CONFLICT, CONNECTIVITY, AND CONFLUENCES: LIMITATIONS AND POSSIBILITIES FOR AMAZON RIVERINE ECOSYSTEM PROTECTION

By Stephannie Fernandes

A Thesis

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Science

in Environmental Science and Policy

Northern Arizona University

December 2021

Approved:

Denielle M. Perry, Ph.D., Chair

Ian J. Harrison, Ph.D.

Simone Athayde, Ph.D.

ABSTRACT

CONFLICT, CONNECTIVITY, AND CONFLUENCES: LIMITATIONS AND POSSIBILITIES FOR AMAZON RIVERINE ECOSYSTEM PROTECTION

STEPHANNIE FERNANDES

In September 2021, the International Union for the Conservation of Nature (IUCN) called for the protection of 80% of the Amazon Basin. This call was made in recognition of its contribution to local and global ecosystem services, many of which are provided by some of the world's longest free-flowing rivers. However, spanning nine countries and 40% of South America, governing this critical Basin has proved difficult. In particular, the lack of protection of rivers has permitted the degradation of the Basin's riverine ecosystems in exchange for development. In this study, I asked what socio-economic factors are degrading the integrity of riverine ecosystems in the Basin and what lessons can be learned from environmental governance in the Amazon to inform the creation of a basin-wide river conservation system. To address these questions, I employed (1) policy analysis; (2) qualitative and quantitative analysis of an international survey, and (3) discourse analysis of gray literature and semi-structured interviews. The findings reveal that riverine degradation is largely caused by a complex combination of development activities that are mostly promoted by policies that intersect at multiple scales, such as national agendas for frontier expansion, bilateral and multilateral free trade agreements, and regional integration schemes that aim to export commodities to global market. Although market activities have substantial environmental costs, there are ways for Amazonian countries to collaborate and mitigate environmental degradation. Building on existing protection strategies across scales, a river conservation system grounded in integrated water resource management principals could protect riverine connectivity and improve conservation governance.

Table of Contents

List of Tables

Page

List of Figures

Page

List of Abbreviations

ACT - Amazon Cooperation Treaty

ACTO - Amazon Cooperation Treaty Organization

BNDES - Banco Nacional de Desenvolvimento Econômico e Social

CBD - Convention on Biological Diversity

COSIPLAN - Consejo de Infraestructura y Planeamiento

EIA – Environmental Impact Assessment

EU - European Union

EWFD - European Water Framework Directive

FFRs - Free-Flowing Rivers

FPAs – Freshwater Protected Areas

FTA - Free Trade Area

GDP – Gross Domestic Product

IIRSA - Integración en Infraestructura Regional Sudamericana

IPBES - Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

IPCC - Intergovernmental Panel on Climate Change

IPCL – Indigenous Peoples and Local Communities

IRBM – Integrated River Basin Management

ITs - Indigenous Territories

IUCN - International Union for Conservation of Nature

IWRM – Integrated Water Resources Management

MEA – Millennium Ecosystem Assessment

MERCOSUR – Mercado Común del Sur

NGOs – Non Governmental Organization

OAS – Organization of American States

PAs - Protected Areas

US – United States

UNASUR - Unión de Naciones Suramericanas

WSR - Wild and Scenic Rivers

WSRA – Wild and Scenic Rivers Act

"The Amazon is a single ecological unit that cannot be conserved via national-level activities alone"

(Charity *et al*., 2016)

1. Introduction

The Amazon Basin is a vast territory that supports human life and biodiversity. It also shapes social and ecological dynamics across space and time. The world's largest expanse of tropical forests and its river system are locally, regionally, and globally vital because of the ecosystem services they offer, especially when integrated. Rivers are an intrinsic feature of the Amazon Basin, and their ecosystems provide goods and services that are vital for all forms of life as well as for economic development. The provisioning of flood control, food, fertile soil, habitat, transportation, recreation, climate refugia, and spiritual and aesthetic benefits are all examples of ecosystem services provided by rivers and their riparian zones (riverine ecosystems) (MEA, 2005; Russi *et al*., 2013), and which are inextricably linked to the health and natural flow of the rivers themselves.

