

Student Handout: Amazon Basin Case Study

QUICK ISSUE DESCRIPTION

The Amazon Basin is the largest hydrographic basin in the world. It is one of the more pristine watersheds in Brazil, with the highest freshwater fish diversity in the world. It also sustains many small-scale fisheries. The Amazon river is over 6600 km long, with a basin area of roughly 5.5 million km². The Amazon region contains an estimated population of 30 million from several different countries, each having jurisdiction over the river. The river is home to 350 ethnic groups, 60 of which remain almost completely isolated.

The Amazon is typically warm all year round with temperatures of 22-43°C and high humidity. Due to the size and variety of habitats, the Amazon basin is the most ecologically diverse place on Earth (WWF, 2019). The Amazon basin "houses at least 10% of the world's known biodiversity, including endemic and endangered flora and fauna, and its river accounts for 15-16% of the world's total river discharge into the oceans" (WWF, 2019). It contains roughly 2200 species of fish - incredible! The Amazonian biome is two times the size of India, and the Amazon river itself has hundreds of tributaries and streams. The Amazon river is a freshwater biome but is a part of the larger Amazon area which is predominantly tropical rainforest, with small portions of vegetations/biome types that are classified as savannas, floodplain forests, grasslands, swamps, bamboos, and palm forests.



CHECK IT OUT!

From the map to the left, you can see just how huge the Amazon Basin is! The Amazon Rainforest and Basin is the most biodiverse place in the world!

Map of the Amazon Basin and Amazon Rainforest (The basin is in the Rainforest)

Photo Credit: WikiTravel/
Quirky Cruise <https://quirkycruise.com/wp-content/uploads/2019/09/map-of-amazon-jungle-brazil-26.jpg>

ISSUES FACING THE AMAZON BASIN

Amazonian communities have a mixed economy based mainly on small-scale agriculture, fishing, and livestock. Large tracts of the Amazon remain in good ecological condition. However, local, small-scale fishers face several challenges, partly due to excessive fishing pressure, which decreases the size and abundance of some key fish populations. These changes impact local food security, fisheries sustainability, and conservation of the richest biodiversity in the world.

Forestry and large scale agricultural development also threaten this vital environmental biome. Currently, land clearing (through fire!) is significantly reducing forest canopy which may impact on the quality of water in Amazonian rivers. "The Amazon has lost at least 17% of its forest cover, its connectivity has been increasingly disrupted, and numerous endemic species have been subjected to waves of resource exploitation" (WWF, 2019). One of the main international concerns is deforestation, which along with land conversion causes the Amazon to release up to 0.5 billion metric tons of carbon per year. This does not include emissions from forest fires, which would make the number even higher.

LAND CONVERSION:

Land conversion refers to the process of changing the use of land, typically towards a more "built" state (i.e. for housing, urbanization, commercial agriculture, etc.).

IMPACTS TO THE CABOCLOS CULTURAL GROUPS

The Caboclos people are of mixed heritage. They are descendants of Indigenous people and Portuguese colonizers, as well as people from African descent. They live along the floodplains of the large Amazonian rivers and have a mixed economy based mainly on small-scale agriculture (cassava, to produce flour), fisheries, and cattle ranching. Such economic activities are closely dependent on the water cycle, marked by a low and high water season. Caboclos fisheries are usually artisanal. In some areas, the main fishing vessels are paddled canoes, while in others low power motorized canoes predominate. Fishers are usually low income people with little political power, and development in the area threatens their livelihoods.

As people who rely mostly on fish as a source of animal protein, the Caboclos are more vulnerable to environmental changes that could affect fish ecology and fish abundance, such as long and unusual periods of drought (climatic changes), dams, mining, and excessive fishing pressure.

CLIMATE CHANGE IMPACTS

Deforestation and land conversion contributes up to 0.5 billion metric tons of carbon per year in greenhouse gases. The emissions from forest fires are also a climate change issue. Forest fires happen during the dry season (between July and October). While fires are caused naturally by lightning, many forest fires are caused by people. Both farmers and loggers use fire to clear their land for crops or grazing. Warmer temperatures caused

by climate change decrease rainfall and increase the chance of drought, leading to an increase in forest fires. In 2019 it was noted that forest fires produced up to 140 million metric tons of carbon dioxide, which is equivalent to the annual emissions from 30 million cars, according to recent findings.

Current models suggest that by 2050 the Amazon will increase in temperatures by 2–3°C and decrease in rainfall during the dry months, leading to widespread drying of the forest and droughts. Should humans continue on our current path, it would mean the forest would be replaced by fire prone brush and savanna, without sufficient rainfall to sustain the forest.

The Amazon forest helps to regulate temperature and humidity, and it is linked both to regional climate patterns and the global climate. There is an enormous amount of carbon stores in the Amazon forest, roughly 90–140 billion metric tons of carbon. The release of even a small amount of carbon would accelerate global warming significantly.



