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REPORT

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2017

STATE OF THE AMAZON

Deforestation Trends

WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries. WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

This publication was produced under the WWF Living Amazon Initiative (LAI), which was one of nine Global Initiatives of the WWF Network. The LAI started in 2006, and in 2013 adopted a focused approach dealing with regional or transboundary issues related to protected areas and indigenous territories, hydropower and deforestation. This complemented work in the Amazon by National and local offices as well as organisations in the WWF Network. Since July 2016 WWFs regional leadership in the Amazon has been undertaken by the Amazon Coordination Unit (ACU), which is part of the Latin America and the Caribbean Secretariat (LAC).

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Aerial view of the Amazon rainforest, Acre state, Brazil.
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STATE OF THE AMAZON

Deforestation Trends

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PREFACE

With more than 6 million square kilometers, the Amazon is the largest tropical forest and the main river system of the Planet. Eight countries and an overseas territory share the Amazon biome, a set of forests, natural grasslands, flooded areas and human settlements.

This study shows the results of an analysis on deforestation in the Amazon during years 2000-2013. Deforestation in this 13-year period was 27 million hectares, equivalent to an area the size of Ecuador or New Zealand.

The authors have identified 31 deforestation fronts driven by non-sustainable practices related to agricultural expansion through cattle and mechanized agriculture; subsistence farming including illicit crop cultivation; dams and infrastructure development; and extractive industries. However, the study also shows that in some areas the deforestation trend has been reduced, although in others, deforestation and forest degradation continues at an alarming rate, threatening to overturn key gains that have been made.

An important finding is that protected areas and indigenous territories are key ways to curb deforestation. It has been proven that these two types of conservation units have much lower deforestation trends than the average for the biome. Both protected areas and indigenous lands cover more than 50% of the Amazon and its conservation and wise management is key to guarantee the environmental services provided by the Amazon, especially those related to climate change adaptation and mitigation.

To curb deforestation a biome wide approach is necessary. Regional coordination will scale up the impact of local efforts, and lessons learned in one area can be applied in others. This approach should include deforestation free supply chains, common trade policies, an effective regional protected areas network, full recognition of indigenous territories, sustainable use of standing forests, independent strong regional civil society networks, and greater access to innovative funds, among others measures.

But probably, we need a strong political commitment by the leaders of our countries for a zero-net deforestation in the Amazon by 2030, a goal that could guarantee that the largest tropical forest in the word continues giving to the Amazon people and to the humanity crucial environmental services to guarantee water, climate resilience and biodiversity.

Despite its problems, the Amazon is still an area with extremely rich biodiversity, with life, peoples and cultures, and with an extraordinary potential to contribute to development and poverty reduction, if managed appropriately. A joint effort among national and local governments, local communities and indigenous peoples, and the private sector with a more sustainable end equitable model of development is now more necessary than ever.

Roberto Troya
Vice President and Regional Director
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LIST OF ANCRONYMS

ACTO Amazon Cooperation Treaty Organization
ANLA Environmental licencing agency of Colombia
ARA Amazon Regional Articulation, a network of Amazon NGOs
ARPA Amazon Region Protected Areas programme,
BNDES Brazilian National Economic and Social Development Bank
CAF Latin American Development Bank
CBD Convention on Biological Diversity
COSIPLAN The South American Infrastructure and Planning Council
CSO Civil Society Organisation
ET evapotranspiration
FARC Revolutionary armed forces of Colombia
GHG Greenhouse gases
GIS Geographic Information System
IBGE Brazilian Institute of Geography and Statistics
IDB Inter-American Development Bank
IIRSA The Initiative for the Integration of the Regional Infrastructure in South America
INCRA National Institute of Colonisation and Agrarian Reform (Brazil)
IPAM Instituto de Pesquisa Ambiental da Amazônia
IPs Indigenous Peoples
ISA Socio-Environmental Institute
ITs Indigenous Territories
IUCN International Union for the Conservation of Nature
LAI Living Amazon Initiative, a WWF Network Global Initiative
MAP Madre de Dois, Acre, Pando area
MeHg methylmercury
MODIS Moderate Resolution Imaging Spectro-radiometer
MW Mega watt
NSPA National Systems of Protected Areas
O&G Oil and Gas
PPCDAm Action Plan for Prevention and Control of Deforestation in the Amazon municipalities
PADDD PAs Downgrading, Downsizing and Degazettement
PAs Protected Areas
Ramsar International convention for wetlands signed at Ramsar in Iran.
REDD (+) Reducing emissions from deforestation and forest degradation
SERNANP Peruvian National Protected Area Service
UNEP United Nations Environmental Programme
WCMC World Conservation Monitoring Centre, the specialist biodiversity assessment centre of UNEP
WCPA World Commission on Protected Areas, of IUCN
WDPA World Database on Protected Areas, a joint product of UNEP and IUCN
WHRC Woods Hole Research Center
WHS World Heritage Site
WWF World Wide Fund for Nature

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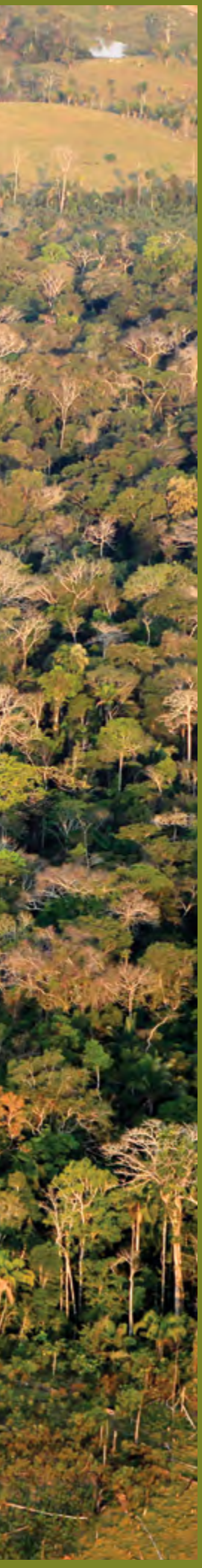

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EXECUTIVE SUMMARY

We have found by using MODIS data at a regional scale that in 2013, 82% of the Amazon biome – or 548 million hectares – was forested, whereas in 2000 there was 86% coverage. Deforestation during the 13-year period studied was 27 million hectares, equivalent to an area the size of New Zealand. However the rate of loss during this period has decreased, especially more recently from 2010-2013, so we are losing forest less rapidly. **Brazil's contribution to deforestation, although still large, has reduced over the 13 years – but consequently the contribution from the Andean Amazon and Guiana Shield has increased**.

In 2004 Brazil brought in significant policies to curb deforestation, including expanding its protected area network. Since then there has also been a new forest code brought into law in 2012 and a significant economic downturn in 2015. Deforestation in Brazil reached its lowest annual amount in 2012 but there have been three consecutive years after this with increasing deforestation rates. However, recent official rates still had not risen above its 2011 annual rate[i], but this may change (PRODES 2016). It is difficult to judge the overall impact the most recent rates will have on deforestation in the biome because it depends on whether the deforestation in the Andean Amazon and Guiana Shield areas also increases or remains stable or even decreases. Regular monitoring of deforestation at the regional scale is required.

Deforestation is not evenly distributed across the biome. It is focused within 31 fronts, as well as those that form part of the traditional Brazilian arc of deforestation that goes from Mato Grosso, and Pará to Rodonia. In 2013 the deforestation in these fronts accounts for nearly 85% of all deforestation in the biome. Even within these fronts the threat of deforestation is not equal; we assessed this by combining the IUCN ecosystem assessment approach with three other deforestation criteria. This identified one front as critically endangered, six as endangered, five as vulnerable and eleven as threatened. These are considered priority areas for further research to identify the causes of forest loss and to address them in order to be able to stabilize or reduce future deforestation.

Protected areas and indigenous territories are nestled between these fronts and are perhaps preventing their expansion in some cases. Both these land categories experience significantly lower deforestation than other parts of the biome, and rates for indigenous territories are even lower than those for protected areas[ii]. However, they cannot be taken for granted. Indigenous territories experienced an increase in deforestation during 2010-2013, which suggests new issues may be emerging and need to be better understood.

When the IUCN status assessment was combined with three other deforestation criteria to assess the level of deforestation threats to these areas, we found that in general a larger number of smaller protected areas and territories were doing well, whereas larger sized areas of both categories were doing less well. Seventy-six per cent of indigenous territories, covering 52 million hectares, have been experiencing no threat but this represents an area of only 15% of the 1,702 territories assessed. Similarly, 64% of protected areas, covering 82 million hectares, also experience no threat but only represent 46% of the area of the 437 areas. Most were found to be vulnerable and threatened status: 22% of indigenous territories (375, representing 74% by area and covering 150 million hectares) fell into these categories; along with 30% of protected areas (132, representing 57% of the total area, and

[i] Initial anual deforestation data for 2016 (7989 km² per year) shows an increase of 29% from 2015 figures and may be worse than 2009 deforestation rates.

[ii] For example protected areas and indigenous territories have rates of change of 0.07% and 0.03%, as well as annual deforestation rates of 155 ha/year and 44 ha/year respectively.

17% OF INDIGENOUS TERRITORIES, COVERING 52 MILLION HECTARES, HAVE BEEN EXPERIENCING NO THREAT, BUT THIS REPRESENTS AN AREA OF ONLY 15% OF THE 1,702 TERRITORIES ASSESSED.

covering 110 million hectares). These areas are priorities for further study, to understand the causes and further monitor, as well as priorities for regeneration or restoration to improve their situation. Ideally these new initiatives would be supported by a results-based payment system or REDD+ mechanism that complements existing basic funding received such as Brazilian protected areas receive through ARPA funds.

The protected areas and indigenous territories that are worst off in terms of deforestation were fewer in number and also smaller in area (an exception to a previous observation). Twenty-three protected areas had relatively high levels of deforestation (representing 1.3% of protected area coverage, or 2.5 million hectares); along with 32 indigenous territories (2% of indigenous territory coverage, or 300,000 hectares). These areas are the highest priority for restoration and regeneration activities complemented by studies and monitoring. They show the greatest opportunity for improvement, but they need investment to enable them to improve and address the causes of relatively higher deforestation. **As a network the protected areas and indigenous territories network cannot be taken for granted: this asset needs to be prioritized for investment to increase the resilience of the biome**.

There are a series of threats that may reverse the downward trend in deforestation that we have documented here. The potential impact of three sectors was considered: mining and oil and gas, dams and linear infrastructure. **Mining, oil and gas have the most significant potential to impact the biome in the future, both in terms of the contracts and concessions already granted but also the sheer number of applications that wait to be assessed**. It is not easy to predict the impact of this as the areas covered by the claims overlap with both protected areas and indigenous territories multiple times, but this does not mean that all of this area will be affected; it just means that the more there are overlapping claims, the higher the risk of impact. However, as with gold mining, once the resource has been identified as potentially being in an area, and if the informal mining sector takes hold, the impact can be significant both through denuding the forest but also through contaminating water from mercury use.[1]

Although Brazil has a ruling that should have stopped mining claims overlapping with protected areas after 2010, it is not clear how this is being implemented – or whether it is at all. The informal sector is proving very challenging to control, and 2016 saw the encroachment of gold mining into the Tampobata national park in Peru and various oil spills in the Marañon tributary of the Amazon. Three hundred and twenty-nine active mining sites are currently impacting on 32 protected areas and 35 indigenous territories, and 87 sites producing oil are directly affecting 12 protected areas and 52 indigenous territories. International assets like Ramsar and World Heritage Sites are also under threat in the biome from both sectors. As much as a quarter of a million hectares could potentially be affected in some way, although it is more likely a much smaller area would be directly impacted in practice.

Dams and infrastructure are also threats with potentially high future impact: estimates range from 1.8 to 5.4 million hectares of deforestation if all the planned dams were to go ahead; however 2015 and 2016 showed that not all these plans will come to fruition as three planned dams in Brazil were cancelled because they were going to impact on a protected area in the Tapajos river basin. With the existing road network across the biome estimated to be 264,000km, the proposed rail link of 5,300km seems less significant – however it is planned to be a coast-to-coast link that would pass through the heart of the Amazon headwaters, which could have devastating consequences on intact forests and watersheds of the biome.

With these threats in mind simple deforestation projections were made to assess whether we could be heading towards the grim 2050 prediction of 40% deforestation made in 2006 by Soares et al. **There has been a downward trend overall in deforestation in the biome, and using MODIS data the linear projections suggest 21% of the Amazon biome could be lost by 2030**. This would still result

in a significant amount of forest loss over 30 years of 44.2 million hectares, equivalent of losing an area almost the size of Morocco. By 2050 the projected loss was estimated to be 24%, which is 64.5 million hectares over 50 years. Using the worst deforestation rate per year for each country and projecting these into the future gave estimates of forest loss resembling those predicted by Soares et al in 2006, and gave 37% by 2050, while reaching 24% loss 20 years earlier in 2030.

The policy analysis gave ten key policy recommendations for the biome level, which would need to be implemented across a number of the countries by national governments. These have been distilled into three priorities.

1. **Deforestation-free supply chains** – Deforestation-free supply chains and sustainable production need to be promoted across relevant sectors, incorporating social and environmental safeguards. These can be complemented and supported by **common trade policies**, which would allow international development institutes to promote bilateral and regional trade agreements incentivizing sustainable deforestation-free products. WWF advocates the development of polices and strategies around the goal of Zero Net Deforestation and Forest Degradation to halt deforestation and forest degradation.[2] This will require better monitoring by national governments of both deforestation and degradation, but monitoring must also take place at the biome level to assess whether these actions are working synergistically or creating gaps or simply moving deforestation from one location to another.

2. **Effective regional protected area and indigenous territories network** – Although deforestation is still very low in these areas, this regional network has some vulnerability to deforestation that needs to be understood and addressed. Policy analysis suggests that best practice can be shared on how to effectively manage protected area systems, including cost recovery policies or self-financing mechanisms. Local communities should see the benefit and participate in the management of these areas. However both policy and deforestation analysis suggests that improved investment in **transboundary management** is needed, combined with better integration and interagency coordination on combating the trafficking of illegal goods and control of the informal/illegal mining sector. The causes of deforestation within both protected areas and indigenous territory boundaries need to be better understood and addressed, and several priorities have been identified where more investment for restoration, regeneration and better protection is needed.

3. **Greater access to innovative funds** – International climate funds need to reward governments and companies committed to deforestation-free supply chains and sustainable management of resources, natural capital and ecosystem services as well as managing the protected areas and indigenous territory network. New financial mechanisms and better programmes are needed to support sustainable forest management at scale, including non-timber forest products.

THE POLICY ANALYSIS GAVE 10 KEY POLICY RECOMMENDATIONS FOR THE BIOME LEVEL

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Section 1

1.1 Introduction

Deforestation and forest degradation across the Amazon biome are two of the most pressing environmental issues facing our planet today.

In recent years the region and the world have woken up to the crisis, and a huge range of people – from local indigenous communities and subsistence farmers to national governments, businesses and international development agencies – have been taking action.[3] Overall rates of deforestation are slowing, and the concept of a sustainable future, where people live in harmony with nature, is taking hold.[4]

But that future hangs in the balance. While the forest is not disappearing as fast as it was a decade ago, that's only a relative measure: enormous amounts of cover are still being lost and degraded; and although conservation and restoration are making progress in some areas, new deforestation fronts are opening in others. The fight to save the Amazon must continue, and serious and sustained action remains absolutely essential.

However, good intentions are not enough: for this fight to have any chance of succeeding, it needs to be informed by solid facts from the region. That's why WWF have commissioned this detailed report on deforestation trends, dynamics, drivers – and what we can do about them.

WWF has been working in the Amazon for 40 years, and in 2008 efforts were consolidated on delivering a Living Amazon Initiative (LAI), a strategy designed to address the challenges facing the biome as a whole. As a result of this work a series of publications have been produced by WWF highlighting the state of the Amazon – protected areas and indigenous territories, freshwater ecosystems, new species, financial flows and an overview report on the living Amazon.[5] As part of this series, this report focuses on deforestation trends. It draws on the knowledge that has been built up through diverse aspects of the LAI work, and with collaboration from the offices in the region: as such it includes new data and information that advances current understanding of many important areas related to deforestation.

It's possible to make general statements about the trends revealed and the actions needed to combat them, but the real value of this information is in the detail. Different Amazon nations face different challenges, different deforestation drivers show different growth patterns, different environmental scenarios play out from different development decisions.

Likewise, many stakeholders and many strategies will need to be involved in essential efforts to combat the issues highlighted in this research. Where deforestation drivers are identified we aim to give an overview of the various ways that their impact may be limited, and where deforestation fronts are located we highlight the local factors that influence them.

Our aim is to provide an up-to-date summary of current deforestation trends, from a systematic data analysis-led approach, to highlight key issues, trends, and to explore the many ways in which the situation must be addressed regionally – with a view, ultimately, to achieving a sustainable future for the Amazon biome. This report complements the RAISG 2015 study on deforestation in the Amazon and its countries, which briefly looked at deforestation trends in the biome from 1970 to 2013. It identifies river basins with the most deforestation during that period as well as highlighting general deforestation rates in protected areas and indigenous territories in the biome. As it focuses most attention on the country-by-country deforestation trends it perhaps emphasises less the regional perspective of the biome, which is the focus here.

1.2 Report structure

After a brief summary of what makes the region so remarkable and important, we start by looking at the current drivers of deforestation across the Amazon biome. This provides the background for the land-cover analysis and detailed survey of general trends in forest loss in the region comparing historical trends with more recent ones from 2000-2013, building a clear idea of which areas are under the greatest threat.

Moving on to individual cases, 31 key deforestation fronts across the region are analysed both in terms of their immediate drivers and the underlying causes of deforestation. Then protected areas and indigenous lands are given particular attention, and their vulnerability to deforestation – which may undermine their effectiveness at curbing deforestation – is analysed and understood. The final case looks at potential threats in the region from three sectors that could drive future deforestation trends.

In the final section we look at some of the key policies in the region that are either working to curb deforestation or which may be contributing to driving deforestation trends. Separating the two key deforestation arcs of the Southern Amazon and Andean Amazon, we assess five key nations in terms of their deforestation policies and explore their positive and negative aspects. This analysis informs and lays the foundations for biome-level recommendations that can address common findings from this analysis.

Finally, the overall conclusions of the study draw from these various sections to call for biome-wide action.

1.3 The Amazon: A place of unique global value

The Amazon forest is home to one out of every five mammal, fish, bird and tree species in the world,[6] providing habitats for at least 40,000 plant species, 427 species of mammals, 1,294 species of birds, 378 species of reptiles, 427 species of amphibians and 3,000 species of fish. When we consider smaller life forms, the numbers are staggering with scientific registers of between 96,660 and 128,840 species of invertebrates described in the Brazilian Amazon alone. Even today, there are still a vast number of species in the region that remain undescribed by science.

This extraordinary biodiversity is shared with a population of 33 million people. These include more than 370 indigenous nations with an estimated total population of 1.6 million people inhabiting more than 2,200 separate territories, and an unknown number of indigenous people living in urban areas and indigenous groups living in voluntary isolation.

Besides this great diversity of indigenous nations there are many traditional communities that depend on the Amazon's rich biodiversity for their livelihoods. However, despite the extraordinary natural wealth of the Amazon region, the majority of the rural population lives in economic poverty according to World Bank definitions. Today these traditional inhabitants of the Amazon forest are obliged to share the region with newcomers with different interests and views on how to exploit the wealth of their environment.

The Amazon forest influences life on Earth through processes that we are still trying to fully understand. This forest is one of the world's greatest air conditioners, transforming half of all the solar energy that reaches it into huge amounts of water through the evaporation from its leaves and other surfaces – approximately 9,600 Km^3 each year.[7] The release of this water vapour to the atmosphere is crucial to the formation of clouds that, in turn, sustain the forest with rainfall.

This vital climatic function of the Amazon forest also sustains climatic conditions in other regions that are essential for food production. According to one modelling experiment, farmers in both the grain belt in the US Midwest and in Brazil's

THE AMAZON FOREST KEEPS MOIST AIR MOVING, LEADING TO RAINFALL IN MAINLAND AREAS, DISTANT FROM THE OCEANS

breadbasket on the central plains of South America may find that their growing season rainfall declines as Amazon forests are converted to cattle pastures, while other changes in rainfall might be felt in such far-flung places as India, the western Pacific, and Central America.[8, 9]

The river Amazon itself extends for 6,400 kilometres, flowing from the high Andean range to the west to the Atlantic Ocean in the east. More than 1,100 tributaries of the Amazon provide approximately 6,700 km^3 of freshwater into the Atlantic Ocean each year, representing 15 to 20% of the world's total river discharge of freshwater into the oceans.[7]

Our lives are also connected to the wellbeing of the Amazon forest through its role as a storehouse of carbon – the element that is driving global warming through its release to the atmosphere in the form of greenhouse gases such as carbon dioxide and methane. The trees of the Amazon contain 90-140 billion tons of carbon,[10] equivalent to 9 to 14 years of current global, human-induced carbon emissions.[11]

In a recent report, Nobre[12] assesses the important role the Amazon plays and explores its relation to the atmosphere, where exchanges of gas, water and energy with the oceans creates the conditions whereby rain produced is a source of water that irrigates the continents. The Amazon forest keeps moist air moving, leading to rainfall in mainland areas, distant from the oceans. Nobre's report states that the trees emit 'signalling chemicals' or volatile organic compounds that help raindrops to form as they act as points for condensing water vapour, resulting in an abundance of clouds and rain which also cleans the air.

The same study recognizes that the forest plays an important role in climatic events and their ability to benefit and support the hydrological cycle through a process of transpiration of the trees, which is greater than evaporation from the adjacent oceans. This transpiration process leads to cloud formation and a corresponding reduction of atmospheric pressure above the forest, which 'sucks' the moist air from over the ocean to the interior of the continent, keeping the rainfall within the continent. For this reason the southern portion of South America, east of the Andes, is not like other desert areas at the same latitude. West of the Andes and elsewhere, not only does the forest keep moist air within the continent, but it exports air and water vapour as 'flying rivers' that flow in the hemisphere in the summer, transporting water vapour as raw material to supply plentiful rains in regions which would otherwise be barren.

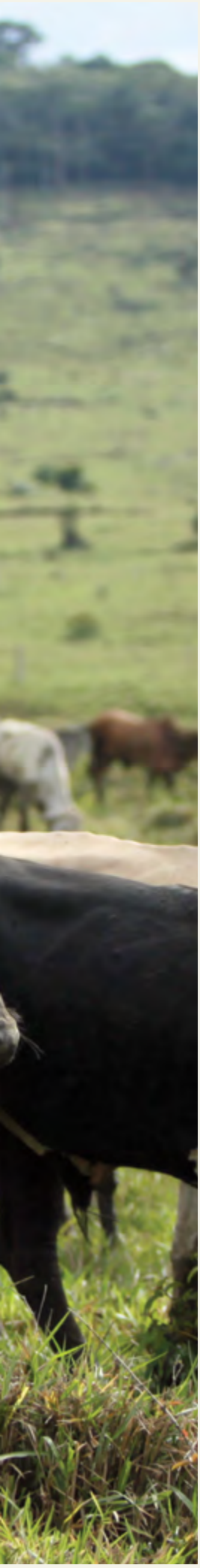
Finally, the Amazon acts as a calming influence on the tropical storms that are driven by oceanic processes in the region. The forest reduces wind speed and calms tropical storms, so that winds and climate extremes are less violent.

Nobre states that all these effects add up to make the forest a hugely valuable partner supporting all human activities that require regular rain, a pleasant climate and protection from extreme winds.

DISTURBANCE, DEGRADATION AND DEFORESTATION COMBINED THREATEN BIODIVERSITY, LOCAL COMMUNITIES, CARBON STORAGE AND CLIMATE REGULATION

Deforestation threatens all of this, but a 2016 article (Barlow et al 2016) suggests that the loss of conservation value is as bad or worse from disturbed forests (i.e. logged over forests).[13] It found that 20% loss of primary forest results in a 39 to 54% loss of conservation value, but areas with less coverage than this this saw an even greater loss of conservation value from disturbance than primary forest loss. Disturbance, degradation and deforestation combine to threaten many aspects of the forest such as biodiversity, local communities, carbon storage and climate regulation.

The unique natural integrity and riches of the Amazon are in the middle of the greatest crisis in their history. What happens across the Amazon biome in the coming years will have enormous consequences for the region and for our planet as a whole.



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Section 2

2.1 Principal drivers of deforestation

The key drivers of deforestation in the Amazon biome are agricultural expansion through cattle and mechanized agriculture, subsistence farming including illicit crop cultivation, dam and infrastructure development, and extractive industries. Their significance varies across different countries, but they all have a direct influence on the state of the forest.

The drivers influence and at times reinforce each other. Expanding soy farming replaces pastures, which pushes cattle ranching further into natural forests. Logging needs roads, which make remote areas accessible, further increasing logging in surrounding areas. A new hydroelectric dam causes deforestation in itself, but also powers mining activities, creates new roads and brings in settlers.

At the same time, the direct causes of forest loss are connected with a range of indirect drivers through complex interactions, such as subsidies, migration, unclear land tenure, economic development, corruption and weak law enforcement.

These drivers are examined in more detail below.

2.2 Cattle ranching

The area under cattle ranching and the density of cattle per hectare greatly increased between 1990 and 2005.[14] The expansion of cattle ranching in South America has been facilitated by improved transportation infrastructure and production systems, more favourable national trade policies and increased investments in the Amazon region for the processing of beef and dairy products. There has also been more involvement by smallholders in cattle ranching, in many cases economic migrants coming from other regions to access land in the Amazon.[15]

However, there are still extensive areas of the Amazon where there is either unclear tenure or which are owned by the state, and these are vulnerable to expansion. Clearing government-owned forests for cattle ranching has for many years been a strategy to demonstrate productive use of an area and to establish land rights by new settlers or private investors.[16] After the land has been deforested the claim over it is more easily maintained through cattle ranching, which is of low productivity and has few additional socio-economic benefits for the community.