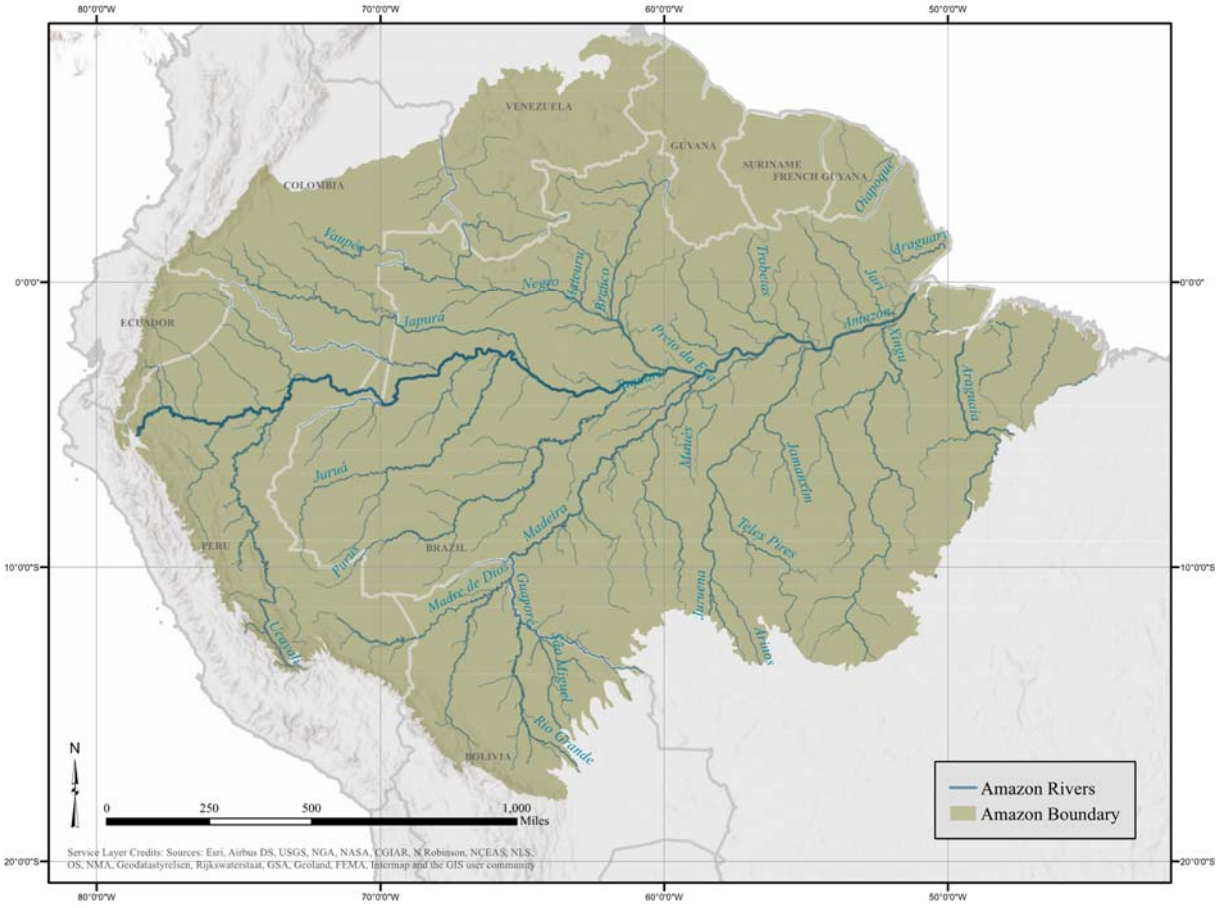
The Amazon Basin comprises the largest river Basin in the planet and hosts the longest remaining free-flowing rivers (FFRs) (Grill *et al.,* 2019; Sioli, 1984). It is a 7,287 million km² expanse (almost the size of Unites States) covering around 40% of the surface area of South America (Mello-Théry, 2019) and encompasses areas of eight countries (Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela) and an overseas territory (French Guiana), hereafter nine countries. The Amazon River itself is 6,992.15 km long from its source in the Peruvian Andes to its estuary in the Atlantic Ocean (Marengo *et al.*, 2012; Martini *et al*., 2008). Its average discharge at its mouth of approximately 206,000 $m^3 s^{-1}$ is equivalent to about 17% of all continental water reaching the oceans (Callède *et al*., 2004; 2010). The Amazon River has roughly 1500 tributaries, four of which are among the world's ten largest rivers (the Amazon, Negro, Madeira, and Japurá rivers) (Goulding *et al.,* 2003; Latrubesse *et al.*, 2005). Moreover, twenty out of the world's 34 largest tropical rivers are tributaries of the Amazon River (Latrubesse *et al.,* 2005). Such statistics present an idea of the size and magnitude of this watershed's importance (Figure 1).