**Fishermen on the Tapajos River preparing the Pirarucu or Arapaima Fish
This is the biggest freshwater fish in the world!**

Photo Credit: Carolina Freitas

Information can be found from the article "Carbon Dioxide Released by Amazon Fires Could Hasten Climate Change" <https://www.capeandislands.org/post/carbon-dioxide-released-amazon-fires-could-hasten-climate-change#stream/0>

"Climate Change in the Amazon" web page from Panda WWF (World Wide Fund) https://wwf.panda.org/knowledge_hub/where_we_work/amazon/amazon_threats/climate_change_amazon/

"Inside the Amazon" web page from Panda WWF (World Wide Fund) https://wwf.panda.org/knowledge_hub/where_we_work/amazon/about_the_amazon/

TRACKING CHANGE RESEARCH EXAMPLE: RESEARCH ON THE TAPAJÓS RIVER AND THE TOCANTINS RIVER (BRAZIL)

Overview:

Research studies in the Amazon showcase the rich biodiversity and need for more community engagement in making decisions about the river. One such study through Tracking Change, led by Dr. Renato Silvano, joined together researchers from the Federal University of Rio Grande do Sul in Porto Alegre (Brazil), others from the University of Alberta, and local people from the Tapajós River and the Tocantins River. Both the Tapajós and Tocantins are part of the Amazon River Basin.

Both the Tapajós and Tocantins have clear waters, with little clay sediment. The water of the rivers is nutrient poor and either very transparent or slightly green in colour. The human population around both rivers belongs to either the Riverside or Caboclos cultural groups.

Objective of the Study:

The main objective of the study was to conduct a detailed comparative analysis of the human ecology of small-scale fishing in two large clearwater rivers of the Brazilian Amazon that differ with respect to the history of environmental impacts.

The studies collected numbers of fish and other biological samples in thirteen different communities (8 in Tapajós and 5 in Tocantins). Researchers conducted a series of activities, including:

- Interviews with fishers about socio-economic issues, fisheries management, and local ecological knowledge about fish;
- Participatory monitoring of the quantity of fish caught and brought to land;
- Standardized sampling of fish communities;
- Mapping of important areas for fishing, spawning, and fish migration; and
- Analysis of stable isotopes analysis and mercury contamination in fish.

STABLE ISOTOPES

"**Stable isotope** analysis of elements such as carbon, nitrogen, and sulphur, is used in ecology to trace the flow of nutrients through food webs and assess trophic levels" (Springer Nature Publishing AG. 2019:1). In other words, stable isotope analysis helps scientists understand aquatic food webs and ecosystem stressors!

FINDINGS OF THE STUDY

Tapajós River	Tocantins River
<ul style="list-style-type: none"> • Presents conservation units and Indigenous areas along its course • No dams yet, however, upcoming plans for dams will likely add another ecological stressor to local communities and species living along/near the river • Major impacts due to mining in upper reaches of the river, with possible mercury contamination in piscivorous fish and riverside communities 	<ul style="list-style-type: none"> • Has fewer conservation units • Several municipalities and communities are located on its margins, resulting in greater changes in the forest and greater fishing pressure • Has at least three dams along its course, creating stress for the communities and species living along the river



KEY DEFINITIONS

CONSERVATION UNITS: are groupings of organisms that have insufficient biodiversity necessary in order to generate new species, to ensure species survive following environmental change, and to continue local adaptation.

PISCIVOROUS: refers to carnivorous animals or fish that eat fish

**The Amazon Basin is full of Piscivorous or Carnivorous Fish!
Including the Piranha!**

Photo Credit: Anton Darius

Looking Towards the Future:

In the last decades, several locally based and bottom-up co-management systems emerged in the Brazilian Amazon. In co-management, local communities manage fishing territories (usually floodplain lakes) by excluding outsiders from the area that do not follow management rules. Co-management is one way to address the issues facing communities that rely on small-scale fisheries by improving fishing yields and increasing fish abundance in the more productive floodplains.

However, the success of local co-management initiatives to promote biodiversity conservation or sustainable use of natural resources is largely unknown for most of the Brazilian Amazon. It is also unclear how much authority the co-management boards have to exclude outsiders from entry. Ongoing research continues to investigate how local Indigenous knowledge informs understanding of the issues. Researchers also seek to communicate findings in ways that help communities and governments better understand how to address the problems facing the Amazon.



Local Fisherwoman on the Amazon River in Brazil

Photo Credit: Stephanie Morcinek

LET'S LEARN PORTUGUESE



Local people in the Amazon speak different local dialects, but most can understand and speak Portuguese! Let's learn a few words together!

Fish = Peixe

Boat = Barco

Fisherman = Pescadore

River = Rio

Place = Lugar

Arapaima = Pirarucu