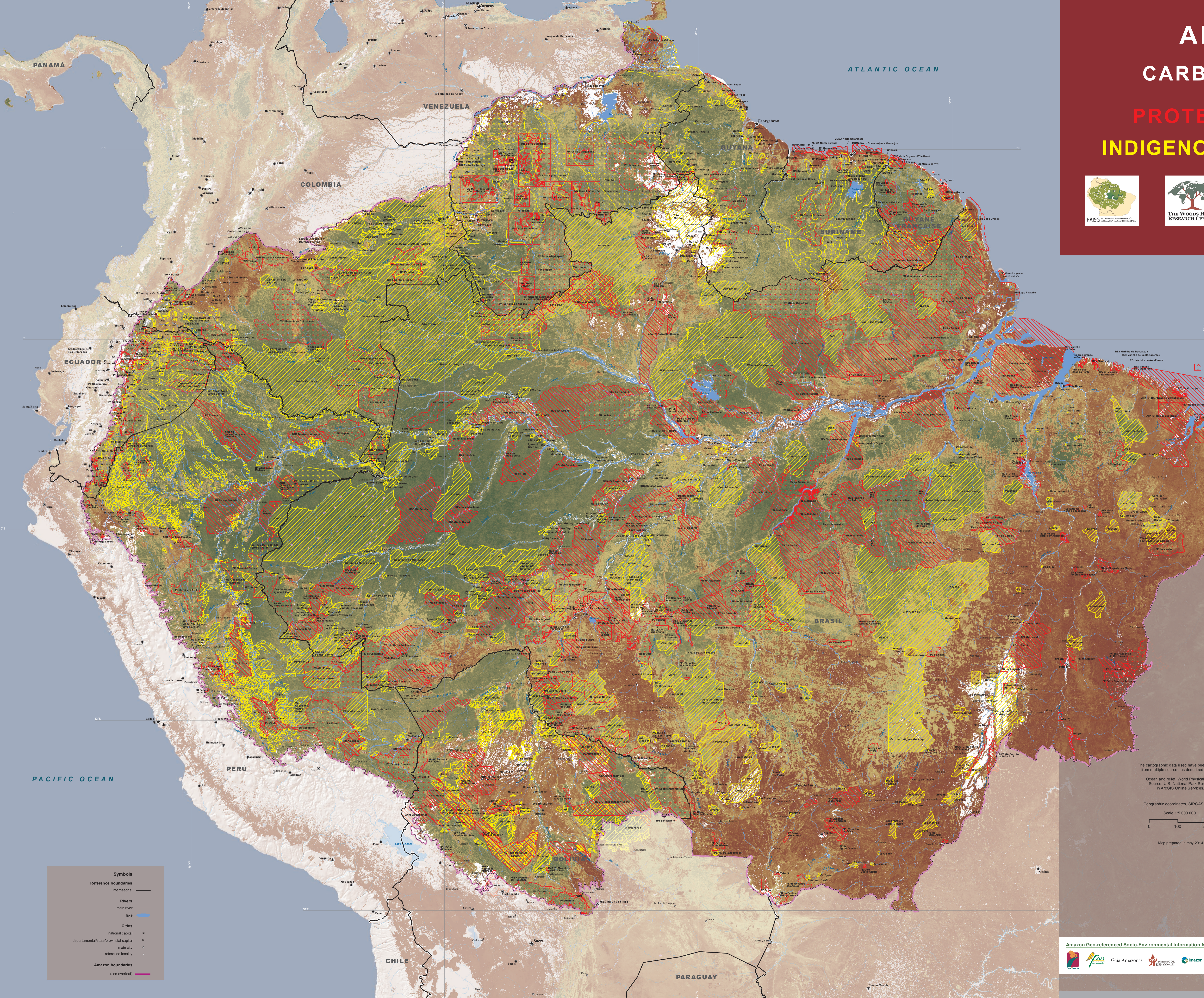


AMAZON CARBON DENSITY PROTECTED AREAS INDIGENOUS TERRITORIES



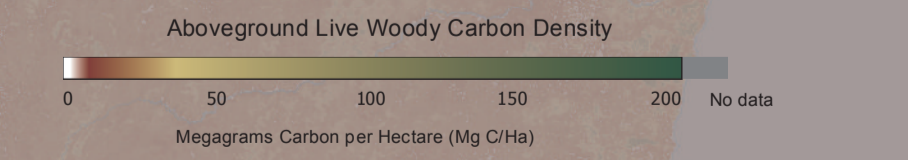
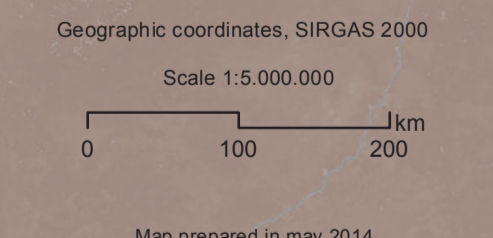
Indigenous Territories

- indigenous territory recognized**
officially recognized
- indigenous territory not recognized**
not officially recognized or in the process of being demarcated (or without status information)
proposed territorial reservations

Natural Protected Areas

- indirect use (comprehensive protection)**
exploitation of natural resources prohibited
- direct use (sustainable use)**
utilization of natural resources permitted
- direct/indirect use**
utilization of the area established through zoning
- transitional categories**
can be changed to other categories

The cartographic data used have been obtained from multiple sources as described overleaf.
Ocean and relief: World Physical Map.
Source: U.S. National Park Service, in ArcGIS Online Services.



