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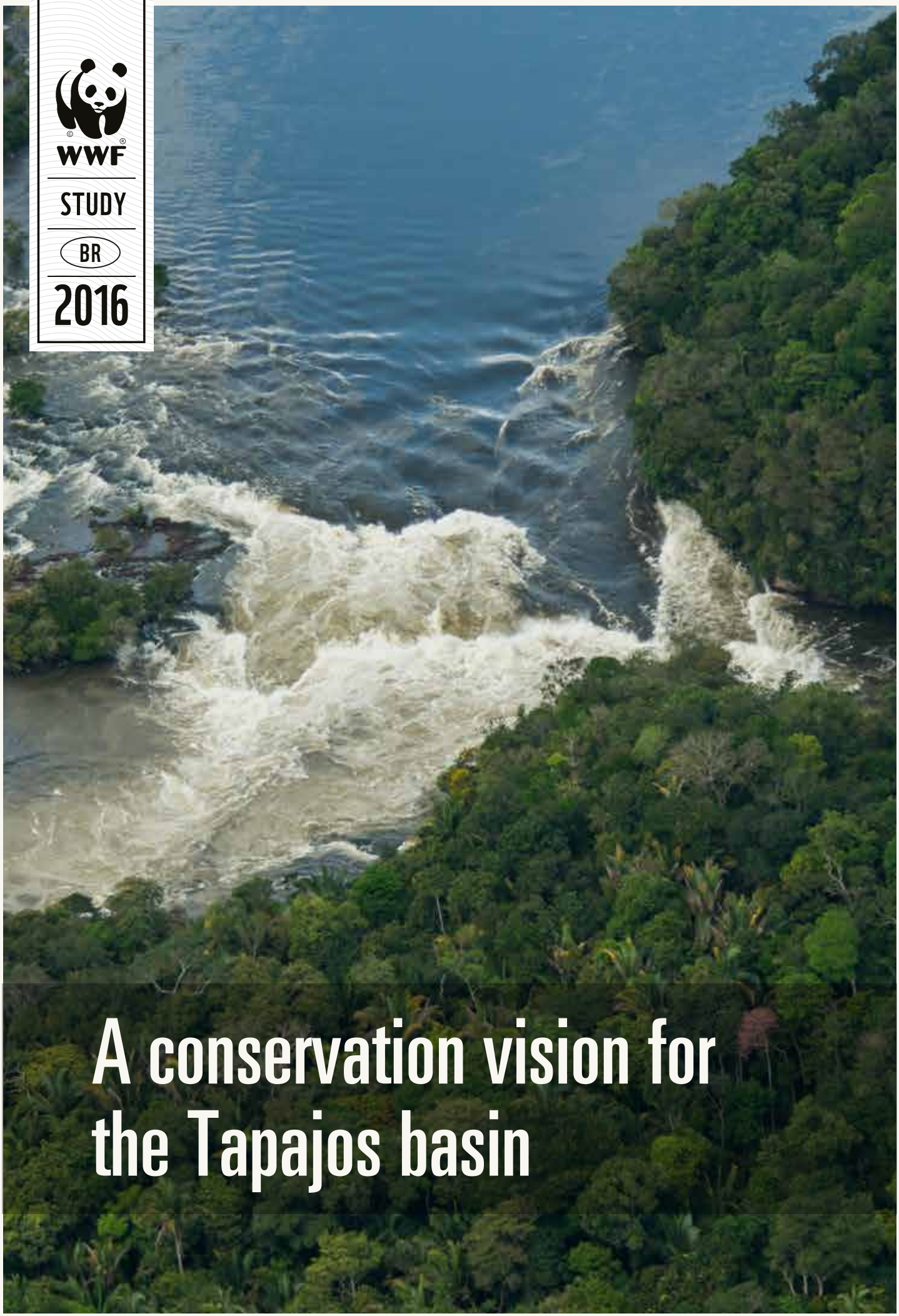
STUDY

BR

2016



A conservation vision for the Tapajos basin

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Salto São Simão, Rio Juruena, states of Mato Grosso and Amazonas, Brazil. Credit: © Zig Koch/ WWF Living Amazon Initiative

Graphic Design:
Talita Ferreira

Cataloguing

C755c A conservation vision for the Tapajos basin. WWF Brazil. Brasilia, 2016.
54p.;il; color 29.7 cm.

ISBN 978-85-5574-029-9

1. Basin of the Tapajos – Mato Grosso, Para and Amazonas
2. Hydroelectric Energy - Brazil 3. Impacts 4. Systematic Conservation Planning

1. WWF Brazil II. Title

CDU 556 (81) (05) =690

A CONSERVATION VISION FOR THE TAPAJOS BASIN

1st edition

Brasilia, Brazil

April, 2016

LIST OF ACRONYMS

ANA
National Water Board

BR
Biological Reserve

CAC
Critical Area for Conservation

DNPM
National Mineral Survey Department

ECI
Indigenous Component Study

EPE
Energy Research Company

ERI
Ecological Risk Index

Flona
National Forest

Funai
National Indian Foundation

HDI
Human Development Index

HE
Hydroelectric Plant

HIS-ARA
Hydrological Information System for Amazon River Assessment

Ibama
Brazilian Institute for the Environment and Renewable Natural Resources

IBGE
Brazilian Geography and Statistics Institute

ICMBio
Chico Mendes Institute for Biodiversity Conservation

INPE
National Space Research Institute

IT
Indigenous Territory

MMA
Ministry of the Environment

MME
Ministry of Mines and Energy

MW
megawatts

PAC
Growth Acceleration Plan

Parna
National Park

PCH
Small-scale Hydroelectric Installations

PDE
Decennial Energy Expansion Plan

PE
State Park

PA
Protected Area

SCP
Systematic Conservation Planning

Terfron
Northern Frontier Port Terminal

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INTRODUCTION

This study of the Tapajos Basin brings together a series of analyses undertaken by WWF and its partner organizations designed to define conservation scenarios and indicators on the basis of hydrological, biological and land use information, in the perspective of the aquatic and terrestrial environments.

INTRODUCTION

The Tapajos River Basin occupies parts of the states of Mato Grosso, Para and Amazonas and a small part of the state of Rondonia. With an area that is almost 6% of Brazilian territory, the basin is of the greatest ecological, scenic, social and cultural importance. Nevertheless it is liable to be severely affected by infrastructure projects that include the construction of seven hydropower plants in the so-called Tapajos Complex alone, among which are two mega-plants – Sao Luiz and Jatoba. Altogether 44 plants are on the list of the inventories made for the Teles Pires, Juruena and Tapajos sub-basins[1].

Integrated planning for a basin like the Tapajos could serve as an example to be replicated in other basins because it helps to define scenarios and indicators regarding the state of conservation of big rivers. Only proper planning can trace the parameters for decision-making regarding the best alternatives capable of conciliating a region's economic development with the conservation of its terrestrial and aquatic ecosystems.

WWF's engagement in the Tapajos Basin is part of a broader initiative designed to face the threats posed by the expansion of unsustainable hydroelectricity generation in the entire Amazon region where there are already 154 dams installed, 21 currently being built and 277 at the early planning stage. In addition to Brazil, WWF has active programs to foster sustainable hydropower in the Bolivian and Peruvian Amazon regions.

This study of the Tapajos Basin brings together a series of analyses undertaken by WWF[2] and its partner organizations designed to define conservation scenarios and indicators on the basis of hydrological, biological and land use information, in the perspective of the aquatic and terrestrial environments.

Information gathering embraced official data, consultation of the scientific literature and workshops held with experts on Amazonian biodiversity, all directed at identifying targets (habitats and species) in the basin and defining their conservation goals as well as calculating the Ecological Risk Indexes which represent the risk of the regional ecosystems losing their integrity.

WWF's intention is to contribute towards developing the knowledge, methodologies and tools needed to support the construction of a form of hydropower planning that is integrated and sustainable and that includes identifying conservation opportunities and allowing for participation of, and discussion with other sectors and organizations of society.

We firmly believe that this Conservation Vision for the Tapajos Basin is a consistent demonstration of how it is possible to adopt a more integrated approach that presents alternatives in the light of the cumulative impacts of multiple infrastructure works.

By sharing this experience we will be shouldering our responsibility to diffuse information and approaches and we hope, in that way, to make it possible for a variety of social actors to participate in the decision-making processes that determine the Amazon's ecological and social future.

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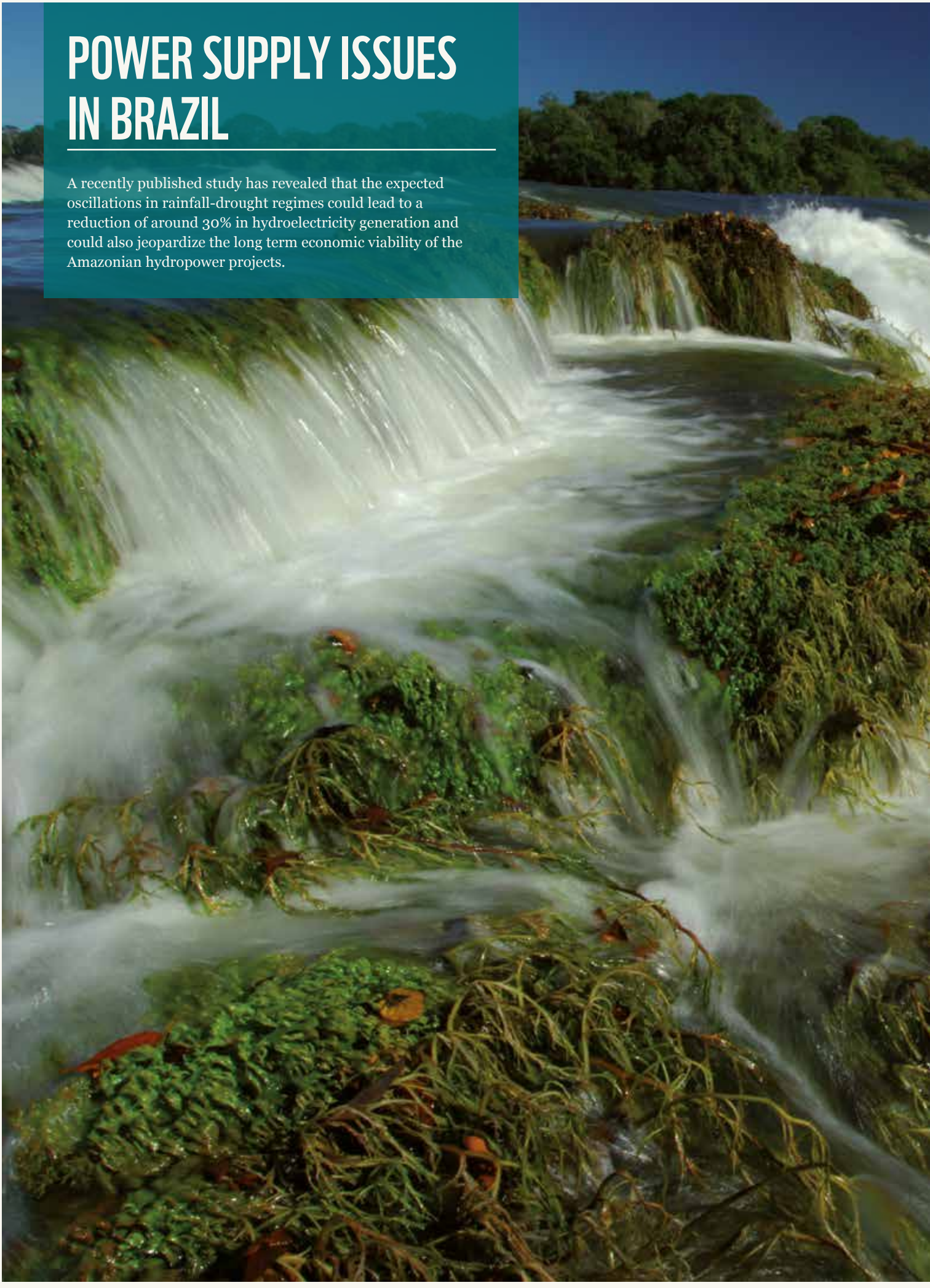
1 Plano Decennal de Expansão de Energia 2020, pág. 80. http://www.epe.gov.br/PDEE/20120302_1.pdf [Decennial Energy Expansion Plan 2020].

2 In 2011 the Ministry of the Environment and WWF-Brazil signed a term of cooperation for the application of the Systematic Conservation Planning methodology to the Tapajos. The work enjoyed the additional collaboration of the Energy Research Company (EPE) attached to the Ministry of Mines and Energy (MME), the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the National Water Board (ANA) and the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama).

Black-collared Swallow (*Pygochelidon melanoleuca*), Juruena River, Mato Grosso, Brazil.

POWER SUPPLY ISSUES IN BRAZIL

A recently published study has revealed that the expected oscillations in rainfall-drought regimes could lead to a reduction of around 30% in hydroelectricity generation and could also jeopardize the long term economic viability of the Amazonian hydropower projects.



POWER SUPPLY ISSUES IN BRAZIL

The Amazon functions as if it were one huge ecological unit but the equilibrium of this system has its limits. The fragmentation resulting from deforestation and the interference in the region's aquatic ecosystems may well lead to a collapse that will have impacts on humidity, rainfall, arable areas, water supply and hydroelectric power throughout the South American continent. Apart from climate change, the consequences of such a collapse could affect the entire world, as a result of the increase in greenhouse gas emissions.

WWF-Brazil recognizes that energy is a crucial issue for Brazil and that generating and distributing electricity are integral aspects of socioeconomic development strategies. Nevertheless, the organization argues in favour of an electricity generating matrix that is safe, efficient and clean and, consequently, it defends the gradual elimination of electricity generation based on fossil fuels and the restriction of their use to exceptional and emergency situations only.

HISTORICALLY HYDROPOWER PLANTS' ENVIRONMENTAL IMPACTS HAVE BEEN ASSESSED PROJECT BY PROJECT WITH LITTLE OR NO ATTENTION PAID TO INDIRECT OR CUMULATIVE IMPACTS

In the case of hydroelectricity, there is serious concern regarding the form of the plants and dams that have been, and continue to be planned and constructed, especially in the Amazon and in the headwaters of the Pantanal. WWF-Brazil proposes that the planning processes need to be improved by adopting an integrated vision that takes into account the multiplicity of vectors and alternatives that exists. It is of fundamental importance that there should be far greater degrees of transparency and social participation so that the biome's conservation priorities as a whole and the resilience of the Brazilian electricity supply system in the light of climate change are duly taken into account. A recently published study has revealed that the expected oscillations in rainfall-drought regimes could lead to a reduction of around 30% in hydroelectricity generation[3], and could also jeopardize the long term economic viability of the Amazonian hydropower projects.

Historically, hydropower plants' environmental impacts have been assessed project by project with little or no attention paid to indirect or cumulative impacts even though the hydropower potential inventories have been made in an integrated manner, on a basin-wide basis, for many years now. It is of fundamental importance that the set of dams now being planned should be assessed as a set, thereby making it feasible to anticipate, prevent and mitigate the greater impacts on biodiversity and on traditional peoples and to achieve the maintenance of strategic stretches of rivers free from dams.

