE MOST EFFECTIVE CONSERVATION STRATEGIES

The Amazon boasts a high percentage of territory under some form of conservation or sustainable management, largely thanks to effective action by governments and non-governmental organizations to establish protected areas that cover approximately one-fifth of the biome.

New, Larger Protected Areas

WWF has been heavily involved in the creation and expansion of protected areas in the Amazon throughout its history. Below are some of the protected areas that WWF has contributed to, whether in terms of their creation or expansion:

COUNTRY OR TERRITORY	NAME	NOTE
Brazil *	Wildlife Refuge and a Sustainable Development Reserve in the municipal county Senator José Porfírio	Creation
	Mosaic of the Eastern Amazon, in Amapá: Gran-Pará Ecological Station Maicuru Biological Reserve Paru State Forest Trombetas State Forest Faro State Forest Santa Maria do Uruará Environmental Protection Area Amazonia State Forest Iriri State Forest Triunfo do Xingú Environmental Protection Area **	Creation
	Ituxi and Médio Purús Extractivist Reserves	Creation

** Available at wwf.org.br.*

*** The established Protected Areas occupy about 15 million hectares, forming one of the largest conservation corridors in the world, linking a large protected area in Amapá (including the Tumucumaque Mountains National Park) and connecting by means of indigenous territories to protected areas in Roraima and Amazonas.*

COUNTRY OR TERRITORY	NAME	NOTE
Colombia * * *Available at wwf.panda.org.*	Serranía de Chiribiquete National Park	Expansion from 2.8 million hectares to 4.3 million hectares
	Tarapoto Lakes as a RAMSAR site	Increased protection of this set of wetlands by more than 40,000 hectares.
	Miraflores and Picachos Regional Natural Park	Creation; a joint project between Corpoamazonia, WWF, the government of Caquetá Department, municipal governments, and local communities.
Ecuador * * *Available at www.wwf.org.ec.*	Cuyabeno-Lagartococha-Yasuni Wetland Complex RAMSAR Site	Recognition; within the Cuyabeno Faunal Production Reserve and Yasuní National Park
Peru * * *Available at www.worldwildlife.org. Available at www.wwf.org.nz.*	Huimeki Communal Reserve	Recognition; North Amazonian Loreto through the Putumayo Three Frontiers Project
	Airo Pai Communal Reserve	
	Güeppi-Sekime National Park	
	Alto Purús National Park Purús Communal Reserve	Creation
	Pastaza River Abanico Wetland Complex RAMSAR Site (Loreto)	Creation
French Guiana [154, 155]	Guiana Amazon Park	Creation; adjacent to the Tumucumaque Mountains National Park in Brazil

In addition, WWF Ecuador and other partners have worked towards the designation of the Achuar Conservation and Ecological Reserve System (SACRE) * within the National System of Protected Areas. If successful, this Achuar territory would be the first community protected area in the country. Similarly, WWF Guyana is working with local communities to design and manage a protected area in northern Rupununi that would establish a new model for the conservation of indigenous and state lands in the wetlands of this region.

Available at www.wwf.org.ec.

Although it has not yet resulted in the designation of a protected area, WWF and partners have contributed to the conservation of an almost uninhabited and pristine region of Suriname since 2012 through the South Suriname Conservation Corridor (SSCC) initiative. This initiative links watersheds to existing protected areas in Suriname, the Amazon Park in French Guiana and the main protected areas and indigenous lands in the Brazilian states of Roraima, Pará and Amapá. The initiative supports a joint management model with local indigenous communities.

Key initiatives for protected areas

Protected areas are a priority for conservation organizations such as WWF because of their importance in reducing deforestation and slowing ecosystem degradation. Much of the work that has been carried out in the Amazon over the last decade has focused on increasing the management efficacy of existing areas, promoting good governance, supporting the designation of new areas, and promoting financial sustainability schemes.

WWF works directly across 228,000 hectares in the biome, in addition to the 120 protected areas included in the ARPA programs (Brazil) and the 38 indirectly supported by WWF through *Patrimonio del Perú*, as well as those that are part of the *Herencia Colombia* initiative. There are indigenous settlements and/or territories in most of these areas [156].

The main conservation activities carried out in and on behalf of protected areas in the Amazon include monitoring – including camera trapping —, capacity building, strengthening conservation corridors between protected areas (for example, the ecological corridor between the *Llanganates* and *Sangay* national parks in Ecuador), and promoting sustainable use activities (timber and non-timber products, where possible). WWF has active interventions in protected areas under various management categories in this sphere, including national parks (IUCN category II) and sustainable resource use areas (IUCN category VI), where the main threats are cattle ranching, fire, land use change, infrastructure, logging, and hunting [157].

WWF has supported countries such as Colombia in the development of tools to measure the effectiveness of protected area management across different administration categories and levels, as well as in the development of public policy to guide the planning and management of these areas. It has also worked with governments and REDPARQUES on the development of regional instruments to address management efficacy, financial sustainability, and inter-sectoral dialogue, among other regional governance issues.

Finally, a key area of work in protected areas concerns the development of planning and management instruments, and the mainstreaming of protected areas into national policy to strengthen their role in conservation and sustainable development. In this area, WWF-Brazil for example, has contributed to the design of ten management plans for Amazonian protected areas, including the Jaú National Park. It has also worked closely with ICMBio and the Ministry of Environment to plan, monitor and evaluate protected areas in the Amazon, including the Application of the Rapid Assessment and Prioritization of Protected Area Management Methodology (RAPPAM) and the Management Analysis and Monitoring System (SAMGe, *for its Spanish acronym*).

WWF has likewise contributed to the development of the IUCN Green List Standard and is working on its application in several protected areas in the region. In Colombia, WWF acts as an implementation partner for the initiative and has been carrying out activities with the IUCN to support protected areas in the pilot phase (2012-2014) and the implementation phase (2015-onwards). Beginning in 2020, efforts are underway for the accreditation of 20 new areas for inclusion in five Amazonian countries, which WWF will support at various levels.

WWF has also been playing an important role in the development of policies and legislation that benefit conservation areas and include them in the different sectoral and territorial plans of Amazonian countries. In 2018, for example, with the support of WWF and strategic stakeholders, an updated Nature Protection Law for Suriname was developed and sent to Parliament for review and approval. There is currently no legal recognition of communal land rights for indigenous and tribal peoples in Suriname and this law is expected to facilitate the co-management of protected lands going forward.

In 2015, WWF supported the Latin American Network of Protected Areas (REDPARQUES), which brings together the directors of protected area systems throughout the region, in the drafting of the Declaration on Protected Areas and Climate Change launched at the COP21 Climate Change Conference. The Declaration recognizes the role of protected areas in nature-based mitigation and adaptation actions.

From a regional perspective, the strengthening of policies related to protected areas goes hand in hand with the strengthening of the government agencies in charge of them. REDPARQUES, IUCN, ACTO, FAO and WWF have been supporting the implementation of a Regional Ecosystem Vision for the Conservation of Biological and Cultural Diversity, better known as the Amazon Conservation Vision, since 2008. As part of this Vision's implementation, and in alliance with other organizations, WWF has provided support to REDPARQUES in the implementation of the Work Program on Protected Areas of the Convention on Biological Diversity in the Amazon. This was achieved through two major regional projects between 2014 and 2020: Amazonian Protected Areas-Natural Solutions to Climate Change (SNACC, for its Spanish acronym) and Integration of Amazonian Protected Areas (IAPA); both have contributed to improving the governance of protected areas and sustainable landscapes in the Amazon and have strengthened the capacities of national protected area agencies in Bolivia, Brazil, Colombia, Ecuador, the Guianas, and Peru.

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WWF has also been playing an important role in the development of policies and legislation that benefit conservation areas and include them in the different sectoral and territorial plans of Amazonian countries.

Guardians of the Amazon

The Coordinator of Indigenous Organizations of the Amazon Basin (COICA) reports that there are 511 Indigenous Peoples groups in the Amazon and more than 66 in isolation, who have inhabited an area of more than 300 million hectares since ancestral times.

Indigenous peoples and local communities are crucial actors in the conservation and sustainable development of the Amazon. Collaboration with indigenous peoples to safeguard their territories is essential given that their traditional practices and livelihoods are among the most effective at conservlng ecosystems and biodiversity.

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** Some indigenous peoples that still retain a significant percentage of their territory are able to maintain their traditional livelihoods, but in other cases, for example in parts of the Peruvian central jungle, land fragmentation due to colonization and the expansion of agriculture have severely restricted traditional modes of production and cultural continuity.*

AMAZONIAN INDIGENOUS TERRITORIES

Show lower levels of deforestation in average

CO_2

Significant reserves of carbon in their forests

Provide ecosystem services to the region and the world

Their conservation is key to fulfill climatic commitments (NDCs)

The conservation of their territories is a guarantee of the physical and cultural survival of these peoples in the Amazon and forms part of their way of life; this model, developed in harmony with nature, is based on a close relationship with, and dependence on, the natural environment [18].

Lands managed by indigenous peoples show lower average levels of deforestation * and, according to a recent study in the Brazilian Amazon, harbor greater species richness and a higher presence of threatened species compared to both protected areas and randomly selected unprotected areas [158]. Furthermore, indigenous territories in the Amazon preserve important carbon stocks in their forests and provide many other ecosystem services to the region and the world.

Indigenous peoples have inhabited the Amazon for 11,000 years, and until recently, were almost entirely dependent on the rivers and forest for their subsistence [2]. The applications of the biome's biodiversity by its ancestral inhabitants are almost as diverse as the biome itself. Indigenous peoples have been found to use 200 different species of trees as sources of timber, 100 of which are also used to produce non-timber goods and have domesticated at least 83 plant species [2]. This diversity of products and uses contrasts sharply with the dominant agricultural model today in which only nine plant varieties account for 66 percent of global agricultural production. The biodiverse agricultural production systems of indigenous peoples in the Amazon help to halt biodiversity loss and soil desertification, while contributing to food sovereignty at the local level.

The actions of Amazonian indigenous peoples have been fundamental to the inclusion of the rights-based approach in the Paris Agreement of the United Nations Framework Convention on Climate Change; their contributions to territorial conservation will be key to meeting the countries' climate commitments, known as Nationally Determined Contributions (NDCs). Most greenhouse gas emissions in Amazonian countries come from the Land Use, Land Use Change and Forestry (LULUCF) sector, so the conservation of forests, 30 percent of which are in indigenous territories in the Amazon, is fundamental [18].

INDIGENOUS WOMEN, WISDOM FROM THE TERRITORY

By: Tabea Cacique Coronado, Coordinator of Education, Science and Technology for COICA and AIDESEP representative.

Ancestral wisdom is the fruit of the close relationship between indigenous peoples and the forest, from which come strategies to defend human life in the face of crises, recently of a sanitary nature and in the past due to colonization and exploitation.

I am a mother, a woman and leader of a community that is constantly struggling to defend its rights against threats from drug trafficking illegal logging, land trafficking, illegal mining and monocrop farming. In the current context, in which the extractivist system has altered our ways of life and frequently forced us to abandon our territories, an important challenge for us indigenous women, as bearers of ancestral knowledge and wisdom, is to pass it on to our sons and daughters and ensure that they do the same.

We indigenous women have demonstrated our abilities in the midst of a pandemic that decimated hundreds and thousands of our brothers and sisters. When the rest of the world was still testing vaccines, we returned to our territory, took shelter and used medicinal plants to cure ourselves; we used *matico (Piper aduncum)* to expectorate the phlegm from our lungs, and consumed bee honey and ginger infusions to prevent or cure ourselves from COVID-19.

We fighters and protectors of the wisdom empowered by our indigenous cosmovision, the same from which the cry of the jungle was born, demand urgent worldwide action to stop the destruction of the Amazon; it is from our voices that Amazonia for Life: Protect 80% by 2025 was born; an initiative which invites everyone to become part of the solution, in a reality that demands urgent action, in an Amazon that we feel with our own hands is dying little by little.

From the upbringing of our children, the care from our medicinal plants, our leadership spaces, which act as our trenches, we will continue to fight not only for our territories and families, but for the rest of humanity that still does not understand that the planet is home to us all, and that its effective defense requires that we unite and become aware of the present moment and that our mother nature needs us, her children, to heal and preserve her for future generations.

It is essential that any conservation vision in the Amazon includes indigenous peoples in the holistic management of their territories

The quality of life of Amazonian indigenous peoples is intimately linked to the protection of their territories; from which they obtain food, medicine, water, and spaces for the development of cultural and spiritual practices. It is therefore **essential that any conservation vision in the Amazon includes indigenous peoples in the holistic management of their territories**.

From a conservation and sustainable development perspective, the following measures should be implemented in support of indigenous peoples:

Guarantee compliance with the collective rights of indigenous peoples, including the right to consultation and prior and informed consent regarding activities that could affect their territories, and recognize the importance of indigenous knowledge for conservation and sustainable development [Cap. 26, Cap. 33]. Linked to this:

Recognize and protect ancestral territories including those of peoples in situations of isolation and initial contact; contribute to the legal protection of territories; and guarantee the right of indigenous peoples to the use of natural resources in their territories.

Strengthen legislation and institutional measures that protect the land and water rights of indigenous and traditional peoples and communities in Amazonian countries.

Contribute to the monitoring of indigenous territories to warn of threats, create measures for their mitigation, and reduce aggressions against indigenous peoples and invasions of their territories by groups engaged in illegal activities [Cap. 31].

Secondly:

Promote and support the participation of indigenous peoples in the design and implementation of conservation and development policies.

Ensure that objectives for the sustainable management of indigenous territories are included in plans, laws, agreements, regulations, and sectoral policies. In this sense, it is important to ensure that the implementation of the Leticia Pact is done in coordination with indigenous peoples.

Strengthen all levels of indigenous governance.

Ensure empowerment and capacity building in the territorial management of indigenous communities, as well as in their communication, awareness, and advocacy systems, and promote collaboration amongst indigenous peoples through their governance structures in conjunction with civil society allies, national governments in the region, international funders, and the private sector.

The following measures would help ensure the holistic management of indigenous territories in the Amazon, another high priority area:

Develop sustainable financial models that allow direct access to funding for indigenous organizations which can then focus on strengthening territorial management in an autonomous manner, with the effective participation of local peoples and communities.

Establish alliances between traditional knowledge and academia to facilitate citizen science and enable indigenous peoples to equitably access the benefits derived from biodiversity (ecosystems, species, and genes) and ancestral knowledge (usage and management), under biocultural protocols that guarantee property rights.

Promote the indigenous economy through initiatives that generate sustainable and culturally appropriate livelihoods for indigenous communities [Cap. 31].

Finally, initiatives should be implemented that:

Recognize and visibilize the contribution of indigenous peoples in the fight against climate change, the strengthening of resilience and the conservation of biodiversity.

Visibilize and enhance the role of indigenous women in the management of indigenous territories, as well as promote strategies to ensure their participation at all levels of decision-making.

Promote and facilitate inclusive practices for indigenous youth that enable them to actively participate in community governance.

Strengthen formal and non-formal educational processes, contextualized and adapted to the needs of the peoples and nationalities, and promote initiatives that respect the biome as an ecological unit. An example of this is seen in the results of research conducted with students in the Brazilian Amazon between 2007 and 2014, which demonstrate greater student interest in learning about local ecosystems from a cross-cultural perspective than through those perspectives contained in the regular educational curriculum [139].


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PARTNERS FOR THE AMAZON

WWF works hand in hand with several indigenous organizations in the biome to safeguard the future of the Amazon.

WWF works hand in hand with several indigenous organizations in the biome to safeguard the future of the Amazon: COICA at the regional level and national Amazonian indigenous peoples' organizations in Brazil (Coordinator of Indigenous Organizations of the Brazilian Amazon – COIAB), Colombia (National Organization of Indigenous Peoples of the Colombian Amazon - OPIAC), Ecuador (Confederation of Indigenous Nationalities of the Ecuadorian Amazon - CONFENIAE) and Peru (Interethnic Association for the Development of the Peruvian Rainforest - AIDESEP), as well as with multiple local indigenous organizations throughout the biome, including representatives in Guyana and Bolivia. The objective is to advance the empowerment of indigenous peoples, contribute to the better management of their territories and the conservation of their natural resources, and support their traditional practices.

Working with indigenous peoples in the Amazon, using their own organizational structures, makes it possible to effectively combine efforts to confront and mitigate the threats facing their territories and promote sustainable development alternatives based on peoples' own worldviews and priorities, thereby simultaneously conserving biological and cultural diversity. For this reason, WWF supports efforts to strengthen indigenous governance and provide valuable support in the formulation of internal policies and documents such as CONFENIAE's Strategic Plan.

Indigenous territories were recognized as key solutions to climate change.

Since 2008, COICA and WWF have partnered in global advocacy efforts, including at the United Nations Framework Convention on Climate Change, where indigenous territories were recognized as key solutions to climate change through innovative proposals such as Amazon Indigenous REDD (RIA, for its Spanish acronym). In the framework of the World Conservation Congress organized by IUCN in Marseille in 2020, the offices of the WWF membership network of IUCN supported and contributed to the discussion and subsequent approval of **COICA's "Amazon for Life" motion 129, in which an urgent call is made to protect 80% of the Amazon by 2025 to avoid reaching the point of no return in the biome**. WWF has also supported COICA's participation in key spaces such as in discussions around the inclusion of an indigenous vision in the safeguards of the Inter-American Development Bank (IDB). Joint participation in these and other multilateral spaces, such as the Convention on Biological Diversity and the Minamata Convention, is key to making the realities and needs of Amazonian indigenous peoples visible and highlighting their role in achieving global conservation and development objectives, which is why WWF and other allies advocate strengthening indigenous representation in these forums.

