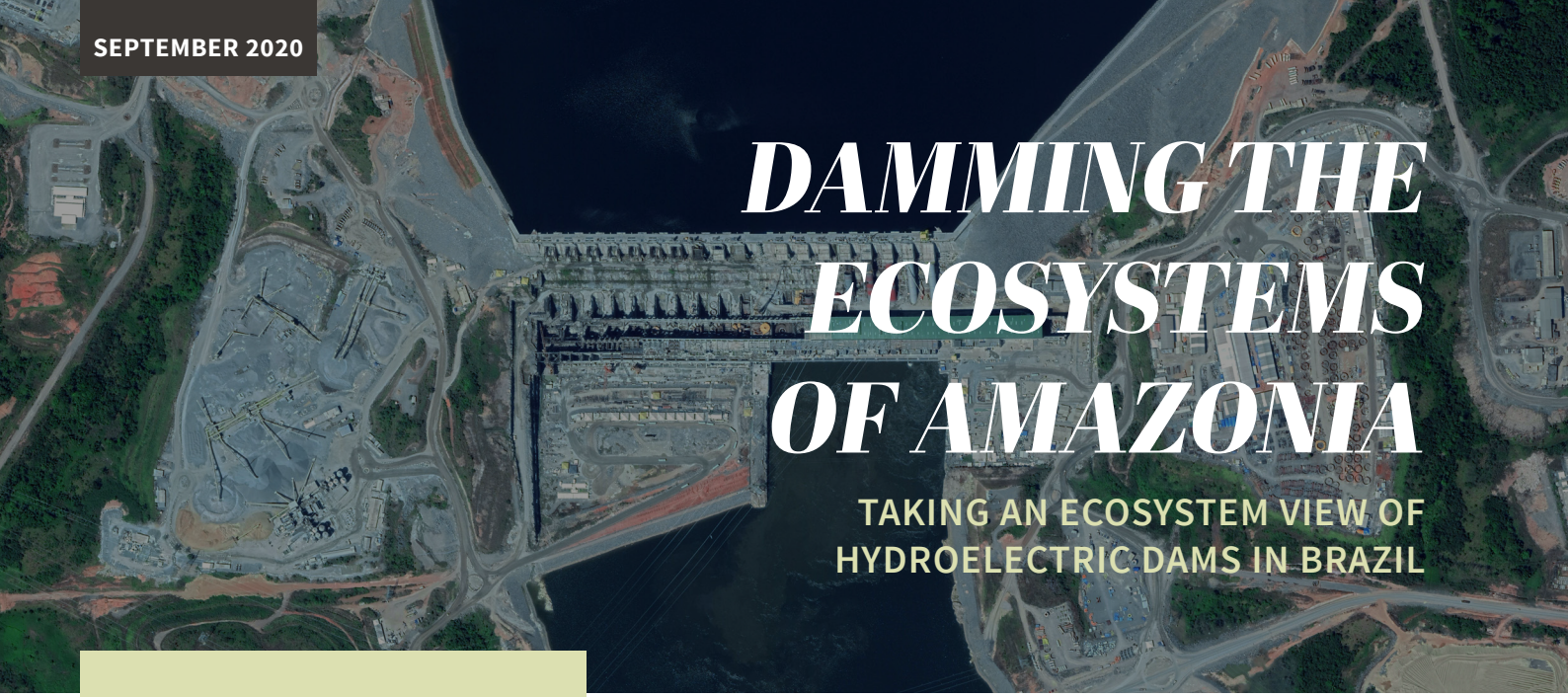
SEPTEMBER 2020



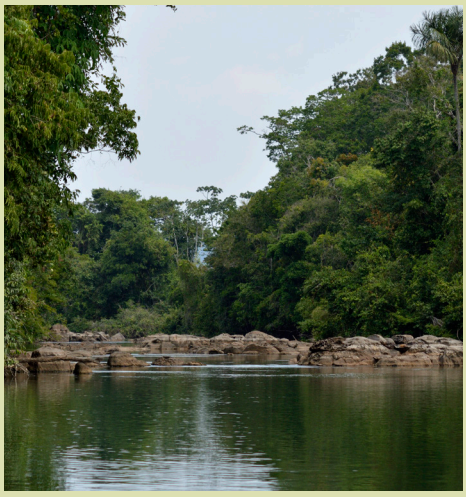
DAMMING THE ECOSYSTEMS OF AMAZONIA

TAKING AN ECOSYSTEM VIEW OF HYDROELECTRIC DAMS IN BRAZIL

BOX 1

Amazonian Ecosystems Include Flooded and Non-Flooded Environments

SEASONALLY FLOODED ENVIRONMENTS experience annual cycles of sediment deposition and erosion as water flows in and out. Flooding ensures that these habitats have sufficient sediments and nutrients to develop. *Várzeas* are flooded by white water rivers (with a large amount of suspended sediments and nutrients), and *igapós* by clear and black waters (with less suspended sediment and nutrients). By contrast, **NON-FLOODED ENVIRONMENTS** exist upland and tend to not experience natural flooding. These habitats are home to very different plants and animals, adapted to either flooded or non-flooded environments.