3 Economia da Mudança do Clima no Brasil: custos e oportunidades (Climate Change Economics in Brazil: costs and opportunities), a 2009 study conducted by the Climate Economics of public and private research organisations coordinated by researchers Carolina Dubeux, Jacques Marcovitch and Sérgio Margulis.

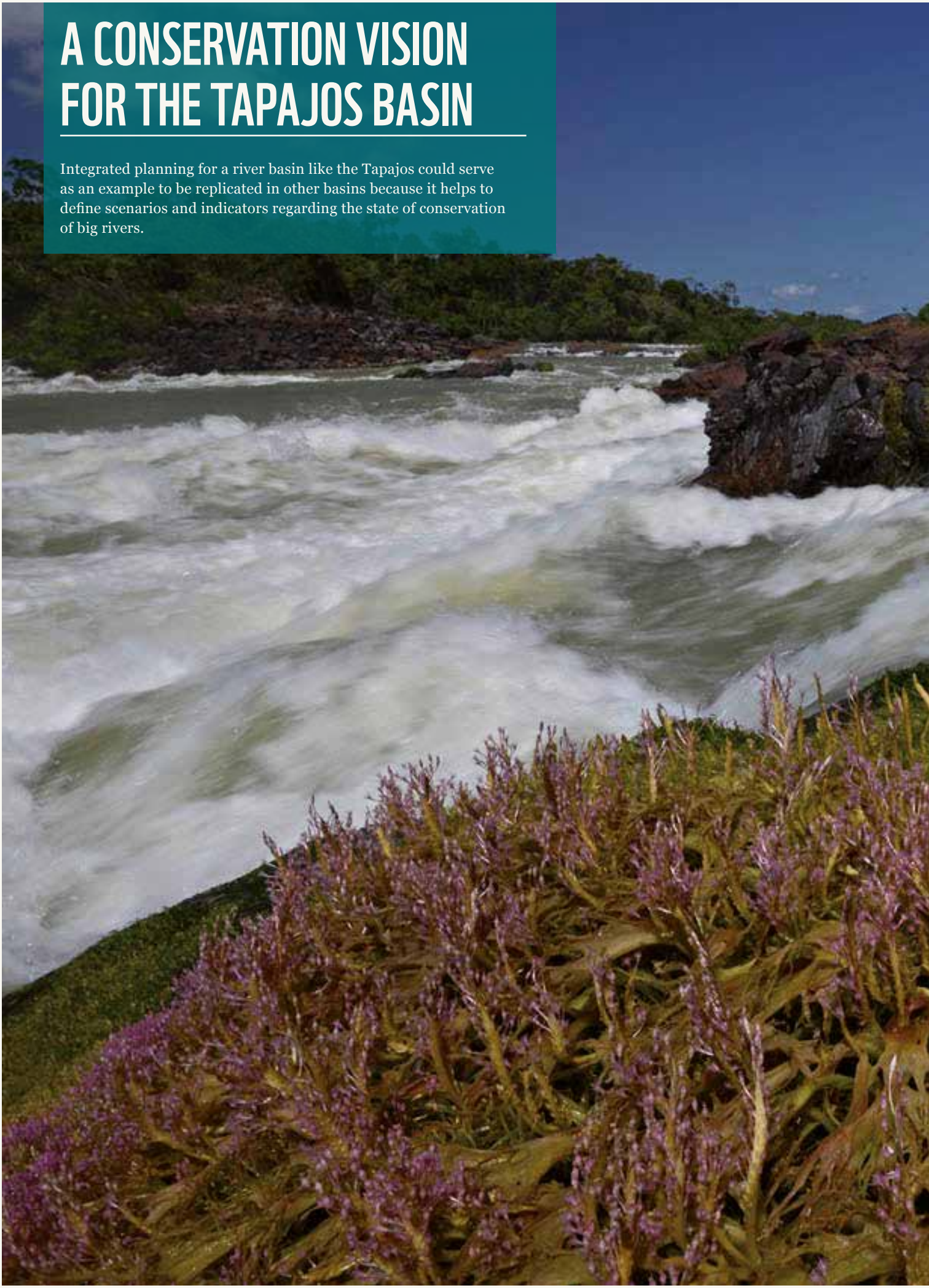
Furthermore, Brazil has wind, sunshine and biomass in abundance. Alternatives exist that allow for the country to have a diversified energy matrix that is clean and secure and that would be competitive from the economic and environmental standpoint. Brazil is possibly the only country where that would be possible to achieve within a reasonable timeframe and at a reasonable cost. To that end, however, it needs to alter its focus on subsidizing and stimulating an unsustainable matrix and focus instead on sustainable technology.

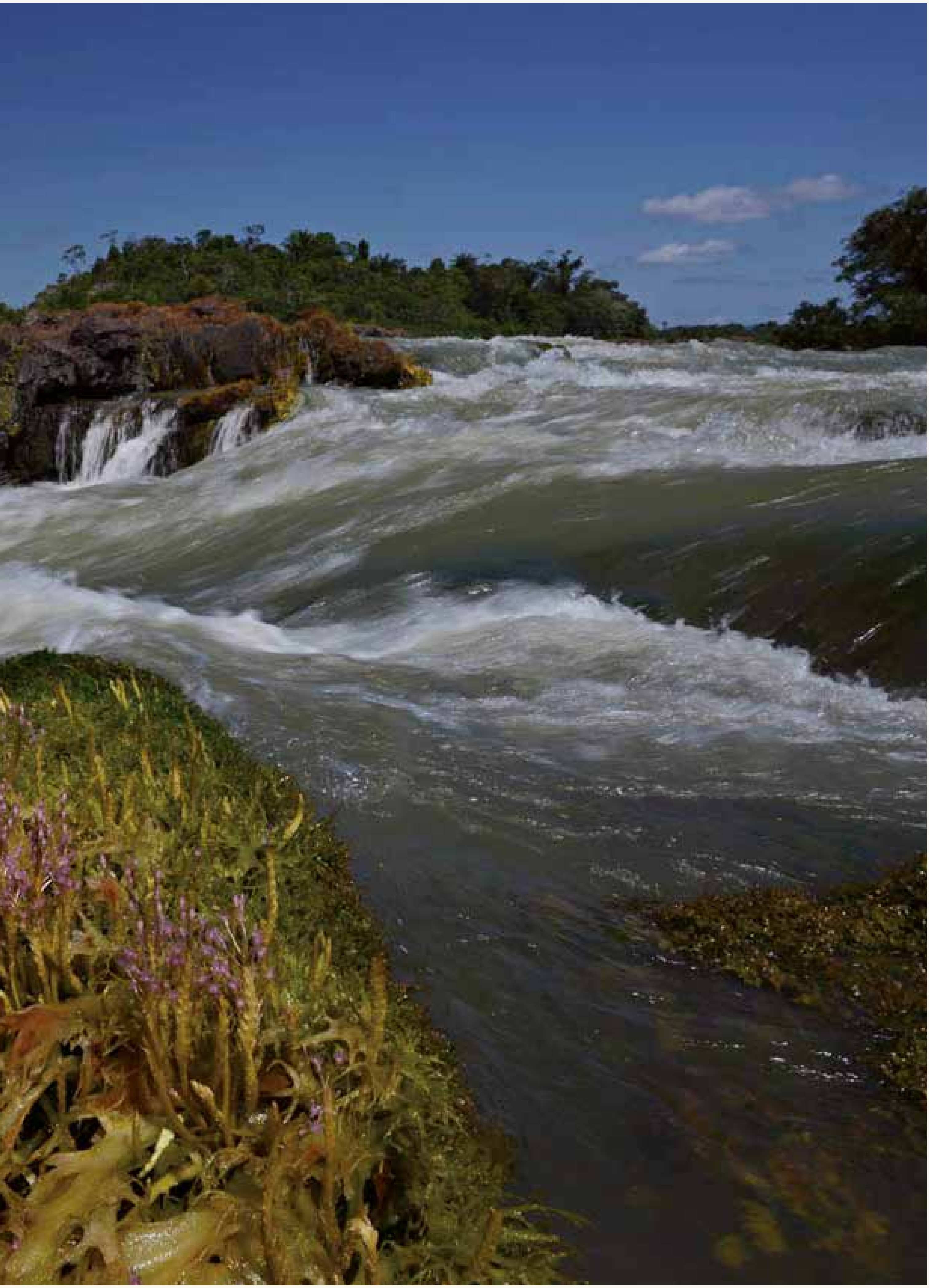
Energy security can be achieved by diversifying generating sources and localities as a way of compensating for climate change impacts in such a widespread territory. Measures must also be taken to reduce waste and increase efficiency in electricity distribution and consumption. Access to electricity is a universal right that needs to be provided in a secure and sustainable manner for the good of all. Thus, in addition to investing in sustainable sources for large scale production, **investments are needed in distributed generation** to reduce overloads on the grid and prevent and dilute the impacts of generating accidents on that process.

Distributed generation means generating electricity near to the places where it will be consumed, regardless of the power level or the source of energy involved. Within that concept, the consumer may even generate the electricity he or she consumes by using renewable sources (like solar panels for example) and any excess can be supplied to the local distribution system.

A CONSERVATION VISION FOR THE TAPAJOS BASIN

Integrated planning for a river basin like the Tapajos could serve as an example to be replicated in other basins because it helps to define scenarios and indicators regarding the state of conservation of big rivers.





A CONSERVATION VISION FOR THE TAPAJOS BASIN

WWF is arguing in favour of integrated planning for the river basins of the Amazon region and proposing a qualified national debate on the conservation of that vast territory. That means defining which rivers must be preserved before the accumulation of innumerable hydropower projects for the region, each one treated in an isolated manner, generates a socio-environmental impact that could potentially be of disastrous proportions.

In that sense, integrated planning for a basin like the Tapajos could serve as an example to be replicated in other basins because it helps to define scenarios and indicators regarding the state of conservation of big rivers. Only such planning can trace the parameters for decision-making as to the best alternatives capable of conciliating a region's economic development with the conservation of its terrestrial and aquatic ecosystems.

To define conservation scenarios and indicators, WWF'-Brazil's Science Programme coordinated a series of analyses of the Tapajos Hydrographic Basin on the basis of hydrological, biological and land use information and in the perspective of the aquatic and terrestrial media.

That methodology, known as Systematic Conservation Planning (SCP) was used to define the basin's conservation priorities based on biodiversity targets and their environments, such as vegetation types, diversity of bodies of water, and other attributes that are important to conservation and that could be mapped throughout the Tapajos basin.

The process of modelling an ecological vision also involves analyses of risks, vulnerability and conservation opportunities. Terrestrial risks are represented by the risk of deforestation while the vulnerability of aquatic systems is defined by the Ecological Risk Index (ERI) calculated on the basis of the impacts generated by anthropogenic activities. Conservation opportunities refer to Protected Areas and Indigenous Territories (ITs).

Salto Augusto Falls, Juruena River, Mato Grosso, Brazil

THE HIS-ARA APPROACH

Currently there are various tools that can facilitate integrated analyses of the environment and help to define land use restrictions and guide the utilization of natural resources. Such tools lead to the identification of priority areas for biodiversity conservation, ecological-economic zoning, environmental vulnerability and so on. Studies using such tools have already been undertaken by governments and other institutions, but in many cases the administrators or the communities in general have not been capable of making full use of their potential.

For that reason, in the context of Systematic Conservation Planning, WWF has developed an approach that makes it possible to obtain an integrated vision of river basins that takes into account risks and potential social and environmental impacts.

The approach is based on an information system and analyses that identify priority areas for conservation and indicate those rivers that need to have their flows kept free so that the natural ebbs and flows of the system can be maintained. That is made possible by analytical tools applied to a Hydrological Information System for Amazon River Assessment (HIS-ARA) which integrates ecological and hydrological information to create a conservation vision of the terrestrial and aquatic ecosystems on a regional scale

The HIS-ARA approach takes into account both local and cumulative impacts in relation to other potential threats and it incorporates data on ecological systems, aquatic habitat types and existing protected areas, as well as various kinds of anthropogenic threats and their potential environmental impacts.

WWF-Brazil has previously used Systematic Conservation Planning for the Serra do Mar, the Cerrado-Pantanal region, the states of Goias and Bahia and for the Xingu River Basin. For each initiative, new analyses and databases were incorporated to take into account regional peculiarities and the particular objectives of the respective study. The innovation, in the case of the Tapajos Basin, is that the organisation has made use of hydrological information in the analyses in order to consider both aquatic and terrestrial ecosystems in the search for conservation solutions.

THE TAPAJOS RIVER BASIN

The Tapajos is a river with transparent waters, a rarity in the Amazon, and that unique feature makes it one of the most sought after tourist destinations in the region. Because they rise in central Brazil and flow out into the main channel of the Amazon River, the Tapajos and its tributaries flow through regions with different types of vegetation and correspondingly varied landscapes with a high degree of biodiversity and a great number of endemic species.

Geographic location of the basin

The Tapajos River Basin embraces an area of 492,000 km² in the states of Mato Grosso, Para, Amazonas and small part of Rondonia. It is situated on the borders of the deforestation front of the Brazilian Amazon but is still very well preserved and represents a kind of great green wall, tending to discourage the deforestation that is driven by commodities production in the transition zone with the region of the Cerrado savannahs. That front is now advancing through the proliferation of small settlements and landholdings from south to north and from east to west along the routes of the Cuiaba-Santarem Federal Highway (BR-163 and the Trans-Amazon Highway (BR-230) respectively. Furthermore, the Tapajos is the only big right bank tributary of the main Amazon river that has not been blocked by very large scale hydropower dams. Currently, however, the Tapajos River Basin is being targeted as the great frontier for hydropower supply and economic development of the Amazon.

The Tapajos's main tributaries are the Jamanxim, Crepori, Teles Pires and Juruena Rivers. The headwaters of the Juruena and Teles Pires are in areas of Cerrado savannah already considerably modified and, as they flow northwards, the savannah is gradually replaced by Amazon forest vegetation in a transition zone also highly affected by human activities. Even farther north, towards the main course of the Amazon, the vegetation is marked by the presence of open ombrophilous forest and dense ombrophilous forest with interspersed areas of seasonal forests, grasslands and *campinarana* formations, as well as alluvial forests close to the courses of the rivers themselves.

Tapajos River, Para, Brazil.