COICA has also worked with WWF to develop a holistic management strategy for indigenous territories and is piloting a jointly designed

Early Warning System that will allow communities to report threats to their territories and initiate rapid response action to reduce conflict and safeguard the wellbeing of the peoples and their territories. In addition, WWF, COICA, OPIAC, CONFENIAE, AIDESEP, COIAB, DAR, NESsT and eight local indigenous organizations are working to protect the rights of indigenous peoples and promote the indigenous economy at the regional level through the Indigenous Amazon, Rights and Resources project (AIRR), implemented from 2019 to 2024, funded by USAID and led by WWF. The project focuses on capacity building and strengthening, implementation of COICA's early warning system based on existing indigenous monitoring systems, and advocacy with relevant international and national political actors for the design and implementation of policies favoring indigenous peoples.

The WWF network and its partners also work closely to support indigenous communities at the local level, **for institutional capacity building, legal recognition of indigenous territories and territorial planning, the training of leaders and the protection of defenders, and the promotion of policies for the fulfillment of indigenous rights in priority landscapes across the biome,** such as around the Colombian-Ecuadorian-Peruvian triple border in the northern Amazon *(Paya, Güepi and Cuyabeno)* and to the south in the *Madre de Dios and Acre Pando Ixiamas* areas between Bolivia, Brazil and Peru. WWF has supported the development of Life Plans in the Ecuadorian communities of *Kupatas, Santiak* and *Wisui* within Achuar territory, to safeguard the integrity of their territories and prevent the exploitation and inappropriate use of their natural resources. Through the Specific Dedicated Mechanism (SDM-Saweto) project implemented by AIDESEP and CONAP, WWF helped to reconize and title more than 200 communities, MDE-Saweto and AIRR financed 50 enterprises managed by indigenous peoples, of which 29 have the support of NESsT-AIRR*. In Peru, WWF, the Peruvian Ministry of Culture, AIDESEP and international cooperation actors have collaborated to develop policies for the protection of Indigenous Peoples in Isolation and Initial Contact (PIACI, for its Spanish acronym), with WWF providing technical assistance to achieve the recognition of PIACI reserves such as *Murunahua, Mashcopiro, Napo Tigre* and *Yavari Miri* **.

WWF ran a successful territorial governance training program for indigenous leaders in the Brazilian, Colombian, Ecuadorian and Peruvian Amazon that ended in 2019 with a total of 121 participants ***. The program focused on promoting indigenous peoples' rights by providing them with tools to address territorial threats and more effectively influence state decision-making ****. WWF also supported AIDESEP in Peru in the creation of **the School of Indigenous Governance and Amazonian Development (EGIDA**, *for its Spanish acronym*), an academic program aimed at indigenous leaders, women and youth that seeks to strengthen and promote Peruvian Amazonian indigenous governance through the strengthening of a political training framework [160].

WWF and indigenous peoples work together under a rights-based and mutually respectful approach to promote the protection of the Amazon and safeguard the indigenous territories that are a key part of the biome.

The livelihoods of many indigenous peoples are linked to the health of the ecosystem in their territories. Productive activities such as fishing traditional agricultural systems, tourism, and many cultural practices are strongly connected to the capacity of the forest to provide the resources that indigenous peoples need. As already noted, biodiversity is one of the pillars that keep an ecosystem functioning and providing ecosystem services. The more native species that can fulfill their biological functions in a natural system, the better that system will function. Species conservation is therefore connected to indigenous territories, since protecting emblematic species with high biological (and cultural) importance and a high capacity to indicate the overall health of the ecosystem directly contributes to the protection and resilience of the livelihoods of indigenous peoples and local communities in the Amazon.


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** Available at: www.wwf.org.pe.*

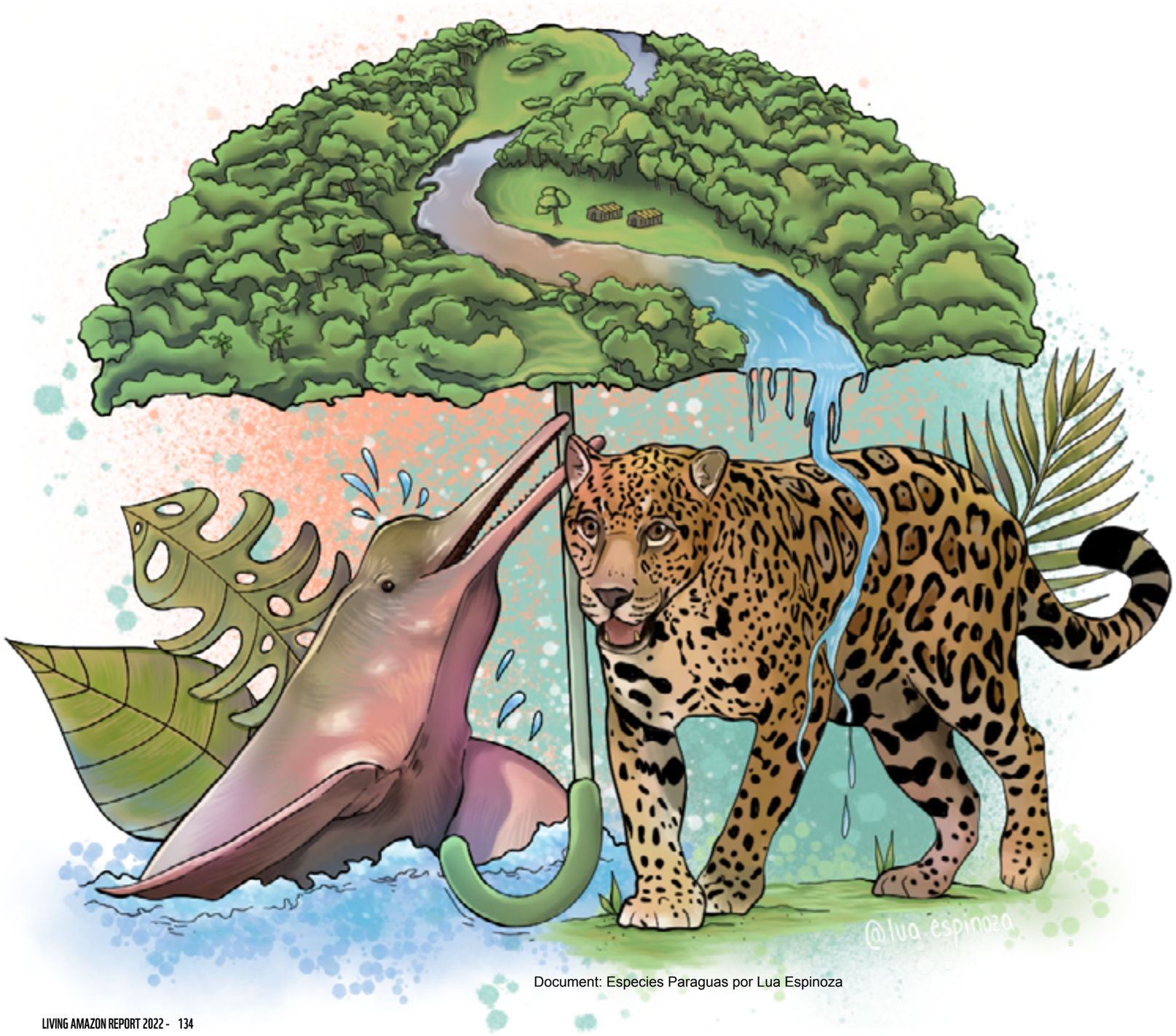
*** Available at: www.wwf.org.ec.*

**** Available at: www.wwf.mg.*

***** Available at: www.wwf.org.pe.*

Jaguar conservation

Efforts to protect and conserve certain species indirectly lead to the protection and conservation of the entire biotic community to which they belong.



Document: Especies Paraguas por Lua Espinoza

They are referred to as *umbrella* species because their protection "covers" that of many others. Umbrella species are selected as part of the management process because they help in making decisions about the location and extension of reserve areas and about an ecosystem's general state of health when it is not practical to study each species in isolation. Large predators are classified as umbrella species because, among other things, their territorial range is wider and therefore encompasses that of many other species.

The jaguar is the largest feline in the Americas and one of the most emblematic species of the Amazon. This majestic feline has become a cultural symbol in the region and has long been an important element of indigenous peoples' spirituality throughout the biome. Like the river dolphin, its ecological importance is undeniable: it is a species at the top of the food chain and its presence indicates the good health of an ecosystem. Jaguars inhabit a range of areas from the southern United States to northern Argentina but, because its forests are one of the few remaining large and well-preserved landscapes, the Amazon is one of its most important strongholds.

The jaguar, however, is by no means unaffected by threats in the Amazon. It's medium- and long-term survival will depend on measures taken in the coming years. The jaguar knows no borders and effective actions for the conservation of its habitat and the reduction of other threats necessarily depend on regional and cross-sectoral cooperation to successfully build on local efforts and replicate best practices within and between countries where jaguars are present [117].

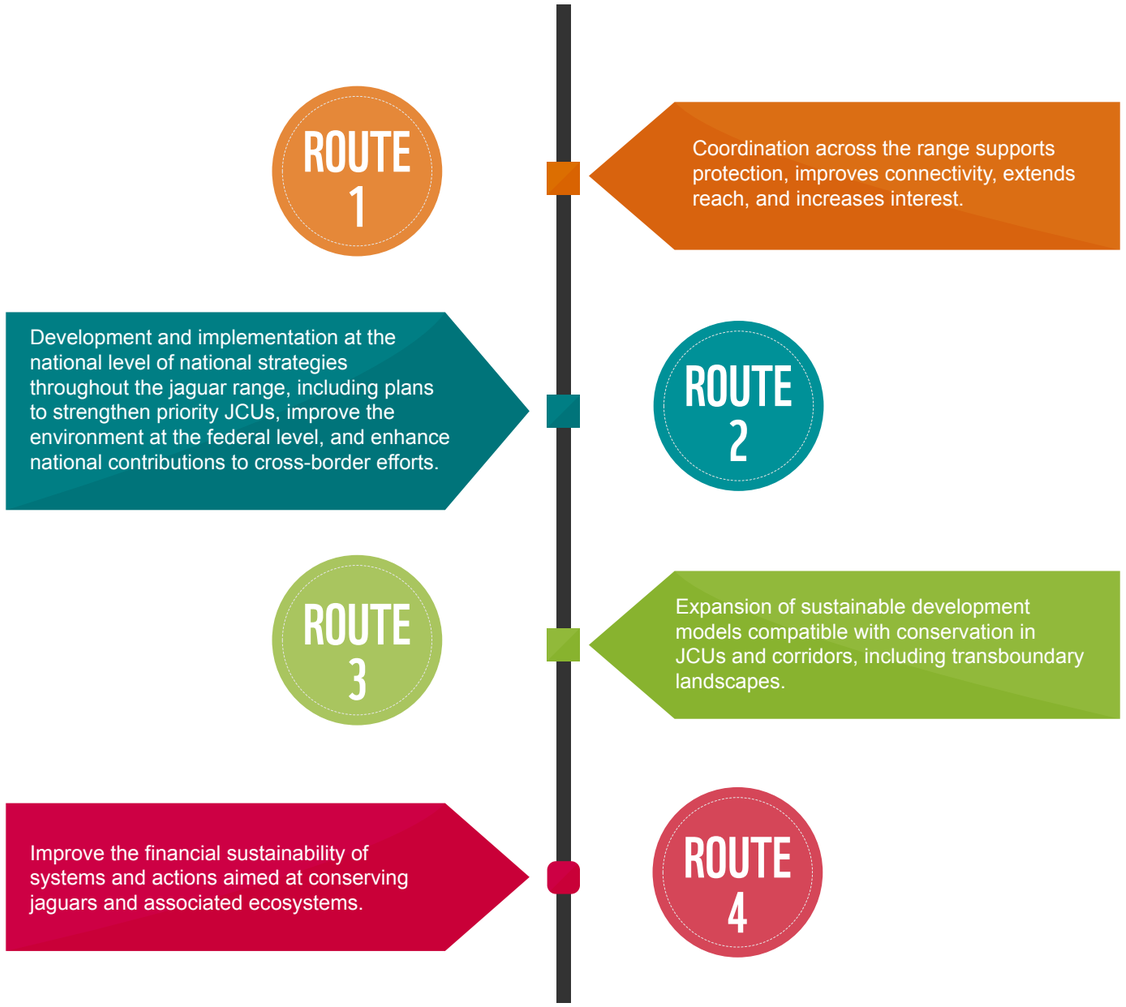
The jaguar requires large areas of territory to meet its essential needs; one of the main threats is therefore habit destruction. The jaguar is also at risk from human encounters, particularly when livestock or other domestic animals are attacked due to their proximity to human populations in the context of habitat loss and the depletion of their natural prey. The jaguar is further threatened by hunting for the illegal trade of its skin and parts [127] .

It is essential that non-governmental organizations, academic institutions, regional governments, and local communities work together to confront the growing threats facing jaguars. Innovative research-based approaches are needed to identify effective and timely measures to confront conservation challenges for the species, as well as to forge regional alliances for the conservation of key jaguar landscapes [125].

The 2030 Jaguar Conservation Strategic Framework, developed by 19 governmental and non-governmental organizations, and convened by WWF in 2018, includes the above and further initiatives. That same year witnessed the 2030 Jaguar High Level Forum in New York, led by the United Nations Development Programme, Panthera, WCS and WWF, as well as governments from the feline's habitat range, which subsequently led to the adoption of the 2030 Roadmap for Jaguar Conservation at the

14th Conference of the Parties to the Convention on Biological Diversity (CBD) *. The 2030 Jaguar Roadmap forms the main strategic plan for jaguar conservation at the regional level and contains the following strategic areas of action [161]:

*Available at www.worldwildlife.org. Available at wwf.panda.org.



Indigenous territories are considered conservation partners in this approach. The approach also requires the creation of technical-scientific information where no established guidelines currently exist, as well as capacity building for local stakeholders.

Just as the jaguar has scientifically proven ecological value, several indigenous communities in the Amazon have valued this species for thousands of years. For many indigenous nationalities connected to the natural environment through their ancient cultures, knowledge about the jaguar, its habits, and behaviors, depends less on rigorous scientific research than on daily life. Indigenous communities know that this feline is the predator par excellence, a magnificent climber and swimmer with crepuscular habits [162]. The jaguar has therefore acquired several symbolic meanings for indigenous communities, with images and aptitudes of a warrior, ruler, guardian, and progenitor attributed to this feline [162]. Certain indigenous communities believe that human capacities can be enhanced through the imitation of its appearance and there is a rich mythology about human-jaguar transmutation [162]. Natural phenomena such as thunder are sometimes attributed to jaguars, understood by some cultures as a roar ensuring the fertility and well-being of the environment; it's sound announcing imminent rainfall [162]. Thus, beyond understanding and valuing the jaguar as a cultural symbol, many indigenous societies have long appreciated the tangible relationship between this feline and the health of the forest [162].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HEALTHY RIVERS

Despite being extremely important to both people and nature, Amazonian rivers are threatened by deforestation, infrastructure development, the over-use of water (especially for agriculture), over-fishing, the introduction of exotic species and pollution.

Maintaining healthy rivers in the Amazon means maintaining the diversity and integrity of freshwater ecosystems through good governance, cooperation and management measures that support basin-wide planning and safeguard priority free-flowing rivers, headwaters, and other valuable habitats to ensure the provision of ecosystem functions that sustain biodiversity, local livelihoods, and regional economies [163].

Safeguarding rivers and aquatic ecosystems in the Amazon depends heavily on halting deforestation *(see section 3.1)*. In addition, a set of complementary strategies for the protection of the basin need to be implemented that can be grouped into three major lines of action: **ensuring healthy free-flowing rivers and freshwater ecosystems; halting mercury pollution; and maintaining or increasing river dolphin populations** over the next decade.