- #### Symbols
- Reference boundaries: international
 - Rivers: main river, lake
 - Cities: national capital, departmental/state/provincial capital, main city, reference locality
 - Amazon boundaries (see overleaf)

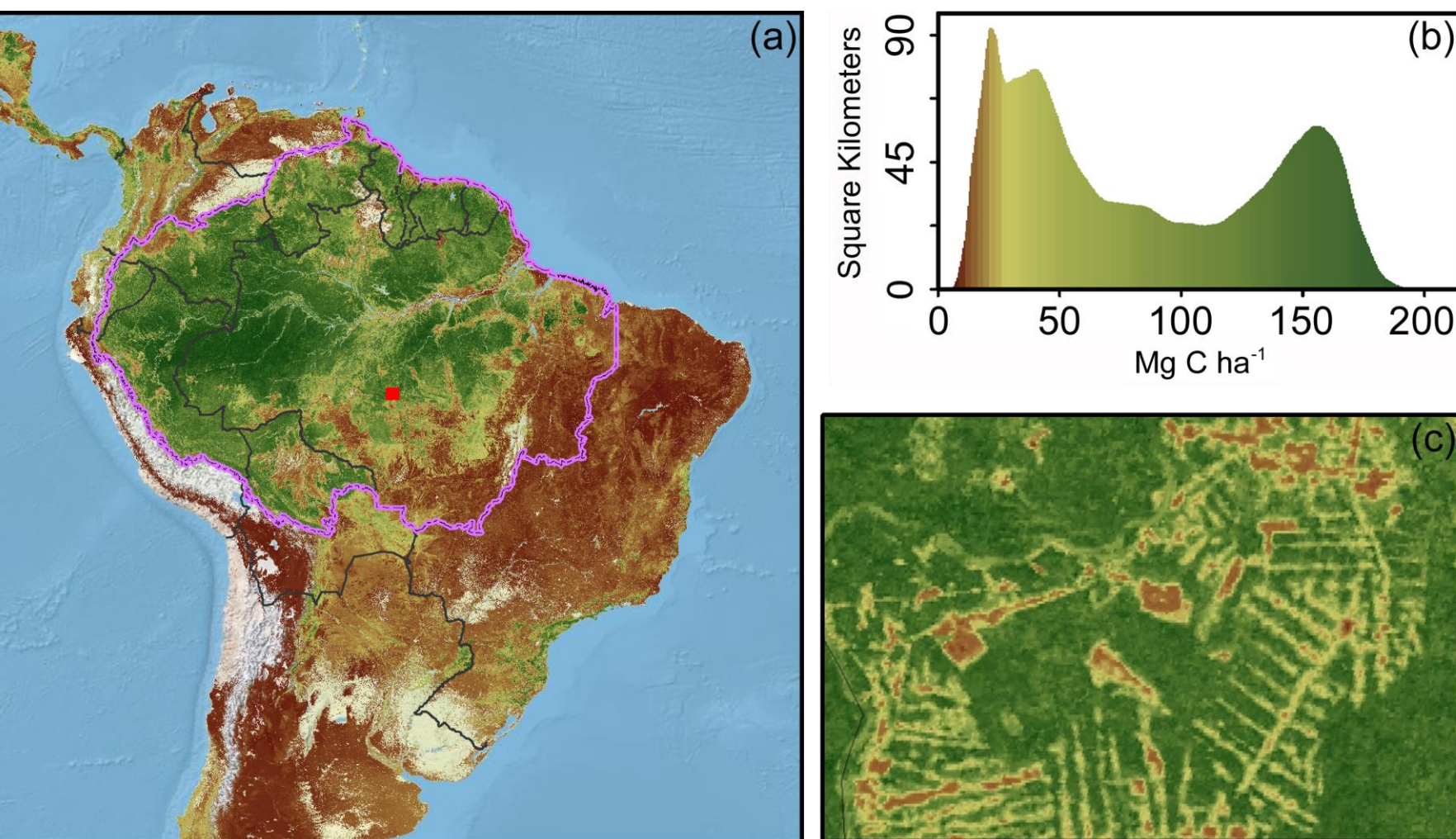
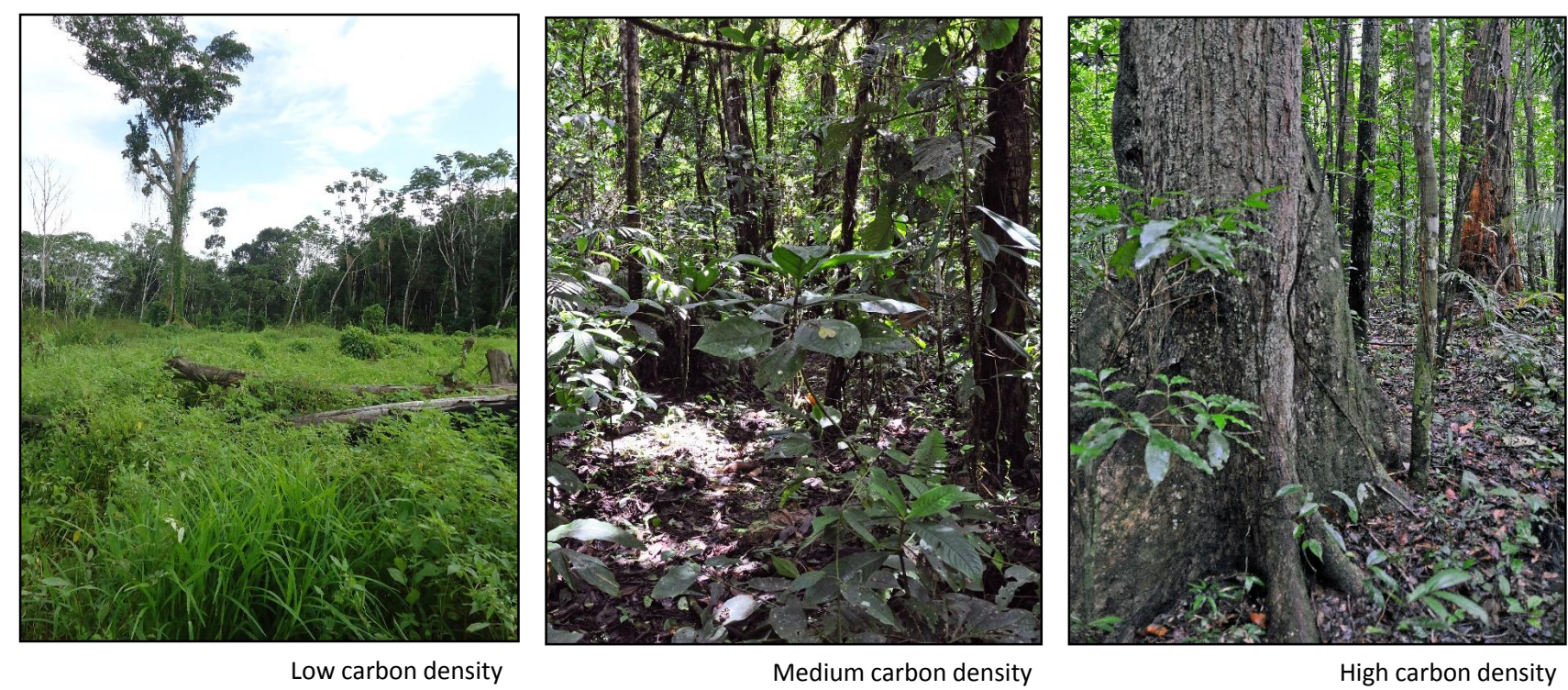
Amazonia Carbon Density Indigenous Territories Protected Natural Areas

