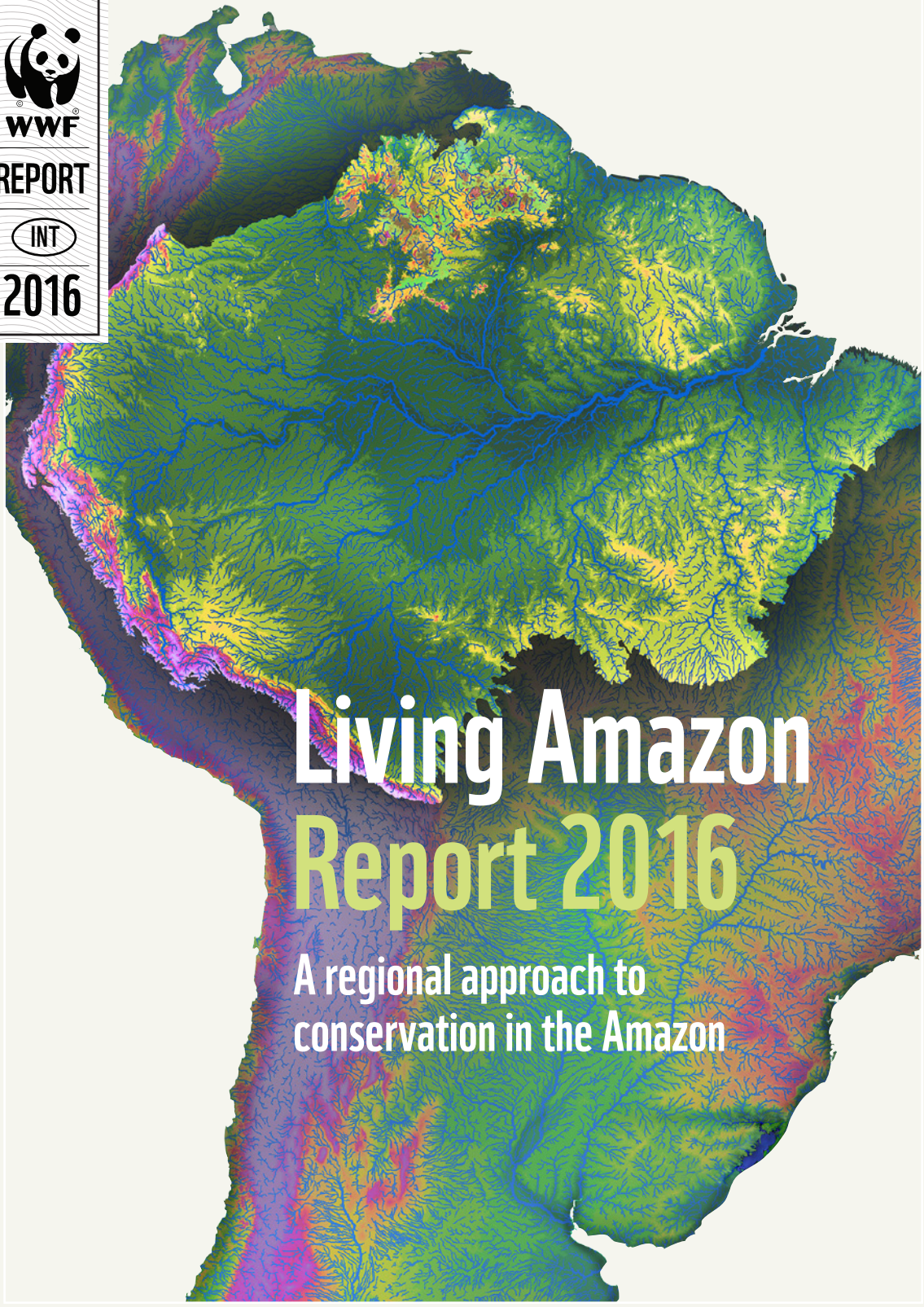
WWF

REPORT

INT

2016



Living Amazon Report 2016

A regional approach to conservation in the Amazon

Report prepared by WWF Living Amazon Initiative.

Published in June 2016 by WWF – World Wide Fund For Nature (Formerly World Wildlife Fund), Gland, Switzerland.

Suggested citation
Charity, S., Dudley, N., Oliveira, D. and S. Stolton (editors). 2016. *Living Amazon Report 2016: A regional approach to conservation in the Amazon*. WWF Living Amazon Initiative, Brasília and Quito.

ISBN: 978-2-940529-37-7

Front cover: Cover image created by Johanna Prüssmann based on Jesse Allen's work, using SRTM data provided courtesy of the US Geological Survey and the University of Maryland's Global Land Cover Facility, and river data provided courtesy of the World Wildlife Fund HydroSHEDS Project. WWF Hydrosheds: Lehner B, Verdin K & Jarvis A. 2008. New Global Hydrography Derived from Spaceborne Elevation Data. Eos, *Transactions, AGU*, 89(10): 93-94. SRTM Digital Elevation Model: USGS. 2006. Shuttle Radar Topography Mission 30 arc second South America mosaic, Unfilled Unfinished 2.0, Global Land Cover Facility, University of Maryland, College Park, Maryland. Amazon Biome delimitation: Olson DM & Dinerstein E. 1998. The Global 200: A Representation Approach to Conserving the Earth's Most Biologically Valuable Ecoregions. *Conservation Biology*, 12: 502–15.
Design: millerdesign.co.uk

For more information please contact: Tarsicio Granizo, Amazon Regional Coordinator, WWF Latin America & Caribbean Programme (LAC), Quito
tarsicio.granizo@wwf.org.ec

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

Living Amazon Report 2016

A regional approach to conservation in the Amazon

Acknowledgements

This report draws on WWF's Regional Amazon work over the last eight years. As such, we have drawn on the work of many people and had meetings and input from across the WWF Network in the Amazon and beyond.

Overall we would like to thank: Cecilia Alvarez (WWF Peru); Andre Dias (WWF Living Amazon Initiative); Mariana Ferreira (WWF Brazil); Julio Mario Fernández (WWF LAC); Damian Fleming (WWF UK); Laurens Gomes (WWF Guianas); Tarsicio Granizo (WWF Living Amazon Initiative); Mary Lou Higgins (WWF Colombia); Sarah Hutchison (WWF UK); Yolanda Kakabadse (WWF International); Karen Lawrence (WWF UK); Patricia León Melgar (WWF Peru); Andrea Marandino (WWF UK); Luis Germán Naranjo (WWF Colombia); Jorge Rivas (WWF Ecuador); Jordi Surkin (WWF Bolivia); Meg Symington (WWF US); Roberto Troya (WWF LAC); Annemarie Winkelhagen (WWF Netherlands); Julia Young (WWF UK); Natascha Zwaal (WWF Netherlands). Many thanks to Mark Wright (UNEP WCMC) who developed the initial concept behind this report and carried out much of the initial research and Johanna Prüssmann (WWF Colombia), Alessandra Mansur and Mariana Soares (both from WWF Brazil) for help with many maps in the report. Also thanks to Caroline Snow for proofreading the document.

Specific thanks also go to the following people who authored material for the sections of the report:

Section 3 – The Amazon: Cláudio Maretti, former leader of the WWF Living Amazon Initiative Regional and Vice Chair for South America at IUCN World Commission on Protected Areas (WCPA); **Biodiversity and heterogeneity**: Diego Amorocho (WWF Colombia); João Valsecchi do Amaral and Miriam Marmontel (both from Mamirauá Civil Society, Brazil); **Importance of the Amazon on the marine environment**: Karin Bilo (formerly WWF Guianas); **Economics and socio-political trends**: Tarsicio Granizo (WWF Living Amazon Initiative); **Amazon Protection: Status and trends**: Edward Lewis and Diego Juffe-Bignoli (Protected Areas Programme United Nations Environment Programme-World Conservation Monitoring Centre); Mariana Napolitano Ferreira (WWF Brazil); **ARPA: Developing protected area systems**: Andréa Leme da Silva (WWF Brazil).

Section 4 – Values of the Amazon: Brazil nuts and other non-timber forest products: Jordi Surkin and José Argandoña (WWF Bolivia).

Section 5 – Pressures on the Amazon: Large-scale monoculture and cattle ranching: Edegar Rosa and Mário Barroso (WWF Brazil) and Luis Germán Naranjo (WWF Colombia); **Transport infrastructure**: Jamie Gordon (WWF UK); **Extractive industries**: Susanne Schmitt (WWF UK), Mário Barroso (WWF Brazil), Mariana Soares (WWF Brazil), Paula Hanna Valdujo (WWF Brazil), Pablo Izquierdo WWF Norway (WWF SIGHT), César Suárez Pacheco (WWF Colombia), Johanna Prüssmann (WWF Colombia), Cecilia Alvarez (WWF Peru), Nelson Gutierrez (WWF Peru) and Karen Lawrence (WWF UK); **Gold mining**: Aiesha Williams (WWF Guianas); **Amazon headwaters – Andean slopes**: Brenda Toledo, Cecilia Alvarez and Claudia Véaliz (WWF Peru).

Section 6 – Guiana Shield: Laurens Gomes, Karin Bilo, Michael Hiwat and Sophie Ruysschaert (WWF Guianas); **Securing water connectivity and integrity**: Damian Fleming (WWF UK); **REDPARQUES – Together against climate change**: Julia Gorricho (WWF Living Amazon Initiative), Analiz Vergara (WWF Living Amazon Initiative); **The role of global instruments**: Flavia Loures (researcher at China International Water Law (CIWL), Xiamen University, China); **Holistic management of indigenous territories and REDD+**: Ricardo Burgos (WWF Living Amazon Initiative); **Environmental Services incentives system in Acre, Brazil**: Sarah Hutchison (WWK UK) and Ricardo Mello (WWF Brazil).

CONTENTS

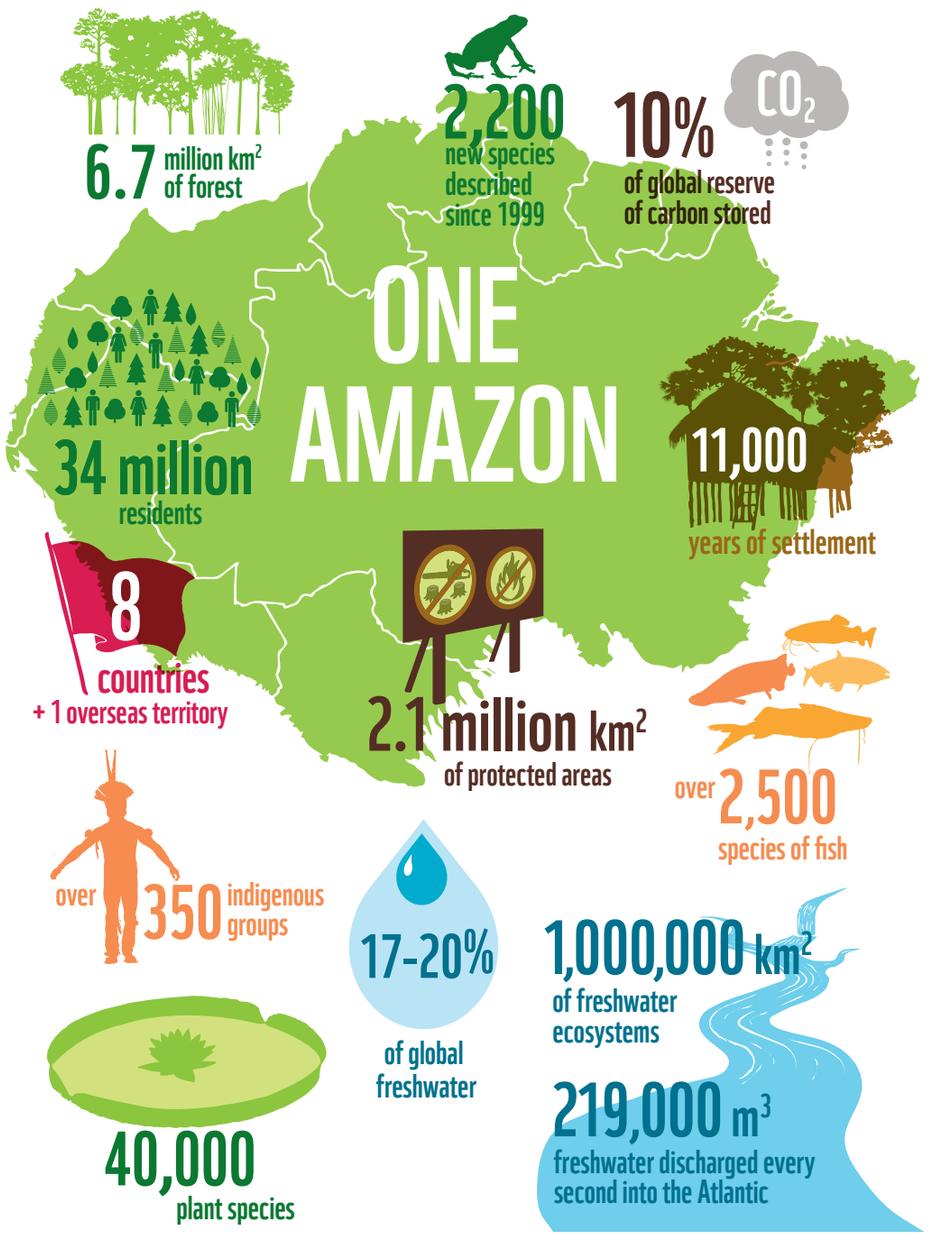
All the titles below are hyperlinks – click on them to navigate the document.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

1 A VISION FOR THE AMAZON

WWF's vision for the Amazon region is to ensure an ecologically healthy Amazon biome that maintains its environmental and cultural contributions to 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, summarizes key pressures and agents of change and outlines a conservation strategy for the next decade, to help realise this vision.

Photo: Kaieteur Falls Rainforest, Guyana © Staffan Widstrand / WWF



FOREWORD

Everyone knows the Amazon is unique: unique in scale, in its diversity of wild nature and human societies, and in the cultural significance it holds in the global consciousness.

Over the last few years, we have learned how important the Amazon is for human well-being, in helping to stabilize the world's climate and hydrological cycle and providing ecosystem services that underpin the region's food, water and energy security. The word "irreplaceable" is over-used but fully justified here.

We have, unfortunately, also gotten used to hearing bad things about the Amazon; images of burning forests tend to shock and dismay. But the reports are not all depressing. There have certainly been serious losses, and for instance, increased threats from mining and oil exploration. But most of the Amazon remains in good ecological condition. Governments have made inspirational commitments to protected areas and sustainable development. They are aware of the region's globally important ecosystem services. Indigenous territories have been recognized in many areas. The mosaic of land and water uses contains much that is good. This is definitely no time to despair.

WWF has been an important force for positive change in the Amazon, and has pioneered integrated, biome-wide and cross-border conservation. This publication provides a status report and an overview of key trends. It outlines lessons learned from WWF's regional Amazon work in recent years, and makes recommendations about critical next steps in Amazon conservation. I urge you to read on for a snapshot of the good news and some of the bad news from one of the world's most extraordinary places and to join WWF in working for a sustainable future for the Amazon.

Yolanda Kakabadse
President
WWF International

1.1 Executive summary

The report outlines the current status of the Amazon, summarizes some key pressures and agents of change and outlines a conservation strategy for the next decade. It has been produced by WWF, both to help drive its own work in the region and also to input into the thinking of other stakeholders interested in the Amazon.

The Amazon is the world's largest rainforest and river system, containing a tenth of the world's species; over 2,000 new species of plants and vertebrates have been described since 1999. Water vapour released from the forest creates vast "flying rivers" in the atmosphere influencing rainfall in central and southern South America, and the carbon stored in vegetation and soils is of global importance in slowing climate change. The Amazon is home to 34 million people including over 350 indigenous groups, some living in voluntary isolation. Although 17 per cent of the forest has been destroyed, large areas remain in good condition. Protected areas and indigenous territories already cover around half of the Amazon, in part due to the Brazilian Amazon Region Protected Areas programme, now being replicated in Peru. The values of the Amazon biome, and the practical and ethical reasons for its conservation and sustainable management, are becoming clearer.

However, the Amazon is also undergoing rapid change; some developments are threatening the integrity of the ecosystem, its constituent species and the astonishing array of local and global goods and services that it provides, undermining its ability to stabilize and regulate regional and global climate patterns. At present the greatest agents of change are agriculture and ranching, both large and small scale, although tighter controls and initiatives like the Brazilian Soy Moratorium are starting to reduce the rate of deforestation. A series of over 250 proposed dam-building projects risks severe alteration to the hydrology of the whole biome and catastrophic impacts on the unique migratory fish species of the Amazon basin. Over 20 giant road-building projects are pushing through dense forests and all prior experience suggests that this will lead to a rapid increase in forest loss. New research by WWF quantifies the dramatic increase in mining and fossil fuel extraction in the biome, with over 800 mining and oil and gas claims already granted in protected areas and another 6,800 under consideration. Although most of these will probably not lead to active exploitation, they show a cavalier disregard for conservation policies in Amazon countries. WWF has also extended its analysis of forest loss and identified 31 "deforestation fronts", which are eating away at the forest from all sides and robbing countries of the immense opportunities offered by more sustainable development pathways in the region. Finally, the financial drivers of unsustainable use are identified, along with discussion about how other parts of the world are impacting on the biome.

6.7
MILLION KM² OF FOREST

17-20%
OF GLOBAL FRESHWATER

1,000,000KM²
OF FRESHWATER ECOSYSTEMS

CO_2
10%
OF GLOBAL RESERVE OF CARBON STORED

WWF has agreed a new global conservation strategy for 2025 to help ensure a viable and sustainable planet, with clearly defined global goals and approaches to tackle the drivers of biodiversity loss. For the Amazon biome, this means ensuring that development is sustainable, equitable and gives proper weighting to the value of the terrestrial and aquatic ecosystems. Core efforts focus on the maintenance of healthy forests and connected freshwater ecosystems, along with enhanced climate resilience. Work will be supported by a range of tools and approaches developed by WWF and partners, within the policy frameworks of a series of global, regional and national initiatives.

Within its overall vision for the Amazon, WWF has identified seven priorities for its own work at the biome level over the next 10 years (in addition to and complementary to WWF's national agendas):

1. **Protected areas, indigenous territories and climate:** maintain at least 50 per cent coverage of the biome as protected areas and indigenous territories, achieve effective management and integration of national protected area systems and indigenous territories and secure forest set aside under climate and biodiversity financial mechanisms
2. **Green economy in Amazon sustainable landscapes:** apply a robust "sustainable landscapes and green economy" approach to reduce deforestation and forest degradation, mitigate high impacting linear infrastructure and promote sustainable use of forests outside protected areas
3. **Safeguards and finance:** implement robust regionally-relevant safeguards in development initiatives of key sectors and stimulate the development of green investment products and opportunities, leading to more sustainable finance and investment in the Amazon
4. **Sustainable hydropower and waterway planning processes** in key sub-basins based on a basin-wide vision for the Amazon that maintains connectivity of Amazon rivers and freshwater ecosystems
5. **Protection of freshwater ecosystems:** promote a regional Amazon strategy for increased ecological representation and protection of freshwater ecosystems, and improved transboundary river basin management and governance
6. **Energy mix in Amazon countries:** initiate a more balanced debate on hydropower in the Amazon along with greater uptake of alternative/non-conventional renewable energy sources
7. **Climate resilience in the Amazon basin:** identify and implement key biome-level actions for increasing Amazon ecosystem resilience and promote a stronger recognition of the importance of the Amazon biome for global climate change resilience.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

2 INTRODUCTION

This report looks forward to the sustainable future of the Amazon. It is full of facts and figures; some encouraging, some disheartening. But there is clearly hope of a more sustainable and socially beneficial Amazon, as exemplified by this picture of Lake Ayapuá, part of the 800km² Piagaçu-Purus Sustainable Development Reserve in Amazonas state, Brazil. The seasonally flooded forests of Piagaçu-Purus have been a sustainable development reserve since 2003. Within it, 55 traditional communities and conservationists collaborate to balance biodiversity conservation with sustainable livelihoods. The main transport is the Purus River, which originates in the Peruvian Andes and flows through more than 3,000km of rainforest before joining the Amazon mainstem.[1] Brazil nuts, açaí berries, fish and wood are the main source of food and economic gain. A community association provides funding for emergencies and the village electricity generator.[2] Co-management and community based monitoring,[3] helped by the Piagaçu Institute established specifically to understand the biodiversity of the reserve to provide the scientific evidence needed for sustainable management,[4] have all demonstrated how enhancing local livelihoods can also benefit the conservation of species like river dolphins,[5] caiman[6] and tapir.[7]

Photo: Ayapua community, Purus River, Amazonas State, Brazil © naturepl.com / Luiz Claudio Marigo / WWF

2.1 The Amazon biome

Mention the Amazon, and our first thought is of the mass of forest and water that circles the top of South America. But on maps the Amazon can have many different boundaries and borders. In this report, we are primarily considering the "ecological" Amazon; the 6.7 million km² Amazon biome represented in the map below.[8] In addition, the map shows the Amazon basin, the world's largest river basin, extending beyond the southern boundaries of the biome, but excluding much of the Guiana Shield in the north.

Eight countries and one overseas territory share responsibility for the Amazon: Brazil (59.17 per cent of the biome), Peru (11.27 per cent), Colombia (7.94 per cent), Venezuela (6.69 per cent), Bolivia (5.99 per cent), Guyana (3.51 per cent), Suriname (2.35 per cent), Ecuador (1.75 per cent) and French Guiana (1.33 per cent). Although by far the greatest area of Amazon lies within Brazil, for other countries the Amazon makes up the majority of their landmass. For instance, over 99 per cent of Guyana and 97 per cent of French Guiana and Suriname lie within the Amazon biome. Nearly 62 per cent of Peru is within the biome with the remaining countries all having a little under half their territory in the Amazon (Bolivia has about 41, Brazil 49, Colombia 42, Ecuador 46 and Venezuela 42 per cent).[9]

Figure 1: Boundaries of the Amazon Region[10]
Basemap source: Esri, DigitalGlobe, Geoeye, Earthstar, Geographics, CNES/Airbus DS, USDA, AEX, Getmapping, Aerogrid, IGN, IGP, awisstopo and the GIS User Community Esri, HERE, DeLorme, MapmyIndia, ©OpenStreetMap contributors and GIS User Community

Key

- Amazon basin
- Amazon biome
- Amazon extended (includes Brazil's geopolitical Amazon boundary, the "Legal Amazon")

2.2 Introduction and purpose of publication

COUNTRIES +1 OVERSEAS TERRITORY

Because nearly 60 per cent of the Amazon is in Brazil, there is a tendency for the rest of the world to assume that the Amazon equals Brazil. But an area of Amazon rainforest the size of Greenland, or four times the size of Spain, is shared by seven other countries and one overseas territory, each having its own relationship with the Amazon biome. In addition, whilst Brazil holds the vast low-lying Amazon floodplains, the crucially important Amazon headwaters are located in the Andean-Amazon countries (Bolivia, Peru, Ecuador and Colombia). While Brazil is dominant in terms of area, paradoxically most Brazilian people never see the Amazon and on a day-to-day level it is as remote to them as it is to people living in much more distant parts of the world. Other countries contain far less of the total but the Amazon covers a larger proportion of their territory and they consequently have a much more intimate relationship with the forest itself, to an extreme in countries like Guyana and Suriname where the Amazon stretches almost to the shore and people are intensely aware of its importance in their lives. For the Andean-Amazon countries, the interaction between the mountains and forests dominates weather and biodiversity patterns, affecting agriculture and livelihoods. For the three Guianas and Brazil's northernmost state, Amapá, the huge outflow of mud and water from the river to the sea creates a unique coastline.

This publication has three main aims:

1. To provide a snapshot of the **state of the Amazon** at the present time (2016), drawing on research and experience from the Living Amazon Initiative (LAI), WWF network and partners to describe the status of the various ecosystems, key pressures, and opportunities for conservation and sustainable development.

2. To describe the **main trends in Amazon conservation** over the last decade: what has improved and what has got worse; innovative solutions and emerging pressures.

3. To summarize some of the experience gained in regional Amazon conservation work and make **recommendations for conservation and sustainable development actions** over the coming decade, both for WWF and also looking more broadly at what action is needed at the biome-scale from other regional and global actors.

The target audience includes a wide range of stakeholders that need to be involved in strategies for the conservation and sustainable use of the Amazon. Governments at all levels are critical partners, along with indigenous organizations operating from regional to community level; civil society groups and NGOs; bilateral and multilateral agencies, banks and other investors; the local and global corporate sector, businesses and productive sector organizations; academics and researchers; and key regional organizations.

Amongst the mass of lessons emerging from years of developing and implementing a biome-level conservation strategy for the world's largest forest and river system, two overall messages emerge:

1. An integrated, Amazon-wide conservation strategy needs to be developed for the next decade: the functions of the biome are too closely inter-related, and the challenges facing the Amazon are too large, for a set of independent, national conservation strategies to succeed in ensuring the long-term future of the Amazon biome on their own. There is a clear need for a ***regional, biome-wide conservation strategy for the Amazon*** that takes into account national and regional development plans and the consumption footprint. Indeed the strategy needs to include many countries far removed from the biome itself, that have either a positive or negative impact on the biome, such as those whose investment and consumption footprint adversely impacts the Amazon, or those who may be playing an active role in promoting or funding Amazon conservation. A robust, Amazon-wide conservation strategy needs to take account of the differences between the countries that share the biome. The nine countries of the Amazon differ profoundly: historically, ethnically, culturally, politically, economically and linguistically. These differences translate into diverse opportunities for conservation and sustainable development, and in many cases also variations in the type and immediacy of pressures on their portion of the Amazon. While a whole-Amazon approach is essential, individual countries need the space to develop their own responses to particular local political realities, opportunities and threats, but guided by a biome-level perspective. At this level, it is important to act together to identify biome-wide priorities for action and also ensure that actions in one country do not undermine efforts in another. For example, successfully curbing deforestation in one country could potentially shift the deforestation frontier to a neighbouring country; or a series of hydropower dams on a major tributary within an Andean-Amazon country could have irreversible negative impacts on hydrological flows in a downstream neighbouring country. Any effective Amazon strategy will therefore have elements of analysis that cross

A BOTTOM-UP APPROACH IS NEEDED, WHICH EMERGES FROM A BROAD SOCIAL DIALOGUE WITH A CROSS-SECTION OF SOCIETY

borders and require strong international cooperation (e.g., biome-level integration of national protected area systems for climate resilience), and elements that address particular priorities in one or more countries that will be less significant elsewhere (e.g., focus actions for sustainable hydropower development on river basins identified as having high hydropower potential such as Amazon tributaries in Brazil, Bolivia and Peru). Such strategies also need to be flexible, reacting to emerging opportunities (e.g., regional-level finance), fresh pressures (e.g., oil palm) and new information (e.g., impacts of climate change on the Amazon) as they emerge.

2. A coordinated approach: a multi-country strategy suggests the need for coordination and integration, but the type and nature of this coordination are critical to its accomplishment. Simplistic, top-down interventions representing the interests of only a few segments of Amazon societies will have very limited success. Instead, a bottom-up approach is needed, which emerges from a broad social dialogue with a cross-section of society, involving all Amazon countries and also representatives from countries outside the region whose ecological footprint on the biome needs to be removed or mitigated. It is becoming increasingly obvious that interventions in the Amazon must be comprehensive, that is, addressing both conservation needs as well as those related to the economic and social development. Key partners need to be identified and engaged, ensuring that once a strategy has been agreed collectively, it needs to be applied through well-coordinated inter-institutional and inter-governmental mechanisms.
Getting the balance between collective strategies and individual initiatives is never easy and perhaps particularly difficult in a vast, dispersed region with multiple languages and cultures.

The aim is not to stop development, but to argue realistically for development pathways that do not undermine the unique contribution of the Amazon to national, regional and global cultures, economies, climate, water supply and biodiversity. WWF remains committed to seeking an integrated and coordinated solution to the challenge of sustainable development in the Amazon.

THERE IS A CLEAR NEED FOR A REGIONAL, BIOME-WIDE CONSERVATION STRATEGY FOR THE AMAZON

2.3 WWF's Regional Amazon approach

Effective conservation strategies are necessarily collaborative. The WWF Living Amazon Initiative (LAI) – a time-limited intervention – was a key step in developing a regional approach to the Amazon. It stressed a biome-level view, as a complementary strategy to national level action in Amazon countries. After developing a vision for the Amazon biome in 2009 and initial implementation (2009-2012) of a comprehensive 12-year strategic plan (2009-2020),[11] in 2013 the LAI produced a 3-year focused strategic plan (2014-2016),[12] which has been implemented through the application of science-based tools and practical conservation action. The over-arching goals defined in 2009 for the 12-year strategic plan remain pressingly relevant.

This report has been produced in collaboration with WWF offices in the Amazon region and with other parts of the WWF network. The LAI is being wound up as a stand-alone initiative in June 2016, the future delivery of its regional elements to be led by the WWF offices of the Amazon region, and its regional coordination role passing to WWF's regional office in Quito. This provides an opportunity to distil some lessons learned through several years working at a regional level in the Amazon so that they can continue to be applied in biome-level work by WWF and others going forward.

The Amazon-wide perspective of the LAI brought a new angle to WWF's Amazon work and coordination amongst offices inside and outside the region. New stakeholders were engaged, ranging from the Catholic Church to financial institutions, government bodies and influential individuals. New tools for biome-wide analysis were developed and research identified threats and opportunities more thoroughly than ever before. A more holistic, region-wide perspective developed within individuals engaged in Amazon conservation work. In its final 3-year phase, the LAI focused on three main topics:

Protected areas: the LAI worked with partners to push for the integration of protected areas and indigenous territories with regional and national development plans (e.g., climate plans, regional energy sector plans). It promoted Amazon conservation to global audiences, in the Convention on Biological Diversity (CBD) and United Nations Framework Convention on Climate Change (UNFCCC), and to regional audiences through the REDPARQUES Protected Areas and Climate Change Declaration. New data on threats were assembled and biome-wide gap analyses identified protection needs at a regional scale. Indigenous peoples' organizations were supported across the region in bringing their concerns to international attention.

Freshwater: a focus on hydropower resulted in detailed information on freshwater conservation priorities and river basin visions for three key basins. A greater awareness emerged on the need for better international engagement for freshwater ecosystem protection and transboundary river basin management, through instruments such as Ramsar and the UN Watercourses Convention, and with regional bodies such as Amazon Cooperation Treaty Organization (ACTO), Latin-American Energy Organization (OLADE) and Union of South American Nations (UNASUR), and other regional and national actors. New planning, assessment and decision support tools were designed, adapted to different national contexts and applied.

Forests: detailed research has identified critical threats in 31 deforestation fronts, from large-scale agriculture, linear infrastructure, mining, oil and gas and to a lesser extent from other pressures. Analysis of financial flows to the most significant economic sectors in the region has focused on the most important financial institutions involved in funding land use change that leads to deforestation. New information on ecosystem services was used to provide transboundary ecosystem planning in the Acre river basin.

Other initiatives: include a regional analysis of climate vulnerability, of relevance to all three topics, engagement with multiple new actors and a focus on the expanding knowledge of biodiversity in the region.

