WWF

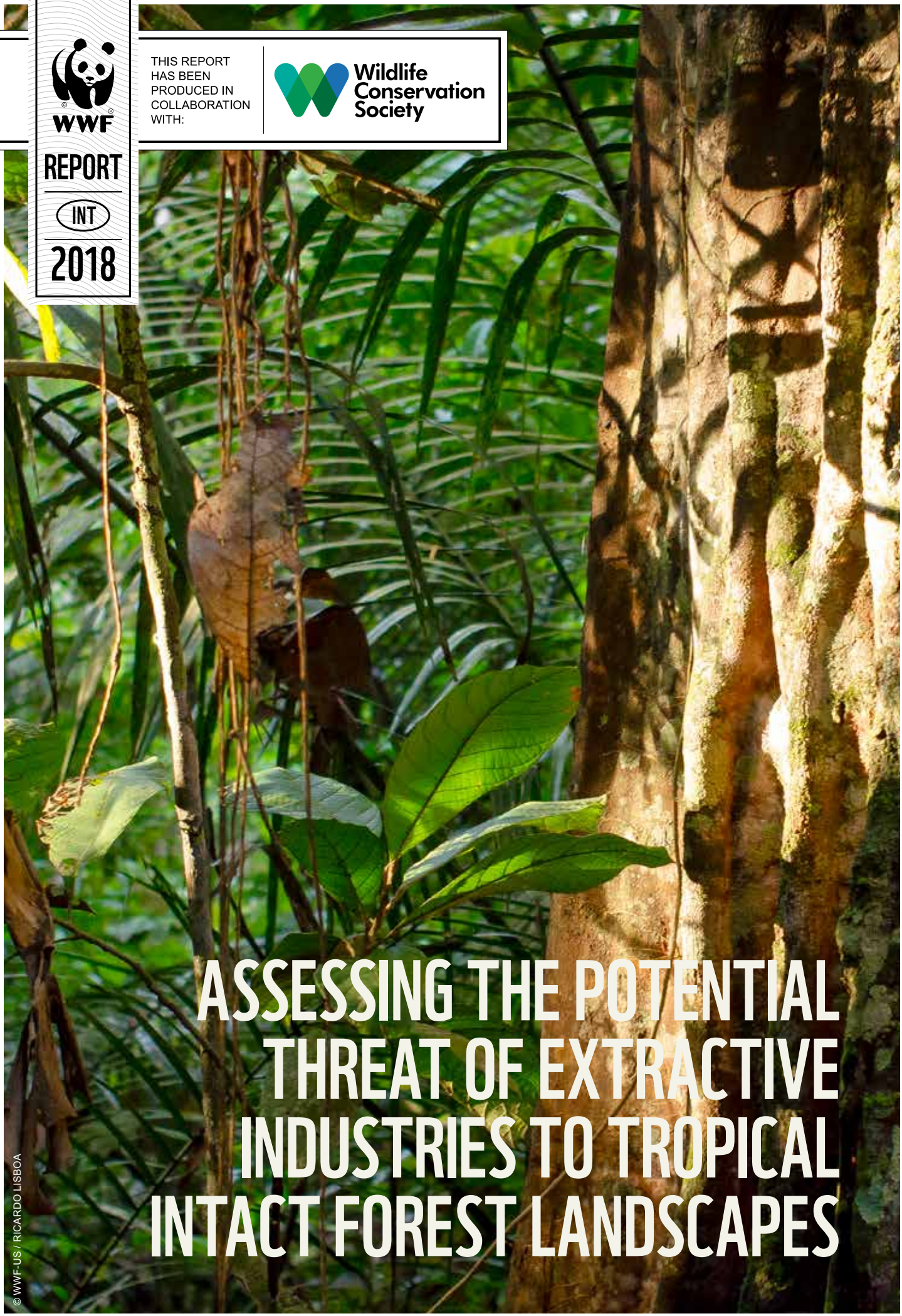
REPORT

INT

2018

THIS REPORT HAS BEEN PRODUCED IN COLLABORATION WITH:

Wildlife Conservation Society



ASSESSING THE POTENTIAL THREAT OF EXTRACTIVE INDUSTRIES TO TROPICAL INTACT FOREST LANDSCAPES

ACKNOWLEDGEMENTS

This report was written by:
Hedley Grantham (Wildlife Conservation Society)
Paolo Tibaldeschi (WWF-Norway).

The GIS analysis was done by Pablo Izquierdo (WWF-Norway). The report benefited from inputs from Gijs Breukink (WWF-Netherlands), Tom Evans (WCS), Kendall Jones (WCS), Karen Mo (WWF-USA), Hugo Rainey (WCS), Joko Sarjito (WWF-Indonesia), Susanne Schmitt (WWF-UK), Ray Victurine (WCS) and James Watson (WCS).

This study was Funded by IKEA.

CONTENTS

INTRODUCTION

An increasing global population and the resulting demand for commodities has made resource rich countries in Africa, South America and Asia hot prospects for industrial expansion [1].

Extractive industries such as oil and gas, and mining, are growing at an increasing pace, and this industry boom is driving an unprecedented expansion of infrastructure (e.g. roads and railways) into sparsely populated regions [2]. These developments are happening at a rapid pace and on a large scale, which is already impacting on land use in areas of ecological and socio-economic importance, such as large forested areas [3].

7.2%

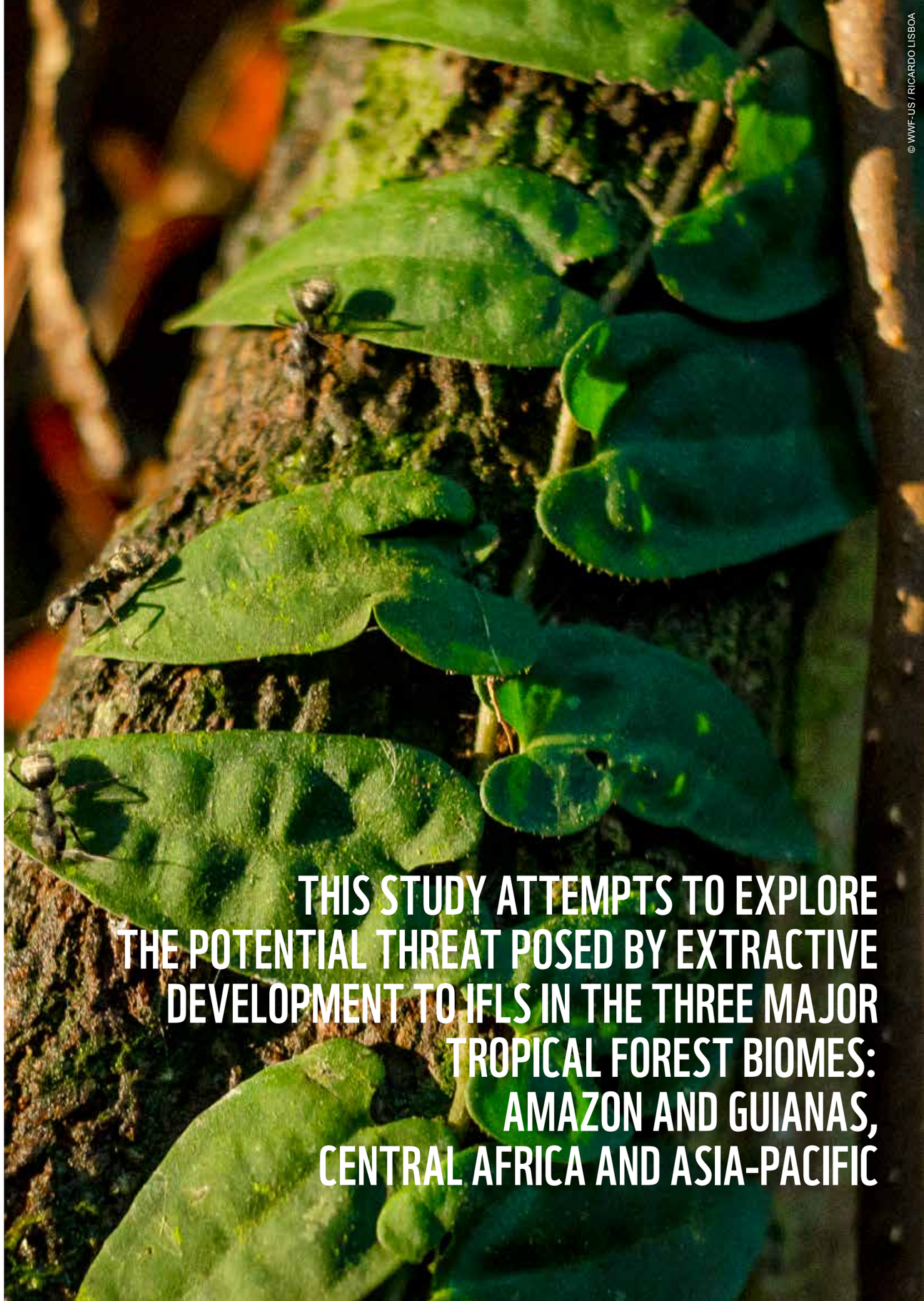
INTACT FORESTS ARE DECLINING FAST, FOR EXAMPLE 7.2% WERE LOST IN 13 YEARS (2000 – 2013) WHICH IS TWICE THE RATE OF OVERALL GLOBAL DEFORESTATION.

An Intact Forest Landscape (IFL) is a large patch of forest, including naturally treeless ecosystems, that has no remotely-sensed signs of human activity or habitat fragmentation, and are large enough to maintain biodiversity, such as, wide-ranging species [4]. The tropical IFLs assessed within this report comprise around 5.2 million Km² of forest in 2016. Intact forests are declining fast, for example 7.2% were lost in 13 years (2000 – 2013) which is twice the rate of overall global deforestation. Intact forests absorb nearly 25% of carbon dioxide emissions from human sources, greatly slowing the pace of climate change [5]. Many indigenous groups live within intact forests and rely on forest resources for their livelihoods and culture [6]. These forests generate significantly more rain than degraded areas, providing water and reducing drought. Forest loss and degradation compromise the supply of medically beneficial species that millions of people rely on, whilst forest degradation brings people into closer contact with infectious diseases [5].

This study explores the potential threat posed by extractive development to IFLs in the three major tropical forest regions: 1) Amazon, 2) Central Africa, and 3) Asia-Pacific. The analysis uses one of the most recent global spatial datasets on extractive concessions (mining, oil and gas accessed in 2018) and assessed against the extent of IFL 2016 data. The goal of this study is to build knowledge and highlight the extent and potential threat of future extractive development on IFL.

INTACT FOREST LANDSCAPES APPROACH

The IFL concept and its technical definition were introduced to help create, implement, and monitor policies concerning the landscapes alteration and fragmentation at the regional-to-global levels. It was developed by a team of research and environmental organizations (University of Maryland, Greenpeace, World Resources Institute, and Transparent World, and more recently Wildlife Conservation Society), the IFL concept, mapping, and monitoring algorithms have been used in forest degradation assessments, forestry certification, conservation policy improvement, and scientific research. The IFL method could be used for fast and cost-effective assessment and monitoring of forest degradation in the context of REDD+ mechanism and for responsible forest management certification process, e.g. according to the Forest Stewardship Council (FSC) standards. The first map was completed for 2005, then it was updated in 2014 (for extent in 2013) including a 2000 version too. A new version for IFL extent in 2016 has just been completed this year. For more information see www.intactforests.org.



Assessing the potential threat of extractive industries to tropical intact forest landscapes (IFL)

FIGURE 1. *Map of the area of assessment with the major tropical areas that contain IFLs. Some countries within this area were not assessed due to data limitations. The main regions were 1) Amazon; 2) Central Africa; and 3) Asia-Pacific.*

For the interactive map, please visit http://wwf-sight-maps.org/IFL/

Legend

- *Area of focus*
- *Tropical region / WWF priority place*
- *Intact Forest Landscape (IFL) area*

REGIONS THAT ENCOMPASS TROPICAL INTACT FOREST LANDSCAPES

This study focuses on the three largest tropical forest regions due to their high biodiversity levels and threat from human development. The boundaries of these three tropical regions namely Amazon, Central Africa and Asia-Pacific correspond to 7 of the 35 WWF priority places which have been identified as being home to irreplaceable and threatened biodiversity, or representing an opportunity to conserve the largest and most intact representative of their ecosystem.

See figure 1 for the study area which includes the tropical regions and WWF priority places of focus

THE CORRESPONDING WWF PRIORITY PLACES ARE:

Amazon:
1) Amazon & Guianas priority place

Central Africa:
2) Congo Basin priority place

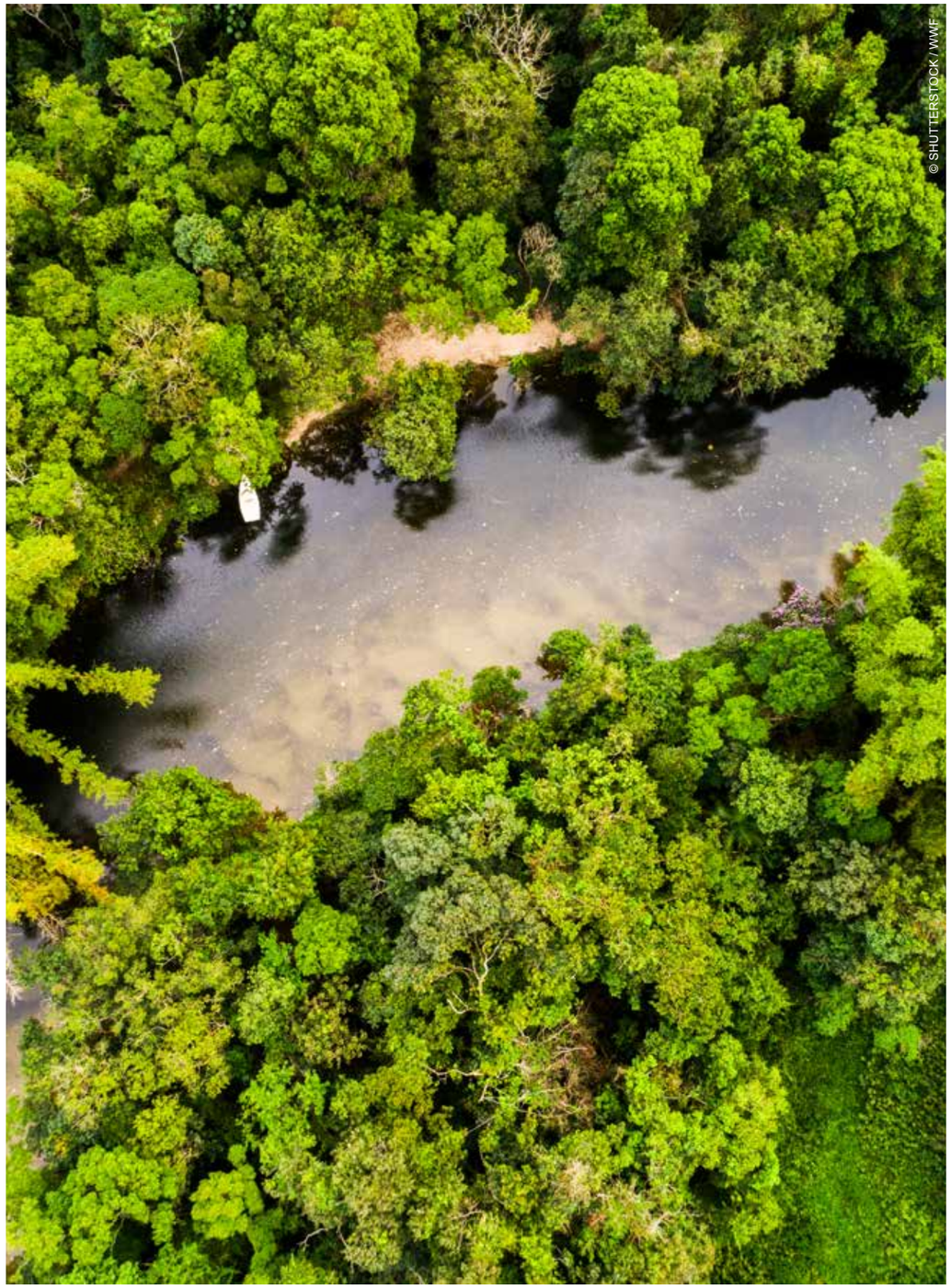
Asia-Pacific:
3) Borneo priority place,
4) Coral triangle priority place,
5) Mekong complex priority place,
6) New Guinea & offshore islands priority place
7) Sumatra priority place