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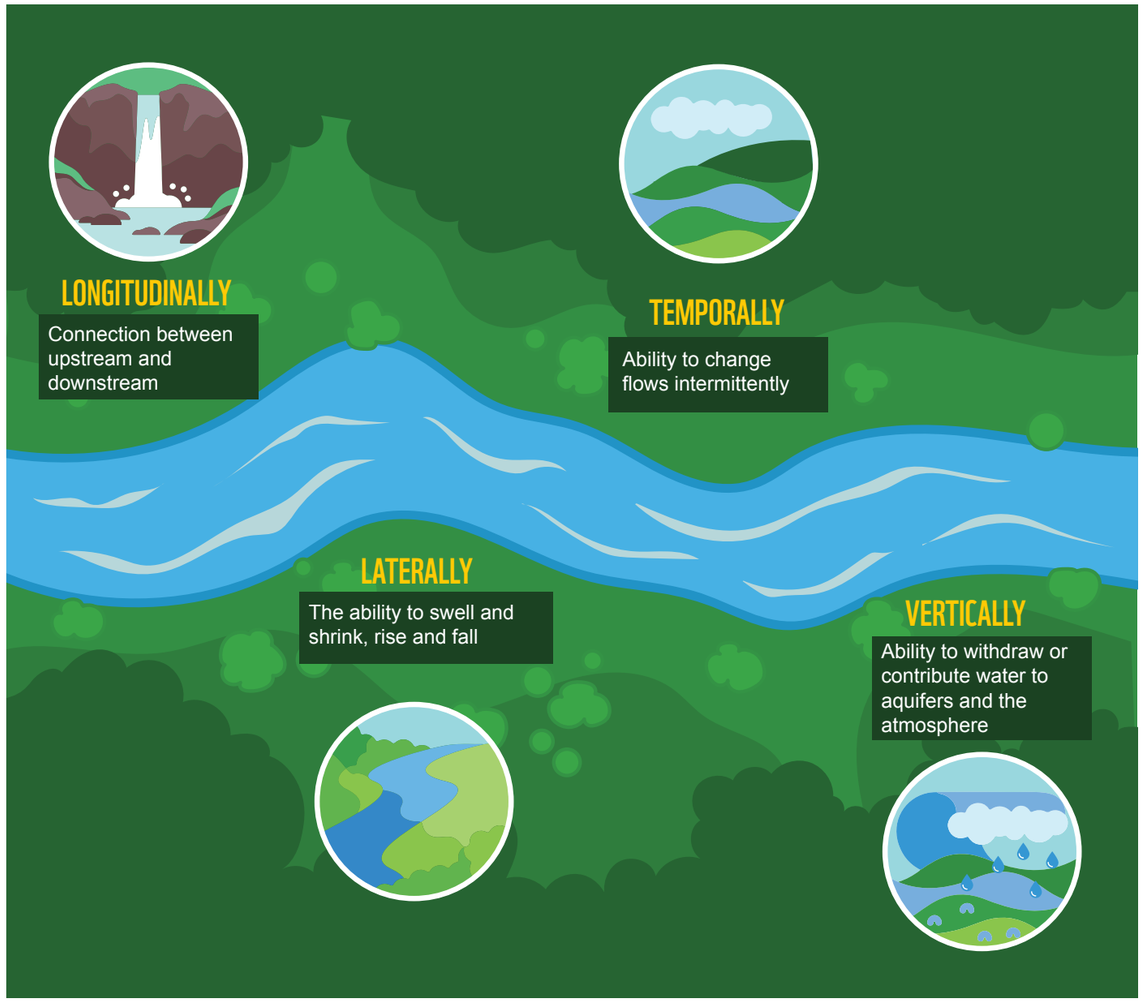
Free-flowing Amazonian rivers and healthy freshwater ecosystems

Rivers flow freely when their flow and connectivity remain largely unaltered by human activities.

Water, silt (the soft clay that forms deposits in rivers), and other materials can move unimpeded and aquatic species can swim up and downstream freely. The river is able to swell and contract naturally, flow at a natural volume and velocity, and recharge groundwater sources. These rivers are not interrupted by dams or other artificial obstacles and their waters are healthly. Free-flowing rivers provide many ecological, economic, and cultural benefits to the communities living along them and within their watersheds. They are fundamental to a *Living Amazon*.

For a river to be considered free flowing, it must exhibit four aspects of connectivity:

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Maintaining the most important connectivity corridors in the Amazon region will protect and restore crucial natural ecosystems and avoid risks to aquatic life, while safeguarding food security, water security and the livelihoods of local populations [164]. **Conserving healthy free-flowing rivers also entails protecting the Amazon's important and unique biodiversity, as it is home to the greatest diversity of freshwater fish species on Earth**. Among the rich aquatic diversity of the Amazon basin, certain large species require large-scale connectivity to maintain viable populations, including migratory fish species, turtles, and river dolphins. Rivers that are critical corridors for more than twenty of these species include the *Amazon, Negro Marañón, Madeira, Putumayo Nanay Napo, Japurá/Caquetá, Jiparana and Purus* [165].

Conserving healthy free-flowing rivers also entails protecting the Amazon's important and unique biodiversity.

**This refers to planning on a basin-wide scale, i.e., encompassing relevant water and energy resource management and development plans.*

Free-flowing rivers require a comprehensive strategy to ensure that connectivity is incorporated into **basin-wide planning * and that mechanisms are put in place to maintain and protect interconnected river networks at the regional level.** This involves incorporating strategic corridors in such planning through transnational infrastructure agreements and raising awareness in the public and private sectors about the impacts of disrupting river connectivity so that informed decisions can be made.

Taking the results of the global- and Amazonian-wide analysis of free-flowing rivers into account (see section 2.2.6), **measures that maintain fluvial connectivity and associated services must be prioritized**, such as the flow of water and sediment to downstream floodplains and the movement of freshwater migratory species. Consideration should also be given to removing barriers that currently fragment rivers and disrupt connectivity.

Finally, **specific protection measures for freshwater ecosystems** should be implemented, with consideration of **non-hydropower alternatives and natural water supply infrastructure**. Where this is not possible, mitigation strategies such as the establishment of regulation related to ecological flows and the protection of non-impacted watersheds is critical.

Specific protection measures for freshwater ecosystems should be implemented, with consideration of non-hydropower infrastructure.

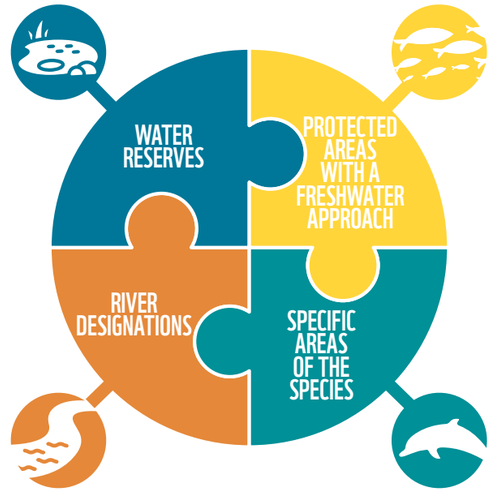
In terms of **energy planning and policy tools**, basin-level strategic planning and environmental assessments can help governments and stakeholders take freshwater ecosystems and the services they provide into account when making decisions about future development options. When properly applied, these tools can help align different development objectives with environmental, social, financial, energy and transport considerations, facilitating the design of projects in ways that minimize harm and optimize benefits, and avoiding their most damaging consequences on ecosystems, communities, and freshwater services, as well as financial risks [166, 167].

Disregarding the loss or degradation of freshwater ecosystems because of poor planning, as in the case of dams and other badly designed river infrastructure, can lead developers, financiers, and governments to provoke social or environmental conflicts in their projects [168]. Strategic solutions that align with environmental and social factors are therefore crucial if project delays and/or cost overruns are to be avoided [20]. Poor planning has been identified as one of the main drivers of the social conflict associated with infrastructure projects in Latin America since the 1980s [169]. With hydropower projects in particular, better planning tools and policies reduce the risk of developing projects in locations with potentially high social or environmental risks. Alternative development options, such as increasing the use of non-hydropower renewables in electricity generation, are an effective long-term strategy to ensuring the free flow of rivers and, at the same time, reducing the vulnerability of the energy matrix to climate change [170].

In terms of **Area-Based Protection Mechanisms**, countries can use tools to protect important rivers and aquatic connectivity corridors [171], by setting out exclusion zones for future dam development along long stretches or entire rivers that are corridors of freshwater connectivity and subsequently important for multiple species, such as the Amazon or larger watercourses on the lower Tapajós. Below are some of the protection mechanisms that could be implemented in the Amazon and adapted to the specific realities and social dynamics of each country [170]:

A volume of water in a river basin allocated only for the protection of nature and for human consumption. This means leaving a certain amount of water in rivers to run freely and allocating the remaining fresh water to other uses.

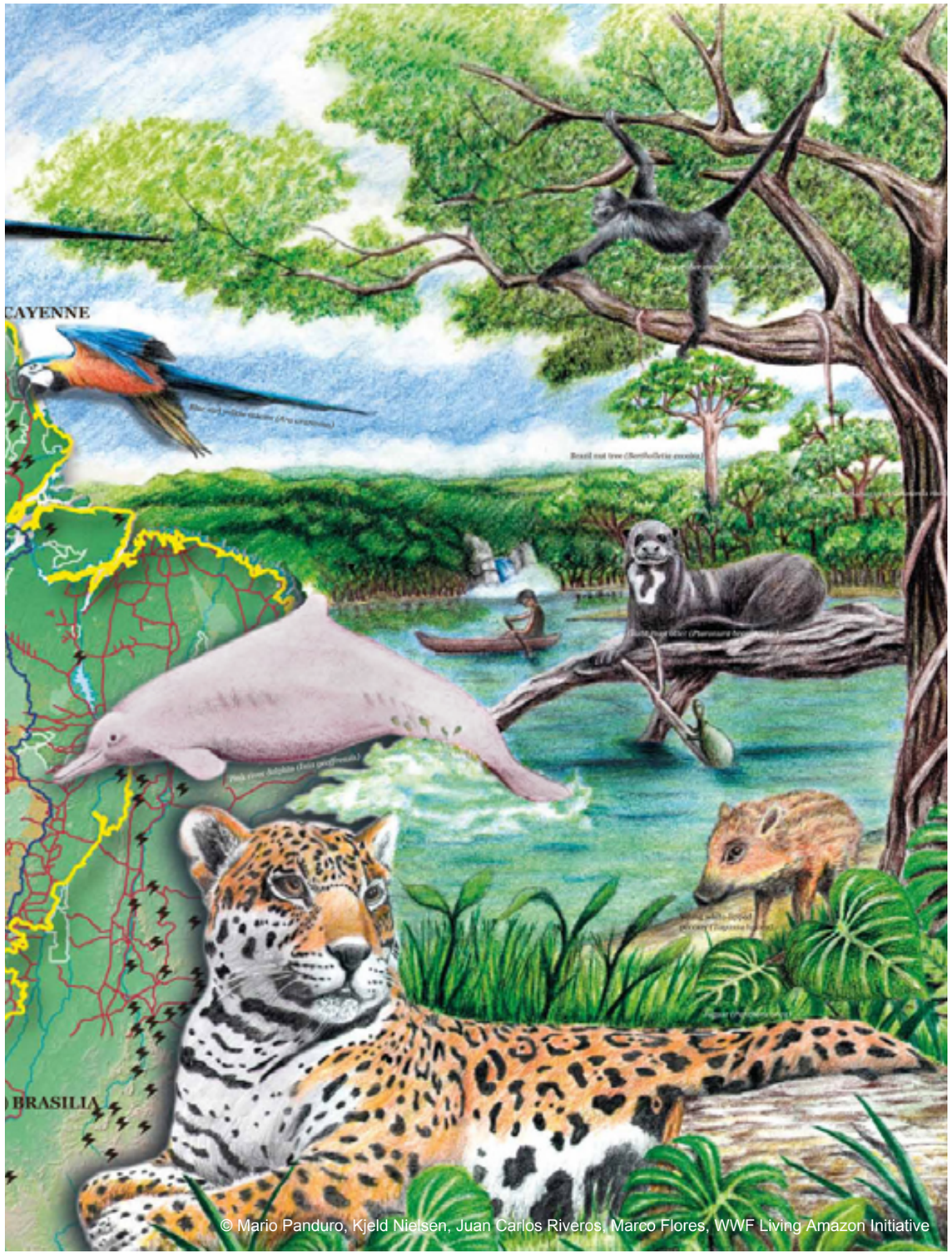
Protection applied to a river that defines and limits the type of uses that can be developed to maintain outstanding values of the freshwater ecosystem.



Protections based on legally recognized areas that incorporate protection of rivers associated with the area. (for example, a Ramsar site designation).

Protection applied to a specific freshwater area for maintenance, augmentation or recovery of a population of freshwater species. For example, in several countries of the world certain stretches of river have been protected for river dolphins and within the Amazon, in particular areas that include community-managed river fisheries [172].

In addition, it is important to prioritize the protection and restoration of **riparian zones along river systems in and around protected areas, as well as in Amazonian landscapes more generally**.



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Healthy freshwater ecosystems must be restored, requiring the implementation of measures to halt overfishing and the introduction of exotic species.

** For strategies for mercury-free gold mining, see section 3.2.2.*

In addition to sustaining free-flowing rivers, **healthy freshwater ecosystems** must be restored, requiring the implementation of measures to halt overfishing and the introduction of exotic species, and techniques applied to remediate polluted aquatic habitats, including those affected by mining *, oil and plastic.

Community-based fisheries management in the Amazon has proven to be an effective strategy for sustainability. The pirarucu, paiche or arapaima governance model, which began in 1998 in small riverside communities in the Mamirauá Reserve, Brazil, is based on a local management committee that emphasizes the role of fisherman in the management and monitoring of the resource. It has been extended to hundreds of communities across that and other Amazonian countries, yielding positive results for the species and its sustainable use by local communities [173]. The Mamirauá model successfully incorporated a scientific component into the project that made it possible to study not only the species populations but the technical, social, and economic aspects to the local fish industry [173]. In the case of pirarucu, previous efforts to control overfishing through protection measures in Brazil in the 1980s were unsuccessful due to a lack of enforcement capacity [173].

With regard to the introduction of exotic fish species into Amazonian rivers, it is essential to establish policies and regulations related to fish farming in order to prevent the introduction of farmed species into the basin's tributaries, including measures to prevent the introduction of species such as paiche, sapuara and boquichico into sub-basins where they do not naturally occur [163] [Cap. 20].

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Mercury-free gold mining

Informal, illegal, and small-scale gold mining is a prominent source of livelihood and income in the Amazon region.

Yet these unregulated operations make intensive use of mercury, causing profound environmental and social impacts on indigenous lands and local communities. The effective implementation of the international agreements signed by the respective countries, coordination between these countries, and full compliance with the legal regulations at the national level, are the best path towards a long-term solution that avoids the devastating consequences of mercury use. **It is indispensable to develop a comprehensive approach that considers prevention, information gathering, the reduction or remediation of impacts on humans, ecosystems, and species, as well as the improvement of livelihoods, employment opportunities and development policies in favor of, and in coordination with, local populations.**

In this context, the Regional Alliance to Reduce the Impacts of Gold Mining * identified the following priority actions to address the impacts of informal and illegal gold mining:

** An inter-institutional platform built around this problem in the Amazon which, since 2018, has sought to eliminate the use of heavy metals in the biome by 2030; formed by FCDS, Colombia National Natural Parks, Frankfurt Zoological Society, GAIA Amazonas, FIOCRUZ, CINCIA, WCS and WWF.*

Though government leadership is crucial to combating this serious public health problem, the private sector and consumers also have an important role to play in eliminating mercury in gold supply chains. Initiatives are therefore required that focus on **improving traceability in the gold trade through more effective measures, such as mercury-free gold certification schemes, produced in a legal, regulated manner and without generating violence or socio-environmental conflicts**. Maintaining responsible sourcing practices would also enable commercial companies to define themselves beneficially against competitors.

On the consumption side, on the one hand it is necessary to promote responsible gold consumption that demands mercury-free supply chains, and on the other hand it is essential that its production comes from processes that prioritize the elimination of the social, cultural, and economic conflicts usually associated with mining areas. A marked shift in consumer preference for mercury-free gold with social and environmental safeguards in place would create the necessary market incentive for companies trading gold products to seek to eliminate mercury from their supply chains and lobby their suppliers to mine gold responsibly. Mercury-based gold mining in the Amazon would become less profitable as a result, fostering a transition to other economic activities or alternative mining techniques [104].

Another part of the solution is local level work. Gold mining supports the livelihoods of numerous individuals and communities in the region and measures are therefore needed to provide effective, long-term support. **Today's mining communities need access to mercury-free techniques and healthier and more environmentally sustainable alternative livelihoods [104].** Pilot projects encouraging the use of mercury-free practices with small-scale miners are important in some countries where appropriate conditions are being created, such as Guyana and Suriname. In other countries where illegal mining is associated with other organized crime enterprises, the goal will be to support local populations in finding economic alternatives, to more closely involve institutions to improve health and education services, and to support sustainable land management practices.

Non-governmental organizations and civil society can collaborate by identifying and communicating the dangers of mercury in the Amazon at the local level and supporting other key actor's efforts to eliminate its use in the region, including raising awareness among decision-makers and the public about the seriousness of the threat and the current impacts that mercury use is having on the surrounding environment and peoples in the Amazon. **Civil society and NGOs are important allies in the implementation of policies geared toward the eradication of mercury use in the Amazon by national government and local authorities [104].**

Investment is required in **research and knowledge creation** * to ensure that decision-making is scientifically informed regarding known mercury stockpiles and purchases, the commercial networks and black markets for gold and mercury, as well as to provide up to date data on contamination in different watersheds and impacts on humans and wildlife. This is particularly true for certain fish species because of their dietary significance, and for river dolphins due to their ecological importance.

** The Mercury Observatory is an open access platform created by Fiocruz, CINCIA and WWF which maps the impacts of gold mining in the Amazon. Available here.*

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Technology and innovation can also play an important role in combating mercury pollution in the Amazon. One of the challenges requiring innovation is to make gold production processes cleaner and equally or more cost-efficient than traditional mercury amalgamation techniques, thus offering a realistic alternative to the people dependent on this activity.

MERCURY AND GOLD ILLEGAL TRADE FLOWS

A report by WWF and the Gaia Amazonas Foundation, presents the alarming reality of mercury contamination in the Amazon and analyzes this heavy metal's journey to its ultimate use in illegal and informal gold mining in the region [93]. Mercury imports globally have decreased from 2,600 tons in 2010 to 1,200 tons in 2015; a 54 percent reduction. In contrast, countries in the Amazon biome recorded a 40 percent increase in total mercury imports. Mercury mining does not occur in Amazonian countries, so the mercury used in illegal and informal gold mining activities in the Amazon region is imported. Where does all this mercury come from?