The Amazon River flows through a region — the Amazon Basin — that is rich in natural resources and provides globally relevant ecosystem services (Dirzo & Raven, 2003; Goulding *et al*., 2003) such as mitigating the effects of climate change (Yang *et al*., 2018) and supplying rain to most

of South America through “flying rivers” (Marengo, 2006). Many Amazonian riverine ecosystem services are made possible only by its essential connectivity, a fundamental characteristic of rivers that allows vital interactions between the land, air, and water.

Figure 1

Amazon Basin Area and its Main Tributaries



Notwithstanding these many benefits, the fragmentation of rivers is increasing globally, including within the Amazon Basin, and the cause of great concern. In fact, less than 40% of rivers longer than 1,000km in the world remain free-flowing (Belleti *et al*. 2020; Grill *et al*., 2019). Fragmentation can be seen as the result of commercial exploitation that converts rivers into commodities, such as for the generation of energy through hydroelectric dam developments (Bakker & Morinville, 2013). Fragmentation of freshwater habitats jeopardizes biodiversity and ecosystem

functioning (Grill *et al*., 2015; Moran *et al*., 2018) and disruptions to the free course of rivers can have detrimental consequences, such as the loss of fish diversity, alterations to nutrient cycling and flood recession, and degradation of water quality (Grill *et al.,* 2019; Shao *et al.,* 2019). In addition to dams and diversions that cause fragmentation, activities such as mining, pollution, and over-exploitation lead to further degradation of these riverine ecosystems (Best, 2019; Dudgeon *et al.,* 2006). Yet, the full impact of these activities remains to be fully evaluated.

River conservation is essential to protect the flow of rivers, the biodiversity, ecosystem services, and to enhance resilience (Tickner *et al.,* 2020), a river's ability to bounce back from disturbances and avoid the tipping point, or when the many functions of rivers no longer persist to provide habitat for species and deliver their natural quantity and quality of its ecosystem services (e.g., Anderson *et al*., 2006). The effects of disturbance on the ecological processes that contribute to the functioning of Amazonian ecosystems are expected to have continental or even global consequences (Houghton *et al.,* 2000). Thus, questions remain about how much a river should be modified as the result of development.

Aquatic species are under extreme threat due to the anthropogenic influences (Dudgeon *et al.,* 2006). There are an estimated 140,000 aquatic species within freshwater habitats throughout the world (IUCN, n.d), of which 35,150 are on the IUCN Red List, 7511 (21%) as threatened, indicating a lack of adequate protection (IUCN, 2021). Between 1970 and 2016, freshwater vertebrate populations have declined globally by 84% (Deinet *et al.,* 2020), yet they continue to be overlooked in conservation strategies such as Protected Areas (PAs) (Abell & Harrison, 2020; Azevedo-Santos *et al.*, 2019). In the Amazon Basin alone there are over 2400 fish species, more than in the entire Atlantic Ocean (Science Panel for the Amazon, 2021). Many of these species are threatened.