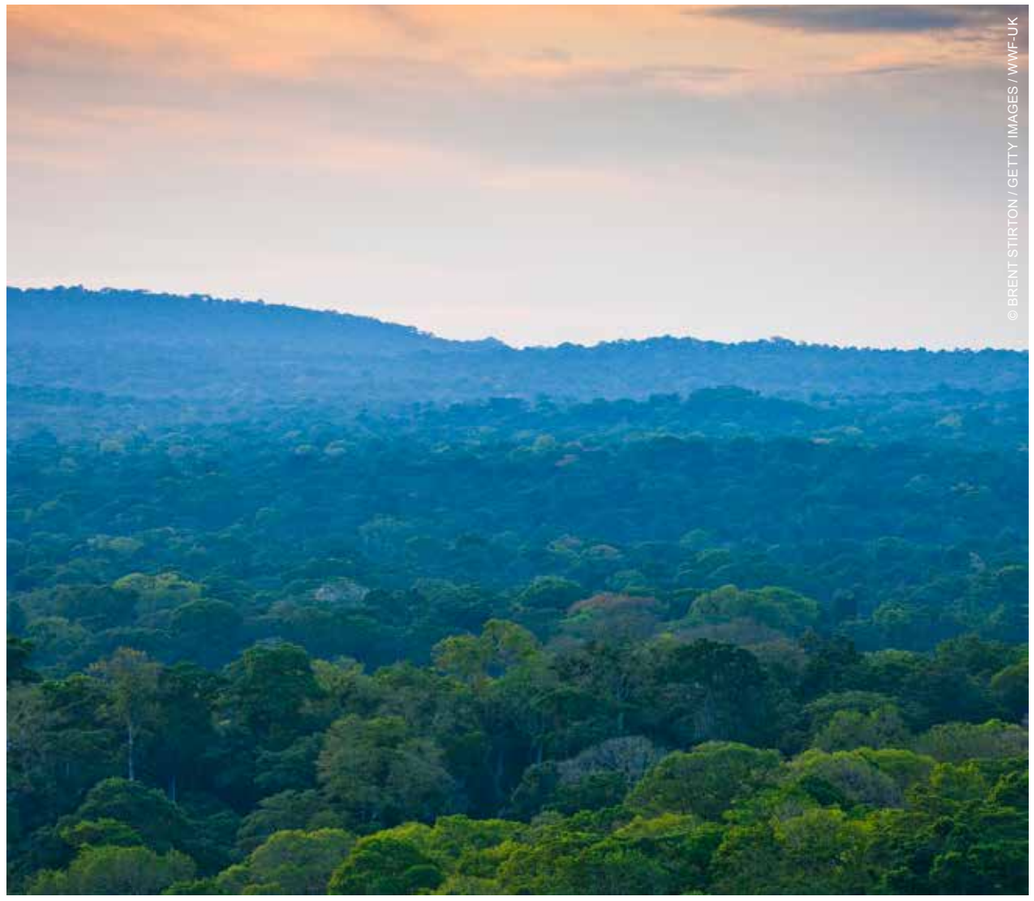
90-140 BILLION METRIC TONS OF CARBON, HELPING STABILIZE LOCAL AND GLOBAL CLIMATE

1) AMAZON

The Amazon (or Amazon & Guianas priority place) is a vast region that spans across eight rapidly developing countries: Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana, Suriname and French Guiana (an overseas territory of France). The landscape contains one in ten known species on Earth, half of the planet's remaining tropical forests, 6,600 km of winding rivers, about 40 percent of South America. There is a clear link between the health of the Amazon and the health of the planet, as these forests contain 90-140 billion metric tons of carbon, helping stabilize local and global climate. Deforestation will release significant amounts of this carbon which could have catastrophic consequences around the world.

Assessing the potential threat of extractive industries to tropical intact forest landscapes (IFL)

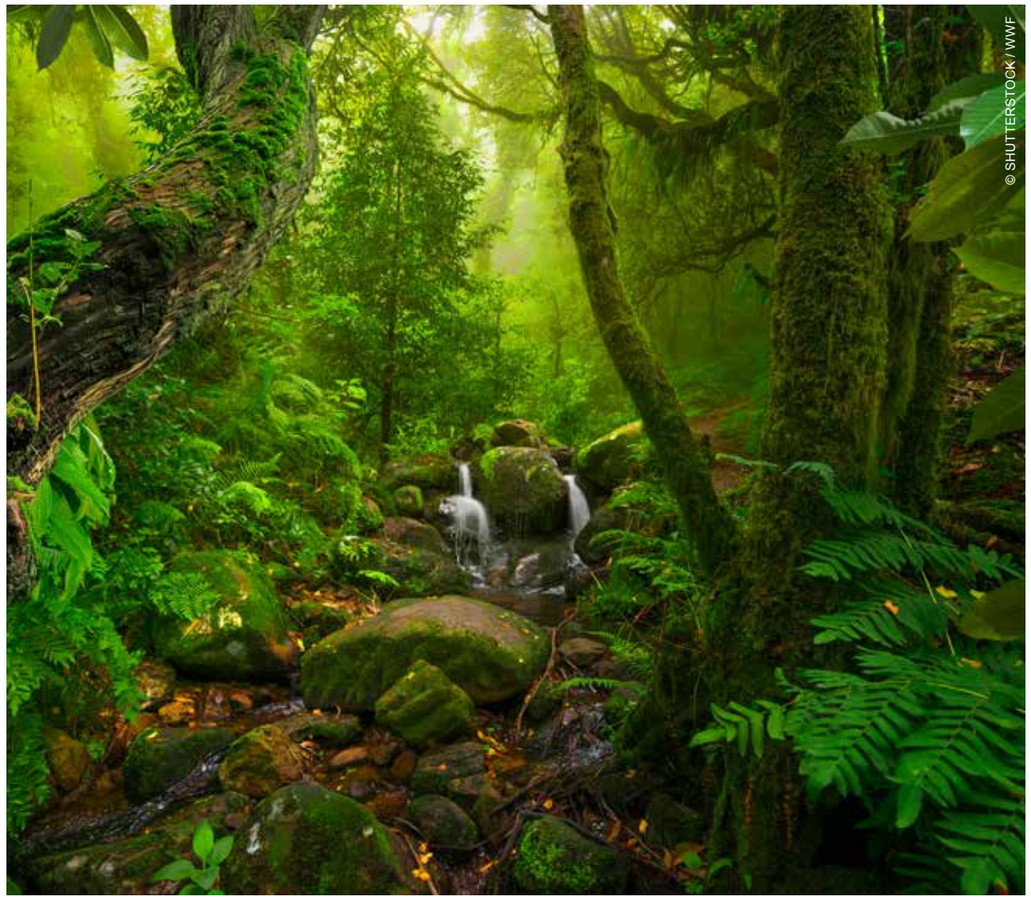




2) CENTRAL AFRICA

CENTRAL AFRICA IS THE SECOND LARGEST TROPICAL RAINFOREST IN THE WORLD

Central Africa (or Congo Basin priority place) is the second largest tropical rainforest in the world, with almost 2 million Km² of humid forest- an area about the size of Mexico. Including secondary and savanna forest, the area equals about 3 million Km². A mosaic of rivers, forests, savannas, swamps and flooded forests, Central Africa is teeming with unique biodiversity such as Gorillas, elephants and buffalo. The core of this region spans across six countries—Cameroon, Central African Republic, Democratic Republic of the Congo, Republic of the Congo, Equatorial Guinea and Gabon. There are approximately 10,000 species of tropical plants in the region, of which 30 percent are found nowhere else on Earth. Endangered wildlife, including forest elephants, chimpanzees, bonobos, and three species of gorillas inhabit the lush forests. 400 other species of mammals, 1,000 species of birds and 700 species of fish can also be found here. Along with the unique biodiversity, the Congo Basin has been inhabited by humans for more than 50,000 years and it provides food, fresh water and shelter to more than 75 million people. Nearly 150 distinct ethnic groups exist, and their lives and well-beings are intimately linked with the forest.



3) ASIA-PACIFIC

THE FORESTS OF THE SECOND SUB-REGION - SUMATRA - ARE HOME TO SOME OF THE WORLD'S RAREST ANIMALS AND PLANT SPECIES.

Asia-Pacific is a diverse region containing many important areas, so we divided it into 5 sub-regions (or WWF priority places) . The first sub-region is the Greater Mekong sub-region (or Mekong Complex priority place) that spans over Cambodia, Laos, Myanmar, Thailand, Vietnam and the southern province of Yunnan in China. The landscapes of this vast area are just as diverse as the countries that it covers, from dusty savannahs to dense rainforests, and from slow-moving rivers to icy torrents. Between 1997 and 2014, over 2,200 new species have been described in the jungles, rivers and even urban areas of the Greater Mekong. This is in addition to rare species including crested gibbons, tigers, Mekong Irrawaddy dolphins and the elusive saola, described as the most remarkable large mammal discovery of the last 70 years.

The forests of the second sub-region – Sumatra (or Sumatra priority place) - are home to some of the world's rarest animals and plant species. There are more than 15,000 known plants in Sumatra's forests; with more than 400 new species been identified since 1995. Sumatra is home to 580 bird species and 201 mammal species

and, including the critically endangered Sumatran rhinoceros and Sumatran tigers, which have less than 300 and 400 wild individuals remaining, respectively. Sumatra is also home to the Sumatran elephant, which is the smallest of the Asian elephants, and the Sumatran orangutan. The main threat to Sumatran biodiversity is habitat loss, with roughly 12 million hectares of Sumatran forest cleared over the last 22 years (a loss of almost 50%).

The third sub-region is Borneo (or Borneo priority place) , the world's third largest island which accounts for only 1% of the world's land yet holds approximately 6% of global biodiversity in its rich, tropical forests. Its species range from the distinct Bornean orangutans and elephants to the giant pitcher plants and Rafflesia flowers. Yet this diversity is under threat - Borneo has already lost over half its forests, and a third of these disappeared in just the last three decades.

The fourth sub-region is Wallacea (or Coral Triangle priority place), which is a biogeographical designation for a group of mainly Indonesian islands separated by deep-water straits from the Asian and Australian continental shelves. Wallacea includes Sulawesi, the largest island in the group, as well as Lombok, Sumbawa, Flores, Sumba, Timor, Halmahera, Buru, Seram, and many smaller islands. Originally, Wallacea was nearly completely covered by forested land mainly tropical moist broadleaf forests. Some areas of the islands also featured tropical dry broadleaf forest. Montane and subalpine forests are present on the higher altitudes. Coastal areas feature mangrove wetlands. Over 10,000 species of flora grow in Wallacea. 15% or nearly 1,500 species of flora are endemic in nature.

After the Amazon, and Central Africa, the final sub-region - New Guinea and Islands (or New Guinea & offshore islands priority place) - is home to the 3rd largest rainforest in the world. Shared by 2 countries – Papua New Guinea to the east and the Indonesian provinces of Papua and West Papua to the west – the island covers just 1% of the world's land area but harbours at least 5% of its animal and plant species; 2/3 of which are found only in New Guinea. This unique wildlife includes tree climbing kangaroos, carnivorous mice, giant pigeons and rats bigger than domestic cats. New Guinea is also home to more orchid species than any other place on the planet.

AFTER THE AMAZON, AND CENTRAL AFRICA, THE FINAL SUB-REGION - NEW GUINEA AND ISLANDS (OR NEW GUINEA & OFFSHORE ISLANDS PRIORITY PLACE) - IS HOME TO THE 3RD LARGEST RAINFOREST IN THE WORLD. SHARED BY 2 COUNTRIES – PAPUA NEW GUINEA TO THE EAST AND THE INDONESIAN PROVINCES OF PAPUA AND WEST PAPUA TO THE WEST - THE ISLAND COVERS JUST 1% OF THE WORLD'S LAND AREA BUT HARBOURS AT LEAST 5% OF ITS ANIMAL AND PLANT SPECIES; 2/3 OF WHICH ARE FOUND ONLY IN NEW GUINEA.

METHODOLOGY

The aim of this study is to define the spatial overlap of extractive concessions including mining, and oil and gas, with the 2016 IFL global dataset.