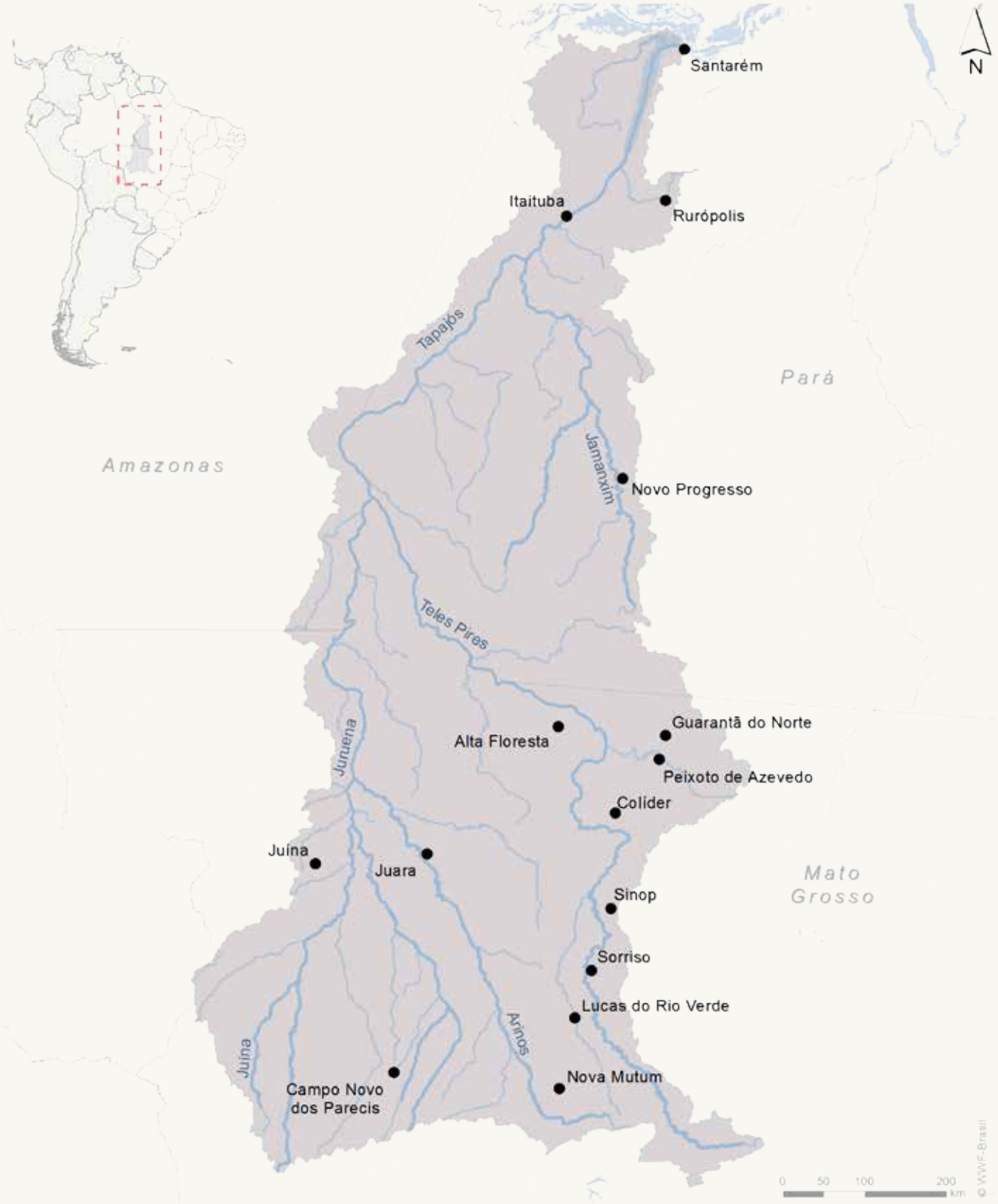


Figure 1: Main rivers of the Tapajos Basin and cities with over 20 thousand inhabitants.

Vegetation

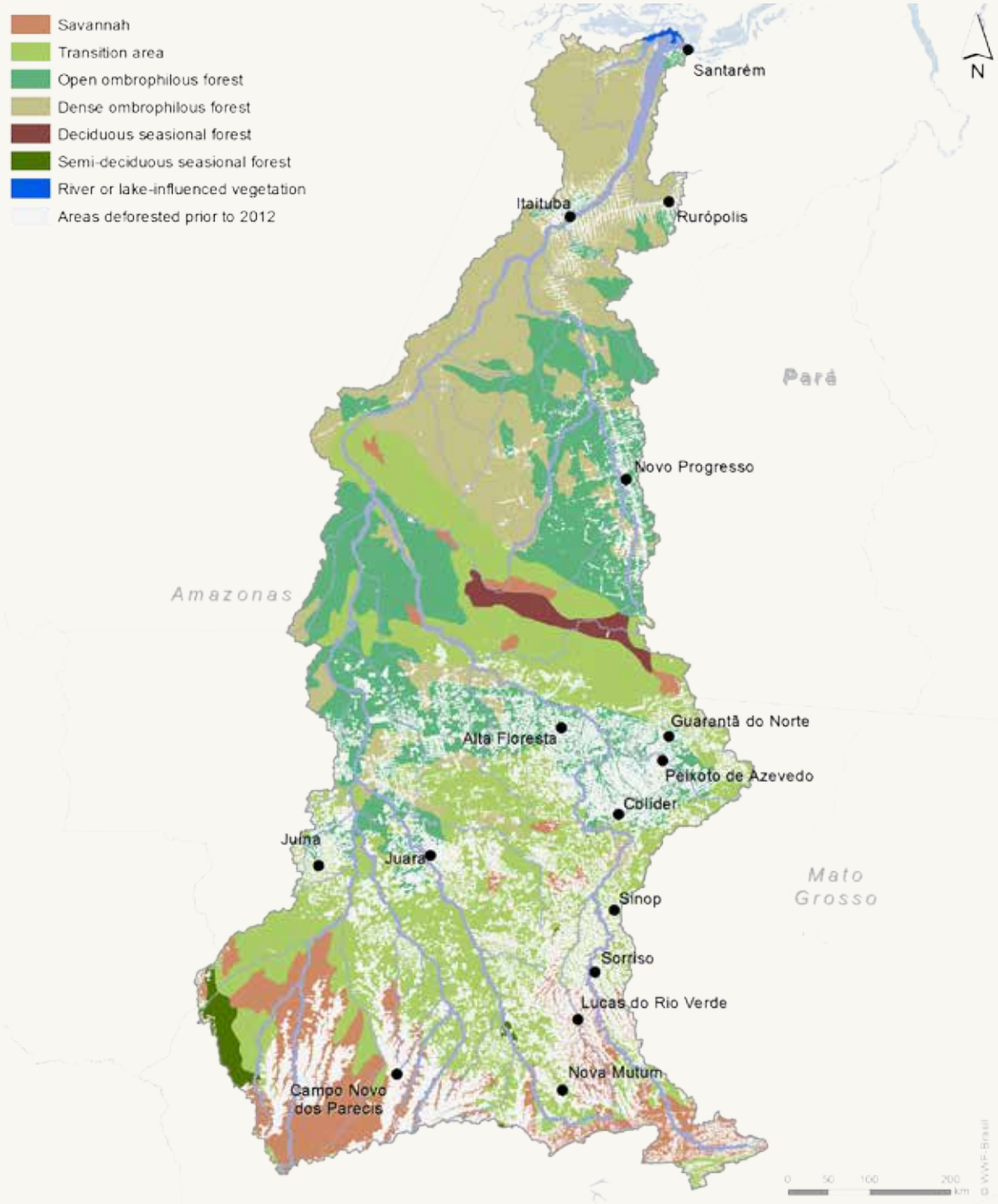


Figure 2: Vegetation in the Tapajos River Basin. Source: IBGE.

According to a survey conducted by the Brazilian Ministry of the Environment based on satellite images for 2008, 77.7% (382,266 km²) of the basin still has its original vegetation. A WWF-Brazil survey based on data from the National Space Research Institute - Inpe, complemented by analyses conducted by the WWF team shows that the most frequent type of land use in the basin is for pastures, occupying 78,128.03 km² followed by agriculture occupying 47,309.31 km² and that there are a further 1,482.04 km² of deforested land without any identifiable form of use.

Protected areas

Almost 40% of the basin is under some form of conservation protection either as protected areas or as indigenous territories: there are nine strict protection areas (8.1% of the basin area), 20 sustainable use protected areas, occupying a total of 13.6% of the basin and 30 indigenous reserves occupying 17.9% of the basin. The oldest protected areas in the Tapajos Basin are the Amazon National Park and the Tapajos National Forest, both created in 1974. The protected areas, however, have been created in the light of terrestrial attributes and the region's freshwater ecosystems are still highly vulnerable to degradation and fragmentation.

Table 1: Protected Areas in the Tapajos Basin

Name	Area lying within the basin (km²)
Strict Protection Areas	
Ique Ecological Station	1,860
Cristalino State Park	590
Igarapes do Juruena State Park	1,028
Sucunduri State Park	4,723
Amazon National Park	3,379
Jamanxim National Park	8,587
Juruena National Park	13,741
Rio Novo National Park	5,382
Nascentes Serra do Cachimbo Biological Reserve	395
Sustainable Use Protected Areas	
Cabeceiras do Rio Cuiaba Environmental Protection Area	1,493
Salto Magessi Environmental Protection Area	78
Tapajos Environmental Protection Area	20,403
Apui State Forest	896
Sucunduri State Forest	621
Altamira National Forest	1,955
Itaituba National Forest I	2,129
Itaituba National Forest II	3,988
Tapajos National Forest	3,122
Amana National Forest	1,592
Crepori National Forest	7,404
Jamanxim National Forest	13,017
Trairao National Forest	2,561
Bararati Sustainable Development Reserve	1,108
Riozinho do Anfrisio Extractive Reserve	147
Tapajos Arapiuns Extractive Reserve	6,744
Cristalino Privately Owned Nature Reserve	25
Cristalino Privately Owned Nature Reserve	16
Cristalino Privately Owned Nature Reserve	5
Cristalino Privately Owned Nature Reserve	18

Biodiversity

There is a high degree of biodiversity in the basin but it is still very little known. However, to give an idea of what it might be, fifteen new bird species were described for the Amazon region in 2013 alone and one of them, *Tolmomyias suncunduri*[4], comes from the Tapajos Basin. The basin's protected areas and natural landscapes are home to various species under threat of extinction or with very restricted distributions. Indeed, the Tapajos River Basin is one of eight areas of endemism in the Amazon, especially in regard to fish and bird species[5]. Furthermore, the Tapajos River itself is an important bio-geographic barrier for some bird species, like the Hoffmanns's woodcreeper (*Dendrocolaptes hoffmannsi*), endemic to the Tapajos-Madeira interfluve and the Tapajos hermit (*Phaethornis aethopyga*) endemic to the Tapajos-Xingu interfluve.

AREAS OF ENDEMISM

Endemic plant or animal species are those that only exist in a certain geographic region. Areas of endemism are territories that are home to various species that can only be found in them.

According to the article "*O destino das areas de endemismo na Amazônia*"[6], (The destiny of areas of endemism in the Amazon), recent compilations have shown that the Amazon, the world's biggest and most diverse tropical forest, is home to at least 40,000 species of plants, 427 mammal species, 1,294 species of birds, 378 reptile species, 427 species of amphibians and around 3,000 species of fish. Considering the variety of heterogeneous plant and animal communities, it is a veritable archipelago made up of eight distinct areas of endemism separated by the region's main rivers. The areas are Tapajos, Xingu and Belem (restricted to Brazil); Rondonia (most of the area is in Brazil); and Napo, Imeri, Guyana and Inambari (areas partly lying in other countries).

According to those authors "the areas of endemism in the Amazon have lost from 2 to 13% of their forests with the exception of Xingu, which has lost around 27% and Belem, which now has only one third of its area still covered by forest. Napo, Imeri and Guyana have more than 40% of their territories in protected areas; Inambari, Rondônia, Tapajos and Xingu, from 20% to 40%; and Belem, less than 20%. However, protected areas in the Strict Protection category are only a small portion of those protected areas and account for 0.28% to 11.7% of the extension of areas of endemism in Brazil".

4 Whitney, Schunck, Rêgo & Silveira, 2013

5 http://www.icmbio.gov.br/portal/images/stories/o-que-fazemos/proj_apoiados/resumo_projeto_313.pdf.

6 Silva, José Maria C. da; Rylands, Anthony B.; Fonseca, Gustavo A. B. da. 2005. Megadiversidade, volume 1, number 1.

THE TAPAJOS REGION

There are 74 municipalities in the Tapajos river basin – two in the state of Amazonas, 60 in Mato Grosso, 11 in Para and one in Rondonia. 47 of them have their main city within the basin's limits (37 in Mato Grosso and seven in Para). Santarem and Itaituba are the two main municipalities in the basin.

SANTAREM IS THE REGION'S BIGGEST CITY WITH AROUND 300 THOUSAND INHABITANTS

Located at the mouth of the Tapajos where it joins the Amazon, Santarem is the region's biggest municipality. It has around 300 thousand inhabitants and also has the largest GDP in the Tapajos Basin. In the last ten years it has become an important grain producing area, especially of soya, due to the expansion of the agricultural frontier. People in Para state call the city "the Pearl of Tapajos" because it is where one of Brazil's most beautiful scenic landscapes is located, the Alter do Chao district, with its paradisiacal white sand beaches and the emerald green waters of the Tapajos itself.

Itaituba is a municipality with 100 thousand inhabitants which, in the 1980s and 90s, had its economy centred on gold mining. When production from the Serra Pelada began to decline at the beginning of the 1980s, all eyes turned to the Tapajos region which was believed to be one of the world's largest auriferous provinces. For that reason Itaituba came to be known as "Cidade Pepita" or Nugget City. Nowadays the mining activity is limited to clandestine artisanal mining that [unfortunately] still uses mercury and cyanide to extract the gold. The city itself is strategically located on the banks of the Tapajos with fast, easy access to Federal Highway BR-163 and only 350 km south of Belem.

The region has a low human development index. Itaituba's score is 0.640 and Santarem's is 0.691), which puts them among the lowest of Brazils 5,565 municipalities; 3,291st and 2,161st places in the ranking, respectively. The presence and performance of the State in more distant localities is also very feeble and there are serious gaps in the provision of health and education services, among others.

LARGE-SCALE VENTURES AND IMPACTS IN THE BASIN

Hydroelectric plants

According to the executive summary of the integrated environmental assessment of the Tapajos River Basin (carried out by the Tapajos Study Group and Ecology Brasil in 2014)[7], within a 20 year timeframe, three hydroelectric plants are planned to be installed in the Tapajos river itself (Sao Luiz, Jatoba and Chacorao) and another four in the basin of one of its main tributaries, the Jamanxim River (Cachoeira do Cai, Jamanxim, Cachoeira dos Patos and Jardim do Ouro), forming what is referred to as the Tapajos Complex.

The scenario, however, could possibly become even more intricate because the Energy Research Company (EPE) has identified 44 sites for possible dam construction in the Tapajos Basin located in the Juruena, Teles Pires and Jamanxim rivers and their tributaries. 14 of those projects appear in the Growth Acceleration Plan (PAC 2), namely, Colider and Teles Pires (at the commercial operation stage), Alto Apiacas (2016), Sinop and Sao Manoel (2018), Sao Luiz do Tapajos (2021), Jatoba (2023), Castanheira (2024), Salto Augusto Baixo and Sao Simao Alto (removed from the PDE for 2022-2023), in addition to those for Cachoeira dos Patos, Chacorao, Jamanxim, Foz do Formiga Baixo and Tucumao which have no date established as yet for going operational because they are not listed in the PDE for 2024.

7 http://www.grupodeestudostapajos.com.br/site/wp-content/uploads/2014/04/Sumario_AAI.pdf.