The report found that prior to 2015, most mercury imports to Amazonian countries and the world came from the European Union, mainly Spain and Germany, as well as from the United States and Mexico. However, a mercury export ban imposed by the European Union and the United States came into force in 2015. The signing of the Minamata Convention also restricts exports and imports of this element. Mexico became the main supplier of mercury to the region in the wake of these changes, with annual mercury exports amounting to 300 tons in 2015, principally to Latin American countries. As of 2015, mercury appeared to be crossing from Mexico to Peru. When Peru stopped importing mercury in 2015, exports from Mexico to Bolivia increased significantly (from 24 to 138 tons per year), leading to speculation that the surplus of mercury in Bolivia was being distributed via transnational smuggling networks to other countries in the Amazon biome. However, there are no official figures on the region's illegal mercury market *.

** Available at wwf.panda.org.*

Another study by WWF [184], not yet published, analyzes the dynamics of illegal gold mining in all the Amazonian countries. As a region of porous borders and interconnected socioeconomic dynamics, analyzing just one country does not allow understanding of the real dimension of illegal gold mining. The study made a general description analyzing economic data, comparing legislation, observing critical points of extraction (hotspots); as well as the role of non-state criminal actors involved.

Among the results is a presentation of the economic dynamics of the production and export of gold, where it was identified that more than 75 percent of Amazonian gold is exported by three countries (Peru, Colombia and Brazil), and that its main destinations are Canada, Switzerland and the United States. Peru appeared as the largest exporter, exporting 50 percent more than it produces, indicating a flow of gold reaching the country through the Amazonian borders. Part of the explanation for this lies in the presence of criminal actors in this productive sector in the last decade. The report surveyed the main players and how they use illegal mining as a way to launder money from other illegal activities. Unlike substances such as cocaine, which cannot be legalized, it is very easy for "laundered" gold to enter national and international markets. Intercontinental

drug trafficking networks facilitate the transport of illegal gold and the necessary inputs for its exploitation. Finally, the study compared the legal frameworks and instruments that allow the exploration, purchase and sale of gold, finding a diversity of bodies and agencies in each country in charge of regulation, inspection and supervision.

Both reports confirm the need for a cross-border vision that allows dealing with the mercury and gold trade on all fronts, based on clear regulations that allow the gradual elimination of illegality and the negative impacts of this trade in the Amazonian countries.

The restoration of degraded areas is another aspect requiring further innovation and knowledge to advance and scale up. Technology could enhance rapid traceability and control solutions that would allow the market to more easily identify the origin of gold and move towards mercury-free supply chains *.

** One of the initiatives seeking to foster innovation is Conservation X-labs' Artisanal Mining Grand Challenge, a competition launched in 2020 that sought to reward innovative solutions to prevent impacts, remediate and restore sites affected by gold mining, reform supply chains and measure their impacts, and improve socio-environmental outcomes related to gold mining (conservationxlabs.com/).*

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River dolphin conservation

River dolphins are a group of cetaceans taxonomically placed into five families and six species.

Like jaguars on land, river dolphins are umbrella species; their conservation status reflects the health of the habitat and the community at large. They are carnivores with a broad diet of fish and demonstrate remarkable mobility over hundreds of kilometers of river.

There are, at present, two species of freshwater dolphin recognized by the international scientific community in the Amazon biome:

THE PINK DOLPHIN
(Inia geoffrensis)

THE RISSO'S DOLPHIN OR TUCUXI
(Sotalia fluviatilis)

Two other species are also present but lack official recognition:

THE BOLIVIAN BUFFLEHEAD
(Inia boliviensis)

THE ARAGUAIA RIVER DOLPHIN
(Inia araguaiensis) from the Araguaia and Tocantins river basins in Brazil, in the southern part of the biome bordering the Cerrado.

If left unchecked, there are specific threats to these species that could leave them extremely vulnerable to extinction *. The most significant are:

** The species is currently listed on the IUCN Endangered Species List as threatened.*

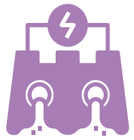
Capture to use dolphin meat as bait

Bycatch

The reduction of fish stocks that they depend on for food

Negative interactions with the commercial fishing operations (dolphins are considered competitors in fishing and therefore experience retaliation from fishermen)

Mercury and hydrocarbon river contamination



Habitat fragmentation due to dam construction

Boat traffic, landscape transformation and deforestation, and tourism malpractice

Improving knowledge about these species is one of the most important conservation measures. Data on their numbers, movement patterns and feeding habits enables the design of more effective conservation measures, more informed decision making, and the establishment of more robust public policy in the medium and long term.

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According to the 2010-2020 South American River Dolphin Action Plan, the following measures are necessary to better ensure river dolphin conservation in the Amazon:

1 **Produce and consolidate scientific knowledge** to conserve and manage populations of river dolphin species and their ecosystems.

2 **Establish and consolidate regional policy,** for the conservation of these species and their ecosystems, harmonizing the instruments and legal frameworks of each country.

3 **Position river dolphins as emblematic species** In decision-making mechanisms and by raising public awareness.

4 **Establish a comprehensive transnational management system for the conservation of aquatic ecosystems,** with river dolphins identified as flagship species, and adopt strategies to strengthen the involvement of stakeholders in the conservation and use of aquatic resources.

5 **Change attitudes towards the conservation of river dolphins and aquatic ecosystems** through contextualized and intercultural education programs with strong environmental components, and the promotion of effective community participation in sustainable management initiatives that guarantee collective benefits.

Following completion of the Action Plan, the main opportunity for continued governmental planning efforts with respect to river dolphin conservation lies in the South American River Dolphin Conservation and Management Plan (CMP), which is part of the International Whaling Commission (IWC) [174]. The CMP is a significant endeavor endorsed by the IWC in 2020 that includes initiatives in Brazil, Colombia, Ecuador, and Peru for the conservation of dolphins in the Amazon, Orinoco, and Tocantins-Araguaia basins [174]. The implementation of the CMP by signatory governments will: i) reduce conflicts between river dolphins and commercial fishing operations; ii) mitigate the effects of illegal fishing retaliation and bycatch on river dolphins; iii) improve connectivity and habitat conservation; iv) increase knowledge on taxonomy, genetics, population trends, ecology and health of river dolphins; and v) engage governments, the private sector and civil society in the conservation of river dolphins in South America [174].

A number of legends and myths about the river dolphin exist in different variations in Amazonian cultures. Perhaps the most widespread is that the pink river dolphin was once a formidable and handsome indigenous warrior transformed into a dolphin by an envious god [175]. It is also thought that, in summer, the dolphin may return to its original human form to visit villages [175]. The Amazon abounds with stories about people in danger of drowning who were rescued by pink dolphins. Indigenous communities usually recognize the animal as a friendly and noble spirit [175]. It is interesting to imagine the origin of a wild animal as being a human, providing yet another example of the connection many indigenous peoples have with their environment.

River dolphin conservation requires the strengthening of ongoing, collaborative regional initiatives. This depends on collaboration between the public sector, researchers, civil society organizations and communities through collectives such as the South American River Dolphin Initiative (SARDI) which has the vision of maintaining the largest and healthiest populations of river dolphins in the world in well-connected habitats *. SARDI is currently working on updating the river dolphin distribution map through population estimates in unexplored watersheds and the establishment of national databases to identify dolphin population trends in each country, as well as defining critical connectivity areas for the species. The initiative also encompasses the mitigation of dolphin-fishermen conflict by involving community support and technology, the implementation of the Conservation Assured River Dolphin Standards (CA|RDS) to evaluate and improve the effectiveness of protected areas in dolphin conservation, and policy advocacy for the conservation of dolphins and their ecosystems, including technical support to governments for the implementation of the CMP.

The conservation of these species is intricately connected to the success of river protection strategies such as ensuring free-flowing rivers and halting mercury contamination from gold mining in the Amazon.

** SARDI has been promoting initiatives for the regional conservation of South American river dolphin populations since 2017. It is composed of the Faunagua organization of Bolivia, Omacha Foundation of Colombia, Solinia of Peru, the Mamirauá and Aqualie Institutes of Brazil, the Ecuadorian National Institute of Biodiversity (INABIO), the Venezuelan Institute of Scientific Research (IVIC) and WWF offices in Bolivia, Brazil, Colombia, Ecuador and Peru. See: river-dolphins.org.*


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OTHER STRATEGIES

The conservation and sustainable management of the Amazon biome, its forests and its rivers, from a long-term regional vision that supports equitable regional development in harmony with nature, requires those specific strategies outlined above, but also **cross-cutting strategies** in three key areas: sound policies, knowledge generation and effective communications.

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The Leticia Pact, established in 2019, provides an important action framework to better coordinate efforts and responses to the current crisis in the Amazon, increase regional collaboration to protect the world's largest tropical forest, and promote the sustainable use of its resources. The pact includes ambitious commitments on key issues such as joint monitoring and strategies to combat deforestation and ecosystem degradation. Among other issues, it also addresses restoration and sustainable use initiatives, cooperation mechanisms, and the exchange of experiences and lessons learned.

Amazonian societies and governance

Public policy can support conservation by including the environmental variable from a sustainability perspective in a country's development model.

Sustainable development cannot occur without human well-being.

If, on the contrary, public policy favors short-term development models that exploit nature, serious ecological imbalances occur in the medium and long term. A solid environmental policy in each Amazonian country is indispensable for the conservation of the biome over time and must be understood in an intersectoral manner, i.e., consider both environmental conservation policies and those related to production and consumption that seek to reduce the ecological footprint of economic activities.

Public policy must better address the needs of rural and urban populations in the Amazon, as **sustainable development cannot occur without human well-being**. The lack of incentives for sustainable local economic activities, lack of public services, and limited opportunities for decent employment fuel participation in clandestine activities and precarious temporary work, their associated health and environmental risks, and incentivize unregulated urban migration and disorderly urbanization [Cap. 14, Cap. 15, Cap. 26]. Rural populations must be guaranteed minimum standards of living such as access to energy and technology, as well as incentives to maintain and expand local sources of income through diversified and sustainable agroforestry and fisheries systems.

One promising way forward is the proposal for an Amazonian *bioeconomy* as a way of overcoming the typical natural resource exploitation route and moving towards income-generating activities that are compatible with nature, such as tourism and payment for environmental services [176] [Cap. 30]. A bioeconomy would require the development of innovative policies and institutional frameworks, and more research on socio-biodiverse Amazonian products. The bioeconomy could gain momentum with greater control of illegal activities and support for value chains based on scientific and traditional knowledge [Cap. 25, Cap. 28].

It is important to promote better relations with the surrounding forest environment and address important sanitation, education and health deficiencies at the city level, where around 60% of the Amazonian population is concentrated [177] [Cap. 34]. *A Living Amazon* requires a population that can live well, thus it is essential to foster **inclusive development models at the policy level, with diversified economies, to improve the living conditions of its inhabitants**.

Improving governance in the Amazon requires specific measures to improve transparency and accountability of local government, expand institutional capacity, curb illegality and crime, deepen financial incentives for conservation, facilitate knowledge sharing between urban centers and rural populations, and democratize access to technology, with a focus on education, to achieve greater ethical and participatory connectivity [Cap. 14, Cap. 25, Cap. 16, Cap. 30].

Research is also critical to achieving a well-conserved Amazon in the long term

Research is also critical to achieving a well-conserved Amazon in the long term. Despite its popularity among researchers, the Amazon biome remains an under-studied region when comparing research levels with the vast size of the biome and its immense biological and cultural diversity. The generation of knowledge must therefore remain a priority for its conservation. **Greater knowledge about the dynamics of the biome enables better management decisions to be taken for its conservation.** Scientific information is an essential component of reducing human impacts on natural environments, obtaining the necessary political and financial support for research, and for the development of interdisciplinary studies focused on the interactions between the components that make up the biome. As part of an integrated development model for the Amazon, the development of regional research should be supported and incentivized, alongside the compilation, systematization, and integration of the region's extensive body of traditional knowledge.

The Science Panel for the Amazon

The Science Panel for the Amazon (SPA), made up of more than 240 scientists, including leaders of indigenous peoples, aims to be a global authority on the Amazon and provides scientific analysis on its status, current trends, and recommendations for long-term sustainable development of its ecosystems and communities. The SPA issued a first Amazon Assessment Report based on a solid scientific analysis, which was launched at the Climate Change COP 26. This report is considered an encyclopedia of sorts for the Amazon region. The SPA is convened under the auspices of the Sustainable Development Solutions Network (SDSN). Professor Jeffrey Sachs, director of the SDSN, serves as convener and Dr. Carlos Nobre (Institute for Advanced Studies - USP) as co-chair.

THE AMAZON WE WANT

Science Panel for the Amazon

There is still a lot of work to be done in terms of **communication and awareness-raising** to highlight the importance oh the Amazon at the planetary level and the urgency of its conservation. It is crucial that governmental and private sector decision-makers are better informed if they are to act in line with sustainable development and, therefore, with the conservation of the biome. **Awareness must also be raised among the public to foster social pressure in favor of development models that operate in harmony with nature.** Decision-makers, government and the private sector will act in favor of the Amazon only to the extent that it is a matter of public interest and human welfare.

The Amazon biome is interconnected in such a way that decision-making in one country affects human, flora, and fauna communities in others. Borders are political rather than natural distinctions. One of the greatest challenges for the biome is to better inform those who inhabit it and those who make decisions about it of its inherent interconnectivity and the potential ecological effects of decisions that are made. Indeed, given the remarkable regulatory function of the biome, these ecological decisions can effect the entire planet.

Improving the quality and content of education in the region, both in formal and informal systems, is essential to ensuring better informed decisions and greater awareness of socio-environmental consequences. Formal education programs are usually designed in cities far from the biome and their contents are not adequately adapted to a context as important and fragile as the Amazon. An intercultural educational approach in combination with the strengthening of science education are therefore crucial to confronting the biome's challenges.

An intercultural educational approach in combination with the strengthening of science education are therefore crucial to confronting the biome's challenges.

Finally, it is essential that conservation and sustainable management strategies be implemented within a framework of **equity and respect for diversity through the implementation of an inclusive conservation model based on the joint construction of a shared agenda with local communities and indigenous peoples**. Conservation and other interventions should be developed in alliance with key actors, incorporating their visions, respecting their rights, and including their interests in decision-making.

Inclusive conservation enables and promotes mutual learning and innovation and transcends traditional conservation approaches to privilege equity and inclusiveness. It counteracts inequitable relations between actors in the economy (regarding access to markets, property * and income), society (access to information, justice, and participation) and decision-making (representation and voice in key spaces), and creates positive synergies between indigenous peoples, local communities and other actors involved in conservation [178]. **Strategies must also incorporate a shift in perspective in which indigenous peoples, traditionally considered beneficiaries of sustainable development initiatives, are now partners.** Equity must also be promoted in the various stakeholder agreements,

** It is important to promote citizen science based on traditional knowledge that guarantees property rights and access to resulting benefits.*

with special attention to discriminated groups such as women and children. The goal is to achieve stronger, fairer, and more effective results for nature and people.

All these strategies require **collaboration between different actors with interests in the Amazon**. The profound changes required in the region's current development model will only be achieved through the concerted action of civil society, governments, the private sector, local communities and indigenous peoples, academia, education professionals, communication specialists and all the people and institutions whose action or inaction have consequences for the biome.

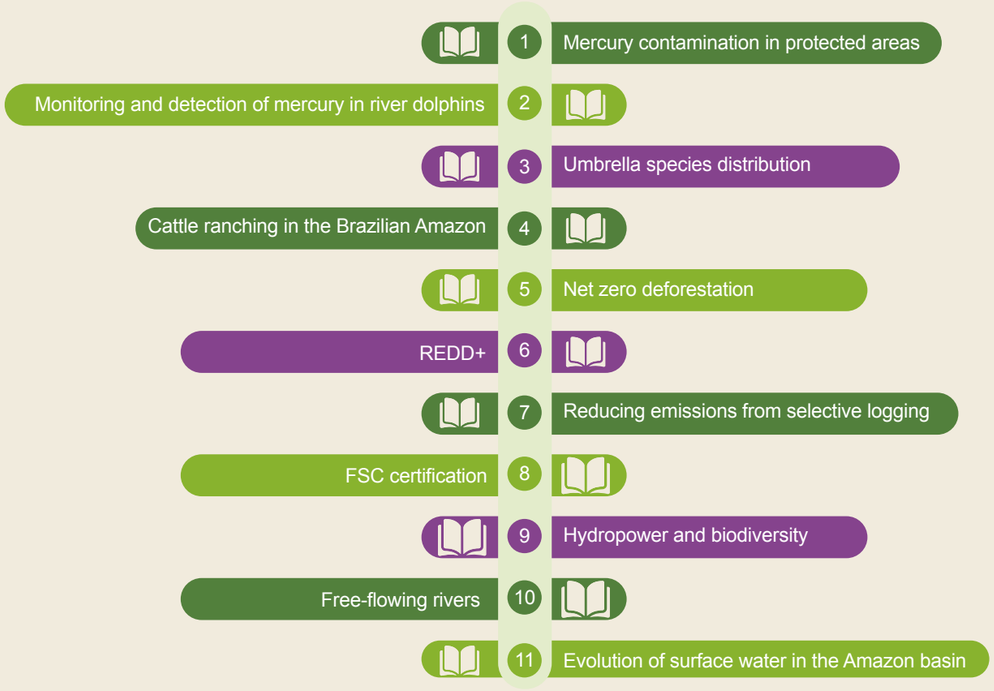
INNOVATIVE RESEARCH FOR DECISION-MAKING

The vastness and inaccessibility of some areas of the Amazon biome make it a place about which we know very little. **Many of the species that inhabit the Amazon — indeed, most of the insect species — have not yet been documented by science**. Within this complex reality, the Amazon is transforming; climate change and human activities are modifying ecosystem dynamics and setting complex processes of transition in motion that have yet to be scrutinized. Research and innovation are indispensable for increasing knowledge and influencing decision-making, and WWF supports research in all the countries where it operates.