The overlap analysis was done using WWF-SIGHT, a Geographic Information System (GIS) platform developed by WWF that provides a global overview of all the major sectoral developments (e.g. extractives) against all the major environmental assets (e.g. Intact Forest Landscapes) in order to monitor and understand the environmental and social implications of human development around the world. The following datasets were used:

- Data defining the spatial location of mining concessions was sourced from the SNL Metals & Mining, an offering of S&P Global Market Intelligence. Contains copyrighted and trade secret material distributed under license from SNL (accessed January 2018).
- Data defining the spatial location of oil and gas concessions was sourced from Drilling Info. Contains copyrighted and trade secret material distributed under license (accessed January 2018).
- The world's IFL map is a spatial database (scale 1:1,000,000) that shows the extent of the intact forest landscapes (IFL) for year 2016. Data from Greenpeace, University of Maryland, World Resources Institute and Transparent World. "Intact Forest Landscapes 2016" Available at www.intactforests.org.
- Data defining sub-basins was based on HydroBASINS Level 4 which provides a seamless global coverage of consistently sized and hierarchically nested sub-basins at different scales follows the traditional Pfafstetter coding. Accessed January 2018, available at http://www.hydrosheds.org/page/hydrobasins

The spatial overlap between these datasets as recorded by the GIS analysis was exported to MS Excel®. Data was filtered, where any extractive activity that could be interpreted as having a limited or negligible impact on a protected area was excluded by applying the following filters:

OIL & GAS

- Included all claims with the following status: "Application", "Contract", "Reserved areas" and "under negotiation".
- Excluded contracts with status "Force majeure" or "Open" as these are not active/not assigned to a company.
- Removed contracts that are registered as expired before 01.01.2018.
- Removed contracts not linked to any company ("Not operated").
- Removed contracts with overlap area smaller than 5 Km²

Assessing the potential threat of extractive industries to tropical intact forest landscapes (IFL)

MINING CLAIMS

- Include all claims with status "Granted" and "Application"
- Removed claims with status "Not operated" or not linked to any company.
- Removed contracts that are registered as expired before 01.01.2018.
- Removed mining claims with overlap area smaller than 1 Km²

Results were then combined to provide an overall summary of extractive activity overlapping IFLs. Maps were generated using these filtered results.

LIMITATIONS:

Regarding the data gaps and limitations, countries with no data which are within the areas of study are:

MINING GAPS:

- ***Amazon:*** Suriname and Venezuela.
- ***Asia-Pacific:*** Bangladesh, Brunei, China, India, Malaysia, Singapore, Timor-Leste, Thailand and Vietnam
- ***Central Africa:*** Angola, Equatorial Guinea, Nigeria, São Tomé and Principe

OIL AND GAS GAPS:

- ***Asia-Pacific:*** Singapore

NB: There were a few places that both oil and gas contracts, and mining claims overlap. When combined statistics are given, this is taken into account to avoid double counting.

RESULTS

WHAT IS THE OVERLAP OF TROPICAL IFLS AND EXTRACTIVES?

Within the entire study region there are nearly 5.2 million Km² of IFLs (Table 1). Of the total IFL area assessed, 74% of IFLs are in the Amazon, 16% in the Central Africa, and in Asia-Pacific 10% (Table 1).

In terms of the oil and gas contracts, there is a total overlap of just under 408,000 Km² with IFLs in the area of assessment, which amounts to just under 8% (Table 1). Central Africa has the highest overlap in total area (221,000 Km²) and proportionally with an overlap of just over 26% of IFLs within that region. Asia-Pacific is next with 18% overlap, and Amazon 2.5% (Table 1).

This is compared with mining claims that have a total of 589,000 km² overlap, which amounts to just over 11% of IFLs within the region assessed (Table 1). The highest area of overlap is Amazon (407,000 Km²), but in terms of the proportion of the IFL in that region it is highest in Central Africa with 16.5%, followed by Amazon with 11%, and Asia-Pacific with 9% (Table 1).

In total the overlap with the 16,000+ overlapping oil and gas contracts and mining claims within IFLs amounts to 975,000 Km² (there is a 21,000 km² overlap of oil and gas, and mining). This is around 19% of IFLs assessed.

TABLE 1. *Summary of the overlap of IFLs and oil and gas contracts and mining claims by tropical regions, Amazon,Central Africa, and Asia-Pacific and by WWF priority places.*

TROPICAL REGION	WWF PRIORITY PLACE	AREA (KM2)	INTACT FOREST LANDSCAPE (IFL)		OIL & GAS CONTRACTS OVERLAPPING IFL			MINING CLAIMS OVERLAPPING IFL		
			AREA (KM2)	% [1]	AREA (KM2)	NUMBER OF CONTRACTS	% [2]	AREA (KM2)	NUMBER OF CLAIMS	% [3]
Amazon	Amazon & Guianas	6 689 165,21	3 833 345,10	57,3	95 518,16	82	2,5	406 603,81	14 394	10,6
Central Africa	Congo Basin	3 947 103,19	840 471,64	21,3	221 467,49	27	26,4	138 781,30	988	16,5
Asia - Pacific	Borneo	722 178,34	94 800,47	13,1	1 316,42	9	1,4	6 111,69	83	6,4
	Coral triangle	742 803,49	63 537,73	8,6	3 283,00	18	5,2	8 902,24	142	14,0
	Mekong complex	2 520 763,43	63 277,12	2,5	7 860,27	7	12,4	2 849,31	12	4,5
	New Guinea & offshore islands	746 101,37	251 722,99	33,7	76 784,32	91	30,5	23 357,07	158	9,3
	Sumatra	433 115,15	36 611,67	8,5	1 407,73	8	3,8	2 464,86	55	6,7
TOTAL		15 801 230,20	5 183 766,71	32,8	407 637,40	242	7,9	589 070,26	15 832	11,4

[1] PERCENTAGE OF ECOREGION COVERED BY IFL
[2] PERCENTAGE OF IFL AREA COVERED BY O&G CONTRACTS
[3] PERCENTAGE OF IFL COVERED BY MINING CLAIMS

Assessing the potential threat of extractive industries to tropical intact forest landscapes (IFL)

WHERE ARE THE OIL AND GAS CONTRACTS THAT OVERLAP WITH IFLS IN THE THREE REGIONS?

Amazon

Within the Amazon region, there are nearly 4 million Km² of IFLs (Table 1) which represents 57% of the region assessed. The total overlap of oil and gas contracts with these IFLs is over 95,500 Km², which includes 82 contracts, and covers 2.5% of the IFL area (Table 1). These Oil and Gas contracts are generally in the western part of the region, and an area within the central Amazon (Figure 3). The country with the biggest overlap of Oil and Gas contracts and IFLs is Bolivia, followed by Colombia then Peru (Figure 2). The water basin which has the highest overlaps are Solimoes with just over 60,000 Km². This is a large basin and the overlap includes nearly 11,000 Km² in Brazil, just over 15,000 Km² in Colombia, and nearly 20,000 Km² in Peru. The next highest basin is the Madeira basin found only in Bolivia with nearly 30,000 Km².

Central Africa

Central Africa has around 840,000 Km² of IFLs (Table 1) which represents 21% of the region assessed. There are 27 contracts overlapping with just over 221,000 Km² of IFLs (26% of area) (Table 1). The country with the majority of contracts is DRC with 82% of the total area of overlap covering around 182,000 Km² of IFL (Figure 2). In DRC, the overlap is generally in the central region, and north-eastern Republic of Congo (Figure 4). The basins where the greatest overlaps are Moyen Congo with 88,000 Km², and Kwa-Kasai with just under 80,000 Km² which together comprise 76% of the area of overlap. The Second country with the greatest Oil and Gas overlap is the Republic of Congo covering around 36,000 Km² (Figure 2).

Asia-Pacific

There are nearly 510,000 Km2 of IFL within the Asia-Pacific which represents 10% of the region assessed. Within this region oil and gas contracts overlap with IFLs by 91,000 Km², which is an overlap of nearly 18% (Table 1). The general region with the highest overlap is New Guinea and offshore islands with 77,000 Km² and 30% overlap (Figure 8). There is also significant amount of overlap on the island of Borneo and north western Myanmar (Figure 5-7). The country with the highest overlap of IFL and Oil and Gas is PNG with just over 73,000 Km², followed by Indonesia with 8,000 Km², and Myanmar with just 7,500 Km² (Figure 2).
The basins with the biggest overlap of contracts and IFLs are all in New Guinea (Figure 5-7).

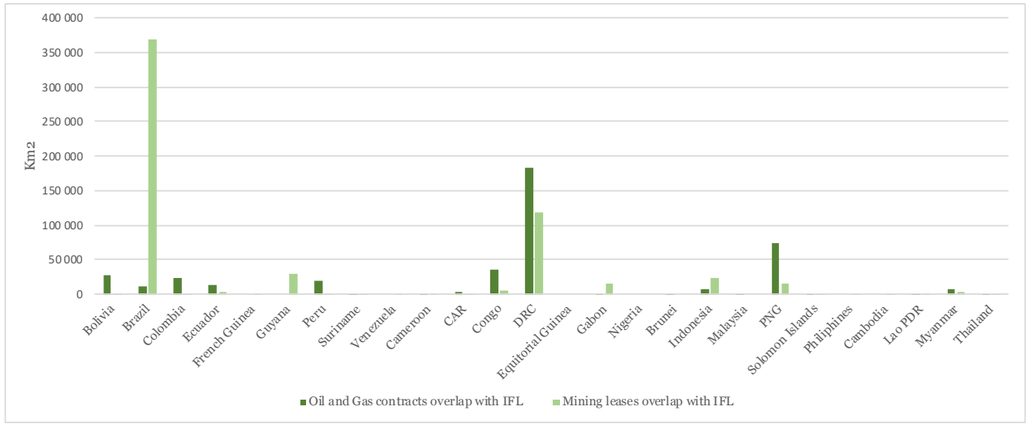
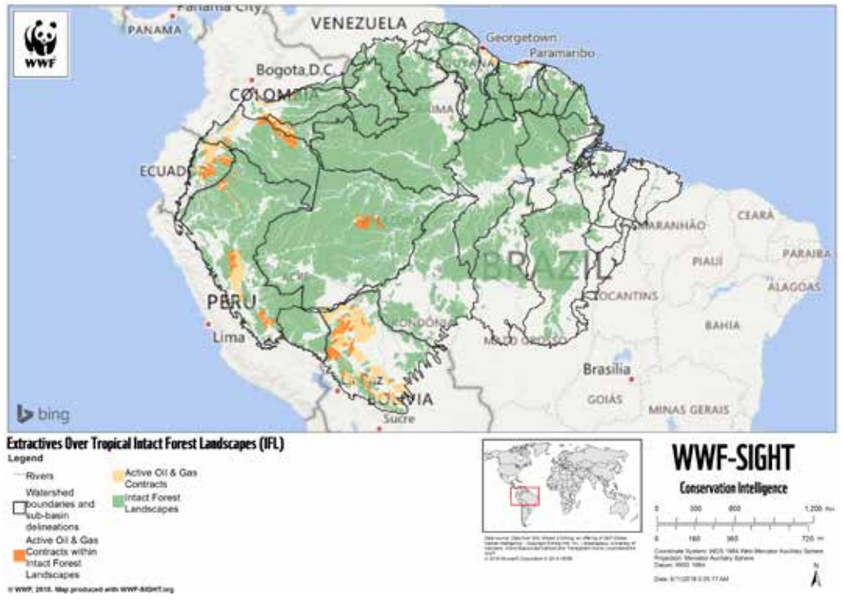


FIGURE 2. *The overlap of Oil and Gas contracts, and mining claims within each country in the study region. Not that data were missing for some countries here for Oil and Gas contracts or mining leases.*

FIGURE 3. *Map of the overlap between IFLs and Oil and Gas contracts in Amazon. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*



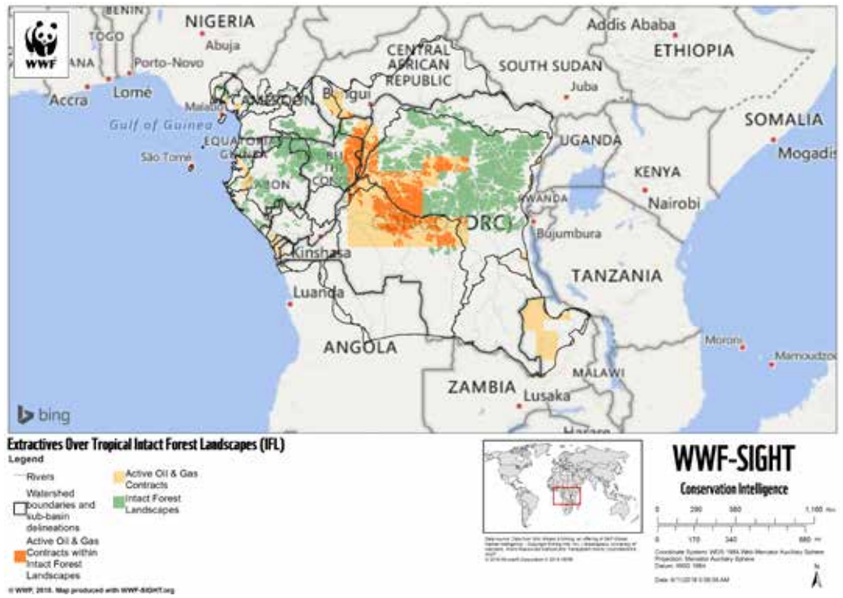


FIGURE 4. *Map of the overlap between IFLs and Oil and Gas contracts in Central Africa. For the interactive map, visit http://wwf-sight-maps.org/IFL/*

FIGURE 5. *Map of the overlap between IFLs and Oil and Gas contracts in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

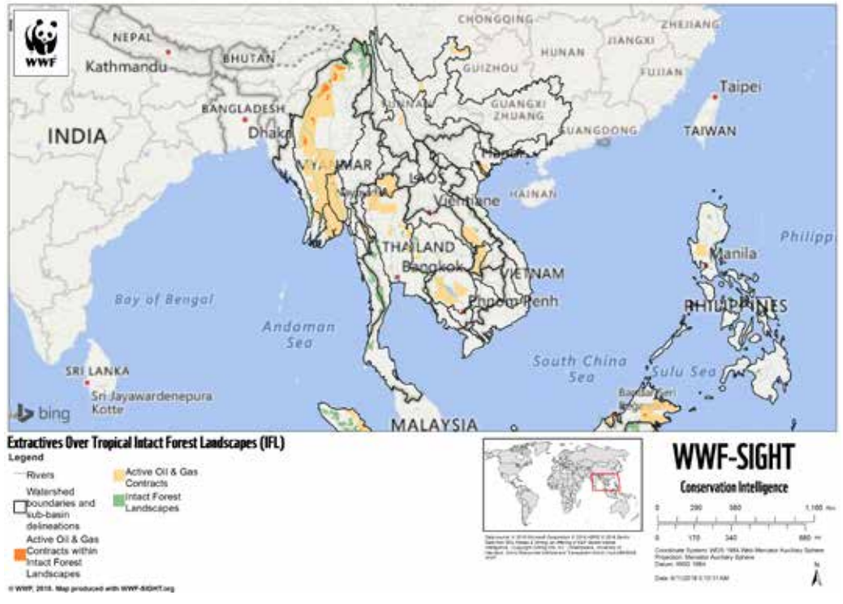


FIGURE 6. *Map of the overlap between IFLs and Oil and Gas contracts in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