The Amazonian Region covers the largest expanse of tropical forest ecosystems in the world. Encompassing approximately 7.8 million km², the region is shared by nine countries and is occupied by 33 million inhabitants, including 385 indigenous peoples. Recognized globally for its enormous socio-environmental diversity, as a regulator of the planet's climate, and as a carbon sink for large quantities of greenhouse gases, the region is now undergoing rapid change. Increasing pressures over the last 50 years resulting from agriculture expansion, road and hydroelectric plant construction, and the extraction of timber, fossil fuels and precious metals have put the integrity of Amazonian ecosystems at risk.

Approximately 52% of the Amazonian surface area is contained within a network of 2,344 indigenous territories (ITs) and 610 protected natural areas (PNAs). This network, characterized by its continual evolution, provides a fundamentally important yet inherently porous buffer against the host of current pressures and future threats. By virtue of its own existence, the network of ITs and PNAs contributes to protecting the rights of indigenous communities to remain physically connected with their ancestral lands while at the same time protecting biodiversity and the myriad benefits derived from Amazonian ecosystems, including environmental services such as carbon capture and storage.

The primary objective of this map is to promote a more comprehensive and integrated vision of Amazonia. The map highlights the crucial role that Amazonian ITs and PNAs and their ecosystems play not only in sequestering carbon, but also in maintaining the broad array of features and functions as well as associated goods and services that such large stores of carbon represent.

The map and accompanying analysis presented here provides for the first time quantitative confirmation of what has been heretofore appreciated only in qualitative terms: That the amount of carbon contained aboveground in the ITs and PNAs of the Amazonian Region is considerable and is of global significance when compared with regions having the largest carbon stocks in tropical Africa and Asia.



Carbon contained in the aboveground live woody biomass of vegetation in tropical South America (a) based on Baccini et al. (2012). The distribution of carbon in the region is shown in (b) together with an example of the spatial detail (c) found in the map (see red rectangle in the Brazilian Amazon).

Data Used

The limit of the Amazon region referenced here, and on which the following analysis is based, consists primarily of the biogeographical boundary of the Amazon ecosystem with exceptions for Ecuador and Brazil where additional legal and administrative criteria are applied (RAISG 2012).

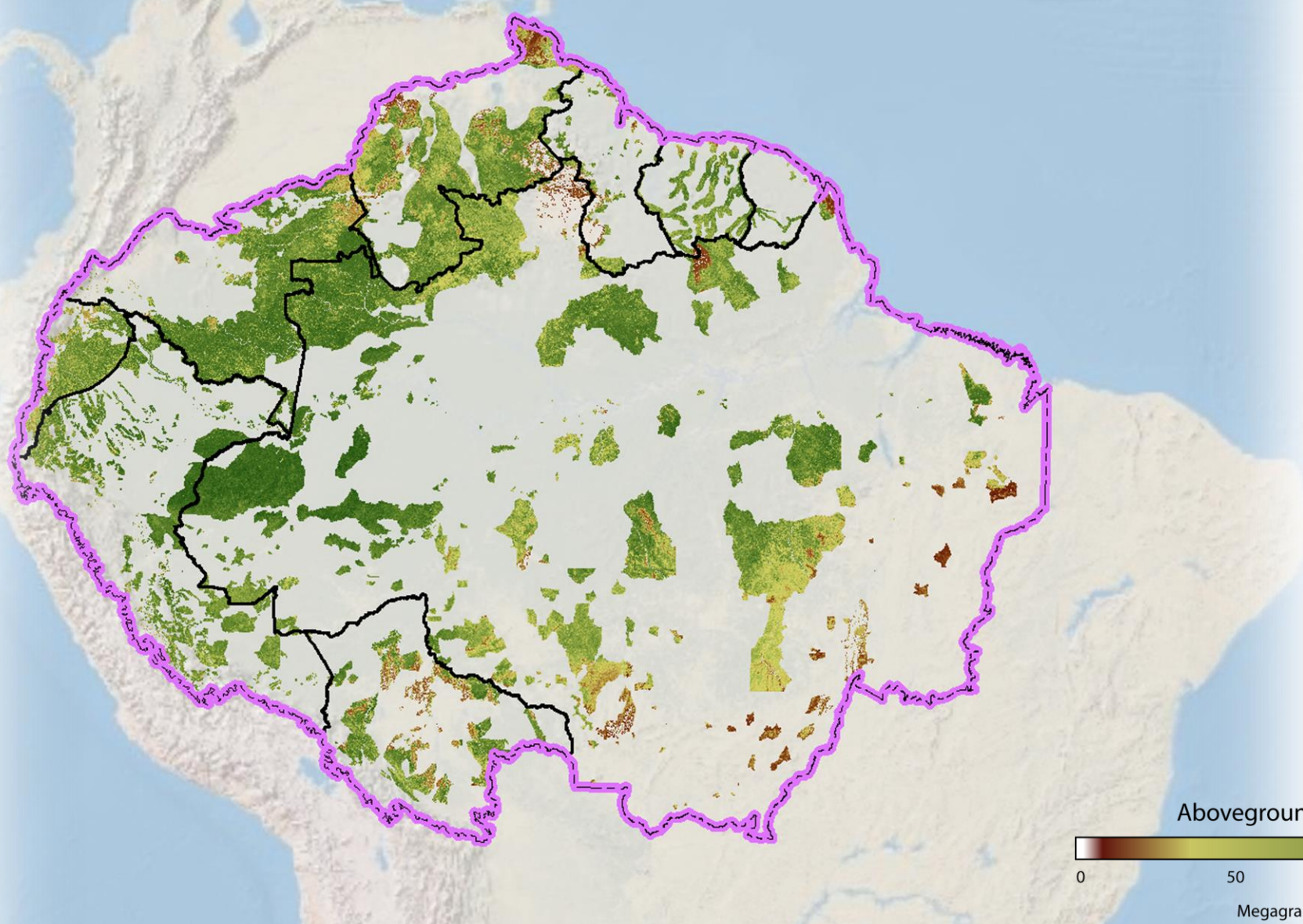
The boundaries of ITs and PNAs were compiled by RAISG's members from a range of sources, which are listed at the bottom of this map. However, because boundaries change over time, updates to the database are ongoing as new information is obtained.