Nevertheless, in some countries stricter public regulations and private sector initiatives since the mid-2000s – such as land titles, the soy moratorium, monitoring of environmental regulations and a ban by meat exporters on beef from recently deforested lands – have helped to slow down deforestation rates over the past decade in some parts of the Amazon.[17]

2.3 Mechanized agriculture

Since the 1980s, South America has been an important region for the cultivation of agricultural commodities, such as soybean and sugarcane, for which demand is booming on the world market. The expansion of agricultural land has been an important economic growth factor in the Amazon countries, especially in Brazil.

DIRECT CAUSES OF FOREST LOSS ARE CONNECTED WITH A RANGE OF INDIRECT DRIVERS THROUGH COMPLEX INTERACTIONS, SUCH AS SUBSIDIES, MIGRATION, UNCLEAR LAND TENURE, ECONOMIC DEVELOPMENT, CORRUPTION AND WEAK LAW ENFORCEMENT.

In the Amazon, land cleared for agriculture and cattle ranching constitutes the biggest source of net greenhouse gas emissions.[18] Although soybean cultivation generally takes place on already deforested lands previously under pasture, the increase in demand for soy has led to croplands becoming more cost-effective than pasture, which then pushes pasture expansion further into forested areas. The availability of land at low prices also favours the expansion and development of extensive agriculture systems.[19]

World demand for biofuels is pushing further investments in soy, oil palm, and ethanol from grains and sugar. Palm oil cultivation has also started in the Amazon in recent years. While agricultural intensification can contribute to more efficient land use and diminishing conversion of forestlands, this requires good environmental governance implementation and enforcement on the ground.[20]

2.4 Small-scale agriculture

Individual smallholders generally deforest less than large-scale mechanized agriculture, as they work on smaller scales and use diversified production systems. However, due to their location in the forest, when smallholders rely less on subsistence agriculture and more on cattle ranching they tend to deforest more, especially when combined with land ownership expectations.[21] Their cumulative impact may have a more extensive impact than mechanized agriculture.[22]

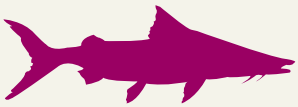
The extent of deforestation by smallholders varies from case to case. It generally increases depending on the credit and other resources that the smallholder possesses, the opening of secondary roads in the region, low occupancy by other players and weak law enforcement. It is also associated with illicit crops in at least two Amazon countries: Colombia and Bolivia. Deforestation accelerates when smallholders subsequently sell their land to large-scale farmers or companies and further move the deforestation frontier.[23]

Slash-and-burn cultivation by settlers increases along new roads, pushing deforestation into the forest. In established forest frontiers however, smallholders tend to diversify their strategies, which can either increase or decrease related impacts on forests.[24] On the other hand, shifting cultivation practiced by indigenous communities in the Amazon is conducted in large territories using long rotations and results in both stable and low deforestation rates for these areas.[25]

2.5 Hydropower dams

The high demand for electricity in the growing economies of Latin America has led to a rapid increase in the expansion of hydro-electric power. More than 150 larger hydropower dams (not including small dams below 2 MW) are currently in operation in the Amazon biome. Estimates of hydropower dams in different planning stages vary. In a 2013 study, Castello et al. counted an additional 21 dams already under construction and 277 dams in planning stages. The majority of the planned dams (74%) have a capacity below 100 MW; 15 dams (5%) are so-called mega-dams with capacities above 1,000 MW.

The proliferation of small dams (<2 MW) not included in these figures could have a considerable cumulative effect on smaller waterways. Their construction often occurs on private lands along agricultural deforestation frontiers, and remains largely unregulated.[26]



150 DAMS IN OPERATION

While the planned dams are often located in the mountain areas bordering the Amazon biome, breaks in river connectivity between the Andean headwaters and the

THE CONSTRUCTION OF DAMS MOBILIZES IMMIGRANTS TO FLOOD INTO SPRAWLING URBAN CENTRES, LEADING TO FURTHER DEFORESTATION AND DEGRADATION.

lowland Amazon are of concern.[27] If all these dams are finalized as planned, only three free-flowing Amazon tributaries would remain: the white-water rivers Juruá and Içа-Putumayo and the clear-water river Trombetas.[28]

Dams bring major consequences, including hydrological fragmentation and critical changes in continental water flows; the building of new roads; the installation of transmission lines; and significant environmental damage with unpredictable ecological effects. Forty-seven per cent of the proposed dams identified by Little et al. (2014) were classified as having high potential impact, with 34% medium and only 19% low potential impact.[29]

The construction of dams mobilizes immigrants to flood into sprawling urban centres, leading to further deforestation and degradation.[30] It also has an impact on the climate, releasing considerable amounts of potent greenhouse gases, including carbon dioxide from the decomposition of trees and methane from reservoir surfaces, spillways and rivers downstream.[31] In addition, dams have substantial social impacts, such as loss of fish and other river resources of indigenous people, and loss of livelihoods of downstream communities depending on fishing and agriculture in floodplains and the displacement of people.[32]

2.6 Transport infrastructure

A total of 93,900km of roads cross the Amazon region, and this network is expanding rapidly.[33]

New east-west corridors are opening up, connecting South American countries with each other and to wider overseas export markets. Road and infrastructure development are important underlying causes for further deforestation as they give settler farmers access to previously inaccessible forest areas.[34] This is clearly visible in the traditional Brazilian 'arc of deforestation[iii]' and around recent road projects. Official road building spawns larger and denser networks of unofficial roads that facilitate economic activities in forest landscapes, aggravating impacts on the environment and indigenous people.[35]

ROAD AND INFRASTRUCTURE DEVELOPMENT ARE IMPORTANT UNDERLYING CAUSES FOR FURTHER DEFORESTATION AS THEY GIVE SETTLER FARMERS ACCESS TO PREVIOUSLY INACCESSIBLE FOREST AREAS.

Road construction in the Amazon is driven by regional and international trade policies that centre on significant economic sectors. South American governments develop regional infrastructure to facilitate imports, expand exports and strengthen the regional economy. The east-west corridor and export opportunities to East Asian markets have become more important now that many of the South American governments maintain closer connections to new economic powers such as China (see section 5).[36]

2.7 Illegal logging

ILEGAL EXTRACTION OF TIMBER GENERATES US$10-$15 MILLION ANNUALLY

The illegal extraction of timber is a widespread and serious problem, with proceeds generated from these criminal activities estimated at US$10 to 15 billion annually.[37] There is also damage caused by widespread selective logging that removes the most valuable trees leaving the remaining forest degraded; gaps in the canopy allow soil to dry out so that becomes it more susceptible to fire.

The extent of logging impacts are difficult to measure as the task requires on-the-ground monitoring or high-resolution satellite imagery and it's difficult to differentiate this from other factors causing degradation; but it is estimated that in

[iii] Traditionally the "Arc of deforestation" includes Eastern Pará state, Central Mato Grosso and Central Rodonia in Brazil.

MORE THAN 100 MILLION HECTARES OF THE AMAZON IS CURRENTLY UNDER CONCESSION FOR OIL AND GAS EXPLORATION AND EXTRACTION

the Brazilian Amazon, degradation in general, including selective logging, leads to complete forest cover loss in subsequent years in about 25% of the cases.[38]

Logging activities in the Amazon drive to a large extent the expansion of road networks in the region. Valuable timber species represent a mean gross value of US$813 per hectare throughout the Amazon. The highest value of timber (US$3,150) is found in the northeastern Amazon, which is likely to spur future road-building and patterns of deforestation. However, at present the net profits of logging are highest around existing infrastructure networks.[39] A study among households along the Trans-amazon highway found that smallholders use timber sales mainly as an additional source of income and when in need of immediate cash. Smallholder timber logging increases with access to credit, formal settlement and forest area; and decreases when other income sources are available.[40]

2.8 Mining

The five Amazon countries – Brazil, Peru, Colombia, Bolivia, and Suriname – account for considerable quantities of the world's production of bauxite (14%), copper (8%), gold (11%), iron ore (14%), lead (7%), nickel (6%), silver (6%), tin (23%) and zinc (15%).[41] Production of iron ore and bauxite is especially significant in the Brazil Amazon biome, particularly the state of Para[42]; the country is the third-largest global producer of both minerals.

Gold mining, both large-scale and small-scale (artisanal), is an important economic activity in the Amazon region, with Peru being the world's fifth-largest gold producer and Bolivia, Brazil, Colombia and Suriname all among the top 30 gold-producing countries. Gold mining often takes place in remote and forested areas that have to be cleared before opening up a mining pit.[43] In many cases mining extends into protected natural areas and indigenous territories, causing considerable environmental damage due to contamination of soil and rivers.[44] For example, in July 2016 the impact of illegal gold mining encroachment on Tambopata natural reserve in Peru had exceeded an area of 350 hectares since September 2015.[45]

Between 2001 and 2013, tropical forests covering 168,000 hectares in Latin America were cleared for gold mining, some illegally or informally. The proliferation of gold mining is seen as accelerating deforestation across the region, and threatening biodiversity. The areas in Latin America most affected by gold mining are the Guianas (spanning Venezuela, Suriname, French Guiana, Brazil and Colombia), the south-west Amazon region (Peru, Bolivia and Brazil), Tapajos-Xingu (Brazil) and the Magdalena-Uraba valley (Colombia), largely located in the Amazon biome.[46]

2.9 Oil and gas

More than 100 million hectares of the Amazon is currently under concession for oil and gas exploration and extraction. This is concentrated in the Andean countries – Bolivia, Peru, Ecuador and Colombia – where approximately 80% of the oil and gas concessions are located.[47] Oil and gas development is of concern because of the associated environmental impacts, including deforestation accelerated by road construction; habitat fragmentation caused by pipeline construction; air and water pollution through toxic by-products and flaring; and conflict with and displacement of indigenous and local communities.[48] Since 2011 there have been at least 20 emergencies due to pipeline faults. The latest in early 2016 were two events that resulted in over 3,000 barrels of oil spilling into the Chiriaco and Marañon rivers in the Peruvian Amazon.[49]

Hydrocarbon production has four stages[iv]; applications (areas where deposits might be found), granted (administrative requests made), and some of these may go onto exploration (prospecting), and finally few will ever go into production (extraction). Of the more than 300 concessions, only 25% were in the production phase by 2012. Although this indicates a high potential for the expansion of wells in the coming years[50] it is often difficult to know the true impact associated with this sector. When a concession is in its production phase there could be many wells drilled; and although concessions generally cover large areas, only a small part of this will be directly impacted through the wells and buildings. The associated impacts – for example pipelines, roads and settlements – are also cause for concern. Yet due to low oil prices and shifts to low-carbon economies, the potential for expansion may be limited. Many of the hydrocarbon blocks overlap with protected natural areas and indigenous territories, and the implications of this are discussed in more detail in section 5.

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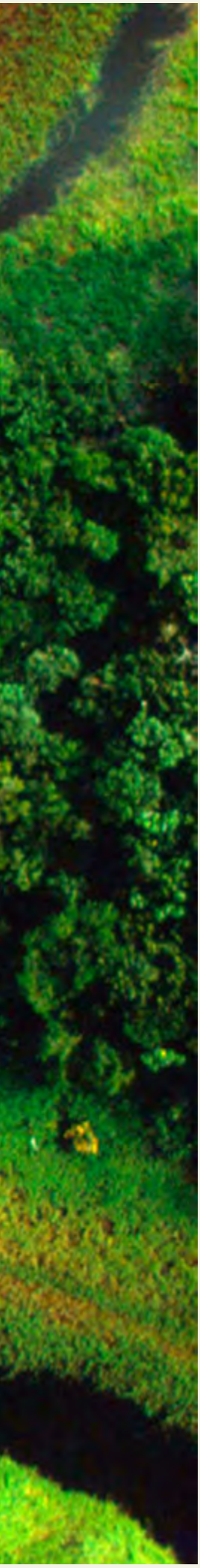
THE EXPANSION OF CATTLE RANCHING IN SOUTH AMERICA HAS BEEN FACILITATED BY IMPROVED TRANSPORTATION INFRASTRUCTURE AND PRODUCTION SYSTEMS, MORE FAVOURABLE NATIONAL TRADE POLICIES AND INCREASED INVESTMENTS IN THE AMAZON REGION FOR THE PROCESSING OF BEEF AND DAIRY PRODUCTS.

[iv] There is a seismic phase that occurs prior to the concession and also has impacts. The seismic allows to determine if there is or not oil and then determines whether to call the tender and concession.



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Section 3

3.1 Deforestation rates and land-cover change

There is a clear need for a comprehensive and systematic understanding of the impacts of the deforestation driven by the sectors described above. Although there is no official dataset for the region as a whole, various sources are available (see Annex 1). For the purposes of this study, we used a regional data set from MODIS[v] of land-cover for each period (2000, 2005, 2010 and 2013) and forest cover change between the periods to determine forest loss or deforestation. This analysis integrated the use of highly automated processes and traditional digital image processing techniques and was based on a review of international and national methodologies. This method determines whether pixels from 250-metre resolution satellite imagery change their classification compared with the previous period.[51] This allowed areas to be surveyed at regional scale 1:500,000, which permits us to identify trends and considerable land-cover changes, but it is less effective analysing small area changes. The land-cover analysis and deforestation map were validated by comparing results with reference data from finer resolution images (e.g. Landsat), as well as regional experts revising results: see Annex 1, figure 1 for more detail.

Methods for measuring deforestation

There are several online options for global data (Global Forest Watch-GFC, Terra-i). There are differences with the various data sets and these have been highlighted in Annex 1 table A1.1 illustrating the characteristics of each method. Each data source has its strengths and weaknesses, a common challenge being that they have different scales, and therefore the selection of which approach to be used needs to best meet the monitoring requirements. For planning purposes, for example, national data would be preferred – but if it is six years out of date, its validity has to be questioned (e.g. Bolivia has very infrequent national deforestation monitoring), and a regional or globally available data set may be preferable. Similarly for biome analysis a consistent regional approach may be preferred, although it may not be able to capture subsistence-level deforestation impacts due to the large minimum map-able areas used in the methodology (Annex 1, table A1.1).

Although there is no official deforestation data set for the region, official data sets from Brazil, Colombia and Peru use similar sources (Landsat), and data was synthesized for two periods (2005-2010 and 2010-2013), thus covering 79% of the Amazon biome. The official results were compared with WWF MODIS data, which was very similar to the official data sets in both time periods. These results are highlighted in a recent technical paper.[52] This study also found that the WWF MODIS analysis gives consistently lower estimates of deforestation, but this may reflect the changing nature of deforestation. It is no longer dominated by large areas being cleared (which are easier to analyse from larger-scale data like MODIS), deforested clearings are getting smaller, and loggers are cutting areas to pass below satellite detection methods employed by some governments in the Amazon.

[v] Moderate Resolution Imaging Spectro-radiometer, MODIS is a remote sensing optical spatial resolution medium

THE CHANGE IN FOREST COVER WAS ANALYSED FOR THREE PERIODS: 2000-2005, 2005-2010 AND 2010-2013

The land-cover classification using MODIS data was conducted over a 13-year period: for years 2000, 2005, 2010 and 2013. The change in forest cover was analysed for three periods: 2000-2005, 2005-2010 and 2010-2013. Deforestation was defined as a change in forest cover during those periods. This allowed us to look at different deforestation patterns and trends in the data. In broad terms, historical deforestation and non-forested areas were defined as areas identified in the 2000 land-cover classification. Another key deforestation measure was the proportion of an area deforested in the biome.

Overall deforestation for the 13-year period was the difference in forest cover between 2000 and 2013. More recent forest loss in the Amazon biome was calculated by knowing the total forest loss between each of the three study periods and dividing this total by the number of years in each to get the average annual rate for each period. To understand what the recent direction of travel for deforestation was, the average annual area deforested per year for each of the three periods was calculated (as above for 2000-2005, 2005-2010 and 2010-2013). The trend was then the difference between the annual rates for the three periods; so that the difference between rates between 2000-2005 and 2005-2010 was one trend, and the difference between 2005-2010 and 2010-2013 was the most recent trend. The results of the land-cover and deforestation analysis are discussed in the rest of Section 3 and Section 4.

3.2 Land-cover analysis

Before looking at the deforestation data in detail, it is useful to understand the broad categories of land-cover in the Amazon biome, and their relative areas.

The following map shows the 2013 land-cover analysis for the Amazon biome.

The classification used in the map is explained in the following table.

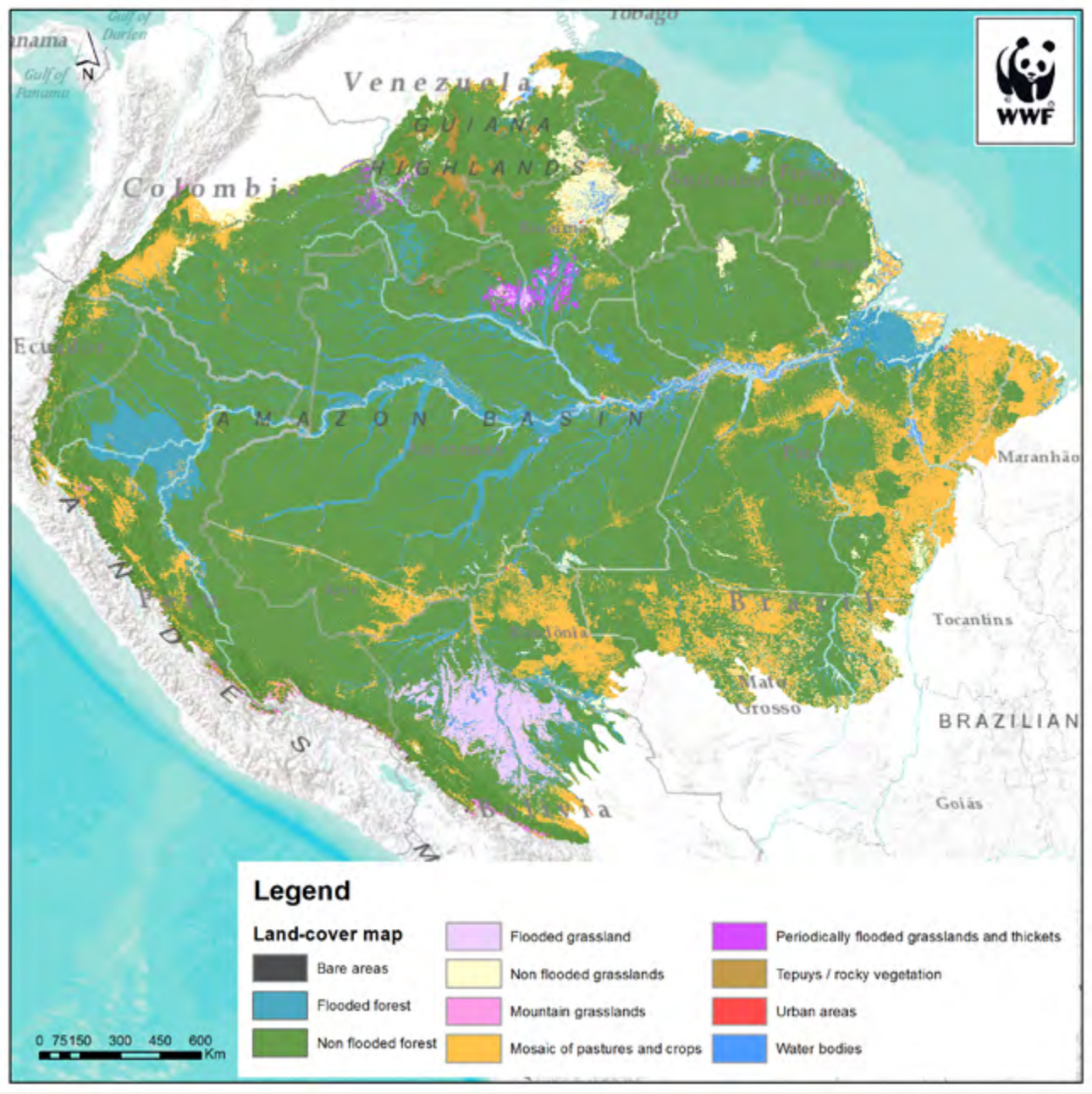


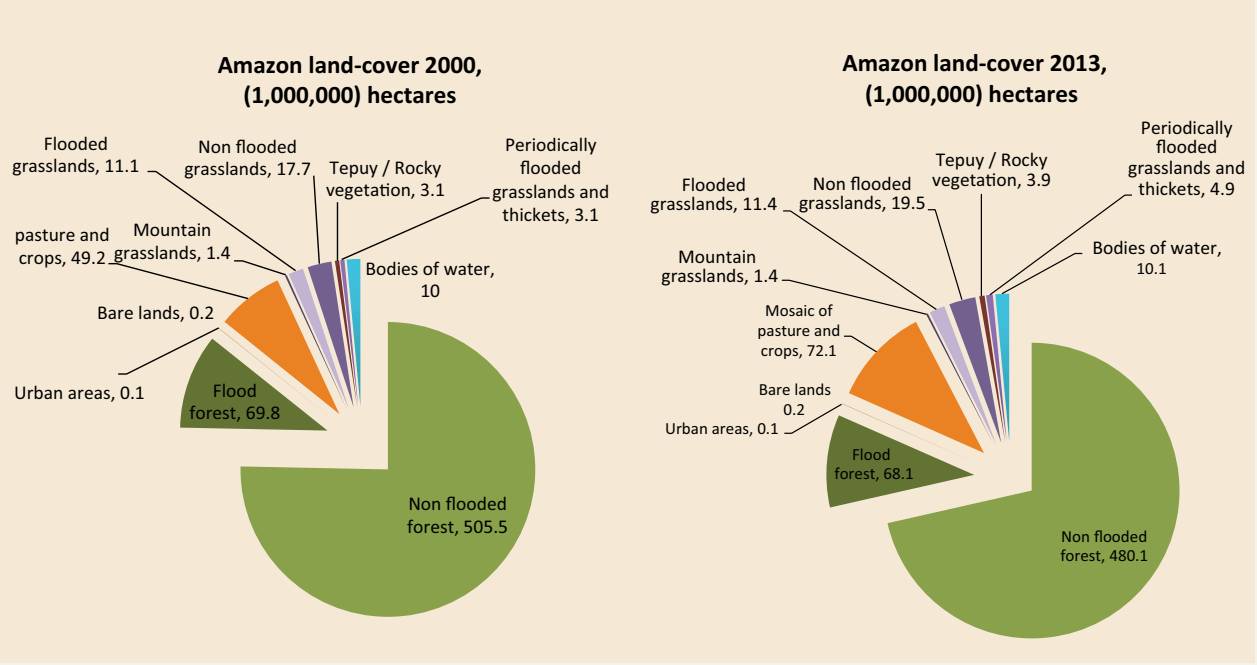
Table 1: Amazon biome land-cover classification descriptions

Broad category	Amazon biome land-cover classifications	Portion of area for 2013
Natural vegetation-forest	**Flood forest:** Annually flooded forest with a tree cover of at least 70%. Located adjacent to wandering rivers and floodplains that experience periodic floods.	10.1%
	Non flooded forest: Areas of continuous dense rainforest with a tree cover of over 70%, which does not experience flooding.	71.5%
Natural vegetation - non forest	**Flooded grasslands:** Natural vegetation, mostly grassland that has not undergone encroachment by alien species, that can allow low-impact livestock activities but is subject to periods of flooding. May include arboreal elements and/or scattered shrubs.	1.7%
	Non flooded grasslands: Natural vegetation dominated by low-growing herbaceous plants with a greater coverage than 70%, may have woody plants and/or scattered shrubs in non-flooded areas. (This classification includes the Cerrado of Boa Vista and the grand savannah of Venezuela, which cannot be differentiated in the images.)	2.9%
	Periodically flooded grasslands and thickets: Areas of permanent and seasonal wetlands located in the basin of the black river in Brazil, characterized by scrub, grassland and/or wetland.	0.7%
	Mountain grassland: Natural vegetation dominated by low-growing herbaceous plants with coverage greater than 70%, which may have woody species and/or scattered shrubs, located in the headwaters of the Andes.	0.2%
	Tepuys/ rocky vegetation: Areas dominated by herbaceous and natural shrub vegetation that develops on predominantly rocky and stony substrates that do not retain moisture.	0.6%
Water	**Bodies of water:** This category includes rivers, lakes, natural wetlands and floodplains where the period of free water levels considerably exceeds the exposure of vegetation. It also includes artificial water bodies such as dams and canals.	1.5%
Non natural land cover	**Bare land:** Bare surfaces devoid of vegetation or with sparse vegetation cover, largely caused by human impacts but may include some small naturally occurring areas of erosion and extreme degradation.	0.03%
	Mosaic of pasture and crops: Land used for pastures and crops, including those from intensively-used agriculture. In some areas the pasture and crops are in a mosaic, which may include small wooded or shrubby areas.	10.7%
	Urban areas: Cities and settlements, it includes urban and semi-urban areas characterized by housing and road construction.	0.02%

NATURAL FOREST COVERED 81.6% OF THE AMAZON IN 2013

There has been significant change in land-cover since 2000, as the two graphs illustrate. The most striking change is the loss of forest cover during the 13-year period.

Graph 1: Comparison of land-cover in the Amazon biome, 2000 and 2013



SIGNIFICANT AREAS OF NON-FLOODED FOREST HAVE DISAPPEARED, ALONG WITH A SMALLER PERCENTAGE OF FLOOD FOREST

- Between 2000 and 2013 significant areas of forest have been lost. In 2000, the total cover was 86%. Significant areas of non-flooded forest have disappeared, along with a smaller percentage of flood forest. By 2013 this combined area had fallen from 575 million hectares in 2000 to 548 million hectares, and total forest cover was only 82% of the biome, or a loss of 4.7%.
- The most notable increase has been in pasture and crops, whose area has increased by 3.4% (22.9 million hectares). Brazil is responsible for 89% of this increase (20.5 million hectares); while Colombia, Peru and Bolivia together represent 8.4% of the increase (1.9 million hectares).
- Urban sprawl has also increased by 20,700 hectares since 2000, with 90% of this occurring in Brazil.
- Natural, non forest vegetation has increased by 3.9 million hectares between 2000 and 2013, although in the imagery used it may be difficult to distinguish between mature agro-forestry areas, fruit trees, abandoned pastures and young regenerating forests (capoeira). This means the increase in these categories may not just indicate regeneration, but could also be due to forests being degraded and appearing as less dense vegetation. This is likely the case for lowland natural vegetation and flooded natural vegetation, but less likely for periodically flooded thickets and grasslands.