A range of lessons emerge:

- There is near universal recognition within the Amazon biome that effective conservation needs to include a regional approach and must not simply be a set of unconnected national conservation initiatives.
- At the same time, there is a strong feeling that coordination needs to be centred within the region itself.
- Cooperation was reflected in many ways, in strategy design and development, design and application of tools, and in transboundary project delivery.
- Conservation objectives for transformational change at the biome level pose significant challenges to multi-stakeholder engagement and a paradigm shift for Amazon sustainable development.
- Developing biome-wide science perspectives is very different, and more time consuming, than simply assembling a set of national-level perspectives.
- Science needs a much higher priority in future initiatives and needs to be made explicit in future biome-level strategic planning.
- WWF country-level organizations have national priorities that sit alongside a regional focus; mining for example, or developing markets in non-timber forest products, and so long as these do not undermine regional efforts they remain as nationally-relevant priorities.
- Communicating regional successes, tools, research and projects is critical to building better understanding of and longer-term support for biome-wide approaches amongst stakeholders, including broader civil society.
- Better coordination with partners; other NGOs and non-traditional partners like companies, religious bodies, banks, energy and agriculture ministries and treasury bodies, is essential to success.
- The changes we are seeking need time and perseverance; it is important that once agreed, strategies are followed through and not changed according to short-term considerations, funding preferences or fashion.
- Challenges of working regionally should not be under-estimated; different languages, political structures, cultures and histories exist, but not enough to make cooperation either impossible or undesirable.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

3 THE AMAZON: A SHARED RESPONSIBILITY

The Amazon breaks many records: the world's largest rainforest, the river discharging the most water into the ocean, the most indigenous peoples' groups, many still isolated.[13] A tenth of all species occur here, the world's greatest concentration of biodiversity, including the highest diversity of freshwater fish (about five times those found in Europe[14]) and longest freshwater fish migration.[15] Forests and soils store a tenth of the world's carbon biomass.[16] Billions of tonnes of water vapour released from the forest create "flying rivers" that nurture agriculture elsewhere in the continent. There are 34 million people[17] and cities like Manaus and Iquitos are fast growing urban centres. One of the most extensive protected area systems in the world, the Amazon contains a diverse array of protected area categories, including the extractive reserves originally developed there and now used globally. But for those of us who care for its future, the Amazon is more than dry statistics. It is an area where rivers are so large that the opposite shore is lost to view; where forests stretch over areas that would swallow a dozen European countries. Countless species remain unknown. Huge areas remain unexplored, except by the scattered human communities who have lived there for millennia. With great diversity comes great responsibility. Today the Pan-Amazon is facing a multitude of threats as a result of interests and demands associated with unsustainable economic development. The search for land, energy and minerals, large-scale deforestation due to agribusiness and infrastructure development and exports both within the Amazon region and to the whole world, have resulted in the loss of 17 per cent of the Amazon forest, with more under severe threat as destruction continues. What is the future for the Amazon? That depends on you! How you engage, what you consume;[18] the choices made by you and millions of other people around the world will decide whether this unique area is still there for future generations.

Cláudio Maretti, Regional Vice Chair for South America of IUCN WCPA

Photo: Abanico del Pastaza, Loreto, the largest Ramsar site in the Peruvian Amazon © Diego Pérez / WWF-Peru

3.1 Biodiversity and heterogeneity

The Amazon is a hugely complex and inter-dependent system of tropical rainforests and rivers that interact with the atmosphere. Whilst containing many different ecosystems, the Amazon forms a single ecological functioning entity, in which its many parts depend on the integrity of the whole. Tropical evergreen forest is the dominant vegetation type, covering nearly 80 per cent of the biome; other forest types include flooded and swamp forests (3.9 per cent) and deciduous forest (1.4 per cent). Four per cent of the biome is savannah and 6.8 per cent is now agricultural landscapes.[19]

The Amazon contains the world's largest river system: notably the Amazon itself, but also 13 major tributaries, many larger than other large global river basins. The Madeira river basin is larger than any Amazonian country except Brazil. Amazon freshwaters include extensive riverine and non-riverine wetlands. Riverine wetlands range from the narrow riparian zones of headwater streams to extensive floodplains bordering the major rivers. Non-riverine wetlands include small, isolated interfluvial flats and large swamp and savannah regions. The Amazon catchment is remarkable for its seasonal flood pulses, which may rise 15 metres during peaks, inundating floodplains to several metres and creating expanses of flooded forests and floating grasses.[20]

Only a fraction of the Amazon's enormous biodiversity is known to science and the species list is growing all the time. While estimates suggest that 90-95 per cent of mammals, birds and plants are known, only 2-10 per cent of insects have been described,[21] and although 2,500 Amazon fish species have been described to date, estimates suggest the region may contain as many as 6,000-8,000 fish species.[22] Most known species are from the courses of the main rivers, near big cities or in some of the more-intensely studied protected areas. New studies of Amazon diversity continually reveal species previously unknown to science especially when they are carried out in more remote regions. Analysis commissioned by WWF identifies 2,200 new species of plants and vertebrates having been described since 1999 (see figure 2).


© Adriano Gambarini / WWF

Callicebus miltoni


© Fabio Schunck

Hypocnemis rondoni


© Dalton Nielsen

Papiliolebias ashleyae


© Gabriel Melo Alves dos Santos

Inia araguaiaensis

MORE SPECIES OF PRIMATES ARE FOUND IN THE AMAZON THAN ANYWHERE ELSE ON EARTH[30]


©João Pedro Fontenelle de Araújo Freire

Potamotrygon limai


©Philippe J. R. Kok

Riolama inopinata


© Tiina Sarkinen

Solanum arenicola

The jaguar (*Panthera onca*) and the unique Amazon (or pink) river dolphin (*Inia geoffrensis*) are both "global priority species" and their conservation is critical to maintaining the Amazon's ecological integrity. Jaguars are the largest predator in lowland forests. Colombia is a particularly important country as it links populations in Central and South America.[23,24] Threatened by habitat loss and persecution, effective conservation in large protected areas is essential for jaguars.[25]

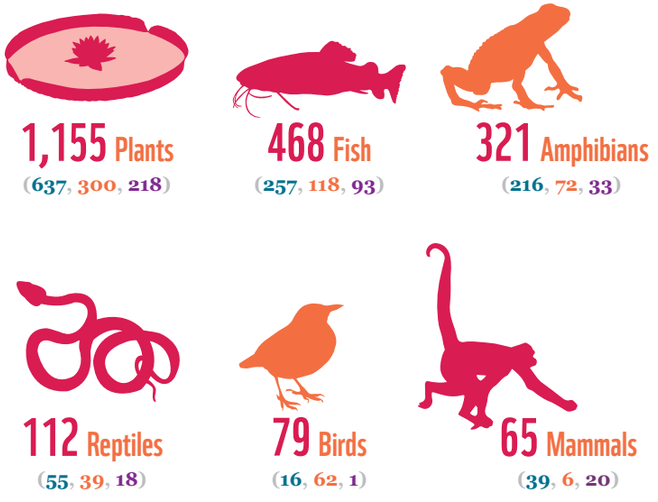
The Amazon river dolphin is also a key indicator of the health of its wider environment. Different parts of the Amazon have different myths about river dolphins. In some parts of Colombia they have long been respected and unharmed because of beliefs that they have magical powers. In the Brazilian Amazon, the myth is that the pink river dolphin becomes a handsome young man that impregnates young women, and dolphins are hunted for their male organs, which are kept as trophies. Seen as competition for fish stocks in many parts, they are actively persecuted and are also victims of "bycatch" when entangled in fishing gear.[26] Other threats include the building of hydroelectric dams, pollution and a reduction in fish stocks. Protection of the dolphins is hindered by a lack of understanding of their preferred habitats and movements.[27] In order to ensure that river dolphins are taken into consideration when dams are being developed, WWF has helped develop a national action plan for river dolphins in Ecuador and Bolivia,[28] and for the whole of South America.[29]

Figure 2: New species to science from the Amazon 1999-2015
(Sources: 1999-2009,[31] 2010-2013 [updated in 2016 to include species discovered during this period but described later],[32] 2014-2015[33])

Key

Numbers of species discovered in each research period

- 1999 - 2009
- 2010-2013
- 2014-2015



BIOME HIGHLIGHT

Importance of the Amazon on the marine environment

Huge amounts of mud from the Amazon River create a unique, dynamic coastline and rich fisheries for Brazil's Amapá state, French Guiana, Suriname and Guyana.

Every year, the Amazon carries between 500-1,000 million tonnes of mud, which plumes out between the Amazon and Orinoco Rivers, creating the muddiest coastal waters found anywhere; a dominating influence on the geology, geomorphology, ecology and economy of the northern coastline of South America.[34] The resulting coast is highly unstable, with mud and sand moving westwards at around 1.5km per year,[35] and periods of rapid beach erosion and accretion. Around 15 massive mud banks are usually present, 20-30km wide and up to 60km long; these and onshore mud bars encourage rapid growth of mangroves; however if the mud banks move, mangroves can as quickly be inundated and destroyed.[36]

The waters are turbid and loaded with nutrients, which together with the nursery function provided by mangroves create some of the world's most productive fishing grounds,[37] and a globally important stop-over point for migrating shorebirds.[38] But marine biodiversity in this region remains poorly understood. A recent survey found one sirenian (manatee) and 13 cetacean species, including a dolphin endemic to eastern South America's coasts; 11 of these were recorded for the first time from Suriname.[39] As fisheries economies and the related coastal biodiversity of this region closely depend on the Amazon nutrients, construction of dams may adversely impact on them; although the scale of this impact is unknown.

MARINE BIODIVERSITY IN THIS REGION REMAINS POORLY UNDERSTOOD

Amazon corals

The discovery of an over 1,000km long coral reef system in the mouth of the River Amazon, between the French Guiana–Brazil border and Maranhão state in Brazil, was announced in April 2016.[40] This extensive carbonate reef system of over 9,500km² in area highlights the scale of discoveries still to be made about the Amazon.

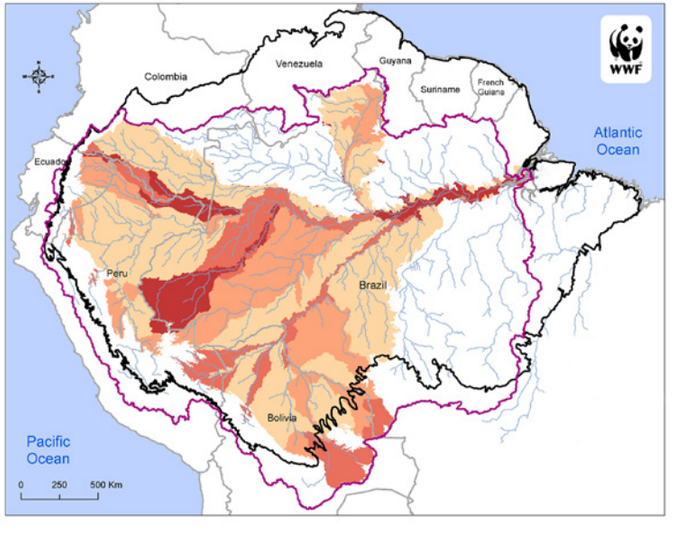
BIOME HIGHLIGHT

Migratory catfish of the Amazon

Some Amazon fish undertake the longest freshwater migrations on Earth; their survival depends on protecting headwaters and maintaining free-flowing rivers.

Several Amazon catfish species swim 6,000km from the estuary on Brazil's Atlantic coast where they mature, to the Amazon headwaters where they spawn. Spawn is washed downriver; a process taking several weeks. This extraordinary journey is only possible due to the connectivity of freshwater ecosystems involved. Catfish life cycles are complex and still poorly understood. Species like the gilded catfish (*Brachyplatystoma rousseauxii*) rely on the integrity of critical spawning areas in the upper parts of the catchment,[41] such as the Juruá and Caquetá Rivers and the upper parts of the Madre de Dios in Peru,[42] and maintenance of freshwater corridors the length of the Amazon. But the latter is under threat from proposals to dam some of the major rivers.[43] Catfish fisheries are an important source of food and income; consumption of fish averages 94kg/yr for riverine communities[44] and Amazon fisheries were valued at US$389 million per year in 2003.[45] There is already evidence of over-exploitation of some species.[46]

Figure 3: Priority areas for migratory catfish modelled with full connectivity[47]



3.2 Cultural diversity

Humans arrived in South America 14,000 years ago[48] and have lived in the Amazon for at least 11,000 years.[49] Until recently the indigenous peoples survived almost entirely from the rivers and forest: using timber to build houses and canoes; palm leaves to thatch roofs; tree resins for glue; fruits, fish and bushmeat for food; and fibres, leaves and bark for medicines, crafts and ornamental resources. In eastern Amazonia, 200 tree species are used for wood, half of which also produce useful non-timber forest products.[50] The Amazon was a major centre of crop domestication, with at least 83 native species domesticated to some degree. Human populations and associated food production expanded rapidly during the mid-Holocene, and complex societies increased in resource-rich areas creating domesticated landscapes that had profound impacts on local and regional ecology.[51]

11,000
YEARS OF SETTLEMENT

Life changed dramatically with the arrival of Europeans and later people from Africa and Asia. New settlements emerged, along with exploitation of natural resources, slavery and genocide. Escaped slaves of African origin settled in the forest (maroons in Suriname, quilombo communities in Brazil, etc.). Large-scale European immigration began with a demand for rubber, linked to the automobile industry, which initiated the modern transformation of the Amazon. In the 1950s deliberate Amazon settlement began, with a rapid influx of people and associated changes in land and water use, particularly clearance of forests, building roads and damming of rivers for hydropower.[52]

Important geopolitical developments related to "national security" and "national integration" policies have increased the establishment of roads, settlements and military presence, further impacting local culture. Besides direct effects, roads opened the way for further settlement, increased exploration, and exploitation of resources. Examples include the expansion of soy plantations in the southern Brazilian Amazon from the 1990s until the establishment of the Soy Moratorium in 2006 (see section 5.1); access to oil and gas deposits in the Amazonian parts of the Andean countries; more technical and capital intensive cattle ranching, and reactivation of hydroelectric projects.

34 MILLION RESIDENTS

In 2011, the Amazon population was estimated at 34 million people.[53] The largest Amazon populations are Brazil (70 per cent) and Peru (11 per cent). Average population density (4.5/km^2) is a fifth of the South American average. Although traditionally associated with forest dwellers and rural settlers, 65 per cent of Amazon people now live in cities like Manaus (Brazil), Iquitos (Peru) and Belém (Brazil), which have some of the highest growth rates in each country.[54]

350
INDIGENOUS GROUPS

The almost 3 million indigenous people, from over 350 groups, have a special importance. This is due to their long residency, recognized territorial rights to over 20 per cent of the Amazon (or over 30 per cent, if non-officially recognized areas are included),[55] cultural perspectives, ecological knowledge and because of the persecution that many have faced. At least 60 groups live in voluntary isolation.[56] Holistic and sustainable management of indigenous territories is an urgent priority.[57]

Rapid technological and environmental changes are putting ancient traditions under pressure. Access to new technologies, changing social expectations and developing markets are leading to the abandonment of traditional natural resource practices. Research in the Colombian Amazon found a decrease in the availability of the most important provisioning services (fish caught for market, bushmeat, materials used for housing, timber and thatch, and traditional ceremonies). The reasons include population increase and thus pressures on natural resources; changing technologies (e.g., cold stores for fish) and changing cultural practices. Wider environmental threats, including deforestation and pollution are causing profound changes in the livelihoods of indigenous communities.[58]

Farmers and ranchers represent an important and diverse group of the population, with a composition ranging from the descendants of the old settlers to new immigrants. This includes small landholders, including those who came in under the aegis of agrarian reform, to big landowners; and "ranchers" with a significant amount of the land illegally or irregularly acquired.

65% THE PROPORTION OF THE AMAZON POPULATION LIVING IN CITIES

3.3 Economic and socio-political trends

Since European colonization, renewable and non-renewable resources have been drawn from the Amazon, usually unsustainably and irresponsibly: gold, rubber, minerals, livestock, oil, timber, soy, etc., have joined the outflow of raw materials. Natural resources transformed perspectives of nature in the Amazon when they went from "use value" (the basic utility of a good) to "exchange value" (its tradable value, often expressed in terms of money).[59]

In the middle of the last century, efforts were made to gain strategic control of the Amazon's natural resource use. In the 1960s and 1970s, the Brazilian military saw colonization as a national security priority: "occupy it to avoid surrendering it". Highways were built and incentives offered to transform the Amazon in the name of development.[60] Although infrastructure development in the 1970s and 1980s was driven by commercial interests (iron, bauxite and dams), demand was also accelerated by growing populations with higher purchasing power. The rise of the BRICS countries (Brazil, Russia, India, China and South Africa) in the last decade and growing middle classes drove greater consumption capacity, and thus infrastructure, agriculture and hydropower projects in the Amazon. Growing exploitation of Amazonian resources increased deforestation especially in the southeastern Brazilian Amazon and the foothills of the Andean-Amazonian countries. Furthermore, foreign investments in the Amazon are becoming increasingly coordinated across national borders, particularly in respect to energy and transport mega-projects.[61]

The rise of Brazil, especially from 1990-2010, and economic integration increased national interests in management of the Amazon region from the perspective of economic liberalization. Milton Reyes (pers. comm.) states that "there are some approaches focused mainly on trade generated by a purely economic liberal vision (neoliberalism), from the perspective of an 'open regionalism'".

Strategists have pushed for strong regional integration that has led to the Initiative for the Integration of Regional Infrastructure – IIRSA, aimed particularly at trade with Asia. This is leading to transport links between the Atlantic and Pacific such as the final 1,000km stretch of the Transoceanic Highway linking Brazil's Amazon river port of Assis to Peru's Pacific ports of Ilo, Matarini and San Juan, which cuts across the Amazon in both countries, raising concerns about further deforestation in the region. Some 544 infrastructure projects are under development across the region (see section 5), mostly through the IIRSA, now administered by the Union of South American Nations (UNASUR), with around

LIFE EXPECTANCY IN THE AMAZON HAS INCREASED FROM 56 TO OVER 74 YEARS IN THE LAST 50 YEARS[64]

US$130 billion investment.[62] Finance comes mostly from BRICS themselves and no longer only from bilateral or multilateral banks. Infrastructure projects usually have public investment, while extractive projects are often funded from private sources. For example, the Brazilian Development Bank (BNDES) has increased its international investments, with particular focus on infrastructure projects, mainly in South America (the value of loans disbursed by BNDES in 2010 was over three times the total provided by the World Bank).[63]

Paradoxically, most of the places from which the Amazon's wealth is extracted remain the poorest. Multiple interests increasingly penetrate the Amazon: soy, oil, livestock, etc., with the common feature that they respond to national priorities rather than local voices. National capital usually occupies a prominent place in these enterprises, and guides development based on the needs and interests of the investor or lender and not on the interests of those who receive the investment first-hand in their territories.

3.4 Amazon protection: status and trends

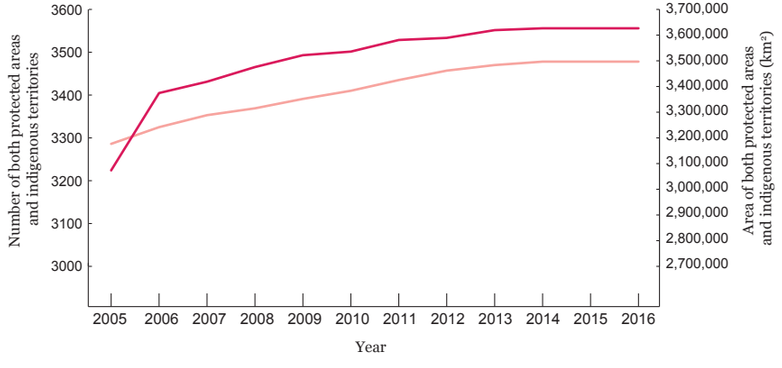
The term "protected area" embraces a wide range of conservation models with varied governance and management, such as government-managed areas focused solely on nature conservation, indigenous territories managed to support cultural, spiritual and natural values, extractive reserves maintaining traditional, low-impact uses of natural resources, and privately protected areas managed for conservation and tourism income, amongst others. All are bound by IUCN's definition of an area set aside to achieve the "long term conservation of nature";[67] in addition international designations are found, such as Ramsar, World Heritage and Man and the Biosphere sites (see section 6.5). Protected areas across the Amazon have been promoted to safeguard biodiversity and ecosystem services and to support local livelihoods, national development and the global environment.[68] Amazon protected areas, which currently cover 2.1 million km²,[69] have generally proved effective in reducing deforestation,[70] although many still face threats from hunting, invasive species and other pressures.[71]

In common with several other parts of the world, most Amazon countries also recognize indigenous territories, which in the Amazon include around 3,000 territories (not all officially recognized),[72] covering over 2 million km² [73]. Many indigenous territories resemble and play a similar role to protected areas although indigenous leaders stress important differences in governance structure and approach. Indigenous territories generally prevent deforestation even where there are high rates of forest loss along their boundaries,[74] with research showing just 2 per cent forest loss in indigenous territories as compared with 5 per cent in protected areas.[75]

10%

THE INCREASE IN PROTECTION OF THE AMAZON BIOME SINCE 2005

Figure 4: Growth in number and area of protected areas and indigenous territories 2005-2016. *Note: Man and the Biosphere sites are not included in this analysis due to poor data quality.*[84]



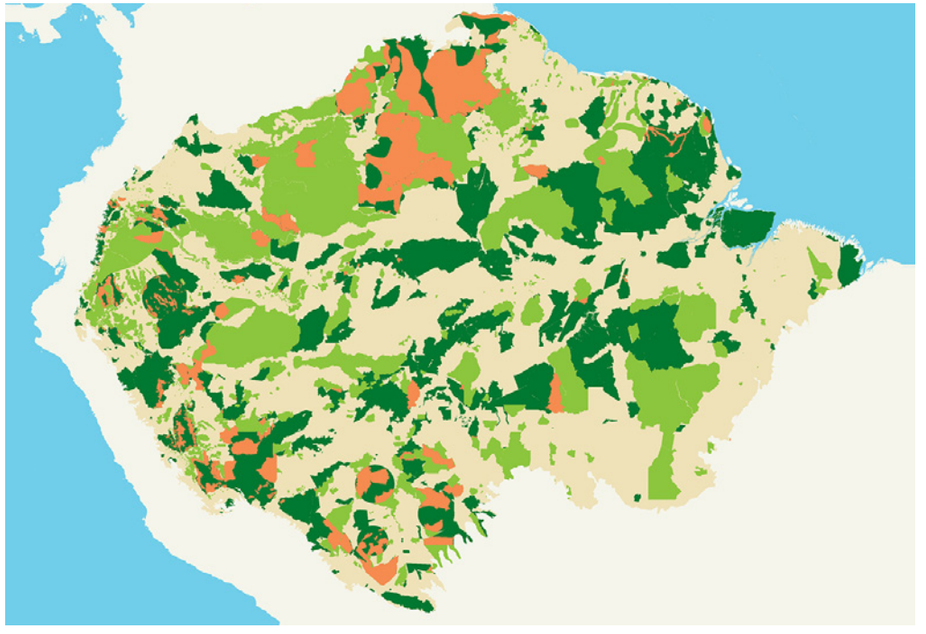


Figure 5: Protected areas and indigenous territories in the Amazon biome as of March 2016[85]
The map and figure show the total area coverage of protected areas and indigenous territories in the Amazon biome, including areas with shared geographies.

Key

- Indigenous lands and protected areas
- Indigenous lands
- Protected areas
- Amazon biome

To guarantee the role of indigenous territories as being critically important for both people and nature, with the support of WWF and other partners, the Coordinator of Amazon Indigenous Organizations (COICA) has developed a *Strategy for the Conservation of Indigenous Territories*.[76] The objectives of the strategy are to promote and ensure autonomy through the consolidation of indigenous territorial integrity as being fundamental to the lives of indigenous peoples and nationalities of the Amazon basin, this is achieved through the holistic management of natural and cultural heritage on their territories.

An additional 10 per cent of the Amazon biome has been gazetted as protected areas since 2005; with an increase in area protected of over 683,000km² in 188 new protected areas (almost a third of the current total of protected areas in the Amazon). All but two countries (Suriname and Venezuela) have seen protected areas grow, with the most growth nationally in Brazil (58 per cent of recorded growth) and Peru (24 per cent of recorded growth) which also gazetted the largest number (from 37 in 2005 to 121 in 2016). The increase in protection before 2008 (see figure 4) is partly explained by gains in French Guiana, where protection rose from 11.3 per cent to 53.2 per cent, mainly due to the declaration of the Parc Amazonien de Guyane, at 20,300km² one of the largest

national parks in the world; and in Guyana, which increased coverage from 2.1 per cent to 5.3 per cent.[77]

However encouraging, this protection is not simply a numbers game. Systems also need to be ecologically representative, connected and effectively and equitably managed to ensure conservation objectives are achieved. Although the Amazon has one of the best systems of protection globally, and Central and South America have been at the forefront of efforts to assess and improve management effectiveness,[78] vital gaps still exist (see page 68) particularly in the Amazon headwaters and Guiana Shield (see case studies). Effectiveness is impacted by a range of threats in particular mining (see section 5.5) and climate change (5.8).

Experience also shows that not all protected areas are protected in the long term. Protected area downsizing, downgrading and degazettement (PADDD) refers to legal changes that impact protected areas by allowing more human activity within them (downgrading),[79] reducing their spatial extent (downsizing), or eliminating their protected status entirely (degazettement). This has occurred in the Amazon;[80] the most recent analysis of PADDD in Brazil since 1900 identified 48 enacted PADDD events, which affected 88,341km^2 of the Brazilian Amazon.[81] Hydropower development and rural human settlements were associated with most of these changes. PADDD events have increased in frequency since 2005 and the trend toward PADDD is increasing. Ten possible proposals currently threaten to eliminate a further 65,715km^2 of protected lands in the Brazilian Amazon. Given the Brazilian government's plans to construct hydroelectric power plants on all large rivers of the Amazon, more PADDD proposals are expected in the near future.[82] As figure 4 illustrates the growth in protected areas has levelled off in the last few years; if these PADDD events become a reality the level of protection could actually drop, making initiatives to secure long-term protection even more vital.

PROTECTED AREAS IN THE BRAZILIAN AMAZON HAVE FOUR TIMES LESS DEFORESTATION THAN UNPROTECTED AREAS EVEN WHEN HIGHLY ACCESSIBLE[83]

CASE STUDY

ARPA: Developing protected area systems

Large-scale, targeted funding support has proven to be a successful model for developing effective and sustainable protected areas across the Amazon.

59 MILLION HA THE AREA OF FEDERAL AND STATE PROTECTED AREAS SUPPORTED BY ARPA

The Brazilian Amazon Region Protected Areas (ARPA) programme redefined large-scale conservation. Set up by a range of stakeholders, including WWF, ARPA was developed in response to a pledge made by the government of Brazil in 1998 to triple the area of the Amazon under legal protection. The aim was to create and support a system of well-managed protected areas and sustainable natural resource management reserves over a 10-year period through a partnership ranging from government agencies to NGOs representing civil society and local communities, to major donors. Vital to the success of the programme was the plan to ensure the financial viability and integrity of the park system in perpetuity.

The initial establishment and work of ARPA was so successful, the decision was taken to increase the target to 60 million hectares, an area equivalent to 15 per cent of the Brazilian Amazon. Currently, the programme supports 114 federal and state protected areas covering about 59.2 million hectares. In 2011, WWF and its partners began working with the government to develop a new financial plan for the long-term sustainability of the ARPA system. Public and private donors, within Brazil and internationally, raised US$215 million to create a 25-year sinking fund, enough to provide the funding needed to maintain ARPA's protected areas until the government of Brazil can assume full responsibility.

Beginning in 2013, Peru began developing its own initiative to ensure the long-term financial sustainability of its national protected areas system, based on the ARPA model. A range of national and international organisations (including WWF and the Gordon and Betty Moore Foundation) is now working together on the initiative to create a world class protected area system in Peru that will have enough funding to cover its recurrent costs and will be self-sustaining in perpetuity.

Securing the financial sustainability of national protected area systems around the world is critical to conserving the world's forests and biodiversity. WWF believes that the Project Finance for Permanence (PFP) approach used in ARPA in Brazil and now under development in Peru, can be an effective solution to achieve financial sustainability and improve protected area management effectiveness in other Amazon countries as well.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

4 VALUES OF THE AMAZON

"Value" is a loaded concept; one person's value is sometimes another person's cost. Some people look at an area of Amazon forest and see a potential cattle ranch; others see a carbon store or a protected area, or both; or a home for wild species; or the lands that their ancestors have lived on for millennia. All may be valid, but they cannot all be accommodated in the same place. Whilst recognizing the role of development for human well-being, the living Amazon ecosystem itself has a critically important and irreplaceable function and value that needs to be retained in large part, for the local, national, global and intrinsic services that it provides. In the following section we look at some of the key values of the ecosystem.

Photo: Latex extraction (*Hevea brasiliensis*) from Manuripi National Wildlife Reserve, Bolivia © Eduardo Ruiz / WWF

4.1 Local, national and global value

A large proportion of the global population receives goods and services from the Amazon. The beef in burgers and leather in shoes could come from the Amazon; chicken and pork could be fed on soya grown there; health food snacks and drinks could contain nuts and fruits from Amazon forests.

But these are only the most obvious products. Ecosystems such as the Amazon provide four types of goods and services: supporting, regulating, provisioning and cultural. Supporting services describe the three essential elements of life: ecosystem process maintenance (soil formation, nutrient cycling, primary production, etc.); lifecycle maintenance (nursery habitats, seed dispersal, species interactions, etc.) and biodiversity maintenance and protection (genetic, species and habitat diversity). Without these, other services would not exist.[86]

The role the Amazon biome plays in providing regulating services makes it one of the most important ecosystem service providers on the planet. Its contribution to mitigating global climate change is discussed in section 6.3, regionally the predominately humid and relatively cool climate is also regulated by the Amazon.[87] The biome's forests recycle 50-75 per cent of annual rainfall back into the atmosphere.[88] If unaffected by deforestation and degradation (see figure 6), this cycle pumps some seven trillion tons of water per year into the atmosphere via evapotranspiration,[89] (the movement of water to the air from sources such as the soil, canopy interception and water bodies). The Amazon's position means this water impacts the whole continent by regulating rainfall in key agricultural regions.[90] The 6km high barrier provided by the Andes causes the moist Amazonian air to make "a bend" near Acre state in Brazil and, during the summer, water vapour is carried down to a vast quadrangle of land bounded by Cuiabá to the north, São Paulo to the east, Buenos Aires to the south, and the Andes to the west. This area is responsible for 70 per cent of the continent's GDP (primarily through agricultural production); which without the influence of the Amazon would be far more arid. This circulation of water vapour has been termed the "flying rivers" of the Amazon to help explain its importance to the whole continent and its 380+ million population.[91]

The role of the Amazon in securing the region's prosperity and wealth goes beyond climate regulation. Other vital regulatory services to agriculture include helping ensure the survival of pollinators; in Brazil alone, the economic contribution of pollinators has been estimated at around US$12 billion a year[92] and prevention of soil erosion estimated to be worth US$238 per ha per year.[93] Pest and disease regulation is another important, but often overlooked

90%

OF LATIN AMERICA'S AGRICULTURE IS RELIANT ON PRECIPITATION RATHER THAN IRRIGATION[110]

service of intact ecosystems; research in the Peruvian Amazon found malarial mosquito biting rates were more than 278 times higher in deforested areas than areas heavily forested.[94]

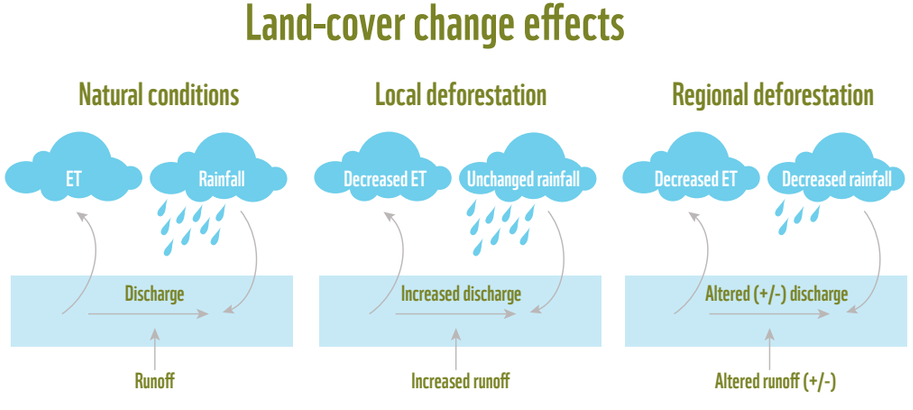
Ecosystems also provide provisioning services such as water, food, medicine and raw materials. For example, the production of non-timber forest products has been assessed to be worth about US$50-100 per ha per year.[95] The exploitation of rubber (*Hevea brasiliensis*) is a traditional activity in the Amazon region, research in 11 Extractive Reserves estimated potential revenues of R$16.5 million (about US$4.8 million) per year.[96] The huge fungal biodiversity of the biome means that compounds for new drugs are regularly found,[97] whilst the whole biome provides a vast medicine cabinet for many local and indigenous residents.[98]

Cultural services are also provided through a range of non-material benefits. Most, such as homeland, spiritual and aesthetic value, are beyond simple assessment by economic equivalent values; however, one study estimated the recreational and ecotourism use of the Amazon as worth US$3-7 per ha per year.[99]

Conserving the Amazon is thus not simply about maintaining a forest and river system; but rather maintaining climate stability, cultures and economies far beyond the biome. Understanding and ensuring the sustainability of the ecosystem services can provide a powerful argument for conservation.[100]

In 1997, Costanza et al. helped begin what is rapidly becoming a new science, the understanding and valuing of ecosystem services.[101] Their assessments that ecosystem services provided trillions of dollars of benefits to populations around the globe attempted to give value to the complex natural systems that keep us alive. However turning these values into real financial benefits or arguments for conservation remains a challenge.