Nonetheless, nation states need water resources to develop economically. Rivers flow across political borders, complicating how and where countries can acquire their resources. The Amazon Basin is an iconic example of the utilitarian use of rivers by governments. Amazon nations are

developing their societies through water resources developments and the Amazon is a new hydropower frontier with over 300 dams planned across the basin (see Fearnside *et al.,* 2021; Latrubesse *et al.,* 2017; Winemiller *et al*., 2016). As stated in the doctrine founded by Jeremy Bentham and Stuart Mill, a utilitarian approach means a normative ethics by which an activity is morally correct if it enhances the well-being of the entire [hegemonic] community (Bentham, 1789; Mill, 1861). However, in some cases a gap in strong freshwater and social protection prevails, regardless of what is done, yet the value of an activity is measured by the benefits it provides and/or the repercussions of its implementation.

Although the Stockholm Conference in 1972 resulted in the world developing an International Environmental Law, at the same time it experienced an increase in integrationist ideas and a resurgence of exploitation in the Amazon by governments (Toledo, 2012). Thus, while countries try to protect the environment, they also seek routes to develop at its expense, resulting in a fast route to degradation. The argument is being made for the need to advance environmental protection, not only in the Amazon Basin but throughout the world. For example, a recent Intergovernmental Panel on Climate Change (IPCC) report raised global awareness to the fact that the planet is on the verge of reaching a tipping point (IPCC, 2021). According to Amazon research scientist Paulo Artaxo, in a TV interview regarding the new IPCC report, our current environmental problems are not driven by our daily human behaviors but by the socioeconomic system in which we are inserted (Provoca, 2021).

Activities are occurring that degrade the riverine ecosystems of the Amazon Basin. Recognizing the global significance of the Amazon Basin, the IUCN has called for the protection of 80% of its expanse (IUCN Resolution WCC_2020_Res_129). Due to the vitality of its forests and biodiversity, and the importance the of ecosystem services it provides, plus the potential impact of reaching an environmental tipping point (Boers *et al*., 2017; Nobre & Borma, 2009), the Amazon has become a center of attention globally. However, although the Amazon is a unique tropical ecosystem, conservation efforts and policies have been more directed towards its forests, leaving

aside its riverine, savanna, and mountain environments (Castello, 2021; Leal *et al.*, 2020), perhaps because forest products mediated colonization processes.

1.1. Arteries of Colonization and Neocolonialism

Amazonian rivers are not only integral components of the natural landscape, but they are also routes modified for the historical and current colonization (neocolonialism - control of less-developed nations or groups by developed nations or groups through indirect means) of the region. Anthropogenic activities began to negatively impact Amazonian riverine ecosystems when Europeans first arrived in the region circa 1492 (Costa, 2018). Shortly thereafter, Portugal and Spain signed the Treaty of Tordesillas (1494), which divided control of colonial South America between the two European powers — Spain taking possession of the west and Portugal the east, the latter eventually becoming Brazil (Tanzi, 1976).

Conquistadores (conquerors) came to South America in search of personal wealth and prestige. They forcefully converted Indigenous peoples to Catholicism and led battles against advanced Indigenous civilizations (e.g., Incas) (Alemán, 2020). The economic policies of Portugal and Spain were deeply influenced by mercantilism, a policy which dictated the accumulation of capital through strong State intervention to enrich the mother countries. These policies included mineral resource extraction on a large scale and agriculture (Bomfim, 2008). Some roots of mercantilist economic practice remain present in current capitalist economic systems around the globe. Profit-maximization privately held means of production, and trend definitions are all products of mercantilism (Athayde, 1933; Bresser-Pereira, 2017).

To meet the neocolonial market demands of 19th Century, a population boom occurred in the Amazon Basin stimulated by the expanding rubber industry, which drastically changed the socioeconomic landscape (Santos, 2019). The rubber market generated parallel commercial activities including international trade in wild-animal fur and hides. The rubber market grew substantially over the course of 22 years until competition with the new Malaysian market resulted in a collapse in the price of rubber from the Amazon in the 1930s (Antunes *et al.*, 2016; Veríssimo & Pereira, 2020).