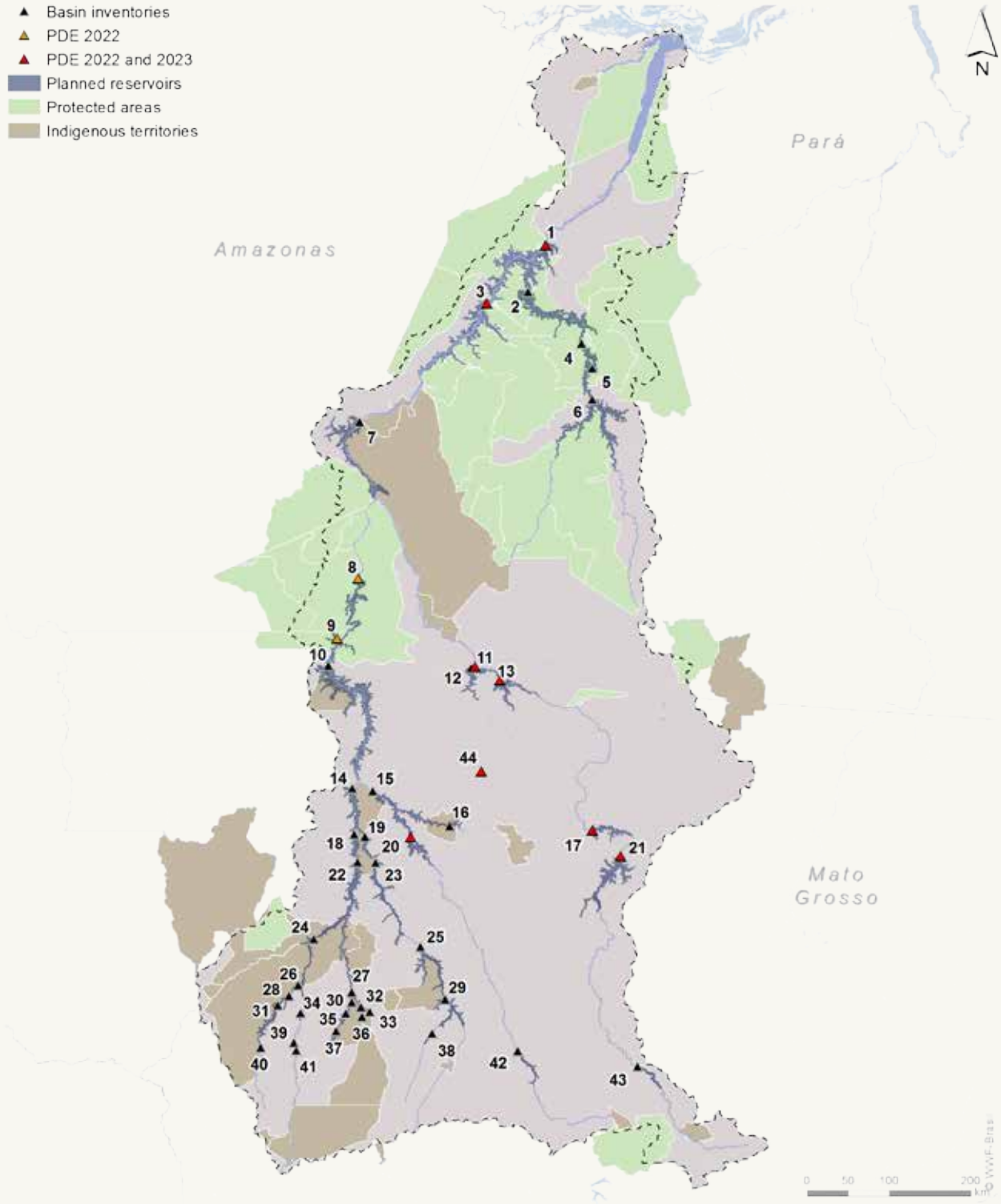


Figure 3: Hydroelectric plants and reservoirs identified, planned or under construction in the Tapajos River Basin. Location of HE plants listed in the PDE 2023 in red (Sao Luis do Tapajos and Jatoba, in the Tapajos River; Castanheira in the Arinos River; Sao Manuel, Teles Pires, Colider and Sinop in the Teles Pires River); plants listed in the PDE 2022 excluded from the PDE 2023 in orange (Sao Simao and Salto Augusto, in the Juruena River), and all the other plants listed in inventories of the Tapajos, Juruena and Teles Pires Basins in black.

Table 2: Inventoried HEs in the Tapajos Basin (Source: EPE)

Number on map	Name of HE Plant	River	Power (MW)	Reservoir Area (ha)
1	São Luiz do Tapajós	Tapajós	8,040	73,242
2	Cachoeira do Caí	Jamanxim	802	51,972
3	Jatobá	Tapajós	2,338	64,875
4	Jamanxim	Jamanxim	881	8,360
5	Cachoeira dos Patos	Jamanxim	528	12,415
6	Jardim do Ouro	Jamanxim	227	44,550
7	Chacorão	Tapajós	3,336	62,527
8	São Simão Alto	Juruena	3,509	28,100
9	Salto Augusto Baixo	Juruena	1,461	12,525
10	Escondido	Juruena	1,248	110,341
11	São Manoel	Teles Pires	700	5,708
12	Foz do Apiacás	Apiacás	275	7,904
13	Teles Pires	Teles Pires	1,819	14,585
14	Tucumã	Juruena	510	21,997
15	Travessão dos Índios	Arinos	252	25,898
16	Apiaká-Kayabi	do Peixe	206	3,296
17	Colider	Teles Pires	300	12,334
18	Erikpatsa	Juruena	415	8,972
19	Tapires	do Sangue	75	4,441
20	Castanheira	Arinos	192	11,905
21	Sinop	Teles Pires	400	32,963
22	Fontanilhas	Juruena	225	56,303
23	Kabiara	do Sangue	241	25,424
24	Enawenê-Nawê	Juruena	150	8,021
25	Roncador	do Sangue	134	23,838
26	Nambikwara	Juína	73	866
27	Foz do Buriti	Papagaio	68	1,887
28	Foz do Formiga Baixo	Juína	107	2,575
29	Parecis	do Sangue	74	20,050
30	Buriti	Buriti	60	1,479
31	Jacaré	Juína	53	10,926
32	Foz do Sacre	Papagaio	117	2,103
33	Matrinxã	Sacre	34	85
34	Juruena	Juruena	46	186

Number on map	Name of HE Plant	River	Power (MW)	Reservoir Area (ha)
35	Tirecatinga	Buriti	37	3,187
36	Salto Utiariti	Papagaio	76	191
37	Água Quente	Buriti	42	3,315
38	Paiaguá	do Sangue	35	2,249
39	Cachoeirão	Juruena	64	284
40	Pocilga	Juína	34	130
41	Jesuíta	Juruena	22	859
42	Barra do Claro	Arinos	61	6,776
43	Magessi	Teles Pires	53	6,393
44	Salto Apiacás	Apiacás	45	75

Construction of a hydroelectric plant on the Teles Pires River, Mato Grosso and Para, Brazil.

Potential and impacts

Considering just the seven plants foreseen in the Executive Summary of the Integrated Environmental Assessment of the Tapajos Basin, - Sao Luiz, Jatoba and Chacorao (in the Tapajos) and Cachoeira do Cai, Jamanxim, Cachoeira dos Patos and Jardim do Ouro (in the Jamanxim), their hydroelectric potential is 14 thousand megawatts, equivalent to the bi-national Itaipu plant on the Brazil-Paraguay border.

According to Eletronorte data for the year 2008, as cited in a report of the Agencia Publica[8], at least 2.3 thousand people belonging to 32 riverside communities will be directly affected if the seven projects are effectively implemented. Furthermore, 16 indigenous villages of the Munduruku ethnic group will also have parts of their territories inundated by the reservoir waters that the dams will form. Social movements and entities advising those communities consider that the number is underestimated.

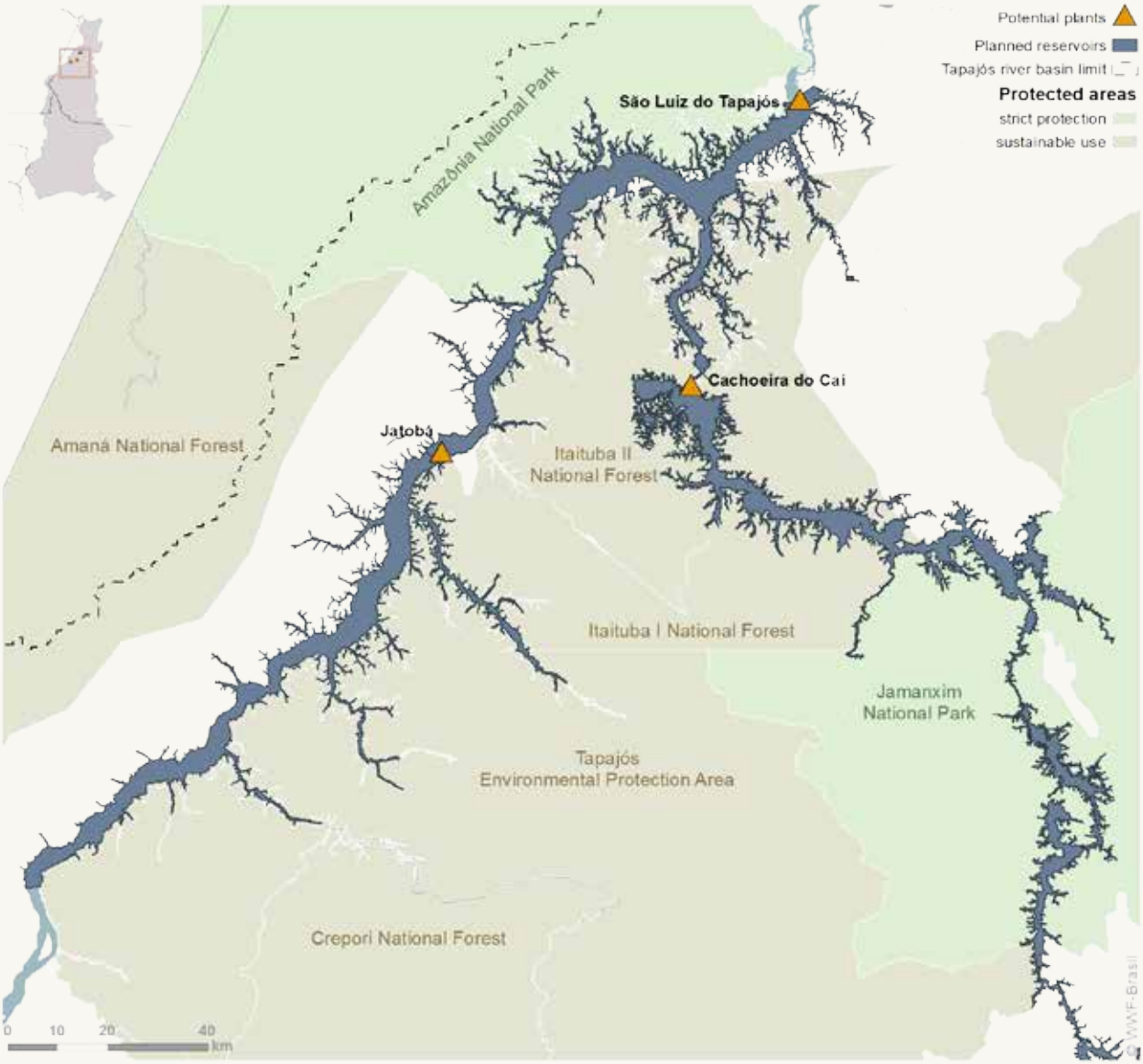


Figure 4: Projection of the reservoirs of three of the seven HEs inventoried for the Tapajos Basin. Source: EPE and MME

8 Amazônia Publica. São Paulo, SP. Publica, 2013 (http://www.apublica.org/amazoniapublica/).

The Sao Luiz do Tapajos hydroelectric project stands out in government planning as the largest plant of the complex, with a generating capacity of 8,040 megawatts. According to the project, it will be Brazil's fourth largest hydroelectric installation only surpassed by Itaipu, Belo Monte (in course of construction) and Tucurui, with the last two being in the Amazon region as well. The dam will be 3,483 metres long and 39 metres high and it is expected to inundate almost 732 km² (half the size of the municipality of Sao Paulo). Pimental, founded 120 years ago and home to 760 inhabitants[9], is the largest of the riverside communities that will be submerged by the reservoir waters.

Again according to the Agencia Publica report, the environmental impacts the plants will cause may be even more serious than those generated by the Belo Monte dam whose reservoir will occupy an area of 510 km². In the Xingu, the stretch of river that will be dammed up will be 200 km long. In the Tapajos, it will be two and a half times greater. The Jamanxim with its three plants installed will become just a series of lakes.

Anther source of concern is the relation between the muddy waters of the Amazon and the clear green waters of the Tapajos which meet, but do not mix, in front of Santarem. There is concern that the Amazon River waters may invade the waters of the Tapajos due to the reduced flow of the latter river and that would mean the end of the tourist attraction of Alter do Chao.

Aerial view of forest cover, Mato Grosso, Brazil.

9 Report "O pesado custo ambiental de Tapajós" [The heavy environmental cost of Tapajos], de André Borges, Valor, 25-07-2012.

Reduction of protected areas

To enable the construction of the hydroelectric plants, above all Sao Luiz and Jatoba, protected areas in the basin were reduced by 750 km² by Provisional Act nº 558/2012, converted into Law nº 12.678, on June 25, 2012. That measure reduced the territories of the Amazon National Park, and the Itaituba (I and II) and Crepori National Forests and that of the Tapajos Area of Environmental Protection. All the parts of protected areas liberated for expropriation are courses and floodplains of rivers that may come to be permanently immersed if the dams are effectively built.