Figure 6: Impacts of land use change on the hydrological connectivity of Amazon freshwater ecosystems. *Relative to undisturbed conditions (left), local deforestation (middle) generally decreases evapotranspiration (ET), increasing runoff and discharge but not rainfall. Deforestation at regional scales (right) may decrease ET sufficiently to also decrease rainfall. Runoff and discharge may experience a net increase or decrease (+/-), depending on the balance between rainfall and ET (rainfall – ET = runoff). Adapted from Macedo, M. and Castello, L. 2015*



To date, research into ecosystem services in the Amazon tends to focus on a few services linked to hydrology and climate regulation.[102] Studies by WWF and others have begun to summarize the overall value of the Amazon.[103,104] The InVEST tool was used to work out the value of ecosystem services in Madre de Dios, Peru, in a trinational protected area between Peru, Colombia and Ecuador and in the state of Acre in Brazil.[105] In the Brazilian Amazon, ecosystem services from protected areas provide national and local benefits worth 50 per cent more than the returns from smallholder farming,[106] and can draw three times more money into the economy at regional level than extensive cattle ranching.[107]

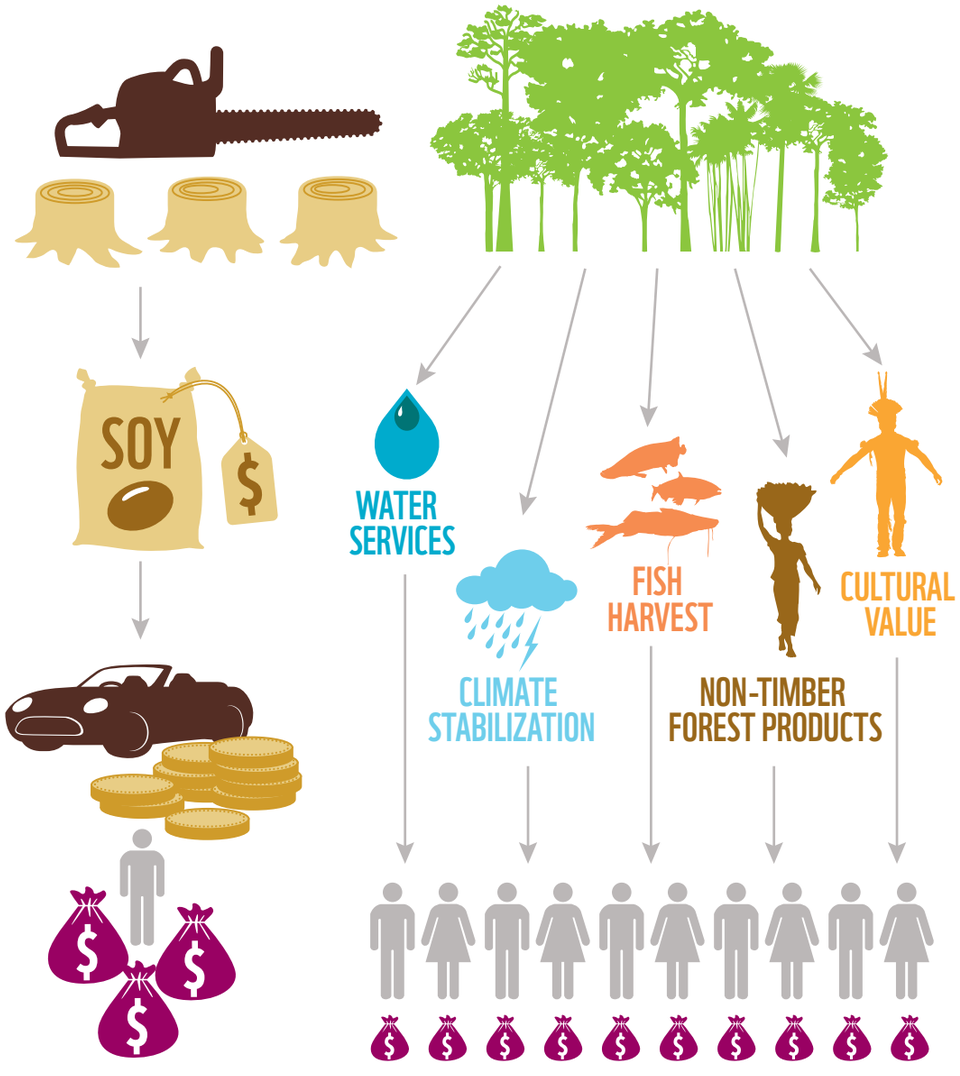
To make the case for valuation, questions need to be answered in terms of value of "what", "for whom", "when", "why" and "where".[108] For example, conversion of the rainforest to a soy plantation could benefit agricultural businesses and workers, provide export earnings and support beef production in Europe, whilst protection of the forest could help ensure climate stability and provision of local goods (food, materials, medicinal plants, etc.). Trade-offs are inevitable – as our understanding of values grows so does our need to find ways to balance equitably and sustainably their benefits locally, nationally and globally.

Medicinal plants
Of the 12 medicinal plants sold most widely in eastern Amazonia, five are harvested for wood.[112] For example, a powerful anti-inflammatory medicinal oil extracted from the seeds of andiroba (*Carapa guianensis*). Andiroba oil can mend badly sprained ankles, repel mosquitoes[113] and is used in veterinary medicine to cure the infected cuts of animals. Because the deep, golden-hued wood is of superior quality, andiroba is considered on a par with mahogany.[114] For this reason, it is increasingly difficult to find in logged areas.[115]

AIR TRAVELLING OVER EXTENSIVE FOREST COVER MAY GENERATE TWICE AS MUCH RAINFALL AS AIR OVER DEFORESTED LAND[109]

THE EQUITABLE ALLOCATION OF THE REGION'S NATURAL WEALTH WOULD HELP REDUCE INEQUITIES AND TENSIONS[111]

Different ways of valuing the forest



CASE STUDY

Brazil nuts and other non-timber forest products

Brazil nuts form a compelling economic and social incentive for communities to keep forests standing.

Although considered a minor product in global terms, Brazil nut (*Bertholletia excelsa*) collection has a US$175 million annual turnover in northern Bolivia, employing 20,000 people from a population of 110,000 in the region.[116] Large markets also exist in Acre state, Brazil, employing 15,000 families and worth US$34 million,[117] and Madre de Dios, Peru. Production is traditional: families travel through the forest collecting for 3-4 months a year. Brazil nuts are one of the few internationally traded foods that are exclusively wild harvested,[118] and require a healthy forest ecosystem to survive. Under Bolivia's policy of sustainable use for the whole forest, collection often occurs in extractive reserves (IUCN protected area category VI) thus providing communities with incentives to conserve forests, although increasing timber harvest in the region is undermining non-timber forest products in some areas.[119] Bolivian producers work cooperatively to meet international food safety and packaging standards, and as a result gain preferential access to the European market: Bolivia now controls over three-quarters of global trade.[120] Forest Stewardship Council certification has helped build the market.[121] WWF has promoted new "producer to table" models, reducing the number of steps in the market chain and increasing the value to producers. At the same time, WWF works with Brazil nut collectors themselves to help them diversify into other non-timber forest products,[122] including sustainable production of caiman skins, wild cacao, wild rubber and açaí (*Euterpe* spp.), a palm fruit. Monitoring, research and careful management is also important to ensure sustainability of production and to avoid simplifying floristic communities across the Amazon favouring species of economic interest.[123,124]

"THE LIVING DEAD"

THE NAME GIVEN TO SOLITARY BRAZIL NUT TREES AS THEY CANNOT REPRODUCE WITHOUT SPECIALIZED POLLINATORS (USUALLY BEE SPECIES) FROM THE FOREST UNDERGROWTH[125]

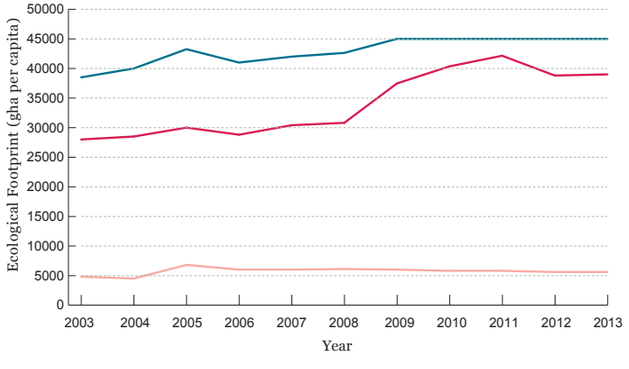


Figure 7: Brazil nut (Bertholletia excelsa) production 2003-2013 by tonnes with shell[126]

Key

- Bolivia
- Brazil
- Peru

INTRINSIC VALUES

The moral argument for securing the Amazon

Amazon conservation has a moral basis alongside practical concerns; for many people ethical and emotional arguments are equally or more important.

85%

A NATIONAL POLL IN BRAZIL FOUND 85% OF RESPONDENTS CHOSE PROTECTION OF THE AMAZON OVER FURTHER AGRICULTURAL PRODUCTION[132]

Conservation of the Amazon is driven by more than utilitarian concerns about ecosystems services like climate and water, whatever their importance. Facts only play a partial role in shaping our attitudes and behaviour toward conservation and sustainable development, with emotions often a far more important driver. Emotions are, in turn, heavily influenced by dominant cultural values, particularly by intrinsic values such as a sense of community and self-development.[127] Recognizing these complexities is often critical to making the case for issues like conservation of ecosystems or species.

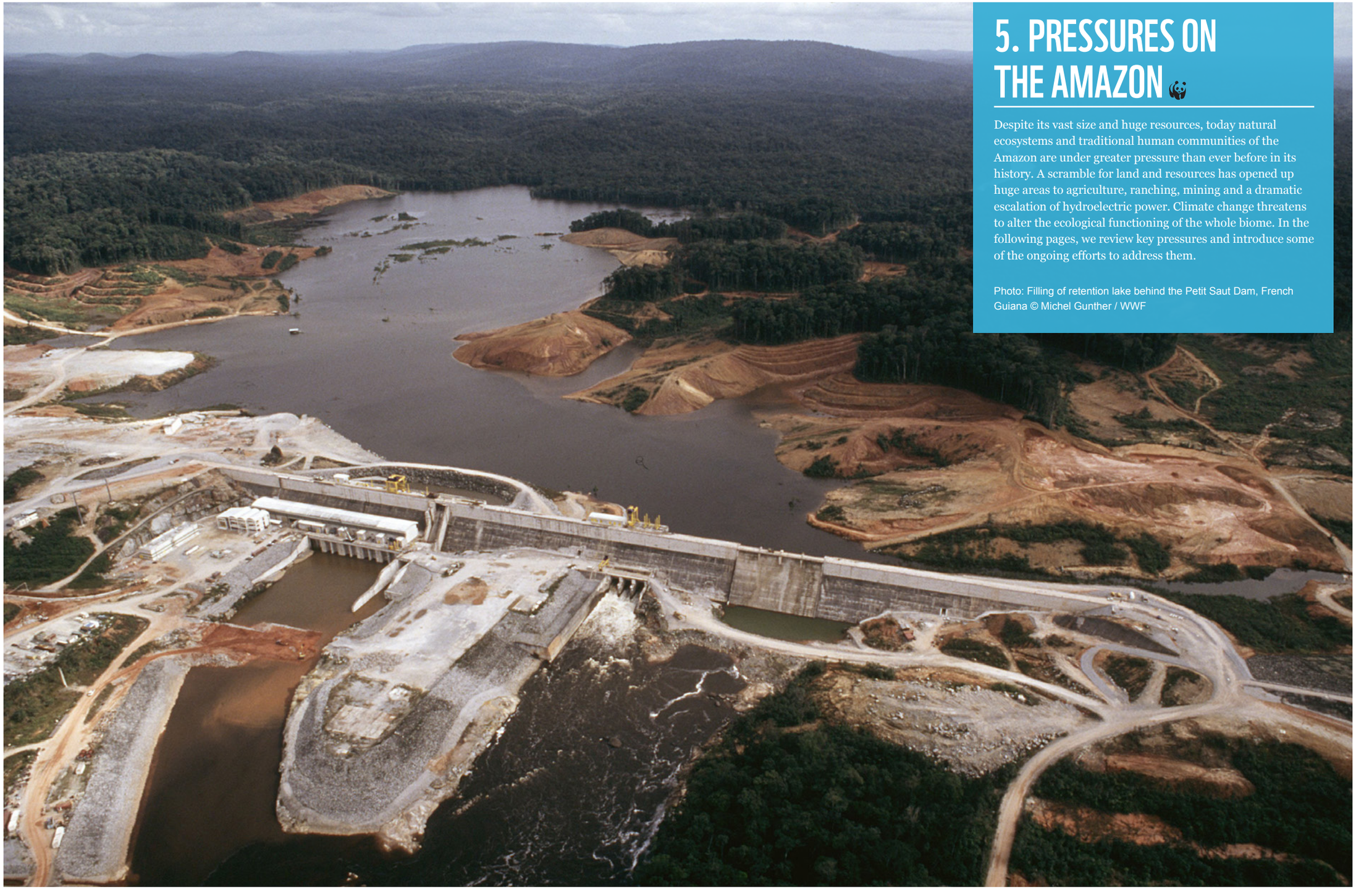
The concept of biodiversity rights – the right of all ecosystems, habitats and species to follow their natural evolutionary pathway without being driven into premature extinction by human actions – is gaining ground.[128] Repeated surveys show that most people believe that we have a moral obligation to prevent extinctions as a result of our own actions. Amazon conservation is also centrally about human rights, and particularly the rights of isolated and fragile indigenous societies to continue to exist and follow their chosen lifestyles, bringing us a rich and unique set of languages, philosophies, knowledge and skills.[129] Conserving the Amazon, and conserving the Amazon at scale, is therefore a key ethical imperative for the 21st century.

These concepts are not confined to a small fringe of green activists. All the world's major faiths have expressed unequivocal support for the moral basis for conservation and for our role as stewards of the natural world.[130] They speak for the vast majority of people alive.[131] Many other faiths, including those of indigenous peoples, have far more fundamental beliefs about the importance of maintaining the natural world in its entirety and in good health. Philosophers have mapped out in detail the moral basis for conservation. Clearly many people care passionately about places like the Amazon, even if they are unlikely to ever go there themselves.

NATURE MUST BE EXPERIENCED THROUGH FEELING

Alexander von Humboldt to Goethe

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon



5. PRESSURES ON THE AMAZON

Despite its vast size and huge resources, today natural ecosystems and traditional human communities of the Amazon are under greater pressure than ever before in its history. A scramble for land and resources has opened up huge areas to agriculture, ranching, mining and a dramatic escalation of hydroelectric power. Climate change threatens to alter the ecological functioning of the whole biome. In the following pages, we review key pressures and introduce some of the ongoing efforts to address them.

Photo: Filling of retention lake behind the Petit Saut Dam, French Guiana © Michel Gunther / WWF

Pressures on the Amazon forest[133]

Pasture and **cattle ranching**, specifically farm gate beef and dairy, is the dominant cause of deforestation in many areas and is also linked to land speculation in some countries.

Expansion of **mechanized agriculture**, particularly for animal feed and biofuels, using soy, oil palm and also corn, is a key pressure, with increased production linked to subsidized resettlements in some countries. **Indirect land-use change** can be significant, e.g., if soy replacing pasture results in cattle rearing moving into natural forest.

Small-scale agriculture is expanding in regions such as northern and eastern Bolivia, Colombia, Ecuador, Peru and the Guianas, where high levels of poverty, pressure for land, unsustainable practices and problems of control are leading to an agricultural expansion.

Dams and **hydropower expansion**, including settlement around dams and associated infrastructure, is a major driver behind deforestation. The area at risk from deforestation impact occurs between 40 and 100km from hydroelectric dams. There are 154 constructed dams, and another 277 either under construction or planned in the Amazon biome. Sites selected for dams and reservoirs often overlap with protected areas and indigenous territories.

Roads give access to remote areas, bringing people and land speculation inwards. Mechanisms to manage or reduce the impacts of new roads are often absent or poorly implemented. Greatest deforestation rates are in areas with more roads, showing a strong correlation between deforestation and the presence of roads and projections of new roads. Nearly 95 per cent of deforestation in the Brazilian Amazon was found to be within 5.5km of roads and 1km of navigable rivers.

Forest fires due to poorly controlled burning for land clearance and management are a contributing factor to both deforestation and forest degradation.

Road development accompanies mines, oil and gas drilling, often deepening deforestation. Mining is significant in places such as Peru, where artisanal and small-scale alluvial **gold mining** has increased 400 per cent since 1999.

Unsustainable legal and illegal timber trade contributes to forest degradation and can be the first stage of forest conversion.

Primary cause of forest loss and/or severe degradation

Important secondary cause of forest loss and/or severe degradation

Less important cause of forest loss and/or severe degradation

5.1 Large-scale monoculture and cattle ranching

BRAZIL HAS THE LARGEST COMMERCIAL CATTLE HERD IN THE WORLD[156]

Export-driven large-scale agricultural production has been responsible for the largest losses of natural habitat in the Amazon in recent decades.[134,135,136] The role of China as a major soy and beef importer has been particularly identified.[137]

Cropland expansion is a key driver of forest loss.[138] Soy has contributed to deforestation in the Brazilian and Bolivian Amazon,[139] both through direct conversion[140] and by displacing cattle production to the forest frontier.[141,142] Attempts to reduce soy's impacts include the Soy Moratorium in Brazil, which encourages industry players to commit to zero deforestation.[143] Amazon deforestation associated with soy in Brazil fell from nearly 30 per cent to less than 1 per cent of the area brought into production following the Moratorium which was agreed in 2006,[144] and has been maintained by successive extensions. Although industry representatives argue that environmental governance is now robust enough to justify ending the agreement (see section 5.6),[145] the Moratorium has recently (May 2016) been extended indefinitely, a major step toward curbing deforestation in the Brazilian Amazon.

Other crops impacting the Amazon include oil palm, which, despite being relatively new in Amazon countries, is positioned to grow faster than any other commodity in the region. Oil palm currently covers around 250,000ha in Brazil's state of Pará, and although zoning requirements to minimise environmental impact have been defined, a recent influx of large national and international investors in the Brazilian oil palm sector has raised concerns about the potentially adverse social and environmental effects.[146]

Deforestation from the cattle sector is an equally serious challenge.[147] Expansion of cattle pastures continues to be a major cause of deforestation.[148] In 2014, nearly 5,000km² was cleared in the Brazilian Amazon, although the trend is declining.[149] The industry has developed good control of direct suppliers to slaughterhouses, producing some evidence of decreased deforestation,[150] but control of indirect suppliers (farmers providing animals to direct suppliers) is still a challenge.[151]

Roundtables on soy (RTRS[152]), palm oil (RSPO[153]) and beef (GTPS[154] and GRSB[155]) play an important role in helping to reduce deforestation pressure with their criteria to avoid forest conversion and other social and environmental issues related to commodities production. Overall, a landscape-integrated production approach, preserving environmental services and promoting social development would provide a sustainable strategy. Adding value to the forest and other ecosystem services is important, as is promoting timber and non-timber forest products that preserve ecosystem functions as an alternative to industrial scale agro-commodity based strategies.

5.2 Small-scale agriculture

Legal and illegal settlement by small-scale farmers has been a significant cause of land use change in the Amazon. Such deforestation is linked to the availability of credit, presence of roads (particularly secondary roads), low occupancy by other players and weak rule of law. Crops include annual rice, cassava, maize and bananas. Smallholder ranchers usually clear more forest than those growing crops.[157] Countries experiencing smallholder related deforestation include:

Bolivia: smallholding is currently fairly limited but settlement is expected to increase in the north and eastern lowlands[158] and enforcement of planning controls is currently weak.

Brazil: the Agrarian Reform Programme, although socially and economically necessary, encouraged settlement by hundreds of thousands of smallholders, and led to contradictory laws relating to forest protection. It is, nonetheless, still a much smaller cause of forest loss than large-scale ranching, but in recent years accounts for a growing percentage of total deforestation. Between 2004 and 2011, smallholders accounted for 12 per cent of deforestation.[159]

Colombia: small-scale agriculture is the major cause of deforestation in parts of Colombia, including slash and burn and illegal coca cultivation.[160] It is estimated that 100,000ha of coca were grown in four departments in 2011, although there have been efforts to reduce this trend.[161] Forced displacements, colonization and cattle ranching all impact on complex land use patterns[162] and the post-conflict period could change the dynamics by opening new areas for colonization.

Ecuador: smallholder agriculture is generally small-scale, but mixed farming is more significant than ranching and in the northern part of the country it is responsible for over half the deforestation.

Peru: smallholders have been a major cause of forest loss although this has declined; use of poor quality land and bad farming techniques mean that much land is abandoned or used in long rotations. Policies associated with cattle expansion and credit incentives both influence conversion.[163]

Addressing smallholder farming is complex. Many settlers are poor and desperate for land but smallholders also have a history of detrimental clashes with indigenous people. The increasing role of small-scale farmers in deforestation suggests that different conservation measures may be needed, with a greater focus on incentives[164] and policy shifts rather than moratoria and certification schemes.

PERIPHERAL RURAL ECONOMIES ARE INEXTRICABLY TIED TO ENVIRONMENTAL DEGRADATION, BECAUSE THEY LACK LEGAL OR FORMAL ECONOMIC ALTERNATIVES[165]

Infrastructure development

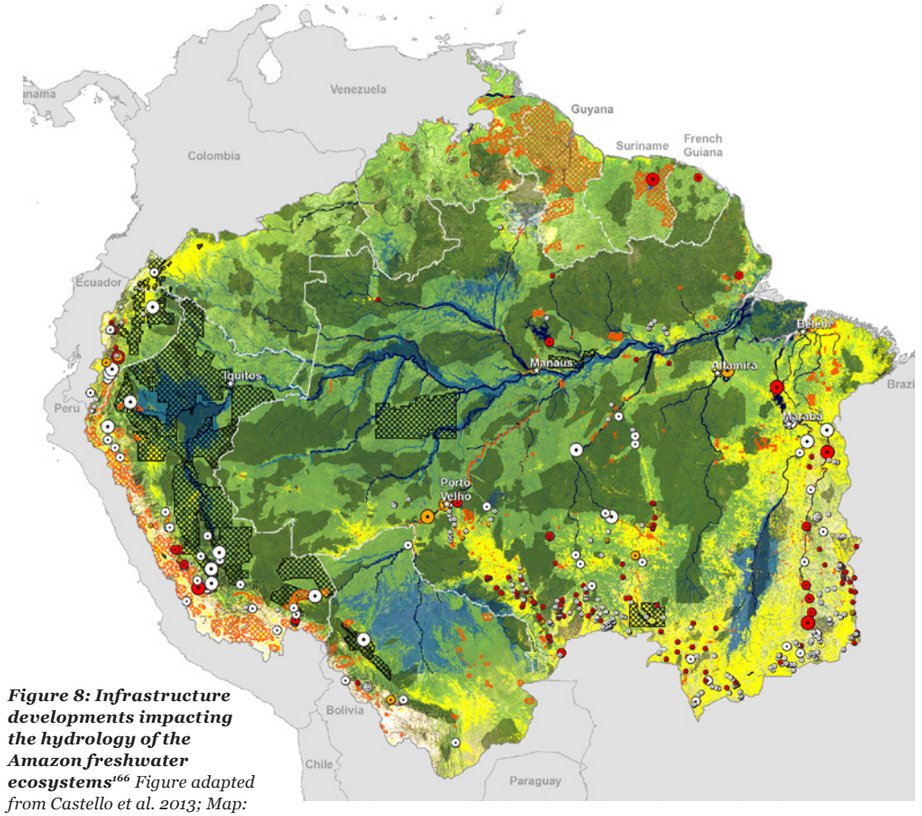


Figure 8: Infrastructure developments impacting the hydrology of the Amazon freshwater ecosystems[166] *Figure adapted from Castello et al. 2013; Map: Paul Lefebvre, WHRC.*

Key

Dams: existing and in development

- < 100MW
- 100 - 1000MW
- > 1000MW
- Planned
- Construction
- Operational

Petroleum leases

Mining leases

Deforestation

Reserves

Freshwater ecosystems

5.3 Dams

An explosion of dam construction threatens the flow and integrity of most Amazon rivers and tributaries (see figure 8),[167] impacting terrestrial and aquatic ecosystems, putting migratory fish at risk, threatening river dolphins, interfering with river transport and food and water supply for local communities, and dramatically reducing downstream and coastal sediment deposition.[168]

There are already 154 dams in operation, predominantly in Brazil, generating around 18,000MW of power,[169] although most apparently operate below capacity.[170] Tens of thousands of small dams have also been built, mainly by ranchers to collect water for cattle;[171] all disrupt the river's flow. An estimated 277 additional large dams are in initial planning stages,[172] which if they were all to go ahead would only leave three free-flowing tributaries in the Amazon basin, the Juruá, Trombetas and Içá-Putumayo,[173] permanently affecting the ecology, economics and climate of the sub-continent.[174] Seventeen parks, reserves, and indigenous territories will be directly or indirectly impacted by 10 hydroelectric power plants planned for the Brazilian Amazon in the next eight years,[175] and hydroelectric power is identified as the major cause of PADDD, the loss of existing protected areas (see section 3.4).[176]

The gains in energy are high, with an installed capacity of around 95,000MW if all the proposed dams were built,[177] with important export potential.[178] But the costs would also be high, given the loss of both longitudinal and lateral connectivity of freshwater ecosystems, particularly disruption of the unique migratory movements of catfish (see case study page 25), the annual flooding of the extensive Amazon floodplains associated to the main rivers and streams, and the downstream movement of sediment,[179] blocking critical annual water pulses, and trapping of fish larvae and young in reservoirs.[180] Water storage in reservoirs can also alter downstream water temperatures.[181] Dam construction itself causes direct forest loss, encourages settlement and triggers further deforestation.[182] Influxes of workers alter traditional societies and often compete for land and resources. People, especially indigenous people, are displaced by flooding. For these reasons in some countries there is a long history of resistance to major dams in the Amazon.[183]

DEFORESTATION CREATES A NEGATIVE FEEDBACK, INCREASING SILTATION AND CHANGING HYDROLOGY, REDUCING THE OUTPUT AND LIFETIME OF THE HYDROELECTRIC POWER

IF EVERY DAM PROPOSED IN THE AMAZON BASIN IS BUILT, ONLY 3 FREE-FLOWING TRIBUTARIES WILL REMAIN

If poorly constructed, hydroelectric projects are not even long-term energy sources. Deforestation, whether or not it is associated with dam construction, creates a negative feedback, increasing siltation and changing hydrology, reducing the output and lifetime of the hydroelectric power system.[184] One study projected that under business-as-usual forest loss for 2050, hydropower generation could be reduced by up to 75 per cent of maximum plant output.[185]

It is likely that dams will continue to be built in the Amazon and WWF recognizes well designed dams as part of a low carbon energy future. But impacts could be reduced by moving to basin scale planning and incorporating socio and environmental criteria into decision making. In addition, WWF supports the use of the Hydropower Sustainability Assessment Protocol (see section 6.2), which allows developers independently to assess a project at any stage in development against a set of international standards. Hydroelectric power is not the only or necessarily the best renewable energy option and further support for solar and wind power technologies is needed to provide long-term alternatives.

Figure 9: Samuel Dam impact, Rondônia, Brazil
The Samuel Dam is located along the Jamari River in Rondônia, Brazil. These images show the area in 1984 (left), shortly after construction of the hydroelectric dam began, and in 2011 (right). The reservoir created by the dam flooded the upstream forest and displaced many people. Also evident in the images is the deforestation that has affected much of the region; as the 1984 image shows, roads were already causing deforestation. Hydropower projects increase deforestation pressure not only due to the direct impacts of the construction site and the reservoir, but especially due to the indirect impacts on forests and people, due to the opening of new access roads, the migration of workers to the project site, and the infrastructure needed to accommodate the workforce. Images taken by the Thematic Mapper sensor aboard Landsat 5. Source: USGS Landsat Missions Gallery, "Samuel Dam, Rondônia, Brazil," U.S. Department of the Interior / U.S. Geological Survey.

BIOME HIGHLIGHT

Amazon headwaters - Andean slopes

Water flowing from the Andes creates seasonal pulses over huge stretches of the Amazon and regional differences create unique ecosystems.

Many Amazon rivers drain east or northeast, flowing from the Andes to the floodplain and *varzea*, the seasonal flooded forests.[186] The Marañon River in Peru is the westernmost large tributary of the Amazon River and joins the Ucayali (generally considered to be the main headwater tributary of the Amazon River) to form the "Amazonas", as the Amazon is called in Peru. The peculiar flow dynamics and geography creates unique ecosystems, including seasonally dry tropical forest.

The intimate relationship between the Andes and Amazon results in a water pulse during the wet season, with 6-9 metres difference in river height; an annual event that has formed specially adapted ecosystems and that local human communities have learned to accommodate. Climate change could increase the severity of the pulse[187] and plans to build over 20 hydropower plants on the Marañon[188] could completely alter the river's sediment load, critical for primary productivity downstream. Rivers transport sediment and seeds, and form shifting sandbanks used for fish migration and spawning, reptile and bird breeding and colonization by plants. However, despite its ecological importance, the region has few protected areas and no basin-wide development plan, leaving it vulnerable to unsustainable development.

5.4 Transport infrastructure

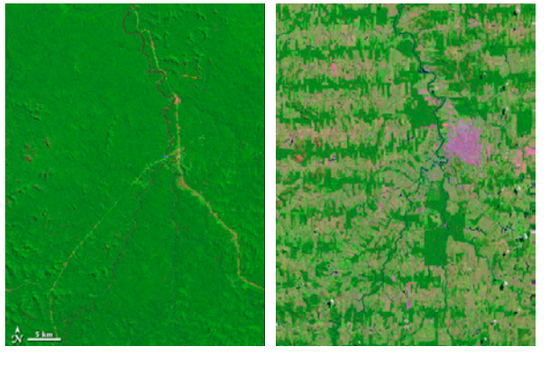
$60 BILLION

ROAD INVESTMENT IN 2013

Roads, railways and new water transport routes are transforming the Amazon. Tens of thousands of kilometres of roads already cross the Amazon;[189] and road building will continue to increase, with a particular focus on east to west routes linked to export markets in East Asia.[190] For instance, the Interoceanic Highway linking Peru and Brazil passes through relatively well conserved areas of Madre de Dios in Peru and Acre in Brazil.[191] There is often a dense network of un-mapped roads spinning off from the state network,[192] the well-known "fishbone effect".[193]

In the Brazilian Amazon 22,713km of federal or state roads are complemented by 190,506km of unofficial roads,[194] often associated with logging and rural access,[195] and unpredictable in their development.[196] The Initiative for the Integration of the Regional Infrastructure of South America (IIRSA) is running over 20 road building projects through intact forest, with almost US$60 billion of investments in 2013.[197] Roads, such as the Belém-Brasilia highway,[198] play a proven role in deforestation,[199] and in forest degradation by opening new areas to migrant farmers, settlers and miners.[200] There are few examples of road building without unplanned forest loss, and cost-benefit analyses have argued that the loss of ecosystem services sometimes outweighs the economic benefits of a road.[201] Integrated planning can reduce the problems, as is being attempted in Colombia with the Pasto-Mocoa road.[202]

At the same time many other transport links are opening: such as a proposed Chinese-funded Atlantic to Pacific railroad between Brazil and Peru and "hydro-way" and road corridors between Ecuador and Brazil,[203] which could also impact on ecosystems and communities. Protected areas generally prevent deforestation and forest degradation in the areas of influence of transport infrastructure,[204] and are thus key tools in reducing pressures from transport developments.