3.3 Changing rates of deforestation

The data from 2000-2013 can give us a useful overall picture of what has taken place in the 13-year period. The following graph illustrates the situation.

Graph 2: Deforestation rates in the Amazon biome

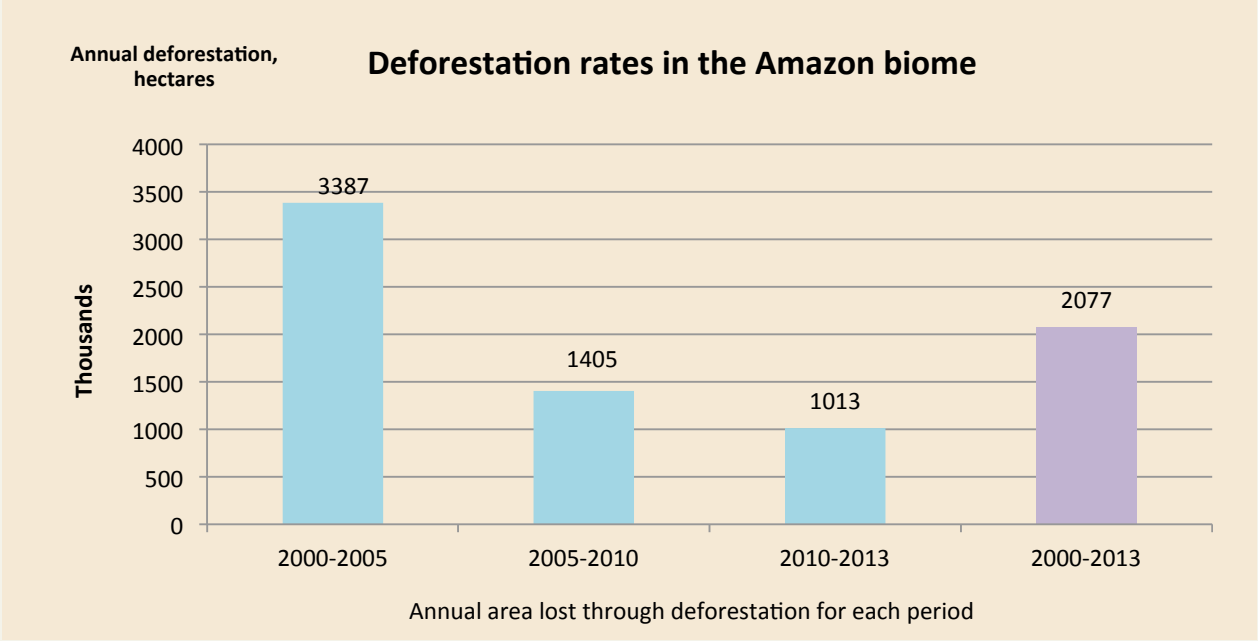


Table 2: Deforestation rates for the biome per year and study period

Amazon biome	2000	2005	2010	2013
Forest cover (hectares)	575,238,138	558,301,782	551,279,046	548,241,110
Percentage area forested	85.6%	83.1%	82.1%	81.6%
Amazon biome – study period	**2000-2005**	**2005-2010**	**2010-2013**	**2000-2013**
Forest loss (hectares)	16,936,356	7,022,735	3,037,936	26,997,028
Average annual area deforested (hectares)	3,387,271	1,404,547	1,012,645.5	2,076,694.5
Rate of change in forest cover % (Puyravaud – r) [53]	-0,60	-0,25	-0,18	-0,37

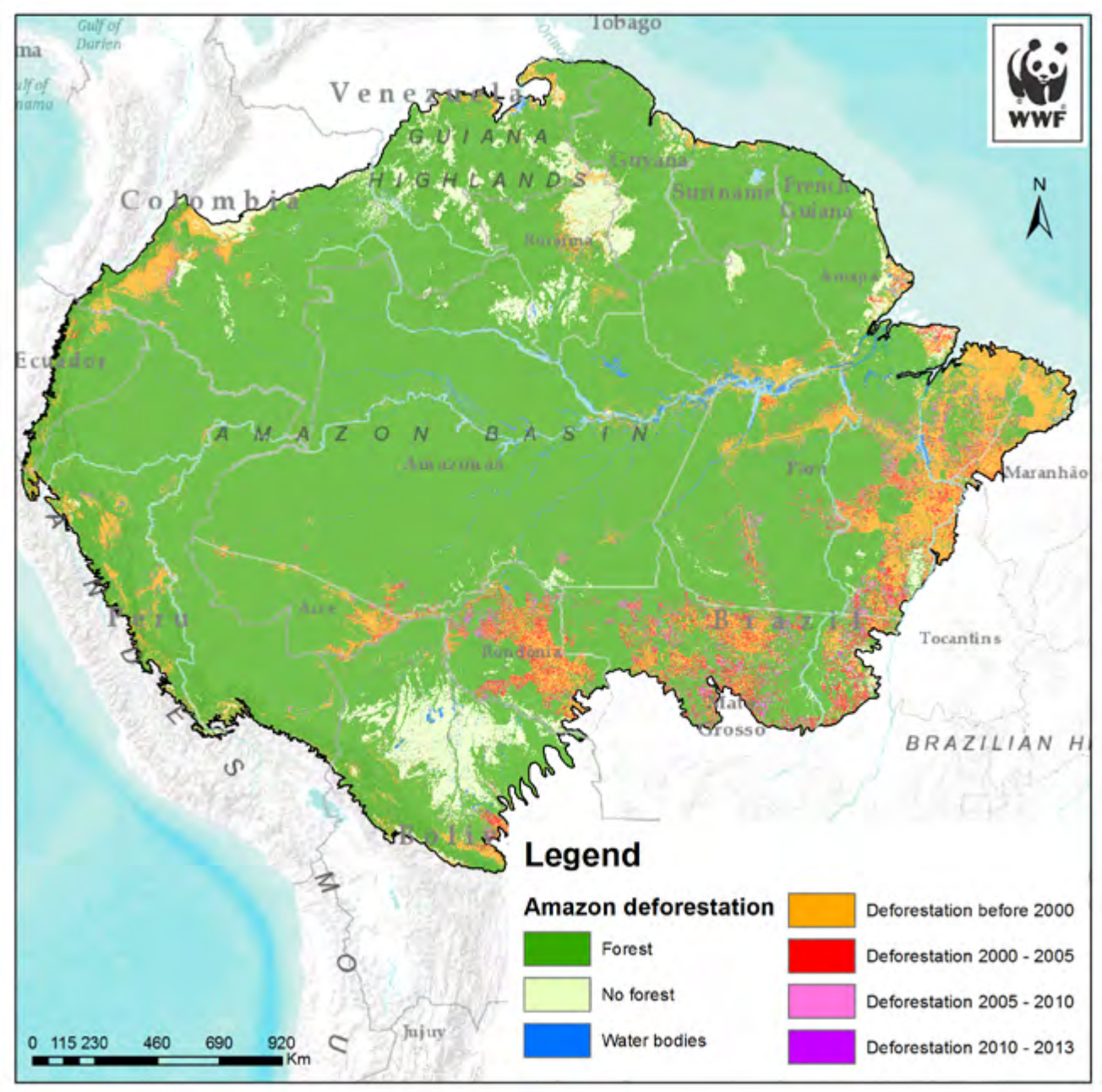
- Overall rates of deforestation for the biome are falling, which is similar to other studies.[54] While the annual deforestation during the whole period was just over 2 million hectares per year, there were higher rates in the earlier period between 2000 and 2005, with an annual average of 3.39 million hectares per year. The annual deforestation for the most recent period is much lower and shows an average of just over 1 million hectares per year.
- Forest loss over the 13 years in the biome is approximately 27 million hectares; with the largest amount – nearly 17 million hectares – occurring in the 2000-2005 period.
- The rate of change in forest cover for the biome follows similar patterns, with an overall deforestation rate for the area of 0.37, which is relatively low, although the absolute annual deforestation values between 2000 and 2013 are almost equivalent to losing El Salvador per year.

85.6%
FOREST COVER
IN 2000

Although this is definitely good news, more detailed analysis in the next section shows that the trend is not the same for everywhere in the biome.

3.4 Regional trends in deforestation

The map below shows deforestation concentrations by region and time period.



Brazil, Bolivia, Colombia and Peru were responsible for 97.5% of all deforestation from 2000-2013; which resulted in the loss of 27 million hectares over the 13-year period, which is equivalent to losing New Zealand. In 2000 Brazil was responsible for 89% of the total deforestation, but this reduced to 75% between 2010-2013 as it better controlled deforestation in its boundary – but deforestation in other Amazon countries also took hold.

Table 3: Forest change per period per country

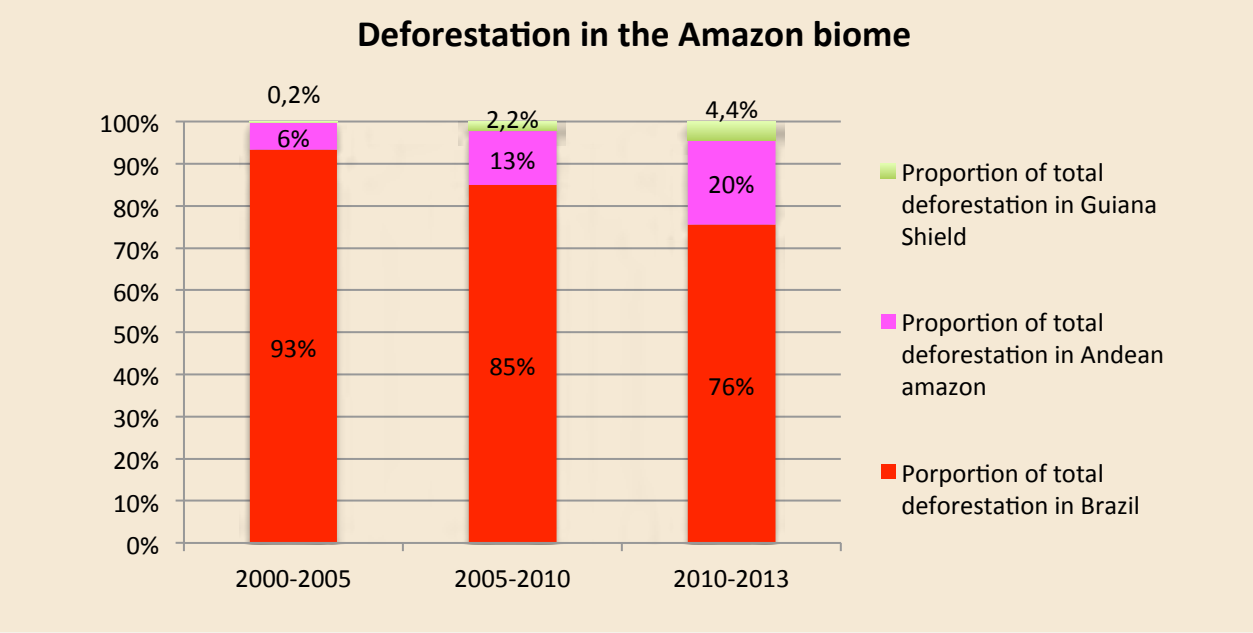
Country	Remaining forest in 2000 (hectares)	Forest change (hectares)			Remaining forest cover 2013 (hectares)
		Total deforestation 2000-2005	Total deforestation 2005-2010	Total deforestation 2010-2013	
Brazil	346,900,679	15,814,173	5,966,230	2,294,454	322,825,821
Andean Amazon countries					
Venezuela	32,449,602	76,024	99,286	48,865	32,225,427
Colombia	42,643,544	243,627	180,037	99,528	42,120,352
Ecuador	10,540,881	62,409	40,038	19,184	10,419,250
Peru	72,723,918	242,162	252,063	147,416	72,082,277
Bolivia	29,808,220	462,838	330,748	293,877	28,720,756
Guiana Shield countries					
Guyana	18,567,898	15,449	102,157	87,003	18,363,288
Suriname	13,597,164	16,603	32,782	25,339	13,522,440
French Guiana	8,006,233	3,069	19,394	22,270	7,961,500
	Forest in the biome	**Deforestation in the biome**			**Forest in the biome**
Total	**575,238,138**	**16.936.356**	**7.022.735**	**3.037.936**	**548,241,110**

Most deforestation is still taking place in Brazil, although notably there is recent deforestation in the Andean Amazon and Guiana Shield, which were previously areas of low rates. This shift is clear in the following pair of graphs.

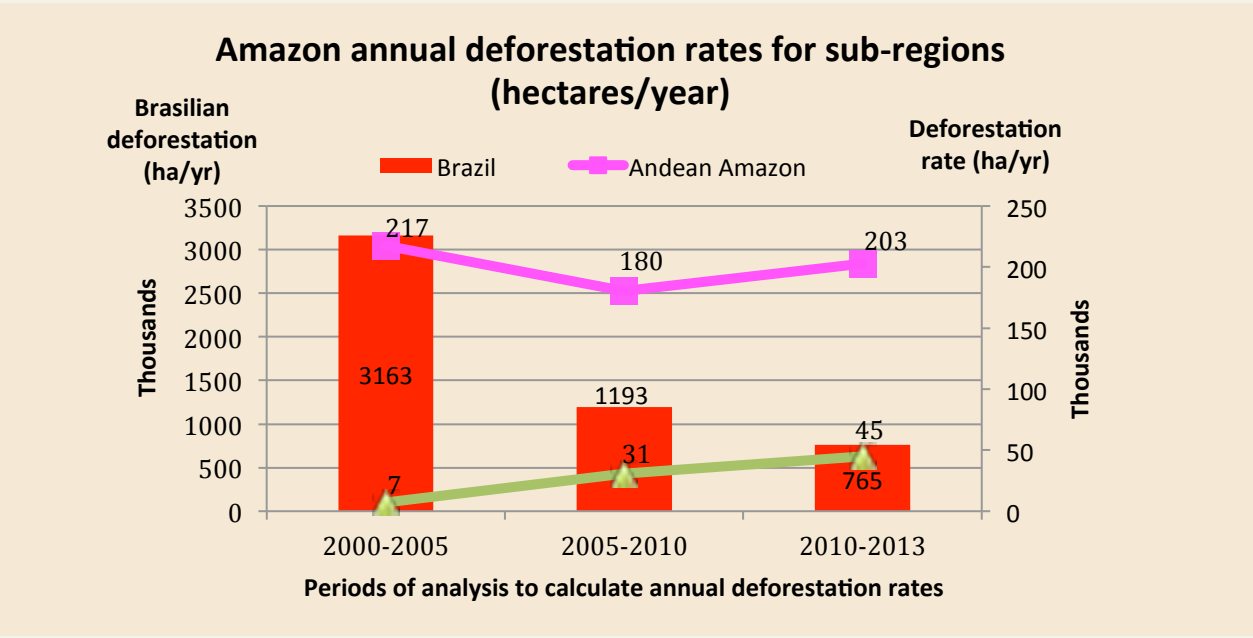
© Day's Edge Productions / WWF-US

MOST DEFORESTATION IS TAKING PLACE IN BRAZIL, ALTHOUGH THERE IS RECENT DEFORESTATION IN THE ANDEAN AMAZON AND GUIANA SHIELD

Graph 3: Deforestation in the Amazon biome; proportion per sub-region



Graph 4: Annual deforestation rate for the Amazon biome per sub-region



BRAZIL REACHED ITS LOWEST ANNUAL AMOUNT OF DEFORESTATION IN 2012

In 2004 Brazil brought in significant policies to curb deforestation, including expanding its protected area network. Since then there has also been a new forest code brought into law in 2012 and a significant economic downturn since 2015. Deforestation in Brazil reached its lowest annual amount in 2012 but there have been three consecutive years after this with increasing deforestation rates. Until recently however, rates in the Brazil legal amazon still had not risen above the 2011 annual deforestation rate (PRODES 2016), although this may change in the future.[vi]

[vi] According to PRODES, Brazilian legal amazon initial annual deforestation data for 2016 (7989 km² per year) shows an increase of 29% from 2015 figures and may be worse than 2009 deforestation rates.

Section 4

Deforestation poses a varying level of environmental threat depending on a range of regional factors. Deforestation dynamics are not simply a case of calculating current rates; there are other factors to consider, such as total deforestation over time, the percentage of an area already deforested, and the intensity of the most recent deforestation. When considered together these factors can give a more complete sense of the deforestation of an area, and therefore how much pressure an area is under and the impact resulting from that.

In 2015 WWF identified 11 global 'deforestation fronts' where the largest concentrations of forest loss are projected,[55] and the Amazon was one of these 11.[56] This complemented an earlier 2014 publication that identified 25 new deforestation fronts in the Amazon biome, which used a different data set than this report (Hansen et al 2013).[57] However, as the following section illustrates, a re-examination of new regional deforestation patterns for the Amazon biome has identified more deforestation fronts, including three large-scale cross-border deforestation fronts.[58] Part of that re-examination includes a more detailed analysis of the ecosystem status and deforestation trends in these fronts, to understand the nature of their threat to the biome.

Recent guidelines from IUCN on red-listing ecosystems[59] encourage a more complex understanding of how ecosystems are performing. In light of this new initiative the following sections seek to explore the concept of ecosystem status through a threat status analysis.[60] A fuller picture emerges of how much of a threat deforestation is to an area when the ecosystem threat status assessment is combined with three other deforestation trend criteria, which link to similar concepts in the IUCN guidelines. Together these can give us a sense of how deforestation is affecting different habitats or areas in the Amazon.

Areas to be assessed go through a three step process; step 1 set thresholds for the IUCN assessment categories and assess the threat status of the areas (table 5), step 2 determine the values for the three deforestation criteria, which by passing these values, an area would trigger concern and be assigned "1". Those not passing these trigger values would be assigned "0". Step 3 combines the results of the first two steps to give a new category of threat status assessment for each area (graph 4).

Step 1: assesment of the thesholds for the IUCN categories

- Ecosystem threat status assessment (based on percentage of total loss of natural habitat)

Step 2: determine values for three criteria and assess which areas pass any one of them

- Overall forest loss during the study period (2000-2013)
- Recent rate of forest loss (2010-2013)
- Trends in the rate of forest loss between periods (2000-2005 to 2005-2010 and 2010-2013) – whether these are increasing, decreasing or stable

Step 3: assesment of the thesholds for the IUCN categories

- Use graph 4 below to combine the IUCN categories and the 3 criterion

4.1 Amazon deforestation fronts

We analysed the MODIS data from 2000-2013, and overlaid the area limits of the 25 fronts identified in a previous study.[61] We then gathered expert opinion in the region to verify whether the areas of the fronts were still active by considering the rate of change of deforestation as well as the nature of the direct threats identified within each area. Deforestation density maps for 2010 and 2013 were then examined to see where the most recent deforestation concentrations (2010-2013) had been focused (see Annex 1). This allowed us to identify 31 active fronts in addition to the three areas of 'consolidated fronts' marked A, B and C on the map below, known as the arc of deforestation. Most of the fronts are located in Brazil, where further deforestation is likely to be limited to within existing areas, in many cases following roads.[62]

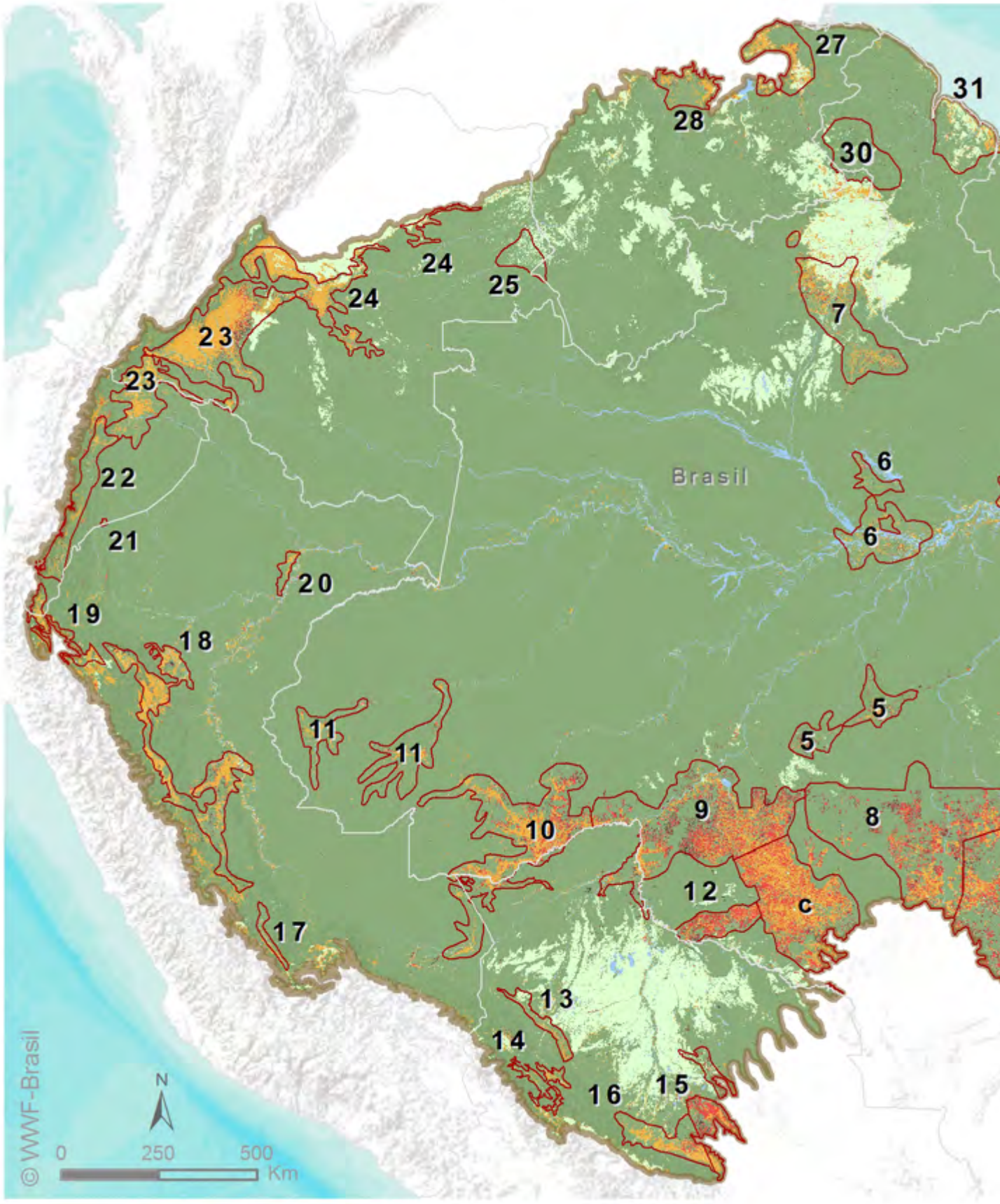
We also need to note here that the level of forest degradation is not being measured or analysed in this study. There is no one single agreed methodology in the region and most countries are not yet able to measure it consistently at scale.

These fronts are identified and described in the following table. It also analyses the underlying causes and determining drivers behind each front, and provides a framework for assessing where and how these fronts progress over time. Applying the IUCN ecosystem status approach discussed above to the fronts allows us to assess which status category each front has, and this can be compared with later assessments or combined with other deforestation criteria for a more complete analysis.

Table 4: IUCN habitat threat status definition for the deforestation fronts

Habitat threat status (IUCN)		Trigger values
CR	CRITICALLY ENDANGERED	Area of habitat remaining is less/equal to 35% of the total area
EN	ENDANGERED	Area of habitat remaining is less/equal to 50% of the total area.
VU	VULNERABLE	Area of habitat remaining is less/equal to 80% of the total area
NT	NEAR THREATENED	Area of habitat remaining is more than 80% of the total area
LC	LEAST CONCERNED	Not used here

Table 5: below shows the basic deforestation analysis for each front and the results of applying the IUCN status assessment. By using the IUCN habitat threat status, we see that 21 fronts are vulnerable (14), endangered or critically endangered and only 14 are Near Threatened (NT) status. There are also eight deforestation fronts with increased deforestation trends, 25 fronts with decreased deforestation trends and two fronts with fairly steady deforestation rates. However, it is useful to understand whether there are more emerging or urgent threats by looking at three other deforestation criteria (introduced above) combined with the IUCN assessment. This is explored in the next section.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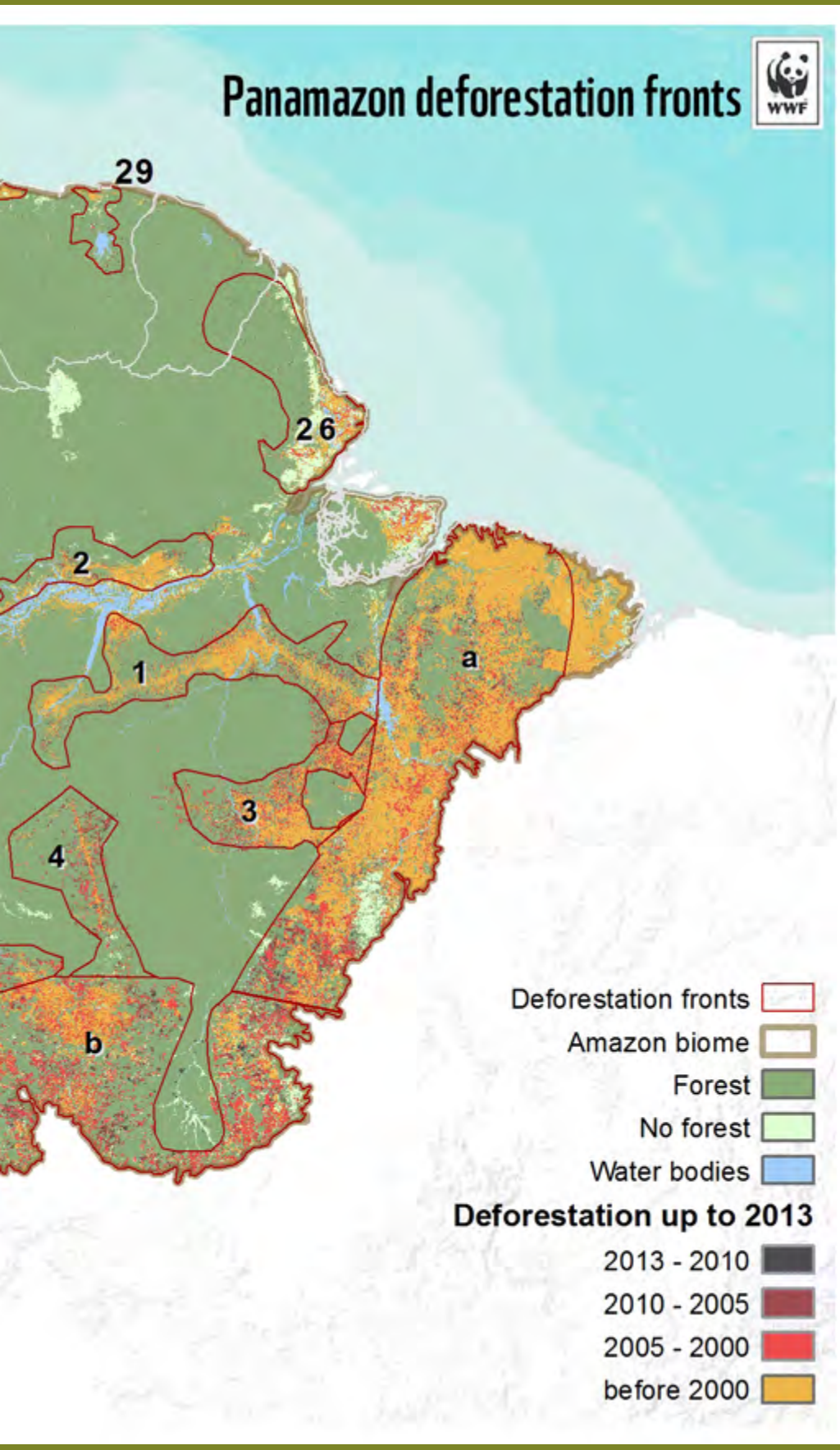


The 31 regional deforestation fronts are defined in the areas where there has been rapid and persistent deforestation occurring in the biome. Overall historical deforestation has left these areas on average 30% deforested. The total deforestation for 13 years in all of the fronts is 22,808,022 hectares (2000-2013), and this represents 84.5% of the total deforestation in the biome for this same period. These fronts represent the worst areas in terms of deforestation in the biome. However, deforestation is not distributed evenly within them and some may be more of a priority to address through management measures than others.