WWF monitors biodiversity in most areas where it works to improve species understanding of the species present and the threats they face, and thereby better direct effective protection measures. Through camera traps, radio transmitters, satellite monitoring and other methodologies, the behavior of jaguars, pumas, macaws, parrots, peccaries, river dolphins and other species is studied to determine their spatial requirements and help maintain healthy populations *.

** Available at www.wwf.org.pe.*

As a result of their participation in research, both in the field and through secondary analysis of geographic and biological information with various stakeholders, WWF team members have published several scientific articles since 2015 on key topics to improve decision-making for Amazon conservation:



WWF has also supported the development of important research on issues such as the impact of dams on golden catfish populations in Bolivia and the commercial mercury trade in recent years, all using a holistic approach that considers the wellbeing of species in relation to general ecosystem health and the wellbeing of human populations.

JAGUARS AND DOLPHINS: AMAZONIAN AMBASSADORS

The jaguar and the river dolphin are considered priority species by WWF because their conservation is critical to the integrity of the Amazon. Both are key indicators of ecosystem health and at-risk species, and their protection requires cross-border approaches and regional coordination among Amazonian countries. For this reason, much of WWF's research has focused on these species, ambassadors of the basin's forests and rivers.

RIVER DOLPHINS

A dolphin population estimation program was established in 2000 around a work network comprising the Omacha Foundation, WCS, WWF and several local organizations, which to date has covered more than 7,000 kilometers in the Amazon and Orinoco basins. This group contributed to the 2010-2020 South American River Dolphin Action Plan, with the participation of 11 countries, governments, specialists, and civil society, and resulted in the establishment of several national plans *. The Plan included several measures to ensure the survival of these species, including sustainable fisheries, the cessation of species capture, free-flowing rivers, and alternative local community revenue streams [179].

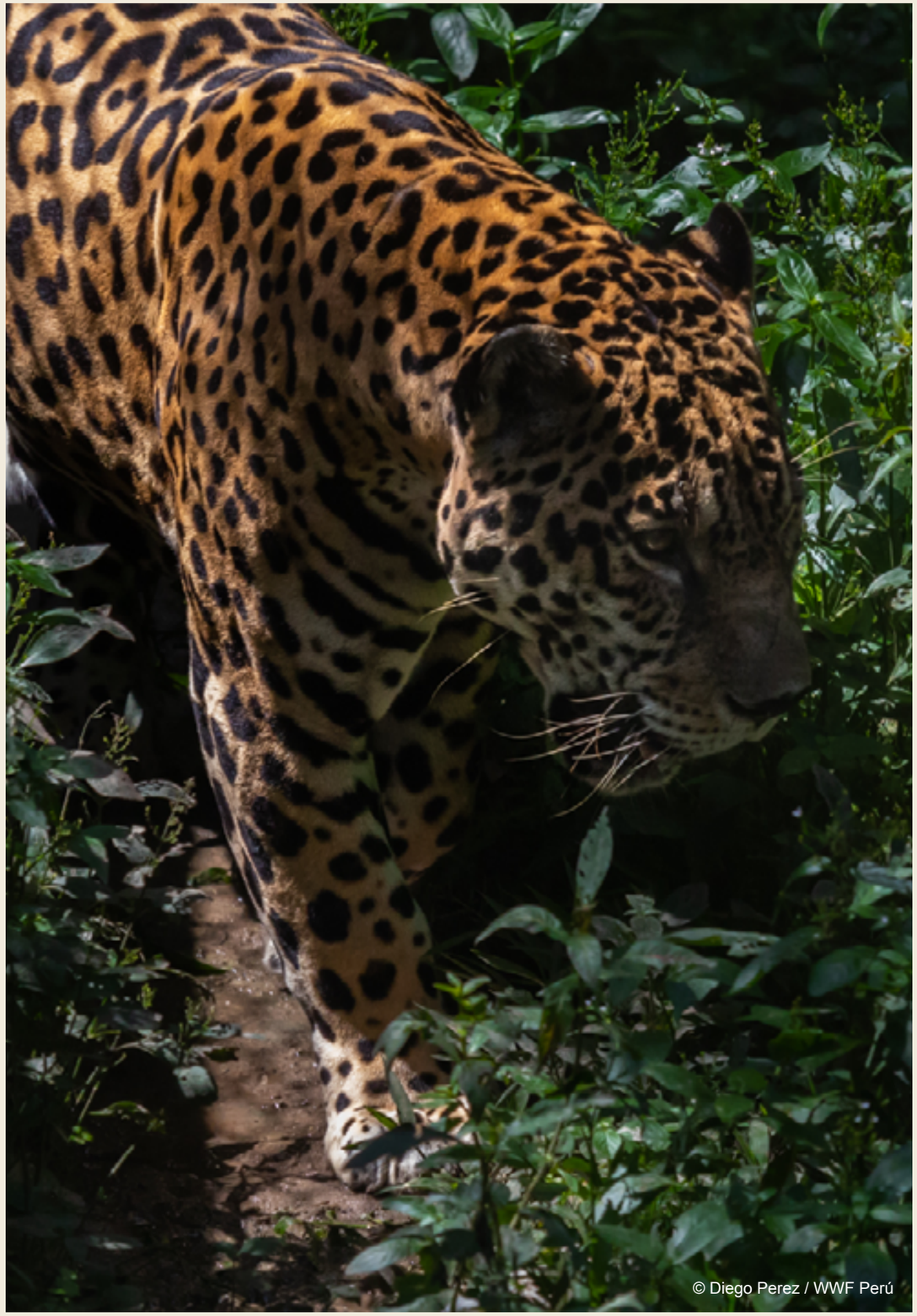
** Action Plan for the Conservation of River Dolphins in South America: Executive Summary and Progress 2010-2020.*

As of 2015, collaboration around the issue was strengthened under the South American River Dolphin Initiative (SARDI), which brings together specialists and organizations from Colombia, Brazil, Bolivia, Peru, and Ecuador, including Faunagua, Omacha Foundation, Mamirauá Institute, Prodelphinus and WWF. SARDI works with government authorities on scientific research, awareness raising local community work, and education and management initiatives for the conservation of river dolphins and their habitats in the Amazon and Orinoco [180].

SARDI's population estimation program uses a standardized methodology to establish population sizes and identify key threats in Bolivia, Brazil, Colombia, Ecuador, and Peru, which in turn facilitates the preparation of action and management plans. In 2017, the first satellite transmitters were placed on freshwater dolphins in the Amazon and Orinoco regions of Colombia, Bolivia, Brazil, and Peru as part of the program. The first results, collected in late 2019, provided important information on their key habitats and movements, as well as on the increasing threats they face [180]. The results of this research formed a key part of the development of the River Dolphin Conservation and Management Plan (CMP) submitted to the International Whaling Commission by the governments of Colombia, Peru, Brazil, and Ecuador, which was approved by the Commission's scientific committee in May 2020.

Through the research cooperation of SARDI member organizations, **a publicly accessible virtual river dolphin data dashboard was created** **, providing an important decision-making support tool for river dolphin conservation on a regional scale. Building on multiple expeditions and local conservation efforts, the dashboard presents all the existing scientific information on the populations of the different species and subspecies of dolphins in South America. Based on this data, the IUCN conducted a re-evaluation of the Risso's or tucuxi dolphin, a species on which data was lacking, and classified it as endangered.

*** The dashboard is available at: www.arcgis.com*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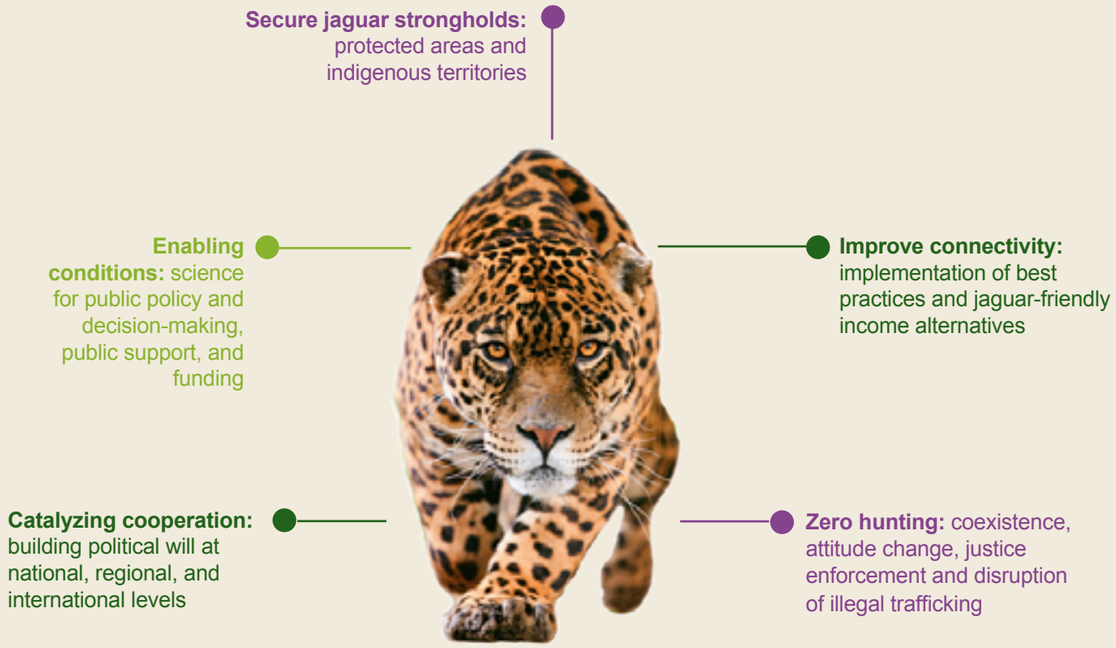
THE JAGUAR

WWF offices in Latin America and Fundación Vida Silvestre Argentina, with and through partner organizations, have been working on jaguar conservation for a number of years in an effort that extends from Mexico to Argentina. In collaboration with organizations such as Panthera and WCS, as well as with local organizations, academia and governments, several initiatives have been implemented in the Amazon to protect habitats and corridors, monitor, and create population density baselines, reduce human-fauna conflicts, and carry out preliminary assessments on the illegal trade of jaguar parts while strengthening governmental control capacity.

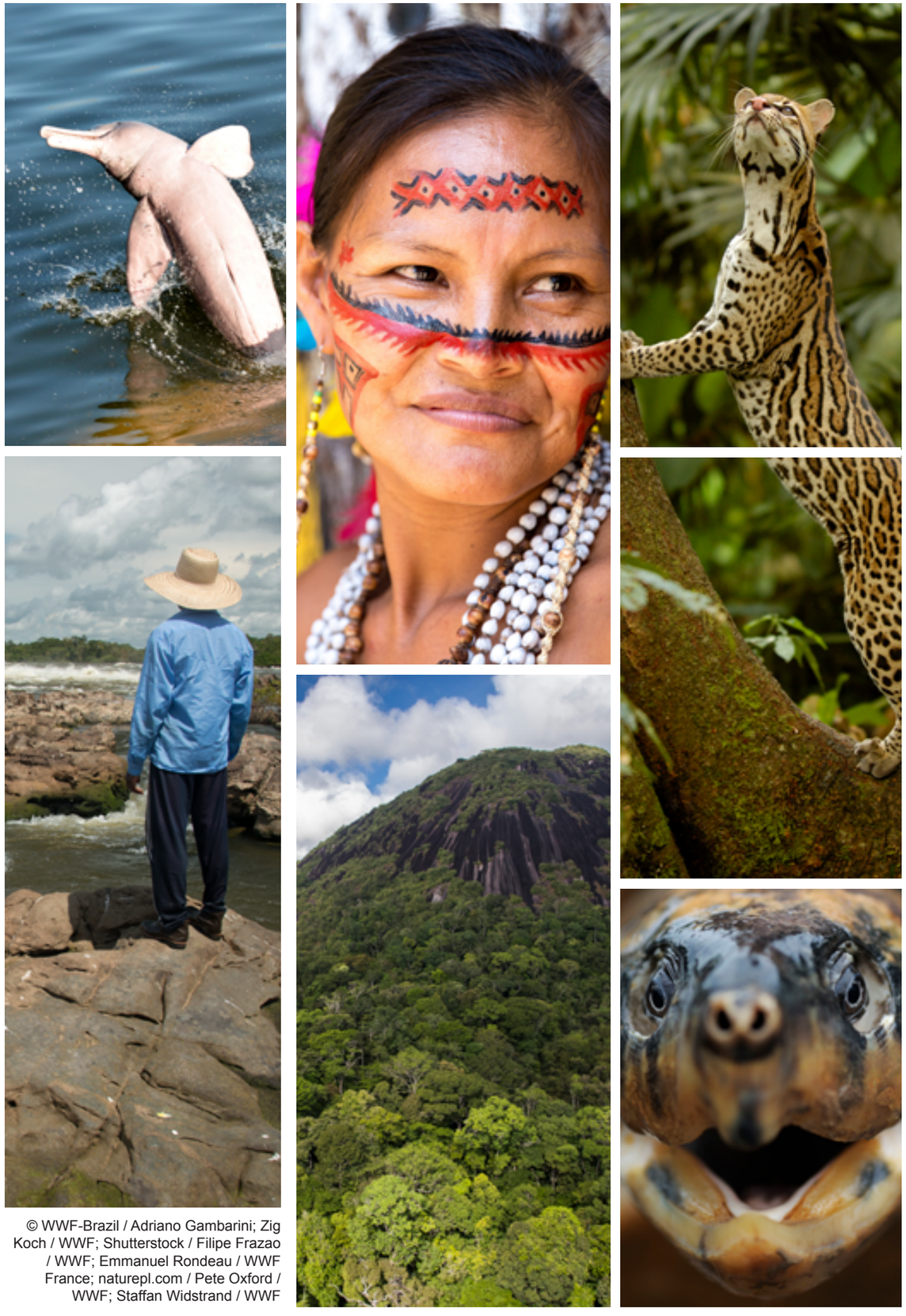
Panthera, WCS and WWF held an initial workshop on jaguar conservation in the Amazon in 2014. In 2018, these organizations supported the realization of the Jaguar 2030 High Level Forum convened by UNDP to promote a regional approach to the conservation of jaguars and their habitats, and sustainable development for the communities associated with these habitats. A coordination committee, Jaguar 2030, was subsequently established, which is working on a regional roadmap and seeking to leverage resources to implement joint initiatives. In parallel, WWF led an effort by 19 governmental and non-governmental organizations to develop the Jaguar 2030 Strategic Framework; a common platform for the strategies and approaches needed to safeguard the species. Internally, WWF has a Regional Strategy for Jaguar Conservation, aligned with the Strategic Framework and the Jaguar 2030 roadmap, whose strategic lines reflect indispensable measures for the long-term survival of the jaguar [181]:



The priority sites identified in the Regional Strategy for jaguar conservation in the Amazon are:

In 2019, WWF's offices in the northern Amazon carried out a trinational monitoring project in three areas of the Napo-Putumayo Corridor: The *Cuyabeno Wildlife Production Reserve* (Ecuador), the *Güeppi-Sekime National Park* (Peru) and the *Predio Putumayo Indigenous Reserve* (Colombia). More than 30 individuals were sighted, and it is estimated there are at least 2000 individuals across the entire Corridor *.

** Available at www.wwf.org.ec.*



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4. CONCLUSION

The Amazon covers 6.7 million square kilometers and encompasses the largest complex of forests and rivers in the world, with incalculable natural and cultural wealth. The region plays a fundamental role in the bio geophysical interactions that allow our planet to properly function. It produces 20% of freshwater discharge into the Atlantic and stores 150 to 200 billion tons of carbon in its soils and vegetation.

THE AMAZON

Is home to enormous biodiversity:

at least **9%** of **SPECIES OF MAMMALS**

at least **14%** of **BIRDS**

at least **8%** of **AMPHIBIANS**

13% of **FRESHWATER FISH**

22% of **VASCULAR PLANTS**

there are places in the biome where up to

90% **OF THE BIODIVERSITY**

has not yet been scientifically documented

But the region is also a repository of ancestral human history and culture:

47 MILLON live there

2 MILLON are indigenous peoples

from more than **500 DISTINCT GROUPS**

66 INDIGENOUS PEOPLE GROUPS live in isolation

Amid a global environmental crisis, the Amazon still harbors a substantial proportion of humanity's heritage.

In addition to being a *basin*, the Amazon is a *biome,* and its interconnected ecosystems form a complex web of connections between thousands of species, some as charismatic as the river dolphin and jaguar, with human beings inhabiting large cities, communities of varying sizes and vast indigenous territories. Interactions between people and nature trigger both symbiotic and antagonistic results in these landscapes: from positive interactions, such as the ways indigenous peoples manage their ancestral territories, to extremely negative ones such as the devastation and transformation of certain human activities on natural ecosystems, leaving a trail of death and destruction.

More than 17 percent of Amazonian forests have already been destroyed and a further 17 percent are degraded.