Habitat fragmentation is a major cause of biodiversity loss

Contrasting images from 1975 and 2012 show the fishbone effect of deforestation in Rondônia, Western Brazil. Access to this remote region began with the building of a major road stretching from north to south. Secondary roads were then cut through the dense forest at right angles to the initial road as part of a government settlement project. Settlers cleared the area by first cutting and then burning the forest. As farmed lands grew larger and closer together, they began to merge into a large area of deforestation. This in turn created more exposed edges between deforested areas and intact forest. Edge areas suffer more wind damage and desiccation and access for hunting, poaching, animal capture, and legal and illegal logging increase © NASA images courtesy Landsat team. Caption edited from text by Aries Keck.

5.5 Extractive industries

Between 2005 and 2010 there has been an explosion of extractive claims in South America and particularly in the Amazon. Although the number of contracts and claims granted per year has slowed, the area under potential threat is significant.

Even well managed mines clear forests, create tailings and open areas for other use through creating a road and energy network.[205] Poorly managed and illegal mining can create devastation, including release of toxic chemicals like mercury (see gold case study).

Hydrocarbon operations are also growing, particularly in the Andean Amazon, including controversial projects such as poorly executed hydrocarbon developments in northern Peru; the massive potential for further oil extraction in the Yasuní region of Ecuador;[206] and exploration in Putumayo (Colombia, Peru, Ecuador), Madidi (Bolivia) and Amazonas (Brazil).[207] Mining and oil companies know that protected area status is often no block to their operations.[208] Stronger controls and best practice[209] are both urgently needed.

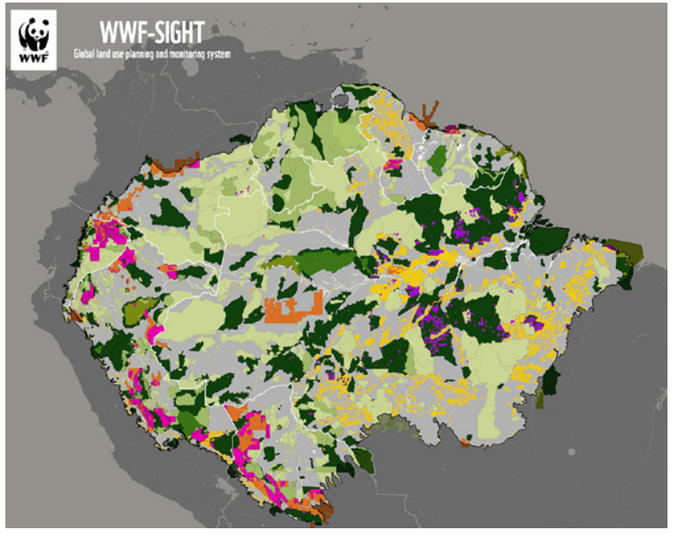


Figure 10: The intersection between extractives contracts and claims overlapping on different types of protected areas and indigenous territories.

Key

- Indigenous territories
- Ramsar sites
- World Heritage sites
- Protected areas
- Granted Mining claims
- Awarded oil and gas contracts
- Granted mining claims within Ramsar sites, World Heritage sites, protected areas and indigenous territories
- Awarded oil and gas contracts within Ramsar sites, World Heritage sites, protected areas and indigenous territories

Data sources: SNL Metals214 and Mining database (mining concessions) and Dillinginfo database (oil and gas concessions). Methodology Notes: To remove marginal data the following filters (Standard WWF) were applied to the dataset. Mining Concessions: 1. Exclusion of all mining concessions that expired before 01/02/2016. All mining concessions with no expiry date listed remain included. 2. Removal of all mining concessions with less than 1km² overlap with asset of interest (e.g., World Heritage sites, protected areas). Oil and Gas Concessions: 1. Removal of all oil and gas concessions with an overlap of less than 5km². 2. Exclusion of all oil and gas concessions that are "Not Operated" (e.g., currently unowned). Values reported may contain error. Source data is dynamic and may be outdated © WWF

$21.7 BILLION

IN 2010 THE MINING SECTOR ACCOUNTED FOR $21.7 BILLION OR APPROXIMATELY 61% OF TOTAL PERUVIAN EXPORTS[212]

Recent research by WWF[210] found that 15 per cent of the Amazon biome is potentially covered by mining claims and oil and gas contracts; although this figure is much higher, 30 per cent, if claims in just protected areas are considered. Over 800 mining and fossil fuel claims have already been granted in protected areas and approximately another 6,800 are under application. Analysis of 439 protected areas found almost half overlapped partially or completely by mining claims and 13 per cent by exploration contracts for oil and gas. In addition, over 600 (37 per cent) of indigenous territories are affected by over 400 mining contracts and 100 oil and gas contracts. Overall, the Amazon has 1,400 granted extractives claims; contracts that overlap and potentially impact up to 24 million ha. The large majority are in Brazil and there is potential for other countries to expand. Most granted claims are for exploration and many, probably most, will not lead to extraction. So far 329 mining sites are productive, impacting on 32 protected areas and 35 indigenous territories; whereas 87 sites are producing oil and gas affecting 12 protected areas and 59 indigenous territories.

Events of the last few years demonstrate a tendency to disregard national and international protection designations. Of 16 Ramsar sites in the biome or on the coast and dependent on the biome, two Brazilian sites together have 28 mining claims from ten companies, mainly for gold. Additionally, Ramsar sites in Ecuador, Peru and Suriname have oil concessions: in Ecuador and Peru these cover 100 per cent of the sites. Several World Heritage sites, in theory the highest value protected areas of all, are potentially under threat from extractives: five sites in Bolivia, Brazil, Peru and Venezuela together have 77 claims from 22 companies covering a range of activities from sand dredging to diamonds (although most only marginally overlap two World Heritage sites or are in their buffer zones).

Furthermore, informal and artisanal mining operate over such huge areas that it is no longer "small-scale". A study for WWF found artisanal and small-scale mining in protected areas in Bolivia, Brazil, Colombia, Ecuador, French Guiana, Peru, Suriname and Venezuela, with the majority of the 168 claims given to cooperatives granted in Bolivia.[211] There is also a huge illegal mining industry and a lack of monitoring for this sector in many countries.

OIL EXTRACTION OCCURS IN SEVERAL SITES WITHIN YASUNI NATIONAL PARK IN THE ECUADORIAN AMAZON[213]

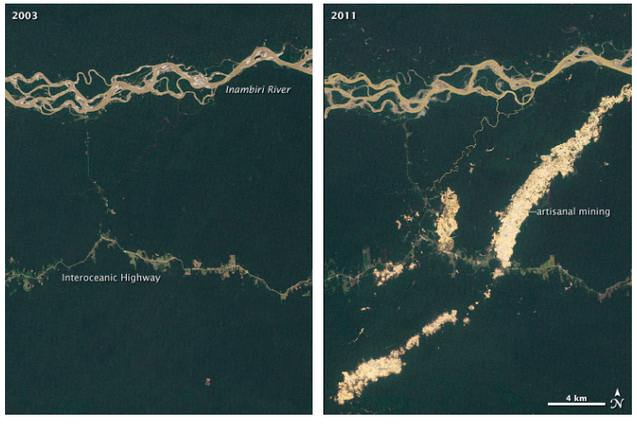
CASE STUDY

Gold mining

Gold mining in the Amazon increases deforestation, and mercury used in processing contaminates water, fish, humans and air.

An increase in the price of gold has created a gold rush in the Amazon,[215] with hotspots identified in Peru,[216,217] Bolivia, Suriname,[218] Guyana and French Guiana[219] amongst others.[220] Gold mining is big business; Peru is the world's sixth biggest producer,[221] while in 2011 small-scale mining employed around 20,000 people in Suriname, generating US$950 million.[222]

Mining has two significant environmental impacts: direct deforestation and destruction of riverine structure as a result of mining and associated settlement; and pollution from sedimentation in rivers and the release of toxic materials. While the loss of forest due to mining is smaller in extent compared to deforestation caused by other land uses, such as agriculture or grazing areas, it is a regionally important driver and, for instance, currently the largest cause of forest loss in Guyana.[223] Increased sediment produced by breaking up riverbanks and adjacent forest with high pressure



The rapid impact of unlicensed gold mining

Images from October, 2003 (left), and September, 2011 (right), by the Thematic Mapper on the Landsat 5 satellite highlighted issues far less obvious from ground level. With the price of gold skyrocketing (360 per cent in 10 years from 2001 to 2011), unlicensed miners began pouring into Peru's Madre de Dios. Local deforestation increased by 26 per cent per year and investigators, who visited the forest after reviewing these images, found serious mercury poisoning affecting both the people and the wildlife © NASA images by Robert Simmon, using Landsat data from the USGS Global Visualization Viewer. Caption edited from text by Joel N. Shurkin.

22%

IT IS ESTIMATED THAT 22 % OF THE GOLD EXPORTED FROM PERU IS OF ILLICIT ORIGIN[237]

water hoses has highly negative impacts on downstream aquatic life, including fish.[224] Both cyanide and mercury are used in gold production; cyanide is the more toxic but is generally used by larger operations and usually, although not always, better contained. In the case of unofficial, usually illegal artisanal mining, mercury use for amalgamation of the gold is widespread and in consequence has become the major environmental impact from Amazon gold mining. For every kilogram of gold produced, an estimated kilogram of mercury is lost into the environment.[225] Over twenty years ago, it was estimated that 90-120 tonnes of mercury were discharged annually into local rivers in the Amazon,[226] and mining activity has increased dramatically since. Research in Suriname found 41 per cent of predatory fish had mercury levels exceeding European Union standards for human consumption,[227] and elevated mercury levels are measured in gold miners,[228] and children from gold mining areas.[229] Mercury enters the atmosphere and can thus be transported upstream as well as down[230] creating dangerous concentrations far from the mining, as measured in the air in Paramaribo, Suriname.[231]

Mining can have severe impacts on indigenous peoples living in the Amazon, and clashes between the Yanomani people and illegal miners have been well documented in Brazil,[232] as have the impacts of large-scale gold mining on maroon communities in Suriname.[233] Wider social impacts include an increase in violence, alcohol and drug abuse, prostitution and unsafe working conditions.[234] Although there are laws controlling mining, these are widely flouted. Mining impacts a growing number of protected areas, such as Parc Amazonien de Guyane in French Guiana, Brownsberg Nature Park in Suriname, Kaieteur National Park in Guyana,[235] Manu National Park in Madre de Dios, Peru and the Montanhas do Tumucumaque National Park on the border of Brazil and French Guiana. Efforts to get more Amazon countries to ratify and implement the Minamata Convention banning mercury in gold mining is now an important priority, with for instance Ecuador introducing a Zero Mercury plan.[236]

5.6 Deforestation

Deforestation is the consequence of the major pressures being exerted on the Amazon (large-scale agriculture and cattle ranching, small-scale agriculture, road and hydropower infrastructure, extractives and logging). It has numerous, complex impacts on the biome: increasing erosion, altering hydrology,[238] releasing carbon, changing local and global climate[239] and destroying biodiversity. Loss of forests means loss of associated ecosystem services and impacts directly and indirectly on the livelihoods of people living inside and outside the Amazon biome.

For several years, WWF has been identifying "deforestation fronts": places where the largest concentrations of forest loss or severe degradation are projected,[240] including in the Amazon.[241] The latest analysis from WWF has identified 31 separate deforestation fronts, mainly but not entirely around the edge of the biome.[242] Analysing data from 2000-2013, there are nine deforestation fronts with increased deforestation trends, 15 fronts with decreased deforestation trends and seven fronts with fairly steady deforestation rates. Three more "consolidated fronts" (marked a, b and c in figure 11) are also identified, mainly in Brazil, where further deforestation is limited within existing areas rather than expansion into new areas.[243]

Overall 4.7 per cent of Amazon forests were lost from 2000 to 2013, with coverage falling from 575 million ha to 548 million ha. This was mainly through replacement with pasture and crops, which increased by 22.9 million ha. While total losses in Brazil remain dominant, the country has also made the greatest efforts to reduce rate of loss;[244] its contribution falling by 75 per cent from 2010 to 2013.[245] Conversely, six new fronts have been identified recently in the Andean Amazon and the Guiana Shield (see case study on gold mining); where in contrast deforestation rate is increasing, albeit total losses are still comparatively very small.

40%

A REDUCTION OF APPROXIMATELY 40% OF THE RAINFOREST MAY TRIGGER A LARGE-SCALE TRANSITION TO A SAVANNAH[253]

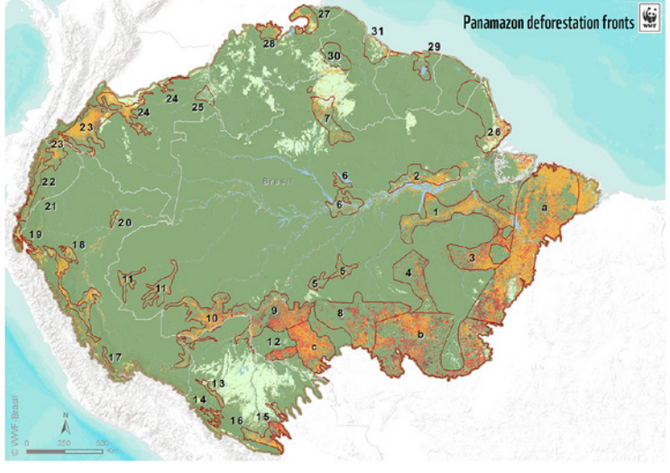


Figure 11: Amazon deforestation fronts: see main text for explanation[255]

Key

- Deforestation fronts
- Amazon biome
- Forest
- Other habitat types
- Water bodies

Deforestation up to 2013

- 2013-2010
- 2010-2005
- 2005-2000
- before 2000

Degradation is important[246] but far less carefully monitored. Statistics are also confused by forest regeneration in abandoned pastures etc.; one estimate is of 362,000km² under regeneration over the 2000-2010 period[247] and fragmentation dynamics have changed.[248]

Analysis of 439 protected areas by WWF, covering 195 million hectares, found very low levels of deforestation: 287ha/yr from 2000-2013 falling to 155ha/yr from 2010-2013, with average deforestation of 2.95 per cent. Protected areas were divided into different risk classes: 83 protected areas are judged more threatened by deforestation, with an average 6.9 per cent of their area deforested. Of 1,702 indigenous territories analysed; average area deforested is 1.59 per cent, so most are resisting deforestation. The average annual deforestation per year for 2010 to 2013 in these territories was only 44ha/yr.

Projections of future loss vary widely. Earlier models do not take into account policy advances and changes in Brazil, nor more recent threats and changes in the Brazilian Forest Code. Projections range from 25 per cent loss by 2020[249] for Brazil's "Legal Amazon"; to 55 per cent of the Brazilian Amazon affected by 2030, with 31 per cent suffering deforestation and 24 per cent damaged by drought;[250] to 40 per cent loss in the Amazon basin by 2050.[251] Using recent regional analysis WWF identified a worst case scenario could predict a 27 per cent loss of forest by 2030 resulting in 85.4 million hectares of forest loss, of which almost 15 per cent would be due to new deforestation. Other projections from this analysis are shown in the table below.

WWF advocates the development of polices and strategies around the goal of Zero Net Deforestation and Forest Degradation (see section 6.1) to halt deforestation and forest degradation.[252]

Table 1: Regional deforestation projections using WWF analysis of MODIS (2000-2013) data[254]

WWF analysis using MODIS (2000-2013)	2030 projections in terms of % of area of the biome	Projected deforestation from 2000-2030 in terms of total area lost in ha	Projected deforestation from 2010-2030 in terms of total area lost in ha
Case 1 (Average between 2010-2013)	21.0%	44.2 million	21.7 million
Case 2 (Average between 2005-2013)	21.6%	48.4 million	25.8 million
Case 3 (worst case average 2000-2013)	27.2%	85.4 million	62.9 million

5.7 Logging

Logging is a relatively minor cause of deforestation in the Amazon, but creates significant forest degradation and more importantly opens up forest to other exploitation and land use, including complete forest clearance.

The scope of selective logging is often under-estimated[256] but it can have a damaging impact on biodiversity.[257] While felling trees for sale on the domestic or international timber market generally has less impact on Amazon forests than agriculture, cattle ranching or mining,[258] it is a significant pressure in some areas and dozens of timber companies operate. Analysis of carbon released after selective logging shows that most of the losses come from damage to surrounding vegetation.[259] More broadly, selective logging has been estimated to lead to complete land use change in a quarter of cases in the Amazon.[260]

Analysis of legal logging concessions only gives a partial picture of impacts, as illegal logging is also a serious threat.[261] According to research by WWF, it is widespread in Bolivia, Brazil, Colombia, Ecuador and Peru[262] (e.g., 78 per cent of logging in Pará state in Brazil between August 2011 and July 2012 was judged to be illegal).[263] Legal timber concessions also sometimes open up forests to illegal exploitation.[264] However, satellite analysis and monitoring is not able to measure the extent of degradation from selective logging, whether illegal, or for local consumption.

The Forest Stewardship Council (FSC) principles provide a useful benchmark to assess the sustainability of production forestry,[265] but to date certified timber concessions are quite limited in scope in the Amazon.[266]

78%

ESTIMATE OF ILLEGAL LOGGING IN PARÁ STATE, BRAZIL BETWEEN AUGUST 2011 AND JULY 2012

5.8 Climate change

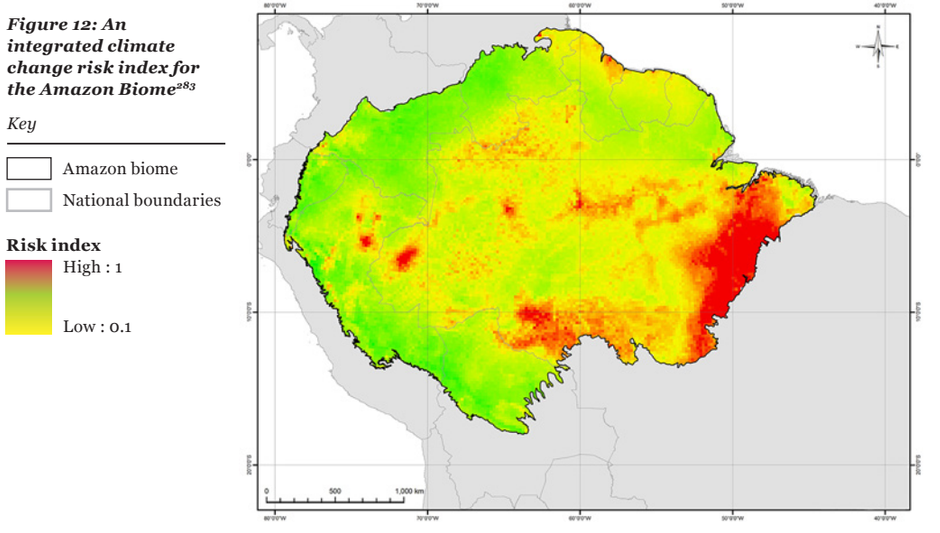
Research consistently shows that the climate of the Amazon is changing, with consequences for the whole biome (see figure 12).[267,268,269,270]

WWF assessed the Amazon's vulnerability to climate change,[271] considering: (i) climate trends; (ii) capacity to provide carbon storage, habitat for species and provision and regulation of freshwater; (iii) assessment of overall resilience, including identification of areas of greatest resilience. Changing climate often interacts with other human impacts such as land use change (particularly deforestation)[272] to create a cumulative pressure on the ecosystem. Forest fires are likely to increase, driven by both climate change and land clearance.[273,274] Droughts and floods are natural occurrences but have increased in frequency and intensity, and this trend will likely continue.[275,276] Periodic water deficits can reduce forest productivity,[277] reduce hydroelectric potential[278] and impact on river transport,[279] as will overall drier conditions.[280] Species distribution will change, with declines in diversity expected in particular toward the edges of the biome. Impacts will be strongest in climate change "hotspots" like southeast Amazon, where drier conditions are projected.[281] Deforestation continues to reduce the ability of the biome to store and sequester carbon, thus contributing to further climate change, and directly alters local climate.[282] And significantly, almost 35 per cent of existing protected areas are facing a high risk of detrimental changes based on trends in precipitation and temperature.

69%

SINCE THE YEAR 2000, PRECIPITATION HAS DECLINED ACROSS 69% OF THE TROPICAL EVERGREEN FOREST[284]

Figure 12: An integrated climate change risk index for the Amazon Biome[283]



5.9 Finance and investment

The largest pressures on the Amazon, agriculture, ranching and infrastructure, are driven largely by finance from commercial and investment banks, export credit agencies and development banks.

Financial institutions have good reasons to embed sustainability and conservation in their lending and investment practices – however unfortunately few do.[285] Generally, there is insufficient participation in international voluntary initiatives relevant to forests and land issues by such institutions, lack of explicit social and environmental safeguards or encouragement for customers to improve corporate disclosure through participation in international reporting frameworks, and weak environmental, social and governance policies and guidelines. Few major financial institutions have clear policies on investment activities in high conservation value areas, high carbon stock forests or protected areas. There is also low uptake of voluntary initiatives (both financial and related to resource use such as FSC – only 8 per cent of global wood production is FSC-certified) or land use expansion moratoria.[286]

A series of voluntary environmental agreements, tools and risk management frameworks have been created. These include the Equator Principles,[287] the Natural Capital Declaration[288] (and its Soft Commodity Forest Risk Tool),[289] the Soft Commodities Compact[290] and the UN's Principles for Responsible Investment (UN-PRI).[291] Other agreements include the UN Global Compact,[292] the Global Reporting Initiative,[293] UNEP's Finance Initiative (UNEP-FI),[294] the Banking Environment Initiative (BEI)[295] and OECD's Guidelines for Multinational Enterprises (which includes an accountability mechanism whereby signatory companies commit to being compliant with international law).[296] These are all useful but insufficient: limited by their voluntary approach, applicable only to certain types of transactions, and focusing on specific sectors.

Analysis by WWF suggests that banks and investors providing companies with financial capital can play a major role in safeguarding the Amazon. By developing sustainability-based investment portfolios, financial institutions have the opportunity to deliver financial returns from investments that contribute to sustainable development, rather than to environmental degradation.[297]

FEW MAJOR FINANCIAL INSTITUTIONS HAVE CLEAR POLICIES ON INVESTMENT ACTIVITIES IN AREAS OF HIGH CONSERVATION VALUE

5.10 The world's consumption impact on the Amazon

Many of us impact the Amazon without knowing it, by purchasing goods produced on converted forest land or made using energy from dammed rivers. WWF defines an ecological footprint as "A measure of how much biologically productive land and water an individual, population or activity requires to produce all the resources it consumes, and to absorb the waste it generates…"[298] We have not yet quantified the world's ecological footprint on the Amazon; but just as the biome has positive influences way beyond its boundaries, the decisions of investors, producers and consumers around the globe, including the Amazon countries themselves, can impact even the remotest part of its forests. This can be positive or negative.

The Amazon region's export market suggests how much the rest of the world uses resources from or supported by the biome. In 2012, Brazil exported US$1.6 billion of beef produced in the Amazon and US$8.8 billion of iron ore from Para state alone; while Bolivia earned US$940 million from soya and US$3.8 billion from natural gas exports.[299] In 2013, EU countries imported tropical timber products worth US$148 million from the Brazilian Amazon with one-third of all timber exported from the region going to EU countries.[300] Research commissioned by WWF Netherlands concluded that the total area under soy cultivation in Brazil (this is by no means all in the Amazon) needed to supply the Dutch market was 25.3 million ha in 2005 – over half of the Netherlands land area and larger than the area under agriculture in the country.[301]

US$8.8 BILLION

THE VALUE OF IRON ORE EXPORTS FROM PARA STATE IN BRAZIL IN 2012

Globally, we can all help to reduce our impact on the Amazon. Techniques such as traceability of commodities and certification schemes enable responsible consumers to choose products from sustainable sources. But this will involve considering the ecological footprint across a range of investments, as well as production and consumption choices.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

6 SAFEGUARDING THE AMAZON

WWF's vision for the Amazon Region is an ecologically healthy Amazon biome that maintains its environmental and cultural contributions to local peoples, the countries of the region, and the world, within a framework of social equity, inclusive economic development and global responsibility. WWF is developing its Amazon strategy for the next ten years. It focuses on three main goals: the conservation and sustainable management of forest ecosystems; the protection of critical freshwater ecosystems and maintenance of Amazon river connectivity; and minimizing the damaging impacts of climate change by enhancing resilience in the Amazon biome. In the following pages, we lay out some critical steps in this process.

Photo: Wayampi fisherman, Oyapock River, French Guiana © Roger Leguen / WWF

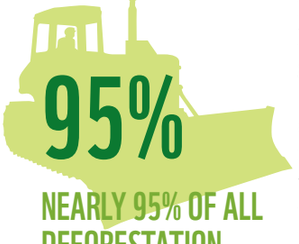
6.1 Securing forest integrity

THE AMAZON FOREST SHOULD REMAIN STANDING AND PROTECTED

WWF believes that to maintain essential environmental services, global and regional climate regulation and Amazon biodiversity, most of the Amazon forest should remain standing and protected. It should be secured through a mixture of conservation in protected areas, recognition and consolidation of indigenous territories, and sustainable management. This view presupposes a 20 per cent maximum conversion area by 2020 (acknowledging that 17 per cent of the Amazon forest had already been cleared by 2014)[302] and assumes "zero net deforestation and forest degradation" (ZNDD – see box for details) by 2020.[303] Integrative management policies and use of sustainable development tools, incentives and financial mechanisms, coupled with robust safeguard policies for developers can help secure healthy forests within vibrant economies in Amazon countries. Natural forests are an opportunity for sustainable development, rather than a block or impediment on development. Three strategies are important:

Securing half the forest in a mosaic of effectively managed protected areas, indigenous territories and standing forest, supported through REDD+ mechanisms or similar for ecosystem services such as carbon retention or biodiversity conservation. This entails completing an Amazon-wide system of protected areas (a "system of national systems"), filling conservation gaps, integrating indigenous territories, and where necessary expanding total area to achieve full ecological representation of biodiversity. It includes improving management effectiveness and delivering sustainable financing for protected areas that exist in name but have not been consolidated. By early 2016, protected area coverage was already over 31 per cent for protected areas and over 30 per cent for indigenous territories; although not all the latter are officially recognized and several areas do overlap with protected areas (see section 3.4). Together these areas have seen levels of protection in the Amazon biome rise from 45.7 per cent in 2005 to 53.8 per cent in 2016.[304] However, not all ecosystems are adequately represented (for example, freshwater ecosystems), so some further designation is needed. A regional plan to boost resilience to climate change is also needed, which recognizes protected areas and indigenous territories as important sources of mitigation and adaptation. A key priority is to ensure that high value landscapes (protected areas, indigenous territories, Ramsar and World Heritage Sites) remain conserved following science-based zoning including identification of no-go areas for extractives and infrastructure development. This needs to be complemented with more systematic annual monitoring of deforestation at the biome level, officially recognized by the governments in the region.

What is Zero Net Deforestation and Forest Degradation?
WWF defines ZNDD as no net forest loss through deforestation and no net decline in forest quality through degradation. ZNDD provides some flexibility: it is not quite the same as no forest clearing anywhere, under any circumstances. For instance, it recognizes people's right to clear some forests for agriculture, or the value in occasionally "trading off" degraded forests to free up other land to restore important biological corridors, provided that biodiversity values and net quantity and quality of forests are maintained. In advocating ZNDD by 2020, WWF stresses that: (a) most forest should be retained – the annual rate of loss of natural or semi-natural forests should be reduced to near zero; and (b) any gross loss or degradation of pristine natural forests would need to be offset by an equivalent area of socially and environmentally sound forest. In this accounting, plantations are not equated with natural forests as many values are diminished when a plantation replaces a natural forest.[306]



NEARLY 95% OF ALL DEFORESTATION IN THE BRAZILIAN AMAZON OCCURS WITHIN 5.5KM OF ROADS[305]

Developing a cohesive and robust "Amazon sustainable landscapes" approach to reduce poverty, allow economic growth and reduce deforestation and forest degradation. Protected areas and indigenous territories should not stand apart from the rest of the biome, but be fully integrated into regional development and investment plans. Plans should include vulnerability assessments and climate adaptation strategies. Land use planning needs to take sustainability seriously, reflecting the UN's Sustainable Development Goals, best practice standards and voluntary commodity certification schemes. Encouragement and incentives should be given to business models that maintain natural forests in good condition, or encourage sustainable use rather than conversion to other, often short-term land uses. Some tools, such as timber tracking technologies and certification schemes like the Forest Stewardship Council (FSC), are well established but may be usefully applied to a wider range of forest goods, including the promotion of sustainable non-timber forest products. An improved sustainable development focus needs to be adopted by national and sub-national governments, especially in transboundary areas.

Developing and promoting the uptake of strong biome-relevant safeguards by companies and their investors in the key economic sectors operating in the Amazon, leading to more sustainable finance and investment. Robust social and environmental safeguards and sustainability criteria are needed for national and transboundary development initiatives such as hydropower infrastructure projects, mining, oil and gas activities, agriculture, cattle ranching, transport infrastructure projects and forest management. The aim is not to stop development in the Amazon, but to encourage deforestation-free development that reduces poverty, improves human well-being and is compatible with the long-term ecological security of the forest biome, as well as water security, energy security and food security in the Amazon region. Safeguards are needed equally for developers and their financial backers. The aim is for relevant private and public finance institutions to adopt robust environmental and social safeguards in their lending and investment policies thus creating new financial incentives to scale up sustainable forest economy practices, supporting zero net deforestation plans and poverty reduction in the Amazon region. In addition to safeguards, alternative economic models are needed that derive their profitability from the maintenance and restoration, rather than the destruction, of natural forests.

BIOME HIGHLIGHT

Guiana Shield

This massive, largely pristine and enigmatic part of the Amazon provides a chance to integrate conservation, cultural rights and sustainable development.

The Guiana Shield covers a third of the Amazon, including Guyana, Suriname, French Guiana and parts of Brazil, Venezuela and Colombia. It contains some of the most unique and intact Amazon ecosystems, including the amazing "tepui" table-top formations. Human population is low and poor transport links keep it remote. The region offers unique opportunities for conservation, but also faces several threats. Key conservation priorities include:[307,308]

Figure 13: The Guiana Shield is an old Precambrian geological formation in the north of the Amazon biome, spanning approximately 37% of the Amazon biome. *The three countries of the Guiana's (French Guiana, Suriname, Guyana) comprise roughly 7% of the Amazon biome and form a vital part of the Guiana Shield*[309]

- Expanding existing protected areas into a conservation mosaic (no-go areas, protected areas, indigenous territories and sustainable use) covering 7 million hectares along the spine of the Guianas
- Addressing threats from legal and illegal gold mining, including the need for Guiana Shield countries to sign and implement the UN Minamata Convention to eliminate the use of mercury, which currently pollutes water and air, with grave consequences for wildlife and humans
- Maintaining freshwater systems, particularly in parts of the catchment responsible for the flow regimes that maintain aquatic connectivity
- Strengthening the capacities of indigenous peoples and African maroon communities to resist pressures on their traditional territories
- Managing the unique marine environment, particularly conserving mangroves that maintain fisheries and buffer coastal communities from storms.

CASE STUDY

Status of gap analyses across the Amazon

Action needs to be taken urgently to ensure protection is both representative and effective across the biome. Research and mapping projects provide a clear picture of current and potential threats to the Amazon, and gaps in protection.

Despite the seemingly extensive coverage of protected areas and indigenous territories across the Amazon (see section 3.4), ecological representation of the biome remains incomplete.