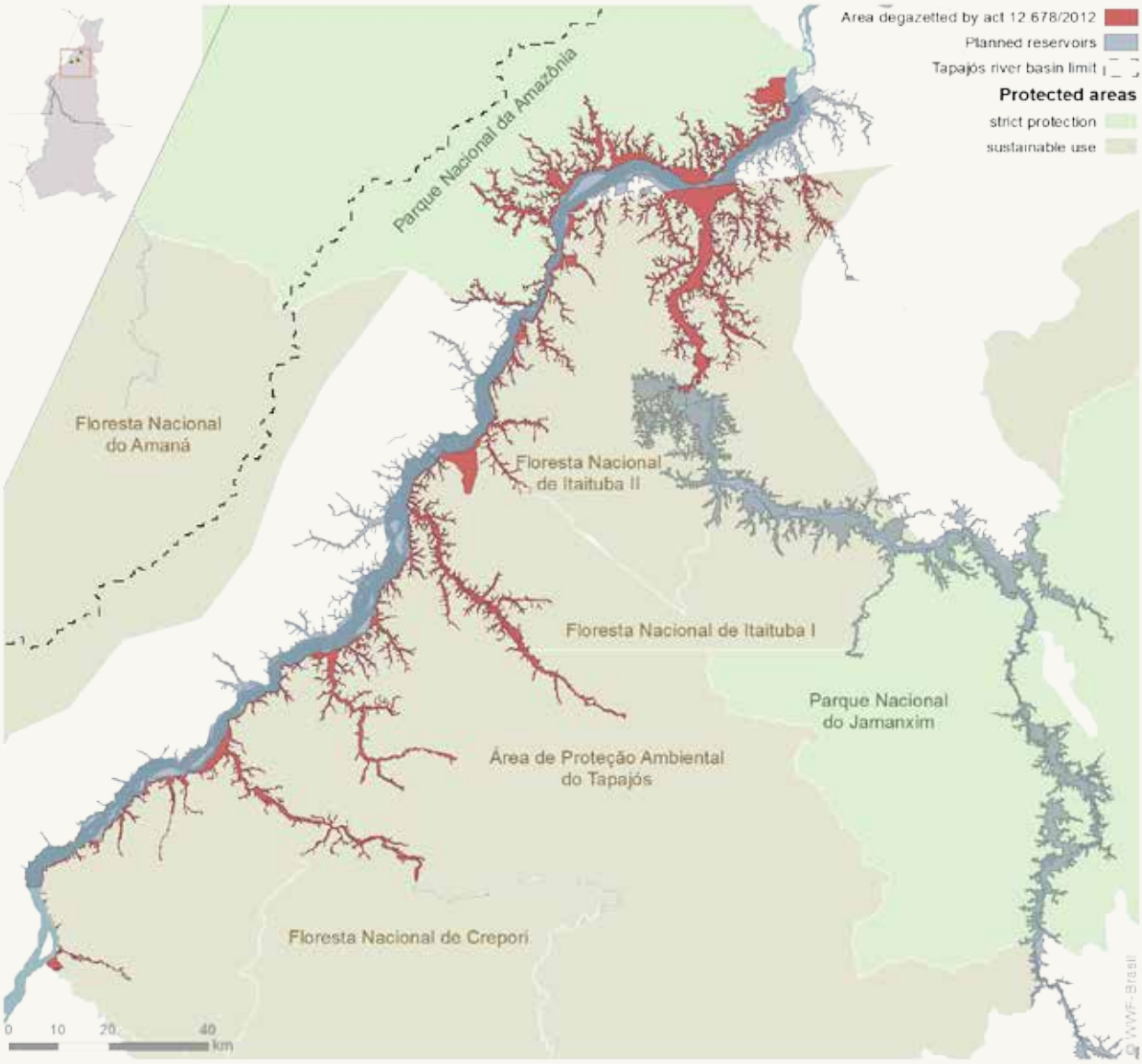


Figure 5: Area liberated for expropriation by Act nº 12.678, dated June 25, 2012 in the Amazon National Park, the National Forests Itaituba I and II and Crepori, and the Tapajos Environmental Protection Area.

In 2012, staff of the ICMBio's Itaituba office, responsible for 12 protected areas in the Tapajos Basin, launched a public manifesto[10], in which they declared that "information compiled up to the moment indicates the existence of an extremely high level of biodiversity with a considerable degree of endemism and great representativeness of species under threat of extinction in the areas affected by that act".

Making adjustments to protected area perimeters, especially those areas that were established before the existence of a specialized database or without due consultation of society, can be an important way to remediate historical injustices, solve local conflicts and ensure the conservation of areas with high biodiversity value. Nevertheless, transparent technical analysis and public consultation processes need to be established to assess the real importance of any intended reduction, reclassification or protection-cancelling affecting protected areas. In extreme cases, where alterations are absolutely inevitable, a process should be established to compensate for the areas being lost by expanding existing protected areas or creating new ones in such a way as to guarantee the representativeness of the system and the protection of areas with a biodiversity equivalent to those that have been affected. In the light of Act nº 12.678, two protected areas in the Madeira River Basin have already been expanded by the addition of a total area of 3,473 km² to compensate for the loss of 1,404 km² of protected areas in the Madeira and Tapajos Basins. However, in spite of the increase in the extension of protected areas, there was no compensation for the floodplain ecosystems that were lost.

THE #SOSJURUENA CAMPAIGN

Another protected area at risk of having its area reduced to accommodate the construction of hydropower plants is the Juruena National Park located on the border between the states of Mato Grosso and Amazonas. It is Brazil's fourth largest National Park with an area of almost 2 million hectares, representing 2.5% of the total area of federal protected areas in the Legal Amazon and 5.3% of the total area of National Parks in the region. Reducing the area under protection would be the first step towards the construction of the Sao Simao and Salto Augusto Baixo hydropower plants. To warn society about that threat, WWF-Brazil launched the SOS Juruena campaign (wwf.org.br/sosjuruena; #sosjuruena) calling for the support of society to pressure the Ministry of Mines and Energy not to permit the construction of those projects and to maintain the Park's integrity.

If the two plants are eventually constructed, their reservoirs will inundate an area of 40 thousand hectares in the Juruena National Park, the Igarapes de Juruena and Sucunduri State Parks and in the indigenous territories Escondido, dos Apiakas do Pontal and isolated native peoples. In addition to local human populations, the dams will affect the survival of animal and plant species already under threat of extinction and of many species that are endemic to the region, putting at risk the Juruena River rapids and nullifying ecological processes that are vital for species like migratory fish, for example.

That appeal to society brought in good results: the two plants were removed from the PDE 2023 list which means they will not become operational at least in the next ten years. However, to totally eliminate the threat they represent, a commitment needs to be obtained from the Ministry of Mines and Energy that it will remove them definitively from its planning.

10 http://www.oeco.org.br/noticias/26290-icmbio-servidores-divulgam-carta-aberta-contra-recorte-de-ucs/

Impacts of the Tapajos Complex

If the Sao Luiz do Tapajos dam (the first power plant of the Tapajos Complex) is eventually constructed then, according to the Agencia Publica, 112 kilometres of the road that cuts across the Amazon National Park, the Trans-Amazon highway, will go under water. Furthermore the physical barrier constituted by the dams would make it impossible for various fish species to make the annual run to their spawning areas upstream. According to ICMBio technical staff interviewed for the Agencia Publica report, 90% of the 400 species registered for the park may fail to survive. A study conducted by Maringa State University researchers in Parana shows that fish ladders are actually a death trap for tropical fish species. Their work was published in the news section of Nature magazine in 2008 and it shows that after fish have gone up the ladder, the adults and the larvae are retained in the waters above the dam and never get back downstream again to complete the reproductive cycle[11]. The dams will also alter the seasonal cycles of high and low water, not only in the Tapajos and Jamanxim rivers themselves but in the entire hydrographic network associated to them. In addition, there are 390 registered bird species in the region as well as many other animal species under threat of extinction such as the jaguar, the giant anteater and the ocelot.

THE DAMS WILL ALSO ALTER THE SEASONAL CYCLES OF HIGH AND LOW WATER, NOT ONLY IN THE TAPAJOS AND JAMANXIM RIVERS THEMSELVES BUT IN THE ENTIRE HYDROGRAPHIC NETWORK ASSOCIATED TO THEM

Together the hydropower plants of the Tapajos Complex would inundate an area of 3,084.85 km² and generate severe impacts on indigenous communities. The Sao Luiz plant would affect the communities of Munduruku and Apiaka de Pimentel, Akaybae and Remedio. The Chacorao plant would inundate 121.1 km² of the Munduruku Indigenous Territory and would also directly affect the indigenous territories of Sai Cinza, Sao Martinho and Boca do Igarape Pacu, just 2.5 kilometres from the dam.

A new version of the Indigenous Component Study (*Estudo do Componente Indigena - ECI*) included in the Sao Luiz do Tapajos hydropower project identifies 14 negative impacts on the region's indigenous inhabitants. Furthermore, the study, coordinated by Eletrobras, shows that indigenous communities will be directly affected by the flooding caused by the dam which means that the project is not viable from the environmental standpoint.[12]

Hydropower projects also generate significant indirect impacts on people and the forests but they are more difficult to measure than direct impacts stemming from the dam construction and the reservoirs. The main indirect impacts caused by hydroelectric projects are the deforestation associated to opening up access roads, the migration of people going to work on the project and the installation of the infrastructure needed to accommodate all the workers.

According to the article *Cenários do Desmatamento na Área de Influência do Complexo Tapajós* (Deforestation Scenarios in the Area of Influence of the Tapajos Complex) [13], produced by the INPA and WWF, the two main drivers of deforestation in the Tapajos region are the northward expansion of soy crop farming in the state of Mato Grosso and the paving of the Federal Highway BR-163 which links Cuiaba in Mato Grosso to Santarem in Para and crosses the Trans-Amazon highway BR-230, as yet unpaved. The impacts of those factors could be aggravated by land speculation, increased emigration and increased costs for goods and services resulting from expectations of profiting from the future hydroelectric power in the region, especially in the light of the precarious land use planning and the lack of

11 http://www.nature.com/news/2008/080117/full/news.2008.445.html

12 O Globo, 29/09/2014, "Técnicos avaliam usina no rio Tapajós como inviável por impactos para índios"[Technical staff consider power plant on the Tapajos to be unfeasible because of impacts on indians]evaluate , http://oglobo.globo.com/economia/tecnicos-avaliam-usina-no-rio-tapajos-como-inviavel-por-impactos-para-indios-14049436#ixzz3ES20JJ2G

13 "Deforestation Scenarios in the Area of Influence of the Tapajós Hydropower Complex", published on page 50, in "State of the Amazon: Freshwater Connectivity and Ecosystem Health", available on http://d2ouvy59p0dg6k.cloudfront.net/downloads/wwf_livingamazon_state_of_the_amazon_freshwaterconnectivity__links_web_eng.pdf

any controls that might mitigate the main impacts in this region. In 2013, 19% of the Tapajos Complex's area of influence had already had its forests cleared and 76% of that deforestation was in the state of Mato Grosso.

Another consequence of implanting the hydropower plants will be the increase in population, thereby causing an impact on urban centres. According to the Agencia Publica report, Itaituba with its current population of 100 thousand would be liable to receive an additional 43 thousand inhabitants with the advent of the Sao Luiz do Tapajos plant alone, as foreseen in the Eletronorte inventory. If all the plants planned for the Tapajos are included, then there would be an estimated increase of 130 thousand people. While the possibility exists that the Sao Luiz do Tapajos plant could be constructed in the form of a platform like those used by the Petrobras Company to extract oil from the sea bed offshore and also already used to construct a gas pipeline in the Amazon, experts doubt whether that would reduce the impacts on the cities. Apart from the large numbers of employees involved (around 13 thousand at the height of the construction operations), which would make it difficult to transport them all by helicopter, they would need a place to stay on land anyway.

Furthermore, hydropower plants are not alone in their potential for generating impacts on the Tapajos Basin. Taking into account other large scale infrastructure works to be carried out in Itaituba in the near future, such as the construction of river ports to ship out grain coming in mainly from Mato Grosso, the population is expected to double over the next five years.

Other projects for the region

Small scale hydroelectric installations

There are various projects for small scale hydroelectric plants (PCHS) in the Tapajos Basin and they too can have a cumulative impact on the basin. The Electricity Sector Geo-referenced Information System (Sigel) of the National Electricity Regulatory Board (Aneel) reveals that currently there are 13 PCHS in operation in the Juruena, Formiga, Cravari, Sacre and Sangue rivers, all in the Juruena Basin, and in addition, there are at least another 40 PHCS either planned or already inventoried for that same basin[14].

Highways

The Tapajos region is a strategic corridor that enables the reduction of exportation costs by shipping the soy bean production of Mato Grosso state, Brazil's biggest producer, via the Amazon river. To further that end, Brazil intends to conclude the paving of the 1,739 kilometre-long BR-163 federal highway linking the city of Cuiaba to Santarem, at the mouth of the Tapajos[15].

Railways

There is also a new agenda for railways in the region and feasibility studies have already been authorized for a rail link that would connect Sinop in Mato Grosso to the river port of Mirituba (Para state), from where cargoes would be shipped in barges to ports further north. It is estimated that up to 40% of all grain and meal production from the state could eventually embark via that railway line which has been nicknamed the "Ferrograo" or grain line"[16].

14 Revisão dos impactos ambientais gerados na fase de instalação das hidrelétricas: uma análise da sub-bacia do Alto Juruena- MT, pág. 74. [Review of environmental impacts generated by the installation stage of hydroelectric plants: an analysis of the Upper Juruena sub-basin]. {http://periodicoscientificos.ufmt.br/ojs/index.php/biodiversidade/article/viewFile/707/605.

15 http://www.apublica.org/amazoniapublica/tapajos/rio-de-ouro-e-soja/

16 http://www.em.com.br/app/noticia/economia/2014/06/10/internas_economia,538079/governo-autoriza-estudos-para-novas-ferrovias.shtml

Navigation

There is already one port in operation in the region (Santarem) and a port complex between Miritituba and Barcarena. Another port is being constructed in Miritituba and the federal government is studying the feasibility of implanting two locks to connect the Teles Pires and Tapajos rivers as set out in detail below:

- The Cargill Company has installed a port at the mouth of the Tapajos in Santarem for the exportation of grain produced in Mato Grosso; the grain is transported in trucks to Rondonia where it is loaded onto barges that go down the Madeira River to the Amazon River and on to the port of Santarem where it is loaded onto ships with a 60 thousand ton cargo capacity. Although 95% of the cargo handled by that port comes from Mato Grosso, there has been an increase in the number of crop farms, not only in the municipality of Santarem but in neighbouring Belterra.

- Approximately 100 km of the Tapajos between Itaituba and Santarem is navigable and there the port of Miritituba is being built by the Hidrovias do Brasil S.A Company. It is expected to go operational some time in 2016. It is a strategic location not only because of the river connection but also because of the road connection with access to BR-163 and the Trans-Amazon highways.

- In April 2014, the Bunge Company inaugurated the Miritituba-Barcarena port complex in the municipality of Itaituba; an investment of 700 million reals. The complex consists of two terminals and a shipping company. At one point there is the *Estaçao de Transbordo de Miritituba* (Miritituba Transhipment Station) and at the other there is the *Terminal Portuario Fronteira do Norte-Terfron* (Northern Frontier Port Terminal) in the port of Vila do Conde, in Barcarena. The shipping company was created in a partnership arrangement with the Maggi group. The company has a fleet of 50 barges and two tugs to push them[17].

- The federal government has begun technical studies to take advantage of the construction of hydroelectric plants and implant two locks to make the connection of the Teles Pires and Tapajos Rivers feasible, thereby facilitating direct shipment in river vessels from the north of Mato Grosso to the Amazon via the Tapajos river and from there directly to the Atlantic. This latter possibility, however, was not originally foreseen in the projects for dams that are currently under construction.

Another impact associated to waterways is the presence of speedboats (high speed launches that function as river taxis) between Santarem and Itaituba. There is no overall navigation plan for the Tapajos and regulations that might help to avoid the impacts of the traffic of such launches on local communities and biodiversity are lacking.

17 O Estado de S. Paulo: "Com complexo portuária de R$ 700 mi, Bunge abre nova rota de exportação" [With its R$700 million port complex, Bunge opens up a new exportation route], 25/04/2014. http://economia.estadao.com.br/noticias/geral,com-complexo-portuario-de-r-700-mi-bunge-abre-nova-rota-de-exportacao-imp-,1158345.