Although the negative impacts of deforestation on terrestrial ecosystems caused by this commercial activity continue to be poorly understood, deforestation was likely strong enough that a scenario of "empty forests", or defaunation due to unsustainable harvest for international trade, occurred, as proposed by Stokstad (2014). According to Peres *et al.* (2016), defaunation usually has cascading effects that can ultimately disrupt the global functioning of ecosystems.

However, analysis of commercial records throughout the 20th Century reveals that, historically, the disturbances caused by the expanding occupation (and accessibility of rivers to hunters) in the Amazon Basin may have been more drastic and less recoverable for rivers than for forests, which suggests a hypothesis of "empty rivers" due to declines in freshwater wildlife (Antunes *et al.,* 2016). Disturbances haven not been solely limited to population declines of aquatic animals, such as the Pirarucu (*Arapaima gigas*) and the giant Amazon River turtle (*Podocnemis expansa*) (Figures 2). However, terrestrial animals have also seen declines since temporary increases in their densities during the seasonal flooding of forests facilitates hunting. This seasonal fluctuation explains the more pronounced declines of terrestrial animals in some specific Amazonian ecosystems such as *várzea* and *igapó* forests (Antunes *et al.,* 2016).

Figures 2

Pirarucu and Amazon River Turtle

Note. (A) Pirarucu, From Gonçalves, A. C. T., Cunha, J. B. C., & Batista, J. S. (2018). *The amazing giant: sustainable management of Arapaima (Pirarucu)*. Instituto de Desenvolvimento Sustentável Mamirauá. (B and C) Amazon turtles. Gonzales, J. (2019). *Amazon's giant South American river turtle holding its own, but risks abound*. Mongabay Environmental News.

The threats imposed by human disturbances in the Amazon Basin are numerous. Amazonian ecosystems have been heavily compromised by the ideals of economic development. These ideals are entrenched in the national economic agendas of each Amazonian country, with the expansion of the Amazonian frontier and regional integration schemes (e.g., *Iniciativa para la Integración de la Infraestructura Regional Suramericana* - IIRSA) that aim to develop the region by implementing bilateral and multilateral free trade agreements (FTAs) and infrastructure to move commodities across the territory. Thus, the Amazon Basin appears doomed to deforestation (West & Fearnside, 2021), mining (Diele-Viegas *et al.,* 2020), fire (Escobar, 2019), agribusiness (Pereira *et al.,* 2020; Rajão *et al.,* 2020), climate change (Azevedo *et al.,* 2020), highway construction (Ferrante *et al.,* 2020a), hydroelectric plants (Fearnside, 2016) and their associated infrastructure (Anderson *et al,* 2019).

Neocolonization also jeopardizes Indigenous and riverine peoples of the Amazon as development projects expand frontiers and invade PAs and ITs (Indigenous Territories). The Basin is home to 350 Indigenous groups that speak roughly 240 languages (Neugarten *et al.,* 2015; WWF, n.d). The ethnological and linguistic diversity of the 35 million residents of the Amazon (10% of the population of South America), a mix of Indigenous, African, and European influences, is under threat (Macedo & Castello, 2015; Neugarten *et al.,* 2015; WWF, n.d). Rivers are so intrinsically related to the traditional communities of the Amazon Basin that local inhabitants have been referred to as "water people" by many authors (e.g., Castello *et al.*, 2013; Furtado *et al.,* 1993). With the growing demand for natural resources to feed industry and human populations beyond the Basin itself, its natural resources and local communities are under the greatest pressure yet. Beyond the costs to the livelihoods of Indigenous and traditional peoples (Athayde *et al.,* 2014, 2019; Gallice *et al.,* 2019) is the loss of biodiversity including endemic species (Tófoli *et al.,* 2017). Yet, Indigenous peoples and local communities (IPLCs) are the players of conservation of the Amazon Basin and its natural resources, including the rivers that run inside PAs and ITs (Athayde *et al*., 2021). A collaboration with IPLCs may be a route to improve knowledge and awareness on lessons to conserve and enhance Amazon riverine ecosystems.