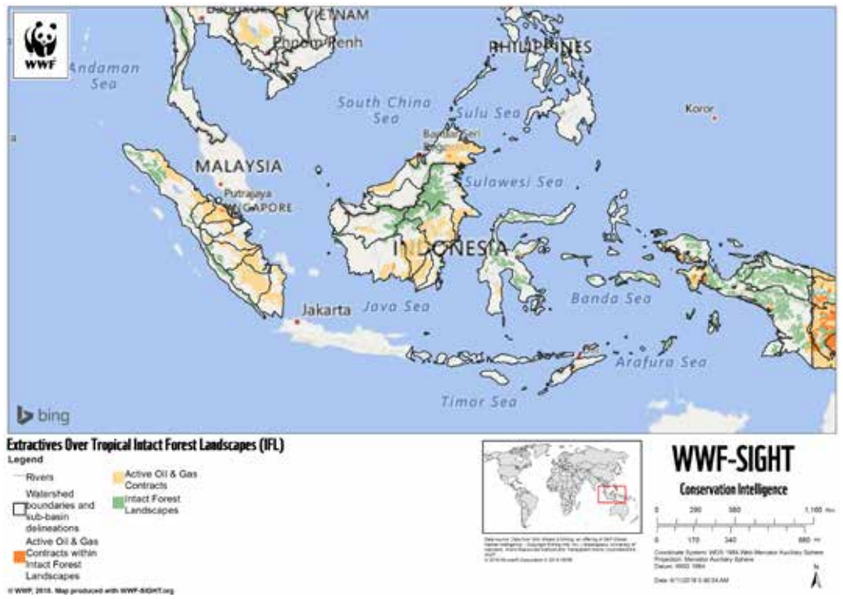
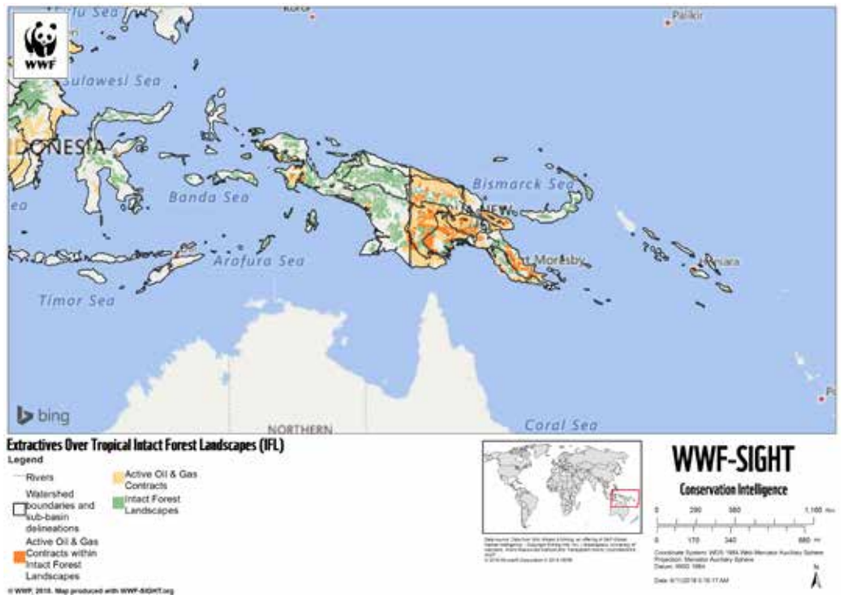


FIGURE 7. *Map of the overlap between IFLs and Oil and Gas contracts in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*



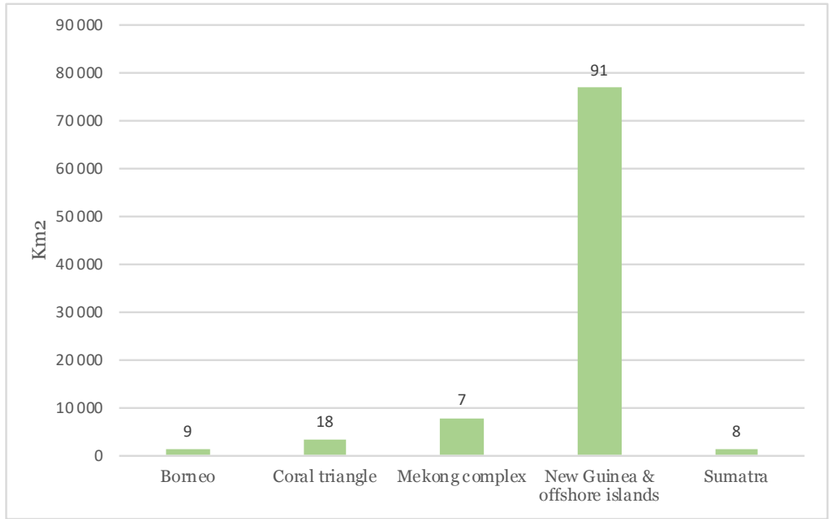


FIGURE 8. *The overlap of IFLs and Oil and Gas contracts within the subregions of Asia-Pacific. Column totals reflect the total area of contracts within each sub-region, and the numbers on the bars are the number of contracts.*

WHERE ARE THE OIL AND GAS CONTRACTS THAT OVERLAP WITH IFLS IN THE THREE REGIONS?

The following describes the characteristics of the oil and gas contracts. For oil and gas contracts these can be for oil, gas, oil and gas together, and/or gas and condensate. For some contracts this was unknown. A description of the most commonly used oil and gas development stages is found in Table 2.

TABLE 2. *The different development stages of Oil and Gas projects .*

STAGE	DEVELOPMENTSTAGE	TIMING	DESCRIPTION
Pre-stage	Government Reserved	Variable	These are the oil and gas reserves of a country
Stage 1	Exploration	1-5 years	Exploration for potential viable oil/gas sources through geological surveys.
Stage 2	Evaluation	4-10 years	Sites identified as potentially containing viable oil/gas sources are examined in more detail. Infrastructure may be developed to access sites. Site drilling is planned and exploratory wells are drilled to seek to discover and map oil/gas reserves.
Stage 3	Development	4-10 years	Government contracts and permits may be revised/renewed and the site is prepared for production. Limited infrastructure and site development will already be in place as part of the exploratory and initial drilling phase, but during the field development phase activity will dramatically increase and first oil/gas will be produced towards the end of this phase.
Stage 4	Production	20-50 years	Oil/gas reserves are being extracted and transported for processing and distribution. There is uncertainty in any field about the amount of oil/gas, so it can be difficult to predict the volume of production which will fluctuate across this phase, with the rate of extraction typically rising to a peak and tapering off towards the end of the field's commercial lifetime
Stage 5	Close	2-10 years	Once it is no longer cost-effective to extract remaining reserves, the site is decommissioned and the operating companies are typically responsible for returning the site to as close to original state as possible. This phase can take decades if environmental monitoring is required.

Assessing the potential threat of extractive industries to tropical intact forest landscapes (IFL)

Amazon

There are 82 contracts in the Amazon overlapping with IFLs. Combined oil and gas contracts are most common in this region with 33 contracts covering nearly 40,000 Km² (Figure 9). Around half of these contracts are at the stage of exploration and production (Figure 10), and one-fifth are reserved by government for potential future exploration (Figure 10) based on overlapping area.

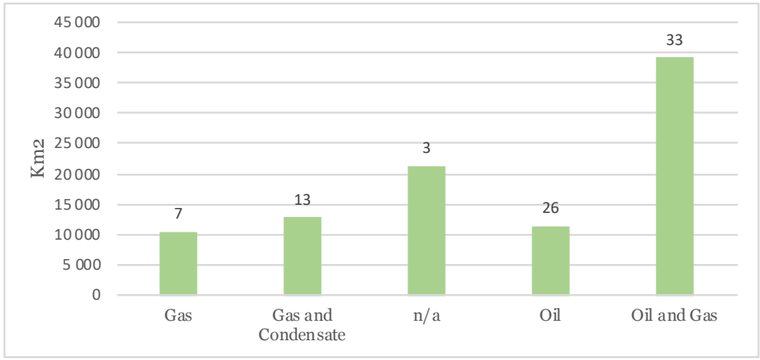


FIGURE 9. *Type of Oil and Gas contract overlapping with IFLs in the Amazon. The number above the bars are the number of contracts.*

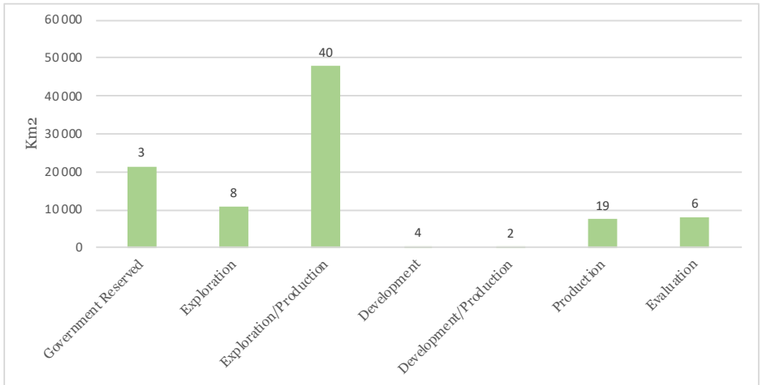


FIGURE10. *The production stage of contact for Oil and Gas contracts overlapping with IFLs in the Amazon. The number above the bars are the number of contracts.*

Central Africa

There are 27 contracts overlapping with IFLs in Central Africa (Table 1). The majority of contracts are for oil, with 17 contracts covering 81.5% of the overlap area (180,000 Km²). Combined oil and gas contracts cover a much smaller area of 42,000 Km² overlap. Almost all of these contracts are in the exploration stage (Figure 11), with only 5 contracts currently allowing some level of production.

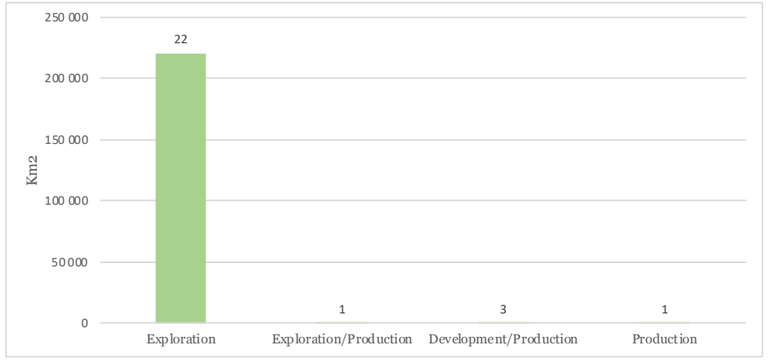


FIGURE 11. *The production stage of contract overlapping with IFLs in Central Africa. The number above the bars are the number of contracts.*

Asia-Pacific

There are 134 contracts overlapping with IFLs in Asia-Pacific (Table 1). The majority of these contracts are combined Oil and Gas, with 76 contracts covering 47,000 Km² (52%) of IFL area (Figure 12). The remainder are mostly "gas only", with 39 contracts covering 41,000 Km² of IFL area (Figure 12). The majority of all contracts (87 out of 133) are at the exploration stage, with only 9% of overlap area (82,000 km) currently licensed either for production or for exploration/production (Figure 13).

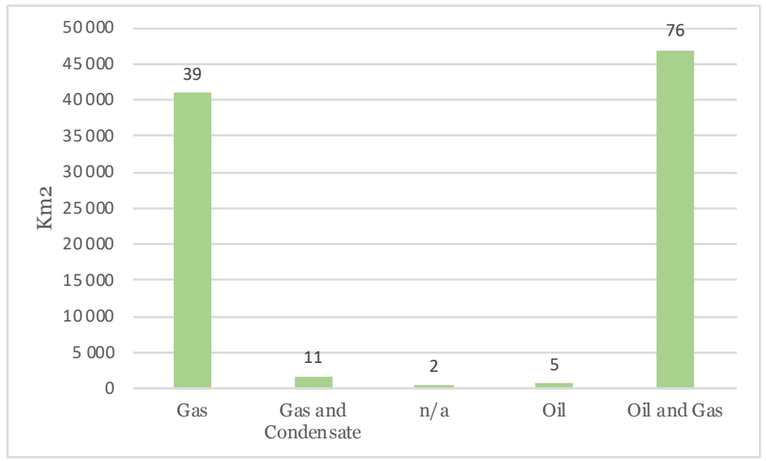


FIGURE 12. *Type of Oil and Gas contract overlapping with IFLs in the Asia-Pacific. The number above the bars are the number of contracts.*

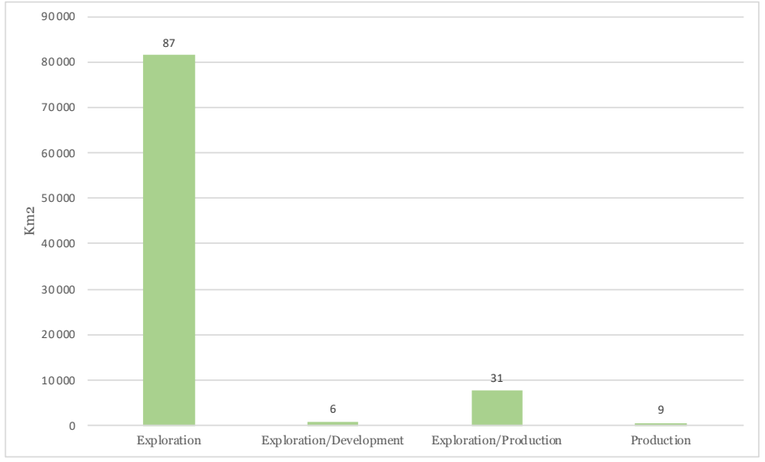


FIGURE 13. *The production stage of contract overlapping with IFLs in Asia-Pacific. The number above the bars are the number of contracts.*

WHERE ARE THE MINING CLAIMS THAT OVERLAP WITH IFLS?