Mining

Gold is the main mineral being mined in the Tapajos Basin. There are no big mining companies operating in the region, however, because the gold in this basin is scattered and there are no single large deposits. Furthermore there is a lack of the roads and electricity that might otherwise make larger operations feasible. That situation has favoured smaller-scale artisanal/prospector mining which predominates in the region.

The Para State government has set up a working group to study migration measures and regulate the small-scale mining activity which is the leading source of employment and income in Itaituba where the Sao Luiz do Tapajos dam and power plant are planned to be built. 85% of the state's gold mining exploration licences are concentrated in the municipality of Itaituba. There are 466 regularized concessions for the activity. Another 9.3 thousand requests for mining permissions are still awaiting analysis in the National Mineral Research Department (DNPM) – many of them with little chance of success as they are superimposed on protected areas[18].

Nevertheless, it has been calculated that there more than two thousand artisanal mining sites along the course of the Tapajos, almost all of them irregular and many of them operated from pontoons, working material brought up directly from the bed of the river. With the reduction of the protected areas that took place in 2012, the number of such pontoons went up from 5 to 35 in the 400 km of river between the municipalities of Itaituna and Jacareacanga, according to the Agencia Publica.

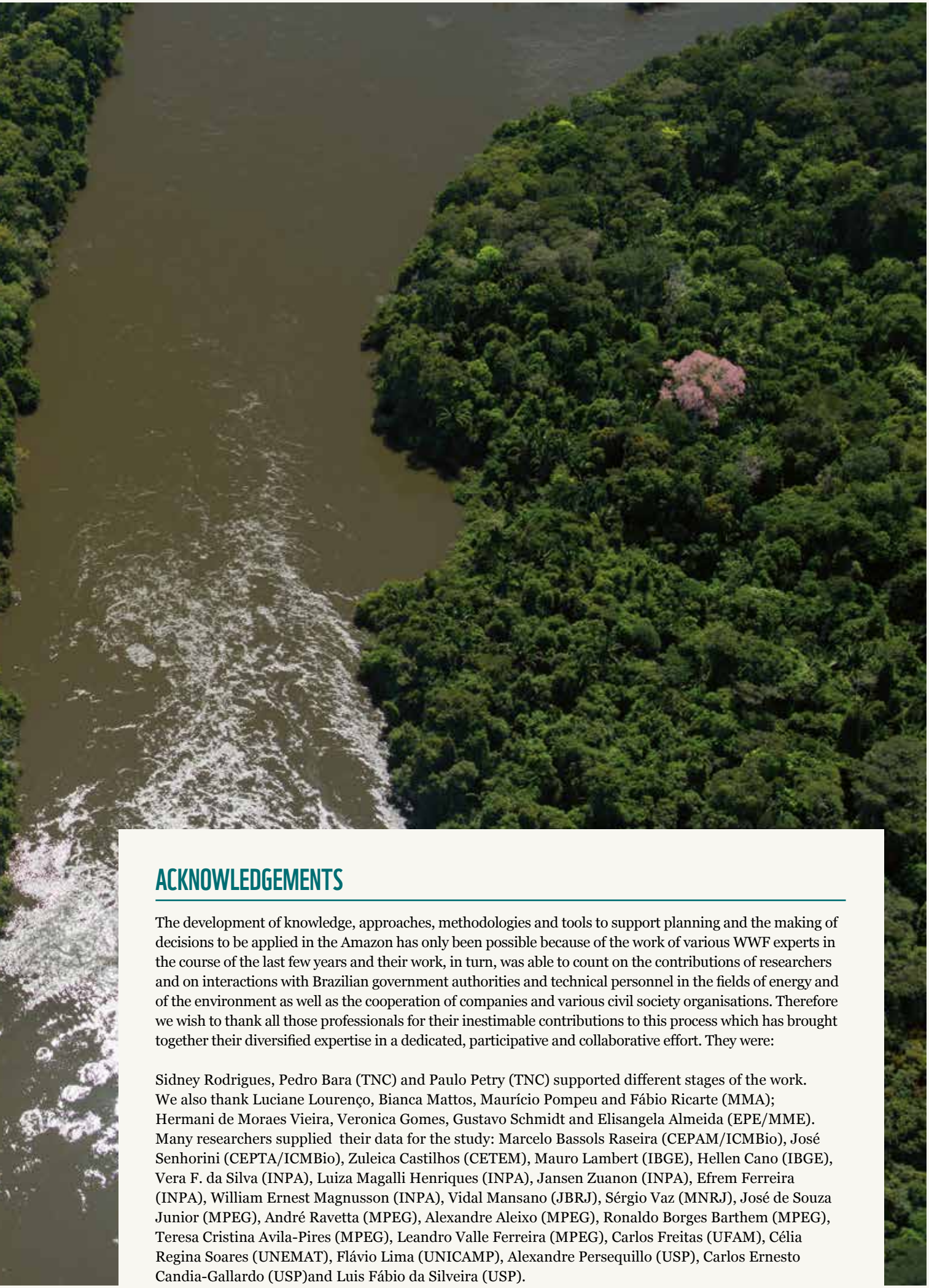
The expected implantation of new infrastructure such as roads and hydropower plants has also begun to attract the mining companies. Currently only one medium-sized Canadian mining company, Eldorado Gold, has any concrete investments in the Tapajos (the Tocantinzinho Project in Itaituba, scheduled to go operational in 2016). However, the giant South African Anglo Gold Ashanti Company, one of the biggest gold mining companies in the world, has also filed requests for exploration permissions for areas in the west of Para state and is currently undertaking a survey to determine the potential of a copper ore deposit in the Jamanxim National Forest.

18 A transição entre o ouro e a hidrelétrica [The transition from gold to hydroeectric plants], Brasil Econômico, 6/8/2014.http://brasileconomico.epaper.grupodia.com.br/contents_brasileconomico/paper140728344993.pdf; pág. 10.

Inferno Rapids, Juruena River, Mato Grosso and Amazonas states, Brazil

APPLYING SYSTEMATIC CONSERVATION PLANNING TO THE TAPAJOS

Systematic Conservation Planning is highly valuable in the elaboration of conservation scenarios that envisage the protection of biodiversity and the ecosystems and persistence of species, ecological processes and landscapes and that also envisage conservation opportunities and ways to minimize costs.



ACKNOWLEDGEMENTS

The development of knowledge, approaches, methodologies and tools to support planning and the making of decisions to be applied in the Amazon has only been possible because of the work of various WWF experts in the course of the last few years and their work, in turn, was able to count on the contributions of researchers and on interactions with Brazilian government authorities and technical personnel in the fields of energy and of the environment as well as the cooperation of companies and various civil society organisations. Therefore we wish to thank all those professionals for their inestimable contributions to this process which has brought together their diversified expertise in a dedicated, participative and collaborative effort. They were:

Sidney Rodrigues, Pedro Bara (TNC) and Paulo Petry (TNC) supported different stages of the work. We also thank Luciane Lourenço, Bianca Mattos, Maurício Pompeu and Fábio Ricarte (MMA); Hermani de Moraes Vieira, Veronica Gomes, Gustavo Schmidt and Elisangela Almeida (EPE/MME). Many researchers supplied their data for the study: Marcelo Bassols Raseira (CEPAM/ICMBio), José Senhorini (CEPTA/ICMBio), Zuleica Castilhos (CETEM), Mauro Lambert (IBGE), Hellen Cano (IBGE), Vera F. da Silva (INPA), Luiza Magalli Henriques (INPA), Jansen Zuanon (INPA), Efrem Ferreira (INPA), William Ernest Magnusson (INPA), Vidal Mansano (JBRJ), Sérgio Vaz (MNRJ), José de Souza Junior (MPEG), André Ravetta (MPEG), Alexandre Aleixo (MPEG), Ronaldo Borges Barthem (MPEG), Teresa Cristina Avila-Pires (MPEG), Leandro Valle Ferreira (MPEG), Carlos Freitas (UFAM), Célia Regina Soares (UNEMAT), Flávio Lima (UNICAMP), Alexandre Persequillo (USP), Carlos Ernesto Candia-Gallardo (USP)and Luis Fábio da Silveira (USP).

APPLYING SYSTEMATIC CONSERVATION PLANNING TO THE TAPAJOS

The study is based on the need to plan the use and conservation of biodiversity, of the ecosystems and of natural resources in an integrated manner and for the long term, and to adopt a conservation vision for the Tapajos River basin as a whole. The Systematic Conservation Planning approach is a valuable tool to support decision-making that assists in selecting priority areas for conservation based on the distribution of biodiversity, of ecosystems and of environmental services, while bearing in mind the costs of conservation and the connectivity of ecosystems along the rivers and that of flood plains and forests.

SCP is highly valuable in the elaboration of conservation scenarios that envisage the protection of biodiversity and the ecosystems and persistence of species, ecological processes and landscapes and that also envisage conservation opportunities and ways to minimize costs. Currently protected areas are planned primarily with terrestrial habitats in mind and they fail to foster the connectivity with aquatic ecosystems, thereby jeopardizing protection for the interface between the two environments. That goes to underscore the importance of integrated studies that contemplate the connectivity of environments along the rivers and the maintenance of natural flow regimes.

Deforestation and the loss of terrestrial and aquatic connectivity resulting from various conflicting types of land use such as agriculture, livestock raising, mining, urban occupation and infrastructure works intensify the need to evaluate all the threats together so that it becomes feasible to foresee the risk of losing aquatic ecosystems' integrity because of the expansion of infrastructure, while at the same time bearing in mind those other uses.

ECOLOGICAL RISK INDEX

The Ecological Risk Index (ERI) evaluates the loss of aquatic ecosystems' integrity resulting from the various conflicting types of land use consolidated in each of the microbasins that make up the study area. The conflicting uses that have been mapped out are those that threaten ecological integrity because they modify the structure of the environment, the chemical composition of the water, the flow regime, biodiversity and energy flows.

The Index combines the extent of different uses in each microbasin (for example, kilometres of road, cultivated areas) to a weighting coefficient that identifies the intensity of the impact caused by each type of use and another that indicates the differences in the sensitivities of each area according to its slope, the size of the rivers, and the climate type.

To calculate the ERI the occurrence and distribution of new kinds of conflicting use in the Tapajos Basin as described in Table 3 and Figure 6 were mapped:

Table 3: Land use and coverage in the Tapajos basin – area occupied by each conflicting use in the basin.

Conflicting uses	Extension in the basin (ha)
1 - Agriculture	4,707,122
2 – Irrigated agriculture (Centre-pivot)	17,708
3 - Pasture	7,800,181
4 - Mining	67,571
5 – Urban Areas	816,180
6 – Deforestation- use unidentified	147,566
7 - Dams	15,207
8 - Roads	51,576
9 – Poultry and pig farming	291 installations

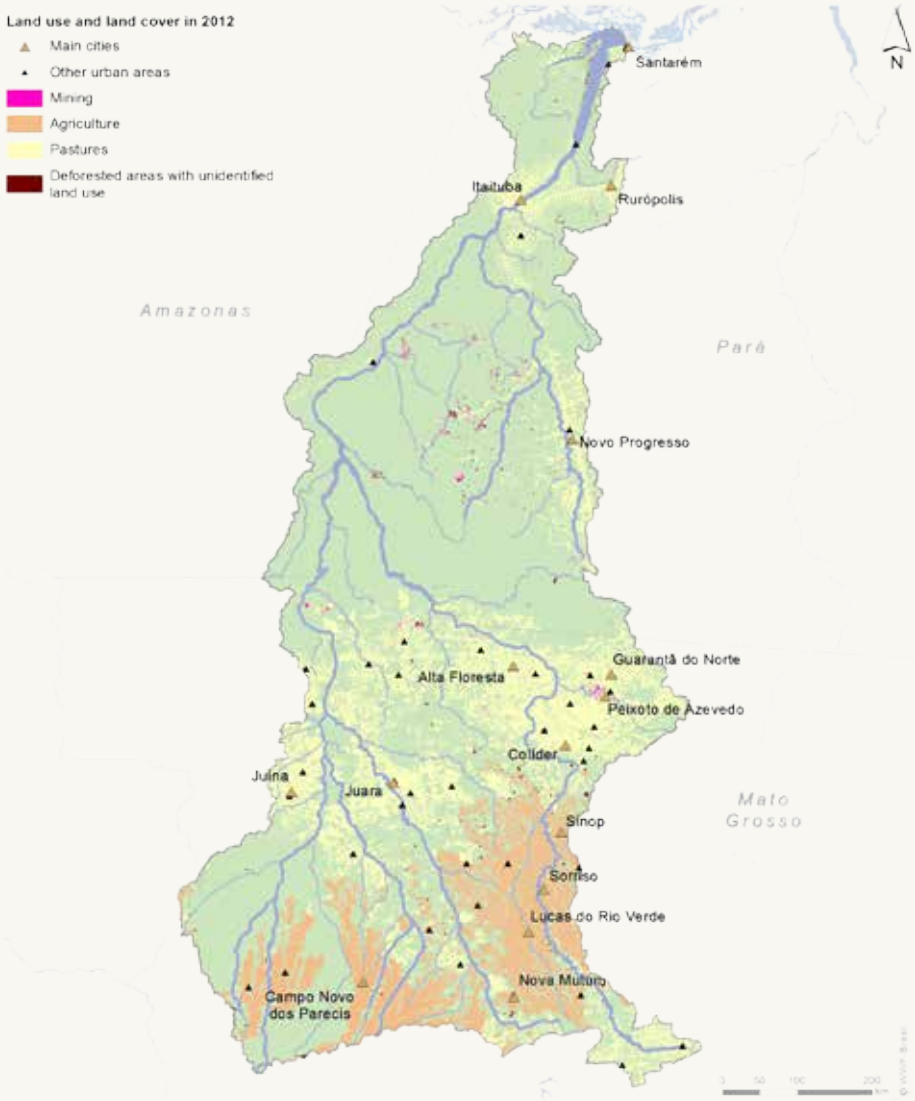


Figure 6: Land use and coverage in the Tapajos basin. Sources: Science Programme/WWF-Brazil, based on the Terraclass (Inpe) and interpretation of LandSat 2012 satellite images.

The severity and sensitivity indexes were obtained with the assistance of various experts with experience in the region during a workshop organized by the EPE, the Ministry of the Environment and other partners, with the support of the WWF-Brazil technical team. The highest severity indexes were attributed to urbanized areas, hydroelectric installations and mining. The experts considered that those threats have the greatest impact on aquatic biodiversity due to the increased pollution, the loss of connectivity and the structural modification of the aquatic habitats that they engender. Areas with hot humid climates were considered to be more sensitive and threatened than areas with seasonal climates (with some exceptions). Also areas at high risk of erosion such as headwaters and springs areas were considered as being more sensitive to most of the threats. By cross-referencing the whole set of data it became possible to establish a scale of high to low ecological risk (Figure7).