Reconciling the sustainable use of rivers with the environmental and socioeconomic characteristics of different regions has been a major challenge for institutions focused on freshwater ecosystems. As rivers often flow through multiple jurisdictions across scales, it makes riverine governance a difficult task. While economic integration and infrastructure implementation continue in the Amazon Basin, the current lack of solid policy (-ies) to protect water resources, especially rivers, must be addressed. Because the Amazon and its tributaries includes a vast amount of water flowing within the territory that are now threatened by grey infrastructures, the Basin's countries could take lessons from other parts of the world that have undergone similar economic transitions, namely Europe and the United States (US), to manage water resources including rivers. After a boom in hydropower construction, the US and European countries are now advancing their river

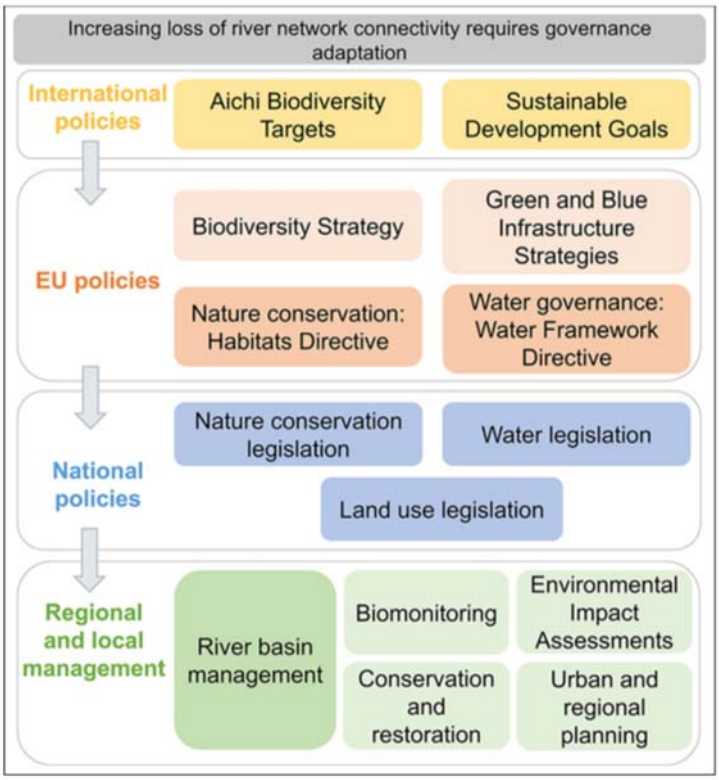
conservation and dam removal agendas (Moran *et al.,* 2018). The US, for instance, has served as a leader regarding river protection policy with its implementation of the Wild and Scenic River Act of 1968 (WSRA) to safeguard rivers or river stretches from barriers and maintain their free-flowing nature and ecosystem services (Perry *et al.,* 2021).

The management of transboundary rivers is also a matter of State, and so requires cooperative international policy mechanisms (e.g., Colorado River Compact; Columbia River Treaty; Mekong River Commission; European Water Framework Directive, UN Watercourse Convention). Supranational agreements have also been created to protect and manage wetland areas, such as the Ramsar Convention that defined priority areas for the conservation of rivers and wetlands in the Amazon Basin (The Ramsar Convention Secretariat, 2014). Nonetheless, river conservation is particularly critical in the Amazon Basin due to its size, dense forests, transboundary features, and key interface with terrestrial ecosystems, particularly due to the seasonal flood cycle.