Analysis by WWF in 2014[310] concluded a minimum protection target of 30 per cent of each ecoregion within the Pan-Amazon should be protected in order to safeguard a representative portion of Amazon biodiversity. In addition to ensuring the continued provision of ecosystem services for the region and the world (including the mitigation of global climate change), protected areas, collectively, need to safeguard a sufficiently representative amount of Amazon biodiversity. The 30 per cent ecological representation target needs to be accompanied by efforts to broadly maintain ecosystem processes and freshwater flows in about 60-70 per cent of the Amazon, as well as reaching zero net deforestation by 2020, and assumes a 20 per cent maximum conversion area. Equally, the target should not be understood simply as 30 per cent of the species or 30 per cent of the ecosystems, but rather the best possible attempt, using proxies, to protect an ecologically representative sample of 100 per cent of Pan-Amazon biodiversity.

With respect to freshwater systems, the target is based on the finding that although the majority (61 per cent) of 312 defined aquatic systems identified were represented in protected areas (a figure which rises to 78 per cent when both protected areas and indigenous territories are assessed) the actual area protected was quite low. Only 65 freshwater systems (21 per cent) have more than 30 per cent of their area within protected areas, a figure which rises to over 30 per cent of freshwater systems when indigenous territories are added (see figures 14 and 15).

Effectively managed protected areas and indigenous territories have a proven history of conserving forests in the Amazon. But unless they are ecologically representative of Amazon biodiversity, including the vital freshwater systems of the Amazon, the biome is unlikely to maintain resilience, especially under projected climate change. Ecoregions with less than 30 per cent representation in protected areas need to be targeted for further protection or at least adequate management, whilst the physical and legal integrity of protected areas and indigenous territories needs to be considered when new infrastructure projects are planned. New protection models are needed, such as the water reserves concept developed in Mexico or “wild and scenic rivers” in the USA.

Figures 14 and 15 show the results of WWF’s 2014 ecological representation study.[312] *31 of 36 terrestrial ecoregions meet the outdated 10% target, but only 23 meet the CBD’s 17% target (Aichi Biodiversity Target 11) and only 11 meet WWF’s recommended 30% target. When indigenous territories and similar areas are included, ecological representation increases. The 10% target is achieved throughout; the 17% target in 34 out of 36 ecoregions; and under the 30% target, there are gaps in five ecoregions. Although the area of protected areas has been increasing, the challenge is ensuring that new protected areas include under-represented ecoregions, which are concentrated in the south-eastern Amazon in Brazil and extensive low lands in central Bolivia, along with large areas in central Amazon (Brazil), central north (Brazil, Venezuela, Colombia and Guyana) and central western (Peru, Ecuador and Colombia). Mato Grosso seasonal forests, Beni and Guianan savannahs, Guianan freshwater swamp forests, Xingu-Tocantins-Araguaia, Tocantins/Pindare, Napo and Solimões-Japurá moist forests, and Marañón and Apure-Villavicencio dry forests are all particularly poorly protected.*

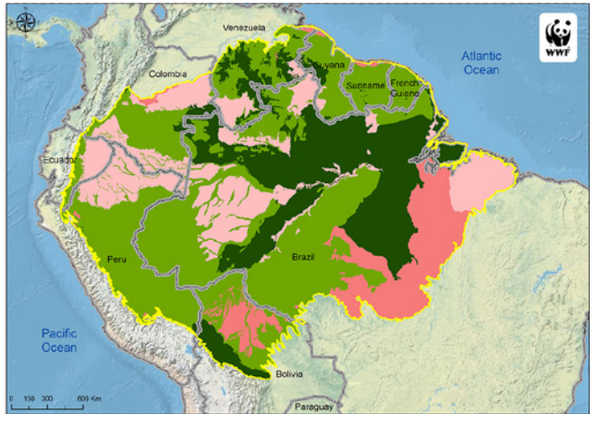


Figure 14: Ecological representation: level of protection of Amazon terrestrial ecoregions – by protected areas (2013).
Source: WWF Brazil´s Science Programme

Key

- 0-10 %
- 11-17 %
- 18-30 %
- > 30%
- Amazon biome
- International boundaries

Figure 15: Ecological representation: level of protection of Amazon terrestrial ecoregions – by protected areas and indigenous territories (2010/2013)[311]
Source: WWF Brazil´s Science Programme

Key

- 0-10 %
- 11-17 %
- 18-30 %
- > 30%
- Amazon biome
- International boundaries

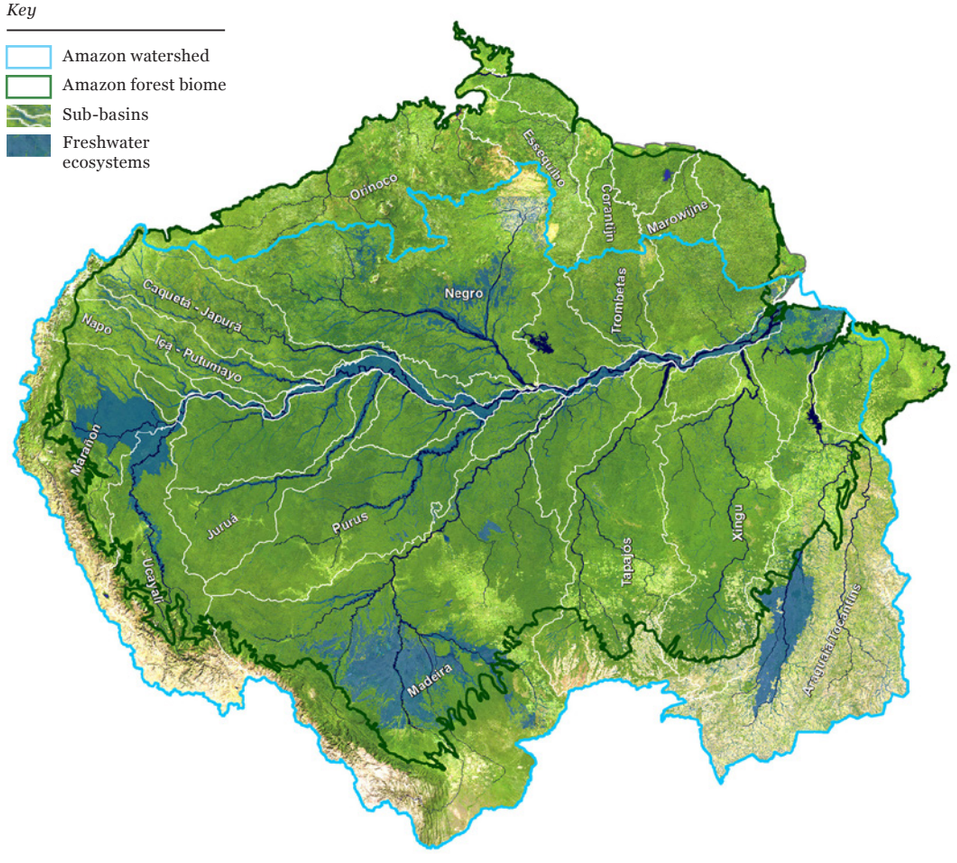
6.2 Securing water connectivity and integrity

Securing the life, cultural values and ecosystem services supplied by the Amazon and its tributaries requires multiple steps. The most urgent is the need to change the planning system for hydropower. If even a fraction of the over 250 large dams planned are built, this will cause a dramatic change to the overall hydrology of the basin. Similarly, despite a large percentage of the basin being covered by protected areas or indigenous territories, these are not created or managed from a freshwater perspective. Until now, the world's largest river basin has been largely managed, from a conservation perspective, as a forest landscape. There is an urgent need to bolster the network of protected areas from a freshwater perspective including wetlands and protected rivers (see pages 68-69). Three strategies are important:

MAINTAINING CONNECTIVITY OF AMAZON RIVERS AND FRESHWATER ECOSYSTEMS IS OF CRITICAL IMPORTANCE

Sustainable hydropower and waterway planning processes in key sub-basins needs to be informed by a basin-wide vision for the Amazon that maintains connectivity of Amazon rivers and protects high value freshwater ecosystems. Of critical importance is maintaining connectivity of Amazon rivers and freshwater ecosystems, along with protection and where necessary restoration of key habitats and species. A particular focus is needed on three priority basins (Madeira, Marañon, Tapajós) as frontiers of hydropower development and places where sustainable planning and management tools can be tested and refined. Full cost accounting is needed, which can make many projects unviable on purely economic terms, along with more effective communication on the impacts of hydropower development to governments, industry and civil society. There are now a suite of tools and scientific and social data to inform sound hydropower planning at the basin scale (see section 6.4). Since dams that are poorly planned from a social and environmental perspective usually also deliver poor economic results, policy makers are beginning to engage with civil society and scientists to support the planning process. Decision support tools such as Hydrological Information Systems for Amazon River Assessment (HIS-ARA), which is being applied in the Tapajós and Marañon basins, inform decision makers of the configuration of dams in the basin which results in the best environmental and social outcomes, while producing the same energy output (in MW) as more damaging scenarios. Similarly, the Hydropower Sustainability Assessment Protocol (HSAP) is a voluntary industry standard that WWF supported in its development, which, if applied, informs planners and decision makers on how to improve the sustainability of individual hydropower projects. However, despite all of these available tools and information, today hydropower planning is more of a political than scientific process. Where decision makers continue to ignore available science and fail to fully engage civil society, resulting in poorly planned and high impact dams, then campaigning could sometimes be necessary against dams or a combination of dams in no-go areas or dams likely to have significant environmental impact.

Figure 16: The Amazon basin (i.e. watershed; blue outline) includes areas of tropical forests and savannahs and is defined by the hydrology of the Amazon River and its tributaries[313]
Figure adapted from Castello et al. 2013; Map: Paul Lefebvre/WHRC.

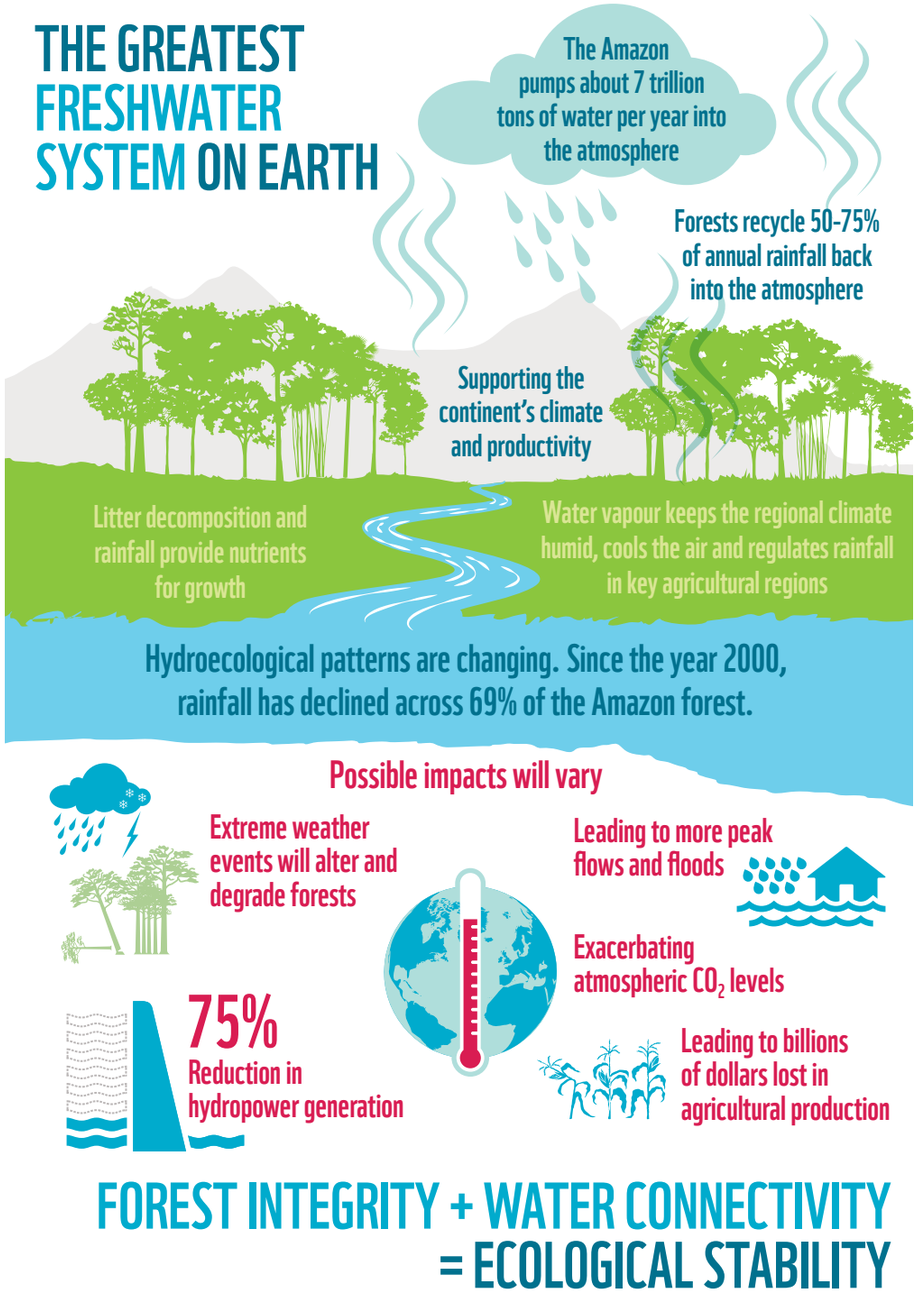


Greater protection of freshwater ecosystems and habitats in the Amazon basin is still needed, as analysis shows serious gaps in ecological representation and the ability to maintain overall river system flow dynamics. There is an urgent need to increase the representation and management of Ramsar sites as well as introduce new forms of protected river legislation and more effective transboundary and basin-wide

water governance. A mixture of legal protection, customary or traditional management systems and other forms of conservation measures may all be useful. At an Amazon-wide level, this means building the case for free-flowing rivers; and considering environmental, economic and social values along with proofing against future risk, particularly climate change. Legal opportunities for freshwater protection need careful consideration in the Amazon context, particularly the UN Watercourses Convention. Improved transboundary governance and management of freshwater resources and planning is essential, as is a push to integrate freshwater management into wider land use planning.

Maintenance of the health and integrity of existing freshwaters remains critical, inside or outside protected areas, for example through reduction of mercury pollution. A healthy Amazon basin is more than just about water connectivity and freshwater ecosystem protection. Of critical importance in some parts of the Amazon biome is reducing pollution pressure, particularly from often illegal, small-scale artisanal mining operations and the resulting release of mercury into the environment. River systems not only need to be adequately protected, with their hydrological functions intact, but also healthy enough to maintain the host of species, including humans, who rely on them for food and water.

HYDROLOGICAL FUNCTIONS NEED TO REMAIN INTACT AND HEALTHY TO MAINTAIN THE HOST OF SPECIES, INCLUDING HUMANS, WHO RELY ON THEM FOR FOOD AND WATER



6.3 Enhancing climate resilience

Even if the ecological integrity of forests and rivers is effectively maintained, the whole Amazon region will continue to change due to current and future impacts of climate change: rising temperatures, increased droughts which lead to forest die-back and catastrophic floods which displace riverside dwelling populations and wildlife alike. There is only a limited amount we can do directly to address these fundamental changes, although WWF continues to lobby for stronger controls on greenhouse gas emissions through the UN Framework Convention on Climate Change. A regional conservation plan for the Amazon needs to consider all possible ways to mitigate and adapt to climate change. This includes adaptation actions in the Amazon itself to maximize resilience in the ecosystems. More generally mitigation actions in the Amazon countries are needed to promote a more balanced energy mix with greater use of non-conventional renewables (solar, wind, biomass), less reliance on hydropower in the future, and measures to reduce energy demand and increase energy efficiency within integrated national energy production systems. Two strategies are important:

10%

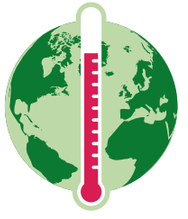
OF GLOBAL RESERVE OF CARBON STORED

Identifying and implementing key biome-level actions for increasing resilience of the Amazon biome. While the science of resilience is still quite new, we already know several strategies that can help to build ecosystem resilience in the Amazon:

- Maintaining functional diversity: resilience is likely enhanced through the protection of ecological functions and structural diversity.
- Conservation of large, well conserved ecosystems and ecological processes: at a scale that maintains ecosystem structure and diversity, with viable populations of all species.[314]
- Conservation of fragments of endangered ecosystems: useful where key features are at risk within otherwise managed landscapes or waterscapes, and for migratory species.[315]
- Conservation of a proportion of natural ecosystems with minimum human interference.
- Conservation of species or habitats through management tailored to their specialized needs: particularly important in habitats threatened by fire, drought and invasive alien species.
- Protecting range-limited and endemic species: by minimizing other human induced stressors.
- Conservation of particular aspects of species' life cycles: for example, fish breeding grounds.[316]

- Introducing land and water use planning systems that seek to deliver more resilient ecosystems, by reducing additional stresses from fire, pollution and other pressures.
- Restoration of critically damaged ecosystems.

Within the Amazon biome priorities include improving scientific understanding on climate vulnerability at the biome scale, ecosystem services and resilience; ensuring biome-level integration of protected area systems and indigenous territories to maximize scale and connectivity; and achieving recognition of the importance of the biome for global climate change resilience by politicians and civil society.



MITIGATION ACTIONS IN THE AMAZON COUNTRIES ARE NEEDED

Promoting a more balanced debate on hydropower in the Amazon region and promoting the uptake of alternative/ non-conventional renewable energy systems in biome countries. Although hydropower is often promoted as a "clean" energy source, large-scale hydropower projects come with high costs if they disrupt the Amazon hydrological cycle. There is considerable debate about associated greenhouse gas emissions from hydropower plants,[317] particularly when large areas of forest are flooded by reservoirs.[318] While reducing greenhouse gas emissions is critical, the trade-offs must be recognized and an optimum energy mix developed.[319] Renewable energy alternatives within Latin America are needed that are not over-reliant on the growth of hydropower in the Amazon, with its risks of energy shortages during times of drought and the associated impacts of dams on freshwater connectivity across the basin.[320] At the same time, renewable energy systems are needed for people living inside the biome.[321] Initial steps include setting a collective target for production of non-conventional renewable energy in Amazon countries to reduce pressure from hydropower and provide greater energy security, along with a platform to position an Amazon energy agenda with elected representatives, building on experience already developed in Peru.

A REGIONAL CONSERVATION PLAN FOR THE AMAZON NEEDS TO CONSIDER ALL POSSIBLE WAYS TO MITIGATE AND ADAPT TO CLIMATE CHANGE

CASE STUDY

REDPARQUES – Together against climate change

Eighteen Latin American countries, including all nine Amazon territories, issued a declaration in 2015 calling for recognition of the role of protected areas in addressing climate change.

Protected areas have a role in both mitigating and adapting to climate change.[322] Cross-border cooperation on protected areas is essential to foster the changes in perspective needed to build resilience of the biome and promote sustainable development.

During 2015, Latin American governments developed a statement about the role that protected areas play in climate change mitigation and adaptation.[323] It was coordinated by REDPARQUES, the Latin American Technical Cooperation Network on Protected Areas, with support from the WWF Living Amazon Initiative.[324]

The *Declaration on Protected Areas and Climate Change* was agreed during the REDPARQUES Council meeting in August 2015. It comprises commitments related to strengthening protected areas, promoting co-management, implementing education programmes, promoting awareness amongst citizens, and boosting research and assistance, and includes an important statement on the integration of protected areas and climate change adaptation and mitigation strategies (see side bar).

The declaration was delivered officially at the UN Framework Convention on Climate Change meeting in Paris (CoP21) in December 2015, where Latin American governments stressed the role of protected areas in climate planning and financing strategies. It was recognized by high level environmental authorities from governments, multilateral institutions, civil society and academia as the most important and the most positive policy initiative for protected areas in the last decade. The declaration stimulated commitment for the creation of additional protected areas in Colombia. It also raised a lot of positive publicity, bringing protected areas to the attention of the climate change community. Peruvian Environment Minister Pulgar Vidal hailed the initiative as unique, highlighting the importance of countries coming together to designate protected areas in transboundary regions and shared river basins.

***Integrate** protected areas as climate change adaptation and mitigation strategies that promote sustainable and climate friendly development, through:*

a. Strengthening protected areas in the actions of the United Nations Framework Convention on Climate Change;

b. Inclusion of national protected areas systems in the national adaptation strategies, including in the National Adaptation Programs of Action (NAPAs) and National Adaptation Plans (NAPs), and other programmatic documents;

c. National recognition of the role of protected areas as mitigation strategies to absorb, store and reduce greenhouse gas emissions, as well as their benefits beyond carbon capture;

d. Monitoring and reporting of the contribution of protected areas and other effective conservation measures for climate change adaptation and mitigation.

6.4 Tools, approaches and guidelines

Poor long-term planning has led to serious environmental degradation in the Amazon. A greater understanding has developed in recent decades of the way that Amazon forest and freshwater ecosystems interact regionally and globally. WWF has developed a suite of tools, approaches and guidelines to help decision makers, from national governments to local communities, to balance conservation and development and thus ensure long-term environmental, economic and social security. Three are summarized below.

HIS-ARA INTEGRATES HYDROLOGICAL AND ECOLOGICAL INFORMATION TO OBTAIN A REGIONAL VISION OF CONSERVATION

1. HIS-ARA decision support approach

Hydroelectric projects impact much of the Amazon (see section 5.3). Given the sheer scale of developments a regional, biome-wide approach to addressing the impacts is required. WWF has developed a decision support system using Hydrological Information Systems (HIS) suitable for Amazon River Assessment (ARA). HIS-ARA integrates hydrological and ecological information (using appropriate software and indicators for mapping and evaluating conservation targets and risks) to obtain a regional-scale vision of terrestrial and aquatic ecosystem conservation. The approach aids the development of long-term conservation visions and evaluates local and regional impacts on rivers, forests and people stemming from hydroelectric development. It does this by helping decision makers construct and evaluate development and conservation scenarios in dialogue with interested parties.

The HIS-ARA approach has been used in the Tapajós river basin (see figure 17); a mosaic of intensive agriculture and natural forest covering nearly 500,000km^2 in the states of Mato Grosso, Pará, Amazonas and a small portion of Rondônia.[325] The basin is Brazil's most important in terms of its hydroelectric energy-producing potential, and plans have been developed to build 44 dams on the Tapajós, including two major hydroelectric plants (São Luiz do Tapajós and Jatobá). Protected areas and indigenous territories cover 40 per cent of the basin, but the development plans led the federal government to enact a Law in 2012 degazetting 750km^2. Interacting with government authorities and technical personnel in the fields of energy and the environment and with contributions from several research studies, WWF developed a conservation vision for the basin. The vision balances development of hydropower with integrated conservation planning which prioritizes the maintenance of longitudinal and lateral connectivity of freshwater ecosystems.[326]

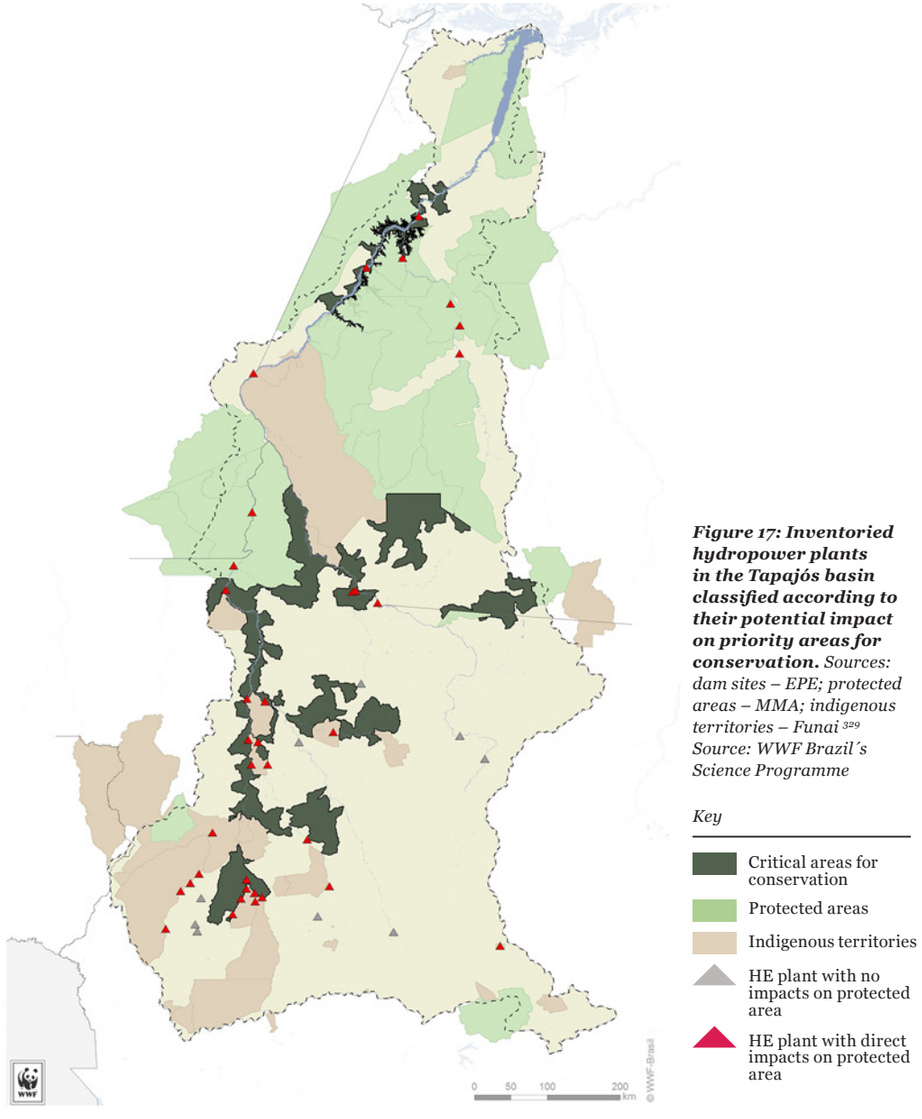


Figure 17: Inventoried hydropower plants in the Tapajós basin classified according to their potential impact on priority areas for conservation. *Sources: dam sites – EPE; protected areas – MMA; indigenous territories – Funai* [329]
Source: WWF Brazil´s Science Programme

2. Building sustainability into financial flows to the Amazon
WWF is in the process of publishing a benchmark for a responsible investment policy, which focuses on three steps.

Commitments: The need for banks and other investors to join the range of initiatives and platforms (see section 5.9) that inform and improve their policies, taking into account impacts throughout their entire supply chain. It should be standard practice for all banks to require good reporting from all companies they lend to or invest in.

Sector and cross-sector policies: Financial institutions need to adopt and implement more stringent cross-sector requirements to avoid and mitigate forest and biodiversity loss as a result of companies' operations in different sectors in the Amazon biome. Clear no-go policies need to be developed along with demands for full transparency from clients and potential clients when it comes to financing activities in or adjacent to protected areas.

Enforcement and monitoring: Good policies need to be enforced on the ground, which requires strong monitoring and implementation checks. Monitoring needs to encompass the whole supply chain and not just direct sales. Investors need good information to be able to make informed decisions: good disclosure and reporting standards from clients are paramount. Clear criteria for due diligence checks and possible consequences in case of noncompliance should be part of comprehensive environmental, social and governance (ESG) policies.[327]

3. Biome-level vulnerability analysis
A methodology was developed to assess climate vulnerability across the whole Amazon biome, necessarily at a broad scale (see section 5.8). The methodology had three steps:

1. Understanding the context and possible evolution of climate conditions within the Amazon biome and assessing whether these are either drivers of change and/or potential hazards. The main tools used were climate change scenarios, including prediction of climate variability and extreme weather events.
2. A climate risk assessment including technical evaluation of the biome's capacity to provide three critical ecosystem services – carbon storage, species habitats and freshwater provision and regulation – under current and future climate and land use conditions.
3. Assessment of ecosystem resilience building on the results of the climate risk assessment, in particular identifying sectors of the Amazon where there is less risk of losing the capacity to provide these ecosystem services.[328]

6.5 The role of global instruments

Amazon countries draw on various global instruments that encourage sustainable use and conservation. Some promote protected areas or other sustainable management of land and water, while others more generally encourage sustainable development and environmental stewardship.

Various UN Conventions, including the Convention on Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC) and various UNESCO instruments have a direct influence on conservation in the Amazon. In particular, the CBD sets a broad framework for biodiversity conservation with specific targets for curbing deforestation and for consolidating national protected area systems, and UNESCO's World Heritage Convention and Man and the Biosphere programme provide models of protection. The UN-Reducing Emissions from Deforestation and Forest Degradation (REDD) programme provides funding for forest conservation. The Ramsar Convention on Wetlands encourages protection of critical wetland areas. Despite long debate, there is no global treaty on forests, but there is a UN "Non-Legally Binding Instrument on All Types of Forests", with an associated Forum on Forests. This has four goals relating to reversing deforestation, enhancing forest-based benefits, increasing sustainable forest management and mobilizing financial resources.

The UN Watercourses Convention (UNWC) came into force in 2014.[330] It offers a solid framework for transboundary water cooperation, promoting equitable and reasonable use and prevention of harm. The UNWC is designed to strengthen dialogue, harmonize data collection, mitigate conflict and foster ecosystem-based development. At present, no Amazon country is a party. Venezuela has signed but not ratified, and France is a member, making the UNWC applicable in French Guiana. Brazil, Guyana, Suriname and Venezuela voted in favour of adoption, while Bolivia, Colombia, Ecuador and Peru abstained.

The Sustainable Development Goals, agreed in 2015, will also be a major influence on national policies. The earlier Millennium Development Goals have already been a stimulus in the creation of protected areas in the Amazon.[331]

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

Instrument	Details
UN Convention on Biological Diversity (CBD)	The strongest instrument for biodiversity conservation and protected areas. The *Programme of Work on Protected Areas* provides a detailed framework for protected areas systems, albeit in need of updating, while the 2010 *Aichi Biodiversity Targets* set area-based goals for protected area designation (target 11). All Amazon countries are signatories. Protected area coverage of the Amazon biome is currently over 50%, therefore, the priority now is ensuring effectiveness, ecological representation, connectivity of national systems and integration into wider landscapes, as well as preventing protected area downgrading, downsizing and degazettement (PADDD).
UN Framework Convention on Climate Change (UNFCCC)	The UN-REDD programme aims to create a financial value for the carbon stored in forests, offering incentives for developing countries to reduce emissions from forested lands and invest in low-carbon sustainable development. "REDD+" goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks. Many Amazon countries use this mechanism. From its 2015 Conference of Parties in Paris the UNFCCC is also aware of mitigation and adaptation benefits from protected areas, particularly through the REDPARQUES declaration (see page 76).
UN Watercourses Convention (UNWC)	Based around the principle of equitable and reasonable utilization of water resources. UNWC could serve as a basis for stronger transboundary governance, management and conflict resolution across the Amazon's many international watercourses; and bring greater attention to the biome's many transboundary aquifers. Currently no signatories from Amazon countries.
UNESCO World Heritage	Natural World Heritage sites represent the world's most important ecosystems. World Heritage is the one designation that some (but not all, see section 5.5) mining companies have agreed is no-go. There are six sites in the Amazon: Canaima National Park: Venezuela; Central Suriname Nature Reserve: Suriname; Central Amazon Conservation Complex: Brazil; Noel Kempf Mercado National Park: Bolivia; Manu National Park: Peru; and Sangay National Park: Ecuador.
UNESCO Biosphere Reserves	The Man and the Biosphere (MAB) Programme designates biosphere reserves, where conservation in a *core zone* is balanced with sustainable development in a *buffer zone* and *outer transition zone*. Several Latin American MAB reserves include both Amazon and Andean habitats, some are purely Amazonian. There are seven MAB sites in the Amazon, some are also World Heritage sites: Alto Orinoco-Casiquiare Biosphere Reserve: Venezuela; Central Amazon: Brazil; Beni Biosphere Reserve: Bolivia; Pilón-Lajas Biosphere Reserve: Bolivia; Manu National Park: Peru; Sumaco Biosphere Reserve: Ecuador; Podocarpus – El Cóndor Biosphere Reserve: Ecuador; and Yasuni Biosphere Reserve: Ecuador.
Ramsar Convention	Promotes wise use of wetlands. Designated Ramsar sites commit to maintain conservation values, often alongside sustainable use. There are several Ramsar sites in the Amazon; two stand out: the Mamirauá wetland in Brazil (1.1 million ha) and Llanos de Moxos in Bolivia, the world's largest Ramsar site (6.9 million ha). Amazon freshwater ecosystems are poorly represented in protected areas; Ramsar offers an opportunity to increase the coverage.
Sustainable Development Goals (SDGs)	Several of the SDGs refer to the environment or can be affected by management of ecosystems such as those in the Amazon. In particular: • Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture • Goal 6. Ensure availability and sustainable management of water and sanitation for all • Goal 9. Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all • Goal 13. Take urgent action to combat climate change and its impacts • Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.
Minamata Convention	An international treaty designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds. Particularly significant for the Guiana Shield, Brazil and Peru.