Amazon

There is a total of 589,000 Km² of overlap between IFLs and mining claims in the Amazon (Table 1). This consists of 15,832 claims covering nearly 11% of IFLs in the region (Table 1), with most claims located in the eastern part of the region (Figure 14). These mining claims are overwhelming within Brazil, which includes 91% of the total, and nearly 370,000 Km² in area and 6483 contracts, followed by Guyana with nearly 29,000 Km² in area (Figure 2). Not surprisingly, the basins with the highest overlaps are primarily within Brazil. The country though with the highest number of contracts is Guyana (7,285), followed by Brazil, which make up the majority of all the contracts. These are scattered across numerous basins.

Central Africa

Of the 840,000 Km² of IFLs, there are just under 139,000 Km² of mining claims, which are 988 contracts covering 16.5% of the IFL area (Table 1). The primary country with by far the highest overlap of mining claims and IFLs is DRC with around 118,500 km (84% of total area of overlap) and nearly all the contracts 991 out of 1038 (Figure 2). Next is Gabon followed by Republic of Congo. The general area of overlap is in the eastern part of Central Africa, and the river basins with the highest overlaps are Moyen Congo with 92,000 Km² followed by Kwa-Kasai with 79,000 Km² (Figure 15).

Asia-Pacific

Within the Asia-Pacific region, of the IFLs cover 95,000 Km² of the region (Table 1). The highest overlap of mining claims and IFLs is New Guinea and offshore islands with just over 23,000 Km² (and 158 out 450 contracts) (Figures 19). The country with the highest overlap is Indonesia with just over 23,000 Km², followed by PNG with just over 15,000 Km². The basins with the highest overlap are predominantly on the Island of New Guinea (Figure 16-18).

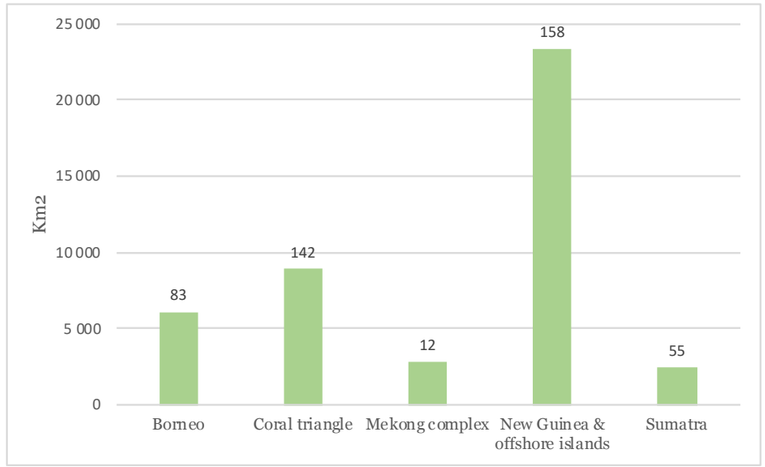


FIGURE 19. *The overlap of IFLs and mining claims broken down by different regions within Asia-Pacific. The numbers on the columns are the number of claims.*

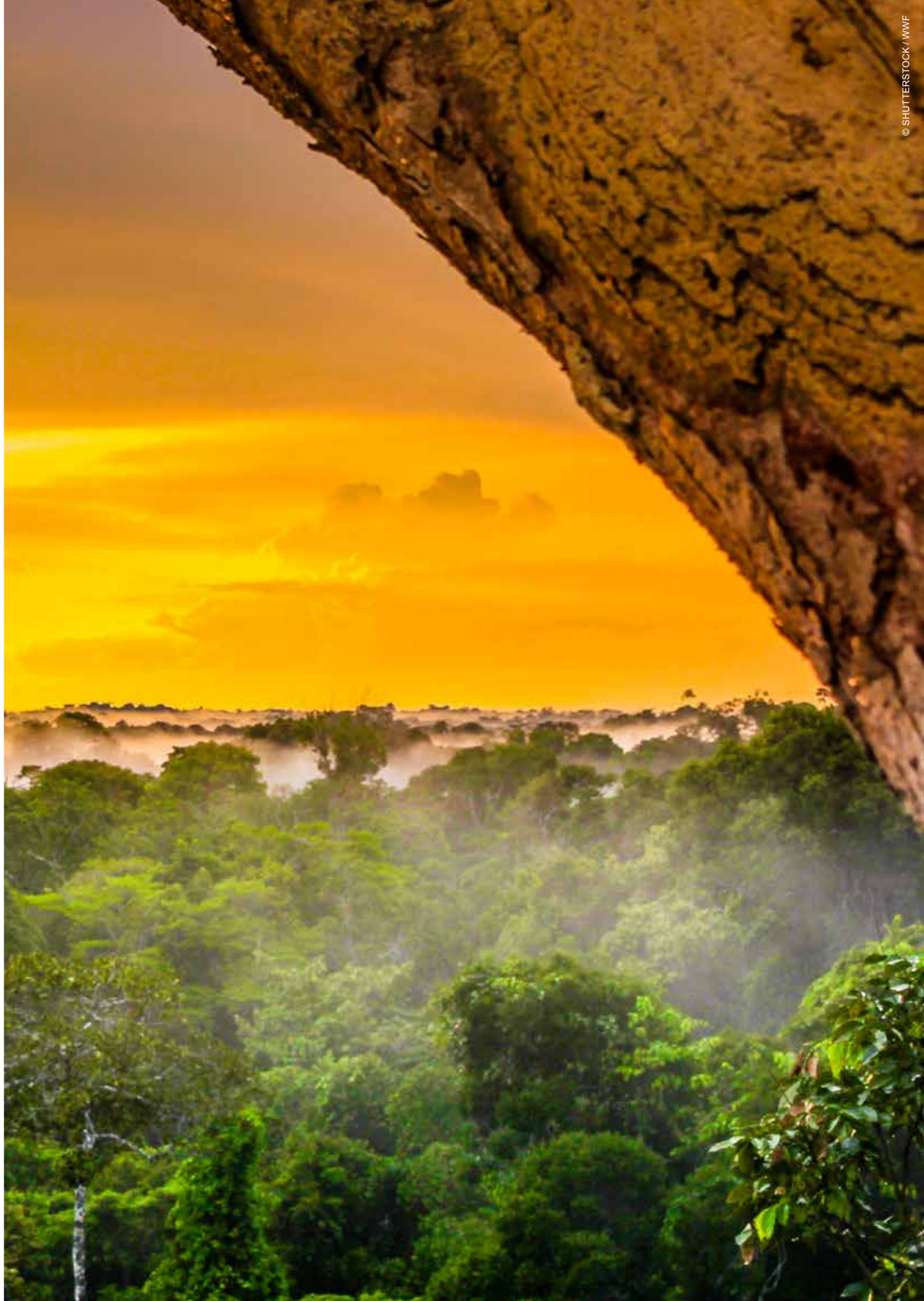


FIGURE 14. *Map of the overlap between IFLs and mining leases in Amazon. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

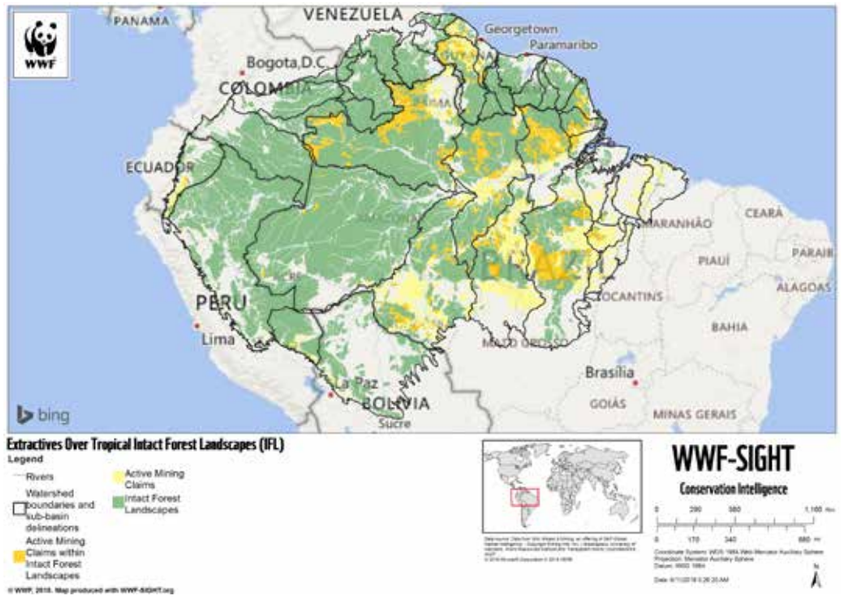


FIGURE 15. *Map of the overlap between IFLs and mining leases in Central Africa. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

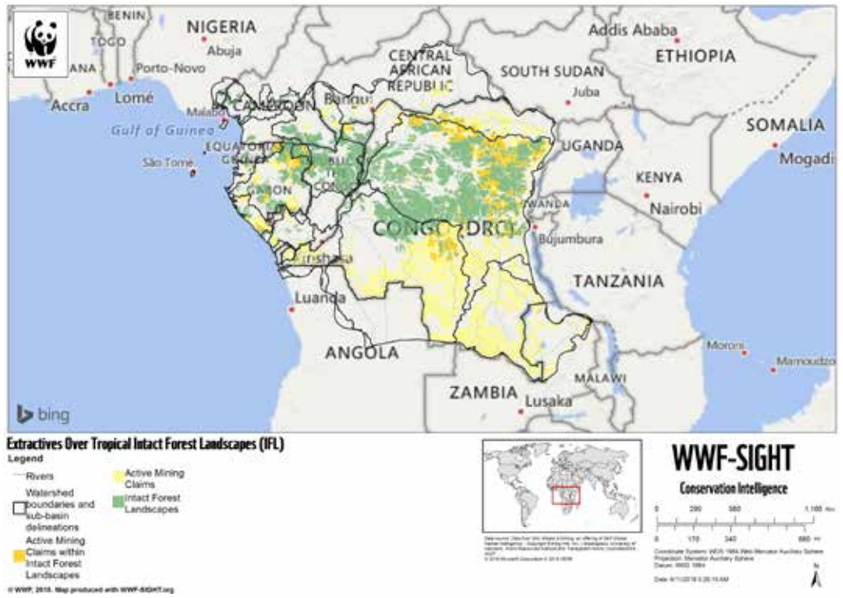


FIGURE 16. *Map of the overlap between IFLs and mining leases in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

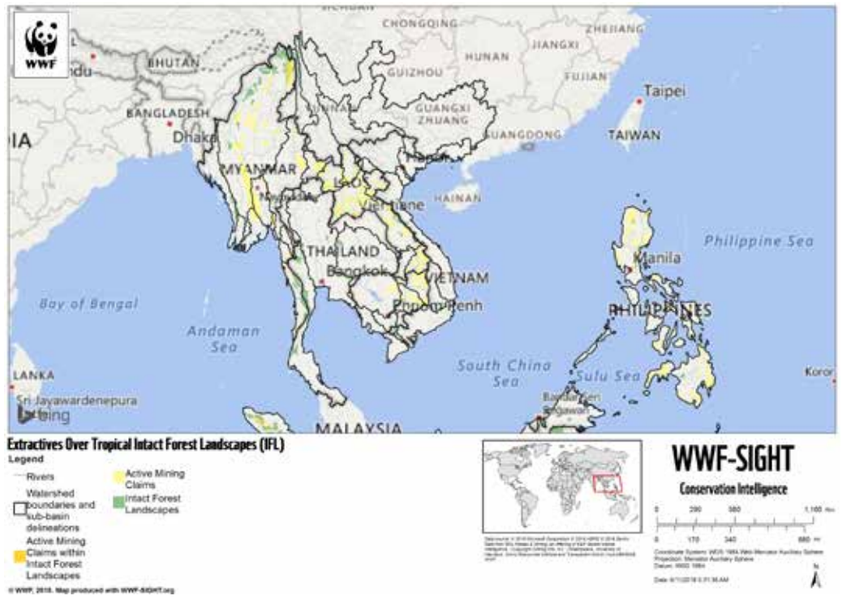


FIGURE 17. *Map of the overlap between IFLs and mining leases in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

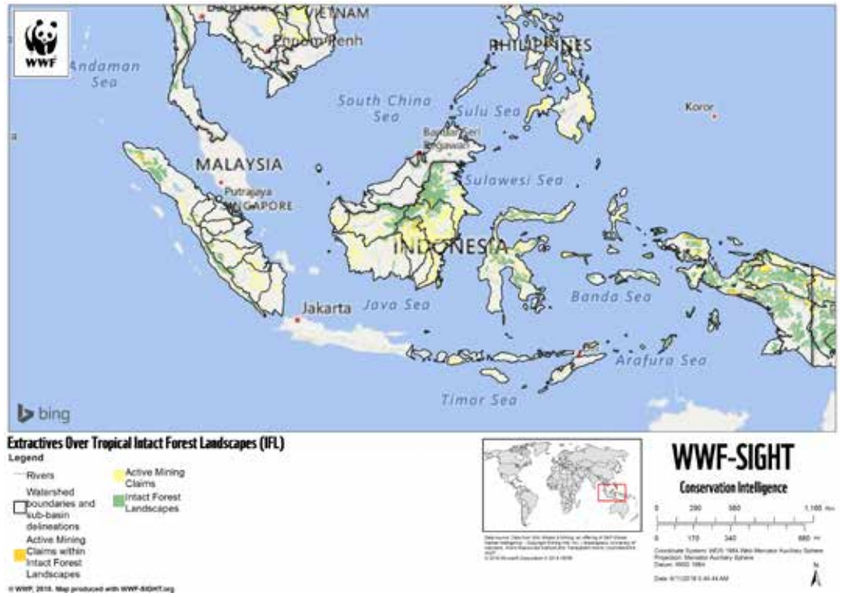


FIGURE 18. *Map of the overlap between IFLs and mining leases in Asia-Pacific. For the interactive map, please visit http://wwf-sight-maps.org/IFL/*

WHAT ARE THE CHARACTERISTICS OF THE MINING CLAIMS THAT OVERLAP WITH IFLS?

The following describes the characteristics of the mining claims. First we summarize the commodity type. This is complex as often one claim might be for numerous minerals. For the development stage of mining claims see Table 3.

TABLE 3. *Different mining stages of mining claims*

MINING STAGE	DESCRIPTION
Claim	The ground covered by this polygon has been set aside for an activity to take place. Minerals have been found in this area but no mining has taken place.
Exploration Lease/License	The ground covered by this polygon has been leased or licensed to be explored. No extraction activity.
Exploration Permit	The owner of this ground covered by the polygon has a permit for exploration of minerals to occur. No extraction activity.
Mining Lease/License	The ground covered by this polygon has been put aside for a mining activity or mining activity is currently taking place.
Other	Any other lease type not assigned to the other types. EG Infrastructure leases.
Prospecting	The ground covered by this polygon has been leased or licensed to be prospected for minerals.
Patent	A Patent claim is one where the owner has more freedom over what they can do with that land after exploration has taken place and possibly more ownership of the land.