Table 5: Deforestation fronts, basic data, descriptions, analysis of deforestation drivers and trends

N	Country	Deforestation fronts	Criterion 1 Average annual deforestation during 2010-2013 (ha/year)	Criterion 2 Overall deforestation from 2000-2013 (ha)	% of area deforested	Habitat threat status based on % remaining cover 35%, 50%, 80%	Underlying causes	Determining drivers	Criterion 3 Trend in change in rate between 2005-2010 and 2010-2013
1	Brazil	Eastern Trans-Amazon highway -Northern section of BR-163	40631	908494	38.6%	VU	• Colonization policy • Infrastructure development: Bel Monte and São Luiz dams, Trans-Amazonian highway BR-163 • High commodity prices	• Directed colonization • Cocoa agroforestry • Large-scale cattle ranching • Soy production	↓ Down – Very high deforestation
2	Brazil	Terra Santa-Oriximiná-Prainha	5570	165140	28.1%	VU	• Colonization policy • Infrastructure development • Historical settlements	• Directed colonization • Large-scale cattle ranching	↓ Down – High deforestation
3	Brazil	Central southern Pará state	11060	1235792	51.9%	EN	• Infrastructure development • Trans-Amazonian highway BR-230 • Weak control of illegal logging • Colonization policy	• Large-scale cattle ranching • Land conflicts • Small-scale agriculture	↓ Down – Very high deforestation
4	Brazil	Central segment of the BR-163	18923	683546	17.3%	NT	• High commodity prices • Land grabbing • Infrastructure improvements • Weak control of illegal logging	• Soy production • Large-scale cattle ranching • Large-scale agriculture • Informal gold mining	↓ /Down – Very high deforestation
5	Brazil	Central Trans-Amazonian highway	8148	150710	13.5%	NT	• Colonization policy • No land-use planning • Access to markets • High commodity prices • Infrastructure development and improvements BR-230	• Spontaneous settlement • Cocoa agroforestry • Increasing deforestation in settlements • Expanding large-scale cattle ranching (including dairy) • Informal gold mining	↓ Down
6	Brazil	Manaus – Presidente Figueiredo	2379	58830	10.5%	NT	• Colonization policy • Settlement centres • Infrastructure development, BR-174 and BR-319 • Construction of Balbina Dam	• Small-scale agriculture • Large scale cattle ranching • Illegal logging	↓ Down
7	Brazil	Boa Vista, Caracaraí and Rorainópolis	7650	190984	21.5%	VU	• Colonization policy • Infrastructure development, BR-210 and BR-174	• Directed colonization • Large-scale rice production • Small scale agriculture	↓ Down – High deforestation
8	Brazil	Northeastern Mato Grosso	28607	1739397	25.3%	VU	• High commodity prices • Fiscal policy favours large farm sector • Colonization policy • Weak control of logging sector • Infrastructure development, dams, secondary roads	• Large-scale cattle ranching • Commercial soy production • Directed and spontaneous colonization • Land conflicts • Illegal logging • Small-scale cattle ranching	↓ Down – Very high deforestation
9	Bolivia/Brazil	North Rondonia and North Eastern Bolivia	59909	2030892	39.9%	VU	• Infrastructure development, BR-364 and BR-425 • Colonization policy	• Large-scale cattle ranching • Land grabbing • Illegal logging	↓ Down – very high deforestation

N	Country	Deforestation fronts	**Criterion 1** Average annual deforestation during 2010-2013 (ha/year)	**Criterion 2** Overall deforestation from 2000-2013 (ha)	% of area deforested	Habitat threat status based on % remaining cover 35%, 50%, 80%	Underlying causes	Determining drivers	**Criterion 3** Trend in change in rate between 2005-2010 and 2010-2013
10	Brazil/Peru/ Bolivia	Acre Sul Puerto Maldonado	15528	751381	34.9%	VU	• Infrastructure development, inter-oceanic highway BR 317, highways 8 and 13. • Dams • Weak control of illegal logging	• Large-scale cattle ranching • Land speculation • Illegal gold mining • Land grabbing • Illicit crop production • Illegal logging (Peru, Bolivia) • Spontaneous colonization (Bolivia, Peru)	↓ Down – very high deforestation
11	Brazil	Acre Amazonas	3991	71221	11.2%	NT	• Land-use policy • Road infrastructure improvements BR-364 (possible consolidation with Pan-Pacific) • Colonization policy, settlements • Farming	• Weak land-use planning • Gas exploration in west • Expanding medium-scale farming and cattle ranching • Small-scale cattle ranching • Slash-and-burn agriculture	Up
12	Brazil	Western Rondonia	6658	488586	57.1%	EN	• Road infrastructure improvement BR-429, BR-319 • Historical settlements, farming	• Medium-scale agriculture • Small-scale cattle ranching • Soy production	↓ Down – high deforestation
13	Bolivia	Yucumo – Ixiamas	669	17784	16.1%	NT	• Colonization policy • Infrastructure development highways 2 and 8	• Promotion of a sugar refinery • Slash-and-burn agriculture • Forest fires	↓ Down
14	Bolivia	Coroico, Caranavi, Guanay and Palos Blancos	157	7974	16.5%	NT	• Road infrastructure highway 3 • Cash crops production	• Slash-and-burn agriculture • Illicit crop production • Informal gold mining	↓ Down – low deforestation
15	Bolivia	Santa Cruz de la Sierra	9278	402795	52.4%	EN	• Government agricultural expansion policies; export incentives • Roads and infrastructure development; 9 and 4 • Colonization policies	• Extensive commercial crops, soy and cattle production • Slash-and-burn agriculture • Charcoal • Directed colonization	↓ Down – high deforestation
16	Bolivia	Chapare	3207	88995	38.5%	VU	• Road infrastructure highway 7 • Settlements • Cash crop production	• Soy production, agriculture • Illicit crop production • Bananas, palm hearts • Cattle • Logging	Up
17	Peru	Route 18C – Huanuco and Ucayali	140	5185	16.9%	NT	• Historical settlements • Road infrastructure development 18C • Gas pipeline	• Food crops, slash-and-burn agriculture • Small-scale cattle • Expanding oil palm production	↓ Down – low deforestation
18	Peru	Highway Marginal de la selva and Highway F. Basadre	14836	185549	41.6%	VU	• Colonization policy • Road infrastructure improvements, F. Basadre and Inter-American Highway; secondary roads • Forest concessions	• Directed colonization • Historical settlements • Agriculture • Cattle ranching • Oil palm plantations	↓ Down – high deforestation

N	Country	Deforestation fronts	**Criterion 1** Average annual deforestation during 2010-2013 (ha/year)	**Criterion 2** Overall deforestation from 2000-2013 (ha)	% of area deforested	Habitat threat status based on % remaining cover 35%, 50%, 80%	Underlying causes	Determining drivers	**Criterion 3** Trend in change in rate between 2005-2010 and 2010-2013
19	Peru	Route 5N – Amazonas	785	15047	50.3%	EN	• Road infrastructure, Inter-American Highway • Historical settlements • Planned hydroelectric projects	• Agriculture • Land speculation	Up
20	Peru	Loreto Iquiros and the Marañón valley	38	2324	21.3%	VU	• Road infrastructure development • Historical settlement • Commodity prices	• Slash-and-burn agriculture • Cattle production • Oil palm plantations	Down – low deforestation
21	Ecuador	Puerto Morona	0	32	9.7%	NT	• Recently emerging: infrastructure (access to hydrovía Morona – Marañón – Amazonas)	• Agriculture	Stable – low deforestation
22	Ecuador	Route E45	1127	33470	14.1%	NT	• Road infrastructure (Ruta Marginal de la Selva)	• Agriculture • Small-scale cattle production • Logging • Secondary roads	Down
23	Colombia/ Ecuador	Upper rivers of Putumayo, Caqueta and San Pedro (Colombia) with	1063	26864	32.9%	VU	• Historical settlements • Infrastructure development • Petroleum exploration • Spontaneous colonization	• Slash-and-burn agriculture • Illicit crop production • Cattle ranching • Soy production	Down – high deforestation
		Sucumbios – Orellana – Nueva Loja (Ecuador)	16156	319103	55.5%	EN	• Infrastructure development, Routes 20, 45 • Spontaneous colonization • Opening petroleum routes	• Small-scale agriculture • Mono-cropped oil palm production	Down – very high deforestation
24	Colombia	Rivers Puerto Rico, S. José de Guaviare and Calamar	5710	88258	43.6%	VU	• Historical settlements • Development of access roads in the sub-Andean foothills • Petroleum exploration • Area of internal conflict	• Slash-and-burn agriculture • Illicit crop production • Cattle ranching • Soy production	Up
25	Colombia	Lower River Guaviare – River Orinoco	30	359	0.3%	NT	• Major centre of internal conflict	• Slash-and-burn agriculture • Illicit crop production	Stable
26	Brazil – French Guiana	Amapa – French Guiana	13580	2872	12.2%	NT	• Gold mining • Coastal road	• To be investigated further	Up
27	Venezuela	Outside scope	2111	4565	33.4%	VU	• Coastal development	• Outside of scope	Down
28	Venezuela	Outside scope	1637	1354	27.2%	VU	• Coastal development	• Outside of scope	Up
29	Suriname	Outside scope	2395	3121	9.3%	NT	• Gold mining • Road	• To be investigated further	Down
30	Guyana	Outside scope	6533	438	1.1%	NT	• New road • Border trade	• To be investigated further	Up
31	Guyana, coastal	Outside scope	4969	1896	17.2%	NT	• Road	• To be investigated further	Up

N	Country	Deforestation fronts	**Criterion 1** Average annual deforestation during 2010-2013 (ha/year)	**Criterion 2** Overall deforestation from 2000-2013 (ha)	% of area deforested	Habitat threat status based on % remaining cover 35%, 50%, 80%	Underlying causes	Determining drivers	**Criterion 3** Trend in change in rate between 2005-2010 and 2010-2013
A	Brazil, Arc of deforestation	Eastern Pará state	116413	4813325	63.1%	EN	• Colonization policy • Historical settlements, Belem • Road development, BR-010, BR-230 • Large infrastructure projects, dams • Commodity prices • Iron ore smelting	• Medium-to-large-scale cattle ranching • Mechanised agriculture • Soy production • Land-grabbing/speculation • Mining, informal mining • Charcoal production • Bio fuel plantations	Down – very high deforestation
B	Brazil Arc of deforestation	Central Mato Grosso	150083	6291805	41.8%	VU	• Directed and spontaneous colonization • Infrastructure development, BR-158, BR-163 • Large infrastructure projects, Bel monte dam • Commodity prices	• Extensive large-scale cattle ranching • Large-scale mechanized agriculture • Soy production	Down – very high deforestation
C	Brazil Arc of deforestation	Central Rondonia	7253	1608874	70.0%	CR	• Colonization policy • Infrastructure development, dams, BR-364 • Commodity prices	• Cattle ranching • Land-grabbing, illegal public land encroachment • Mechanized agriculture • Grain, bio-fuels and soy production • Logging • Fire from pasture management • Cocoa agroforestry	Down – high deforestation

4.2 Current trends in key fronts

As discussed previously, assessments of the threat of deforestation have not been based on a single indicator (eg annual deforestation rates). We first identified the habitat threat status based on the percentage of natural vegetation remaining after deforestation in each front, using a similar method to the IUCN ecosystem status assessment.[63] We then looked at the number of times each front triggered another deforestation criterion limit and combined them to give a new threat status: see the table below of combined status per front.

- **Criterion 1, Recent rate of forest loss:** annual rate of loss for 2010-2013 with a trigger value of 8,103 ha/yr (or 50% of the mean average deforestation rate)
- **Criterion 2, Overall forest loss:** total deforestation during 13 years with a trigger value of 325,000 hectares (or 50% of mean average total deforestation)
- **Criterion 3, Trends in rate of loss:** trend between 2005-2010 and 2010-2013 with a trigger value that shows an increasing trend (more than 100 hectares difference between the two periods)

The way we combined these three criteria with the IUCN status assessment value in the 3 step approach is best explained by looking at one of the fronts as an example.

> Front 10, for example, has an annual rate of forest loss for 2010-2013 of 15,528 hectares per year, and this is greater than the trigger value for criterion 1, so it gets triggered. The total deforestation during the 13-year period for front 10 is 751,000 hectares, and this again is greater than the trigger value for criterion 2, so it triggers or passes criterion 2 as well. It now has a total of two other deforestation criteria it has triggered. However, its rate of change in forest loss between 2005-2010 and 2010-2013 is downward so it does not trigger criterion 3.
>
> We now combine the assessment value and number of criteria triggered for front 10. In this case the IUCN value is Vulnerable status (VU) and it has triggered two out of three other deforestation criteria (so it is designated a VU2 category in the table below), which means its new **combined threat value** is Vulnerable (V) using the table below. However, if the front had triggered all three criteria thresholds or watermarks it would it have been designated VU3 and resulted in a new combined threat value of Endangered (E).

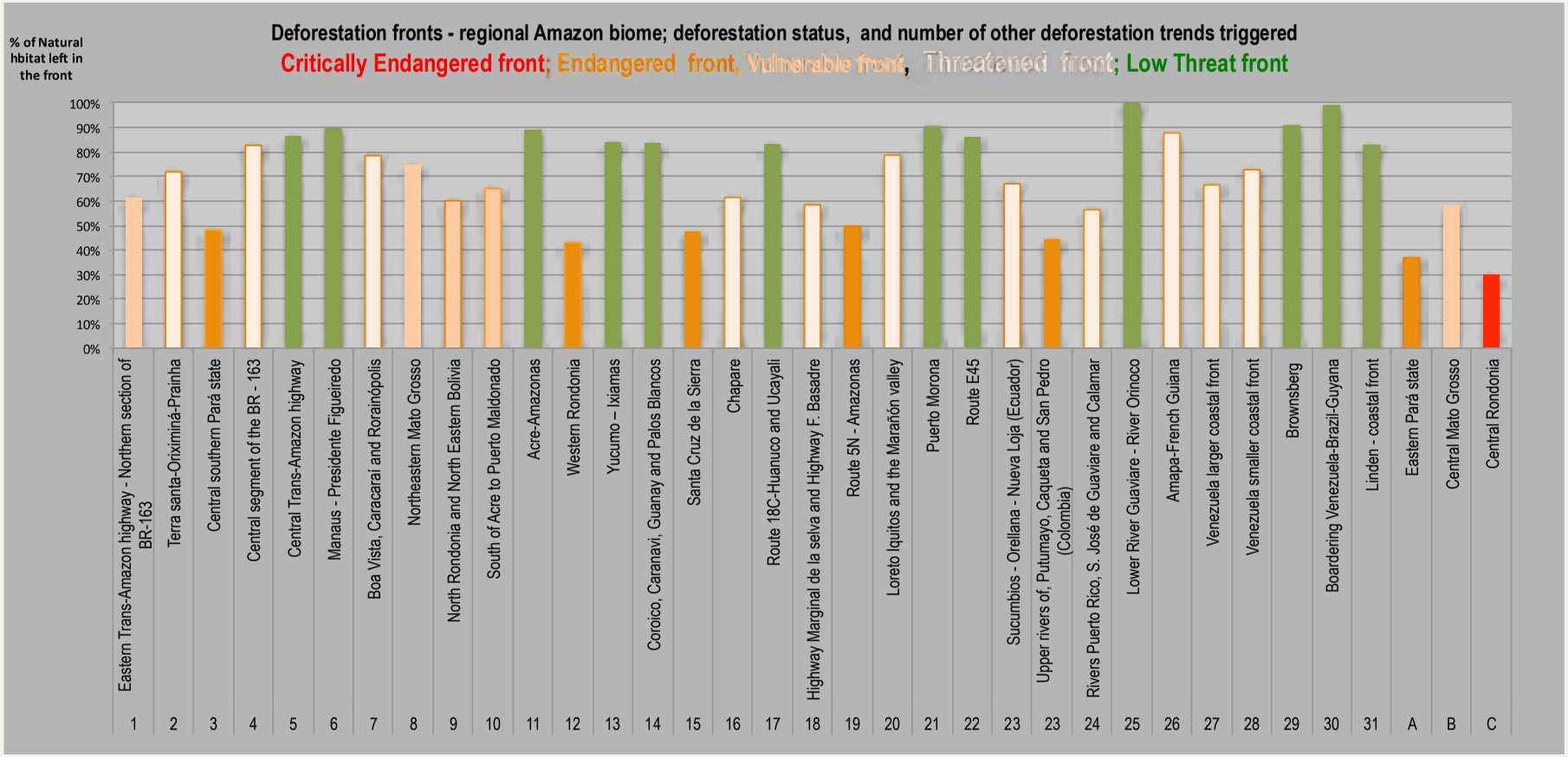
Table showing the IUCN ecosystem status categories and if any of the three other deforestation criteria values were passed or triggered for the front.

Table 6: Combined ecosystem status and deforestation criteria

IUCN ecosystem status category NT=80%, VU=50%, EN=50%, CR=35%)				Combined threat status	
No other criteria	1 other criterion passed	2 other criteria passed	3 other criteria passed		
NT 0	NT 1			Low Threat	L
VU 0	VU 1	NT 2		Threatened	T
		VU 2	NT 3	Vulnerable	V
EN 0	EN 1	EN 2	VU 3	Endangered	E
CR 0	CR 1	CR 2	EN 3	Critically Endangered	CE
			CR 3	Extremely Critically Endangered	XCE

The graph shows the combined results for each front identified above to give a more complete sense of how much each area is threatened.

Graph 4: Deforestation fronts with combined deforestation threat status



- In the traditional arc of deforestation (fronts A, B, and C), although trends have been reducing, each one has a combined status of either Critically Endangered, Endangered or Vulnerable: this means both historical and emergent deforestation is high. In the eight fronts that are showing an increasing trend (from 11 to 31), one has a combined status of Endangered and four are Threatened, whereas the remaining three are Low Threat. Four of these fronts are newly identified and all require more study to assess the causes of deforestation, verify their status and prioritize actions to address issues identified.
- Of the 22 fronts (between fronts 1 and 29 in the graph) with reducing deforestation trends, four had a combined status of Endangered and four were Vulnerable. Most are in Brazil, but two are in the Andean Amazon (Bolivia and Colombia). In addition seven of these 22 fronts have Threatened status, and these are mostly in Brazil but three are in the Andean Amazon region; Peru, Ecuador and Venezuela. Steps need to be taken to address the deforestation drivers here, and increase restoration in severely degraded or deforested areas through agro-forestry, silvo-pastoral and natural generation.
- Of the 12 fronts that have Low Threat status, while two are stable, seven are reducing and three have increasing deforestation trends. They have triggered no other deforestation criteria, so they need to be monitored to ensure that they continue on track, their status can be improved further through natural regeneration, and scrutinized for lessons that can be applied elsewhere in the biome.

22 FRONTS HAVE A REDUCING DEFORESTATION TREND, BUT STEPS NEED TO BE TAKEN TO ADDRESS THE DRIVERS AND RESTORE ECOSYSTEMS

There are significant gaps between the fronts where in many cases the protected area and indigenous territory network are found. Protected areas have been used as a policy instrument by the Brazilian government since 2004 seeking to curb deforestation. Many studies confirm they have a significant role to play in reducing and controlling deforestation.[64] However they cannot be taken for granted, so the following section seeks to understand whether deforestation is being curbed within their boundaries.

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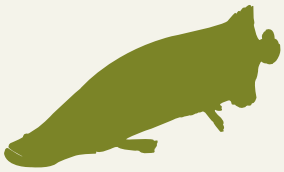


PROTECTED AREAS HAVE BEEN USED AS A POLICY INSTRUMENT BY THE BRAZILIAN GOVERNMENT SINCE 2004 SEEKING TO CURB DEFORESTATION

Section 5

5.1 Status of deforestation in indigenous territories and protected areas

INDIGENOUS TERRITORIES ARE A CRITICAL PART OF THE CONSERVATION STRATEGY FOR THE BIOME, AND INDIGENOUS PEOPLES ARE AN ESSENTIAL PARTNER

Both protected areas and indigenous territories are considered key ways to curb deforestation,[65] and in Brazil at least indigenous territories are considered a type of protected area, although there are differences in how they are managed. There are 61 areas where protected areas and indigenous territories overlap, which generally enhances conservation outcomes, although it can also be a source of conflict as well. The two types of conservation unit both have much lower deforestation trends than average for the biome.[66] However, it is often assumed that they are not under pressure from deforestation drivers due to their low average rates; this analysis confirms that and found the average deforestation rate for protected areas is -0.07%, whereas it is -0.03% for indigenous territories. However, more recent publications have highlighted that some protected areas face the threat of degazettement.[67]

5.2 Prioritizing indigenous territories

Indigenous territories are a critical part of the conservation strategy for the biome, and indigenous peoples are an essential partner. The 1,702 indigenous territories analysed cover an area of 20,284,545 hectares of the biome[vii]. The table below shows that on the whole these areas are experiencing less deforestation than the biome average, both historically and also more recently. However, there are exceptions to this.

The following table shows the overall values for deforestation trends found in indigenous territories, per country and for the whole biome.

Table 7: Summary data for forest loss in indigenous territories in the Amazon biome

Country	Total number of territories analysed	Proportion of the total area deforested, 2013	Overall deforestation 2000-2013 (ha)	Proportion of the 2000-2013 deforestation occurring in 2010-2013	Rate of deforestation (r) for 2000-2013 %	Rate of deforestation (r) for 2010-2013 %	Annual deforestation for 2010-2013 (ha/year)
Bolivia	33	3.8%	106074	39%	-0.089	-0.151	418
Brazil	292	1.2%	384314	28%	-0.031	-0.037	122
Colombia	142	0.9%	21641	37%	-0.007	-0.011	19
Ecuador	12	5.4%	43604	15%	-0.047	-0.031	181
French Guiana	11	0.5%	2644	77%	-0.029	-0.098	62
Guyana	103	2.9%	14628	63%	-0.045	-0.122	30
Peru	1073	1.7%	64927	31%	-0.025	-0.034	6
Suriname	12	1.0%	19071	31%	-0.033	-0.043	162
Venezuela	24	1.5%	74511	32%	-0.027	-0.037	335
Total	**1702**		**731414**				
Average value		**1.59%**	**430**	**31%**	**-0.030**	**-0.040**	**44**

[vii] 1,702 may include non officially recognized territories but on the whole are those registered in the national databases.

THE TERRITORIES IN GUYANA, ECUADOR AND BOLIVIA HAVE THE HIGHEST VALUES FOR AVERAGE AREA DEFORESTED.

- WWF found that in 2013 indigenous territories in the biome had an average 16% of their area deforested and an average rate of deforestation from 2000-2013 of 0.03%. Compared with the biome in general, deforestation is very low in indigenous territories. However, just under one-third of this deforestation occurred in the last three years of the 13-year period between 2000-2013, which means deforestation pressure is increasing in indigenous territories. This is confirmed by a higher rate of deforestation, 0.04%, although the annual area deforested for the same period is still only 44 hectares per year.
- Peru has the largest number of indigenous territories, but many are small in size. The territories in Guyana, Ecuador and Bolivia have the highest values for average area deforested. This means that the indigenous territories in these countries have experienced significant deforestation in the past.
- Guyana and French Guiana have proportionally more deforestation occurring in their indigenous territories during 2010-2013 compared to other periods of analysis, and a significantly higher proportion than average for the biome. Bolivia and to a degree Colombia also have higher-than-average values for this period, but not as high as the two Guiana Shield countries.

The data suggests that there may be a high potential in the future for deforestation in indigenous territories if these trends continue. We need to understand in more detail what may be driving deforestation in these territories and look at the measures required to address the causes.

To understand how individual territories may be threatened by deforestation or to assess where there may be emerging threats, the IUCN ecosystem assessment was used in combination with other deforestation trend criteria in the three step approach (as described on page 35). This will allow management options to be prioritized. The results are shown in the following table. The way values for the IUCN criteria were set and threshold or trigger values were decided for the other criteria are found in Annex 1.