As immense and impressive as it is, the Amazon is also fragile and vulnerable to the impacts of today's short-sighted dominant development model, which is incompatible with the planet's biophysical limits and global environmental phenomena such as climate change. More than 17 percent of Amazonian forests have already been destroyed and a further 17 percent are degraded. Economic activities, most notably extensive cattle ranching, and agriculture, followed by extractivism, illegal activities and poorly planned infrastructure, threaten the region and cause deforestation and degradation throughout the biome, with many areas severely affected, especially in the south and southeast and along the eastern foothills of the Andes in areas bordering Amazonian cities and ports, but also in more inaccessible places rich in commercially viable natural resources. The advance of this infamous and often illegal development does not stop; destroying, disconnecting, contaminating, and disappearing sources and forms of life across the Amazon.

The situation has begun to show signs of nearing a point of no return: seasons are changing, surface water is being lost, rivers are becoming increasingly disconnected and polluted, and forests are under immense pressure from increasingly devastating waves of deforestation and fire. This could lead to irreversible change in the near future, posing a serious, extremely serious, risk for the planet: the loss of one of the pillars of planetary stability in terms of climate and biodiversity, and one of the main bastions of cultural diversity and ancestral knowledge. An ecologically healthy Amazon is part of the delicate balance of the Earth's environmental systems that enable life as we know it. Its alteration could drastically change the climatic characteristics of South America, affecting the entire region's food security, and intensifying the harmful effects of climate change, ultimately affecting the entire planet. A regional perspective is vital in order to understand the overall complexity of the biome, and a collective effect is essential to save it. Such a vision starts from the fundamental recognition that the existence of the Amazon as an integral ecological unit requires coordinated efforts for its conservation. All Amazonian countries have a role to play in the protection and sustainable management of the biome under a common vision: their actions, both positive and negative, affect other parts of the biome and therefore must be coordinated as part of an interconnected system.

The Amazon is made up of portions of eight countries and one overseas territory which, far from presenting a united front, constitute a diverse and complex set of cultural and political contexts. Although proud of the Amazon they share, Amazonian countries have not coordinated


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effectively to protect it, and major social and economic challenges remain in Amazonian societies that are rarely resolved in harmony with the environment. A diverse array of actors with different degrees of responsability and power, and divergent interests, influence the current. state of the Amazon and the potential to reverse existing trends.

The governments of Amazonian countries bear a large part of the responsibility, burdened with the urgent need to implement sustainable development models and socioeconomic policies that are not based on environmental depredation; to implement science-based, inclusive and sustainable environmental policies for the protection of natural capital; to regulate and control activities that affect the environment; and to cooperate across borders to curb illegal activities and strengthen conservation corridors.

Corporations that exploit the Amazon's natural resources and constitute a devastating economic force behind deforestation need to get their supply chains in order and stop exporting environmental destruction to so-called first world countries; livestock, timber and agriculture industries need to ensure far higher environmental standards; and international financiers need to stop bankrolling the destruction of the Amazon. Small-scale agriculture and family livestock farming are also a factor in land-use change, albeit to a lesser extent, and these practices must also transition across to low-impact systems.

For their part, civil society organizations and academia also have an important role to play in filling gaps in scientific knowledge, bringing science to decision-makers, and contributing to the establishment of local models of sustainable development that are beneficial to communities and friendly to nature. Finally, consumers can no longer feign indifference: the purchase of illegal products derived from the trafficking of species must end; the purchase of legal but environmentally irresponsible products, as found in the beef, soy, timber, and other sectors, must cease to be a commercial option; and the local degradation of aquatic species due to overfishing, and the poor management of other species by Amazonian populations, must also stop.

The long-term survival of the Amazon requires the protection of its rivers, which must be kept free and healthy, and the cessation of deforestation and degradation.

The 2022 Living Amazon Report points out the urgency of formulating and implementing action plans based on resilience to global change, as developed in the third chapter of this report. The long-term survival of the Amazon requires the protection of its rivers, which must be kept free and healthy, and the cessation of deforestation and degradation. The latter depends on the protection of biodiversity strongholds such as protected areas and indigenous territories and the use of landscape approaches that favor sustainable local development in harmony with nature. There are several examples of successful measures implemented in the biome that could be replicated on a larger scale. These are included in the report as a way of demonstrating that a different future is possible for the Amazon

The Amazon urgently requires effective policies, the expansion of research, and greater awareness on the part of decision-makers and the public about its current status, the threats it faces, and potential conservation avenues going forward. Efforts such as those of the Science Panel for the Amazon

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should be continued and strengthened. Throughout this report there are links to chapters corresponding to the topic in question in the Panel's Report, which bring the most important and up-to-date scientific findings on the Amazon to the table so that they can be incorporated into the decision-making processes of the various actors that have influence in the region.

It is time to establish a model of coexistence with the ecological attributes of the biome that is based on respect for the processes responsible for the origin and maintenance of its biological diversity and, above all, for the territories and traditional knowledge of the indigenous peoples who have inhabited the Amazon for millennia. The future of the Amazon biome depends on the extent to which humanity understands its co-dependence with the largest complex of forests and wetlands in the world. Governments, the private sector and, above all, the public - with its capacity to exert social pressure - must act together in favor of this unique place on our planet and establish a new pact in favor of nature and people; a different future in which the Amazon remains alive for generations to come.

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REFERENCES

1 Macedo, M. and Castello, L. 2015. State of the Amazon: Freshwater Connectivity and Ecosystem Health. Oliveira, D., Maretti, C. and Charity, S. (eds.). Brasilia: WWF Living Amazon Initiative.

2 Charity, S., Dudley, N., Oliveira, D. and Stolton, S. (eds.). 2016. Amazonia Viva Report 2016: A regional approach to conservation in the Amazon. Brasilia and Quito: WWF Amazonia Viva Initiative.

3 Beer C., Reichstein M., Tomelleri E. et al. 2010. Terrestrial Gross Carbon Dioxide Uptake: Global Distribution and Covariation with Climate. Science 329: 834-8.

4 FAO. 2020. The State of World Fisheries and Aquaculture 2020. Sustainability in Action. Rome: United Nations Food and Agriculture Organization.

5 ACTO. 2021. Integrated Water Resources Management, Amazon Basin Project. Available at: http://otca.org/la-cuenca-amazonica-de-cara-al-oceano-atlantico/

6 Mittermeier R.A., Mittermeier C.G., Brooks, T.M., et al. 2003. Wilderness and biodiversity conservation. Proc Natl Acad Sci 100: 10309-13.

7 Hubbell S.P., He F., Condit R. et al. 2008. How many tree species are there in the Amazon and how many of them will go extinct? Proc Natl Acad Sci U S A 105: 11498.

8 Jézéquel C., Tedesco P.A., Bigorne R. et al. 2020. A database of freshwater fish species of theAmazon basin. Sci data 7: 1-9.

9 Arnold, A.E. and Lutzoni, F. 2007. Diversity and host range of foliar fungal endophytes: are tropical leaves biodiversity hotspots? Ecology 88: 541-9.

10 Tedersoo L., Bahram M., Põlme S. et al. 2014. Global diversity and geography of soil fungi. Science 346.

11 Pires Costa, L., Leite Y.L.R., Fonseca G.A.B. and Fonseca M.T. 2000. Biogeography of South American Forest Mammals: Endemism and Diversity in the Atlantic Forest. Biotropica 32: 872-81.

12 Solari, S., Velazco, P.M. and Patterson BD. 2012. Hierarchical Organization of Neotropical Mammal Diversity and its Historical Basis. In: Bones, Clones, and Biomes. Chicago: University of Chicago Press.

13 Nores, M. 2000. Species richness in the Amazonian bird fauna from an evolutionary perspective. Emu 100: 419-30.

14 WWF et al. Amazon Vision: Protected Areas: Natural Solutions to Climate change (Policy Brief). Supported by BMU. Available at: https://wwfint.awsassets.panda.org/downloads/policy_brief__protected_areas_natural_solutions_to_climate_change.pdf

15 Nobre Donato, A. 2014. The Future Climate of Amazonia: Scientific Assessment Report. Brazil. Available at: https://d2ouvy59p0dg6k.cloudfront.net/downloads/the_future_climate_of_amazonia_report.pfd

16 Lawrence, D. and Vandecar, K. 2015. Effects of tropical deforestation on climate and agriculture. Nature climate change, 5(1), 27-36.

17 Maretti, C.C., Riveros S.J.C., Hofstede, R., Oliveira, D., Charity, S., Granizo, T., Alvarez, C., Valdujo, P. and Thompson, C. 2014. State of the Amazon: Ecological Representation in Protected Areas and Indigenous Territories. Brasilia and Quito: WWF Living Amazon (Global) Initiative.

18 AIDESEP and OPIAC. October 2018. Talanoa Dialogue: AIDESEP and OPIAC Presentation. Available at: http://www.aidesep.org.pe/sites/default/files/media/documento/FINAL%20-%20OPIAC%20y%20AIDESEP%20-%20Talanoa_espanol.pdf

19 The World's Forgotten Fishes. 2021. Alliance for Freshwater Life, Alliance for Inland Fisheries, Conservation International, Fisheries Conservation Foundation, Freshwaters Illustrated, Global Wildlife Conservation, InFish, IUCN, IUCN SSC FFSG, Mahseer Trust, Shoal, Synchronicity Earth, The Nature Conservancy, World Fish Migration Foundation, WWF, and Zoological Society of London.

20 Opperman, J. J., Shahbol, N., Maynard, J., Grill, G., Higgins, J., Tracey, D. and Thieme, M. 2021. Safeguarding free-flowing rivers: the global extent of free-flowing rivers in protected areas. Sustainability, 13(5), 2805.

21 WWF-Brazil. 2022. Technical Note: What forests and deforestation have to do with our health. Available at: wwfbr.awsassets.panda.org/downloads/wwf_notatecnica_saude_2022_v6.pdf.

22 Science Panel for the Amazon. 2021. Amazon Assessment Report 2021. Nobre, C., Encalada, A., Anderson, E. et al. (eds). New York: United Nations Sustainable Development Solutions Network. Available at: https://www.theamazonwewant.org/spa-reports/. DOI: 10.55161/RWSX6527.

23 Silva, C.V.J., Aragão, L.E.O.C., Youngm P.J. et al. 2020. Estimation of multi-decadal carbon deficit of burned Amazonian forests. Environ Res Lett 15: 114023.

24 Lovejoy, T.E. and Nobre, C. Amazon Tipping Point. Sci. Adv.4, eaat2340 (2018). Available at: https://advances.sciencemag.org/content/advances/4/2/eaat2340.full.pdf

25 Lovejoy, T.E. and Nobre, C. 2019. Winds of will: Tipping change in the Amazon. Sci. Adv. 5, eaba2949.

26 Boulton, C.A., Lenton, T.M. and Boers, N. 2022. Pronounced loss of Amazon rainforest resilience since the early 2000s. Nat. Clim. Chang. 12, 271-278 2022. https://doi.org/10.1038/s41558-022-01287-8.

27 Parry, I., Ritchie, P. and Cox, P. 2022. Evidence of Amazon rainforest dieback in CMIP6 models, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2022-82

28 Castro, M., March, C. and Scardamaglia, V. 2019. WWF: Articulation with the states and incidence in the public. Published by InnContext. A Fundación Avina initiative.

29 Environmental Justice Atlas. n.d. EJAtlas - Global Atlas of Environmental Justice. Accessed March 13, 2020. Available at: https://ejatlas.org/

30 Romo Espinoza, V. and Alvitres, G. 2022. Unpunished crimes: the murders of 50 indigenous leaders in the Amazon of Brazil, Colombia, Ecuador and Peru are still awaiting justice. Mongabay. Available at: https://es.mongabay.com/2022/06/crimenes-de-50-lideres-indigenas-de-la-amazonia-siguen-esperando-justicia/

31 Pousadela, I. M. 2016. Threats to civic space in Latin America and the Caribbean. CIVICUS: 55.

32 Global Witness. 2020. Defending tomorrow. Available at: https://www.globalwitness.org/es/defending-tomorrow-es/

33 Somos COICA Magazine, 2022. Issue 2, page 5. COICA. Available at: https://coicamazonia.org/revista-coica/

34 Valsecchi, J., Marmontel, M., Franco, C.L.B., Cavalcante, D.P., COBRA, I.V.D., Lima, I.J., Lanna, J.M., Ferreira, M.T.M., Nassar, P.M., Botero-Arias, R. and Monteiro, V. 2017. Update and compilation of the untold treasures list: new species discoveries in the Amazon 2014-15. WWF Living Amazon Initiative (Denise Oliveira and Sandra Charity), WWF-Brazil (Jorge Eduardo Dantas and Mariana Gutierrez), Brasilia, DF and Tefé, AM: WWF and Mamiraua Institute for Sustainable Development.

35 Coe, M. T., Latrubesse, E. M., Ferreira, M. E. and Amsler, M. L. (2011). The effects of deforestation and climate variability on the streamflow of the Araguaia River, Brazil. Biogeochemistry, 105(1), 119-131.

36 Barlow, J., Lennox, G.D., Ferreira, J. et al. 2016. Anthropogenic disturbance in tropical forests can double biodiversity loss from deforestation. Nature 535: 144-7.

37 Baccini, A., Walker, W, Carvalho L. et al. 2017. Tropical forests are a net carbon source based on aboveground measurements of gain and loss. Science 358: 230-4.

38 Qin Y, Xiao X, Wigneron, J.-P. et al. 2021. Carbon loss from forest degradation exceeds that from deforestation in the Brazilian Amazon. Nat Clim Chang 11: 442-8.

39 Bullock, E.L., Woodcock, C.E., Souza, C. and Olofsson, P. 2020. Satellite-based estimates reveal widespread forest degradation in the Amazon. Glob Chang Biol 26: 2956-69.

40 Ríos Cáceres, S. and Oliveira-Miranda, M. 2015. Deforestation in the Amazon (1970 - 2013). Brasilia: RAISG.

41 Kalamandeen, M., Gloor, M., Mitchard, E, Quincey, D, Ziv, G., Spracklen, D., Spracklen, B., Adami, M., Aragão, L. and Galbraith, D. 2018. Pervasive Rise of Small-scale Deforestation in Amazonia. Scientific Reports. 8. 10.1038/s41598-018-193582.

42 Hansen, M., Potapov, P. V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, Thau, A.D. Stehman, S.V. Goetz, S.J., Loveland, T.R., Kommareddy, A., Egorov, A., Chini, L., C. , Justice, O. and Townshend, J.R.G. 2013. High-Resolution Global Maps of 21st-Century Forest Cover Change. Science 15.

43 Global Forest Atlas. n.d. Amazon Logging: Practice and Policy. Available at: https://globalforestatlas.yale.edu/amazon/forests-and-logging/amazon-logging-practice-and-policy

44 MapBiomas. 2020. MapBiomas Amazonia v2.0. https://amazonia.mapbiomas.org/.

45 Smith, C.C., Healey, J.R., Berenguer, E. et al. 2021. Old-growth forest loss and secondary forest recovery across Amazonian countries. Environ Res Lett 16: 085009.

46 INPE. 2021. TerraBrasilis: Deforestation Panel. Available at: http://terrabrasilis.dpi.inpe.br/app/dashboard/deforestation/biomes/amazon/increments

47 Ministry of Environment and Sustainable Development - IDEAM. 2020. Deforestation Monitoring Results 2019. 16. Available at: http://www.andi.com.co/Uploads/PRESENTACION DEFORESTACION 2019 (July 9) _compressed.pdf.

48 Finer, M. and Mamani, N. 2022. Deforestation and Fires in the Amazon 2021. MAAP: 153.

49 WWF Guianas. 2012. Living Guianas Report 2012. Paramaribo: WWF Guianas.

50 Dias, A. S., Lawrence, K., Suarez, C. F., Charity, S., Granizo, T. and Maretti, C. 2017. State of the Amazon: Deforestation Trends. Brasília and Quito: WWF Living Amazon (Global) Initiative.

51 FAO. 2012. Global Food Losses and Food Waste - Extent, Causes and Prevention. Rome: United Nations Food and Agriculture Organization.

52 Sierra, Y. 2018. “El momento de la verdad”: estudio revela que alto porcentaje de la madera que Perú exporta es ilegal. Mongabay. Available at: https://es.mongabay.com/2018/02/peru-madera-ilegal-informe-eia/

53 Amancio Luna, N. 2018. Madera sucia: Los últimos árboles de la Amazonía. Published by Ojo Público and Mongabay Latam. Available at: https://ojo-publico.com/especiales/madera-sucia/

54 EIA. 2019. Condenando el bosque: ilegalidad y falta de gobernanza en la Amazonía colombiana. Available at: https://content.eia-global.org/posts/documents/000/000/894/original/Condenando_el_Bosque.pdf?156 1565558

55 WWF- Ecuador. 2022. Análisis del Sistema de Explotación de la Balsa y sus Impactos Socio Económicos y Ambientales en Territorios Indígenas de Amazonía; Illanes, J., Kawarim, T., Samaniego, C. and Sierra, R. For the project: Aumento de la Capacidad de Ejecución y Cooperación para Combatir el Tráfico Ilegal de Fauna Silvestre y de Madera en la Región Andes- Amazonas. Quito: WWF.

56 WWF- Ecuador. 2021. Evaluación de los impactos socio económicos y ambientales en territorios indígenas de la Amazonía por la extracción y comercialización de la balsa; Samaniego, C. For the project: Aumento de la Capacidad de Ejecución y Cooperación para Combatir El Tráfico Ilegal de Fauna Silvestre y de Madera en la Región Andes-Amazonas. Quito: WWF (unpublished).

57 Ray, D., Nepstad, D., and Moutinho P. 2005. Micrometeorological and canopy controls of fire susceptibility in a forested Amazon landscape. Ecol Appl 15: 1664-78.