Amazon

For this region, the majority of the mining commodity type overlapping with IFLs at nearly 50% combined is Gold and Gold Ore (Figure 20). This is followed by n/a (i.e. commodity not specified) (8%) and Cassiterite (nearly 4%) (Figure 20).
The vast majority of these mining claims by area are at the exploration permit stage (just above 89%, ~364,000 Km²), followed by exploration lease/licence (Figure 21). In contract numbers, there are slightly more at the exploration lease/licence stage but few mining claims are actually at the mining lease/licence stage, with 412 contracts covering less around 8,000 Km².

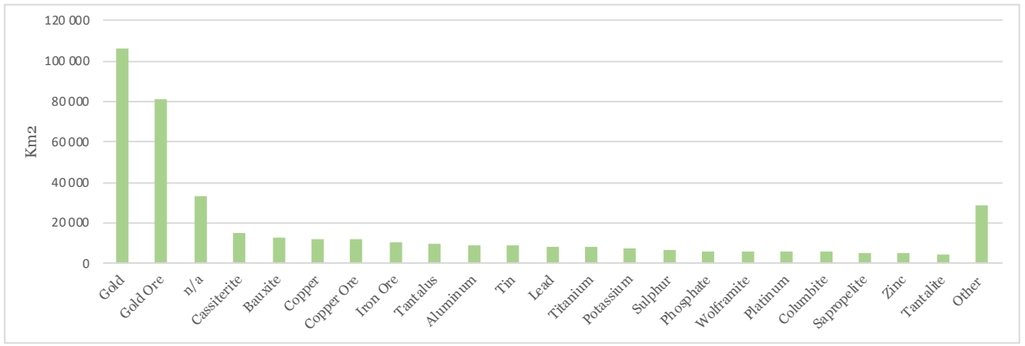


FIGURE 20. *The overlap of IFLs and the commodity within the mining claim with the Amazon.*

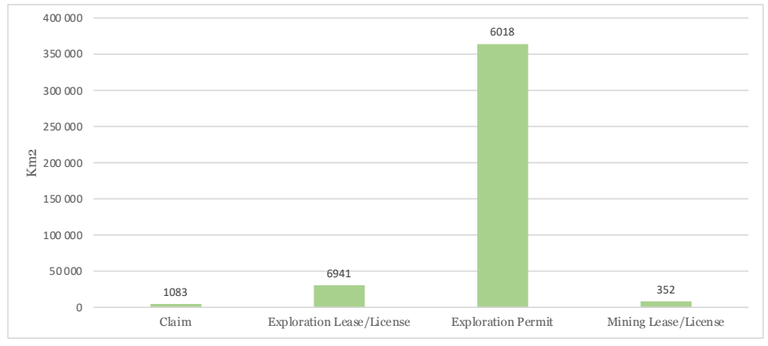


FIGURE 21. *The overlap of IFL and the production stage of the mining claim within the Amazon. For description of the stage please see the methods.*

Central Africa

Within the Central Africa region, the overlap of IFLs and mining claims and their commodity is primarily gold, diamond which covered just 22% of the area (just over 30,000 Km²), followed by n/a, gold, and diamond (Figure 22). Together the combinations of gold and diamond cover just over 50% of the overlap area.
The production stage of most mining claims is not clear, with almost all classified as "other" (Figure 23). These "other" claims make up nearly 80% of the IFL overlap area (111,000 Km²), followed by exploration lease/licence with just over 20,000 Km² (15%; Figure 23).

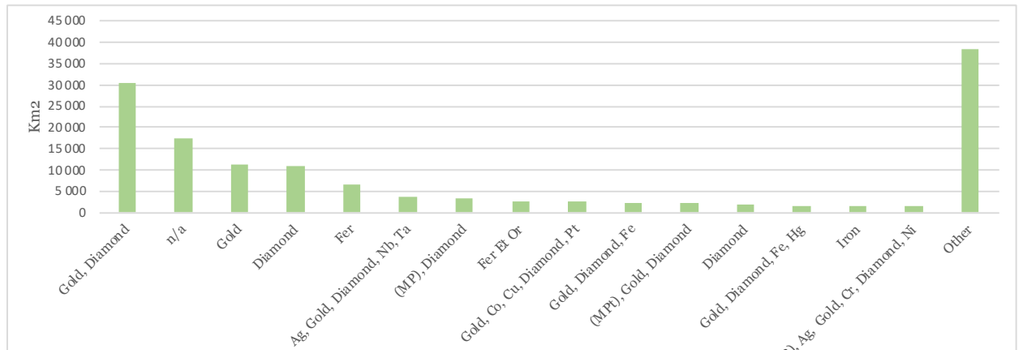


FIGURE 22. *The overlap of IFLs and the commodity within the mining claim within Central Africa. Numerous claims had multiple minerals.*

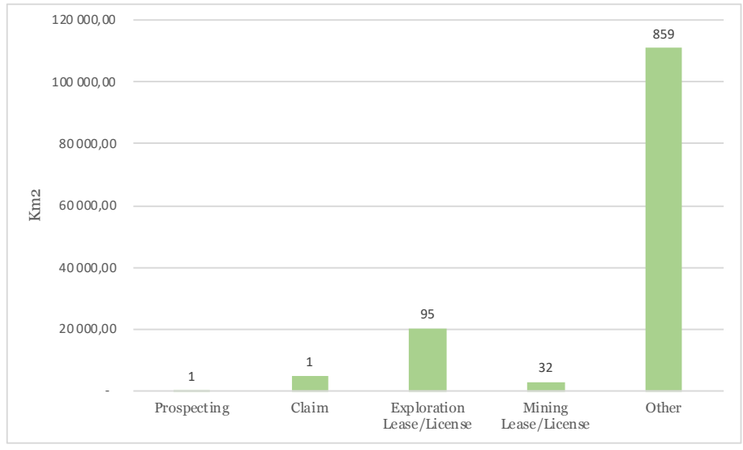


FIGURE 22. *The overlap of IFL and the production stage of the mining claim within Central Africa. For description of the stage please see the methods.*

Asia-Pacific

Of all mining claims and overlaps with IFLs in the Asia-Pacific, the commodity is unknown for most, followed by Gold (11,500 Km²), and coal (just over 9,000 Km²) (Figure 24). The stage of mining is mostly exploration lease/licence with just over 34,000 Km² (Figure 25).

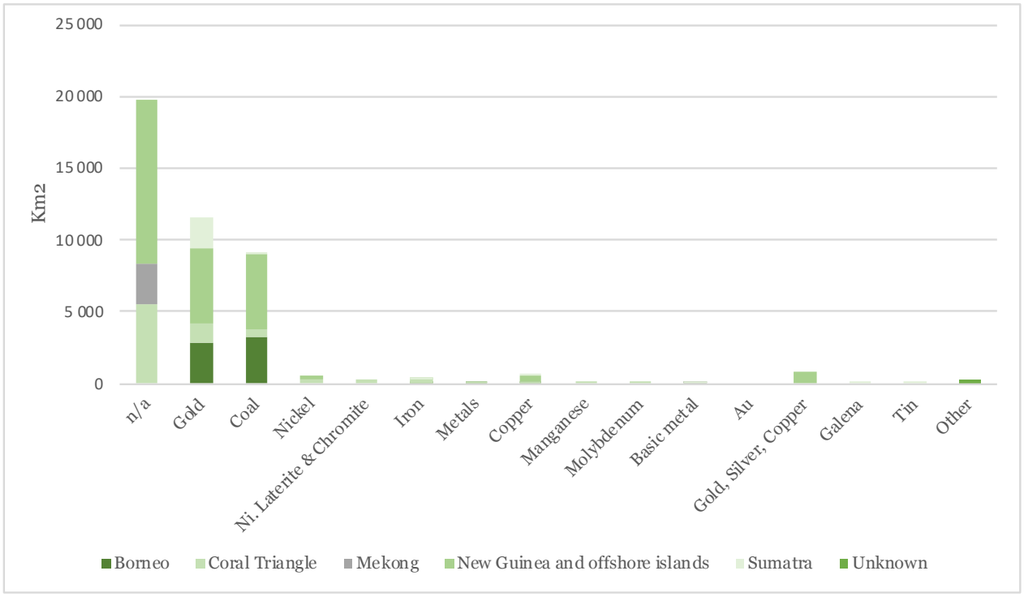


FIGURE 24. *The overlap of IFLs and mining claims including which commodity the claim is for.*

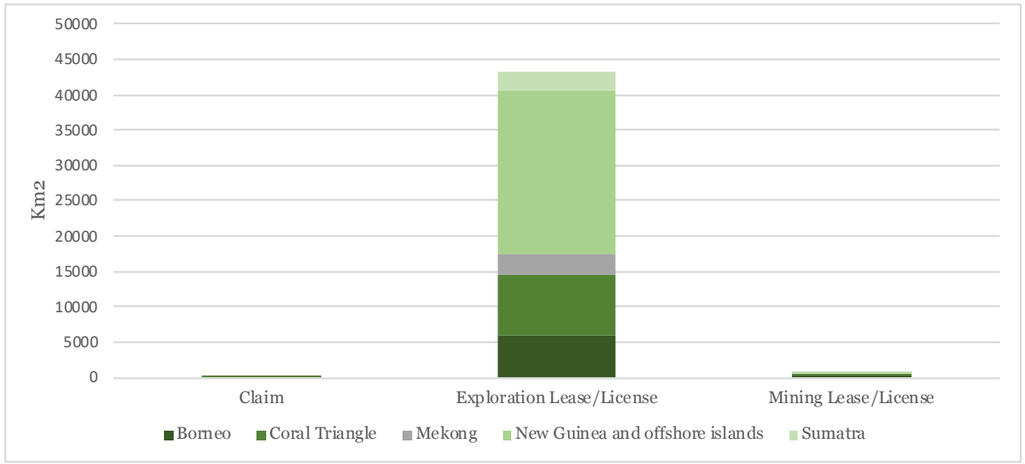
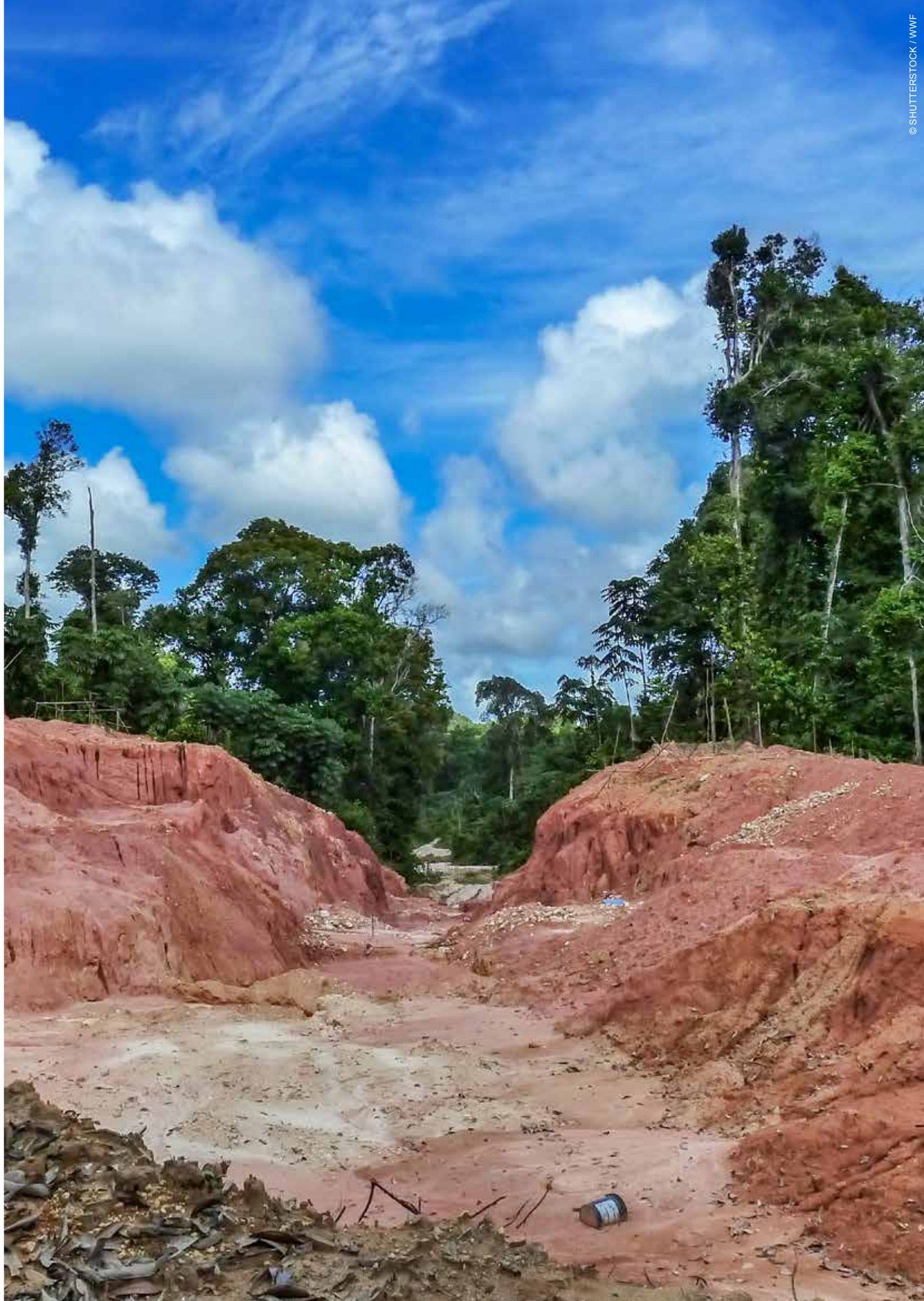


FIGURE 25. *The overlap of IFLs and mining claims including which stage of production the claim is for. This is also broken down by sub-region. For description of the stage please see the methods.*



DISCUSSION

Our results show that the extractive sector poses a substantial threat to tropical IFLs worldwide, with oil and gas contracts overlapping around 8% (408,000 Km^2) of these tropical IFLs, and a larger overlap of 11% (590,000 Km^2) for mining claims within the area assessed.