Other criteria are triggered for a territory if:

1. The overall forest lost between 2000-2013 is greater than 215 hectares;
2. The annual deforestation rate between 2010-2013 is more than 22 hectares per year; or
3. There is an increasing deforestation trend between the two most recent study periods (between 2005-2010 and 2010-2013).

The trigger values chosen for these complementary criteria are based on half of the mean average values for the criteria. For these trigger values the assumption would be that the annual deforestation rate is equivalent to 44 families each opening half a hectare for farming every year. Their total area for farm production over the 13 years would be less than five hectares per family to give the 215 hectares forest loss, so these represent subsistence farming values. Absolute values are used as triggers and not percentages because deforestation is not spread evenly in a territory, but tends to cluster around a settlement. Where territories are large a percentage would be negligible, but it would not reflect a potential honeypot effect or clustering of deforestation due to settled populations.

76% OF INDIGENOUS TERRITORIES ARE EITHER LOW THREAT OR NOT THREATENED

The following table summarizes the combined result of applying the IUCN status assessment approach with the three other deforestation criteria, to create six categories of threat.

Table 8: Combined ecosystem status and deforestation criteria for indigenous territories

IUCN ecosystem status category (LC, NT, VU, EN, CR – see annex for definitions)				Combined threat status	
No other criteria	1 other criterion passed	2 other criteria passed	3 other criteria passed		
LC 0				Not Threatened	N
NT 0	NT/LT 1			Low Threat	L
V U 0	VU1	LC 2/NT 2		Threatened	T
		V 2	NT 3/LC 3	Vulnerable	V
EN 0	EN 1	EN 2	EN 3	Endangered	E
CR 0	CR 1	CR 2	CR 3	Critically Endangered	CE
			CR 3	Extremely Critically Endangered	XCE

Table 9: Number of indigenous territories in the biome that meet threat status limits and trigger the three other criteria.

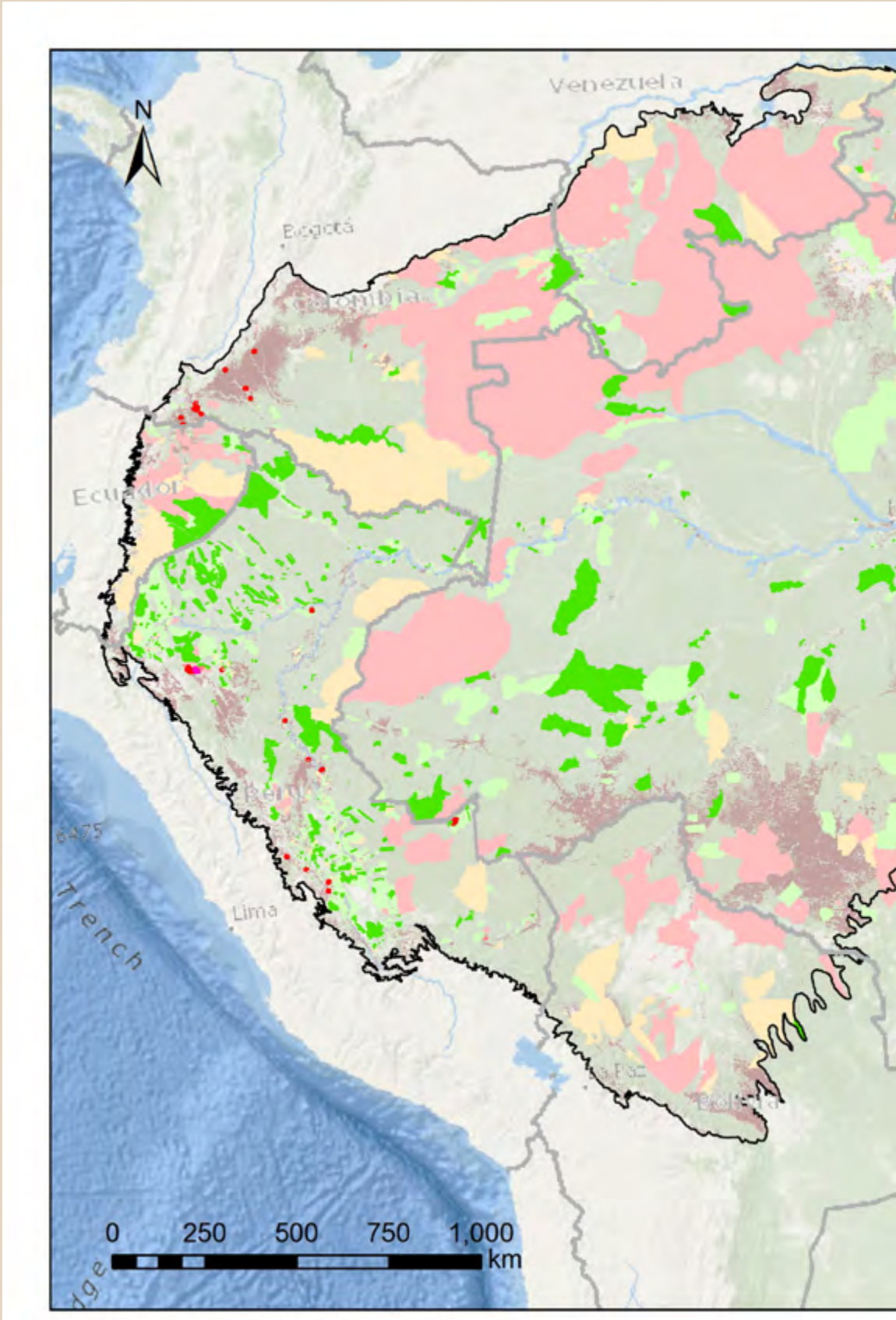
Threat status defined by combining IUCN ecosystem status and 3 other threat criteria	Number of territories per category	Proportion of the total number of territories	Area of territories with this category (hectares)	Portion of the area coverage with this category
Extremely Critically Endangered	1	0.1%	10,802	0.01%
Critically Endangered	22	1.3%	44,013	0.02%
Endangered	9	0.5%	258,960	0.13%
Vulnerable	126	7.4%	109,633,647	54.3%
Threatened	249	14.6%	40,226,101	19.9%
Low Threat	790	46.4%	26,951,582	13.3%
Not Threatened	505	29.7%	24,949,440	12.3%
Total	**1702**		**202,074,545**	

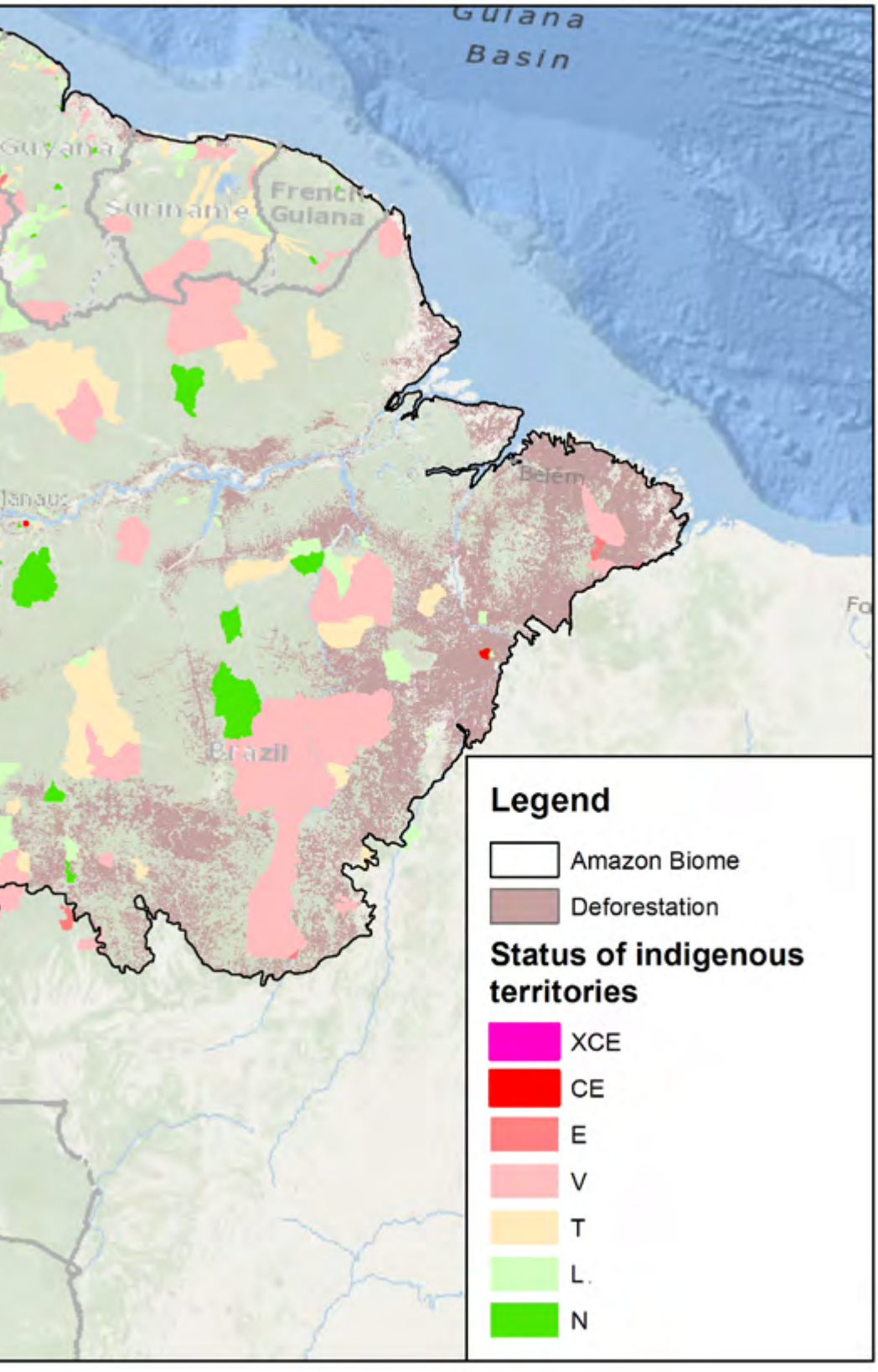
- When considering the combined threat status, the majority of indigenous territories (76% or 1,295 territories) are classed as either Low Threat or Not Threatened. This represents only about 26% of the area covered by the 1,702 territories, so the smaller territories are less threatened.
- Relatively few – 32 or nearly 2% of all territories – were identified as being Extremely Critically Endangered, Critically Endangered or Endangered. However together these have a coverage of only 313,775 hectares. **After more study these could be a priority for reducing deforestation and demonstrating improvements**.
- However 22% (375) of the territories were either Vulnerable or Threatened. This is more significant when we consider the size of the territories. The area of the territories in these two categories is almost 150 million hectares, or 74% of the total area covered by territories, with 126 being classed as Vulnerable but covering 54% of the total area of territories in the biome. These areas reflect where more emerging threats are found, rather than those areas with historically low levels of deforestation, and therefore they could be considered the highest priority to further investigate and potentially prioritize for investment.

INDIGENOUS TERRITORIES ARE IMPORTANT FOR CURBING DEFORESTATION

The map below illustrates these results spatially.

MAP – Indigenous territories with combined threat criteria.

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- As expected, most territories have a good status (L and N), but this is not reflected in their area coverage. The territories that are most vulnerable seem to be either in the current arc of deforestation, which is not surprising, or they are trans-boundary territories. It must be remembered that although these territories are vulnerable to emerging threats, they still have low levels of deforestation occurring in them. There is also a northern strip of territories on this map that may be prioritized for further investigation and be considered a priority for reducing deforestation through results-based improvement schemes.

Indigenous territories are an important asset in curbing deforestation so more needs to be done to increase their effectiveness where they are shown to be under pressure from current deforestation and future pressures. We have demonstrated here that a combined IUCN assessment approach can offer a way to prioritize the sites for further study to understand the causes, and can offer opportunities for further investment in ways that can address the causes of deforestation.

5.3 Prioritizing protected areas

A similar analysis for the 439 protected areas covering 194,570,686 hectares of the biome has found that, in general, they have good habitat coverage and have very low values of deforestation when compared to the rest of the biome, but slightly higher than those for indigenous territories as the general data illustrates below. This is similar to previous studies.[68] The following table illustrates the basic results.

Table 10: Summary of deforestation data for protected areas in the biome

Country	Total number of territories analysed	Proportion of the total area deforested, 2013	Overall deforestation 2000-2013 (ha)	Proportion of the 2000-2013 deforestation occurring in 2010-2013	Rate of deforestation (r) for 2000-2013 %	Rate of deforestation (r) for 2010-2013 %	Annual deforestation for 2010-2013 (ha/year)
Bolivia	47	3.8%	112,095	20%	-0.091	-0.078	156
Brazil	247	3.6%	1,242,381	9%	-0.094	-0.036	148
Colombia	30	1.5%	47,577	18%	-0.040	-0.031	95
Ecuador	17	5.6%	47,523	14%	-0.129	-0.078	128
French Guiana	15	0.7%	16,362	67%	-0.030	-0.086	242
Guyana	6	0.5%	1,964	83%	-0.009	-0.031	91
Peru	45	1.0%	33,035	13%	-0.013	-0.008	32
Suriname	13	0.9%	2,608	62%	-0.011	-0.029	41
Venezuela	19	2.5%	134,859	29%	-0.039	-0.050	692
Total	**439**		**1,638,405**				
Average value		**2.95%**	**3,732**	**12%**	**-0.072**	**-0.039**	**155**

- The largest proportion of protected areas is in Brazil (50%), but Bolivia and Peru each have about 10% of the total. They tend to be larger in size than indigenous territories: areas can range from about 4 million hectares (largest protected areas in Brazil and Venezuela), down to less than 1,000 hectares.
- On average protected areas in the biome have 2.95% of their area deforested, which is slightly higher than for indigenous territories, but still low. The proportion of this occurring more recently, in 2010-2013, is only 12%. This suggests protected areas are under less pressure than the indigenous territories, whose proportion of deforestation increased for the same period.
- Ecuador has the highest proportion of its protected areas deforested, although Guyana, French Guiana and Suriname have a higher proportion of the 13-year deforestation occurring between 2010-2013. The deforestation in Venezuelan and Brazilian protected areas contributes most to the total 1.6 million hectares of deforestation.
- The average deforestation rate for protected areas is low at 0.072%, and the deforestation rate for the 2010-2013 period is lower still, but there are exceptions; protected areas in French Guiana and Venezuela have an average deforestation rate that is increasing and above the average for protected areas during this three-year period (2010-2013).
- The average annual forest loss is 155 hectares per year during 2010-2013 for protected areas in the biome; those in Venezuela, French Guiana and Bolivia all have average annual rates higher than this figure. This may suggest there is more pressure on the protected areas in these places than those overall in the biome.

The data table shows that the protected area network for the biome has some weaknesses; however, we need a better understanding of these vulnerabilities. The ecosystem status approach was applied to understand the deforestation threats in the protected area network. The IUCN ecosystem assessment approach was used in combination with other deforestation trend criteria to understand historical and emerging threats inside protected areas. The results are shown in the table below. The values for the IUCN status criteria are based on the percentage of natural cover threshold (e.g. 35%, 50%, 80%, 99.5%). The trigger values for the three other deforestation criteria used in combination with the IUCN assessment are similar to those used before, but based on the average values for the protected areas (i.e. 50% of the mean average value, see Annex 1).

The other deforestation criteria are triggered for a protected area if:

1. The overall forest lost between 2000-2013 is greater than 1,866 hectares;
2. The annual forest loss between 2010-2013 is more than 78 hectares per year; or
3. There is an increasing deforestation trend between the two most recent study periods (between 2005-2010 and 2010-2013).

The trigger values chosen for these complementary criteria are based on half of the mean average values for the criteria. On average these values show more forest loss in protected areas than in indigenous territories. This confirms other studies.[69]

What do these trigger values mean? The trigger value for the annual deforestation rate in protected areas is equivalent to 156 families opening half a hectare each for farming each year. During the 13-year period, their total area deforested for farm production would be less than 12 hectares per family, to give a total of 1,866 hectares. This level of farm is typical for tapioca flour production or small-scale cattle ranching. So although these still represent subsistence farming values, their larger size would allow for commercialization of production. Again values are used and not percentages because we are interested in identifying pockets in the protected areas where there may be concentrations of deforestation, both historical and emerging.

The following table summarizes the combined result of applying the IUCN status assessment approach with the three other deforestation criteria to create six categories of threat. It is the same as that presented for indigenous territories in table 8.

IUCN ecosystem status category (LC, NT, VU, EN, CR – see annex for definitions)				Combined threat status	
No other criteria	1 other criterion passed	2 other criteria passed	3 other criteria passed		
LC 0				Not Threatened	N
LC 0/NT 0	LC 1/ NT 1			Low Threat	L
VU 0	VU 1	LC 2/NT 2		Threatened	T
		VU 2	LC 3/NT 3	Vulnerable	V
EN 0	EN 1	EN 2	VU 3	Endangered	E
CR 0	CR 1	CR 1	EN 3	Critically Endangered	CE
			CR 3	Extremely Critically Endangered	XCE

Table 11: Number of protected areas in the biome that meet threat status limits and trigger the three other criteria.

Threat status defined by combining IUCN ecosystem status and 3 other threat criteria	Number of territories per category	Proportion of the total number of territories	Area of territories with this category (hectares)	Portion of the area coverage with this category
Extremely Critically Endangered	3	0.7%	760,343	0.39%
Critically Endangered	11	2.5%	36,416	0.02%
Endangered	9	2.1%	1,808,568	0.93%
Vulnerable	37	8.5%	46,150,874	23.7%
Threatened	95	21.7%	63,964,851	32.9%
Low Threat	177	40.5%	52,802,483	27.1%
Not Threatened	105	24.%	29,047,151	14.9%
Total	**437**		**194,570,686**	

2 Brazilian PAs had insufficient habitat data to establish overall threat status.

- In general 64% of protected areas (282) are found to be classed as either Low Threat or Not Threatened; this represents about 42% of the area coverage or about 82 million hectares, which is very good news. However nearly 3% can be considered as being Critically Endangered, and 2% Endangered.

- Of the 23 protected areas that are either Extremely Critically Endangered, Critically Endangered or Endangered, this covers a total area of just over 1.3%. Further study is required and urgent action needed to understand the causes of deforestation in these areas.
- There are 132 protected areas that have either Vulnerable or Threatened status. Although this only represents 30% of protected areas, these cover 57% of the total area, which means that an area the equivalent of Bolivia is under potentially significant emerging deforestation threats. Those that are Vulnerable, 37, cover 24% of the total area. This group of protected areas are a high priority in terms of understanding the causes, seeking to address them, and showing improvements. These would also be ideal areas to demonstrate improvements in management as part of results-based payment schemes or REDD+.

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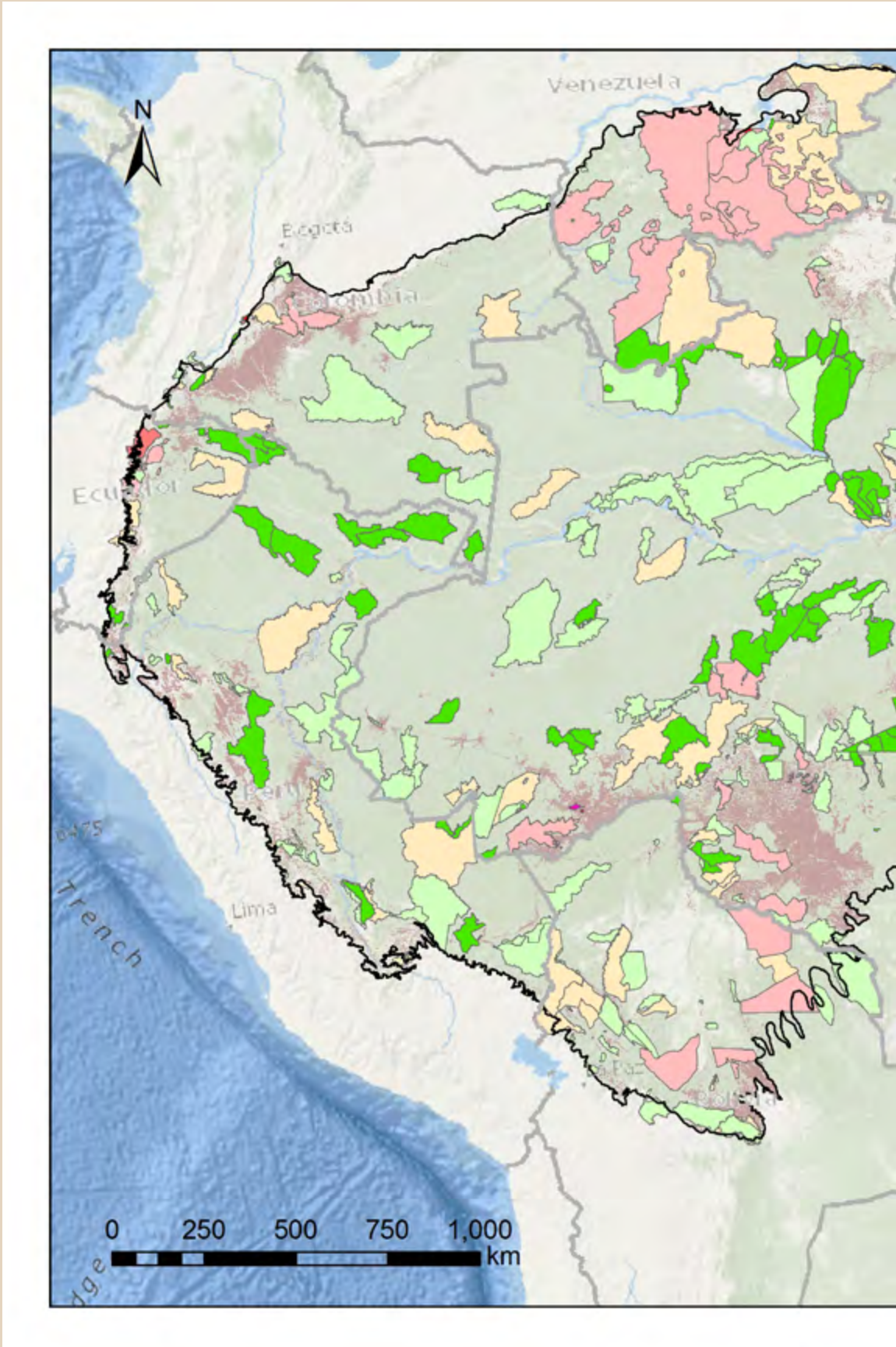
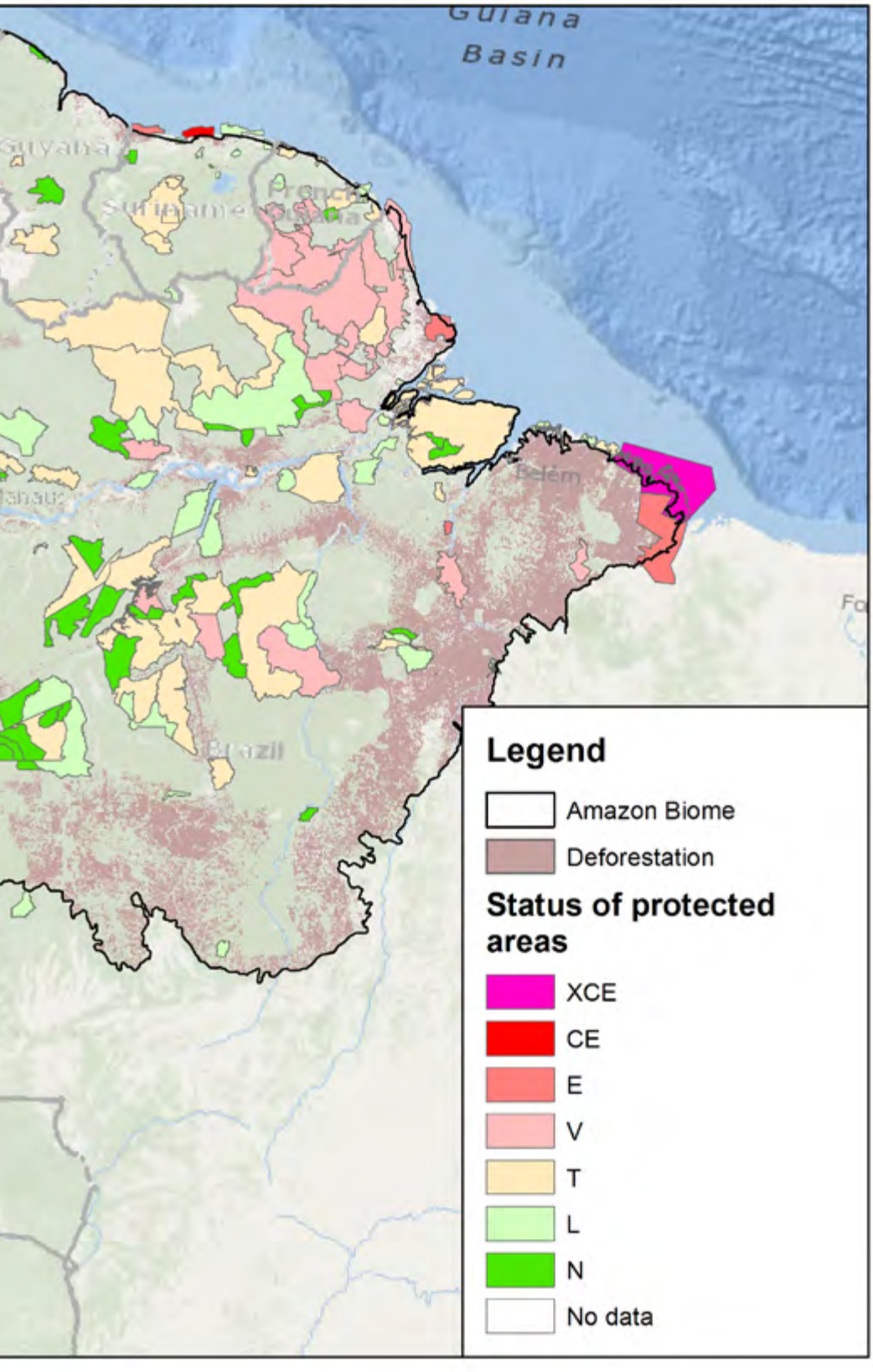
- Steps need to be taken to restore degraded ecosystems, and/or monitor more closely the impact of activities inside and surrounding protected areas to increase protection efforts.
- There seem to be a spatial cluster of protected areas (see the map below) where deforestation is more of a threat: those located in the arc of deforestation are not a surprise, but there are several in trans-boundary zones where more recent threats seem to be emerging.