According to Cid *et al.* (2021), the maintenance of river connectivity requires international collaboration and governance across scales (Figure 3). Although some of the mentioned policies can be found across scales in the Amazon watershed, others are missing. And those that are present are still fragmented policies that do not consider the Amazon Basin as an entire socioecological unit. And/or do not focus on freshwater. Recent global awareness about freshwater protection (e.g., IUCN Resolutions) and calls for the conservation of Amazon forests (e.g., Leticia Pact and Science Panel for the Amazon), can be best addressed if Basin countries collaborate with one another. A basin-wide system must be put into place that, at least, instantly fully safeguards rivers that already have some degree of protection so that their conservation status can be elevated. An Amazon Basin conservation system would also help address the most urgent global guidelines for freshwater ecosystems. Such a system could encompass the policies suggested by Cid *et al.* (2021) that are already in existence for the Amazon (e.g., Integrated Water Resources Management), while incorporating new policies that are missing (e.g., National River Conservation System such as the US Wild and Scenic Rivers), to effectively protect Amazonian rivers.

Figure 3

Increasing Loss of River Network Connectivity Requires Governance Adaptation



Note. This example is specific for European rivers. From Cid, et al. (2021).

Given the lack of any basin-scale conservation system for freshwater protection in the Amazon Basin, I undertook this study to answer the question: 1) What socio-economic factors are degrading the integrity of riverine ecosystems in the Basin? 2) What lessons can be learned from environmental governance in the Amazon to inform the creation of a basin-wide river conservation system? To answer these questions, I deployed an international survey (questionnaire), conducted discourse analysis of the literature and semi-structured interviews, and performed policy analysis to understand the different approaches and perspectives on the governance of Amazonian rivers. The main objective was to assess the understanding that scientists, NGOs, fishers, and government officials from different Basin countries have about the ecological, economic, social, and political importance of Amazon riverine ecosystems and their current conservation status, in addition to the perspectives that these actors have on the effects of river exploitation and possibilities for a basin-

wide riverine conservation system. By employing these methods, I aimed to uncover the constrains and possibilities for a basin-wide conservation system focused on riverine protection. Findings suggest that Basin countries are already integrating river basin management from an economic perspective, but at the expense of social and environmental contexts. To balance the repercussions of regional integration, a conservation system must be developed so rivers can be protected.

2. Literature Review

2.1. Ecosystem services of the Amazon

In 1935, Sir Arthur Tansley (1935) defined an ecosystem as a community of species that lives in a specific place during a given time interval, and that interact with each other and with the environment, constituting a relatively stable and balanced system (Pickett & Cadenasso, 2002). Eighty-five years later, some authors have concluded that due to the close relationship and interdependence between humans and natural ecosystems the concept of ecosystems is no longer limited to the world of natural sciences, but has incorporated areas such as economics and politics (Resende *et al.,* 2014). This broader conceptualization of what constitutes an ecosystem has led to the implementation of socio-environmental conservation programs such as the Millennium Ecosystem Assessment (MEA, 2005), which resulted in government institutions adopting the terms 'ecosystem' and 'ecosystem services' in their legal systems (e.g., Daily *et al.,* 2009; Daly & Farley, 2010; IPBES, 2019; Resende *et al.*, 2014).

The concept of ecosystem services emerged in the 1970s, and its use in publications on the benefits of ecosystems to human welfare has grown exponentially over the past few decades (Costanza *et al.,* 1997; Daily *et al*., 2000; de Groot *et al*., 2002; IPBES, 2019; Limburg & Folke, 1999). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) builds on the ecosystem services concept and developed Nature's Contributions to People theory. This theory is more inclusive of the reality of stakeholders as it addresses the human-nature relationship, its cultural context, and factors in positive and negative values of nature (Díaz *et al.,* 2018; Ellis *et al.,*

2019). In general, ecosystem services are products of natural cycles mediated by sunlight determining primary productivity. These cycles are usually complex because they operate on multiple interdependent scales. For instance, carbon transported among organisms and physical environments on a molecular scale influences the sedimentary composition of soils and oceans, and ultimately the global climate (Janzen, 2002). A more pragmatic and useful definition of ecosystem services for natural resource management could simply consider ecosystem services as benefits provided by ecosystems directly or indirectly to humans. This definition is broad enough to cover the flow of matter and energy, and all ecosystem information required to sustain human life, social well-being, and capitalization of resources (Costanza *et al.,* 1997).