The map of carbon stock was produced by the Woods Hole Research Center using an approach that relies on information acquired by Earth observing satellites. Baccini et al. (2012) originally mapped the amount and distribution of carbon stored aboveground in the live woody biomass of vegetation across the tropics for the period 2007-2008 at a resolution of circa 500 meters. This data set was generated using field measurements co-located with satellite-based Light Detection And Ranging (LIDAR) observations from the NASA Geoscience Laser Altimeter System (GLAS), together with a cloud-free temporal mosaic generated from NASA Moderate Resolution Imaging Spectrometer (MODIS) and Nadir Adjusted Reflectance (NBAR) data.

Country boundaries were derived following adjustments to national borders based on geographic considerations. Such adjustments were necessary to address in an unbiased fashion the coarse nature of existing boundary databases as well as ongoing boundary disputes between some countries. As a result, the limits used here cannot be considered strictly official (RAISG 2012).

Together, the four datasets were analyzed in a geographic information system (GIS) using a raster-based approach. The political-administrative layers were used as a basis for quantifying the amount and distribution of carbon contained within the various IT and PNA units across the Amazonian Region. The figures and tables that follow provide a summary of the results.

Carbon density in Indigenous Territories



Amazonian Indigenous Territories encompass a significant portion of the region's forest estate in terms of both surface area (25.6%) and carbon stock (27.1%), exceeding that of PNAs by 3.8% and 5.0%, respectively. When we also consider the ITs that overlap with PNAs (4.8%), Amazonian ITs, with a total surface area of just over 2.4 million km², are responsible for storing almost one third (32.8%) of the region's carbon.

The biological diversity harbored by indigenous territories is comparable in importance to that of protected natural areas. However, like PNAs, the plant, animal, and human inhabitants of Amazonian ITs are threatened by rapidly expanding natural resource extraction, including logging, mining, and oil exploration as well as infrastructure projects and implementation.

Current pressures and future threats facing Amazonian ITs are, in many countries, exacerbated by long standing land tenure disputes. Although government titling of indigenous lands across Latin America has increased significantly over the past 30 years, there remains a considerable deficit in official recognition for territories spanning hundreds of thousands of square kilometers. Official recognition has not yet been granted in Suriname and Venezuela (official recognition has been given to a single area but the spatial information is not yet available) as well as for parts of Bolivia, Ecuador, and Peru. As a result, of the 28,247 MtC stored in the forests of Amazonian ITs, 22.2% (6,276 MtC) lies within ITs having no official recognition. This includes approximately 83% of the indigenous carbon in Ecuador and 27% of the indigenous carbon in Peru.

Carbon Distribution in Indigenous Territories of the Amazon by Country

Country	Officially Recognized			Without Official Recognition		
	ITs (MtC)	Overlap between ITs-NPAs (MtC)	% *	ITs (MtC)	Overlap between ITs-NPAs (MtC)	% *
Bolivia	576	491	21.4	286	77	7.3
Brazil	13,401	1,023	27.9			
Colombia	3,191	476	58.1			
Ecuador	31	139	12.0	697	124	58.1
Guayane Française	10	91	8.7			
Guyana	338	13	13.6			
Peru	2,000	192	20.1	537	266	7.4
Suriname				666	99	40.3
Venezuela				1,648	1,878	67.7
Amazonia	19,547	2,425	25.5	3,833	2,443	7.3