6.6 Regional governance and key actors

At a regional level, the Amazon Cooperation Treaty (ACT) is probably the most relevant agreement.[332] It includes a focus on forests, health and biodiversity with specific short and medium term activities for member countries. ACT is the only regional legal instrument among the biome countries (except French Guiana, which is an overseas territory of France), which touches upon the issue of shared freshwater resources. The associated Amazon Cooperation Treaty Organization (ACTO) sets a series of priorities including forest monitoring, conservation, sustainable management and restoration, strengthening of protected area systems and integrated use of water resources.

Other key actors in Amazon regional governance include sub-national governments in transboundary areas (e.g., the government of Acre state, Brazil, see case study on page 86) and non-governmental organizations.

Actor	Details
Amazon Cooperation Treaty Organization (ACTO)	The Amazon Cooperation Treaty (ACT) was signed on 3 July 1978 and amended in 1998.[333] ACTO was created in 1995 to implement the Treaty, with a permanent secretariat established in Brasilia in 2002. French Guiana is not a member. It covers the whole range of development issues, infrastructure, transport, and tourism; health management; natural resources conservation and sustainable use; indigenous affairs; regional development, climate and energy as emerging areas; and institutional, financial and legal matters.
Coordinator of Indigenous Organizations of the Amazon River Basin (COICA)	COICA coordinates nine Amazonian indigenous organizations.[334] It encourages the interaction of indigenous peoples with its member organizations, defends the self-determination and rights of indigenous peoples, coordinates members' actions at an international level, and cultivates mutual collaboration between all indigenous peoples of the region. It is currently championing the concept of "Indigenous REDD+" (see page 84).
Latin American Energy Organization (OLADE)	OLADE is an international body facilitating cooperation, coordination and advice on energy issues.[335] It focuses on the integration, protection, conservation, defence and rational use of energy resources. It provides: a political and technical tool for promoting regional energy integration; official statistics, products and services; training for civil servants and promotion of regional cooperation. French Guiana is not a member.
REDPARQUES	The Latin American network of protected areas system directors has been a very active partner for WWF´s work in the Amazon, providing a vehicle and forum for cooperation throughout the continent (see page 76).
Regional and international NGOs (e.g., ARA, CDKN, FFLA, WWF, WCS, TNC, CI* and International Rivers)	A variety of national, regional and local offices of international NGOs play an important role in conservation and development in the region, often working in partnership. For example, from 2005 WWF and partners implemented an integrated pilot programme in the transboundary Putumayo river basin across the borders of Colombia, Peru and Ecuador (see page 87).
Union of South American Nations (UNASUR in Spanish)	UNASUR is an intergovernmental regional organization comprising 12 South American countries that has a range of goals including protection of the environment: "Protection of our biodiversity, water resources and ecosystems as well as cooperation among Member States in matters of disaster prevention and the fight against the causes and effects of climate change". Its South American Infrastructure and Planning Council (COSIPLAN) includes the Initiative for the Integration of Regional Infrastructure (IIRSA), and will be a critical player in discussions about future energy policies.

* ARA – Regional Amazon Articulation, a network of Amazon NGOs
CDKN – Climate and Development Knowledge Network
FFLA – Fundación Futuro Latinoamericano
WWF – World Wide Fund for Nature
WCS – Wildlife Conservation Society
TNC – The Nature Conservancy
CI – Conservation International

CASE STUDY

Holistic management of indigenous territories and REDD+

Safeguarding indigenous territories from the impacts of climate change, and recognizing their role in mitigating its impacts, are benefiting from new concepts and partnerships.

AMAZON INDIGENOUS PEOPLES HAVE A CRUCIAL ROLE IN COMBATING CLIMATE CHANGE THROUGH INTEGRATED LAND MANAGEMENT

The Amazon is the "cultural scenery" of indigenous people, imbued with a matrix of cultural, social, spiritual and utilitarian values, which are as relevant as the region's environmental importance or global significance.[336] This is particularly true for those indigenous people who live in isolation or initial contact, where special protection zones have been created.

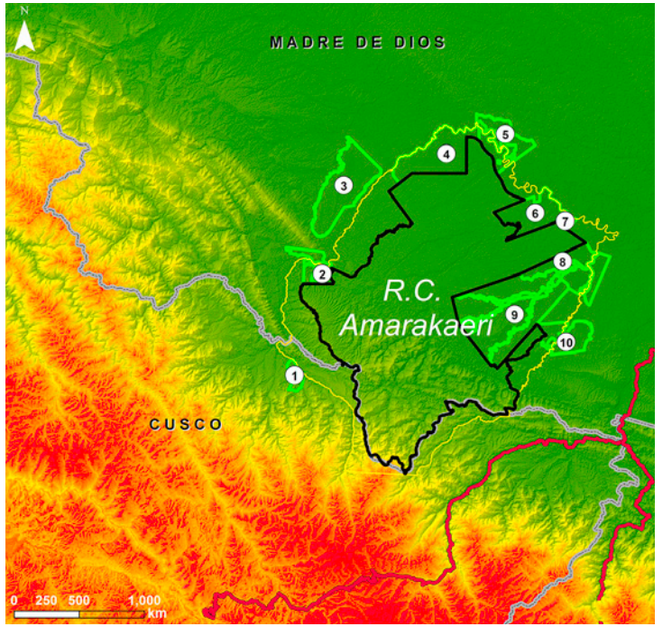
Amazon indigenous peoples have a crucial role in combating climate change through integrated land management; their livelihoods being directly dependent on the ecosystem services provided, whilst simultaneously maintaining other ecosystem services with a wider global importance, including carbon stocks.[337] But due to this close interaction, indigenous peoples also have a high probability of being vulnerable to and affected by the consequences of climate change.[338]

Indigenous territories form a mosaic of legal forms of territorial tenancy covering a large area of the Amazon (see section 3.4). In addition to the unquestionable role of indigenous territories in safeguarding the territorial rights of indigenous peoples, their importance over other types of formal protection is evident. Research shows that indigenous territories under certain circumstances protect biodiversity even better than protected areas.[339]

As part of the strategy to guarantee the integrity of indigenous territories, the Coordinator of Amazon Indigenous Organizations, COICA, has developed an Amazon Indigenous REDD+ concept, as an innovative approach to REDD+, collectively developed by the indigenous organizations of the Amazon and their key allies. This proposal actively contributes to REDD+ at a global level, with a focus on environmental and human rights. WWF, with German funds from the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety – International Climate Initiative (BMUB-IKI), is supporting the project that aims for the official recognition of Indigenous REDD+ and its incorporation into national REDD+ strategies by 2017. The Amazon Indigenous approach, REDD+ Indígena Amazónico (RIA), has already been recognized at local, national and international levels in Colombia, Ecuador and Peru.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

Figure 18: Indigenous REDD+ in the Madre de Dios region of Peru. *Highlighting the Amarakaeri communal reserve and 10 other indigenous territories; it is estimated that the forests of Madre de Dios can store about 125 metric tonnes of carbon per hectare, which represents a potential reserve of approximately 101.25 million metric tonnes of carbon (C) in the 900,000ha of the total territories of the indigenous peoples of Madre de Dios.*



Key

- Interoceanic Highway
- Native Communities
- (1) Queros
- (2) Shintuya
- (3) Shipitiare
- (4) Diamante
- (5) Puerto Azul
- (6) Boca Ishiriwe
- (7) Masenawa
- (8) San Jose de Karene
- (9) Puerto Luz
- (10) Barranco Chico
- Communal Reserve Amarakaeri
- Buffer zones
- Departmental boundaries

This initiative seeks to strengthen the indigenous governance of indigenous territories and their land use planning according to cultural uses of natural resources and to empower and build capacity within indigenous peoples' groups for the management and sustainable use of their territories. Moreover, the project aims at wider recognition about the contribution of indigenous peoples to climate change mitigation, to the improvement of local economies and to the maintenance of their natural and cultural heritage through local knowledge. Last, but not least, the strategy incorporates the need for wider cultural and political recognition and for disseminating and replicating models of indigenous governance and mechanisms of territorial management.

CASE STUDY

Environmental services incentives system in Acre, Brazil

Jurisdictional level REDD+ is already showing results and successful projects are spreading across the region.

86%

ORIGINAL FOREST COVER IN ACRE

The state of Acre, Brazil, has legally adopted an Environmental Services Incentives System (SISA in Portuguese) to help maintain ecosystem services. This includes one of the world's most advanced public policies for REDD+; the Environmental Incentives for Carbon scheme (ISA Carbon in Portuguese).

Acre has over 86 per cent original forest cover and the deforestation rate fell by 71 per cent between 2003 and 2012, making it ideal for jurisdictional REDD+.[340] WWF supported the development of ISA Carbon by sponsoring public consultations and by working with the state government and other partners to strengthen and implement the state system for environmental and social safeguards. WWF supports SISA more generally by helping develop parallel programmes for ecosystems services associated with freshwater and biodiversity; and sits on CEVA, the commission governing SISA (which has equal representation from government and civil society). Through its partnership with media company Sky in the UK, WWF has funded a range of actions associated with SISA that are directly benefiting subsistence farmers, rubber tappers, and other families that rely on the rainforest and help safeguard the ecosystem services it provides.

Lessons from SISA and ISA Carbon are spreading, for example in a similar scheme in Bolivia.[341] The strategic approaches are also helping to integrate ecosystem services into cross-border land use planning between Brazil, Bolivia and Peru in the Rio Acre region.[342]

CASE STUDY

Developing a transboundary protected corridor

The Tri-National Programme for the Conservation and Sustainable Development of Protected Areas Corridor covers a vast territory and includes three protected areas, two communal reserves and their buffer zones.

WWF managers and government stakeholders from three countries have been working since 2005 to identify strategies for the area's management and sustainable development including vulnerability to climate change.[343] The corridor is located in the trinational border area of Colombia, Ecuador and Peru, covering half of the Putumayo River basin, and several other rivers in this corridor. The Programme covers an area of almost two million ha: La Paya National Park in Colombia (422,000ha); Güepí-Sekime National Park (203,882ha); Huimeki (142,832ha) and Airo-Pai (248,095ha) communal reserves in Peru; and Cuyabeno Wildlife Reserve in Ecuador (603,380ha). The Programme's objective is to develop and implement a coordinated regional model for management of protected areas and their areas of influence addressing such issues as control and vigilance; research and monitoring; ecotourism and environmental goods and services; zoning and regulation of use; and training and capacity-building of local and national teams. It focuses on four main issues: managing protected areas and their zones of influence; social participation; strengthening the conservation corridor; and strengthening institutional capacities.

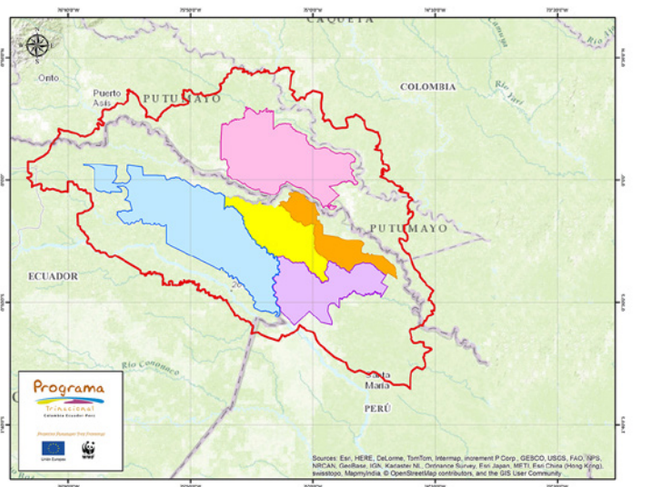
Figure 19: Map showing the borders of the Tri-national Programme
© Tri-national Programme Colombia-Ecuador-Peru

Key

- Country Boundaries
- Tri-National Corridor

Neighbouring protected areas

- La Paya
- Güepí-Sekime
- Huimeki
- Airo-Pai
- Cuyabeno



Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

7 RECOMMENDATIONS

Much is being achieved, as described in this report. However, this is a time of transition in the Amazon. Governments, funding agencies, non-governmental organizations, indigenous peoples' organizations and businesses are all considering what to do next, and how the needs and views of multiple stakeholders can best be met. In the following pages, we present a conservation organization's view of some urgent priorities for the next decade.

Photo: South American squirrel monkeys (*Saimiri sciureus*), Colombia © Gernant Magnin / WWF-Netherlands

7.1 Recommendations

In the previous section (section 6), a number of **strategies** are discussed relating to each of three main goals identified by WWF (forests, freshwater and climate and energy). In this final section, a set of broad **principles** for achieving WWF's vision are outlined along with a series of **recommendations** emerging from WWF's experience of almost a decade of working in the Amazon at the regional level. Finally, we include a summary of **priorities** for WWF's work in the Amazon region for the next ten years.

Principles

A biome perspective: The Amazon vision is rooted in a biome-level perspective of the Amazon, where the "national parts" of the Amazon depend on the integrity of the whole biome for long-term ecological sustainability, maintenance of the hydrological cycle, and resilience to climate change. In all its vastness and complexity, the Amazon is still a single ecological unit that cannot be conserved via national-level activities alone. We must address the inter-dependent parts of the biome as a whole to secure the viability of the entire system.

WWF's vision for the Amazon region
To ensure an ecologically healthy Amazon biome that maintains its environmental and cultural contributions to local peoples, the countries of the region, and the world, within a framework of social equity, inclusive economic development and global responsibility.

A landscape approach: The biome perspective calls for the adoption of an integrated model of conservation, which combines protection, sustainable management and where necessary restoration in a landscape approach. It requires bold thinking and readiness to welcome new partners, embrace original ideas and recognize and negotiate the trade-offs inherent in balancing multiple needs. At the heart of the landscape approaches lies the integration of productive land use (agriculture, mining etc.) and environmental priorities, and requires a people-centred approach and negotiated outcomes applied at landscape scales. Cross-boundary initiatives are important given that water flows, ecosystems services and species all ignore national borders. The identification and focus on regional priorities is important to maintain the most critically important parts of the biome.

The global and regional context: The biome perspective of the Amazon and proposed landscape approach need to be mainstreamed into development plans in the region, in collaboration with global and regional frameworks that provide clear and agreed guidance on the needs and rights of the people of the Amazon and the management of its natural resources, in particular:

- UN Sustainable Development Goals
- UN Convention on Biological Diversity and its Aichi Biodiversity Targets and Programme of Work on Protected Areas
- UN Framework Convention on Climate Change with the REDD+ programme and commitments to reducing carbon losses from land use change
- UN Water Courses Convention, which includes guidance on integrated water use but is still not implemented in the Amazon
- UN Minamata Convention on Mercury
- UN Declaration on the Rights of Indigenous Peoples
- Amazon Cooperation Treaty, with commitments to shared water resources and forest conservation
- REDPARQUES joint declaration on the role of protected areas in mitigating and adapting to climate change
- COICA coordination between indigenous organizations throughout the Amazon.

Building popular support: The vision will not be secured by a minority of decision makers or by force of law alone, but requires a broad social dialogue with all sectors of society to enable a fundamental shift in attitudes toward the role, importance and future of the Amazon. This means building a powerful constituency behind the vision with governments, politicians, industry and other economic sectors, and civil society.

Political context: Geopolitically, there is a need to strengthen the sovereign and strategic agendas of regional integration and national and regional autonomy and participation of local populations. Key aims include cross-border initiatives in Amazon countries (both politically and economically) in order to achieve multiple conservation and development objectives and the integral security of the region. Both liberal and neoliberal agendas can impact negatively on national sovereignty. The need for an Amazon geopolitical observatory is thus critical to understanding the "big picture" of the Amazon and defining the areas where institutions working in the region need to have effective interventions.

Critical elements for implementing the vision: future conservation and development work in the Amazon needs to focus on a range of issues:

- **Forests:** protecting key areas of forest and their biodiversity, and addressing forest loss through a mixture of conservation and sustainable use, applying the principle of Zero Net Deforestation and Forest Degradation
- **Freshwater:** conserving the water balance (precipitation, discharge, evaporation), ensuring water quality in particular through tackling mercury contamination from gold mining, maintaining hydrological flows in priority Amazon rivers and their headwaters, and protecting key wetland sites and their biodiversity
- **Marine:** maintaining the unique coastal systems produced by the Amazon River, and ensuring that the fluvial sediment supply and river mouth hydrology are maintained within normal ranges
- **Climate:** building resilience in the biome and agreeing a regional energy policy that reduces greenhouse gas emissions without destroying Amazon ecology through excessive use of hydropower
- **People:** strengthening the capacity of indigenous peoples, traditional and local communities to stand up for their rights, resist incursions on their lands and maintain sustainable livelihoods

- **Economy:** ensuring a thriving economy for all people living in the Amazon, based on sustainable use of natural resources and careful stewardship of forests and freshwaters
- **Governance:** incorporating conservation issues in land use planning and planning processes of economic sectors, local government, and the private sector working in the Amazon
- **Finance:** introducing safeguards and best practices to ensure that financial mechanisms avoid supporting unsustainable development options.

Recommendations

This list comprises a selection of the most critical recommendations emerging from WWF's experience of a decade working at regional level in the Amazon. Full sets of recommendations on each topic can be found in previous WWF literature produced in recent years.

Integration of protected areas and indigenous territories

1. Adopt a more integrated vision of sustainable development and nature conservation, where protected areas are part of a broader set of conservation strategies (biodiversity, ecosystem services and landscapes), development plans and economic policies.
2. Fully implement the CBD Aichi Biodiversity Targets[344], particularly Targets 5, 12 and especially 11, and agree an integrated approach to increase protection of each ecoregion to 30 per cent, to ensure representation of Pan-Amazon ecosystems.
3. Increase the integration between protected area systems, sub-systems and individual protected areas, and between protected areas and areas such as indigenous territories and community conserved areas, aiming to establish functional ecological networks.
4. Engage in collaborative arrangements with neighbouring countries in establishing transboundary protected areas, as well as ecologically-based (e.g., for migratory fish) and thematically-related (e.g., cross-boundary ecotourism initiatives) networks.
5. Actively seek international recognition of high value sites for conservation and sustainable development in the Amazon, including by the Ramsar Convention on wetlands of international importance and the World Heritage Convention.
6. Fully recognize the rights of Amazon indigenous peoples and local communities in all Amazon countries including recognition of indigenous territories, community conserved areas and the sub-national political entities of the region.
7. Adopt national policies and programmes to control and avoid ecosystem conversion (including deforestation and river fragmentation) in under-represented ecoregions in the Amazon

biome, and in particular, apply the "non-regression principle" to prevent the downgrading, downsizing and degazettement of protected areas (PADDD) in the region.
8. Ensure that spatial and land use policies and practice integrate protected areas and indigenous territories alongside other forms of land use, communicating land tenure pressures, and ensuring access by local communities and indigenous peoples to the natural resources they depend on.
9. Ensure adequate resourcing for the development of scientific knowledge needed for environmental monitoring in the Amazon.[345]

Protected Areas – Natural Solutions to Climate Change

1. Support countries in implementing the commitments of the REDPARQUES Declaration on Protected Areas and Climate Change (see page 76).
2. Include the role of protected areas in climate change policies and strategies, and in development and land use plans at the sectoral, regional, national and local levels.
3. Evaluate the contribution of protected areas to reducing vulnerability to climate change, building resilience and supplying ecosystem services in the context of environmental change at national and local levels.
4. Include protected areas in the National Contribution to the UNFCCC and use protected areas as one of the strategies to achieve the goals stated in the Intended Nationally Determined Contributions (NDCs)/ Nationally Determined Contributions (NDCs).
5. Mainstream climate change in protected areas' design and management.
6. Include protected areas in project bids to the Green Climate Fund and other multilateral and bilateral cooperation efforts to address climate change.
7. Expand, reshape and increase level of protection and/or create new protected areas to cover key ecosystems facing climate change impacts, and integrate existing protected areas through landscape approaches.
8. Raise awareness among the general public and decision makers on the role of protected areas for mitigation, adaptation, resilience and sustainable development.[346]

Freshwater ecosystem protection and hydrological connectivity

Decision makers need to adopt true cost basin scale hydropower planning, going beyond case by case plans that focus on electricity generation potential and do not account for cumulative and indirect impacts, nor incorporate social and environmental costs and benefits. Better informed planning and more balanced decisions by governments, including early and open engagement with a broader set of stakeholders will result in stronger economic, social and environmental outcomes. Specifically:

1. Base hydropower planning decisions on more than just electricity generation potential of alternative dam sites, including early consideration of the maintenance of ecological flows in the river basin and to the potential multiple uses of water and reservoirs.
2. Conduct Amazon basin-wide integrated assessments of the cumulative environmental and social impacts of whole project portfolios (i.e. access roads, hydro-ways and mining projects, and hydropower) on the main stem of the Amazon River, and its tributaries.
3. Conduct assessments that include indirect impacts of hydropower projects such as: impacts of dam construction on deforestation; establishment of construction sites for workers that later become permanent settlements; access roads; and in-migration.
4. Engage all affected stakeholders early in the planning process, in particular indigenous peoples and other traditional communities, discussing site options and alternatives through open, broad-ranging democratic debates with free, prior and informed consent.

Ensure best practice standards and safeguards are applied in planning, construction and operation of hydropower plants and associated infrastructure. Widespread uptake and application of Industry standard HSAP should result in projects that minimize direct and indirect impacts and engage meaningfully with civil society. Specifically:

5. Ensure informed, free and democratic participation of local communities in all decisions related to energy and infrastructure development. Technical analyses must incorporate the social dimension, enabling local communities to participate in the process, evaluate results and identify key threats and potential solutions.
6. Mitigate direct and indirect impacts of hydropower projects, including avoiding those that impact existing protected areas and indigenous territories. Where impacts are unavoidable

(after following due consultation), suitable offsetting and compensation mechanisms should be implemented based on specific biodiversity and ecosystem services provision.

7. Address the means for avoiding and reducing environmental damage caused by the project at the environmental licensing stage of hydropower planning, and define resulting mitigation measures prior to investments being made and initial project implementation.

Build national ambitions for alternative renewable energy targets (e.g., solar, wind, biomass) and advance regional renewable energy integration. A more balanced energy mix with greater uptake of alternative energy sources will increase energy security, reduce negative social and environmental impacts and support efforts to increase off-grid energy generation. Specifically:

8. Make the case for a stronger focus on energy efficiency (in the generation, transport and consumption of electricity) and diversification and decentralization of energy sources (solar, wind and biomass; urban and rural generation; avoiding fossil fuels and nuclear).

Strengthen protection and governance of freshwater habitats in the Amazon. Existing protected areas have largely been designed and managed from a terrestrial perspective. Freshwater ecosystem management should be incorporated into development plans and protected area networks; legal instruments such as protected rivers created or improved, and transboundary water governance improved through ratification of the UN Watercourses convention. Specifically:

9. Encourage governments and the finance and private sectors to incorporate freshwater ecosystem management into development plans, economic policies and voluntary standards at regional, national and sub-national levels.
10. Designate new protected areas that increase ecological representation of freshwater ecosystems, thus helping to preserve hydrological connectivity and ecosystem function.
11. Create or improve legal instruments for the designation of "protected rivers" as a special type of official protected area, targeting rivers in national territories and transboundary rivers (through bilateral or trilateral agreements), to secure cross-boundary connectivity.
12. Sign and ratify the United Nations Watercourses Convention. This offers Amazon country governments a flexible global legal framework for the use, management and protection of international watercourses.[347]

Ecosystem services valuation in decision-making

1. Ecosystem services and biodiversity need to be related to changes in livelihoods and other aspects of human well-being, to track how the consequences of ecosystem change can affect human well-being.
2. Ensure that biophysical estimates of environmental services precede economic assessments; an important conceptual step for many decision makers to discuss issues which they had previously disregarded.
3. Keep ecosystem service assessments simple at the outset; government representatives normally require decision-making tools that are simple, understandable and easy to use, and can be rapidly incorporated into scientific and policy-making processes.
4. Generate information on ecosystem services that matches local realities. InVest models are dependable but too generalized and may overlook key differences. In Colombia, for example, it was necessary to make adjustments to ensure that the outcomes reflected the local and regional context.
5. Incorporate social dimensions into technical analyses to enable local communities to take part in the process and substantiate results. This process also helps social empowerment and expands opportunities for incorporating the results into spatial planning decisions.[348]

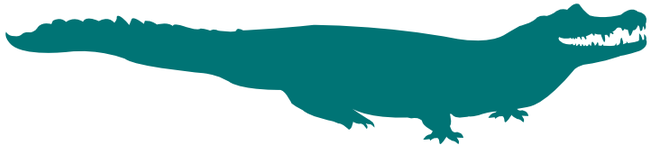
Sustainable finance for sustainable development in the Amazon

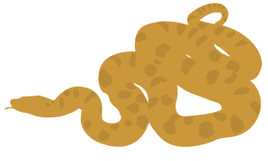
1. Allow clients and the wider public easy access to information about banks' forest policies, including lending criteria and enforcement plans.
2. Encourage banks to join initiatives and platforms where they can learn from the experiences of other financial institutions and participate in efforts to develop collective policies for specific issues and sectors, such as UN-PRI, UNEP-FI, Equator Principles, Natural Capital Declaration, the BEI, and the Soft Commodities Compact (see section 5.9 for details of these initiatives).
3. Where credible agro-commodity standards exist, banks should encourage clients to obtain independent verification or certification as pre-conditions for financing. Where audit costs are high, particularly for small producers, banks should work with clients and determine actions to achieve such verification or certification over an appropriate period of time.
4. Encourage financial institutions to develop clear no-go policies and demand full transparency from clients and potential clients when financing activities in or adjacent to protected areas.

5. In some cases, whilst critical risks associated with forests are described in financial institutions' policies, it is not clear how far these policies are implemented in practice and how adherence of banks' customers is being verified. Clear criteria for due diligence checks and possible consequences in case of noncompliance should be part of comprehensive environmental, social and governance (ESG) policies.[349]

Reversing deforestation trends

1. Encourage Amazon governments to show strong political will to design and implement "zero net deforestation" plans that take into account an Amazon regional vision and specific contexts and characteristics of each deforestation front. Introduce national programmes to avoid and control deforestation, integrated cross-sectorially and among Amazon countries.
2. Review how incentive mechanisms contribute to reducing the rate of deforestation, by avoiding perverse incentives that promote activities that cause or are related to deforestation and by promoting economic incentives for investments in more sustainable productive activities.
3. Promote and apply sustainable forest management and use of other ecosystems, including research to raise their value, and by recognizing the rights of indigenous peoples and local communities, as a way to promote sustainable development and give value to the standing forests and free flowing rivers.
4. Facilitate cross-border dialogue between national and sub-national governments, and the finance and private sectors, as well as scientific institutions, local communities and civil society organizations, based on the exchange of experiences and lessons learned in halting deforestation.
5. Recognize the rights of indigenous peoples and local communities and work with them to improve their management and wise use of lands and to publicize their important role in conservation (ecosystem services, biodiversity, carbon storage, water, etc.).[350]





2025 Priorities for WWF's Amazon work at the biome scale

Within its overall vision for the Amazon, WWF has identified a series of overarching priorities for its own work at the biome-level (in addition to and complementary to WWF's national agendas):

- **Protected areas, indigenous territories and climate:** maintain at least 50 per cent coverage of the biome as protected areas and indigenous territories, achieve effective management and integration of national protected area systems and indigenous territories and secure forest set aside under climate and biodiversity financial mechanisms
- **Green economy in Amazon sustainable landscapes:** apply a robust "sustainable landscapes and green economy" approach to reduce deforestation and forest degradation, mitigate high impacting linear infrastructure and promote sustainable use of forests outside protected areas
- **Safeguards and finance:** implement robust regionally-relevant safeguards in development initiatives of key sectors and stimulate the development of green investment products and opportunities, leading to more sustainable finance and investment in the Amazon
- **Sustainable hydropower and waterway planning processes:** in key sub-basins based on a basin-wide vision for the Amazon that maintains connectivity of Amazon rivers and freshwater ecosystems
- **Protection of freshwater ecosystems:** promote a regional Amazon strategy for increased ecological representation and protection of freshwater ecosystems, and improved transboundary river basin management and governance
- **Energy mix in Amazon countries:** initiate a more balanced debate on hydropower in the Amazon along with greater uptake of alternative/non-conventional renewable energy sources
- **Climate resilience in the Amazon basin:** identify and implement key biome-level actions for increasing Amazon ecosystem resilience and promote a stronger recognition of the importance of the Amazon biome for global climate change resilience

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

8 REFERENCES AND NOTES

The Living Amazon report draws on much of the work undertaken by the Living Amazon Initiative, and by other parts of WWF, over the last few years. But it also draws heavily on research carried out by academics, independent researchers and other NGOs. Key references and notes are given in the following section.