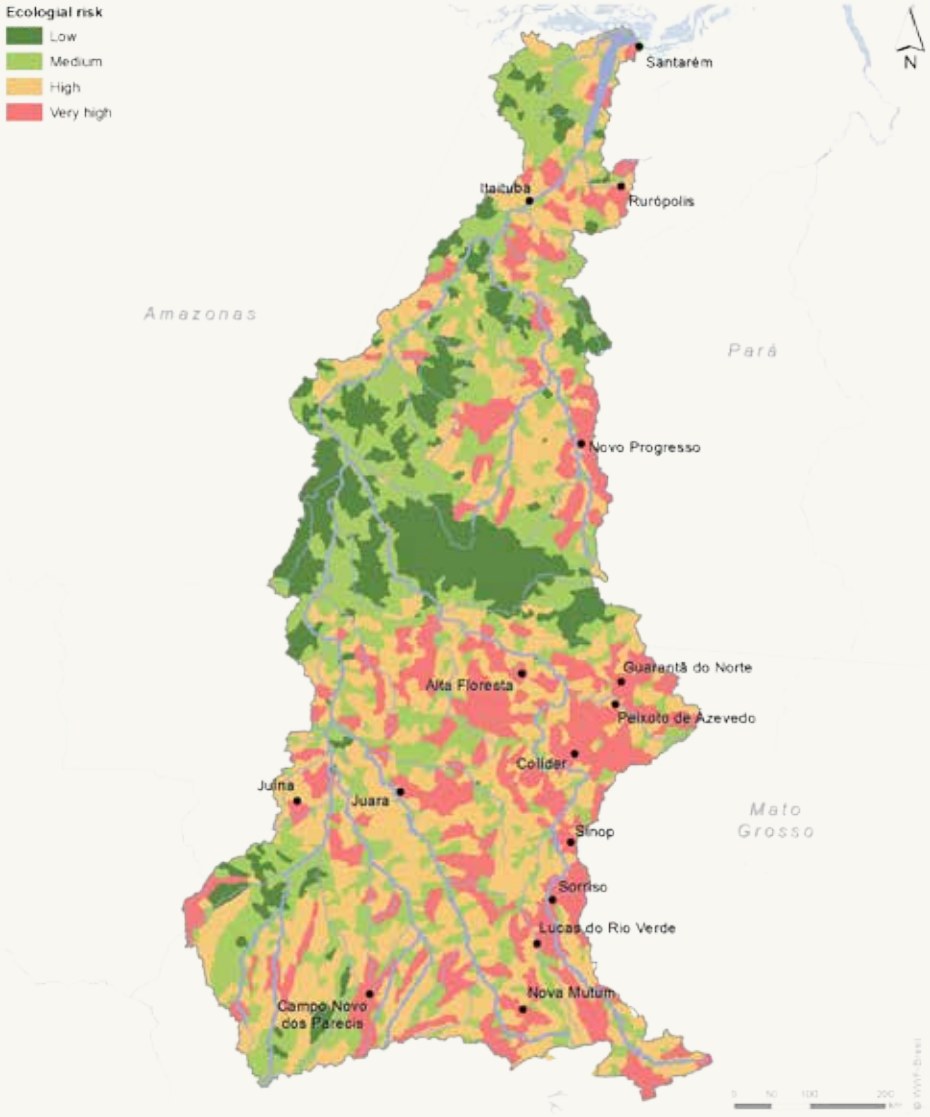


Figure 7: Ecological Risk Index, by micro-basins, on a high to low risk scale.

PRIORITY AREA IDENTIFICATION

Various stages of data preparation and analysis are needed to identify priority areas. The different layers of data generated, on which the analyses were based, can be grouped in three categories, namely, conservation targets, cost surface and connectivity:

- **I. Conservation targets:** are the aspects of the study area that need to be preserved, such as species, habitats, vegetation types etc. For each target a specific conservation objective is defined representing the percentage of the extension of each target that needs to be preserved and varying from 10 to 100% of the area of the species or the ecosystem's distribution and that percentage was determined by the experts during the workshop.

Visual interpretation of satellite images enabled the mapping of certain environments that represent the distribution of functional groups of aquatic species such as turtles and fish and that can serve for other species as well; they are referred to as biodiversity substitutes. To represent the places where turtles lay their eggs, for example, all the sandbanks along the main rivers were mapped. To represent fish species whose life cycles are associated to specific types of environment, all the rapids, rocks, islands and lakes alongside rivers were mapped.

Table 4: Conservation targets contemplated

i. Potential distribution models for bird and mammal species elaborated using Maxtent software and revised by experts;
ii. Locations where fish species with restricted distribution occur;
iii. Vegetation;
iv. Geo-morphology;
v. Aquatic habitats (rapids, beaches, lakes, marshes).

Source: Science Programme/WWF-Brazil

- **II. Cost surface:** Differentiates areas that have similar conservation value but different land use with the aim of increasing the efficiency of the solution, maximizing conservation attributes and minimizing costs.

- **III. Connectivity:** Areas that are import for the maintenance of connectivity among forests and rivers with a view to maximizing the long term persistence of species and ecosystems.

The conservation scenarios generated by the Marxan[19] decision-making support system are designed to optimize the arrangement of the areas selected as priorities in such a way as to fulfil the conservation goals while at the same time ensuring the greatest possible connectivity and the lowest conservation costs.

The selected areas were projected onto maps of protected areas, indigenous territories, military areas, maps of natural vegetation and the hydrographic network in order to identify gaps in conservation and areas for new conservation actions.

19 Widely adopted software for systematic conservation planning

To guarantee the persistence of species, ecosystems and environmental services in the Tapajos basin, eight areas stand out for their high biodiversity value, high quality of the environment and potential for complementing and connecting the existing system; their total area is 43,800 km² (Table 5).

Table 5: Conservation gaps: crucial areas for complementing the Tapajos basin PA system

Nome	Area (km²)
Juruena Corridor	10,035
Connection of ITs along the Papagaio River	3,650
Interfluve of the Arinos and Sangue Rivers	3,439
Lower Teles Pires River	7,425
Interfluve of the Peixes and Apiacas Rivers	5,930
Cachimbo mountains	6,148
Cachimbo mountains 2 – connection between Cristalino and Nascentes do Cachimbo BR	3,389
Tapajos floodplain	3,761

Juruena Corridor

Area with very high conservation value for aquatic and terrestrial ecosystems, including migratory fish species and threatened bird species like the very rare cone-billed tanager (*Conothraupis mesoleuca*) which inhabits flooded areas of Cerrado along the headwater streams of the Tapajos River. Great diversity of aquatic habitats such as marginal lakes, wetlands and rapids, fosters great diversity of aquatic species. This important area makes the connection between the Juruena National Park, the Igarapes de Juruena State Park, the other PAs that make up the Apui Mosaic, the indigenous territories of Escondido, Japuira and Erikpatsa in the middle course of the Juruena River, and the block of six indigenous territories in the upper Juruena, thereby making it possible to maintain those natural processes that depend on the regions hydrological dynamics. Part of the area is considerably fragmented and requires urgent action to recompose areas of permanent protection (gallery forest and wetlands) so that it can achieve its conservation objectives.

Connection of Indigenous Territories along the Papagaio River

Area of transition between the Cerrado savannah and the Amazon covered by unique formations that are not satisfactorily represented in the form of protected areas such as grasslands and *Camparinas* along the Buriti, Papagaio and Saue-Uina.

Interfluve of the Arinos and Sangue Rivers

This encloses fragments of natural vegetation on the right bank of the Sangue River and the left bank of the Arinos River.

Lower Teles Pires River

An area with high conservation value bordering on the Munduruku and Cayabi ITs and the Juruena National Park, protecting the only free stretch of the Teles Pires River downstream from the Apiacas River and making the connection possible with the Juruena, Tapajos and Amazon rivers.

Interfluve of the Peixes and Apiacas Rivers

One of the few remaining stands of natural vegetation in the interfluve from the right bank of the Juruena River to the left bank of the Teles Pires River. It connects the Apiaca-Kayabi and Batelao ITs along the Peixes River and includes the headwaters of the Apiacas River.

Cachimbo Mountain

An area of continuity with the Tapajos and Jamanxim PAs and, to the south, with the Rio Novo National Park and the Jamanxim National Forest that has a great diversity of vegetation types, including ombrophilous and seasonal forests, savannah and areas of transition. Most of this area lies within the limits of the Brazilian Airforce's Brigadeiro Velloso Testing Range.

Connection between Cristalino State Park and Nascentes do Cachimbo Biological Reserve

Like the preceding area, it is part of the Brazilian Airforce's Brigadeiro Velloso Testing Range. The area forms a corridor between two important PAs, the Cristalino State park and the Nascentes do Cachimbo Biological Reserve.

Tapajos Floodplain

Area liberated for expropriation by Act nº 12.678, with very high environmental quality but threatened by the potential expansion of deforestation associated to the Trans-Amazon highway and the hydropower plants planned for installation in the Tapajos River.

Tapajos River, Para, Brazil.

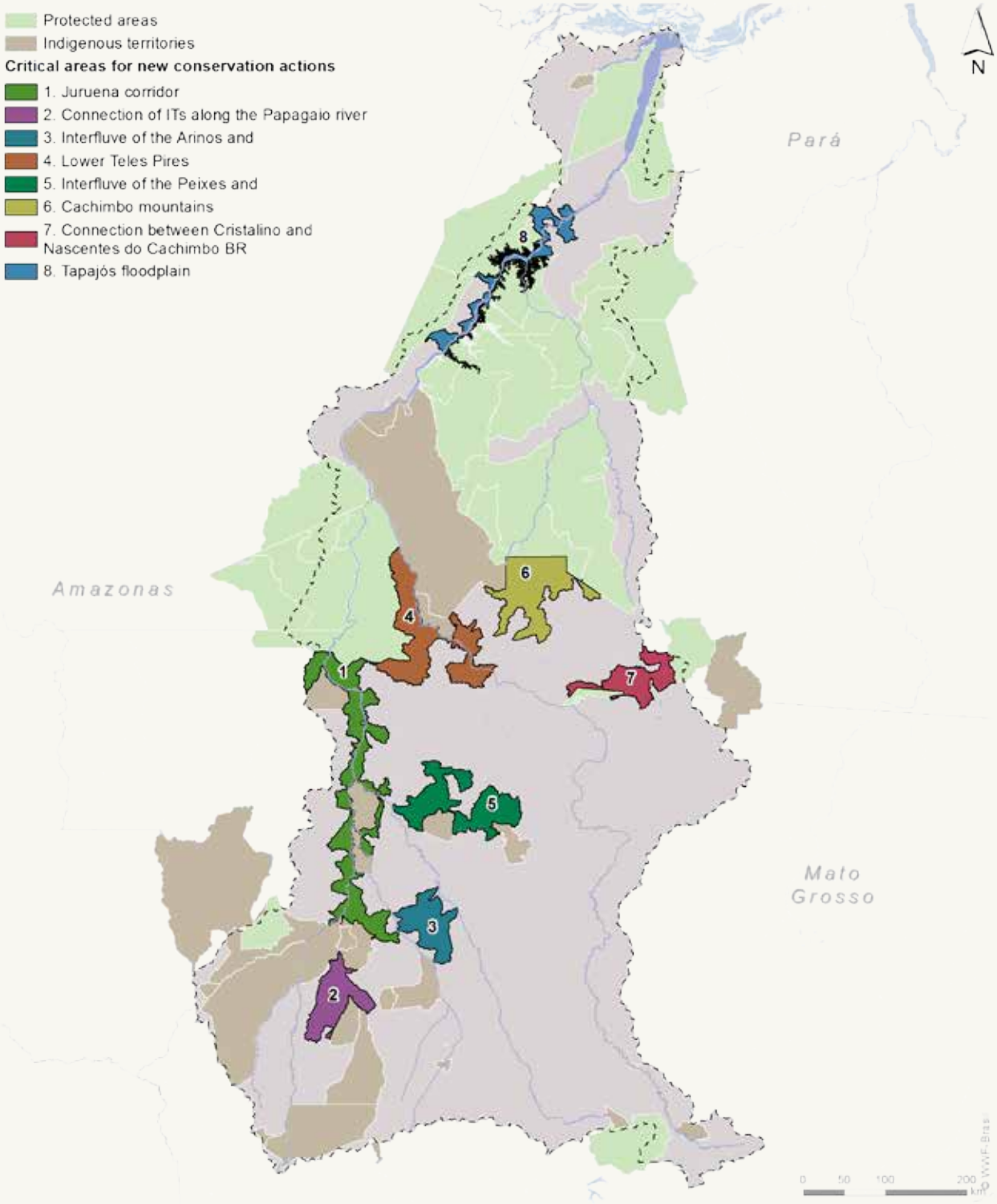
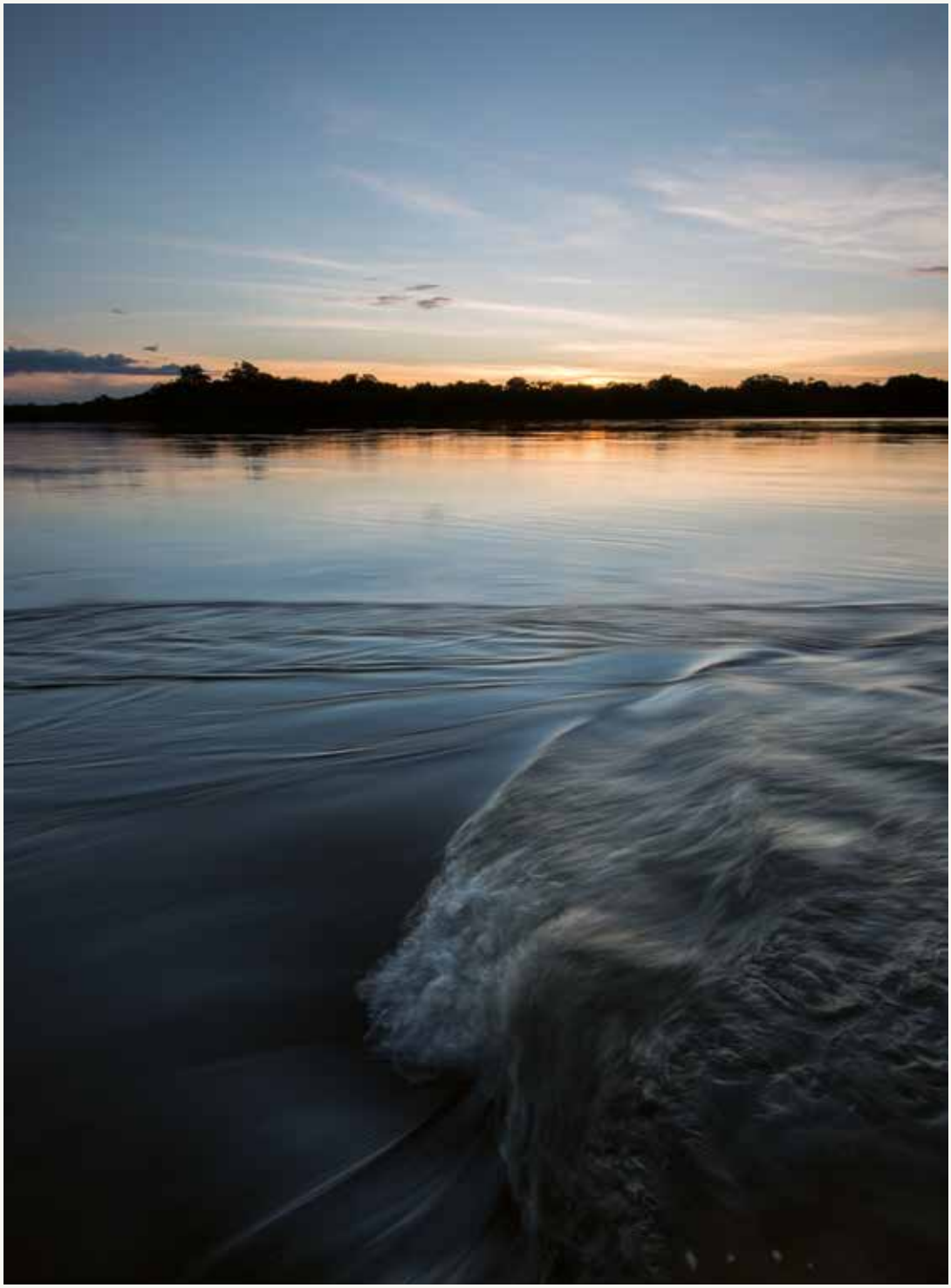


Figure 8: Conservation gaps: crucial areas for complementing the Tapajos basin PA system.
Source: WWF-Brazil Science Programme



Juruena River, Mato Grosso, Brazil.