* relative to the total carbon stock in each country

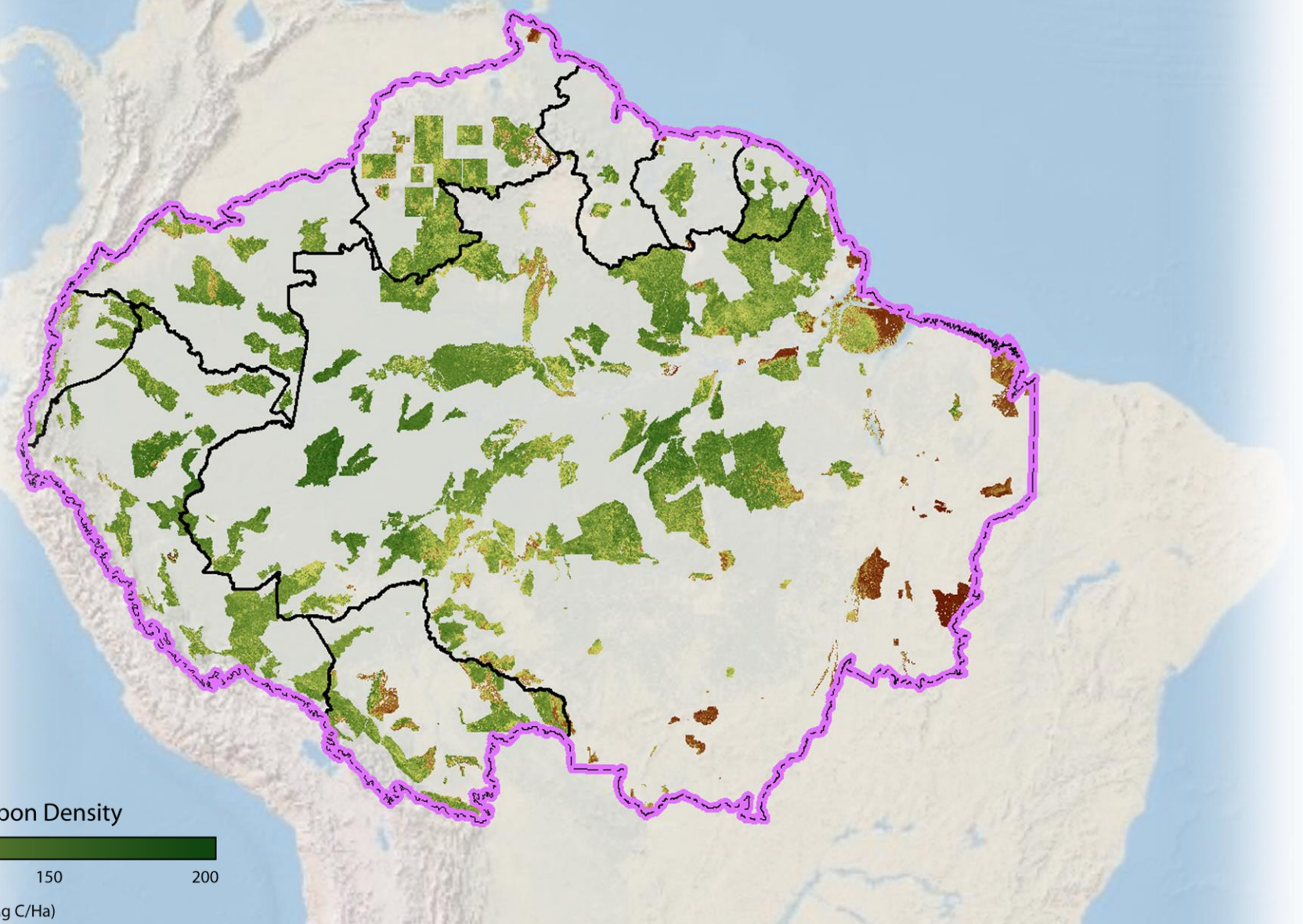
Sources:
Bolivia: FAN – Roads, settlements and political boundaries: National Statistics Institute (INEI), 2001; Community Homelands: Vice-Ministry of Lands, 2007; National Protected Areas: Ministry of Sustainable Development (MDS), 2005; State and Municipal Protected Areas: Ministry of the Environment and Water (MMAEA), 2009 – Santa Cruz Autonomous Departmental Government, 2010; Population: INE, 2001
CENSUS: Indigenous population: elaborated by FAN based on INE, 2001 CENSUS.
Brazil: ISA and Amazon – Rivers, roads, main cities and political boundaries: IBGE database, 2006; Indigenous Lands and Protected Areas: digitized by ISA based on official documents, using the IBGE 1:1,000,000 database; Boundaries of Amazonia: Brazilian Legal Amazonia, as per Law 5.173/66 and biogeographical boundary corresponding to the Amazonian Biome, Map of Brazilian Biomes, 1st version, IBGE, 2004; population: IBGE, 2010 (2009 demographic estimate); Indigenous Population: estimate made by ISA (population in ILS and nearby urban centers) based on a variety of sources, 2012.
Colombia: FGA – Political boundaries and roads: Digital cartography, scale 1:500,000 of the Agustín Codazzi Geographical Institute – IGAC (2007); National National Parks System: Digital cartography, scale 1:500,000 of the Special Administrative Unit of the National National Parks System – UASPN (2009); Indigenous Reservations: Digital cartography IGAC (2008) and Gaia Amazonas Foundation (2010); Forestry Reserve Zones established by Law 2 of 1959: Institute of Hydrology, Meteorology and Environmental Studies – IDEAM (2005); Boundary of Amazonia: Amazonian Scientific Research Institute – SINCHI (2008); Population: National Population Census of Statistics – DANE (2005).
Ecuador: EcoCiencia – Roads, rivers, main cities: Military Geographic Institute (IGM) Recognition of Information BMU, EcoCiencia – MAE, 2005; Protected Areas and Protective Woodlands: Ministry of the Environment (MAE), 2002; Indigenous Lands: Sierra, R. and P. Maldonado (Compilers), 2010. "Indigenous Territories of Ecuadorian Amazonia," digital map (.shp format), version 2, EcoCiencia, Quito, Ecuador; ECOSX, 2011. Indigenous Lands: Sucumbios Decentralized Autonomous Government, 2011. Indigenous Lands: Under-Secretariat of Lands, 2011. Indigenous Lands: Aoriste Foundation, 2002; Political Boundaries and Amazonian Administrative Political Boundary: National Institute of Statistics and Censuses of Ecuador (INEC), 2007; Amazonian Biogeographical Boundary: Sierra, 1999; Population: INEC, 2010; Indigenous Population: ECOMAE, 2002. Ecological-Economic Zoning of Ecuadorian Amazonia.
Guayane Française: ISAL – Roads, rivers, main cities and political boundaries: Protected Areas and Areas of Collective Use for Local Communities: ISAL, 2007.
Guyana: with the collaboration of **Reynir K. Bolles, Coordinator of GIS/IT of Iwokrama International Centre for Rain Forest Conservation and Development** – Roads, rivers, main cities and political boundaries: DCW; Protected Areas: Iwokrama, 2012; Indigenous Lands: Office of Indigenous Affairs/Government of Guyana, 2009.
Peru: IBC – Rivers: National Geographic Institute (IGN), digitized by MINEDU; Roads: Ministry of Transport and Communications (MTC), 2005; Political boundaries: National Institute of Statistics and Information (INEI), 2005; Boundary of Amazonia: Peruvian Amazonia Research Institute (IIRAP) generalized for the 1:1,000,000 scale, proposal based on ecological criteria; Native communities georeferenced in the field: IBC/CIPIA; Native communities georeferenced in the office: AIDESEP/CPIA, GEP/INUI – GORTEL – PIS; Territorial Reserves: Expedientes AIDESEP-CIDPA; Proposals for Territorial Reserves: AIDESEP/CPIA and IBC/ PENACCOCA, 2013; Protected Natural Areas: National Protected Natural Areas Service (SERMANP), 2013; Population: INE, 2007 – 2007 National Census – XI: Population and VI: Residence, Growth and Distribution of the Population, Lima, p10.
Suriname: ACT Suriname – Roads, rivers, main cities and political boundaries: DCW; Protected Areas: World Database Protected Areas (WDPA), 2006.
Venezuela: IWS and ProVita – Roads, rivers, main cities and political boundaries: digitized using the Political Map of the Bolivarian Republic of Venezuela, Simón Bolívar Geographic Institute of Venezuela, Ministry of the Environment and Natural Resources, 2003; Protected Areas of Venezuela: Rodríguez, J. P., S. Zambrano-Martínez, R. Lazo and M. A. Oliveira-Miranda (eds.) 2010. Digital Representation of the Protected Natural Areas of Venezuela: National Parks, Natural Monuments, Fauna Refuges, Fauna Reserves and Biosphere Reserves. Centre of Ecology, Venezuelan Institute of Scientific Research (IVIC) and Total Venezuela, S.A., Caracas, Venezuela; Indigenous Areas: Freire, G. and Tillett, A. (eds.) 2007. Indigenous Health in Venezuela. Vol. I. Ministry of Popular Power for Health, Caracas, Venezuela. 381pp + Map; Boundaries of Amazonia: Biogeographical boundary based on González, S. and J. C. Serrano, 1998. Contribution to the Herpetofauna of the Venezuelan Guyana. A Data Base. Scientia Guayanae. R. FUNDACIÓN Guayana, Botanical Institute Foundation of Venezuela, Caracas, Venezuela. 269 pp, Eva, H. D. and O. Huber (eds.) 2005. A proposal for the Definition of the Geographical Limits of Amazonia. Workshop of Official Publications of the European Community, Luxembourg. 39 pp., corresponding to the states of Amazonas, Bolívar and Delta Amacuro. Population and Indigenous Population: Total population, by federal entity, according to age group, 2003; Census of Indigenous Communities. Data downloaded 11/02/2009. <http://www.ine.gov.ve/geografica/PolicialComunidades.htm>, and [http://www.ine.gov.ve/index.php?option=com_content&id=95&Itemid=98](http://www.ine.gov.ve/index.php?option=com_content&view=category&id=95&Itemid=98).
Other databases used – Rivers of Colombia, Bolivia, Ecuador, Guyana, Suriname and rivers outside of Amazonia: Hydrosheds, <http://hydrosheds.cr.usgs.gov>; Political Boundaries and Capitals to second level: systemization of data by country based on relief, resulting in "reference boundaries"; Amazonian Basin: Hydrosheds, <http://hydrosheds.cr.usgs.gov>.