As the demand for hydroelectric power in South America grows, evidence suggests that hydroelectric dams are harming Amazonian ecosystems. Research shows these impacts are greatest on specific, unique, and fragile ecosystems—even in areas distant from the dams themselves.

The Amazon River basin is the world's most complex river system—a source of water, nutrients, habitats, and biodiversity throughout South America. Altering ecosystems of the Amazon River basin by constructing dams may have widespread and permanent consequences for the economies, people, plants, and animals of South America.

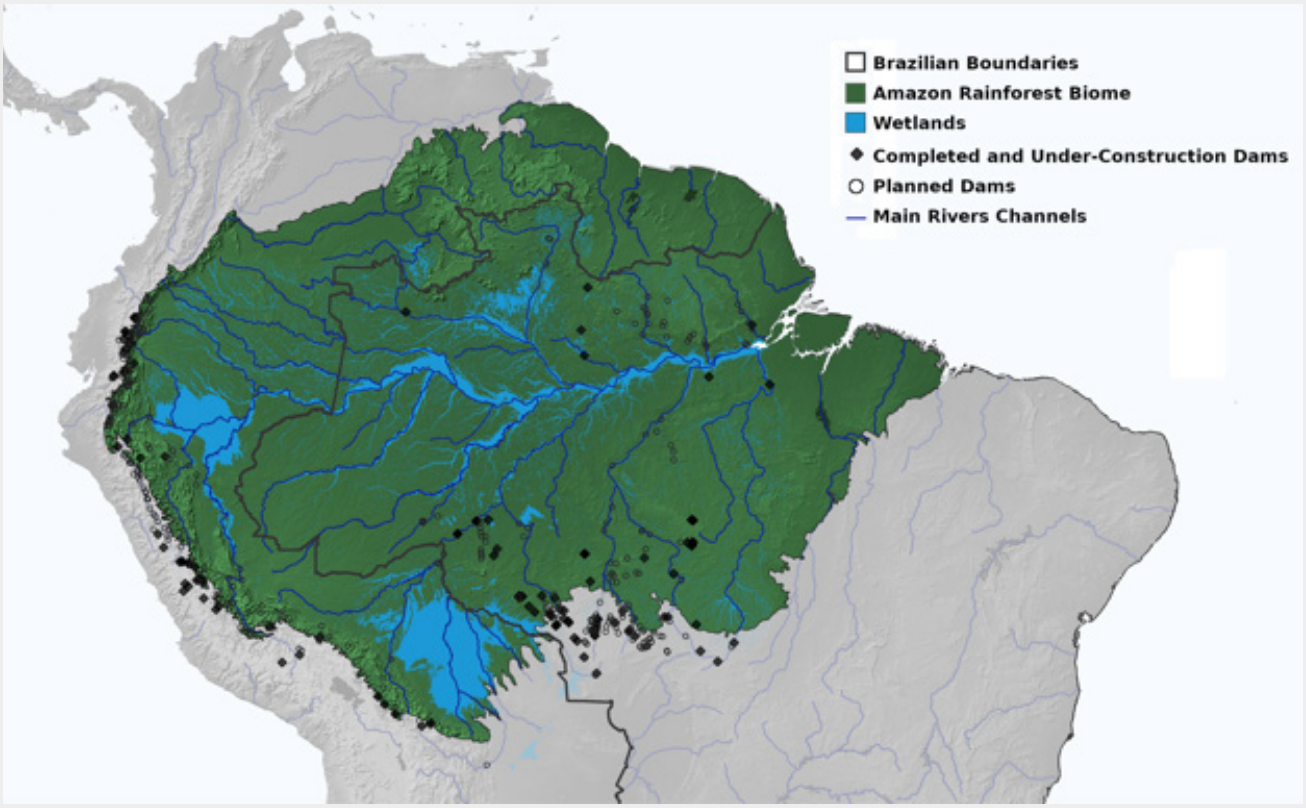
The ecosystems of the Amazon River basin are home to diverse plants and animals that have adapted over millions of years to the patterns and flow of the river network, including annual cycles of flooding. The plants and animals of Amazonia depend on the rivers and flooding cycles to transfer nutrients and sediments. Wetlands and floodplains, where rivers flood occasionally or routinely, are home to unique species and are also essential to sustaining and connecting other landscapes and wildlife.