IMPACTS OF THE CONSTRUCTION OF HYDROPOWER PLANTS IN THE TAPAJOS BASIN

According to WWF-Brazil' Science Programme assessment, 35 of the 44 hydropower projects listed on the inventory for the Tapajos basin would have direct impacts on protected areas, indigenous territories and and/or unprotected areas that are crucial for biodiversity conservation (Table 6). Direct impacts are considered to be those in which the planned reservoirs overlap protected areas or areas of critical importance for conservation or when the planned dams are upstream from such areas and would cause decreased flows in the rivers.

BUILDING DAMS IN PROTECTED AREAS OR AREAS OF CRITICAL IMPORTANCE FOR CONSERVATION WILL LEAD TO GREAT LOSS OF BIODIVERSITY AND A COLLAPSE IN THE FUNCTIONING OF AQUATIC ECOSYSTEMS.

That scenario shows that current hydropower planning is incompatible with the conservation of the Tapajos basin's biodiversity. Long term persistence of biodiversity and guaranteed provision of ecosystem services depend on the maintenance of the structure and functioning of the basin's ecosystems and on the maintenance of connectivity among the remaining stands of forest and, even more so, on the longitudinal and lateral connectivity of the water courses that form it. The results of that study show that the only way to make sure it happens is through the good management and maintenance of the protected areas, the protection of additional areas where species and ecosystems occur that are not represented in protected areas, and the establishment of corridors connecting protected areas. The said additional protection can be achieved, either by creating new protected areas, or by proper planning of legal reserve areas, or through the restoration of permanent protection areas and by combating deforestation in areas that are considered to be of critical importance for conservation. Building dams in protected areas or areas of critical importance for conservation will lead to great loss of biodiversity and a collapse in the functioning of aquatic ecosystems.

Degradation caused by mining

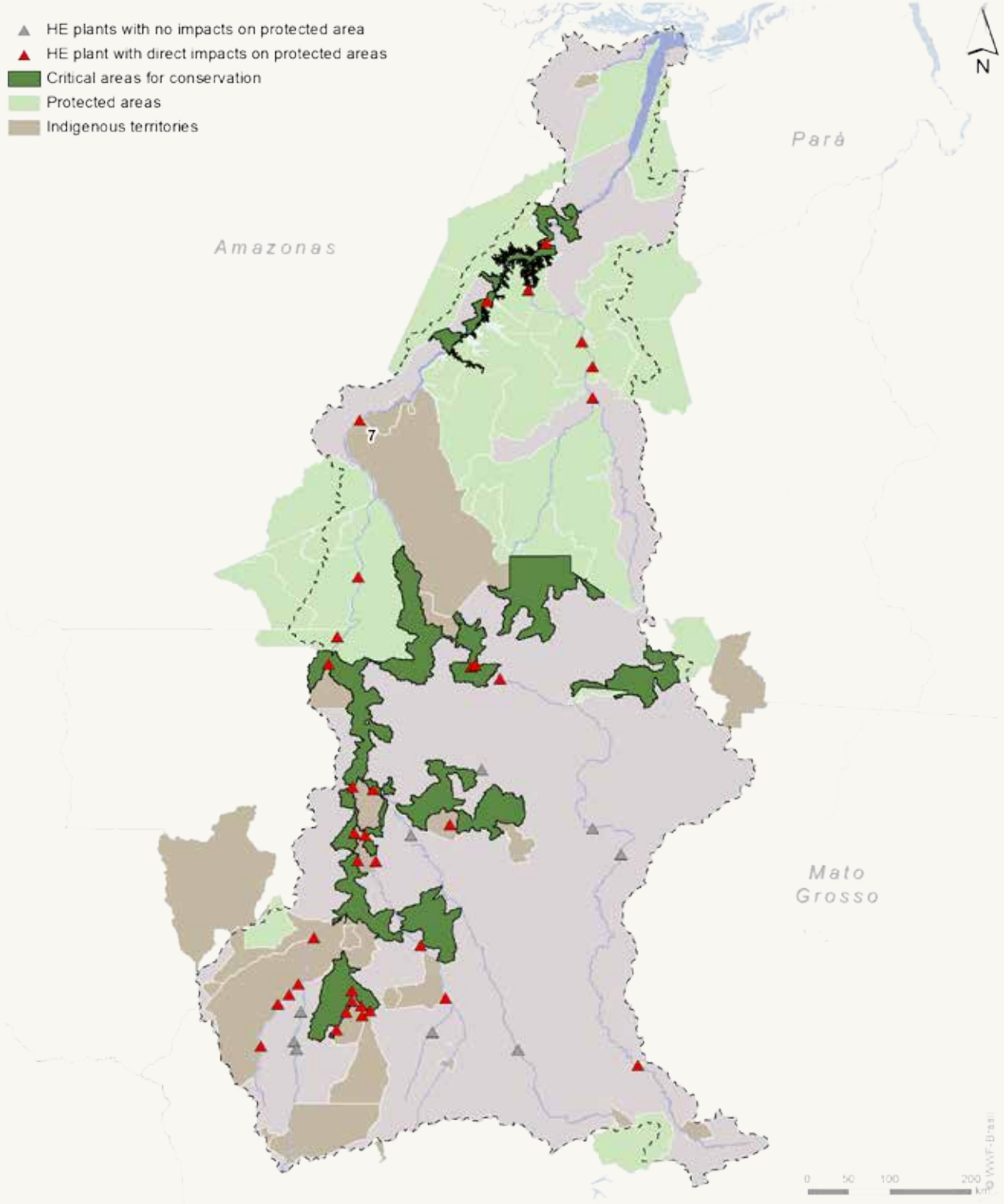


Figure 9: Inventoried hydropower plants in the Tapajos basin classified according to their potential impact on priority areas for conservation. Sources: dam sites – EPE; PAs – MMA; ITs – Funai.

Table 6: Projects listed in the inventories of the Tapajos basin classified by impacts on priority areas for conservation and by planning stage

(PA – protected area; IT – indigenous territory; CAC – critical area for conservation).

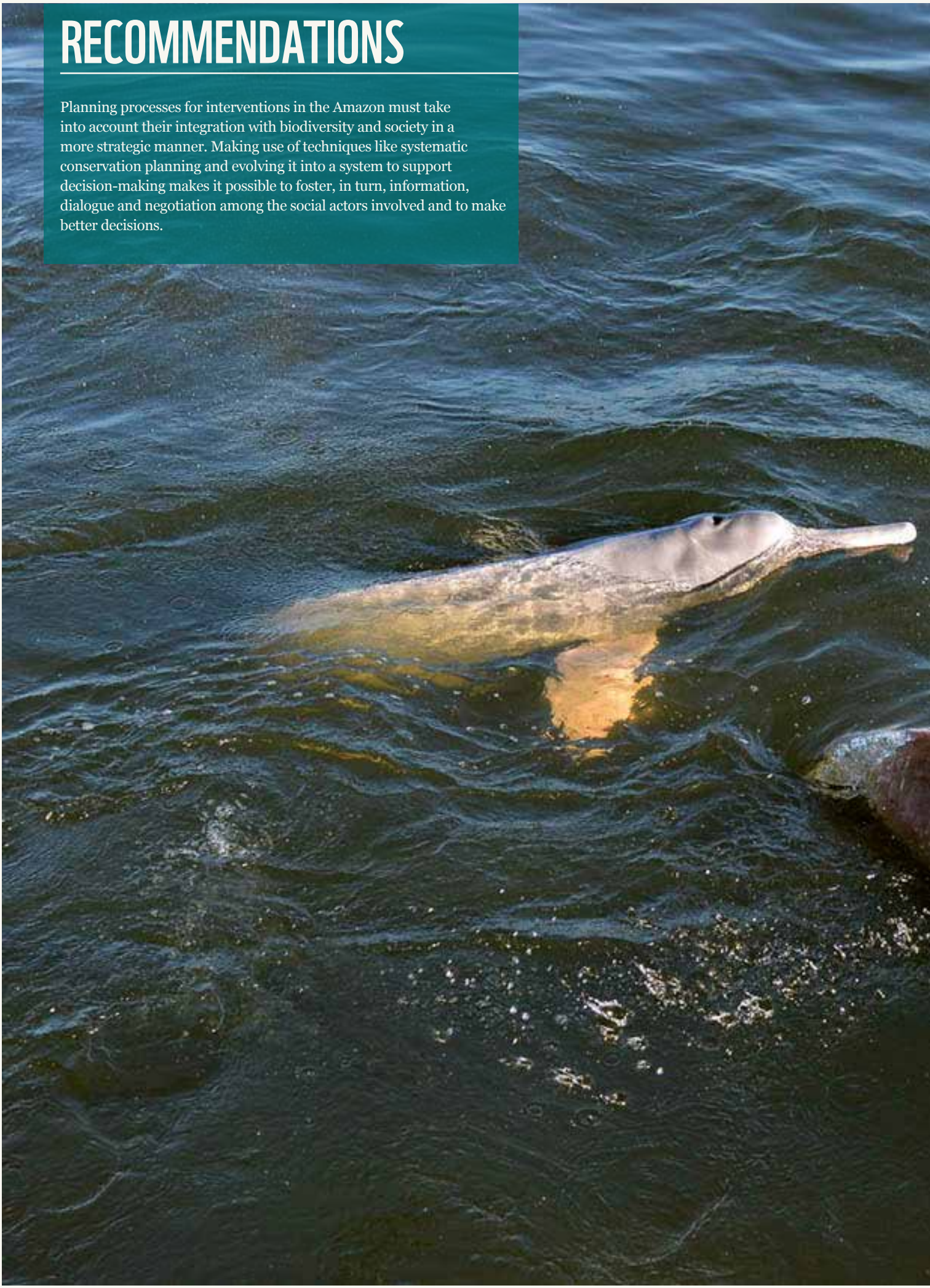
Name of HE plant	Impact	Planning instrument -Forecast
Agua Quente	IT, CAC	
Apiaka-Kayabi	IT, CAC	
Barra do Claro		
Buriti	IT, CAC	
Cachoeira do Cai	PA, CAC	
Cachoeira dos Patos	PA	PAC
Cachoeirao		
Castanheira		PDE 2024 – Operational in 2024
Chacorao	PA, IT	PAC
Colider		PDE 2024 – Operational in 2016
Enawene-Nawe	IT	
Erikpatsa	IT, CAC	
Escondido	PA, IT, CAC	
Fontanilhas	IT, CAC	
Foz do Apiacas	CAC	
Foz do Buriti	IT, CAC	
Foz do Formiga Baixo	IT	PAC
Foz do Sacre	IT, CAC	
Jacare	IT	
Jamanxim	PA	PAC
Jardim do Ouro	PA	
Jatoba	PA, CAC	PDE 2024 – Operational in 2023
Jesuita		
Juruena		
Kabiara	IT, CAC	
Magessi	PA	
Matrinxa	IT, CAC	
Nambikwara	IT	
Paiagua		
Parecis	IT	
Pocilga	IT	
Roncador	IT, CAC	
Salto Apiacas		PDE 2024 – Operational in 2016
Salto Augusto Baixo	PA, IT, CAC	Foreseen in PDE 2022, but removed from PDE 2023 e 2024
Salto Utiariti	IT	
Sao Luiz do Tapajos	PA, CAC	PDE 2024 - Operational in 2021
Sao Manoel	CAC	PDE 2024 - Operational in 2018
Sao Simao Alto	PA, IT	Included in PDE 2022, but absent from PDE 2023 and 2024
Sinop		PDE 2024 - Operational in 2018
Tapires	IT, CAC	
Teles Pires	CAC downstream	PDE 2024 - Operational in 2015
Tirecatinga	IT, CAC	
Travessao dos Indios	IT, CAC	
Tucuma	IT, CAC	PAC

Source: WWF-Brazil Science Programme and PDEs 2022, 2023 and 2024 (at consultancy stage).

Fishing on the Tapajos River, Para, Brazil.

RECOMMENDATIONS

Planning processes for interventions in the Amazon must take into account their integration with biodiversity and society in a more strategic manner. Making use of techniques like systematic conservation planning and evolving it into a system to support decision-making makes it possible to foster, in turn, information, dialogue and negotiation among the social actors involved and to make better decisions.



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Based on the work of developing an ecological vision for the Amazon region as a whole and for the Tapajos River Basin in particular, we now present some final considerations:

1 Land use and infrastructure implantation planning that makes full use of a systematic conservation planning approach constitutes a real opportunity

2 There is an urgent need to integrate biodiversity conservation and social considerations to hydropower and infrastructure planning as well as the political elements needed for the elaboration of an integrated reference framework for the management of the aquatic and terrestrial ecosystems.

3 An integrated approach to planning the use and occupation of the Amazon's (terrestrial and aquatic) landscapes is the key to achieving long term conservation and sustainable management of natural resources.

4 Maintaining the Amazon's hydrological connectivity and the function of the freshwater ecosystems is of vital importance and will require integrated management of terrestrial and aquatic ecosystems to ensure their equilibrium and the provision of ecological services to the population.

5 It is of fundamental importance to respect the rights of indigenous populations and those of other traditional communities, in regard to their territories, waters and natural resources and to ensure the informed, voluntary and democratic participation of local communities, including indigenous populations, in all decisions related to energy issues and the development of infrastructure.

6 It is recommended that the cumulative social and ecological impacts of the dams and their associated infrastructure in the river basin as a whole should be assessed as part of project feasibility and environmental impact assessments, and that applies to the entire portfolio of projects being proposed by government.

7 An integrated approach to monitoring Amazonian aquatic ecosystems could lead to improved conservation and sustainable use of these areas and to the maintenance of the region's hydrological connectivity.

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Apiakas indigenous community group: a basin-wide view of the Tapajos

A conservation vision for the Tapajos basin

Almost 40%

of the basin is under some form of conservation protection either as protected areas or as indigenous territories.

492,000 km²

is the area of the Tapajos River basin, representing 6% of Brazilian territory.

44

dams are planned for the basin, interrupting the free flow of its main rivers.

3,084.85 km²

of land will be inundated by the hydroelectric plants of the Tapajos Complex causing serious impacts on indigenous communities.

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