The real value of protected areas comes when they operate as a network, providing connectivity and a critical refuge for wildlife in future climate change scenarios.[70] It is also clear that as a key biodiversity asset the protected area and indigenous territory network needs to be regularly assessed to see where emerging threats are to be found, and to assess whether these will persist in the future. The following section seeks to understand more broadly what potential future drivers of deforestation may be on the horizon and how they may impact on protected areas and indigenous territories.

The map below illustrates these results spatially.

MAP – Protected Areas with combined threat criteria.




Guiana
Basin
Belém
Brazil
Legend
Amazon Biome
Deforestation
Status of protected areas
XCE
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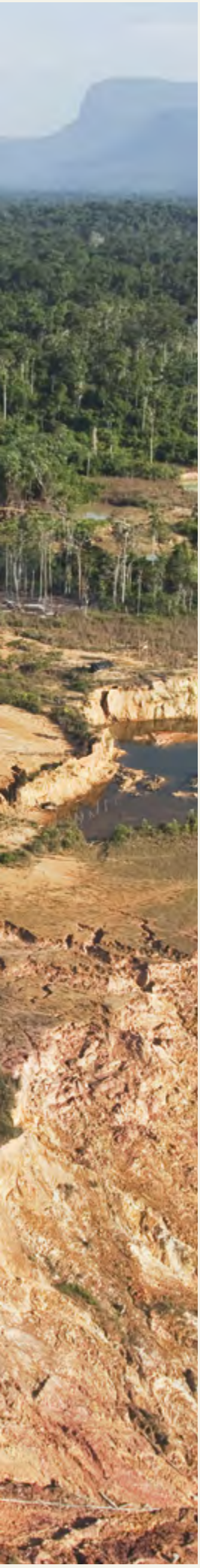

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Section 6

6.1 Anticipated future deforestation trends

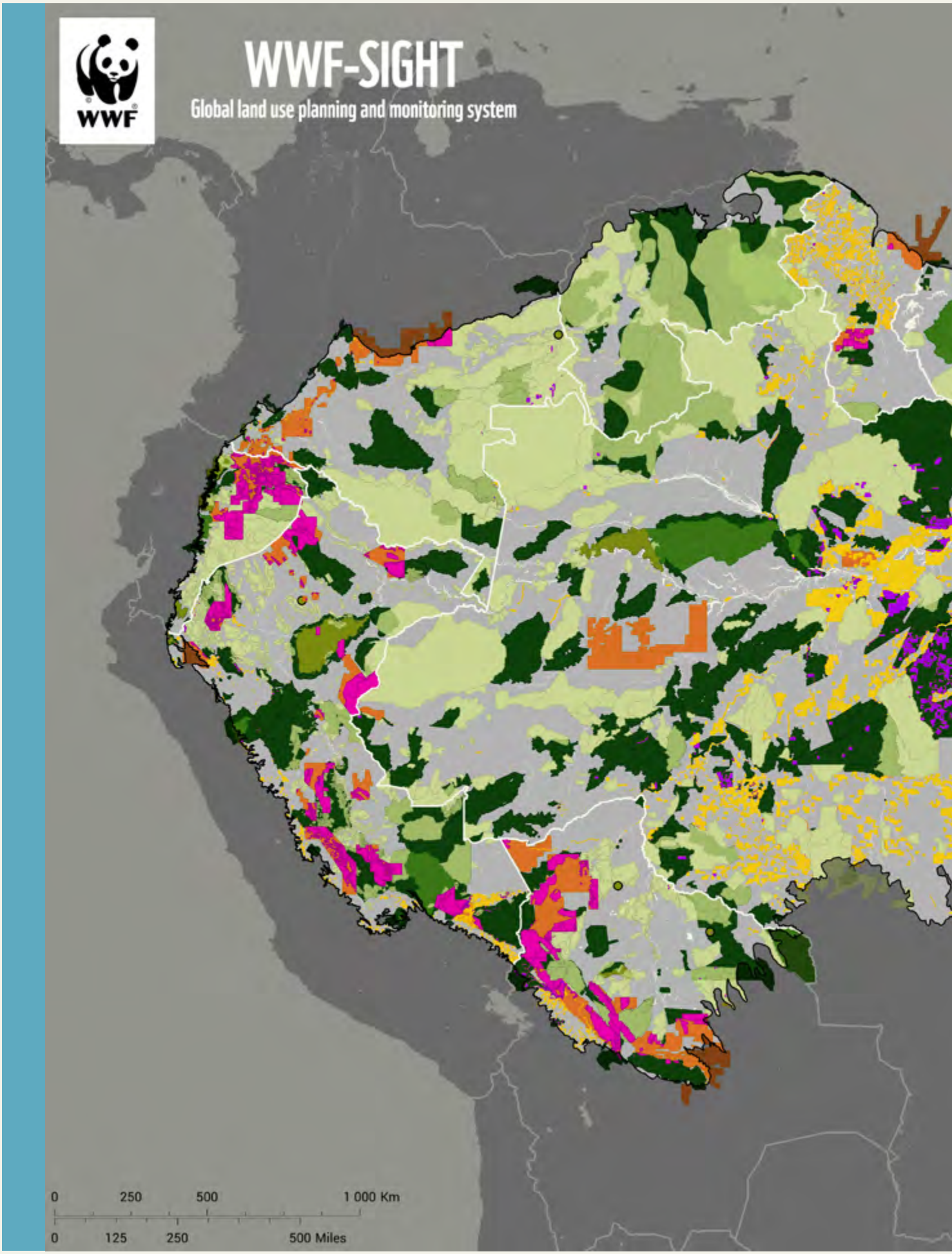
The previous sections have confirmed that over the last decade there has been an important reduction in the rate of deforestation across parts of the Amazon region, but deforestation and forest degradation continues at an alarming rate, threatening to overturn key gains that have been made. We need to understand the likelihood that the downward trend for the biome overall will continue. Or are there potential future threats that could tip the balance or even reverse this trend? We therefore seek to assess the potential future threats from three key sectors: extractives (oil and gas and mining), dam development and linear infrastructure.

6.2 Extractives

An analysis of key industry data sets shows there has been an explosion of extractive claims in South America – and the Amazon has not been spared.[71] In the first quarter of 2016 alone there were both oil spills threatening Peruvian wetlands and rivers and illegal gold mining invading protected areas.[72] Reports have illustrated the high risks associated with these two industries and their potential social and environmental impacts when things go wrong.[73] Even without these catastrophic impacts this sector requires linear infrastructure developments and settlements, and has a high demand for energy (often provided by large hydro-power projects).[74] Widespread small-scale artisanal gold mining by individuals and collectives also contributes to deforestation, as well as causing other ecological damage across the biome. Although the number of contracts and claims granted per year has slowed, the area under potential threat is significant.[75]

Even well-managed mines clear forests; they create tailings of mine residues, and open areas for other uses through creating a road and energy network. Poorly-managed and illegal mining can create devastation, including the release of toxic chemicals like mercury.[76] A recent study [77] found that between 2001 and 2013, tropical forests covering 168,000 hectares in Latin America were cleared for gold mines, some of which are illegal. The proliferation of gold mining in many areas of Latin America is seen as accelerating deforestation across the region, and through this threatening biodiversity.[78]

The impacts of these sectors can be slow to develop, but are often persistent or irreversible. And when permits for future extraction are taken into account, the scale of their coverage of the biome – including particularly vulnerable areas – is of great concern. It is starkly illustrated in the graphic below – although not all the areas claimed or under concessions would be mined, the map shows the blocks where resource exploration is permitted.


WWF-SIGHT
Global land use planning and monitoring system
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125
250
500 Miles

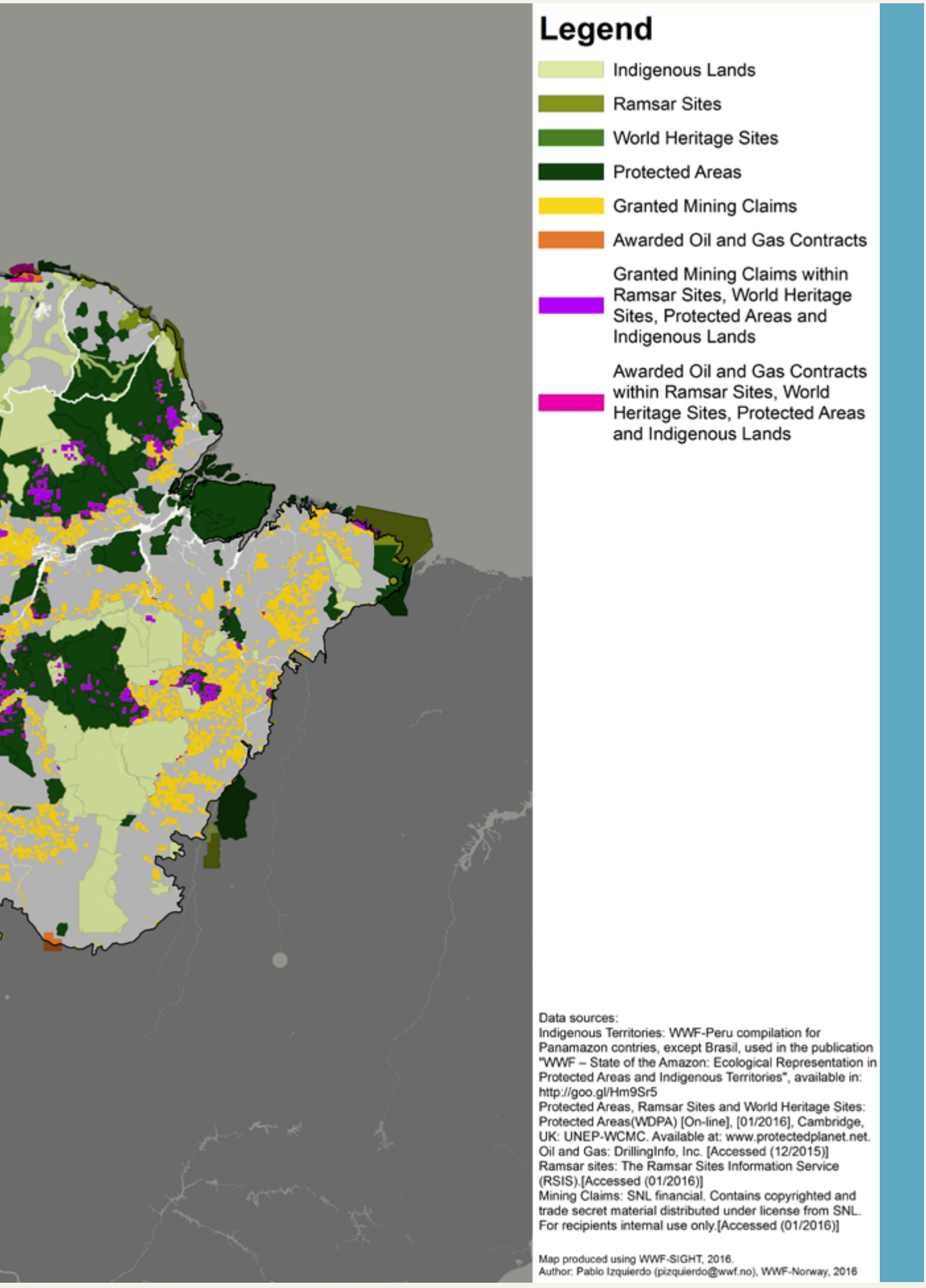
Legend
Indigenous Lands
Ramsar Sites
World Heritage Sites
Protected Areas
Granted Mining Claims
Awarded Oil and Gas Contracts
Granted Mining Claims within Ramsar Sites, World Heritage Sites, Protected Areas and Indigenous Lands
Awarded Oil and Gas Contracts within Ramsar Sites, World Heritage Sites, Protected Areas and Indigenous Lands
Data sources:
Indigenous Territories: WWF-Peru compilation for Panamazon contries, except Brasil, used in the publication "WWF – State of the Amazon: Ecological Representation in Protected Areas and Indigenous Territories", available in: http://goo.gl/Hm9Sr5
Protected Areas, Ramsar Sites and World Heritage Sites: Protected Areas(WDPA) [On-line], [01/2016], Cambridge, UK: UNEP-WCMC. Available at: www.protectedplanet.net.
Oil and Gas: DrillingInfo, Inc. [Accessed (12/2015)]
Ramsar sites: The Ramsar Sites Information Service (RSIS).[Accessed (01/2016)]
Mining Claims: SNL financial. Contains copyrighted and trade secret material distributed under license from SNL. For recipients internal use only.[Accessed (01/2016)]
Map produced using WWF-SIGHT, 2016.
Author: Pablo Izquierdo (pizquierdo@wwf.no), WWF-Norway, 2016

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Table 12: Summary of mining, oil and gas contracts overlapping with protected areas and indigenous territories

Combined data for all extractives	All extractives claims and contracts applied and granted	All extractives claims and contracts only granted		All extractives claims and contracts applied and granted	All extractives – maximum potential impact	
	Totals for applications and granted contracts for extractives (mining and O&G) that overlap with protected areas	Granted extractives that overlap with protected areas	Granted extractives that overlap with indigenous territories	Totals for applications and granted contracts for extractives (mining and O&G) that overlap with indigenous territories	Total extractive contracts, granted that overlap with both PAs and ITs	Totals for applications and granted contracts for extractives (mining and oil & gas) that overlap either with PAs or ITs
No. of licences that overlap	7,520	1,843	545	4,703	2,388	12,223
No. of impacts – number of times a licence overlaps	8,940	2,103	1,103	5,841	3,206	14,781
No. of companies with these concessions or contracts	1,454	830	327	767	NA	NA
Areas of potential impact (overlap) on either unit (ha)	59,248,373	15,285,372	9,479,082	44,416,468	24,764,454	103,664,841
Area coverage of concession in the biome (ha)	65,313,537	9,883,595	25,044,751	73,471,449	34,928,345	138,784,986
Area impact as % of total area for units	30.5%	7.9%	4.7%	22.0%	NA	15.4%
Area coverage % of total biome	9.7%	1.5%	3.7%	10.9%	5.2%	20.7%

Summary tables are presented in Annex 1 showing mining and oil and gas separately – these have been combined in table 12.

The following points are of interest:

- 20 % of the Amazon biome is potentially covered by claims and contracts from the extractives industry, with 15% of the area of the protected area and indigenous territories network being potentially affected by these claims. Most of this will not be realized, but it is a potential risk.
- Over 800 mining and fossil fuel companies have already been granted contracts in protected areas, and approximately 5,700 contracts are under application that impact 6,800 times; meaning that of 439 protected areas, 44% are being overlapped partially or completely by mining claims, and 16% by exploration contracts for oil and gas.
- In addition, of the 1,702 indigenous territories, 30% are potentially affected by 106 granted oil and gas contracts as well as 439 granted mining contracts. Approximately another 4,100 contracts are under application. However, not all of these will come to fruition as there is a significant drop between applications and granted concessions and contracts, as seen in the data tables in Annex 1.
- Overall, the Amazon has over 2,300 granted extractives claims and contracts, which overlap and potentially impact up to 25 million hectares (with mining overlapping 7.5 million hectares of protected areas and indigenous territories, and oil and gas overlapping 17 million hectares).
- In terms of area this impacts almost 8% of the protected area and 5% of the indigenous territories network.
- If applications for both mining and oil and gas are also considered the area of potential impact through overlapping licences could be as much as 30% of protected areas and 22% of indigenous territories at risk.

The large majority of mining contracts are in Brazil but there is potential for other countries to expand. **However, most granted claims are for exploration and many, probably most, will not lead to extraction. In Brazil, ruling 525 states that all mining claims made after 2010 are invalid, but so far this ruling has not had any impact on applications being granted nor resulted in any cancellations** (see Annex 1 for details). There are also moves to amend the current Brazilian mining code and allow mining in indigenous territories.

The following table summarises the distribution of the threats from the extractives sector in the biome on both protected areas and indigenous territories. The area of overlap is where a concession claim or contract overlaps and encroaches on the protected area or indigenous territory by a standard amount.[79] An ‘overlap impact’ is the sum of the times the same claim encroaches on the territory or protected area more than once. For example, one claim can overlap the same protected area say five different times, by five different-sized areas. Its total overlap impact is the sum of the five areas that overlapped on the one protected area.

Table 13a: Summary data of mining and oil and gas contracts in Amazon indigenous territories

	Granted and active mining concessions that overlap with indigenous territories						Granted and active oil and gas contracts that overlap with indigenous territories (excluding those stopped)					
Indigenous territories	**No. of territories affected**	**% no. of territories affected**	**No. of active companies**	**No. of granted and active mining**	**Total no. of times mining affects the ITs**	**Total area of the IT potentially affected (ha)**	**No. of territories affected**	**% no. of IT affected**	**No. of active contracts**	**No. of companies with contracts**	**Total no. of times O&G affects the ITs**	**Total area of the ITs potentially affected by O&G contracts (ha)**
Bolivia	16	0.9%	98	117	120	55,099	50	2.9%	15	2	60	2,269,560
Brazil	31	1.8%	49	98	100	459,980	1	0.1%	1	1	1	595
Colombia	8	0.5%	17	33	38	74,906	17	1.0%	16	10	22	276,854
Ecuador	3	0.2%	3	3	3	857.5	79	4.6%	51	19	173	2,228,468
Guyana	11	0.6%	20	49	49	19,069	18	1.1%	2	2	18	327,528
Peru	36	2.1%	92	136	144	41,208.5	345	20%	21	17	363	3,625,009
Suriname	0	0%			0	0	4	0.2%	4	1	7	98,931
Venezuela	2	0.1%	3	5	5	1,018	0	0%	0			
Total	**107**	**6.3%**	**281**	**439**	**459**	**652,137**	**514**	**30%**	**106**	**46**	**644**	**8,826,944.5**
Several overlap in multiple countries												

Although we are able to show the potential area impacted by both mining concessions and oil and gas contracts, it is the informal and illegal mining sector that often has the highest impact. Concessions held by cooperatives are the most likely areas where the informal sector start production, as the cooperatives have less resources to control mining activities and are set up to bring together individual miners for marketing. The same data analysis identified that 63 cooperatives have granted mining concessions covering an area of 35,270 hectares, and that overlap with 87 indigenous territories by 24,751 hectares; most of these are for gold mining. Mining from the informal sector can become illegal small-scale mining if production activities start to encroach on either protected areas (for example Madre de Dios in Peru) or concessions for tourism or other legal land designations where they have no permission.

Table 13b: Summary data of mining and oil and gas contracts in Amazon protected areas

	Granted and active mining concessions that overlap with protected areas						Granted and active oil and gas contracts that overlap with protected areas (excluding those stopped)					
Protected areas	**No. of PAs affected**	**% no. of territories affected**	**No. of active companies**	**No. concessions granted**	**Total no. of times mining affects PAs**	**Total area of the PAs potentially affected (ha)**	**No. of PAs affected**	**% no. of PAs affected**	**No. of active contracts**	**No. of companies with contracts**	**Total no. of times O&G affects the PAs**	**Total area of the PAs potentially affected by O&G contracts (ha)**
Bolivia	18	4%	165	193	226	104,896	24	5.5%	15	2	33	2,602,892
Brazil	155	35%	451	1327	1491	6,626,583	1	0.2%	1	1	1	2,375
Colombia	2	0.5%	2	3	3	3,701	4	0.9%	4	4	4	4,205
Ecuador	0	0%					5	1.1%	17	6	21	660,843
Guyana	1	0.2%	2	6	6	2,421	1	0.2%	1	1	1	94,244
Peru	18	4%	185	256	259	75,430	33	7.5%	19	15	52	5,006,036
Suriname	0	0%					2	0.5%	3	1	4	101,304
Venezuela	1	0.2%	2	2	2	440	0	00%	0	0	0	
Total	**195**	**44%**	**807**	**1787**	**1987**	**6,813,471**	**70**	**16%**	**56**	**23**	**116**	**8,471,900**

Several overlap in multiple countries

- Both in terms of numbers and area, the extractives sector has a significant impact on indigenous territories, more so than for protected areas. However mining potentially impacts 44% of protected areas as opposed to 6% of indigenous territories, so there is great pressure on the protected area network from mining. The reverse is true for oil and gas, which potentially impacts 30% of indigenous territories.

PROTECTED AREAS IN BOLIVIA AND PERU ARE MOST LIKELY TO BE AFFECTED BY OIL AND GAS CONTRACTS.

- Although mining in Brazil potentially impacts most on indigenous territories, oil and gas in Peru is also a significant threat. Whereas mining is potentially impacting most on Brazilian protected areas, this should be significantly reduced if ruling 525 is implemented (see Annex 1). Protected areas in Bolivia and Peru are most likely to be affected by oil and gas contracts.

From the data, for protected areas at least, we can identify the specific names of some well-known protected areas that could be impacted. So far only 329 sites are at the active mining stage, impacting 32 protected areas and 35 indigenous territories; whereas 87 sites are producing oil and gas, affecting 12 protected areas and 59 indigenous territories.

Table 14: Examples of some protected areas affected by mining and oil and gas contracts

	Examples of protected areas impacted by granted concessions and contracts			
Bolivia	Madidi is affected by 41 mining concessions and two O&G contracts		Manuripi is affected by one mining concession and one O&G contract	
Brazil	Amapa is affected by 112 mining concessions	Tapajos is affected by 215 mining concessions	Serra do Divisor is affected by one mining concession and one O&G contract	
Colombia	Rio Mocoa is affected by two mining concessions		La Paya is affected by one O&G contract	
Ecuador	Yasuni is affected by 10 O&G contracts		Limoncocha is affected by one O&G contract	
Guyana	Kanuku Mountains is affected by six mining and one O&G contracts			
Peru	Amarakaeri is affected by 108 mining concessions and one O&G contract	Rio Abiseo is affected by 16 mining concessions	Manu is affected by two O&G contracts	Pacaya Samira is affected by two O&G contracts
Suriname	Noord Saramaca is affected by three O&G contracts			
Venezuela	Imataca is affected by two mining concessions			

Hydrocarbon operations are significant, 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;[80] and exploration in Putumayo (Colombia), Madidi (Bolivia) and Amazonas (Brazil). [81] Mining and oil companies know that protected area status is often no block to their operations.[82] Stronger controls and best practice [83] are both urgently needed.

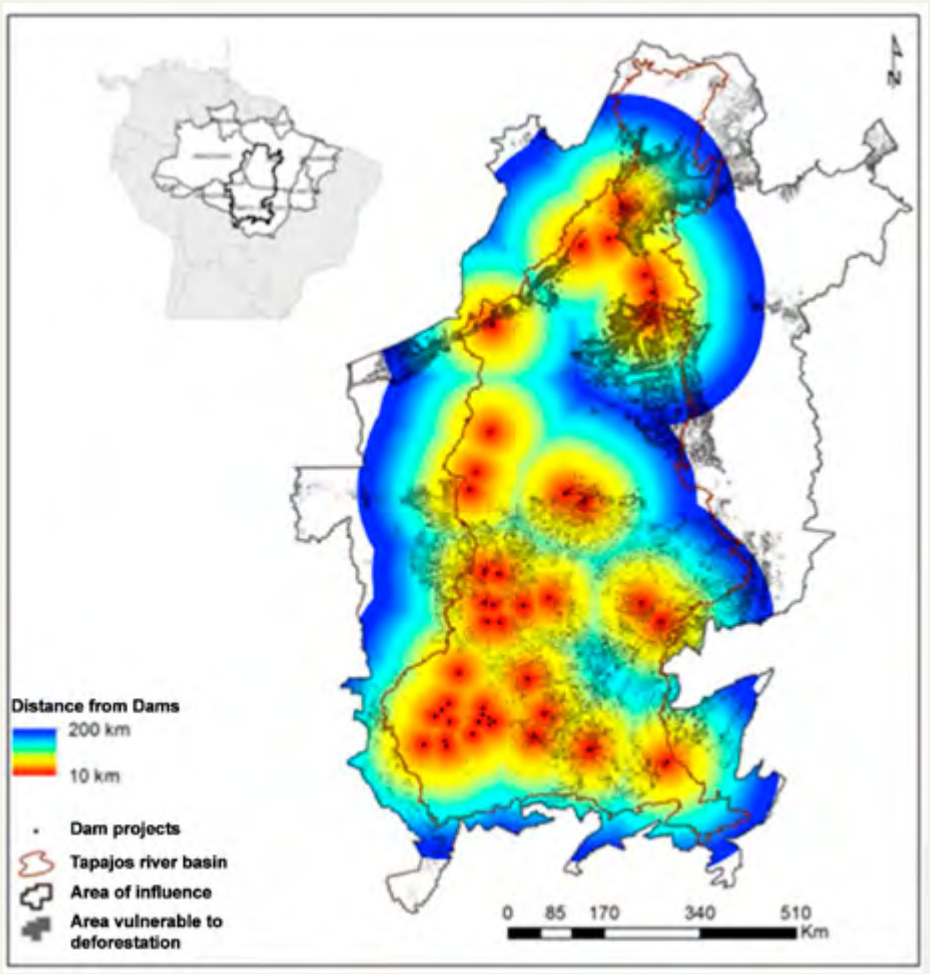
Nonetheless, operators show a tendency to disregard national and international protection designations as the summary here shows (the details are presented in the Annex).

- Of 16 Ramsar sites in the biome or on the coast and dependent on sediments from the biome, 30% are affected; two of the Brazilian sites together have 28 mining claims from 10 companies mainly mining for gold.
- Additionally, Ramsar sites in Ecuador, Peru and Suriname have oil concessions: in Ecuador and Peru these concession cover 100% of the Rasmar sites in these countries.
- Over a quarter of a million hectares of World Heritage Sites could be potentially under threat from extractives-related development: five of these sites – in Bolivia, Brazil, Peru and Venezuela – together have 77 claims from 22 companies covering a range of activities from sand dredging to diamond mining (although most only

marginally overlap in two World Heritage Sites and are active in the buffer zones of four other sites). In practice it's unlikely that all of these areas would be affected by the two industries, but the potential threat is still there.