Photo: Amazon River, Cuyabeno, Ecuador © Alejandro Polling / WWF-Colombia

1 voices.nationalgeographic.com/2012/06/11/the-pride-of-the-purus-river-an-iridescent-income-from-ornamental-fish-2/
2 ibid.
3 de Mattos Vieira, R., Albuquerque, M., von Muhlen, E.M. and G.H. Shepard. 2015. Participatory Monitoring and Management of Subsistence Hunting in the Piagacu-Purus Reserve, Brazil. *Conservation & Society* 13 (3): 254-264.
4 voices.nationalgeographic.com/2012/06/11/the-pride-of-the-purus-river-an-iridescent-income-from-ornamental-fish-2/
5 us.whales.org/wdc-in-action/2014-wdc-bharathi-viswanathan-award
6 Marioni, B., Botero-Arias, R. and S. Fonseca-Junior. 2013. Local community involvement as a basis for sustainable crocodilian management in Protected Areas of Central Amazonia: Problem or solution? *Tropical Conservation Science* 6 (4): 484-492.
7 www.rufford.org/projects/marina_albuquerque_regina_de_mattos_vieira
8 Olson, D.M. and E. Dinerstein. 1998. The Global 200: A representation approach to conserving the Earth's most biologically valuable ecoregions. *Conservation Biology* 12: 502-515.
9 Suarez, C., Prüssmann, S.J., Lopez, C., Abud, M., Guevara, O., Vergara, A., Zuñiga, L.A., Gorricho, J. and L. Germán Naranjo. 2015. *Vulnerability Analysis of the Amazon Biome and its Protected Areas*. WWF Living Amazon (Global) Initiative, Brasília and Quito.
10 ibid
11 Flores, M., Nielsen, K. and J.C. Riveros. 2010. *WWF's Living Amazon Initiative: A comprehensive approach to conserving the largest rainforest and river system on Earth*. WWF Living Amazon Initiative, Brasilia.
12 Living Amazon Initiative FY14-16 Focused Strategic Plan, Sept. 2013.
13 Macedo, M. and Castello. L. 2015. *State of the Amazon: Freshwater Connectivity and Ecosystem Health*; edited by D. Oliveira, C.C. Maretti and S. Charity. WWF Living Amazon Initiative, Brasília, Brazil.
14 Calculated from Freyhof, J. and Brooks, E. 2011. *European Red List of Freshwater Fishes*. Publications Office of the European Union, Luxembourg.
15 voices.nationalgeographic.com/2014/05/23/recognizing-world-fish-migration-day-in-the-amazons-waters/
16 *Melillo, J.M., McGuire, A.D., Kicklighter, D.W., Moore III, B., Vörösmarty, C.J. and A.L. Schloss. 1993. Global climate change and terrestrial net primary production. Nature 363: 234-240. doi:10.1038/363234a0*
17 Celentano, D. and Vedoveto, M. (eds). 2011. *The Amazon Millennium Goals*. ARA Regional, Quito, Ecuador.
18 Martin, C. 2015. *On the Edge: The state and fate of the world's tropical rainforests*. A report to the Club of Rome. Greystone Books.
19 Maretti, C.C., Riveros Salcedo, J.C., Hofstede, R., Oliveira, D., Charity, S., Granizo, T., Alvarez, C., Valdujo, P. and C. Thompson. 2014. *State of the Amazon: Ecological Representation in Protected Areas and Indigenous Territories*. WWF Living Amazon Initiative, Brasília and Quito. 82pp.
20 Macedo, M. and Castello, L. 2015. *Op cit* and beta.amazonwaters.org/basins/great-sub-basins/madeira/
21 Hoorn, C. and F. Wesselingh. (eds). 2011. *Amazonia, Landscape and Species Evolution: A Look into the Past*, John Wiley & Sons
22 Macedo, M. and Castello, L. 2015. *Op cit*
23 Murcia, C., Kattan, G.H. and G.I. Andrade-Perez. 2013. Conserving biodiversity in a complex biological and social setting: The case of Colombia. In N.S. Sodhi, L. Gibson and P. Raven. (eds) *Conservation Biology: Voices from the Tropics*, John Wiley & Sons.
24 Rabinowitz, A. and Zeller, K.A. 2010. A range-wide model of landscape connectivity and conservation for the jaguar, *Panthera onca*. *Biological Conservation* 143 (4): 939-945.
25 Sollmann, R., Mundim Tôrres, N. and L. Silveira. 2008. Jaguar Conservation in Brazil: The role of protected areas. *Cat News Special Issue 4: The Jaguar in Brazil*. IUCN Species Survival Commission Cat Specialist Group.
26 Iriarte, V. and Marmontel, M. 2013. River dolphin (*Inia geoffrensis*, *Sotalia fluviatilis*) mortality events attributed to artisanal fisheries in the Western Brazilian Amazon. *Aquatic Mammals* 39 (1): 116-124: DOI 10.1578/AM.39.2.2013.116.
27 Gomez-Salazar, C., Trujillo, F., Portocarrero, M. and H. Whitehead. 2012. Population density estimates and conservation of river dolphins (*Inia* and *Sotalia*) in the Amazon and Orinoco river basins. *Marine Mammal Science* 28 (1): 1748-1762. DOI: 10.1111/j.1748-7692.2011.00468.x.
28 Trujillo, F., Crespo, E., Van Damme, P.A. and J.S. Usma. (eds). 2010. *The Action Plan for South American River Dolphins 2010 – 2020*. WWF, Fundación Omacha, WDS, WDCS, Solamac. Bogotá, D.C., Colombia.
29 ibid
30 Maretti, C.C., et al. 2014. *Op cit*
31 Thompson, C. 2009. *Amazon Alive! A decade of discovery 1999-2009*. WWF Living Amazon Initiative, Brasília and Quito.
32 WWF (unpublished) Amazon new species list 2010-2013, WWF-UK, Woking; updated by do Amaral, J.V., Pedrociane, D., Cobra, I.V.D., Lima, I.J., Lanna, J.M., Ferreira, M.T.M., Marmontel, M., Nassar, P.M. and R.B. Arias. 2016. *New species of Vertebrates and Plants in the Amazon 2014 and 2015*, WWF Living Amazon Initiative and Mamirauá Civil Society, Brasília.

33 do Amaral, J.V., Pedrociane, D., Cobra, I.V.D., Lima, I.J., Lanna, J.M., Ferreira, M.T.M., Marmontel, M., Nassar, P.M. and R.B. Arias. 2016. *New species of Vertebrates and Plants in the Amazon 2014 and 2015*, WWF Living Amazon Initiative and Mamirauá Civil Society, Brasília.
34 Anthony, E.J., Gardel, A., Proisy, C., Fromard, F., Gensac, E., Peron, C., Walcker, R. and S. Lesourd. 2013. The role of fluvial sediment supply and river-mouth hydrology in the dynamics of the muddy, Amazon-dominated Amapá Guianas coast, South America: A three-point research agenda. *Journal of South American Earth Sciences* 44: 18-24.
35 ibid
36 Allison, M.A. and Lee, M.T. 2004. Sediment exchange between Amazon mudbanks and shore-fringing mangroves in French Guiana. *Marine Geology* 208: 169-190.
37 Brichet, M., Martinez, C. and H. Souan. 2011. *Elements for a regional cooperation project for marine mammal conservation in areas under Amazonian influence in northeastern Latin America*, Agence des Aires Marines Protégées – SPAW RAC.
38 www.whsrn.org/sites/map-sites/sites-western-hemisphere-shorebird-reserve-network
39 De Boer, M.N. 2015. Cetaceans observed in Suriname and adjacent waters. *Latin American Journal of Aquatic Mammals* 10 (1): 2-19.
40 Moura, R.L., Amado-Filho, G.M., Moraes, F.C., Brasileiro, P.S., Salomon, P.S. et al. 2016. An extensive reef system at the Amazon River mouth. *Science Advances* 2 (4): DOI: 10.1126/sciadv.1501252
41 Barthem, R. and Goulding, M. 1997. *The catfish connection: Ecology, migration and conservation of Amazon predators*. Columbia University Press, New York.
42 Riveros Salcedo, J.C., Tadeu Rodrigues, S., Suárez, C., Oliveira, M. and L. Secada. 2009. *Hydrological Information System and Amazon River Assessment – HIS/ARA: FY09 Final Report*. WWF Peru, Bolivia and Colombia.
43 Finer, M. and Jenkins, C.N. 2012. Proliferation of Hydroelectric Dams in the Andean Amazon and Implications for Andes-Amazon Connectivity. *PLoS ONE* 7 (4): 335126.
44 Castello, L., McGrath, D.G., Hess, L.L., Coe, M.T., Lefebvre, P.A., Petry, P., Macedo, M.N., Renó, V.F. and C.C. Arantes. 2013. The vulnerability of Amazon freshwater ecosystems. *Conservation Letters* 6: 217-229. doi: 10.1111/conl.12008
45 Almeida, O., Lorenzen, K. and D. McGrath. 2003. The Commercial Fishing Sector in the Regional Economy of the Brazilian Amazon. *The Second International Symposium on the Management of Large Rivers for Fisheries, 11th - 14th February 2003*, Phnom Penh, Cambodia.
46 Petrere, M. Jr., Borges Barthem, R., Agudelo Córdoba, E. and B. Corrales Gómez. 2004. Review of the large catfish fisheries in the upper Amazon and the stock depletion of piraíba (*Brachyplatystoma filamentosum* Lichtenstein). *Reviews in Fish Biology and Fisheries* 14: 403-414. DOI 10.1007/s11160-004-8362-7.
47 Riveros Salcedo, J.C., et al. 2009. *Op cit*
48 Goldberg, A., Mychajliw, A.M. and E.A. Hadly. 2016. Post-invasion demography of prehistoric humans in South America. *Nature* 532: 232-235.
49 Roosevelt, A.C., Lima da Costa, M., Lopes Machado, C., Michab, M., Mercier, N., Valladas, H., Feathers, J., Barnett, W., Imazio da Silveira, M., Henderson, A., Sliva, J., Chernoff, B., Reese, D.S., Holman, J.A., Toth, N. and K. Schick. 1996. Paleoindian Cave Dwellers in the Amazon: The Peopling of the Americas. *Science* 272 (5260): 373-384.
50 Shanley, P., Cymerys, M., Serra, M. and G. Medina (eds). 2011. *Fruit trees and useful plants in the Amazon*. FAO, CIFOR and PPI, Rome.
51 Clement, C.R., Denevan, W.M., Heckenberger, M.J., Junqueira, A.B., Neves, E.G., Teixeira, W.G. and W.I. Woods. 2015. The domestication of Amazonia before European conquest. *Proceedings of the Royal Society B* 282: 20150813. http://dx.doi.org/10.1098/rspb.2015.0813.
52 Maretti, C.C., et al. 2014. *Op cit*
53 Celentano, D. and Vedoveto, M. (eds). 2011. *The Amazon Millennium Goals*. ARA (Amazon Regional Articulation), Quito, Ecuador.
54 ibid
55 Maretti, C.C., et al. 2014. *Op cit*
56 COICA (Coordinator of the Indigenous Organizations of the Amazonian River Basin). 2004. *Returning to the Maloca – Amazon Indigenous Agenda* (*comprehensive approach to conserving the largest rainforest and river system on Earth)*. WWF, Brasília. www.coica.org.ec/ingles/aia_book/present03.html
57 Burgos R., de la Cruz y, R. and T. Granizo. 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*. Alianza COICA – WWF/ TNC. Quito, Ecuador.
58 Ramirez-Gomez, S.O.I., Torres-Vitolas, C.A., Schreckenberg, K., Honzák, M., Cruz-Garcia, G.S., Willcock, S., Palacios, E., Pérez-Miñana, E., Verweij, P.A. and G.M. Poppy, 2015. Analysis of ecosystem services provision in the Colombian Amazon using participatory research and mapping techniques. *Ecosystem Services* 13: 93-107.
59 Linera, Á.G. 2012. *Geopolítica de la Amazonía: Poder hacendal-patrimonial y acumulación capitalista*. Agencia Latinoamericana de Información.

60 Barrionuevo, A. 2008. Whose Rain Forest is this, anyway? *The New York Times*, May 18. www.nytimes.com/2008/05/18/weekinreview/18barrionuevo.html (accessed 1st May 2016).
61 Little, P.E. 2013. *Megaproyectos en la Amazonía: Un análisis geopolítico y socioambiental con propuestas de mejor gobierno para la Amazonía*
62 www.iirsa.org/Page/Detail?menuItemId=108 (accessed 24th April 2016).
63 OECD. 2015. *State Owned Enterprises in the Development Process*, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264229617-en
64 Hoffman, M. and Grigera, A.I. 2013. *Climate Change, Migration, and Conflict in the Amazon and the Andes: Rising Tensions and Policy Options in South America*. Center for American Progress, Washington D.C., USA.
65 ibid
66 www.iirsa.org/Page/Detail?menuItemId=108 (accessed 24th April 2016).
67 Dudley, N. 2008. *Guidelines for Applying Protected Area Management Categories*. IUCN, Gland, Switzerland.
68 Maretti, C.C., et al. 2014. *Op cit*
69 Data researched by UNEP-WCMC based on biome data from WWF and IUCN and UNEP-WCMC. 2016. The World Database on Protected Areas (WDPA) [On-line]. UNEP-WCMC, Cambridge, UK. Available at: www.protectedplanet.net. and UNEP-WCMC. 2015. Dataset combining Exclusive Economic Zones (EEZ; VLIZ 2014) and terrestrial country boundaries (World Vector Shoreline, 3rd edition, National Geospatial-Intelligence Agency). UNEP World Conservation Monitoring Centre, Cambridge, UK.
70 Barber, C.P., Cochrane, M.A., Souza, C.M.Jr., and W.F. Laurance. 2014. Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation* 17: 203-209.
71 Hockings, M., Dudley, N., Courrau, J., Valenzuela, S. and S. Chamorro. 2011. *Analisis de efectividad del manejo del Sistema de Parques Nacionales Naturales de Colombia*. Parques Nacionales Naturales de Colombia, Bogota, D.C. Colombia.
72 WWF LAI. 2014. *Protected areas and indigenous territories*. Brasilia.
73 Data researched by UNEP-WCMC based on biome data from WWF and IUCN and UNEP-WCMC. 2016. The World Database on Protected Areas (WDPA) [On-line]. UNEP-WCMC, Cambridge, UK. Available at: www.protectedplanet.net. and UNEP-WCMC. 2015. Dataset combining Exclusive Economic Zones (EEZ; VLIZ 2014) and terrestrial country boundaries (World Vector Shoreline, 3rd edition, National Geospatial-Intelligence Agency). UNEP World Conservation Monitoring Centre, Cambridge, UK.
74 Nepstad, D., Schwartzman, S., Bamberger, B. Santhill, M., Ray, D., Schlesinger, P., Lefebvre, P., Alencar, A., Prinz, E., Fiske, G. and A. Rolla. 2004. Inhibition of Amazon deforestation and fire by parks and indigenous lands. *Conservation Biology* 20 (1): 65-73.
75 RAISG. 2012. Mapa Amazonía 2012. Áreas Protegidas y Territorios Indígenas. At raisg.socioambiental.org/amazonia-2012-areas-protegidas-e-territorios-indigenas
76 Burgos R., et al. 2014. *Op cit*
77 Data researched by UNEP-WCMC based on biome data from WWF and IUCN and UNEP-WCMC. 2016. The World Database on Protected Areas (WDPA) [On-line]. UNEP-WCMC, Cambridge, UK. Available at: www.protectedplanet.net. and UNEP-WCMC. 2015. Dataset combining Exclusive Economic Zones (EEZ; VLIZ 2014) and terrestrial country boundaries (World Vector Shoreline, 3rd edition, National Geospatial-Intelligence Agency). UNEP World Conservation Monitoring Centre, Cambridge, UK.
78 Hockings, M., Stolton, S., Leverington, F., Dudley, N. and J. Courrau. 2006. *Evaluating Effectiveness: A framework for assessing management effectiveness of protected areas. 2nd edition*. IUCN, Gland, Switzerland and Cambridge, UK.
xiv + 105 pp.
79 Mascia, M.B. and Pailler, S. 2011. Protected area downgrading, downsizing, and degazettement (PADDD) and its conservation implications. *Conservation Letters* 4: 9-20.
80 Bernard, E., Penna, L.A.O. and E. Araújo. 2014. Downgrading, Downsizing, Degazettement, and Reclassification of Protected Areas in Brazil. *Conservation Biology* 28 (2): 1523-1739.
81 Pack, S.M., Ferreira, M.N., Krithivasan, R., Murrow, J., Bernard, E. and M.B. Mascia. 2016. Protected area downgrading, downsizing, and degazettement (PADDD) in the Amazon. *Biological Conservation* 197: 32-39.
82 ibid
83 Barber, C.P., Cochrane, M.A., Souza, C.M.Jr. and W.F. Laurance. 2014. Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation* 17: 203-209.
84 Data researched by UNEP-WCMC based on biome data from WWF and IUCN and UNEP-WCMC. 2016. The World Database on Protected Areas (WDPA) [On-line]. UNEP-WCMC, Cambridge, UK. Available at: www.protectedplanet.net. and UNEP-WCMC. 2015. Dataset combining Exclusive Economic Zones (EEZ; VLIZ 2014) and terrestrial country boundaries (World Vector Shoreline, 3rd edition, National Geospatial-Intelligence Agency). UNEP World Conservation Monitoring Centre, Cambridge, UK.
85 ibid
86 Millennium Ecosystem Assessment (MEA). 2003. *Ecosystems and Human Wellbeing: A framework for assessment,* Millennium Ecosystem Assessment, Island Press, New York.

87 Moutinho, P. and Schwartzman, S. (eds). 2005. *Tropical Deforestation and Climate Change*, Instituto de Pesquisa Ambiental da Amazôniza, Belém, Brazil; Environmental Defense, Washington, USA.
88 Macedo, M. and Castello, L. 2015. *Op cit*
89 Moutinho, P. and Schwartzman S. (eds). 2005. *Tropical Deforestation and Climate C*hange, Instituto de Pesquisa Ambiental da Amazôniza, Belém, Brazil; Environmental Defense, Washington, USA.
90 Macedo, M. and Castello L. 2015. *Op cit*
91 Nobre, A.D. 2014. *The Future Climate of Amazonia: Scientific Assessment Report*. ARA: CCST-INPE: INPA. São José dos Campos, SP, Brazil.
92 Giannini, T.C., Cordeiro, G.D., Freitas, B.M., Saraiva, A. M. and V.L. Imperatriz-Fonseca. 2015. The Dependence of Crops for Pollinators and the Economic Value of Pollination in Brazil. *Journal of Economic Entomology* 108 (3): 849-857.
93 Verweij, P., Schouten, M., van Beukering, P., Triana, J., van der Leeuw, K. and S. Hess. 2009. *Keeping the Amazon forests standing: A matter of values*. WWF Netherlands.
94 Vittor, A.Y., Pan, W., Gilman, R.H., Tielsch, J., Glass, G., Shields, T., Sánchez-Lozano, W., Pinedo, V.V., Salas-Cobos, E., Flores, S. and J.A. Patz. 2009. Linking deforestation to malaria in the Amazon: Characterization of the breeding habitat of the principal malaria vector, *Anopheles darling, American Journal of Tropical Medicine and Hygiene* 81: 5-12.
95 Verweij, P., et al. 2009. *Op cit*
96 Medeiros, R., Frickmann Young, C.E., Boniatti Pavese, H. and F. França Silva Araújo (eds). 2011. *The contribution of Brazilian conservation units to the national economy*. UNEP-WCMC, Brasilia.
97 Taniwaki, M.H., Pitt, J.I., Iamanaka, B.T., Massi, F.P., Fungaro, M.H.P. and J.C. Frisvad. 2015. *Penicillium excelsum* sp. nov from the Brazil Nut Tree Ecosystem in the Amazon Basin, *PLoS ONE* 10(12): DOI:10.1371/journal.pone.0143189
98 Shanley, P., et al. 2011. *Op cit*
99 Verweij, P., et al. 2009. *Op cit*
100 Stolton, S. and Dudley, N. (eds) 2010. *Arguments for Protected Areas,* Earthscan, London.
101 Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P., and M. van den Belt.1997. The value of the world's ecosystem services and natural capital, *Nature* 387: 253-60.
102 Ramirez-Gomez, S.O.I., Torres-Vitolas, C.A., Schreckenberg, K., Honzak, M., Cruz-Garcia, G.S., Willcock, S., Palacios, E., Perez-Minana, E., Verweij, P.A. and G.M. Poppy. 2015. Analysis of ecosystem services provision in the Colombian Amazon using participatory research and mapping techniques. *Ecosystem Services* 13: 93-107.
103 Verweij, P., et al. 2009. *Op cit*
104 May, P.H., Soares-Filho, B.S. and J. Strand. 2013. *How much is the Amazon Worth? The State of Knowledge Concerning the Value of Preserving Amazon Rainforests*. Policy Research Working Paper 6668, World Bank, Washington D.C., USA.
105 Pacha, M.J. 2015. *Ecosystem services valuation as a decision-making tool: Conceptual bases and lessons learned in the Amazon region*. WWF Living Amazon Initiative, Brasília and Quito.
106 Portela, R. and I. Rademacher. 2001. A dynamic model of patterns of deforestation and their effect on the ability of the Brazilian Amazonia to provide ecosystem services. *Ecological Modelling* 143: 115-146.
107 Amend, M., Gascon, G. and J. Reid. 2007. Beneficios economicios locais de areas protegidas na regio de Manaus, Amazonas. *Megadiversidade* 3: no 60.
108 May, P.H., et al. 2013. *Op cit*
109 Mardas, N., Bellfield, H., Jarvis, A., Navarrete, C. and C. Comberti. 2013. *Amazonia Security Agenda: Summary of Findings and Initial Recommendations*. Global Canopy Programme and International Center for Tropical Agriculture.
110 Hoffman, M. and Grigera, A.I. 2013. *Climate Change, Migration, and Conflict in the Amazon and the Andes: Rising Tensions and Policy Options in South America*. Center for American Progress, Washington D.C., USA.
111 ibid
112 Shanley, P., et al. 2011. *Op cit*
113 Silva, O.S., Romão, P.R., Blazius, R.D. and J.S. Prohiro. 2004. The use of andiroba Carapa guianensis as larvicide against Aedes albopictus. *Journal of the American Mosquito Control Association* 20 (4): 456-457.
114 Klimas, C.A., Kainer, K.A. and L.H. de Oliveira Wadt. 2012. The economic value of sustainable seed and timber harvest of multi-use species. An example using *Carapa guianensis*. *Forest Ecology and Management* 268: 81-91.
115 Shanley, P. and Luz, L. 2003. The Impacts of Forest Degradation on Medicinal Plant Use and Implications for Health Care in Eastern Amazonia. *Bioscience* 53 (6): 573-584: doi: 10.1641/0006-3568(2003)053[0573:TIOFDO]2.0.CO;2
116 Information in this section from Jordi Surkin and José Argandoña of WWF Bolivia.
117 WWF Brazil. 2013. *Environmental Service Incentives System in the State of Acre, Brazil: Lessons for policies, programmes and strategies for jurisdiction-wide REDD+*, WWF Brazil, Brasilia.
118 Shanley, P., et al. 2011. *Op cit*

119 Cronkleton, P., Guariguata, M.R. and M.A. Albornoz. 2012. Multiple use forestry planning: Timber and Brazil nut management in the community forests of northern Bolivia. *Forest Ecology and Management* 268: 49-56.
120 Coslovsky, S.V. 2014. Economic development without pre-requisites: How Bolivian producers met strict food safety standards and dominated the global Brazil-nut market. *World Development* 54: 32-45.
121 Duchelle, A.E., Kainer, K.A. and L.H.O. Wadt. 2014. Is Certification Associated with Better Forest Management and Socioeconomic Benefits? A Comparative Analysis of Three Certification Schemes Applied to Brazil Nuts in Western Amazonia. *Society and Natural Resources* 27 (2): DOI:10.1080/08941920.2013.840022
122 Morsello, C., Ruiz-Malle, I., Montoya Diaz, M. D. and V. Reyes-Gacia. 2012.The Effects of Processing Non-Timber Forest Products and Trade Partnerships on People's Well-Being and Forest Conservation in Amazonian Societies, *PLoS ONE* 7: 8, e43055.
123 Benjamin Freitas, M.A., Guimarães Vieira, I.C., Mangabeira Albernaz, A.L.K., Lima Magalhães, J.L. and A.C. Lees. 2015. Floristic impoverishment of Amazonian floodplain forests managed for açaí fruit production, *Forest Ecology and Management* 351: 20-27.
124 Rockwell C.A., Guariguata, M.R., Menton, M., Arroyo Quispe, E., Quaedvlieg, J., Warren-Thomas, E., et al. 2015. Nut Production in Bertholletia excels across a Logged Forest Mosaic: Implications for Multiple Forest Use, *PLoS ONE* 10(8): e0135464.
125 Shanley, P., et al. 2011. *Op cit*
126 FAO stat, faostat3.fao.org/browse/Q/*/E, accessed 5th March 2016.
127 Crompton, T.C. 2010. *Common Cause: The Case for Working with our Cultural Values*, WWF UK, Woking, UK.
128 Dudley, N. 2011. *Authenticity in Nature*. Earthscan, London.
129 Burgos R., et al. 2014. *Op cit*
130 Hitzhusen, G.E. and Tucker, M.E. 2013. The potential of religion for Earth Stewardship, *Frontier of Ecology and the Environment* 11 (7): 368-376. doi 10.1890/120322
131 Bhagwat, S.A., Dudley, N. and S.R. Harrop. 2011. Religious following in biodiversity hotspots: Challenges and opportunities for conservation and development. *Conservation Letters* 4: 234-240.
132 www.amazonrainforestnews.com/2011/06/majority-of-brazilians-reject-changes.html, accessed 5th March 2016.
133 Taylor, R. 2015. *WWF Living Forests Report*. Chapter 5: Saving forests at risk. WWF International, Gland, Switzerland. wwf.panda.org/livingforests
134 Brown, J.C., Koeppe, M., Coles, B. and K.P. Price. 2005. Soybean production and conversion of tropical forest in the Brazilian Amazon: The case of Vilhena, Rondonia. *Ambio* 34: 462-469.
135 Fearnside, P.M. 2008. The roles and movements of actors in the deforestation of Brazilian Amazonia, *Ecology and Society* 13 (1): 23.
136 Gibbs, H.K., Munger, J., L'Roe, J., Barreto, P., Pereira, R., Christie, M., Amaral, T. and N.F. Walker. 2015. Did Ranchers and Slaughterhouses Respond to Zero-Deforestation Agreements in the Brazilian Amazon? *Conservation Letters*, 9(1), 32-42.
137 Fearnside, P.M., Figueiredo, A.M.R. and Bonjour, S.C.M. 2012. Amazonian forest loss and the long reach of China's influence. *Environment, Development and Sustainability* 15 (2): 325-338. DOI 10.1007/s10668-012-9412-2
138 Morton, D.C., DeFries, R.S., Shimabukuro, Y.E., Anderson, L.O., Aral, E., del Bon Espirito-Santo, F., Freitas, R. and J. Morisette. 2006. Cropland expansion changes deforestation dynamics in the southern Brazilian Amazon. *Proceedings of the National Academy of Sciences* 103 (39): 14637-14641.
139 Kaimowitz, D. and J. Smith. 2001. Soybean technology and the loss of natural vegetation in Brazil and Bolivia. In: A. Angelstam and D. Kaimowitz (eds), *Agricultural Technologies and Tropical Deforestation*, CABI International, Wallingford, UK.
140 Barona, E., Ramankutty, N., Hyman, G. and O.T. Coomes. 2010. The role of pasture and soybean in deforestation in the Brazilian Amazon. *Environmental Research Letters* 5: doi:10.1088/1748-9326/5/2/024002.
141 Lapola, D., Schaldach, R., Alcamo, J., Bondeaud, A., Kocha, J., Koelkinga, C. and J.A. Priesse. 2010. Indirect land-use changes can overcome carbon savings from biofuels in Brazil. *Proceedings of the National Academy of Sciences*, 107: 8 pnas.org/cgi/doi/10.1073/pnas.0907318107.
142 Gasparri, N.I. and le Polain de Waroux, Y. 2014. The coupling of South American soybean and cattle production frontiers: New challenges for conservation policy and land change science. *Conservation Letters* 8 (4): 290-298.
143 WWF. 2014. *The Growth of Soy: Impacts and Solutions*. WWF International, Gland, Switzerland.
144 Macedo, M.N., DeFries, R.S., Morton, D.C., Stickler, C.M., Galford, G.L. and Y.E. Shimambukuro. 2012. Decoupling of deforestation and soy production in the southern Amazon during the late 2000s. *Proceedings of the National Academy of Sciences* 109 (4): 1341-1346.
145 Gibbs, H.K., Rausch, L., Munger, J., Schelly, I., Morton, D.C., Noojipady, P., Soares-Filho, B., Barreto, P., Micol, L. and N.F. Walker. 2015. Brazil's Soy Moratorium. *Science* 347: 6220.
146 Brandão, F. and Schoneveld, G. 2015. *The state of oil palm development in the Brazilian Amazon*. Working Paper 198. CIFOR, Bogor, Indonesia.
147 FAO. 2006. *Livestock's Long Shadow*. FAO, Rome, Italy.
148 Pacheo, P. and Poccard-Chapuis. 2015. Cattle ranching development in the Brazilian Amazon. In: Emel, J. and Neo, H. (eds), *Political Ecologies of Meat* 42-66.

149 Gibbs, H.K., Munger, J., L'Roe, J., Barreto, P., Pereira, R., Christie, M., Amaral, T. and N.F. Walker. 2015. Did Ranchers and Slaughterhouses Respond to Zero-Deforestation Agreements in the Brazilian Amazon? *Conservation Letters*, 9 (1), 32-42.
150 ibid
151 Anon. 2016. *Reconciling production with conservation: The challenge of responsible beef production in South America*. Regional Sustainable Livestock Initiative in South America. WWF.
152 Round Table on Responsible Soy, www.responsiblesoy.org/
153 Roundtable on Sustainable Palm Oil, www.rspo.org/
154 Brazilian Roundtable on Sustainable Livestock, www.pecuariasustentavel.org.br/en/
155 Global Roundtable for Sustainable Beef, www.grsbeef.org/
156 Gibbs, H.K., et al. 2015. *Op cit*
157 This sections draws principally from the analysis in Kuepper, B., Warmerdam, W., van Gelder, J.W. and J. Schure. 2015. *Drivers of forest loss in the Amazon Biome: Stakeholder analysis and policies of major financial institutions*. Profundo for WWF, Amsterdam.
158 Müller, R., Müller, D., Schierhorn, F., Gerold, G. and P. Pacheco. 2012. Proximate causes of deforestation in the Bolivian lowlands: An analysis of spatial dynamics. *Regional Environmental Change* 12: 445-459.
159 Godar, J., Gardner, T.A., Tizabo, E.J. and P. Pacheco. 2014. Actor-specific contributions to the deforestation slowdown in the Brazilian Amazon. *Proceedings of the National Academy of Sciences* 111: 15591-15596, doi: 10.1073/pnas.1322825111
160 Dávalos, L., Bejarano, A.C., Hall, M.A., Correa, H.L. and A. Corthals. 2011. Forests and Drugs: Coca-Driven Deforestation in Tropical Biodiversity Hotspots. *Environmental Science and Technology* 45: 1219-1227: dx.doi.org/10.1021/es102373d
161 Kuepper, B., Warmerdam, W., van Gelder, J.W. and J. Schure. 2015. *Drivers of forest loss in the Amazon Biome: Stakeholder analysis and policies of major financial institutions*. Profundo for WWF, Amsterdam.
162 Sánchez-Cuervo, A.M. and Aide, T.M. 2013. Consequences of the armed conflict, forced human displacement, and land abandonment on forest cover change in Colombia: A multi-scaled analysis. *Ecosystems* 16 (6): 1052-1070.
163 Chávez, A.B., Broadbent, E.N. and A.M. Almeyda Zambrono. 2014. Smallholder policy adoption and land cover change in the southeastern Amazon: A twenty-year perspective. *Applied Geography* 53: 223-233.
164 Godar, J., Gardner, T.A., Tizado, E.J. and P. Pacheco. 2014. Actor-specific contributions to the deforestation slowdown in the Brazilian Amazon. *Proceedings of the National Academy of Sciences* 111 (43): 15591-15596. doi/10.1073/pnas.1322825111
165 Hoffman, M. and Grigera, A.I. 2013. *Climate Change, Migration, and Conflict in the Amazon and the Andes: Rising Tensions and Policy Options in South America*. Center for American Progress, Washington D.C., USA.
166 Macedo, M. and L. Castello. 2015. *Op cit*
167 Tundisi, J.G., Goldemberg, J., Matsumura-Tundisi, T. and A.C.F. Saraiva. 2014. How many more dams in the Amazon? *Energy Policy* 74: 703-708.
168 Castello, L. and Macedo, M.N. 2015. Large-scale degradation of Amazonian freshwater ecosystems. *Global Change Biology* doi: 10.1111/gcb.13173.
169 Castello, L., et al. 2013. *Op cit*
170 Stickler, C.M., Coe, M.T., Costa, M.H., Nepstad, D.C., McGrath, D.G., Dias, L.C.P., Rodrigues, H.O. and B.S. Soares-Filho. 2013a. Dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales. *Proceedings of the National Academy of Sciences* 110 (23): 9601-9606.
171 Macedo, M. and L. Castello. 2015. *Op cit*
172 Castello, L., et al. 2013. *Op cit*
173 wwf.panda.org/wwf_news/?264030/Large-scale-degradation-of-Amazonian-freshwater-ecosystems
174 Finer, M. and Jenkins, C.N. 2012. Proliferation of hydroelectric dams in the Andean Amazon and implications for Andes-Amazon connectivity. *PLoS ONE* 7: e35126.
175 Bernard, E., Penna, L.A.O. and E. Araújo. 2014. Downgrading, Downsizing, Degazettement, and Reclassification of Protected Areas in Brazil. *Conservation Biology* 28 (2): 1523-1739.
176 Pack, S.M., Ferreira, M.N., Krithivasan, R., Murrow, J., Bernard, E. and M.B. Mascia. 2016. Protected area downgrading, downsizing, and degazettement (PADDD) in the Amazon. *Biological Conservation* 197, 32-39.
177 Macedo, M. and L. Castello. 2015. *Op cit*
178 Mardas, N., Bellfield, H., Jarvis, A., Navarrete, C. and C. Comberti. 2013. *Amazonia Security Agenda: Summary of Findings and Initial Recommendations*. Global Canopy Programme and International Center for Tropical Agriculture.
179 Fearnside, P.M. 2014. Viewpoint – Brazil's Madeira River dams: A setback for environmental policy in Amazonian development. *Water Alternatives* 7: 1-15.
180 Canas, C.M. and Pine, W.E. 2011. Documentation of the temporal and spatial patterns of Pimelodidae catfish spawning and larvae dispersion in the Madre de Dios (Peru): Insights for conservation in the Andean-Amazon headwaters. *River Research and Applications* 27: 602-611.