The landscapes, wildlife, and climate of Amazonia are interconnected in the delicately balanced ecosystems of the Amazon River basin. In turn, the ecosystems serve the people of Brazil and neighboring countries through food production, natural resources, and climate regulation. These "ecosystem services" may generate more than $8 billion for the Brazilian economy each year.[1]

HYDROELECTRIC PROJECTS FAIL TO CONSIDER CONSEQUENCES FOR FLOODED ENVIRONMENTS

Many South American countries are building hydroelectric dams to meet the growing energy demands of their people. More than half of all existing and planned dams for the Amazon River basin are in Brazil (see Figure 1, next page).[2] Brazilian researchers predict that planned hydroelectric dam construction will devastate ecosystems throughout the river basin.[3]

FIGURE 1



More than half of all existing and planned dams for the Amazon River basin are in Brazil. Wetland areas are uniquely adapted to river flooding cycles, which dams may permanently change or destroy.

Although environmental assessments are required before dams are constructed, these assessments are limited to areas immediately surrounding the proposed dam; they do not consider consequences for landscapes, wildlife, and people both upstream and downstream of the construction. Guidelines require assessments to consider aquatic and terrestrial environments but fail to specify floodplains and wetlands. Yet, hydroelectric dams may impact these flooded habitats more severely than other landscapes.[4]

DAMS CHANGE LANDSCAPES AND THREATEN WILDLIFE DIVERSITY

When dams alter a river's flow, portions of non-flooded or seasonally flooded landscapes may become permanently flooded. In other areas, the dam may transform floodplains and wetlands to permanently dry landscapes.[5] In addition to landscape changes, disruptions upstream can interrupt the flow of sediment and nutrients downstream—affecting soils, vegetation, and animals throughout the entire river basin.[6]

Changes to the landscape caused by hydroelectric dams threaten species that were uniquely adapted to and dependent on flooded habitats.[7] As these species are affected, all of the plants and animals adapted to living in balance together in the habitat are endangered.[8] The rapid changes to landscapes and habitats caused by dams can make it difficult or impossible for species to adapt or migrate elsewhere.[9]

In recent years, genetic data have revealed that some wetland bird populations are more diverse than previously understood—and may even belong to several distinct species.[10] Nearly 15 percent of Amazonian bird species live only in habitats seasonally flooded by the rivers, including 24 endangered species recognized by the International Union for the Conservation of Nature and the Ministry of Environment (ICMBio).[11] These birds may be further threatened by existing and planned dams.[12]

DAMS REDUCE FOOD SUPPLIES FOR LOCAL POPULATIONS

Local Brazilian communities, such as the Juruna and Arara, living in Amazonian regions like Volta Grande do Xingu, rely on fishing as a means of food security. They also farm, grow fruits and nuts, and hunt. These food sources depend on the river and the landscape of the local ecosystem. In 2016, reduced water flow from the Belo Monte hydroelectric dam caused fish populations to drop, threatening food security for the Juruna and Arara da Volta Grande people.[13] Researchers have demonstrated similar consequences at other dams, including the Jirau and Santo Antonio hydroelectric dams, where fishing catches declined by nearly 40 percent following construction of the dam.[14]

PRESERVING THE ECOSYSTEMS OF AMAZONIA REQUIRES BETTER ENVIRONMENTAL ASSESSMENTS

In Brazil, environmental impact assessments are required before new dams can be approved for planning, licensing, or construction.[15] These assessments, however, have historically failed to predict and monitor the impacts of dam construction on the broader ecosystem, particularly flooded habitats that may be far up or downstream from the dam. To adequately assess environmental impacts from dams, the regulations for planning, licensing, and monitoring of hydroelectric projects should specifically define flooded habitats as a landscape to be evaluated. Currently, stakeholders have inadequate information for planning and evaluating the impacts of hydroelectric dams and preserving ecosystems, as outlined in Box 2.

Várzea and Igapó *forests flood each season. The floods leave behind sediment, creating nutrient-rich soils well-suited for agriculture. These forests are home to diverse species only found in the Amazon. For these ecosystems to thrive, seasonal flooding is critical.*

BOX 2

Improving Assessments for Planning, Licensing, and Monitoring Hydroelectric Projects

To fully assess the environmental impacts of hydroelectric projects, assessments must consider flooded environments. This table outlines priorities for assessments in planning and licensing new dams' impacts and in monitoring dams following construction.