Reference:
 Baccini, A., S.J. Goetz, W.S. Walker, N.T. Laporte, M. Sun, D. Sulla-Menashe, J. Hackler, P.S.A. Beck, R. Dubayah, M.A. Friedl, S. Samanta, and R.A. Houghton. 2012. Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps. *Nature Climate Change* DOI:10.1038/NCLIMATE1354
 RAISG 2012. Amazonia under pressure. 68 pages. <http://raisg.socioambiental.org>

Acknowledgments:
 The data and associated content presented here were compiled during a workshop held in Lima, Peru, October 14-15, 2013, and attended by: Birbel Henningberg, Juan Carlos Jiritchak, Julio Parista, Tuntak (COICA), Juan Calle (EcoCiencia), Chris Meier (EDF), Saul Cuellar (FAN), Milton Romero (GAIA), Carla Soria, Sandra Rios (IBC), Cicero Cardoso (ISA), María A. Oliveira –Miranda (PROVITA), Alessandro Baccini, Wayne Walker (WHRC).
 Map: Carla Soria, Sandra Rios (IBC), Cicero Cardoso (ISA), María A. Oliveira –Miranda (PROVITA), Alessandro Baccini, Wayne Walker (WHRC).
 Text, tables, and figures: Adriana Sarmiento(GAIA), Carla Soria, Sandra Rios (IBC), María A. Oliveira –Miranda (PROVITA), Alessandro Baccini, Wayne Walker (WHRC).
Outside review: Chris Meier (EDF), Daniel Larrea, Saul Cuellar (FAN), María Montes, Richard Smith(IBC), Alicia Rolla, Beto Ricardo (GAIA), Wayne Walker (WHRC).
Editorial process: Carla Soria, Sandra Rios (IBC), Alicia Rolla (ISA), María A. Oliveira –Miranda (PROVITA)

Supported by:
 RAISG/WHRC/EDF/COICA, 2014. Amazonia Carbon Density: Indigenous Territories and Protected Areas.

Carbon density in Protected Areas



Across the Amazonian Region, Protected Natural Areas have been established to meet a variety of socio-environmental ends including biodiversity conservation, climatic regulation, and the long-term safeguarding of ecosystem services whether provisional, cultural, or regulatory in nature. In addition, many PNAs ensure the rights of traditional communities. Amazonian PNAs cover nearly 2.1 million km², representing 26.6% of the region, and storing 27.8% of Amazonian carbon when all PNAs, including those that overlap with ITs, are considered.

Brazil has the largest proportion of carbon stocks in PNAs, storing a total of 14,615 MtC (17.0% of Amazonian carbon), followed by PNAs in Perú and Venezuela which store 2,807 (3.3%) and 2,157 MtC (2.5%), respectively. These countries represent the top three in terms of carbon storage in Amazonian PNAs whereas Ecuador (459 MtC; 0.5%), Suriname (271 MtC; 0.3%), and Guyana (136 MtC; 0.2%) represent the bottom three.