181 Macedo, M.N., Coe, M.T., DeFries, R., Uriarte, M., Brando, P.M., Neill, C. and W.S. Walker. 2013. Land-use-driven stream warming in southeastern Amazonia. *Philosophical Transactions of the Royal Society London B* 368: 20120153.

182 Pearce, F. 1992. *The Dammed: Rivers, dams and the coming world water crisis*. The Bodley Head, London.

183 Cummings, B.J. 1990. *Dam the Rivers, Damn the People: Development and resistance in Amazonian Brazil*. Earthscan in association with WWF, London.

184 Douglas, E.M., Wood, S., Sebastian, K., Vörösmarty, C.V., Chomitz, K.M. and T.P. Tomich. 2007. Policy implications of a pan-tropic assessment of the simultaneous hydrological and biodiversity impacts of deforestation. *Water Resources Management* 21: 211-232.

185 Stickler, C.M., Coe, M.T., Costa, M.H., Nepstad, D.C., McGrath, D.G., Dias, L.C.P., Rodrigues, H.O. and B.S. Soares-Filho. 2013. Dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales, *PNAS*, 110 (23): 9601-9606.

186 Drawing on a report for WWF by Cláudia Véliz.

187 Zulkafli, Z., Buytaert, W., Manz, B., Véliz Rosas, C., Willems, P., Lavado-Casimiro, W., Guyot, J.L. and W. Santini. 2016. Projected increases in the annual flood pulse of the Western Amazon. *Environmental Research Letters* 11: doi:10.1088/1748-9326/11/1/014013.

188 Finer, M. and C.N. Jenkins. 2012. Proliferation of Hydroelectric Dams in the Andean Amazon and Implications for Andes-Amazon Connectivity. *PLoS ONE* 7 (4): e35126. doi:10.1371/journal.pone.0035126

189 Fraser, B. 2014. Carving up the Amazon. *Nature* 509: 418-419.

190 Drawing on a literature review and analysis by Jamie Gordon of WWF UK: Gordon, J. 2015. *Amazonian roads and forests – lessons from the literature*, review for WWF UK, Woking, UK.

191 Killeen, T.J. 2007. *A Perfect Storm in the Amazon Wilderness: Development and conservation in the context of the Initiative for the Integration of Regional Infrastructure of South America (IIRSA)*. Advances in Applied Biodiversity Science 7, Conservation International, Washington DC.

192 Arima, E.Y., Walker, R.T., Sales, M., Souza, C. Jr. and S.G. Perz. 2008. The Fragmentation of Space in the Amazon Basin. *Photogrammetric Engineering & Remote Sensing* 74 (6): 699-709.

193 Ahmed, S.E., Souza, C.M. Jr., J. Riberio, J. and R.M. Ewers. 2013. Temporal patterns of road network development in the Brazilian Amazon. *Regional Environmental Change* 13 (5): 927-937.

194 Barber, C.P., Cochrane, M.A., Souza, C.M. Jr. and W.F. Laurance. 2014. Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation* 17: 203-209.

195 Laurance, W.F., Goosem, M. and S.G. Laurance. 2009. Impacts of roads and linear clearings on tropical forests. *Trends in Ecology and Evolution* 24 (12): 659-669.

196 Rosa, I.M., Purves, D., Souza C.Jr and R.M. Ewers. 2013. Predictive modelling of contagious deforestation in the Brazilian Amazon. *PloS one* 8 (10): e77231.

197 Kis Madrid, C., Hickey, G.M. and M.A. Bouchard. 2011. Strategic environmental assessment effectiveness and the Initiative for the Integration of Regional Infrastructure in South America (IIRSA): A multiple case review. *Journal of Environmental Assessment Policy and Management* 13 (04): 515-540.

198 Laurance, W.F., et al. 2009. *Op cit*

199 Ferretti-Gallon, K. and Busch, J. 2014. *What drives deforestation and what stops it?* Working Paper 361, Centre for Global Development, London.

200 Müller, R., Pacheco, P. and J.C. Montero. 2014. *The context of deforestation and forest degradation in Bolivia: Drivers, agents and institutions*. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

201 Goodstadt, V. and Partidário, M.R. 2012. Spatial planning and environmental assessments. In: H. Wittmer and H. Gundimeda (eds), *The Economics of Ecosystems and Biodiversity in Local and Regional Policy and Management*. Earthscan, London.

202 WWF and Equilibrio. 2015. *Mas allá de una vía: Construcción de la variante San Francisco-Mocca*, Bogota.

203 agenciabrasil.ebc.com.br/politica/noticia/2016-01/dilma-e-correa-conversam-sobre-ligacao-entre-amazonia-e-o-pacifico accessed 5th May 2016.

204 Barber, C.P., Cochrane, M.A., Souza, C.M.Jr. and W.F. Laurance. 2014. Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation* 17: 203-209.

205 Goodland, R. 2012. Responsible mining: The key to profitable resource development. *Solutions* 4: 2099-2106. doi:10.3390/su4092099.

206 Martin, P.L. 2011. Global governance from the Amazon: Leaving oil underground in Yasuní National park, Ecuador. *Global Environmental Politics* 11 (4): 22-42.

207 Finer, M., Jenkins, C.N., Pimm, S.L., Keane, B. and C. Ross. 2008. Oil and gas projects in the Western Amazon: Threats to wilderness, biodiversity and indigenous peoples. *PLoS ONE* 3: e2932.

208 Durán, A.P., Rauch, J. and K.J. Gaston. 2013. Global spatial coincidence between protected areas and metal mining activities. *Biological Conservation* 160: 272-278.

209 Finer, M., Jenkins, C.N. and B. Powers. 2013. Potential of best practice to reduce impacts from oil and gas projects in the Amazon. *PLOS One* 8 (5): e63022. doi: 10.1371/journal.pone.0063022.

210 From a forthcoming WWF report on deforestation fronts in the Amazon.

211 Villegas, C., Weinberg, R., Levin, E. and K. Hund. 2012. Artisanal and small-scale mining in protected areas and critical ecosystems programme (ASM-PACE): Global solutions study. WWF and Estelle Levin Ltd., Godalming and Cambridge, UK.

212 Hoffman, M. and Grigera, A.I. 2013. *Climate Change, Migration, and Conflict in the Amazon and the Andes: Rising Tensions and Policy Options in South America*. Center for American Progress, Washington D.C., USA.

213 Holland, M.B., de Koning, F., Morales, M., Naughton-Treves, L., Robinson, B.E. and L. Suárez. 2014. Complex Tenure and Deforestation: Implications for Conservation Incentives in the Ecuadorian Amazon, *World Development* 55: 21-36.

214 SNL Financial Ltd. disclaimer: Although the data and information represented in the report and maps has been obtained from government sources believed to be reliable, we do not guarantee its accuracy. The maps and their contents are provided 'as is,' and we and our data providers disclaim all expressed and implied warranties, including implied warranties of merchantability and fitness for a particular use. In no event shall we or our data providers have any monetary liability of any kind whatsoever to recipient or to any user of the contents of this report. Any user should contact the government agency for verification of locations and attributes, to supply feedback on suspected inaccuracies or for more detailed information of specific claims from the official register.

215 Alvarrez-Berríos, N.L. and Aide, T.M. 2015. Global demand for gold is another threat to tropical forests. *Environmental Research Letters* 10. doi:10.1088/1748-9326/10/2/029501

216 Swenson, J.J., Carter, C.E., Domec, J.C. and C.I. Delgado. 2011. Gold Mining in the Peruvian Amazon: Global Prices, Deforestation, and Mercury Imports. *PLoS ONE* 6 (4): e18875. doi:10.1371/journal.pone.0018875.

217 Asner, G.P., Llactayo, W., Tupayachi, R. and E. Ráez Luna. 2013. Elevated rates of gold mining in the Amazon revealed through high resolution monitoring. *Proceedings of the National Academy of Sciences* 110: 18454-18459.

218 Legg, E.D., Ouboter, P.E. and M.A.P. Wright. 2015. *Small-Scale Gold Mining Related Mercury Contamination in the Guianas: A Review*. WWF-Guianas, Paramaribo.

219 WWF Guianas. 2012. *Living Guianas Report 2012*. WWF Guianas, Paramaribo, Suriname.

220 Information in this section draws on a report prepared for the Living Amazon Initiative: Marín, S. and May, E. 2012. *Gold Mining in the Amazon: Key issues and engagement strategy*. WWF Living Amazon Initiative.

221 Marín, S. and May, E. 2012. *Gold Mining in the Amazon: Key issues and engagement strategy*. WWF Living Amazon Initiative.

222 WWF Guianas. 2012. *Living Guianas Report 2012*. WWF Guianas, Paramaribo, Suriname.

223 GFC and Pöyry. 2011. Interim Measures Report. Guyana REDD+ Monitoring Reporting and Verification System (MRVS). Guyana Forestry Commission and Pöyry Management Consulting (NZ) Limited and Alvarez-Berríos, N.L. and Mitchell Aide. T. 2015. Global demand for gold is another threat for tropical forests. *Environ. Res. Lett*. 10. doi:10.1088/1748-9326/10/1/014006.

224 Mol, J.H. and Ouboter, P.E. 2004. Downstream Effects of Erosion from Small-Scale Gold Mining on the Instream Habitat and Fish Community of a Small Neotropical Rainforest Stream. *Conservation Biology* 18: 201-214. doi: 10.1111/j.1523-1739.2004.00080.x

225 Ouboter, P.E., Landburg, G.A., Quik, J.H.M., Mol, J.H.A. and F. van der Lugt. 2012. Mercury levels in pristine and gold mining impacted aquatic systems in Suriname, South America. *Ambio* 41: 873-882.

226 Nriagi, J.O., Pfeiffer, W.C., Malm, O., Magalhaes de Souza, C.M. and G. Mierle. 1992. Mercury Pollution in Brazil. *Nature* 356: 389. doi:10.1038/356389a0.

227 Ouboter, P.E., et al. 2012. *Op cit*

228 De Kom, J.F.M., van der Voet, G.B. and F.A. de Wolff. 1998. Mercury exposure of maroon workers in the small scale gold mining in Suriname. *Environmental Research Section A* 77: 91-97.

229 Peplow, D. and S. Augustine. 2007. Community-directed risk assessment of mercury exposure from gold mining in Suriname. Pan American Journal of Public Health / *Revista Panamericana de Salud Pública* 22 (3): 202-210.

230 WWF Guianas. 2012. *Living Guianas Report 2012*. WWF Guianas, Paramaribo, Suriname.

231 Personal communication, Laurens Gomes, WWF Suriname.

232 Rocha, J. 1999. *Murder in the Rainforest: The Yanomani, the gold miners and the Amazon*. Latin American Bureau, London.

233 Kambel, E.R. and MacKay, F. 1999. *The Rights of Indigenous Peoples and Maroons in Suriname*. International Working Group on Indigenous Affairs and Forest Peoples Programme. IWGIA Document 96, Copenhagen.

234 Heemskerk, M. 2001. Maroon gold miners and mining risks in the Suriname Amazon. *Cultural Survival Quarterly* 25 (1): 25-29.

235 WWF Guianas. 2012. *Living Guianas Report 2012*. WWF Guianas, Paramaribo, Suriname. See also Teunissen, P.A. 2005. Management Plan 2005-2010 Brownsberg Nature Park (Suriname) Volume 1 Text. Ministry of Natural Resources, Foundation for Nature Conservation in Suriname and WWF, Paramaribo.

236 Santana, V., Medina, G. and A. Torre. 2014. *The Minamata Convention on Mercury and its implementation in the Latin America and Caribbean Region*. UNEP, Uruguay.

237 Hoffman, M. and Grigera, A.I. 2013. *Op cit*

238 Lima, L.S., Coe, M.T., Soares Filho, B.S., Cuarda, S.V., Dias, L.C.P., Costa, M.H., Lima, L.S. and H.O. Rodrigues. 2014. Feedbacks between deforestation, climate, and hydrology in the Southwestern Amazon: Implications for the provision of ecosystem services. *Landscape Ecology* 29: 261-274. DOI 10.1007/s10980-013-9962-1.

239 Nepstad, D.C., Stickler, C.M., Soares-Filho, B. and F. Merry. 2008. Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point, *Philosophical Transactions of the Royal Society Biological Sciences* 363(1498): 1737-1746.

240 Taylor, R. (ed). 2015. *Op cit*

241 da Silva Dias, A., Maretti, C., Lawrence, K., Charity, S., Oliveira, D., Johnson, J., Gomez Cerveró, L. H., Accacio, G. and G. Abdala. 2014. *Deforestation Fronts in the Amazon Region: Current Situation and Future Trends a preliminary summary***.** WWF Living Amazon (Global) Initiative, Brasília and Quito.

242 Pre-publication data from Andre da Silva Dias and Karen Lawrence, WWF Living Amazon Initiative and UK.

243 Suarez Pacheco, C.F., Wessel, B. and A. Coca. 2016. *Analisis de defoestación del Bioma Amazónico*. WWF-Colombia, and WWF Living Amazon Initiative.

244 Hecht, S.B. 2012. From eco-catastrophe to zero deforestation? Interdisciplinarities, politics, environmentalisms and reduced clearing in Amazonia. *Environmental Conservation,* 39 (1): 4-19.

245 WWF. 2015. *The Brazilian Amazon: Challenges facing an effective policy to curb deforestation*, WWF Living Amazon Initiative and WWF Brazil, Brasília, Brazil.

246 Foley, J.A., Asner, G.P., Costa, M.H., Coe, M.T., DeFries, R., Gibbs, H.K., Howard, E.A., Olson, S., Patz, J., Ramankutty, N. and P. Snyder. 2007. Amazonia revealed: Forest degradation and loss of ecosystem goods and services in the Amazon Basin. *Frontiers in Ecology* 5 (1): 25-32.

247 Aide, T.M., Clark, M.L., Grau, H.R., López-Carr, D., Levy, M.A., Redo, D., Bonilla-Moheno, M., Riner, G., Andrade-Núnéez, M.J. and M. Muníz. 2012. Deforestation and Reforestation of Latin America and the Caribbean (2001–2010), *Biotropica* 45 (2): 262-271 1-10.

248 Laurance, W.F, Camargo, J.L.C., Luizão, R.C.C., Laurance, S.G., Pimm, S.L., Bruna, E.M. et al. 2011. The fate of Amazonian forest fragments: A 32-year investigation. *Biological Conservation* 144 (2011): 56-67.

249 Coca-Castro, A., Reymondin, L., Bellfield, H. and G. Hyman. 2013. *Land Use Status and Trends in Amazonia*. Report for Global Canopy Programme and International Center for Tropical Agriculture as part of the Amazonia Security Agenda project.

250 Nepstad, D.C., Stickler, C.M., Soares-Filho, B. and F. Merry. 2008. Interactions among Amazon land use, forests and climate: Prospects for a near-term forest tipping point, *Philosophical Transactions of the Royal Society Biological Sciences* 363 (1498): 1737-1746.

251 Soares-Filho B.S., Nepstad, D.C., Curran, L., Cerqueira, G.C., Garcia, R.A., Ramos, C.A., Voll, E., McDonald, A., Lefebvre, P. and P. Schlesinger, P. 2006. Modelling conservation in the Amazon basin. *Nature* 440: 520-523.

252 Taylor, R. (ed). 2011. *Living Forest Report*. Chapter 1. Forests for a living planet. WWF, Gland, Switzerland. wwf.panda.org/livingforests

253 Nobre, A.D. 2014. *The Future Climate of Amazonia: Scientific Assessment Report*. ARA: CCST-INPE: INPA. São José dos Campos, SP, Brazil.

254 Suarez Pacheco, C.F., Wessel, B. and A. Coca. 2016. *Op cit*

255 ibid

256 Asner, G.P., Knapp, D.E., Broadbent, E.N., Oliveira, P.J., Keller, M. and J.N. Silva. 2005. Selective logging in the Brazilian Amazon. *Science* 310: 480-482.

257 Zimmerman, B.L. and Kormos, C.F. 2012. Prospects for sustainable logging in tropical forests. *Bioscience* 62 (5): 479-487.

258 Taylor, R. 2015. *Op cit*

259 Pearson, T.R.H., Brown, S., and F.M. Casarim. 2014. Carbon emissions from tropical forest degradation caused by logging. *Environmental Research Letters* 9: doi:10.1088/1748-9326/9/3/034017.

260 Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S. and E. Saxon. 2011. *The Root of the Problem – What is driving deforestation today?* Union of Concerned Scientists Cambridge, USA, p.67,71.

261 Asner, G.P., et al. 2005. *Op cit*

262 Kuepper, B., Warmerdam, W., van Gelder, J.W. and J. Schure. 2015. *Drivers of forest loss in the Amazon biome – Stakeholder analysis and policies of major financial institutions*. Profundo, Amsterdam.

263 Monteiro, A. Cardoso, D., Conrado, D., Veríssimo, A. and C. Souza Jr. 2013. *Transparência Manejo Florestal Estado do Pará - 2011 a 2012*. Imazon: Belém. news.mongabay.com/2013/1023-illegal-logging-brazil.html#DW8BokP3DekRqmEJ.99

264 Finer, M., Jenkins, C.N., Blue Sky, M.A. and J. Pine. 2014. Logging concessions enable illegal logging crisis in the Peruvian Amazon. *Scientific Reports* 4, article number 4719, doi: 10.1038/srep04719.

265 Taylor, R. (ed). 2012. *WWF Living Forests Report*. Chapter 4: Forests and wood products, WWF International, Gland, Switzerland. wwf.panda.org/livingforests

266 Kuepper, B., Warmerdam, W., van Gelder, J.W. and J. Schure. 2015. *Drivers of forest loss in the Amazon biome – Stakeholder analysis and policies of major financial institutions*. Profundo, Amsterdam.

Contents | Introduction | The Amazon | Values of the Amazon | Pressures on the Amazon | Safeguarding the Amazon

267 Malhi, Y., Roberts, J.T., Betts, R.A., Killeen, T.J, Li, W. and C.A. Nobre. 2008. Climate change, deforestation, and the fate of the Amazon. *Science* 319: 169-172.

268 Nobre, A.D. 2014. *The Future Climate of Amazonia: Scientific Assessment Report*. ARA: CCST-INPE: INPA. São José dos Campos, SP, Brazil.

269 Lewis, S.L., Brando, P.M., Phillips, O.L., van der Heijden, G.M.F. and D. Nepstad. 2011. The 2010 Amazon Drought. *Science* 331: 554. DOI: 10.1126/science.1200807.

270 Fu, R., Yin, L., Li, W., Arias, P.A., Dickinson, R.E., Huang, L., Chakraborty, S., Fernandes, K., Liebmann, B., Fisher, R. and R.B. Myneni. 2013. Increased Dry-Season Length over Southern Amazonia in Recent Decades and its Implication for Future Climate Projection. *Proceedings of the National Academy of Sciences* 110: 18110-18115, doi: 10.1073/pnas.1302584110.

271 Suarez, C., et al. 2015. *Op cit*

272 Malhi, Y., Roberts, J.T., Betts, R.A., Killeen, T.J., Li, W. and C.A. Nobre. 2008. Climate Change, Deforestation, and the Fate of the Amazon. *Science* 319: 169-172.

273 Nepstad, D., Lefebvre, P., Lopes da Silva, U., Tomasella, J., Schlesinger, P., Solórano, L., Moutinho, P., Ray, D. and J. Guerreira Benito. 2004. Amazon Drought and Its Implications for Forest Flammability and Tree Growth: A Basin-Wide Analysis. *Global Change Biology* 10: 704-717 DOI: 10.1111/j.1529-8817.2003.00772.x.

274 Brando, P.M., Balch, J.K., Nepstad, D.C., Putz, F.E., Coe, M.T., Silvério, D., Macedo, M.N., Davidson, E.A., Nóbrega, C.C., Alencar, A. and B.S. Soares-Filho. 2014. Abrupt increases in Amazonian tree mortality due to drought–fire interactions. *Proceedings of the National Academy of Sciences* 111 (17): 6347-6352, doi: 10.1073/pnas.1305499111.

275 Gloor, M., Barichivich, J., Ziv, G., Brienen, R., Schoengart, J., Peylin, P., Ladvocat Cintra, B. B., Feldpausch, T., Phillips, O. and J. Baker. 2015. Recent Amazon climate as background for possible ongoing and future changes of Amazon humid forests. *Global Biogeochemical Cycles* 29 (9): 1384-1399.

276 Duffy, P.B., Brando, P., Asner, G.P. and C.B. Field. 2015. Projections of future meteorological drought and wet periods in the Amazon. *PNAS* 112 (43): 13172-13177.

277 Gloor, M., Barichivich, et al. 2015. *Op cit*

278 Stickler, C.M., Coe, M.T., Costa, M.H., Nepstad, D.C., McGrath, D.G., Dias, L.C.P., Rodrigues, H.O. and B.S. Soares-Filho. 2013. Dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales. *Proceedings of the National Academy of Sciences* 110 (23): 9601-9606.

279 Hoffman, M. and Grigera, A.I. 2013. *Op cit*

280 Hilker, T., Lyapustin, A., Compton T.J., Hall, F.G., Myneni, R.B., Wang Y., Bi, J., Mendes de Moura, Y. and P.J. Sellers. 2014. Vegetation dynamics and rainfall sensitivity of the Amazon, *Proceedings of the National Academy of Sciences of the United States of America* 111 (45): 16041-16046.

281 Mardas, N., Bellfield, H., Jarvis, A., Navarrete, C. and C. Comberti. 2013. *Amazonia Security Agenda: Summary of Findings and Initial Recommendations*. Global Canopy Programme and International Center for Tropical Agriculture.

282 Spracklen, D.V. and Garcia-Carreras, L. 2015. The impact of Amazonian deforestation on Amazon basin rainfall, *Geophysical Research Letters* 42, 21: 9546-9552.

283 Suarez, C., et al. 2015. *Op cit*

284 Hilker, T., et al. 2014. *Op cit*

285 WWF. 2016. *Banking on the Amazon: How the finance sector can do more to avoid tropical deforestation*, WWF Living Amazon Initiative, Brasília, Brazil.

286 ibid

287 www.equator-principles.com/

288 www.naturalcapitaldeclaration.org/

289 www.naturalcapitaldeclaration.org/softcommoditytool/

290 www.cisl.cam.ac.uk/business-action/sustainable-finance/banking-environment-initiative/programme/soft-commodities

291 www.unpri.org/about

292 www.unglobalcompact.org/

293 www.globalreporting.org/Pages/default.aspx

294 www.unepfi.org/

295 www.cisl.cam.ac.uk/business-action/sustainable-finance/banking-environment-initiative

296 www.oecd.org/corporate/mne/

297 WWF. 2016. *Op cit*

298 McClennan, R. (ed). 2014. *Living Planet Report 2014*. WWF, ZSL Global Footprint Network and Water Footprint Network, London and Gland.

299 Mardas, N., Bellfield, H., Jarvis, A., Navarrete, C. and C. Comberti. 2013. *Amazonia Security Agenda: Summary of Findings and Initial Recommendations*. Global Canopy Programme and International Center for Tropical Agriculture.

300 Greenpeace. 2014. *The Amazon's Silent Crisis*. Greenpeace, Sao Paulo, Brazil.

301 Verweij, P., et al. 2009. *Op cit*
302 Maretti, C.C., et al. 2014. *Op cit*
303 Taylor, R. (ed). 2011. *WWF Living Forests Report*, Chapter 1: Forests for a Living Planet. WWF International, Gland, Switzerland. wwf.panda.org/livingforests
304 Data researched by UNEP-WCMC based on biome data from WWF and IUCN and UNEP-WCMC. 2016. The World Database on Protected Areas (WDPA) [On-line], UNEP-WCMC, Cambridge, UK. Available at: www.protectedplanet.net. And UNEP-WCMC. 2015. Dataset combining Exclusive Economic Zones (EEZ; VLIZ 2014) and terrestrial country boundaries (World Vector Shoreline, 3rd edition, National Geospatial-Intelligence Agency). UNEP World Conservation Monitoring Centre, Cambridge, UK.
305 Barber, C.P., Cochrane, M.A., Souza, C.M., Jr. and W.F. Laurance. 2014. Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation* 17: 203-209.
306 Taylor, R. (ed). 2011. *Op cit*
307 WWF Guianas. 2012. *Living Guianas Report 2012*. WWF Guianas, Paramaribo, Suriname.
308 Huber, O. and Foster M.N. 2002. *Conservation Priorities for the Guyana Shield*. Conservation International, Washington DC.
309 Plouvier, D. (ed). 2012. *Living Guianas Report 2012. State of the Guianas drivers and pressures towards green economies*. WWF Guianas and Copernicus Institute.
310 Maretti, C.C., et al. 2014. *Op cit*
311 ibid
312 ibid
313 Macedo, M. and Castello, L. 2015. *Op cit*
314 Peres, C.A. 2005. Why we need megareserves in Amazonia. *Conservation Biology* 19: 728-733.
315 Groves, C.R., Jensen, D.B., Valutis, L.L., Redford, K.H., Shaffer, M.L., Scott, J.M., Baumgartner, J.V., Higgins, J.V., Beck, M.W. and M.G. Anderson. 2002. Planning for biodiversity conservation: putting conservation science into practice. *Bioscience* 52: 499-512.
316 Suski, C.D. and Cooke S.J. 2007. Conservation of aquatic resources through the use of freshwater protected areas: Opportunities and challenges. *Biodiversity Conservation* 16: 2015-2029. doi 10.1007/s10531-006-9060-7.
317 Stickler, C.M., Coe, M.T., Costa, M.H., Nepstad, D.C., McGrath, D.G., Dias, L.C.P., Rodrigues, H.O. and B.S. Soares-Filho. 2013. Dependence of hydropower energy generation on forests in the Amazon Basin at local and regional scales, *PNAS*, 110 (23): 9601-9606.
318 De Faria, F.A.M., Jaramillo, P., Sawkuchi, H.O., Richey, J.E. and N. Barros. 2015. Estimating greenhouse gas emissions from future hydroelectric reservoirs. *Environmental Research Letters* 10: doi:10.1088/1748-9326/10/12/124019.
319 Schmidt, J., Cancella, R. and A.O. Pereira Jr. 2016. An optimal mix of solar PV, wind and hydro power for a low-carbon electricity supply in Brazil. *Renewable Energy* 85: 137-147.
320 WWF. 2014. *Green Energy Leaders: Latin America's Top Countries in Renewable Energy*. WWF International, Gland, Switzerland.
321 Sánchez, A.S., Torres, E.A. and R.A. Kalid. 2015. Renewable energy generation for the rural electrification of isolated communities in the Amazon Region. *Renewable and Sustainable Energy Reviews* 49: 278-290.
322 Vegara, A. and Gorricho, J. 2015. *Policies of the Amazon Countries and Climate Change: Protected Areas as an Adaptation Strategy*. WWF Living Amazon (Global) Initiative, Brasília and Quito.
323 REDPARQUES. 2015. *Declaration by the Latin American network for technical cooperation on national parks, other protected areas, and wild flora and fauna (REDPARQUES) to the 21st Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change*. d2ouvy59p0dg6k.cloudfront.net/downloads/redparques_declaration_1.pdf (Accessed 12/12/2015).
324 WWF. 2014. *Protecting the Amazon can protect the Climate*. WWF Living Amazon Initiative, Brasília and Quito.
325 Macedo, M. and Castello, L. 2015. *Op cit*
326 Campanilli, M. (ed). 2016. *A conservation vision for the Tapajos basin*. WWF Brazil. Brasilia.
327 WWF. 2016. *Op cit*
328 Suarez, C., et al. 2015. *Op cit*
329 Campanilli, M. (ed). 2016. *Op cit*
330 This section based on the work of Flavia Loures: Rocha Loures, F. (draft) Legal Research Project – Amazon Biome and Freshwater Conservation. Part II International Water Law in Global Instruments – Role and Relevance in the Amazon Biome. Report for WWF.
331 Celentan, D. and Vedoveto, M. (eds). 2011. *The Amazon Millennium Goals*. ARA (Amazon Regional Articulation), Quito, Ecuador.
332 *Amazonian Strategic Cooperation Agenda 2010-2020*, approved at the X Meeting of the TCA's Ministers of Foreign Affairs. 2010. www.otca.info/portal/admin/_upload/apresentacao/AECA_eng.pdf.
333 otca.info/portal/
334 www.coica.org.ec/
335 www.olade.org/

336 Descola, P. 2013. *Beyond Nature and Culture*, University of Chicago Press, Chicago, translated Janet Lloyd.
337 Ricketts T.H., Soares-Filho B., da Fonseca G.A.B., Nepstad D., Pfaff A., et al. 2010. Indigenous Lands, Protected Areas, and Slowing Climate Change. *PLoS Biol* 8 (3): e1000331. doi:10.1371/journal.pbio.1000331.
338 Hofmeijer, I., Ford, J.D., Berrang-Ford, L., Zavaleta, C., Carcamo, C., Llanos, E., Carhuaz, C., Edge, V., Lwasa, S. and D. Namanya. 2013. Community vulnerability to the health effects of climate change among indigenous populations in the Peruvian Amazon: A case study from Panaillo and Nuevo Progreso. *Mitigation and Adaptation Strategies for Global Change* 18 (7): 957-978.
339 Nelson, A. and Chomitz, K. 2009. *Protected Area Effectiveness in Reducing Tropical Deforestation*, The World Bank, Washington DC.
340 Anderson, A., Rittl, C., Meneses-Filho, B., Brickell, E. and S. Hutchison. 2013. *Environmental Services Incentives System in the State of Acre, Brazil: Lessons for policies, programmes and startegies for jurisdiction-wide REDD+*. WWF Brazil and WWF UK, Brasilia and Woking, UK.
341 wwf.panda.org/wwf_news/?218490/Bolivia-and-Acre-exchange-knowledge-on-combating-Deforestation
342 wwf.panda.org/wwf_news/?265510/Cross-border-initiative-for-land-use-planning-of-310-thousand-hectares-of-Amazon-Forest
343 www.wwf.org.pe/en/our_work/in_peru/amazon/the_importance_of_sharing_conservation/trinational_program__conservation_without_borders_in_putumayo/
344 www.cbd.int/sp/targets/
345 Maretti, C.C., et al. 2014. *Op cit*
346 Vergara, A. and Gorricho, J. 2015. *Policies of the Amazon Countries and Climate Change: Protected areas as an adaptation policy*. WWF Living Amazon Initiative, Brasilia.
347 Macedo, M. and Castello, L. 2015. *Op cit*
348 Pacha, M.J. 2015. *Ecosystem services valuation as a decision-making tool: Conceptual bases and lessons learned in the Amazon region*. WWF Living Amazon (Global) Initiative, Brasília and Quito.
349 Kuepper, B., Warmerdam, W., van Gelder, J.W. and J. Schure. 2015. *Drivers of forest loss in the Amazon Biome: Stakeholder analysis and policies of major financial institutions*. Profundo for WWF, Amsterdam.
350 da Silva Dias, A., Maretti, C., Lawrence, K., Charity, S., Oliveira, D., Johnson, J., Gomez Cerveró, L.H., Accacio, G. and G. Abdala. 2014. *Deforestation Fronts in the Amazon Region: Current Situation and Future Trends a preliminary summary*. WWF Living Amazon (Global) Initiative, Brasília and Quito.

LIVING AMAZON REPORT 2016

100% RECYCLED

SPECIES

At least 2,200 new species have been described in the Amazon region since 1999.

PLACES

Tropical evergreen forest is the dominant vegetation type, covering nearly 80 per cent of the Amazon biome.

PEOPLE

The Amazon is home to 34 million people including over 350 indigenous groups, some living in voluntary isolation.

SPACES

Protected areas are helping conserve 2.1 million km² of the Amazon.

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

panda.org/amazon