Collectively this is around 975,000 Km^2 or 19% of tropical IFLs in the area assessed, which have an overlap with extractives once overlapping oil and gas contracts and mining claims are deleted. These numbers need to be considered against data limitations, which are discussed below. Between 2000 and 2013, extractive industries were a major cause of IFL loss especially in boreal regions (not assessed in this study), but also in Latin America, where they were the third most important driver [7]. Our 2018 analysis using the 2016 IFL dataset shows that there is a significant potential threat of further IFL loss due to the extractive sector, and this appears to be true across all three major tropical regions.

For oil and gas contracts, the IFL overlap is largest in Central Africa, and DRC has the highest overlap for any of the countries assessed (i.e. 82% of its IFL area). In Central Africa these contracts are mostly gas, and predominately at the exploration stage. If significant reserves are found, there is potential for a huge impact on the region (especially DRC and Republic of Congo) unless the right safeguards are put in place (see recommendations below). In Asia-Pacific, most contracts are for combined oil and gas, and most are at the exploration stage. Similar to Central Africa, these contracts pose a potential future threat for countries like Papua New Guinea if significant reserves are found and the right safeguards are not in place. Contracts in the Amazon are mostly oil and gas together, but production is more advanced than the other regions, with similarly many exploration contracts but also a number of contracts already under production.

Our results show that the largest overlap between IFLs and mining leases is in the Amazon region, and Brazil is the country with the overwhelmingly greatest overlap out of all countries assessed, with 370,000 Km^2 of its IFL area. In the Amazon region, mining is mostly for gold and most claims are at the exploration stage. In Central Africa, most claims are also targeting gold, but the stage of most claims is not clear from the data. As such, it is difficult to estimate the current activities of these claims on IFLs. In the Asia-Pacific, gold remains the main commodity, but there is also a significant number of coal claims. Similarly, in the Amazon, most claims are at the exploration lease/licence stage.

THERE ARE NEARLY 5.2 MILLION KM^2 OF IFLS IN THE REGION ASSESSED. THIS BREAKS DOWN TO 74% IN THE AMAZON, 16% IN THE CENTRAL AFRICA, AND 10% ASIA-PACIFIC.

There are some limitations to consider with these results: a) we did not have data for all of the countries within the regions of focus (see methods for a list of missing data) and as such this might result in an underestimation of the threat, b) although extractive data have been purchased from world leading providers, this does not exclude data gaps and could lead to inaccuracies, c) the large surface area of Oil and Gas concessions could lead to inflating the threat level as it is important to know that in most cases, only a fraction of these concession are actually explored and exploited, although indirect impacts are usually large relative to direct footprint (discussed below). Finally, it is important to note that this study only assessed commercial extractives company's contracts and claims, and did not do any assessment of artisanal and illegal activities that can pose high threats to IFLs.

In terms of direct and indirect impacts of extractive industries to IFLs, direct impacts from activities such as exploration drilling (e.g. footprint of drill pads) can be quite limited, the indirect impacts such as exploration infrastructure (e.g. rights of way, roads and power lines creating access to remote areas and fragmenting the forest) are usually more substantial (further discussed below). Additionally, in several cases the presence of large numbers of staff in remote areas can lead to illegal activities such as bushmeat hunting or trade of other local resources. Further, exploration phase activities are not usually subject to the same level of regulatory licensing and Environmental and Social Impact Assessment (ESIA) as production phase activities, despite the major impact of rights of way in IFL and are therefore less likely to be mitigated. Therefore, estimating the scale of impact based on available data of exploration concessions is particularly difficult.

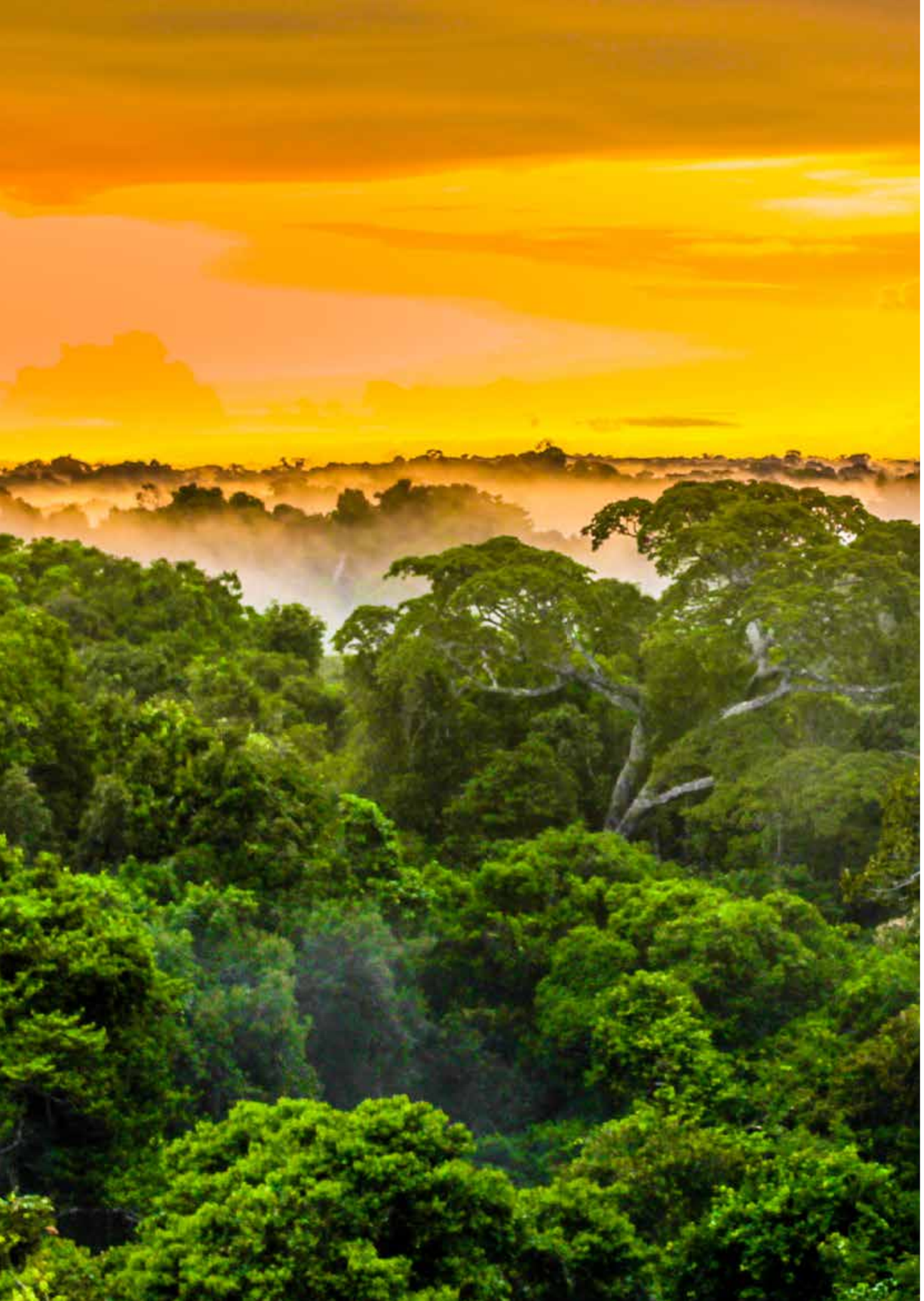
There are numerous types of direct impacts from extractives companies. For example, oil and gas projects often require long pipelines to carry oil or gas from the wells to be exported. A gas project in Peru required a pipeline to be built over 400 km crossing important high-altitude wetlands and important vegetation communities (see case study 1). The clearing of vegetation for mining projects, particularly clear-cut mining can be significant too, for example the clearing needed for the Carajás Mine (see case study 2). For mining projects with tailings dams there can be very significant impacts if the dam fails. One of Brazil's worst environmental disaster ever recorded was the failure of the Samarco (Vale-BHP-Billiton) tailings dam that collapsed causing 40 million litres of water and sediment from iron ore extraction that polluted the water supply of thousands of people and huge biodiversity losses (see case study 3). Mercury from treating process associated with gold mining can be particularly polluting of rivers and wetlands too.

It is clear that the indirect impacts of both oil and gas, and mining almost always extend far beyond their direct footprint. These impacts include the infrastructure needed to access sites and presence of new staff and their families, which fragments intact forest blocks, facilitates increased access to forests and cause further forest loss, habitat degradation and species declines. For example, the Carajás Mine in northern Brazil did fairly well at protecting around the mining site; however, it is likely that the 800 km+ railway has contributed to deforestation along its route (see case study 2). Recent studies in the Amazon show that mining leases drive increased forest loss in areas up to 70 km beyond mining leases [8]. A single badly placed road can cause large areas on either side to fall below the size threshold for an IFL. To mitigate adverse impacts of extractive projects and conserve tropical IFLs, environmental assessments and licensing must consider both on- and off-lease impacts to biodiversity. This is particularly important in places like Tri-National Dja-Odzala-Minkébé or Tridom in Central Africa (see case study 4) where new infrastructure could open up forests to a host of threatened processes to forests and its wildlife [2, 9]

When assessing the impacts of extractive projects on IFLs, it is important to consider that the impacts from a single project cannot be measured in isolation. Where numerous development projects occur within a region, this can lead to cumulative impacts which may be overlooked if concession applications are considered individually, particularly if they are from different sectors (e.g. oil and gas, mining, transport infrastructure, hydropower). Within many of the IFLs and countries assessed here, these cumulative impacts are already occurring with ongoing loss of forests from infrastructure, industrial logging, agriculture etc. This again is a big risk in the Tridom landscape where there are already numerous logging concessions that need to put in place logging roads to gain access to timber, large infrastructure like highways connecting up places within the region, and large-scale dams (see case study 4).

Extractives projects have different stages of development and different decisions are made throughout the development process from: planning including site identification and project design, to implementation, and restoration following the end of the project. Applying the mitigation hierarchy (avoidance, minimization, restoration, and offsets/ compensation) is critical throughout this process to reduce potential impacts and help companies aiming to achieve no net loss of biodiversity or at least minimize overall loss [10]. The mitigation hierarchy includes first avoiding impacts, for example by identifying

OF THE 16,000+ OIL AND GAS CONTRACTS AND MINING CLAIMS THAT OVERLAP WITH TROPICAL IFLS (ASSESSED) IT AMOUNTS TO 975,000 KM^2 OR 19% OF IFL AREA.



critical habitat which should not be impacted. Avoidance planning must take place before project design as changing a project design is costly and complex. Ideally, landscape planning can feed into this process by having readily available information on the most important intact forests areas for companies to consider in their decision-making. This requires coordination with government to understand the plans of other potential projects at the landscape-scale. This might require Strategic Environmental Assessments that can consider numerous projects and environmental values at once. After avoidance, the next step in the mitigation hierarchy is minimization - where management strategies are put in place to reduce potential impacts during their implementation. This might include activities like placing controls on a road to prevent access by non-project vehicles and people. After minimization comes restoration, where companies are expected to restore an impacted site to its previous condition. This is problematic for IFLs, as it is almost impossible to restore the myriad values of intact forests. The final step in the mitigation hierarchy is offsetting – where any residual impacts from the project (after avoidance, minimization and restoration) are offset or compensated to ensure no net loss. It is questionable though if most intact forests are even able to be offset given their irreplaceability [5]

BETWEEN 2000 AND 2013, EXTRACTIVE INDUSTRIES WERE A MAJOR CAUSE OF IFL LOSS ESPECIALLY IN BOREAL REGIONS (NOT ASSESSED IN THIS STUDY), BUT ALSO IN LATIN AMERICA, WHERE THEY WERE THE THIRD MOST IMPORTANT DRIVER [7]. OUR 2018 ANALYSIS USING THE 2016 IFL DATASET SHOWS THAT THERE IS A SIGNIFICANT POTENTIAL THREAT OF FURTHER IFL LOSS DUE TO THE EXTRACTIVE SECTOR, AND THIS APPEARS TO BE TRUE ACROSS ALL THREE MAJOR TROPICAL REGIONS.

CASE STUDY 1: DESIGNING A GAS PIPELINE IN THE PERUVIAN ANDES TO AVOID BIODIVERSITY IMPACTS

Peru LNG is a natural gas liquefaction plant in Pampa Melchorita, Peru. It is the first natural gas liquefaction plant in South America and one of the biggest industrial projects completed for Peru. The total investment for the project, including the liquefaction plant ($1.5bn), related marine and pipeline facilities and development and financing costs, was $3.8bn. The project was financed by a variety of sources, including the Inter-American Development Bank, with which Peru LNG signed an $800m mandate letter in July 2006. A bond issue in the Peru capital market was made in late 2009 for additional funding. International Finance Corporation (IFC) advised Peru LNG in optimising the environmental approach to meet the IFC performance standards. A biodiversity Action Plan (BAP) guided the development of the pipeline to avoid, minimize and restore biodiversity values. A review of this process found successful implementation of the mitigation hierarchy in terms of the avoidance strategies like micro-routing (fine-scale re-routing around important conservation values) and successful restoration schemes [see 11].

CASE STUDY 2: PAST INDIRECT IMPACTS FROM A BRAZILIAN RAILWAY CONNECTING CARAJAS MINE TO THE COAST

In 1967, a helicopter carrying a team of geologists from a Brazilian subsidiary of U.S. Steel landed on a hilltop to refuel. The geologists recognized iron ore on the surface of the hill, and many decades later the Carajás Mine in northern Brazil is now the largest iron mine in the world. Around the mine is a large (4000 km²), very well protected conservation area, and the company has done well at avoiding any impacts to the forest within this area. However, from the mine to the coast is 800 km+ long rail line used to export iron ore from the port of Ponta da Madeira in the northeastern state of Maranhao. It is clear that railways and roads which facilitate access to forests drive increased deforestation, and this railway has probably contributed to deforestation along the route, which has caused protests by some indigenous people and conservationists.

CASE STUDY 3: BURST DAM TAILINGS CAUSE BRAZIL'S WORST ENVIRONMENTAL DISASTER

On 5th November 2015, the biggest environmental disaster occurred in Brazil. It was the mine dam from a joint venture between Vale and BHP-Billiton, Samarco mine spilled the tailings down the Doce River watershed 660 km to the coast. It is the largest tailings dam burst in modern history [12]. The impact on people was huge, it killed 19 people, destroyed homes, polluted water supply and affected the livelihoods of over 1 million people. The 40m litres of water and sediment that polluted the water supply also affected aquatic life including 100+ species of fish [12].