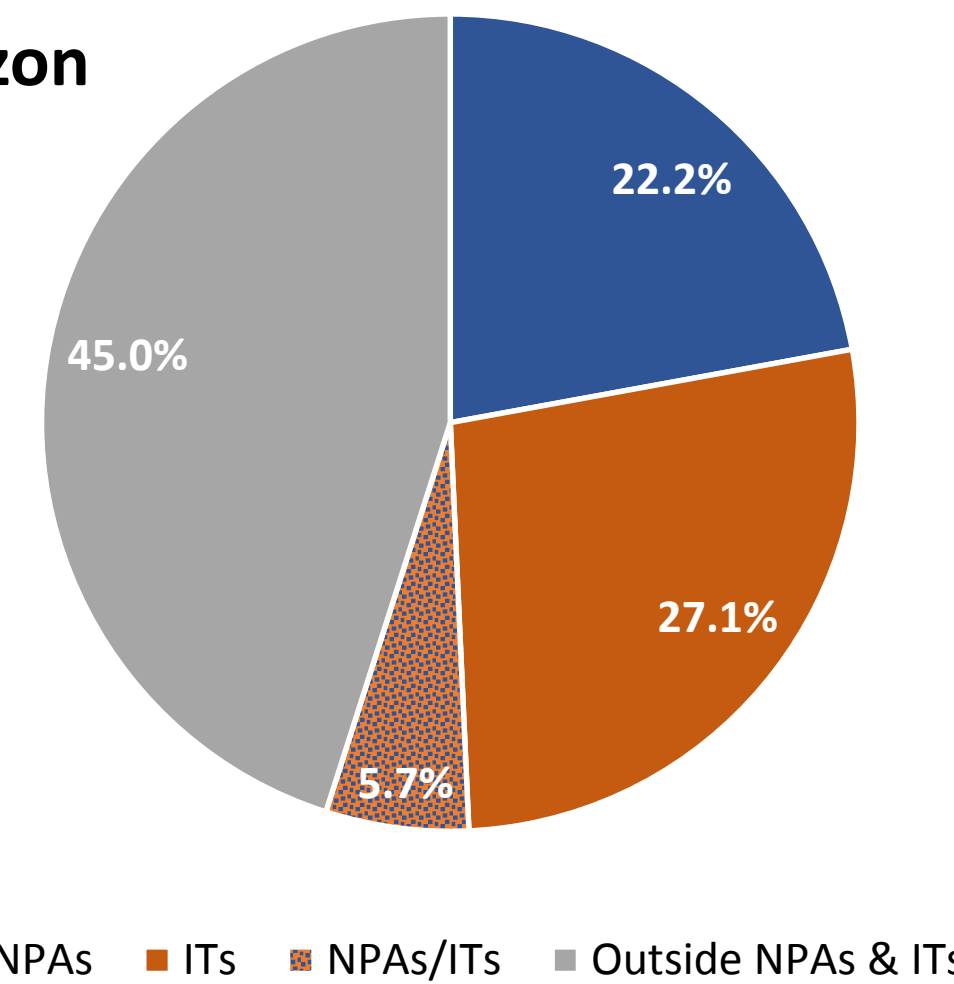
Three primary categories of Amazonian NPAs are recognized: (a) Indirect Use (IU) areas where natural resource extraction is prohibited, (b) Direct Use (DU) areas where extraction is permitted under management plans, and (c) areas of Transitory (or mixed) Use (TU). Of the five countries recognizing both IU and DU PNAs, Bolivia (70%) and Brazil (62%) have the greatest proportion of carbon in DU areas, while Suriname (97%) and Guyane Française (60%) have the greatest proportion of carbon in IU areas. The remaining countries of Colombia, Ecuador, and Venezuela recognize, in this analysis, IU areas where as Guyana recognizes both IU and DU/IU areas (60% and 40%, respectively).

Carbon Distribution in Protected Areas of the Amazon by Country

Country	Indirect Use			Direct Use			Direct Use/Indirect Use, Transitory		
	NPAs (MtC)	Overlap between NPAs-Its (MtC)	% *	NPAs (MtC)	Overlap between NPAs-Its (MtC)	% *	NPAs (MtC)	Overlap between NPAs-Its (MtC)	% *
Bolivia	452	46	10.0	624	522	23.0	5		0.1
Brazil	4,787	837	10.9	8,805	186	17.4			
Colombia	852	476	21.0						
Ecuador	196	262	32.5						
Guayane française	297	41	29.2	174	50	19.3			
Guyana	71	10	3.2				52	3	2.2
Peru	966	122	10.0	1,187	99	11.3	196	237	4.0
Suriname	165	98	13.8	8	1	0.4			
Venezuela	279	1,878	41.4						
Amazonia	8,065	3,770	13.7	10,797	857	13.5	253	241	0.6