58 Brando, P.M., Balch, J.K., Nepstad, D.C. et al. 2014. Abrupt increases in Amazonian tree mortality due to drought-fire interactions. Proc Natl Acad Sci 111: 6347-52.32x

59 Cochrane, M. A. 2003. Fire science for rainforests. Nature, 421(6926), 913-919.

60 Flores, B. M., Holmgren, M., Xu, C. et al. 2017. Floodplains as an Achilles’ heel of Amazonian Forest resilience. Proc Natl Acad Sci 114: 4442-6.

61 dos Santos, A.R. and Nelson BW . 2013. Leaf decomposition and fine fuels in floodplains forests of the Rio Negro in the Brazilian Amazon. J Trop Ecol 29: 455-8.

62 Flores, B.M., Piedade, M.-T.F. and Nelson BW. 2014. Fire disturbance in Amazonian blackwater floodplain forests. Plant Ecol Divers 7: 319-127.

63 Monitoring the Andean Amazon Project (MAAP). 2020. MAAP #129: Amazon Fires 2020 - Recap of Another Intense Year. Available at: https://maaproject.org/2020/fuegos_resumen/

64 IIRSA (n/d). Qué hacemos. Accessed March 13, 2020, at: http://www.iirsa.org/Page/Detail?menuItemId=108

65 Vilela, T., Harb, A. M., Bruner, A., da Silva Arruda, V. L., Ribeiro, V., Alencar, A. A. C., ... and Botero, R. 2020. A better Amazonian road network for people and the environment. Proceedings of the National Academy of Sciences, 117(13), 7095-7102.

66 Barber, C., Cochrane, M., Souza, C. and Laurance, W. 2014. Roads, deforestation and the mitigating effect of protected areas in the Amazon. Biological Conservation. 177. 203-209.

67 De Freitas, M.A., De Printes, R.C., Motoyama, E.K. et al. 2017. Roadkill records of Lowland Tapir Tapirus terrestris (Mammalia: Perissodactyla: Tapiridae) between kilometers 06 and 76 of highway BR-163, Pará State, Brazil. J Threat Taxa 9: 10948.

68 Medeiros, A. 2019. Vertebrados atropelados na Amazônia: monitoramento em longo prazo, influência do fluxo de veículos e alternância de hotspots em um trecho da Rodovia BR-174, Brazil.

69 Tundisi, J. G., Goldemberg, J., Matsumura-Tundisi, T. and Saraiva, A. C. F. 2014. How many more dams in the Amazon? Energy Policy, 74(C), 703-708.

70 RAISG. 2015. Presiones y amenazas sobre las Áreas Protegidas y los Territorios Indígenas de la Amazonía. Available at: https://www.raisg.org/es/publicacion/presiones-y-amenazas-sobre-las-areas-protegidas-y-los-territorios-indigenas-de-la-amazonia/

71 Fraser, B. 2014. Deforestation: Carving up the Amazon. Nature News. Published by Springer Nature. Available at: https://doi.org/10.1038/240311a0

72 Ahmed, S., Souza, C., Carlos, M., Riberio, J. and Ewers, R. 2013. Temporal patterns of road network development in the Brazilian Amazon. Regional Environmental Change. 12.

73 Laurance, W., Goosem, M. and Laurance, S. 2009. Impacts of roads and linear clearings on tropical forests. Trends in Ecology and Evolution, 24.

74 Taylor, R., Dudley, N., Stolton, S. and Clay, S. 2015. WWF Living Forests Report: Chapter 5, Saving Forests at Risk. Edited by Khan, H., Jeffries, B. WWF Living Forests Report.

75 Little, P. E. 2013. Megaproyectos en la Amazonía, un análisis geopolítico y socioambiental con propuestas de mejor gobierno para la Amazonía (No. CIDAB-QH541-L53m). Red Jurídica Amazónica/Articulación Regional Amazónica/Derecho Ambiente y Recursos Naturales.

76 Madrid, C., Hickey, G. and Bouchard, M. 2011. Strategic environmental assessment effectiveness and the Inititative for the Integration of Regional Infrastructure in South America (IIRSA): A multiple case review. Journal of Environmental Assessment Policy and Management (JEAPM). 13: 515-540.

77 Cardoso, A. de A. 2016. Dilma e Correa negociam ligação entre a Amazônia e Pacífico ecuatoriano. Agência Brasil. Available at: https://agenciabrasil.ebc.com.br/politica/noticia/2016-01/dilma-e-correa-conversam-sobre-ligacao-entre-amazonia-e-o-pacifico.
78 Vilela, T. et al. August 2019. Retorno económico y riesgos socio-ambientales de los proyectos viales en la Amazonía Published by CSF. Supported by Moore Foundation, Foundation for Conservation and Sustainable Development and IPAM Amazonia.
79 Andreoni, M. 2020. Multiplying Amazon river ports open new Brazil-to-China commodities routes. Mongabay Series: Amazon Infrastructure, Amazon Soy Investigations, Global Commodities, Land rights and extractives. Published November 19, 2020. Available at: https://news.mongabay.com/2020/11/multiplying-amazon-river-ports-opennew-brazil-to-china-commodities-routes/
80 Bratman EZ. 2019. Governing the Rainforest: Sustainable Development Politics in the Brazilian Amazon. Oxford: Oxford University Press.
81 Leal, A., de Sá, M.E.R., Nascimento, N.S.F. and de Sousa Cardoso, W. 2012. Produção mineral no estado do Pará e reflexos na (re) produção da miséria: Barcarena, Marabá e Parauapebas. Políticas Públicas Journal 16: 157-167.
82 WWF, Instituto Aqualie, Instituto de Desenvolvimento Sustentável Mamirauá, Faunagua and Omacha Foundation. South American River Dolphin Initiative (SARDI): Strategy 2020-2030.
83 WWF, UNEP-WCMC, SGP/ICCA-GSI, LM, TNC, CI, WCS, EP, ILC-S, CM, IUCN. 2021. The State of Indigenous Peoples' and Local Communities' Lands and Territories: A technical review of the state of Indigenous Peoples' and Local Communities' lands, their contributions to global biodiversity conservation and ecosystem services, the pressures they face, and recommendations for actions. Gland.
84 McCormick, S. 2017. Renewable energies in the Brazilian Amazon. In: Arent, D. The Political Economy of Clean Energy Transitions. Available at: https://doi.org/10.1093/oso/9780198802242.001.0001.
85 Pack, S.M., Ferreira, M.N., Krithivasan, R., Murrow, J., Bernard, E. and Mascia, M.B. 2016. Protected Area Downgrading, Downsizing, and Degazettement (PADDD) in the Amazon. Biological Conservation, 197, 32-39.
86 Van Damme, P.A., Córdova-Clavijo, L., Baigún, C., Hauser, M., Doria, C.R. da C. and Duponchelle, F. 2019. Upstream dam impacts on gilded catfish Brachyplatsystoma rosseauxii (Siluriformes: Pimelodidae) in the Bolivian Amazon. Neotropical Ichthyology, 17, e190118.
87 Stehr Gesche, A. 2020. Efectos del represamiento de ríos en países de América Latina y el Caribe sobre la biodiversidad, el agua, la alimentación y la energía. ECLAC. Available at: https://www.cepal.org/sites/default/files/events/files/presentacion_sra_alejandra_stehr.pdf. Accessed 07/25/2022.
88 Grill, G., Lehner, B., Thieme, M. et al. 2019. Mapping the world's free-flowing rivers. Nature, 569, 215-221
89 WWF's Free Flowing Amazon Transformational Initiative Factsheet (unpublished).
90 Stickler, C., Coe, M., Costa, M, Nepstad, D, McGrath, D., Dias, L, Rodrigues, H. and Filho, Britaldo. 2013. Dependence of Hydropower Energy Generation on Forests in the Amazon Basin at Local and Regional Scales. Proceedings of the National Academy of Sciences of the United States of America, 110.
91 Higgins, T. 2020. Belo Monte boondoggle Brazil's biggest, costliest dam may be unviable. Mongabay. Available at: https://news.mongabay.com/2020/01/belo-monte-boondoggle-brazils-biggest-costliest-dam-may-be-unviable/
92 Opperman, J., Hartmann, J., Lambrides, M. , Carvallo, J.P., Chapin, E., Baruch-Mordo, S., Eyler, B., Goichot, M., Harou, J., Hepp, J., Kammen, D., Kiesecker, J., Newsock, A., Schmitt, R., Thieme, M., Wang, A., and Weber, C. 2019. Connected and flowing: a renewable future for rivers, climate and people. Washington: WWF and The Nature Conservancy.
93 Rubiano Galvis, S. 2019. The Amazon biome in the face of mercury contamination: An overview of mercury trade, science, and policy in the Amazonian countries. Surkin, J., Vergara, A., Carrizosa, J., Guío, C. and Pon, J (eds.). WWF and Gaia Amazonas.
94 Soares-Filho, B. and Rajão. 2018. Traditional conservation strategies still the best option. Nature Sustainability 1: 608- 610.
95 Escolhas Institute. 2020. New Amazonian Gold Rush. Sao Paulo: Escolhas.
96 AMAP/UNEP. 2013. Technical Background Report for the Global Mercury Assessment. Geneva: Arctic Monitoring and Assessment Programme, Oslo, Norway/UNEP Chemicals Branch.
97 Pouilly, M., Rejas, D., Perez, T. et al. 2013. Trophic Structure and Mercury Biomagnification in Tropical Fish Assemblages, Itenez River, Bolivia. PLoS ONE 8(5): e65054.
98 Roulet, M., Lucotte, M., Farella, N. et al. 1999. Effects of recent human colonization on the presence of mercury in Amazonian ecosystems. Water Air Soil Pollut 112: 297-313.
99 dos Santos, L.S.N., Müller, R.C.S., Sarkis, J.E.S. et al. 2000. Evaluation of total mercury concentrations in fish consumed in the municipality of Itaituba, Tapajós River basin, Pará, Brazil. Sci Total Environ 26: 1-8.
100 Nuñez-Avellaneda, M., Agudelo, E. and Gil-Manrique, B. 2014. Un Análisis Descriptivo de la Presencia de Mercurio en Agua, Sedimento y Peces de Interés Socio-Económico en la Amazonia Colombiana. Revista Colombia Amazónica.
101 Barbosa, A.C. and Dorea, J.G. 1998. Indices of mercury contamination during breast feeding in the Amazon Basin. Environ Toxicol Pharmacol 6: 71-9.
102 Artaxo, P., de Campos, R.C., Fernandes, T. et al. 2000. Large scale mercury and trace element measurements in the Amazon basin. Atmos Environ 34: 4085-4096.
103 Guimarães, J.R.D., Meili, M., Hylander, L.D. et al. 2000. Mercury net methylation in five tropical flood plain regions of Brazil: High in the root zone of floating macrophyte mats but low in surface sediments and flooded soils. Sci Total Environ 261: 99- 107.
104 Friki E. G., Koster, H., De Wit W., and Dalberg Advisors. 2018. Healthy rivers healthy people: Addressing the mercury crisis in the Amazon. WWF.
105 Villegas, C., Weinberg, R., Levin, E. and Hund, K. 2012. Artisanal and small-scale mining in protected areas and critical ecosystems programme (ASM-PACE); a global solutions study. Nairobi: WWF and Estelle Levin Limited.
106 2020. Estudo analisa a contaminação por mercúrio entre o povo indígena Munduruku. Available at: https://portal.fiocruz.br/noticia/estudo-analisa-contaminacao-por-mercurio-entre-o-povo-indigena-munduruku
107 RAISG. 2020. Oil and gas blocks in 2020. [Map]. Accessed August 12, 2022. Available at: https://www.raisg.org/pt-br/mapas/
108 WCS-Venticinque. 2016. [Map]. An explicit GIS-based river basin framework for aquatic ecosystem conservation in the Amazon. Retrieved August 12, 2022. Available at: https://knb.ecoinformatics.org/view/doi%3A10.5063%2FF1BG2KX8#snapp_computing.6.1
109 Ebus, B., and Martinelli, T. 2022. Venezuela's Gold Heist: The Symbiotic Relationship between the State, Criminal Networks and Resource Extraction. Bulletin of Latin American Research, 41(1), 105-122.
110 Cartró-Sabaté, M., Mayor, P., Orta-Martínez, M, and Rosell-Melé, A. 2019. Anthropogenic Lead in Amazonian Wildlife - Nature Sustainability. Available at: https://doi.org/10.1038/s41893-019-0338-7.
111 Durango-Cordero, J., Saqalli, M., Laplanche, C. et al. 2018. Spatial Analysis of Accidental Oil Spills Using Heterogeneous Data: A Case Study from the North-Eastern Ecuadorian Amazon. Sustainability 10: 4719.

112 Orta-Martínez, M., Rosell-Melé, A., Castró-Sabaté, M. et al. 2018. First evidences of Amazonian wildlife feeding on petroleum-contaminated soils: A new exposure route to petrogenic compounds? Environ Res 160: 514-7.

113 Souza-Filho, P.W.M., Giannini, T.C., Jaffé, R. et al. 2019. Mapping and quantification of ferruginous outcrop savannas in the Brazilian Amazon: A challenge for biodiversity conservation (W Finsinger, Ed). PLoS One 14: e0211095

114 Dezécache, C., Faure, E., Gond, V. et al. 2017. Gold-rush in a forested El Dorado: deforestation leakages and the need for regional cooperation. Environ Res Lett 12: 034013.

115 Caballero Espejo, J., Messinger, M., Román-Dañobeytia, F. et al. 2018. Deforestation and Forest Degradation Due to Gold Mining in the Peruvian Amazon: A 34-Year Perspective. Remote Sens 10: 1903.

116 Ramos Suárez, E., Muñoz, C., and Pérez, G. 2017. La governanza de los recursos naturales y los conflictos en las industrias extractivas: el caso de Colombia. Santiago: CEPAL, United Nations.

117 Scheffers, B. R., Oliveira, B.F., Lamb, I., and Edwards, D.P. 2019 . Global wildlife trade across the tree of life. Science (80-.). 366, 71–76. Available at: https://doi.org/10.1126/science.aav5327

118 Sinovas, P., Price, B, King, E, Hinsley, A. and Pavitt, A. 2017. Wildlife trade in Amazon countries: an analysis of trade in CITES-listed species. 10.13140/RG.2.2.33501.00482.

119 Ortiz-von Halle, B. 2018. Bird's-eye view: Lessons from 50 years of bird trade regulation & conservation in Amazon countries. Cambridge UK: TRAFFIC.

120 Maldonado Rodríguez, A. M. 2011. Tráfico de monos noctturnos Aotus spp. en la frontera entre Colombia, Perú y Brasil: efectos sobre sus poblaciones silvestres y violación de las regulaciones internacionales de comercio de fauna estipuladas por CITES. Rev. Acad. Colomb. Cienc. 35 (135): 225-242. ISSN 0370-3908

121 Ubaid, F. K., Silveira, L. F., Medolago, C. A., Costa, T. V., Francisco, M. R., Barbosa, K. V., and Junior, A. D. 2018. Taxonomy, natural history, and conservation of the Great-billed Seed-Finch Sporophila maximiliani (Cabanis, 1851) (Thraupidae, Sporophilinae). Zootaxa, 4442(4), 551-571.

122 Daly, N. 2017. Special Report: The Amazon Is the New Frontier for Deadly Wildlife Tourism. National Geographic. Available at: https://www.nationalgeographic.com/photography/proof/2017/10/wildlife-watch-amazon-ecotourism-animal-welfare/.

123 Bodmer, R.E., Eisenberg, J.F. and Redford, K, H. 1997. Hunting and the likelihood of extinction of Amazonian mammals: Caza y Probabilidad de Extinción de Mamiferos Amazónicos. Conserv Biol 11: 460-6.

124 Nuñez-Iturri, G. and Howe, H.F. 2007. Bushmeat and the Fate of Trees with Seeds Dispersed by Large Primates in a Lowland Rain Forest in Western Amazonia. Biotropica, 39: 348-354. Available at: https://doi.org/10.1111/j.1744-7429.2007.00276.x.

125 Arias, M. 2021. The illegal trade in jaguars (Panthera onca). CITES. Available at: https://cities.org/sites/default/files/articles/CITES_Study_on_Illegal_Trade_in_Jaguars%20.pdf

126 World Animal Protection. 2018. Uncovering a secret slaughter: Suriname's jaguar trade exposed. Available at: https://www.worldanimalprotection.ca/reports#slice-1.

127 IUCN NL. 2020. Unveiling the criminal networks behind jaguar trafficking in Bolivia. Amsterdam. Available at: https://www.iucn.nl/app/uploads/201/03/iucn_nl_report_jaguar_trafficking_bolivia_media-1.pdf

128 Isaac, V.J., Ruffino, M., and McGrath, D. 1998. In search of a new approach to fisheries management in the middle Amazon region. Alaska Sea Grant Coll Progr: 1-98

129 Ruffino, M.L., and Isaac, V .J. 1999. Dinâmica populacional do surubim-tigre, Pseudoplatystoma tigrinum (Valenciennes, 1840) no médio Amazonas (Siluriformes, Pimelodidae). Acta Amazonica 29: 463-76.

130 Petrere Junior, M., Barthem, R.B., Córdoba, E.A. and Gómez, B.C. 2004. Review of the large catfish fisheries in the upper Amaon and the stock depletion of piraiba (Brachyplatystom filamentosum Lichtenstein). Rev Fish Biol Fish 14: 403-14.