6.3 Dams

The extractive sectors require constant power, and they are largely responsible for the high number of planned dams across the biome. A recent case study by IPAM on the Tapajos river basin suggests that much of the Brazilian 10 year energy plan is designed to deliver energy for the extractive sector.[84] The study also assessed the deforestation potential associated with dam development, identifying a radius of 50 to 200km resulting in approximately 4,000 to 10,000 hectares from the dam that seemed to show a high vulnerability to deforestation.



Map showing the radius of deforestation impacts from Dams

Studies using Amazon deforestation models[85] show the deforestation in 2030 resulting from the dams in the Tapajos river basin. This uses a conservative deforestation rate but one that considers the additional effect of roads and settlements: it projects 272,536 hectares of deforestation per year from 2014 to 2030. The study suggests that dams alone could increase the area deforested in this watershed by more than 20% compared to levels in 2013.

In crude terms if this model was applied to all dams and we consider the number of dams already in the Amazon (154) and those being constructed or being planned (298), the potential area impacted from dams alone could range from 1.8 million hectares to 5.4 million hectares[viii]. These dams dominate particular river basins like the Tapajos, Xingu, Marañon and Madeira, all of which are already threatened by other deforestation pressures. However not all of these dams will be built as planed, for example in 2015 and 2016 Brazil dropped three of its planned dams from the Tapajos river basin in its 10 year energy plan.[86]

6.4 Linear infrastructure

Linear infrastructure will also have a major impact, both as a support to other developments and in its own right. This includes both road and rail plans for the region. Deforestation associated with road construction in the Amazon is well documented. A recent study[87] showed that:

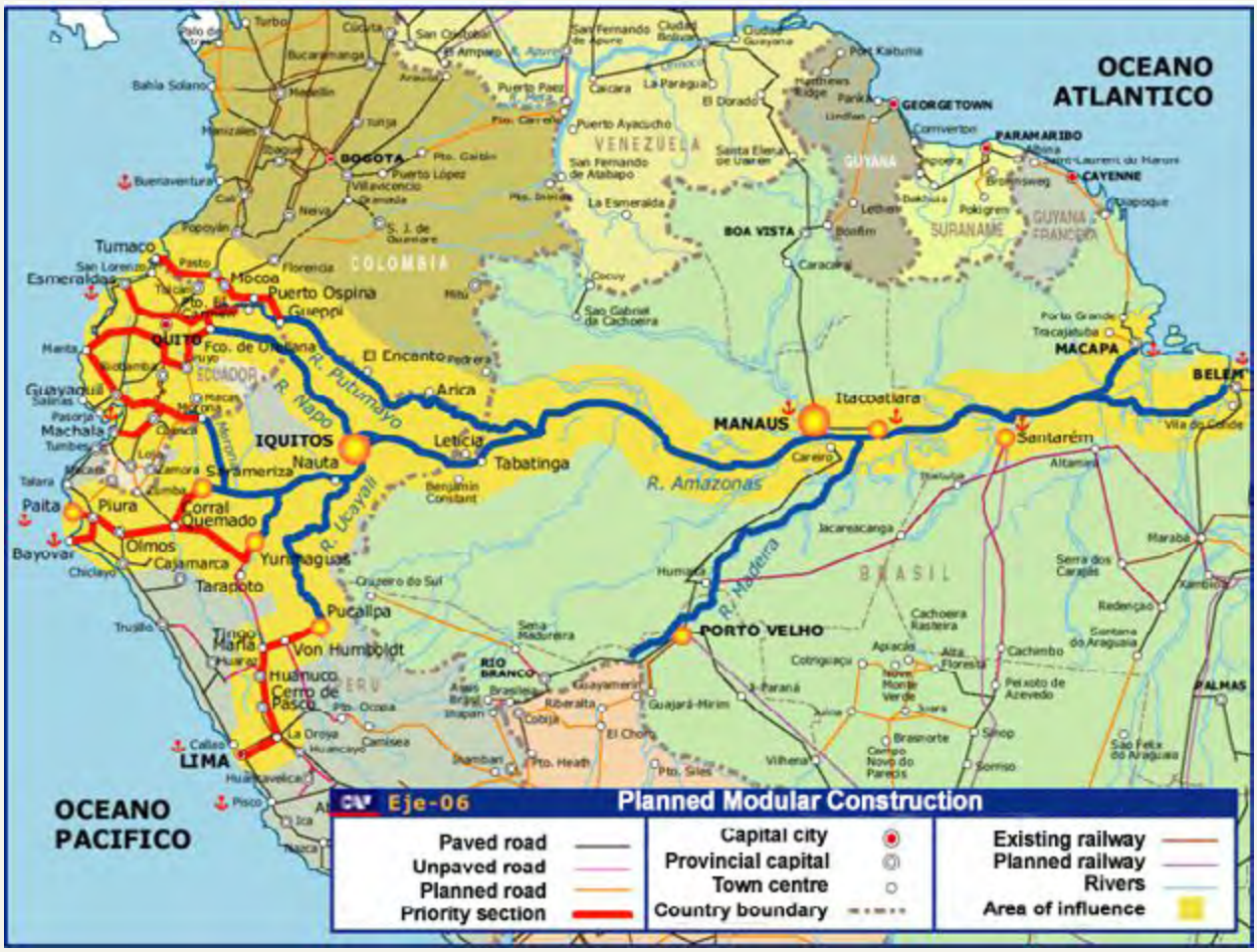
- 95% of deforestation was within 5.5km of a road or 1km of a navigable river; and
- 35.2% of the Brazilian Amazon was highly accessible by river or road.

The same study also suggested that accessibility to protected areas determined how well they were able to curb deforestation. The study estimated that in the Brazil Amazon alone the road and highway network is over 264,068 km, with 72% as unofficial roads (dirt) and 8.6 % as highways. The unofficial network of roads may cause further degradation and fragmentation affects in areas that are not necessarily being picked up by remote sensing images used by governments (e.g. Landsat); while the fishbone affect of official roads can be observed in Google Earth images.

Example of fishbone affect along the Trans-Amazonian highway (BR 230) in Brazil

Plans for further development of the existing network are concerning, as the integrated infrastructure plan for the Amazon below shows.

viii Assuming an area of impact of 12,000 hectares per dam that radiates out from the centre of the dam.



Source: FOBOMADE, Regional integration initiatives, IIRSA, June 2009.

Meanwhile in 2015 it was announced that a 5,300km railway, supported by the Chinese government, would link São Paulo with Lima and other Andean cities.[88] The impacts of this are still not clear but it will need to be considered as it may drive future deforestation.

Future deforestation trends will depend on these factors, along with the others illustrated below in the infographic.

DEFORESTATION PRESSURES – AMAZON[ix]

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

Pasture and **cattle ranching**,[89] specifically farm gate beef and dairy, is the dominant cause in many areas[90] and is also used as a facade for land speculation.

Expansion of **mechanized agriculture**, particularly for animal feed[91] and biofuels,[92] using soy,[93] oil palm[94] and also corn, is a key cause, with increased production linked to subsidized resettlements.[95] Indirect land use change can be significant,[96] e.g. if soy replacing pasture[97] results in cattle rearing moving into natural forest.[98]

Small-scale agriculture is expanding in regions such as northern and eastern Bolivia,[99] Colombia, Ecuador and the Guianas, driven by pressure for land and problems of control.

ix Updated from source: WWF Living forest report, chapter 5, 2014, WWF international, page 20.

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.[100] There are 154 constructed dams, and another 298 either under construction or planned in the Amazon biome.[101] Dam impacts often overlap with protected areas and indigenous territories.

Roads give access to remote areas bringing people and land speculation inwards. The fronts showing the greatest deforestation rates are areas with more roads, showing a strong correlation between deforestation and the presence of roads and projections of new roads. Nearly 95% of deforestation in the Brazil Amazon was found to be within 5.5km of roads and 1km of navigable rivers.[102]

Forest fires due to poorly controlled burning for land clearance are a contributing factor to both deforestation and forest degradation.[103] These are likely to increase due to the impact of climate change.

Mining is significant in places[104] such as Peru, where **gold mining** has increased by 400% since 1999.[105] **Artisanal mining** is also significant. **Oil and gas exploration** can impact larger areas than the drill site. Road development accompanies dams, mines, oil and gas drilling, where it often deepens deforestation.

Unsustainable legal and illegal timber trade contributes to forest degradation and is generally underestimated.[106]

6.5 Projected future deforestation

It is hardly surprising that trends analysed in 2006 and 2008 have suggested that anything from 100 to 300 million hectares of the Amazon rainforest could be at risk, but estimates of the loss vary widely and do not account for recent policy advances nor these more recent threats discussed above. Various projections for the Brazil Amazon give 25% loss by 2020;[107] 55% of the Brazil Amazon affected by 2030, with 31% suffering deforestation and 24% damaged by drought;[108] and 40% loss by 2050. [109] The most significant projections for the Amazon biome were those of Soares et al in 2006, which predicted a 40% forest loss in the Amazon by 2050 using the Dinamica model – however there are now significant differences in the policy context and threats since 2006.

It is not known at what point the Amazon will lose functionality and a collapse of the ecosystem might be triggered. Although there is merit in re-running a more sophisticated deforestation model, there is also value in assessing, even in basic terms, whether we are heading towards the Soares et al [110] future of significant loss as highlighted above, or whether the direction of travel is closer to the more sustainable future.

Using linear projections from the MODIS data three future deforestation cases were considered: case 1 which takes the recent annual deforestation for 2010-2013; case 2 which takes the eight-year average annual deforestation rate for 2005-2013; and finally case 3 which takes the worst annual deforestation rate per year over the 13-year period for each country and projects that into the future. The results are presented below.

Table 15: Regional projections of deforestation based on extrapolation from MODIS data (2000-2013)

WWF analysis using MODIS (2000-2013)	2030 projections in terms of % area of the biome	Projected deforestation from 2000-2030 in terms of total area lost in hectares	Projected deforestation from 2010-2030 in terms of total area lost in hectares	Projected deforestation from 2000-2050 in terms of total area lost in hectares	2050 projections in terms of % area of the biome
Case 1 (latest rate of deforestation 2010-2013)	21%	44.2 million	21.7 million	64.5 million	24%
Case 2 (eight-year average rate of deforestation 2005-2013)	21.6%	48.4 million	25.8 million	73.5 million	25%
Case 3 (worst case for each country used)	27.1%	85.4 million	62.9 million	154.2 million	37%

- Case 1, using the latest 2010-2013 deforestation rate, suggests that 21% of the Amazon biome may be gone by 2030 – although Brazil has significantly curbed its deforestation rates between 2013 and 2015 so this figure could be an overestimation. However, this same projection suggests there will be approximately 44 million hectares of forest lost, which is still a substantial amount of forest cover.
- Case 2 uses an eight-year average from 2005-2013 and suggests that by 2030 almost 22% of the Amazon will not be covered by forests and 25% by 2050. This is similar to current WWF estimates.[111] The 30-year area loss is equivalent to losing an area the size of Cameroon.
- Case 3 gives results that are reaching those predicted by the Soares et al (2006) model for 2050.[112] This scenario predicts that 27% of the biome would be without forest cover by 2030, totalling 85.4 million hectares, of which almost 15% would be due to new deforestation. The remaining 12% would be due to water bodies, other natural ecosystems and historical habitat conversion in a similar way as seen in the land-cover analysis.

These values would cause concern if left unchecked, deforestation could have significant impact on the climate regulation functionality of the forest biome. Given some of the potential impacts considered by three sectors discussed above, the worst case is a possibility – unless development becomes more responsible and values the protected areas and indigenous territories network as a natural capital asset.

Policies to curb deforestation trends – along with the obstacles to doing so – are discussed in the following section.

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EVEN WELL-MANAGED MINES CLEAR FORESTS; THEY CREATE TAILINGS OF MINE RESIDUES, AND OPEN AREAS FOR OTHER USES THROUGH CREATING A ROAD AND ENERGY NETWORK.

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Section 7

7.1 Policies to reduce deforestation

Practical steps can be taken to reduce deforestation across the Amazon biome, but it's essential to understand the issues faced. We synthesized several policy analysis reports[113] to highlight key ways of doing so, while assessing the challenges and areas of particular concern in each case.

Some issues are common across all the countries involved. There is often a mismatch between policy aims and the resources available for their implementation, while the conflicting demands of short-term financial gain from resource extraction and long-term sustainability through resource stewardship are rarely easy to reconcile. Many development policies have conflicting effects, guarding the forest with one hand while increasing incentives for its exploitation with the other. Unclear land tenure, lack of accountability and weak law enforcement also continually cause problems.

But there are many encouraging signs also. All the countries involved recognize the importance of reducing the rate of deforestation, and have put in place national policies to address the challenge. Devolved responsibilities are increasing local participation in stewardship projects; while best practice can be shared as it develops. Indigenous people play a notably important role in each country's efforts, and the involvement of civil society organizations and other groups is increasing all the time.

The following tables – divided into the two main deforestation arcs as identified in the previous section, the Southern Amazon and the Andean Amazon – summarize regional forest policy analysis findings.[114] The key positive elements and the main challenges have been grouped by country but include the deforestation fronts that they may also be affecting. In the light of these factors we then make recommendations for improving the deforestation situation in the biome.

7.2 Southern Arc of Amazon deforestation (Brazil and Bolivia)

Deforestation policies

Country/fronts	Positive	Challenges
BRAZIL Fronts 1 to 8, 11, 12, traditional arc of deforestation (A, B, C)	• Coordinated long-term policy approach through Action Plan for Prevention and Control of the Legal Amazon Deforestation (PPCDAm) – this has seen a 79% reduction in first two phases, increasing the number of protected areas was a key part of this strategy since 2004. Key elements include: - Blacklisting high deforestation municipalities encourages inter-sectorial alliances through the PPCDAm – targeted municipalities, civil society and private sector work together to raise standards, reduce deforestation and access credit - Credit blocked for unsustainable ventures and municipalities needing to curb deforestation; rural credit requires proof of legality - Decentralized power and decision-making has been enabled via PPCDAm, as states can reach local solutions that fit local context • Extensive protected areas (50 million ha) and indigenous territory (10 million ha) coverage, and at least 3 more protected areas created in 2015: - Funds have been allocated to support the protected area network (ARPA) in 2014. • Sustainable Product Act promotes sustainable rural economy, which supports rubber extracting communities both in and outside protected areas: - Alternative funds are being made available for sustainable ventures - Local capacity development improved to support sustainable rural producers and forest management standards - Subsidies value standing forest (ecosystem services recognized) • Rural properties regulated and managed through the new Forest Code: - INCRA has a green settlement programme, where settlements have higher than normal deforestation rates - Thousands of hectares of abandoned land, degraded pastures and depleted bodies of water offer alternative spaces for agricultural development • Infrastructure planning – sustainable forest district created along BR163 – creates a paradigm for the future and includes both protected areas and indigenous territories: - High impact hydro-plans can change (two dams would have impacted protected areas and flooded 418km^2 recently rejected, third rejected in 2016) - 2010 ruling 525 states that mining should not be granted if it overlaps protected areas, and is invalid. It also restricts any concessions granted before this period	• Conflicting interests lead to contradictory political attitudes: accelerated growth plan favours infrastructure and agricultural development versus the aims of PPCDAm • Less pressure to reduce emissions through land-use change takes the focus off deforestation • Local tenure is hard to secure under PPCDAm (lack of administrative/bureaucratic qualifications) • Weak management of sustainable production activities; plans needed in protected areas • Negative political attitudes – forest law weakened in 2012, protected area status can be revoked, and mining potentially to be allowed in protected areas/indigenous territories • Demand for sustainable land use change created without the means of meeting it • Lack of government will: programmes more symbolic than practical; Amazon seen as source of natural resources to exploit • Sustaining policy advances – lack of long-term vision/support – 'showing' response is not the same as entrenching real consequences • Lack of integration with key sectors: infrastructure, mechanized agriculture and colonization policies at odds with forest conservation • Conflicts of interest are apparent in large infrastructure projects: government is procurer and regulator at same time • Dam projects in particular suffer from lack of accountability – speed/administrative efficiency is privileged over environmental and social considerations • Social conflict is increasing over major Amazon infrastructure projects – institutionalized violence against local communities is a real concern • Environmental crime escalates and becomes more sophisticated in light of strong enforcement regulations, and increases in protected areas

Country/fronts	Positive	Challenges
BRAZIL continued	• Very effective control and regulation of deforestation (including illegal timber trading), improved monitoring: - Strong deterrents: fines, seizures, area embargoes, prison terms - Improved control of public forest. 49,000 ha assigned for sustainable forest management, 138,000 ha recuperating for permanent protection areas, increased local land tenure (25,600 rural holdings geo-referenced; 533 environmental licenses granted for settlements - Local and national inter-government coordination are both also strong, and central coordinating body investigates and combats environmental crimes	
BOLIVIA Fronts 13-16	• New national policy framework ('Mother Earth' agenda) values standing forest: - Forest management law focuses on sustainable production, protection of ecosystem services, restoration • Emerging climate policies support forest conservation: - Joint mechanism implemented to reconcile conflicting policies • Good protected area system protects forest resources and biodiversity: - Strong forest certification system developed, 5 million ha certified • NGOs support municipalities in environmental management: - Strengthened technical capacity through regional exchanges – e.g Brazilian soil technologies can reduce pressure on forests and integrate agriculture with other activities • Decentralization and local management skills improving (production development, infrastructure, health, education): - State recognises CSOs, increasing CSO participation and social control - 7 million ha of forest is managed locally in indigenous areas. Good indigenous management: Bolivia respects traditional knowledge and practices - Improved local access to forest resources – greater stakeholder involvement	• Lack of policy integration: forest conservation and food sovereignty at odds • Government attitudes do not value 'unproductive' forest land: - Perverse incentives promote land-grabbing and deforestation – very low fines for illegal timber are seen as a price worth paying to establish land rights or get unfair timber market advantage; and guilty parties are seldom convicted anyway - Inconsistent political discourse promotes both forest conservation and agricultural frontier expansion - Rural development focuses on cattle ranching; technological development, rural extension and credit all promote agriculture - Systemic weakness attracts undesirable investors (eg Brazilian cattle ranchers renting cheaper Bolivian land) - Owners must prove 'productive' use of forest land to secure right of occupancy/title, driving deforestation • Investment in roads has increased 32% since 1990 - Colonization policy leads to secondary colonization and undetected illegal deforestation • Weak state research on integrated forest management, no zoning in land-use planning - Lack of training and capacity of state forest staff • Excessively centralised control system prevents effective enforcement: - Some key functions still maintained centrally by state – environmental and social diversity makes effective management difficult - Political polarization hinders establishment of consultative bodies - CSOs and NGOs considered as 'opposition' in certain sectors leading to weak participation

Country/fronts	Positive	Challenges
BOLIVIA continued		• No funding mechanisms to support sustainable forest management, insufficient resources allocated to follow through with projects – transparency and accountability reduced • Poor management and internal divisions in indigenous territories makes them vulnerable to illegal encroachment • High commodity market prices allow easy payment of fines for illegal activities

Transboundary front 10, MAP (Madre de Dios, Acre and Pando)

Country/fronts	Positive	Challenges
BRAZIL/ BOLIVIA/PERU Front 10 – MAP	• Joint planning between 3 sub-governments through MAP meetings, 10th planning session focused on addressing and managing climatic events, coordinated actions and ecosystem service analysis of Rio Acre river basin	• Bolivia and Peru government attitude: forest areas seen as for human occupancy, non-productive roles not valued • Illegal/informal resource extraction, particularly in Peru – mining, drug trafficking – distort economic and social systems, undermining local governance and exacerbating deforestation • Peruvian state does not enforce local rights against encroachment via illegal logging, mining, coca production

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7.3 Andean Arc of deforestation (Colombia, Ecuador and Peru)

Deforestation policies

Country/fronts	Positive	Challenges
COLOMBIA Fronts 23- 25	• Resource availability: Colombia is no longer poor, economic growth enables investment in priority areas • Political support at top level for environmental agenda, including coherent policies and laws on deforestation and climate change: - There are incentives for reforestation - Good government response to deforestation - High degree of protected areas and indigenous territories, 75% of remaining forest classified as indigenous lands, supported by innovative external finance (US$27m pledged) - Strategy for Rural Development planning uses sustainable development criteria for zoning - State supports local management capacities and rural education to develop human resources - State supports indigenous rights and territories - Strong support for local participation and natural resource management – municipal governments give technical assistance; well developed tradition of public consultations, roundtables etc - CSOs have good involvement and influence which can be further developed • Good intergovernmental coordination between Ministry of Agriculture and Ministry of Environment, Housing and Territorial Development • ENREDD aims to meet regional specificities, particularly with zoning for future investments	• High levels of social inequality in indigenous towns and Afro-Colombian communities – mostly located in the Amazon – may hinder environmental stewardship FARC peace process includes mass relocation of former members into new Amazon areas (particularly fronts 24 and 25): - Weak local control – armed groups bribe authorities, undermine local systems - Armed groups undermine efforts to support local governance • International trade agreements support green policy implementation – but this has been slow to come • High resource requirements for control and supervision, not enough environmental resources allocated to meet requirements - Very little retribution for environmental crime, illegal deforestation is largely unpunished • Insufficient political will for reforming environmental management frameworks, particularly Autonomous Regional Corporation (CAR) role. CAR has poor relationships with subnational government, and little accountability • Land-use planning undeveloped – reforestation strongly supported but not true for natural forest management • Lack of capacity and knowledge of laws, civil society poorly organized in negotiations with authorities • Unclear impact of financial incentives (some credit lines and tax incentives operate both for and against deforestation) • Some government agencies are reluctant to participate in state initiatives; while political officials have too much influence in negotiations - Lack of inter-agency cohesion. Recentralized licensing to environmental regulator ANLA has dismantled established processes and increased bureaucracy, while management has remained with CAR

Country/fronts	Positive	Challenges
ECUADOR Fronts 21- 23	• Sustainable Forestry Development Strategy guides good forest management laws and policies, and provides incentives for sustainable practices • Forest ecosystems protected by Ecuadorian Constitution (2008), government has made reduced rate of deforestation a national priority • Updated Forestry Law prohibits illegal logging, grazing, transport of forest products, forest destruction, encroachment • Intensified rural production systems 1990-2010 have grown productivity without increasing area under use • Government forestry procurement policies demand proof of legality: - Tax system ensures legal timber exports - Improved administrative efficiency and forestry control systems, improved legality • Protected areas cover 30.5% of national territory, targeted to expand to 35.9% by 2017; high number of protected wetlands • Indigenous territories respected, contain more than 60% of remaining forests in Ecuador • Improved forest management system focuses on efficiency and control; sustainability incentives; information-sharing; reforestation; and research, training and outreach: - Strong local dependence on forest resources is recognized (850,000 depend directly for livelihoods) - State promotes indigenous ownership of ancestral territories (6.4 million ha) - Indigenous people have long-term vision combining biodiversity conservation and sustainable resource use (7.5 million ha used for indigenous livelihoods) • Non-monetary incentives for sustainable forest management and conservation – e.g. Socio Bosque programme monitors/supports voluntary stewardship • Government takes responsibility for monitoring deforestation and providing information, but guarantees widespread local involvement in planning, executing and controlling all forest activities – local participation can be further encouraged in future • Well-supported reforestation and training programmes empower local actors	• Rule of law is weak[115]: - Large, unclear, often contradictory body of laws, inconsistently enforced - Weak land title/unclear forest tenure – 60% of 2.7 million rural properties lack current records, an additional 12% lack titles; state lands often in possession of settlers, communities, logging companies - Conflict from overlapping land claims is common, and also affects 60% of the 8 million ha National System of Protected Areas (SNAP) - Conflicting governance claims – 71% of indigenous territories overlap with hydrocarbon blocks • Policies pushing road construction are opening up access to forests. Ecuador has the highest regional road density at 37,300 km/km^2 [116] • Indigenous peoples do not support REDD, making an integrated approach difficult to achieve • Complex timber harvesting regulations and ineffective forest crime detection encourage illegality – 50% of wood sold in domestic markets is illegal: - No forest concession system for production forests - Transparency initiatives still need to be implemented according to new forest governance model - Illegal timber trade common, worth US$100m – responsible for up to 70% of wood extracted in some areas • Government land-use policy favours short term financial returns through resource extraction over sustainable long-term development • Some local governments lack capacity to take on opportunities of devolved authority/decentralized management

Country/fronts	Positive	Challenges
PERU Fronts 17-20	• Positive economic context – resources available for public investment • National climate change strategy supports public policies to control deforestation, including governance decentralization process and participatory models: - REDD pilot projects in Madre de Dios and San Martin have boosted knowledge and experience; and established baselines for monitoring, reporting and verification • Protected areas effectively managed as deforestation barrier by SERNANP • General focus on increasing capacity and knowledge: - Local staff have strong scientific knowledge/ experience through internationally supported projects - 'New' knowledge accessible to managers/ producers through far-reaching technology and innovation system - State recognizes strong traditional/indigenous knowledge of natural resource management • Ministry of Environment (MINAM) provides strong institutional support for forest conservation, encouraging regional governments to take on environmental responsibilities and giving a legal basis to local forest management • Strong national and regional discussions/ coordination on climate change strategy, including international NGO participation • Good scope for scaling up local lessons and pilot projects and applying them more broadly in alternative development, reducing dependency on system of public control	• Environmental requirements adjusted for development projects, promoting extensive exploration and infrastructure: - International demand for biofuels promotes foreign investment/land acquisition, notably in palm oil plantations - Forest management focuses on use of wood rather than sustainability of resources - Concession model excludes local groups, civil society has weak organization • Insecure land tenure promotes deforestation as right of use/occupancy mechanism • Lack of cohesive regulatory and control system, lack of accountability mechanism, low fines – encourages lawlessness • Anti-conservation attitude on part of some government decision-makers – non-productive forest not valued: - Technical assistance supports unsustainable rural development packages – unequal competition with more sustainable models • Political instability in some regional governments delays decentralization process, decreases efficient management and local participation: - Resources not allocated in line with devolved functions/responsibilities - Inadequate budget allocations to essential environmental management systems

The above policy summary from these five key Amazon countries allows some common themes to be identified. These themes have been presented as biome-level recommendations that could be taken by key actors in the region to support the further reduction of deforestation. These are presented in the following section.