CASE STUDY 4: POTENTIAL RISKS OF INDIRECT AND CUMULATIVE IMPACTS IN THE TRIDOM LANDSCAPE IN THE CONGO BASIN

At the intersection of Gabon, Cameroon, and Republic of Congo is a largely intact forest of 178,000 km². It is called the Tri-National Dja-Odzala-Minkébé or Tridom landscape and is amongst the most wildlife rich forests left in the Congo Basin. Vast areas are uninhabited, while Bantu and Ba'ka (pygmy) people live in scattered villages along the few roads. Overall population density is low with around 1 inhabitant per km² and rural livelihoods are based on subsistence agriculture, fishing and hunting, artisanal gold mining and cocoa farming. Almost 97% of Tridom is covered with IFLs, with protected areas covering 24% and logging concessions covering around 60%.

The Tridom landscape is also an emerging iron ore province, and several mining projects are under development, including the Mbalam-Nabeba project straddling the Cameroon-Congo border. Although the planned mines are likely to have limited footprints relative to the size of the Tridom, they will have direct, indirect and cumulative impacts. For example, Sundance Resources estimates only 20 km² of direct deforestation for Nabeba's mine but is building a 500 km+ railroad. When considering potential indirect impacts like infrastructure development (railroads, roads, transmission lines) and population influx, along with cumulative impacts from other sectors (e.g. forestry, proposed highways and dams), it is clear that the impacts of the Tridom iron ore projects will be very significant unless effectively planned and mitigated. These projects could lead to the demise of Tridom as a largely continuous, intact forest landscape, and reduce it progressively to a set of vulnerable and isolated protected areas, which will be unable to conserve their key features like elephants which depend on large scale ecosystem processes. Careful zoning, planning of development projects, and sustainable management of forestry concessions are needed to maintain the intactness of Tridom's forests.

RECOMMENDATIONS

1.

Governments, private sector and financial institutions should apply the recommendations of IUCN at The IUCN World Conservation Congress in 2016 which adopted a motion (Motion 048) that "encourages states, the private sector and international financial institutions to: a. avoid loss and degradation of primary forests, including intact forest landscapes; b. promote conservation of primary forests, including intact forest landscapes".

2.

Governments need to recognise the extraordinary value of intact forests for biodiversity, climate and other ecosystem service provisioning and properly plan for their retention.

3.

International conventions, particularly the United Nations Convention on Biodiversity (CBD) and the United Nations Framework for Combating Climate Change (UNFCCC), also need to recognise and facilitate the setting of targets for countries for intact forest conservation. There needs to be recognition that these values erode quickly when development occurs within boundaries of a intact forest ecosystem and avoidance is often the only effective conservation action.

4.

Governments should consider the use of Strategic Environmental Assessments (SEAs) to plan carefully for extractives and their interactions with other sectors within intact forest areas. This requires cross-sectoral coordination between relevant government agencies and should take place before exploration, and before the early planning and pre-design stages of a project. This will require government policies to account for the full extent of project-related indirect impacts, such as hunting and deforestation, including those that occur off-lease. Careful multi-stakeholder planning of infrastructure that might lead to the loss of intact forests and consideration of potential cumulative impacts in the region is required.

5.

Governments and companies should undertake and implement thorough Environmental Impact Assessments (EIAs) of extractive projects including the exploration licensing phase which should also consider the indirect impacts of linear infrastructure on IFLs, including access routes, rights of way and power lines, and prioritise avoidance of impacts. When Governments license a company's activities in an area, particularly when linear infrastructure are being considered and when moving from exploration to production, they should consider intact forest areas within the terms of the license so that impacts can be avoided.

6.

Governments and companies should design and implement monitoring programmes to measure any loss of intact forests and drivers of this loss so that conservation strategies can be put in place to avoid future loss whether they are from the direct and indirect impacts of industry or from other sources. Monitoring programmes should also be measuring any potential cumulative impacts between and across different sectors. Results of these programmes should be treated as an important aspect of national and global forest assessments. Further analysis in key regions is required to identify the companies holding extractives licenses, and to what extent they are complying with any relevant safeguards.

7.

Government should ensure that processes related to policies and planning (e.g. SEAs), EIAs and monitoring programme should be transparent and participatory including Civil Society organisations (CSOs) in order to inform and involve the public in the decision making process and by doing so, improve cohesion around the project and avoiding conflicts down the line.

8.

Companies and financial institutions should adopt and implement best practice and commit to no net loss of biodiversity and implementation of the mitigation hierarchy. Intact forests should be explicitly valued as high conservation value and impacts avoided.New environmental safeguards requirements should be included as part of loan agreements to recognise the value of intact forests: these can be based on International Finance Corporation (IFC) Performance Standard, World Bank Environmental and Social Safeguard, standards of regional development banks (Africa Development Bank, Asian Development Bank, Inter-American Development Banks) and the Equator Principles for avoiding impacts and mitigating losses.

REFERENCES

1. Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., De Vries, W., and de Wit, C.A. (2015). Planetary boundaries: Guiding human development on a changing planet. Science 347, 1259855.

2. Laurance, W.F., Sloan, S., Weng, L., and Sayer, J.A. (2015). Estimating the Environmental Costs of Africa's Massive "Development Corridors". Current biology : CB 25, 3202-3208.

3. Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., Thau, D., Stehman, S.V., Goetz, S.J., Loveland, T.R., et al. (2013). High-Resolution Global Maps of 21st-Century Forest Cover Change. Science 342, 850-853.

4. Potapov, P., Yaroshenko, A., Turubanova, S., Dubinin, M., Laestadius, L., Thies, C., Aksenov, D., Egorov, A., Yesipova, Y., and Glushkov, I. (2008). Mapping the world's intact forest landscapes by remote sensing. Ecology and Society 13.

5.Watson, J.E., Evans, T., Venter, O., Williams, B., Tulloch, A., Stewart, C., Thompson, I., Ray, J.C., Murray, K., and Salazar, A. (2018). The exceptional value of intact forest ecosystems. Nature ecology & evolution, 1.

6. Malhi, Y., Adu-Bredu, S., Asare, R.A., Lewis, S.L., and Mayaux, P. (2013). African rainforests: past, present and future. Philosophical Transactions of the Royal Society B: Biological Sciences 368.

7. Potapov, P., Hansen, M.C., Laestadius, L., Turubanova, S., Yaroshenko, A., Thies, C., Smith, W., Zhuravleva, I., Komarova, A., Minnemeyer, S., et al. (2017). The last frontiers of wilderness: Tracking loss of intact forest landscapes from 2000 to 2013. Science Advances 3.

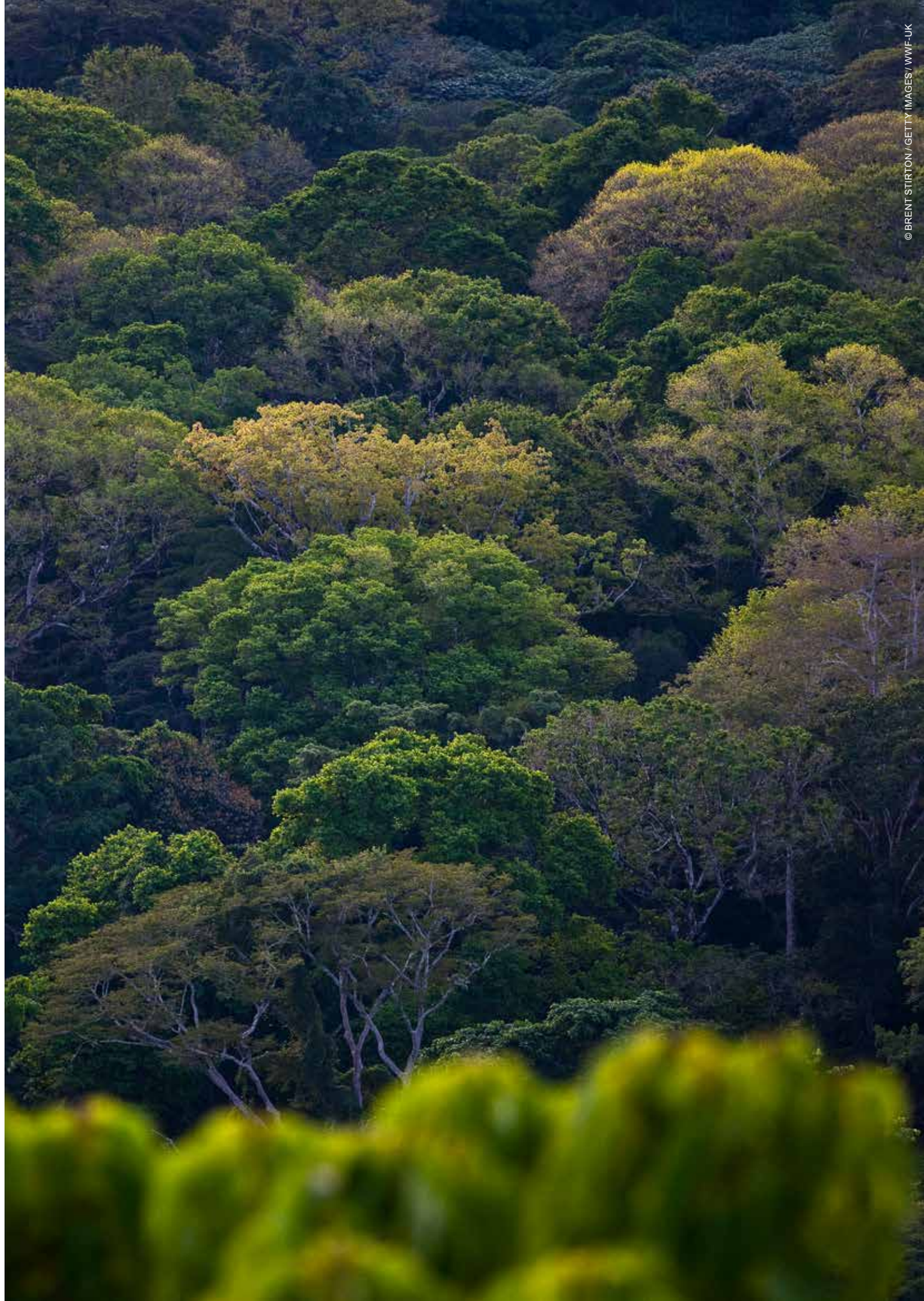
8. Sonter, L.J., Herrera, D., Barrett, D.J., Galford, G.L., Moran, C.J., and Soares-Filho, B.S. (2017). Mining drives extensive deforestation in the Brazilian Amazon. Nature Communications 8, 1013.

9. Maisels, F., Strindberg, S., Blake, S., Wittemyer, G., Hart, J., Williamson, E.A., Aba'a, R., Abitsi, G., Ambahe, R.D., Amsini, F., et al. (2013). Devastating Decline of Forest Elephants in Central Africa. PLOS ONE 8, e59469.

10. Kiesecker, J.M., Copeland, H., Pocewicz, A., and McKenney, B. (2010). Development by design: blending landscape level planning with the mitigation hierarchy. Frontiers in Ecology and the Environment 8, 261-266.

11. Sahley, C.T., Vildoso, B., Casaretto, C., Taborga, P., Ledesma, K., Linares-Palomino, R., Mamani, G., Dallmeier, F., and Alonso, A. (2017). Quantifying impact reduction due to avoidance, minimization and restoration for a natural gas pipeline in the Peruvian Andes. Environmental Impact Assessment Review 66, 53-65.

12. Fernandes, G.W., Goulart, F.F., Ranieri, B.D., Coelho, M.S., Dales, K., Boesche, N., Bustamante, M., Carvalho, F.A., Carvalho, D.C., Dirzo, R., et al. (2016). Deep into the mud: ecological and socio-economic impacts of the dam breach in Mariana, Brazil. Natureza & Conservação 14, 35-45.



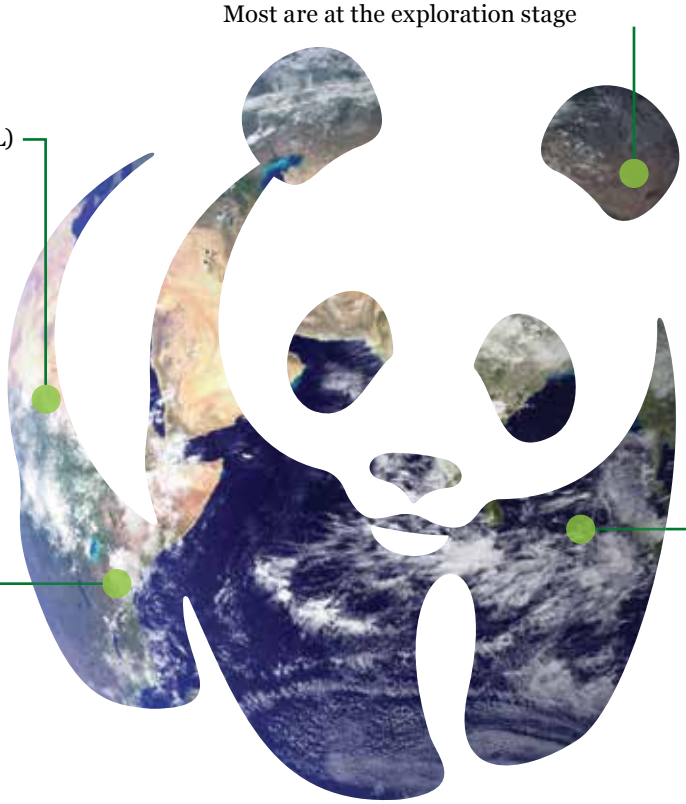
ASSESSING THE POTENTIAL THREAT OF EXTRACTIVE INDUSTRIES TO TROPICAL INTACT FOREST LANDSCAPES

OVERALL

- For the 408,000 km² overlap of oil and gas contracts (8% of IFLs) the highest is in Central Africa (particularly DRC), then Asia-Pacific (particularly PNG) and Amazon (particularly Bolivia). Most are at the exploration stage
- For the 589,000 km² of mining claims (over 11% of IFLs), the highest is in Amazon (Brazil), then Central Africa (DRC) and Asia-Pacific (Indonesia). Most are at the exploration stage

AMAZON

- 3.8 million km² of IFL
- 82 contracts for oil and gas (95,500 km²/2.5% of IFLs)
- 15,932 mining claims (407,000 km²/10.6% IFL)



CENTRAL AFRICA

- 840,000 km² of IFL,
- 27 contracts for oil and gas (221,000 km²/27% of IFLs)
- 988 number of mining claims (139,000 km²/16.5% of IFLs)

ASIA-PACIFIC

- 510,000 km2 of IFL
- 134 number of contracts for oil and gas (91,000 km²/18% of IFLs)
- 450 number of mining claims (44,000 km²/8.5% of IFLs)

WWF

Why are we here?
No more species shall go extinct due to human actions

www.wwf.no

WWF.NO