131 Alonso, J.C. and Pirker, L.E.M. 2005. Dinâmica populacional e estado atual de exploração de Piramutaba e de Dourada. Manaus, AM, Brazil: IBAMA, ProVárzea, pgs. 21-28. Available at: https://bityl.co/4jSQ

132 Córdoba, E.A., León, Á.V.J., Bonilla-Castillo, C.A. et al. 2013. Breeding, growth and exploitation of Brachyplatystoma rousseauxii Castelnau, 1855 in the Caqueta River, Colombia. Neotrop Ichthyol 11: 637-47.

133 Catarino, M.F., Campos, C.P., Garcez, R. and Freitas, C.E. de C. 2014. Population dynamics of Prochilodus nigricans caught in Manacapuru Lake (Amazon Basin, Brazil). Bol do Inst Pesca 40: 589-95.

134 Bonilla-Castillo, C.A., Córdoba, E.A., Gómez, G., and Duponchelle, F. 2018. Population dynamics of Prochilodus nigricans (Characiformes: Prochilodontidae) in the Putumayo River. Neotrop Ichthyol 16: e170139.

135 García-Vásquez, A., Vargas, G., Sánchez, H. et al. 2015. Periodic life history strategy of Psectrogaster rutiloides, Kner 1858, in the Iquitos region, Peruvian Amazon. J Appl Ichthyol 31: 31-9.

136 Fabré, N.N., Castello, L., Isaac, V.J. and Batista, V.S. 2017. Fishing and drought effects on fish assemblages of the central Amazon Basin. Fish Res 188: 157-65.

137 Tregidgo, D.J., Barlow, J., Pompeu, P.S. et al. 2017. Rainforest metropolis casts 1,000-km defaunation shadow. Proc Natl Acad Sci USA 114: 8655-9.

138 Garcia, A., Tello, S., Vargas, G and Duponchelle, F. 2009. Patterns of commercial fish landings in the Loreto region (Peruvian Amazon) between 1984 and 2006. Fish Physiol Biochem 35(1): 53.

139 Franzolin, F., García, P. and Bizzio, N. 2020. Amazonian conservation and students' interest for biodiversity: The need to boost science education in Brazil. Science Advances. 6, 35. DOI: 10.1126/sciadv.abb0110.

140 Brum, S.M., Silva, V.M.F. da, Rossoni, F. and Castello, L. 2015. Use of dolphins and caimans as bait for Calophysus macropterus (Lichtenstein, 1819) (Siluriforme: Pimelodidae) in the Amazon. J Appl Ichthyol 31: 675-80.

141 Correa, S.B., Costa-Pereira, R., Fleming, T. et al. 2015. Neotropical fish-fruit interactions: Eco-evolutionary dynamics and conservation. Biol Rev 90: 1263-78.

142 RAISG. 2016. Cartografía Histórica de Áreas Naturales Protegidas y Territorios Indígenas en la Amazonía. Available at: https://www.amazoniasocioambiental.org/wp-content/uploads/2017/04/cartografia_historica_ANP_TI_06abril.pdf.

143 FAO. 2021. Forest governance by indigenous and tribal peoples: An opportunity for climate action in Latin America and the Caribbean. Santiago, Chile: p.21 (http://www.fao.org/americas/publicaciones-audio-video/forest-gov-by-indigenous/en/).

144 Golden Kroner, R., Qin, S., Cook, C., Krithivasan, R., Pack, S., Bonilla, O., Cort-Kansinally, K., Coutinho, B., Feng, M., Martinez Garcia, M., He, Y., Kennedy, C., Lebreton, C., Ledezma, J., Lovejoy, T., Luther, D., Parmanand, Y., Ruiz, C. Yerena, E. and Mascia, M. 2019. The uncertain future of protected lands and waters. Science. 364. 881-886. 10.1126/science.aau5525.

145 Conservation International and World Wildlife Fund. 2019. PADDDtracker.org Data Release Version 2.0 (May 2019). Arlington, VA: Conservation International. Washington, DC: World Wildlife Fund.

146 Brasil eliminó 11 nuevas áreas protegidas de la Amazonía. El Espectador. 2019. Available at: https://www.elespectador.com/noticias/medio-ambiente/brasil-elimino-11-nuevas-areas-protegidas-de-la-amazonia/.

147 Suárez, C., Prüssmann, J., Lopez, C., Abud, M., Guevara, O., Vergara, A., Zúñiga L.A., Gorricho J. and Naranjo L. G. Vulnerability Analysis of the Amazon Biome and its Protected Areas. WWF Living Amazon Initiative.

148 Warren, R., Price, J., McDougall, A., Cornelius, S., Sohl, H. and Rust, N. 2018. Wildlife in a warming world: the effect of climate change on biodiversity in WWF's Priority Places.
149 Souza, C., Kirchhoff, F., Oliviera, B., Ribeiro, J. y Sales, M. 2019. Long-Term Annual Surface Water Change in the Brazilian Amazon Biome: Potential Links with Deforestation, Infrastructure Development and Climate Change. Water. 11. 566. 10.3390/w11030566.
150 Gonzales, J. 2020. Green alert: How indigenous people are experiencing climate change in the Amazon. Mongabay. Available at: https://news.mongabay.com/2020/05/green-alert-how-indigenous-have-been-experiencing-climate-change-in-the-amazon/#:~:text=Late%20rainfall%2C%20intense%20drought%2C%20dry,transformations%20due%20to%20climate%20change.
151 FAO, T. (2016). State of the World's Forests 2016. Forests and agriculture: land-use challenges and opportunities. Food Agric. Organ. UN Rome, 105-107.
152 Alvim, R., Regina, C., Futemma, T. and Queiroz, H. 2020. Indigenous territories and governance of forest restoration in the Xingu River Land Use Policy Indigenous territories and governance of forest restoration in the Xingu River (Brazil). Land Use Policy:104755.
153 WWF UK, 2022. The Amazon: Action is the Only Option.
154 Butler, Rhett A. 2007. New Park in French Guiana creates largest Amazon protected area in the Amazon. Mongabay. Available at: https://news.mongabay.com/2007/02/new-park-in-french-guiana-creates-largest-amazon-protected-area/
155 Parque Amazónico de Guayana Francesa. Retrieved 01/06/2022. Available at: http://www.parc-amazonien-guyane.fr/
156 WWF-US. 2020. Area-based conservation: The Way Forward for WWF-US.
157 WWF-BR. 2018. Las áreas naturales protegidas son un recurso clave para la economía brasileña. WWF-BR.
158 Burgos R., de la Cruz, R. and Granizo, T. 2014. Construcción de una Estrategia para Manejo Holístico de Territorios de Vida Plena en la Cuenca Amazónica. Una contribución a la reflexión regional sobre la integridad de territorios indígenas amazónicos. Quito: Alianza COICA - WWF/TNC.
159 Utrera, Alberto and García, Miguel A. 2021. Sembrando el futuro. BBVA & El Celler de Can Roca.
160 2020. AIDESEP. Available at: https://www.escuelaegida.com/
161 Panthera, UNDP, WCS, WWF. Jaguar 2030 Conservation Roadmap for the Americas. Available at: https://wwflac.awsassets.panda.org/downloads/jaguar_2030_roadmap.pdf.
162 Gómez García Reyes, C. and Payán Garrido, E. "Iconografías y representaciones del jaguar en Colombia: de la permanencia simbólica a la conservación biológica". Antípoda. Revista de Antropología y Arqueología, n.o 28 (2017): https://doi.org/10.7440/antipoda28.2017.06
163 WWF. 2018. Amazon Freshwater Strategy 2019-2030.
164 Castello, L., McGrath, D.G., Hess, L.L., Coe, M.T., Lefebvre, P.A., Petry, P., Macedo, M.N., Renó, V.F. and Arantes, C.C. (2013), The vulnerability of Amazon freshwater ecosystems. Conservation Letters, 6: 217-229. https://doi.org/10.1111/conl.12008
165 Caldas, B., Thieme, M. et al. Under review. Identifying the current and future status of freshwater connectivity corridors in the Amazon Basin.
166 Almeida, R.M, Shi, Q., Gomes-Selman, J.M., Wu, X., Xue, Y., Angarita, H., Barros, N., Forsberg, B.R., Garcia-Villacorta, R.& Hamilton, S.K. (2019). Reducing greenhouse gas emissions of Amazon hydropower with strategic dam planning. Nature Communications, 4, 1-9.
167 Fortes Westin, F., Santos, M.A.Ed. and Duran Martins, I. (2014). Hydropower expansion and analysis of the use of strategic and integrated environmental assessment tools in Brazil. Renewable and Sustainable Energy Reviews 37, 750-761.
168 McCraine, S., Anderson, C., Weber, C., Shaw, M. R. (2019). The Nature of Risk: A framework for understanding nature-related risk to business. WWF.
169 Graham Watkins, Sven-Uwe Mueller, Maria Cecilia Ramirez, Hendrik Meller, Ioannis Blatsos, Julia Carvalho Fernandes de Oliveira, Cristina Contreras Casado, Andreas Georgoulias, Nikos Georgoulias, Judith Rodriguez (2017). Lessons from four decades of infrastructure project related conflicts in Latin America and the Caribbean.
170 WWF. 2022. Free Flowing Rivers in the Amazon Policy Brief; internal WWF document.
171 Moir, K., M. Thieme, and J. Opperman (2016). Securing A Future that Flows: Case Studies of Protection Mechanisms for Rivers. World Wildlife Fund and The Nature Conservancy. Washington, DC.
172 Campos-Silva J & Peres, C. Community-based management induces rapid recovery of a high-value tropical freshwater fishery. Science Reports 6, 34745. https:// doi.org/10.1038/srep34745.
173 IPBES (2022): Summary for policymakers of the thematic assessment of the sustainable use of wild species of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. J.-M. Fromentin, M.R. Emery, J. Donaldson, M.-C. Danner, A. Hallosserie, D. Kieling, G. Balachander, E.S. Barron, R.P. Chaudhary, M. Gasalla, M. Halmy, C. Hicks, M.S. Park, B. Parlee, J. Rice, T. Ticktin and D. Tittensor (eds.). IPBES Secretariat, Bonn, Germany. 33 pages. https://doi.org/10.5281/zenodo.6425599
174 Iniciativa de Delfines de Río de Sudamérica (SARDI).2022. Políticas y acciones de conservación de los delfines de río en América del Sur: Avances y desafíos en la implementación de acciones nacionales y transfronterizas. Available at: https://wwf.panda.org/es/?5274866/politicasconservaciondelfines
175 El Delfín Rosado del Amazonas. Ministerio de Turismo de Perú. 2021. Available at: https://peru.info/es-pe/turismo/noticias/3/18/el delfin-rosado-del-amazonas#:~:text=El%20delf%C3%ADn%20rosado%20es%20una,ahogadas%2C%20llev%C3%A1ndolas%20a%20la%20orilla
176 Ezzine-de-Blas, D., Wunder, S., Ruiz-Pérez, M., and Moreno-Sanchez, R. del P. 2016. Global Patterns in the Implementation of Payments for Environmental Services (A García-Gallego, Ed). PLoS One 11: e0149847.
177 Guedes, G., Costa, S., & Brondízio, E. (2009). Revisiting the hierarchy of urban areas in the Brazilian Amazon: a multilevel approach. Population and environment, 30(4), 159-192.
178 Anderson, M; Barreto, L. 2021. Inclusive Conservation Guiding Principles: Leaving no one behind. Amazon Frontlines and WWF.
179 Trujillo, F., Crespo, E., Van Damme, P. and Usma, J. S. (eds.). 2011. Plan de Acción para la Concervación de los Delfines de Río en Sudamérica. Resumen ejecutivo y avances 2010 – 2020. Bogotá: WWF, Omacha Foundation, WDS, WDCS and Solamac.
180 South American River Dolphins. 2018. First Ever Tagging of Amazon Dolphins to Boost Conservation Efforts. Available at: http://river-dolphins.com/2018/03/05/first-ever-tagging-of-amazon-dolphins-to-boost-conservation-efforts/.
181 WWF (2020). WWF Jaguar Strategy 2020-2030.
182 RAISG 2020. Amazonia Under Pressure. Amazon Network of Georeferenced Socio-environmental Information.
183 Gagen, M. et al. 2022. Risking the Amazon: why we need immediate action to reduce abrupt change risk. WWF United Kingdom Technical Note.
184 Goldenberg, D., Franchi, T., Ludwig, F., Barreto, L., Tinoco, A., Neves, A., Cabrera, M., Condori, E., Gachet, B., García, V., Hausil, F., Kelle, L., Oliveira, M., Villien, C., Yunda, R., y Williams, A. Gold mining in Amazon: an integrated overview (2022)- Documento interno de WWF. WWF-Brazil, São Paulo. Pp.25.

185 Brienen, R., Phillips, O., Feldpausch, T., et al. 2015. Long-term decline of the Amazon carbon sink. Nature 519, 344–348.
186 Gatti, L.V., Basso, L.S., Miller, J.B., et al. 2021. Amazonia as a carbon source linked to deforestation and climate change. Nature 595, 388–393.
187 Walker, Wayne S., et al. 2020. "The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas". Proceedings of the National Academy of Sciences 117.6: 3015-3025.
188 MapBiomas Project - Collection 6 of the Annual Land Use Land Cover Maps of Brazil. 2021. Disponible en: https://mapbiomas.org/en/colecoes-mapbiomas-1?cama_set_language=en

REFERENCES TO CHAPTERS OF THE SCIENCE PANEL FOR THE AMAZON: ASSESSMENT REPORT

[Res. 1] Nobre, C., Encalada, A., Anderson, E. et al. 2021. Executive Summary. In Science Panel for the Amazon. Amazon Assessment Report 2021. United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 2] Guayasamín, J., Ribas, C., Carnaval, A. et al. 2021. Evolution of Amazonian Biodiversity. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 2). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 3] Zapata-Ríos G., Andreazzi C., Carnaval A. et al. 2021. Biological diversity and ecological networks in the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 3). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 5] Costa, M., Borma, L, Espinoza, J. et al. 2021. The Physical Hydroclimate System of the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 5). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 6] Malhi Y, Melack J, Gatti LV et al. 2021. Biogeochemical cycles in the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 6). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 7] Costa M., Borma L., Brando PM. et al. 2021. Biogeophysical Cycles: Water Recycling, Climate Regulation. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 7). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 10] Athayde, S., Shepard, G., Cardoso, T. et al. 2021. Critical Interconnections between Cultural and Biological Diversity of Amazonian Peoples and Ecosystems. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 10). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 14] Hecht, S., Schmink, M., Abers, R. et al. 2021. The Amazon in Motion: Changing Politics, Development Strategies, Peoples, Landscapes, and Livelihoods. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 14). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 15] De Assis Costa, F., Schmink, M., Hecht, S. et al. 2021. Complex, Diverse and Changing Agribusiness and Livelihood Systems in the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 15). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 16] Josse C., Futada S., von Hildebrand M. et al. 2021. The state of conservation policies, protected areas, and Indigenous territories, from the past to the present. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 16). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 17] Larrea, C., Murmis, M., Azevedo, T. et al. 2021. Globalization, Extractivism and Social Exclusion: Threats and Opportunities to Amazon Governance in Brazil. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 17). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 19] Berenguer, E., Armenteras, D., Alencar, A. et al. 2021. Drivers and Ecological Impacts of Deforestation and Forest Degradation. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 19). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 20] Berenguer, E., Armenteras, D., Alencar, A. et al. 2021. Drivers and Impacts of Changes in Aquatic Ecosystems. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 20). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 22] Marengo, J., Espinoza, J., Fu, R. et al. 2021. Long-term Variability, Extremes and Changes in Temperature and Hydro Meteorology in the Amazon Region. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 22). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 23] Artaxo, P., Almeida-Val, V., Bilbao, B. et al. 2021. Impacts of deforestation and climate change on biodiversity, ecological processes, and environmental adaptation. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 23). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 24] Hirota, M., Flores, B., Betts, R. et al. 2021. Resilience of the Amazon Forest to Global Changes: Assessing the Risk of Tipping Points. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 24). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 25] Alencar, A., Painter, L., Athayde, S. et al. 2021. A Pan-Amazonian Sustainable Development Vision. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 25). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 26] Painter, L., Alencar, A., Bennett, A. et al. 2021. Sustainable Development Goals (SDGS) and the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 26). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 27] Barlow J, Lees AL, Sist P. et al. 2021. Conservation measures to counter the main threats to Amazonian biodiversity. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 27). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 28] Barlow, J., Sist, P., Almeida, R. et al. 2021. Restoration Options for the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 28). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 29] Barlow, J., Sist. P., Almeida, R. et al. 2021. Restoration Priorities and Benefits within Landscapes and Catchments and Across the Amazon Basin. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 29). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 30] Abramovay, R., Ferreira, J., Costa, F. et al. 2021. The New Bioeconomy in the Amazon: Opportunities and Challenges for a Healthy Standing Forest and Flowing Rivers. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 30). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 31] Filho, H., Ramos, A., Barra, C. et al. 2021. Strengthening Governance and Management of Lands and Natural Resources: Protected Areas, Indigenous Lands, and Local Communities´ Territories. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 31). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 33] Varese M., Rodríguez Garavito C., Piland N. et al. 2021. Connecting and sharing diverse knowledge systems to support sustainable pathways in the Amazon. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 33). United Nations Sustainable Development Solutions Network, New York, USA.

[Cap. 34] Lapola D., Páez B., Costa S. et al. 2021. Boosting relations between the Amazon forest and its globalizing cities. In Science Panel for the Amazon. Amazon Assessment Report 2021 (Cap. 34). United Nations Sustainable Development Solutions Network, New York, USA.

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