7.4 Biome-level actions to combat deforestation

REGIONAL COORDINATION WILL SCALE UP THE IMPACT OF LOCAL EFFORTS, AND LESSONS LEARNED IN ONE AREA CAN BE APPLIED IN OTHERS

While the previous section considers actions that already exist, by synthesizing across countries we can make recommendations about what could be addressed through a biome-wide approach. Regional coordination will scale up the impact of local efforts, and lessons learned in one area can be applied in others.

1. Deforestation free supply chains – deforestation-free supply chains and sustainable production need to be promoted across relevant sectors, incorporating social and environmental safeguards. These can be complemented and supported by common trade policies – international development institutes, by promoting bilateral and regional trade agreements, would incentivize sustainable deforestation-free products.

2. Effective regional protected area network – best practice can be shared on how to effectively manage protected area systems, including cost recovery policies for the ecosystems provided. Protected areas and indigenous territories should have a clear status and where possible support sustainable activities to provide further funds to improve their own management. Local communities should see the benefit and participate in the management of these areas.

3. Improved trans-boundary management – improved integration and interagency coordination across countries would also better combat illegal goods trafficking and control the informal/illegal mining sector.

4. Sustainable use of standing forests – national governments can exchange policy lessons over how to incentivize, manage and monitor sustainable forest enterprises, from eco-tourism to legally-verified timber products. This could be complemented by regional regulation – the legal timber trade needs to be regulated and promoted at regional level, with an assurance system and digital traceability from point of production to point of sale.

5. Independent strong regional CSO networks – strengthen existing Non-State Actors/Civil Society Organization (CSO) networks to provide regular feedback on policies and compliance in each nation and monitor forest governance processes. In support of co-management, governments need to aim to increase transparency of information; develop effective complaint/grievance mechanisms; and keep local communities informed, particularly on infrastructure, mining and hydrocarbon projects. Workshops and training are needed on the value of natural capital in meeting government targets on biodiversity, reduced deforestation and emissions; plus its socio-economic benefits to local communities. Also they need to promote good governance, transparency and accountability; and develop capacity by sharing best practice on local environmental management between national colleagues through study tours and visits.

6. Sustainable local management – CSOs and indigenous groups would benefit from strengthened capacity to engage with deforestation-free and sustainable non-timber forest production and supply chains, with rural properties and communities supported to increase capacity for sustainable production, agroforestry and farming. CSOs and indigenous groups need to be given practical and legal support in understanding and monitoring environmental crime. Strengthen sustainable forest management initiatives to include land security and non-timber forest products, and ensure adequate technical assistance.

7. Greater access to innovative funds – international climate funds should reward governments and companies committed to deforestation-free supply chains and sustainable management of resources, natural capital and ecosystem services as well as managing the protected area and indigenous territory network.

8. Effective regional control and enforcement – environmental crime has been linked with other crimes worldwide from illegal drugs to people trafficking, and needs to be taken seriously by being resourced.[117] International development agencies could work to create an integrated regional control, data exchange and enforcement system. The judicial system in several Amazon countries would benefit from being strengthened to impose effective punitive sanctions, which act as a genuine deterrent.

9. Improved monitoring – national governments would benefit themselves and the region by conducting regular forest governance assessments and developing joint work plans to address common issues, exchanging ideas, data and technologies. There is also value in supporting and enabling interagency coordination for transboundary monitoring and intelligence-sharing between governments.

10. Common financial/fiscal policies – financial institutions supported by public funds would benefit from agreeing common policies not to support illegal/informal sectors; and promote sustainable production systems and non-timber forest product supply chains, sustainable farming, agroforestry and eco-tourism both inside and outside of protected areas.

Significant resources have been pledged already through the climate talks, however more effort is needed by the donor community to support biome-wide initiatives as outlined in the 10 areas of recommendations above. National governments have a critical part to play, but so does civil society, including indigenous groups and the corporate sector as active partners.

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NATIONAL GOVERNMENTS HAVE A CRITICAL PART TO PLAY, BUT SO DOES CIVIL SOCIETY, INCLUDING INDIGENOUS GROUPS AND THE CORPORATE SECTOR AS ACTIVE PARTNERS

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Conclusions

The MODIS analysis has shown that in general there is a decline in deforestation over the 13-year period, 2000-2013. **Brazil's contribution to deforestation, although still large, has reduced over the 13 years, but consequently the contribution from the Andean Amazon and Guiana Shield has increased**. More recent figures from Brazil (2014-2016) suggest that this downward trend may not remain strong: this would suggest regular deforestation analysis is needed at the regional scale to enable trends to be re-assessed.

The 31 fronts were designated as such because deforestation is concentrated in these areas. They need to be monitored over time to assess to what extent they are expanding, or whether policy interventions can address the drivers active in these fronts and reduce their deforestation intensity.

While the IUCN status assessment is a useful starting point towards understanding the level of threat the network of indigenous territories and protected areas is under, we have shown that it can be complemented in a simple way with limited data on other deforestation criteria that reflect emerging and more recent threats.

The analysis has shown that in general although protected areas and indigenous territories experience very low levels of deforestation as compared with other forests in the biome, some are under varying degrees of potential threat and may need more management intervention than others. The combined threat status approach used here has shown how the indigenous territories and protected areas can be prioritized for different management interventions and more investment through REDD+ or other innovative finance mechanisms.

As a network protected areas and indigenous territories cannot be taken for granted: this asset needs to be prioritized for investment to increase the resilience of the biome.

Both indigenous territories and protected areas are an important asset in curbing deforestation, so more needs to be done to increase their effectiveness where they are shown to be under pressure from current deforestation and future pressures. The analysis looked at specific sectors in greater detail for their potential future threat.

Mining and oil and gas has the most significant potential to impact the biome in the future, both in terms of the contracts and concessions already granted but also the sheer number of applications that wait to be assessed.

Overall the current deforestation situation seems to be improving, but there is enough evidence to suggest that although **there has been a downward trend overall in deforestation in the biome, by extrapolating MODIS data from 2000-2013, linear projections suggest 21% of the Amazon biome could be lost by 2030**.

The policy analysis covers 10 key biome-level policy recommendations, which would need to be implemented across a number of the countries by national governments. These can be distilled into three priorities:

1. Deforestation-free supply chains – deforestation-free supply chains and sustainable production need to be promoted across relevant sectors, incorporating social and environmental safeguards. These can be complemented and supported by

common trade policies, which would allow international development institutes to promote bilateral and regional trade agreements incentivizing sustainable deforestation-free products. WWF advocates the development of policies and strategies around the goal of Zero Net Deforestation and Forest Degradation.[118] This will require better monitoring by national governments of both deforestation and degradation, but monitoring must also take place at the biome level to assess whether these actions are working synergistically or creating gaps or simply moving deforestation from one location to another.

2. Effective regional protected area and indigenous territories network – although deforestation is still very low in these areas, the network has some vulnerability to deforestation that needs to be understood and addressed. Policy analysis suggests that best practice can be shared on how to effectively manage protected area systems, including cost recovery policies or self-financing mechanisms. Local communities should see the benefit and participate in the management of these areas. However, both policy and deforestation analysis suggest that improved investment in **transboundary management** is needed, combined with better integration and interagency coordination on the combating of trafficking of illegal goods and control of the informal/illegal mining sector. Implementing current policies and laws within key Amazon countries could significantly reduce the potential threat of deforestation in the future. The causes of deforestation within both protected areas and indigenous territory boundaries need to be better understood and addressed, and several priorities have been identified where more investment for restoration, regeneration and better protected is needed.

3. Greater access to innovative funds – international climate funds need to reward governments and companies committed to deforestation-free supply chains and sustainable management of resources, natural capital and ecosystem services as well as managing the protected area and indigenous territory network. New financial mechanisms and better programmes are needed to support sustainable forest management, including non-timber forest products.

INDIGENOUS TERRITORIES AND PROTECTED AREAS ARE AN IMPORTANT ASSET IN CURBING DEFORESTATION

Annex 1

Table A1.1. Comparison of different deforestation monitoring methods

Name (and reference)	*Main producer source*	*Projection*	*Spatial resolution*
GFC: Global Forest Change v.1.1 (Hansen *et al.*, 2013)	University of Maryland – (https://goo.gl/P8E6qt)	Geog. WGS84	1 arc-seg 30 m
Terra-i v. Jan 2004 – Apr 2015 (Reymondin *et al.*, 2012)	Centre of International Tropical Agriculture CIAT (http://goo.gl/q2Jyyr)	Geog. WGS84	7.5 arc-seg 250m
FORMA : Forest Monitoring for Action v. E Jan 2006 – Sep 2015 (Hammer *et al.*, 2009)	The World Resources Institute (http://goo.gl/MI4rBp)	Geog. WGS84	15 arc-seg 500m
WWF MODIS	World Wildlife Fund (contacto)	Sinusoidal	7.5 arc-seg 250m
BOLIVIA – Official deforestation and regeneration of Bolivian forests and protected areas for period 1990-2000 and 2000-2010 (SERNAP, 2013)	National Service for Protected Areas, SNAP (http://goo.gl/eD3qmF)	Proj. UTM WGS 84 Zona 20S	1 arc-seg 30 m
BRAZIL – Official PRODES v. 2005-2013 (Camara *et al.*, 2006) Period covering 1988 to 2016 online data available	National Institute of Spatial Research INPE (http://goo.gl/aEe3n)	Geog. SAD69	1 arc-seg 30 m
COLOMBIA – Official changes between 2005-2010 y 2010-2013 v.1 (Cabrera *et al.*, 2011)	Institute of hydrology, meteorology and environmental studies IHMEA (http://goo.gl/anLoz9)	Proj. MAGNA-SIRGAS	1 arc-seg 30 m
PERU – Official Annual loss v. 261213 (Vargas *et al.*, 2014)	Ministry of Environment forest conservation programme MAP – PCB (http://goo.gl/NOsalq)	Proj. UTM WGS 84 Zona 18S	1 arc-seg 30 m

Figure 1: Process for MODIS WWF data

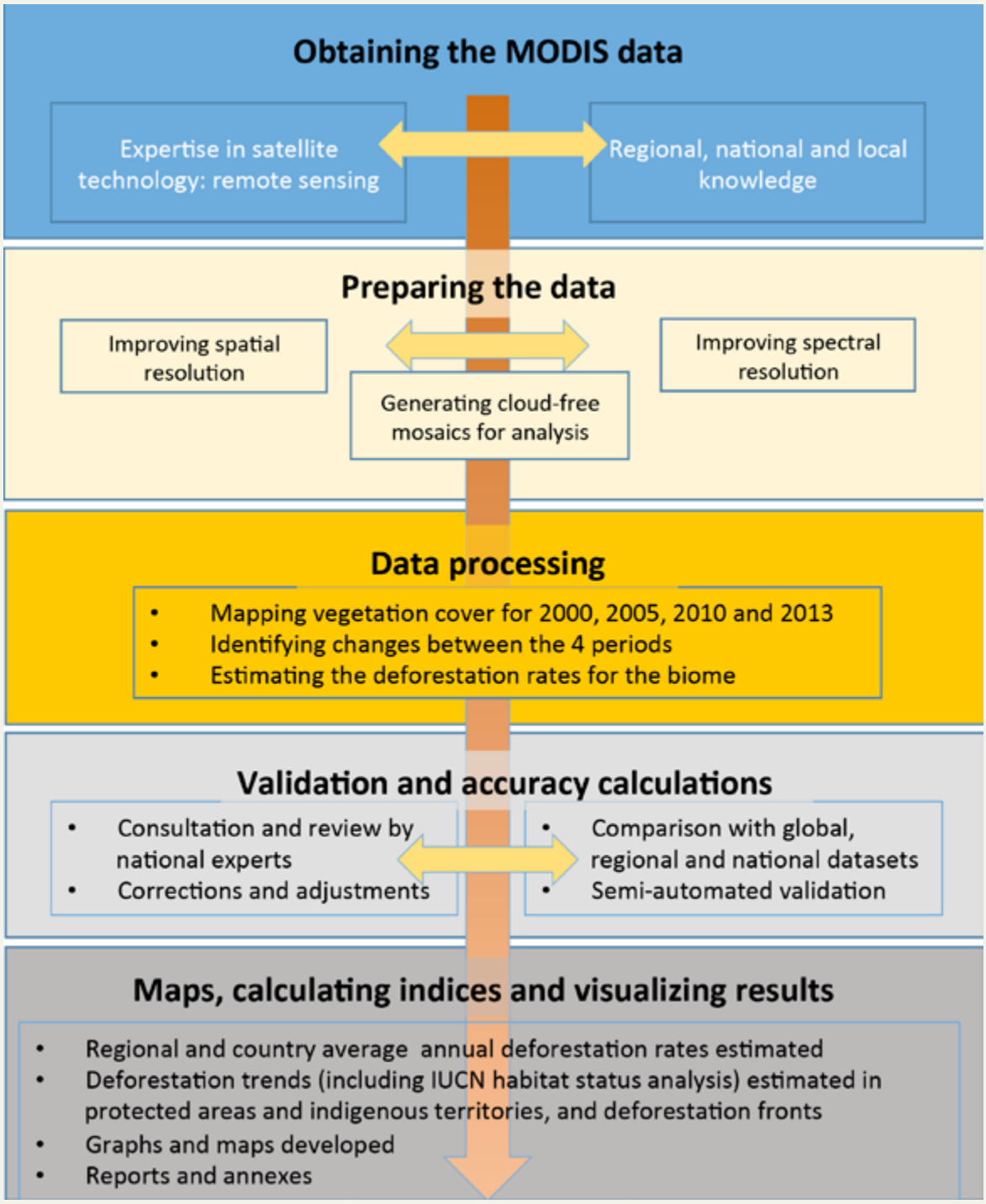
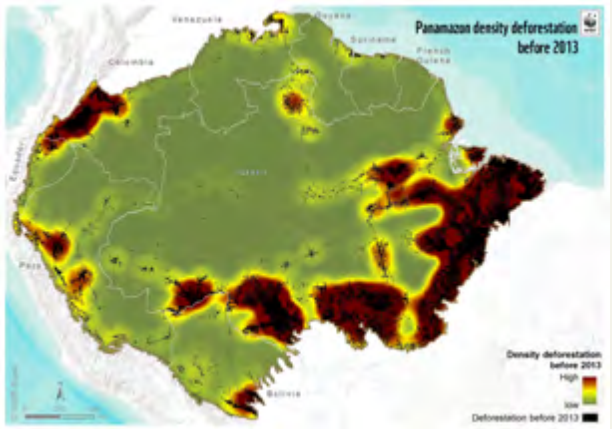


Table A1.2: Percentage forest change data per sub-region per period

Country	Forest change Total deforestation 2000-2005	Forest change Total deforestation 2005-2010	Forest change Total deforestation 2010-2013	Forest change Total deforestation 2000-2013
% total deforestation in Brazil	93.4%	85.0%	75.5%	89.2%
% total deforestation in Andean Amazon	6.4%	12.8%	20.0%	9.6%
% total deforestation in Guiana Shield	0.2%	2.2%	4,4%	1.2%
Total deforestation in the biome	16,936,356	7,022,735	3,037,936	26,997,028

Maps of deforestation density used to verify the limit of the 31 deforestation fronts



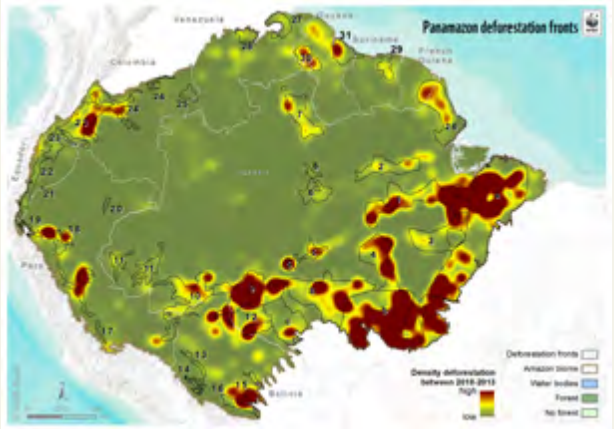


Table A1.3: IUCN ecosystem status criteria values for indigenous territories and protected areas

Indigenous territory threat status		Trigger values for historical loss based on percentage of area that remains with natural vegetation
CR	CRITICALLY ENDANGERED	Area remaining is less/equal to 35% of the total territory
EN	ENDANGERED	Area remaining is less/equal to 50% of the total territory
VU	VULNERABLE	Area remaining is less/equal to 85% of the territory
NT	NEAR THREATENED	Area remaining is more than 85% of the total territory, but less than 99.5%
LC	LEAST CONCERNED	Area remaining is more than 99.5% of the territory

Areas to be assessed go through a three step process; step 1 set thresholds for the IUCN assessment categories and assess the threat status for those areas, step 2 determine the values for the three deforestation criteria, which by passing these values, an area would trigger concern and be assigned a 1. Those not passing these trigger values would be assigned **0**. Step 3 combines the results of the first two steps to give a new category of threat assessment for each area.

Table A1.4: Other three deforestation criteria definitions for indigenous territories

Criterion 1: Trigger value is 215 hectares	Overall loss for the period triggered	The deforestation total from 2000-2013 is greater or equal to the half of the average value in hectares for all territories in the biome
Criterion 2: Trigger value is 22 hectares/year	Recent rate of loss triggered	The average annual deforestation value for 2010-2013 is greater or equal to half of the average value in hectares for the biome
Criterion 3: Increasing trend trigger	Trend in rate of loss triggered	The average deforestation rate in 2010-2013 is greater than that for 2005-2010 by more than 5 hectares/year

Although the IUCN ecosystem status assessment approach is useful, other deforestation criteria need to be considered alongside so that a sense of emerging deforestation can be gained. Three other criteria are considered, and with new trigger values based on the average values for all 437 protected areas, such as the following:

Table A1.5: Other three deforestation criteria defined for protected areas

Criterion 1: Trigger value is 1866 hectares	Overall loss for the period triggered	The deforestation total from 2000-2013 is greater or equal to the half of the average value in hectares for all territories in the biome
Criterion 2: Trigger value is 78 hectares/year	Recent rate of loss triggered	The average annual deforestation value for 2010-2013 is greater or equal to half of the average value in hectares for the biome
Criterion 3: Increasing rate trend is triggered	Trend in rate of loss triggered	The average deforestation rate in 2010-2013 is greater than that for 2005-2010 by more than 5 hectares/year

Table A1.6a and b: Summary tables for the overall status of mining and oil and gas concessions and contracts (based on SNL Metals and Mining database and Drilling info database accessed 02 2016)

A1.6a	Mining concessions				Totals for **granted** mining contracts	**Totals for both *applications* and granted concessions** (companies have multiple contracts)	
	Applications for concessions that overlap with protected areas	Granted concessions that overlap with protected areas	Granted concessions that overlap with indigenous territories	*Applications* for concessions that overlap with ITs	Totals for mining concessions that overlap on either PAs or ITs	Totals for concessions overlapping with protected areas	Totals for concessions overlap with indigenous territories
No. of licences that overlap	5677	1787	439	4122	2226	7464	4561
No. of impacts – no. of times a licence overlaps	6837	1987	459	4464	2446	8824	4923
No. of companies with these concessions	791	807	281	448	NA	1421	703
No. of PAs or ITs affected	307	195	107	209	NA	370	274
Areas of potential impact (overlap) on either unit (ha)	43,963,001	6,813,471	65,2137	29,626,060	7,465,609	50,776,473	30,278,197
Area coverage of concession in the biome (ha)	55,429,942	9,883,595	1,080,339	33,473,717	10,963,933	65,313,537	34,554,056
% impact by number	69.9%	44.4%	6.3%	12.3%	NA	84.3%	16.1%
Area impact as % of total area for units	22.6%	3.5%	0.3%	14.7%	NA	26.1%	15.0%
Area coverage % of total biome	8.2%	1.5%	0.2%	5.0%	1.6%	9.7%	5.1%
Total number of unit analysed	439	439	1702	1702		439	1702

A1.6b	O&G contracts				Total O&G granted contracts	Total for both applications and granted contracts (companies have multiple contracts)	
	Applications for contracts overlapping with protected areas	Granted contracts that overlap with protected areas	Granted contracts that overlap with indigenous territories	Applications for contracts overlapping with indigenous territories	O&G contracts that overlap either in PAs or ITs	Total contracts overlapping with protected areas	Total contracts overlapping on indigenous territories
No. of licences that overlap	0	56	106	36	162	56	142
No. of impacts – no. of times a licence overlaps	0	116	644	274	760	116	918
No. of companies with these concessions	0	33	48	24	NA	33	64
No. of PAs or ITs affected	0	70	514	256	NA	70	746
Areas of potential impact (overlap) on either unit (ha)	0	8,471,900	8,826,944	5,311,326	17,298,845	8,471,900	14,138,271
Area coverage of concession in the biome (ha)	0	no data	23,964,412	14,952,982	23,964,412	no data	38,917,393
% impact by number	no data	15.9%	30.2%	15.0%	NA	15.9%	43.8%
Area impact as % of total area for units	No data	4.35%	4.4%	2.6%	NA	4.4%	7.0%
Area coverage % of total biome	no data	no data	3.6%	2.2%	3.57%	NA	5,8%
Total number of unit analysed	439	439	1702	1702		439	1702

The methodology for the extractives analysis follows that outlined in the *Safeguarding outstanding natural value* report[119] unless otherwise stated. The concept of overlapping used here is also the same as in the report. The same concession and contract may overlap the same protected area or indigenous territory multiple times or may overlap different ones. Similarly, one company may have many concessions or contracts (mining companies and oil and gas companies however are different). Hence the sum of granted and applied-for concessions will not always add up to the value in the column for both applications and granted concessions.

The biome area for the percentage calculations was 671,916,275 hectares; the protected area coverage for 439 areas was 194,570,686 hectares; and the area coverage for indigenous territories was 20,2084,545 hectares.

Where aggregation of the results was appropriate this has been calculated. We know that there are 61 protected areas that overlap in some way with indigenous territories, however we do not know which of these are affected by the overlapping concessions. Therefore in trying to find the overall impact of the extractives on protected areas and indigenous territories we did not sum the number of territories and protected areas, as this would result in erroneous data. However, the areas of overlap with contracts and concessions were summed as this was assumed to still be valid.

Brazilian Mining and Protected Areas Ruling No 525, 2010

UNDER BRAZILIAN LAW ALL THE SUBTERRANEAN RESOURCES OF THE INDIGENOUS LANDS BELONG TO THE FEDERAL GOVERNMENT

The following ruling is provided here as it is not widely known. It is a ruling by the mining regulatory agency for mining rights (National Department for Mineral Production, Brazil – DNPM in the Portuguese acronym, an agency under the ministry of mines and energy) and Conservation Units. These units, together with indigenous and other traditional lands and private lands set aside for forests, are part of the Brazilian protected area system.

The ruling was discussed in 2007 but made official in 2010, following an official statement issued by the general prosecutor of DNPM and approved by its president.

The ruling clearly states that on all integral protection conservation units (biological reserves, national parks, ecological stations, natural monuments and wildlife refuges) and two types of sustainable use conservation units (extractive reserves and private reserves) mining rights are moot and should be revoked. Furthermore, no new mining rights should be issued overlapping with the limit of these areas.

Following this ruling the agency should initiate administrative procedures to evaluate and nullify any mining rights overlapping with the conservation units – but these procedures never took place, and the ministry of the environment never got the green light to push the DNPM.

Official action has not been taken for two reasons:

1. The ruling clearly states that the mining rights are moot. Those in the legal and technical areas of the ministry of the environment never felt much need to take the next steps; and

2. There is a part of the DNPM ruling that indicates the need for the government to compensate the mining right owner with the expected profit of the mine operation – this is unrealistic.

However under Brazilian law all the subterranean resources of the indigenous lands belong to the federal government. There is a discussion in the national congress to make these mining rights on indigenous lands available for development. If a specific law authorizes this, then indigenous people would be paid royalties, but they would loose partial control over the decision to develop these rights (similar to the situation for private landowners).

AS MANY AS 5 RAMSAR SITES AND 5 WHS IN THE AMAZON COULD BE AFFECTED BY EXTRACTIVES

Details of how international convention sites are affected by mining and oil and gas contracts based on WWF Sight data analysis

Mining concessions overlap 2 Ramsar sites

- Environmental area of protection for the maranhenses delta, Brazil and Maranhenses mouth, in Brazil are neighbouring Ramsar sites which have 28 claims granted for mostly gold, that overlap on both sites by 145,739 ha.

Oil and gas overlap 3 Ramsar sites

- The Limoncocha biological reserve in Ecuador has one granted contract and one in application; and the contracts overlap by 100%
- Coppenamemonding Noord Saramacca Surinam has two granted contracts, with 100% overlap
- Pacaya Samiria, Peru, has two granted contracts, one of which only overlaps by a minor degree

Mining contracts overlap with four World Heritage Sites, but only very marginally, so they have a low risk of impact:

- Central Amazon Complex, Brazil, has two granted concessions, but both overlap in a minor way
- Noel Kempff Mercardo, Bolivia, has five granted concessions, all overlap in a minor way with the site but combine to mean that 91 hectares are at risk
- Rio Abiseo, Peru: there are 10 concession applications, and three have been granted – however only the buffer zone is potentially impacted
- Canaima, Venezuela: there is one application for a concession which overlaps in a minor way with the site; and Monte Roraima has 18 applications for concessions – this is all part of the same transnational park

Oil and gas contracts overlap onto one World Heritage Site in the Amazon

- Manu, Peru: there are two contracts, but the overlap occurs in the protected area buffer zone, so there is a low risk of impact

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State of the Amazon: Deforestation Trends

BIOME

It extends across 6.7 million km² and is shared by eight countries; Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana and Suriname and the overseas territory of French Guiana.

RAINFOREST

The Amazon Biome has from 90 to 140 billion metric tonnes of carbon stored in its rainforests.

FOREST LOSS

There are 31 active deforestation fronts in the Amazon region.

SPACES

Protected areas and indigenous territories are helping conserve nearly 4 million km² of the Amazon.

Why are we here?
To stop the degradation of the environment and to build a future where humans live in harmony with nature.

panda.org/amazon