* relative to the carbon stock in each country

Carbon Distribution in the Amazon



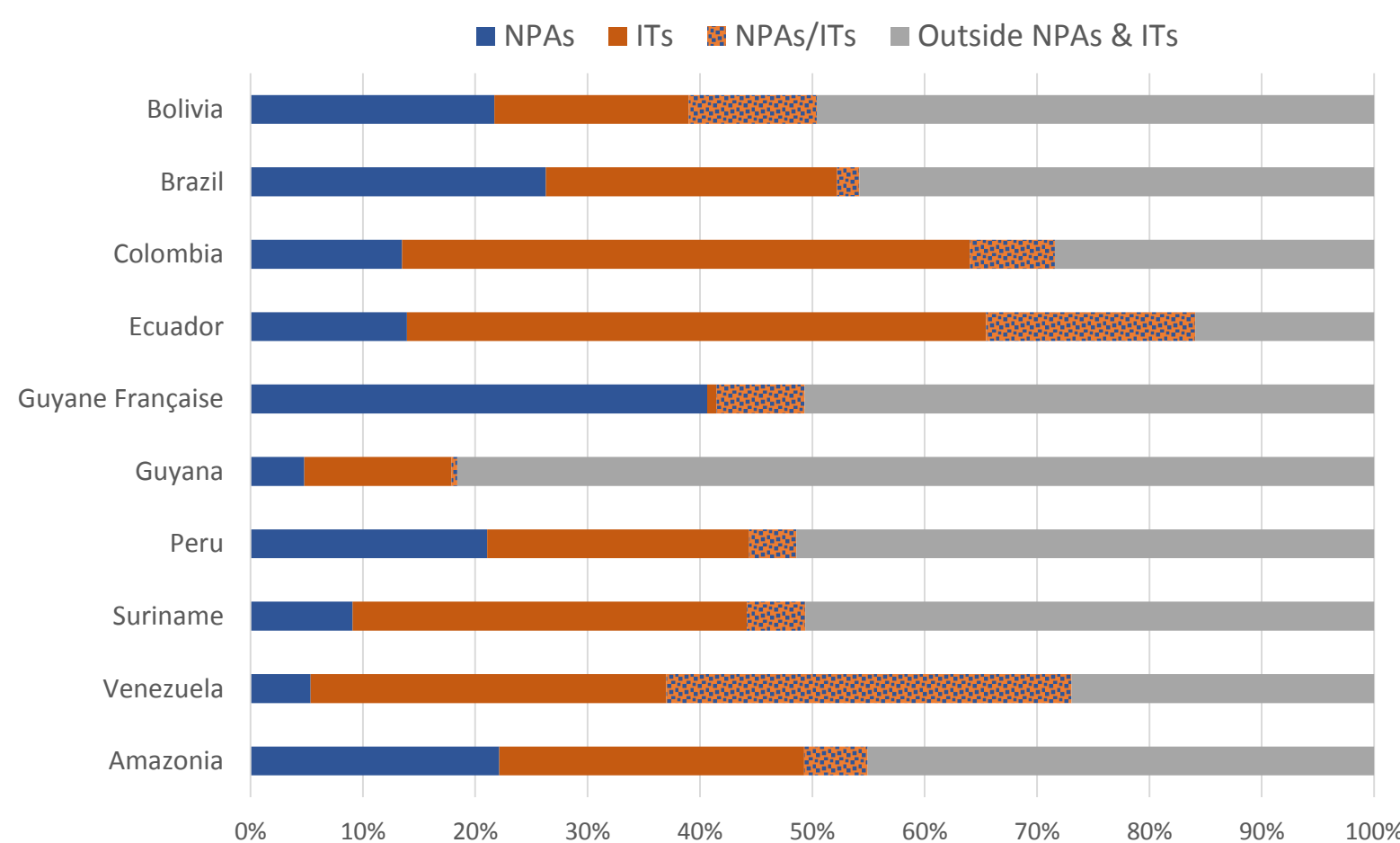
The nine countries store a total of 109,660 million metric tons of carbon (MtC), of which 78.5% is contained within the limits of Amazonia. Of the 86,121 MtC that are stored within the region, 55% (47,363 MtC) occurs within the boundaries of ITs and PNAs. This stock of Amazonian carbon is more than that stored within the Republic of Indonesia (18,581 MtC) and The Democratic Republic of the Congo (22,128 MtC) combined (40,709 MtC).

Among the Amazonian countries, Brazil (65,240 MtC), Peru (11,564 MtC), and Colombia (10,164 MtC) represent the three largest contributors to the total carbon stock, comprising almost 80% among the nations studied. These three countries also account for 80.4% of the national surface area, 80.8% of the Amazonian surface area, and 77.8% of the total surface area contained within ITs and PNAs. Bolivia, Colombia, Ecuador, Guyana Française, and Venezuela all have more than 60% of their Amazonian surface area contained within ITs and PNAs, storing 12,593 MtC combined or nearly 27% of the carbon stored among all Amazonian ITs and PNAs. By comparison, Guyana, whose border is entirely within the Amazonian Region, has 20.4% of its surface area contained within ITs and PNAs and accordingly <1.0% of the carbon stock stored among all Amazonian ITs and PNAs.

Carbon Distribution in the Amazon by Country

Country	Amazonia							Country Total (MtC)
	NPAs (MtC)	ITs (MtC)	Overlap between ITs-NPAs (MtC)	ITs + NPAs (MtC)	% *	Areas outside ITs + NPAs (MtC)	Total (MtC)	
Bolivia	1,082	862	568	2,511	50.4	2,471	4,982	7,960
Brazil	13,592	13,401	1,023	28,015	54.2	23,679	51,695	65,240
Colombia	852	3,191	476	4,519	71.6	1,794	6,313	10,164
Ecuador	196	728	262	1,187	84.1	225	1,412	2,039
Guyane Française	471	10	91	571	49.3	587	1,158	1,158
Guyana	123	338	13	474	18.4	2,098	2,572	2,572
Peru	2,349	2,537	458	5,344	49.1	5,541	10,884	11,564
Suriname	172	666	99	937	49.4	961	1,899	1,899
Venezuela	279	1,648	1,878	3,805	73.1	1,403	5,207	7,065
Amazonia	19,116	23,380	4,867	47,363	55.0	38,758	86,121	109,660

* relative to the total carbon stock in each country



Carbon Distribution in the Amazon by Country

Additional Considerations

The cartographic analysis presented here quantifies for the first time the amount of carbon stored aboveground in the live woody biomass of vegetation occurring within the Indigenous Territories and Protected Natural Areas of the Amazonian Region. On the one hand, the analysis reveals that just over half (55%) of Amazonian carbon has some level of protected status, unofficial ITs notwithstanding. On the other hand, the work reveals the significant proportion of Amazonian carbon (45%) that falls outside of areas with protected status. While the research places into a global context the relative importance of Amazonian ITs and PNAs where carbon storage is concerned, the analysis does not take into account biodiversity or socio-cultural elements, key factors that should also be considered in steering on-the-ground conservation and development efforts. Overall, the information presented here emphasizes the need for countries to continue their support for climate-conscious land management strategies while at the same time complying with existing conservation commitments and promoting intercultural dialogue among government and civil society stakeholders.

This work was made possible through support for the following organizations:

Support to RAISG:



Support to WHRC:



www.raisg.socioambiental.org

www.whrc.org