PLANNING	LICENSING	MONITORING
Revise the Hydroelectric Inventory Manual to specify that seasonally flooded habitats (varzea and igapo) must be evaluated for: • **Local and regional biodiversity.** • **Species unique to specific regions within the habitat (endemic).** • **The importance for sustaining non-flooded habitats.** **Potential responses of the landscape and ecosystems under climate change scenarios require environmental impact assessments to include:** • **Cumulative effects of multiple dams in the Amazon River basin.** • **Changes in sediment deposition and erosion dynamics.** • **Changes in the strength or frequency of flooding (flood pulse).** • **How the landscape is physically connected to other habitats in the ecosystem.**	**Revise the Terms of Reference for Environmental Impact Studies, requiring studies to:** • **Apply a sampling design that includes the different flooded habitats.** • **Assesss the habitats at different phases of annual flooding cycle.** • **Consider the distribution of plants and animals throughout the habitats.** • **Consider ecological processes that connect flooded habitats to aquatic and terrestrial habitats.** • **Estimate the suppression of flooded habitats and loss of biological connectivity.**	**Revise monitoring requirements for dams to continue to assess all questions considered in the planning and licensing phases.** **Adopt systems so that information collected through monitoring activities feeds back to researchers and decisionmakers to inform and improve planning and licensing for future projects.**

AN ECOSYSTEM VIEW CAN IMPROVE POLICIES TO PRESERVE THE AMAZON RIVER BASIN: RECOMMENDATIONS

The Amazon River basin is one of the most complex ecosystems in the world—so complex that research continues to reveal new insights about how the landscapes, wildlife, and climate sustain each other. To help preserve this ecosystem, decisionmakers need to improve and expand upon existing policy instruments to ensure that assessments for new dams in the basin include flooded environments and impacts on the broader ecosystem. We recommend that:

RECOMMENDATION 1

The Ministry of Mines and Energy and the Ministry of Environment (including *Empresa de Pesquisa Energética* [EPE] and *Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis* [IBAMA]) should revise key documents, such as the Hydroelectric Inventory Manual and the Terms of Reference for Environmental Impact Studies, to:

1. **Specifically include flooded habitats, in addition to aquatic and terrestrial habitats, upstream and downstream from the proposed site.**
2. **Define clear questions about how proposed construction will affect the broader ecosystem. These questions must include the cumulative effects of multiple dams and the ecosystem consequences of changed landscapes.**

RECOMMENDATION 2

Researchers should foster platforms for information-sharing with stakeholders. Involving policymakers and local communities in ongoing research is one strategy to ensure that the knowledge generated in scientific studies will inform assessments and decisions for hydroelectric projects.

The ecosystems of the Amazon River basin have evolved over millions of years into some of the most diverse and unique places on the planet. Hundreds of hydroelectric dam projects that would permanently alter Amazonia are currently in different phases of planning, licensing, and construction. Ensuring that environmental assessments consider the full scope of impacts on the ecosystem before approving hydroelectric projects is essential to preserving the beauty and value of Amazonia.

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ACKNOWLEDGMENTS

This document was produced by Population Reference Bureau under the Research Technical Assistance Center (RTAC). RTAC is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the terms of contract no. 7200AA18C00057. The contents are the sole responsibility of RTAC and NORC at the University of Chicago, and do not necessarily reflect the views of USAID or the United States government.

The information in this policy brief is based on research led by Dr. Camila Ribas and Dr. Fernando d'Horta at Instituto Nacional de Pesquisas da Amazônia, Dr. André Oliveira Sawakuchi at the Instituto de Geociências of Universidade de São Paulo, Dr. Joel Cracraft at the American Museum of Natural History, and Dr. Alexandre Aleixo at the Museu Paraense Emílio Goeldi and the Finnish Museum of Natural History of the University of Helsinki, funded in part by USAID's Partnerships for Enhanced Engagement in Research program (Co Ag AID-OAA-A-11-00012). Dr. Ribas can be reached at camilaribas@gmail.com.

The research was carried out in partnership with Instituto Nacional de Pesquisas da Amazônia; American Museum of Natural History; Museu Paraense Emílio Goeldi; Field Museum of Natural History; Universidade Federal do Amazonas; Universidade Federal do Pará; Universidade Estadual Paulista; Universidade de São Paulo; University of Texas, Austin; Instituto Socioambiental; and Wildlife Conservation Society.

The research team would like to acknowledge IBAMA, ICMBio, and EPE for early participation in a research workshop, and the Public Prosecutor Office of Brazil for encouraging the use of scientific data in developing environmental practices.