Given the complexity of biogeochemical cycles, it is common to classify ecosystem services by ecosystem type. This classification facilitates the empirical application of theoretical concepts in social, economic, and environmental programs. Freshwater ecosystem services are fundamental to all forms of life because water is one of the main elements that drives the existence of life itself. Food, nutrient cycles, transportation, recreation, energy, climate regulation, and aesthetic, cultural, and spiritual values are some of the goods and services that living beings derive from freshwater ecosystems (Forslund *et al*., 2009; MEA, 2005). The valuation of these services has been estimated at $4 trillion annually (Costanza *et al.*, 2014; Darwall *et al.,* 2018), of which most is generated by the estuarine mouths of rivers and floodplains (Costanza *et al.,* 1997).

2.1.1. Ecosystem services of the Amazon: riverine connectivity, freshwater, and fish

2.1.1.1. Riverine Connectivity. Riverine connectivity is an essential characteristic to maintain many of the freshwater ecosystem services. Rivers are one of the main freshwater ecosystems providing benefits to nature and society (e.g., food and power generation). Rivers, when healthy, are essential for providing freshwater and maintaining ecosystem integrity; however, sources of freshwater ecosystem services are widely expected to decline (Overton *et al.,* 2014). The flow of water and sediments and connectivity among habitats for freshwater organisms have been largely

obstructed worldwide by human activities, such as hydroelectric dams, mines, roads, diversions for agricultural irrigation, and silting in port and urban areas. Hydropower construction, for instance, has been particularly critical in North America and Eurasia, where free-flowing rivers (FFRs) have deteriorated dramatically, along with their capacity to supply their full extent of ecosystem services. On the other hand, the Amazon Basin still hosts the longest FFRs in South America (Grill *et al.,* 2019). This huge hydrological connectivity and ecosystem-level potential in the Basin allows the provision of many services that are vital locally to globally (Castello & Macedo, 2016).

While freshwater ecosystems are extremely complex and biodiverse (Castello et al., 2011; Naiman & Décamps, 1997), they are the most vulnerable and threatened when compared to terrestrial and marine ecosystems (Dudgeon *et al*., 2006; Harrison *et al.*, 2016). One of the main sources of hazard is the connectivity among river basins and between aquatic and terrestrial habitats that allow the transmission of threats to the system (Castello *et al*., 2013). High levels of connectivity imply strong cascade effects from environmental disturbances. Even seemingly isolated freshwater ecosystems such as lakes, interact with the surrounding terrain, groundwater, and eventually nearby rivers, with which they connect seasonally (Callisto *et al.,* 2019; Castello *et al.,* 2013; Castello & Macedo, 2016).

When a FFR is obstructed by dams, the major negative effects besides barriers to migration routes, are the greenhouse gas emissions, changes in the hydrological and flood patterns (Agostinho *et al.,* 2004), conversion of lotic environments into lentic environments (Pelicice *et al.,* 2015), loss of aquatic and terrestrial biodiversity and function (Ansar *et al.,* 2014; O'Connor *et al*., 2015., Vasconcelos et al., 2021). Dams disrupt the natural flow regime by altering for instance the frequency, duration, timing, and rate of flow, as well as the transfer of riverine sediments, nutrients, and its biota. Floodplain habitat is being degraded because of reduced flood pulses and higher base flows, resulting in the loss of biodiversity and the deterioration of floodplain forests (Timpe & Kaplan, 2017). The flood pulse disturbances caused by dams have the potential to seriously reduce food security in the floodplain ecosystem system. Although hydropower plants are considered

fundamental tools to address energy needs, the economic benefits are generally overestimated while the negative social consequences and biodiversity losses are grossly underestimated. For instance, dams are built in places of great hydroelectric potential that often overlap with important fish habitats where fast moving water is an important condition for species vitality (Winemiller *et al.,* 2016).

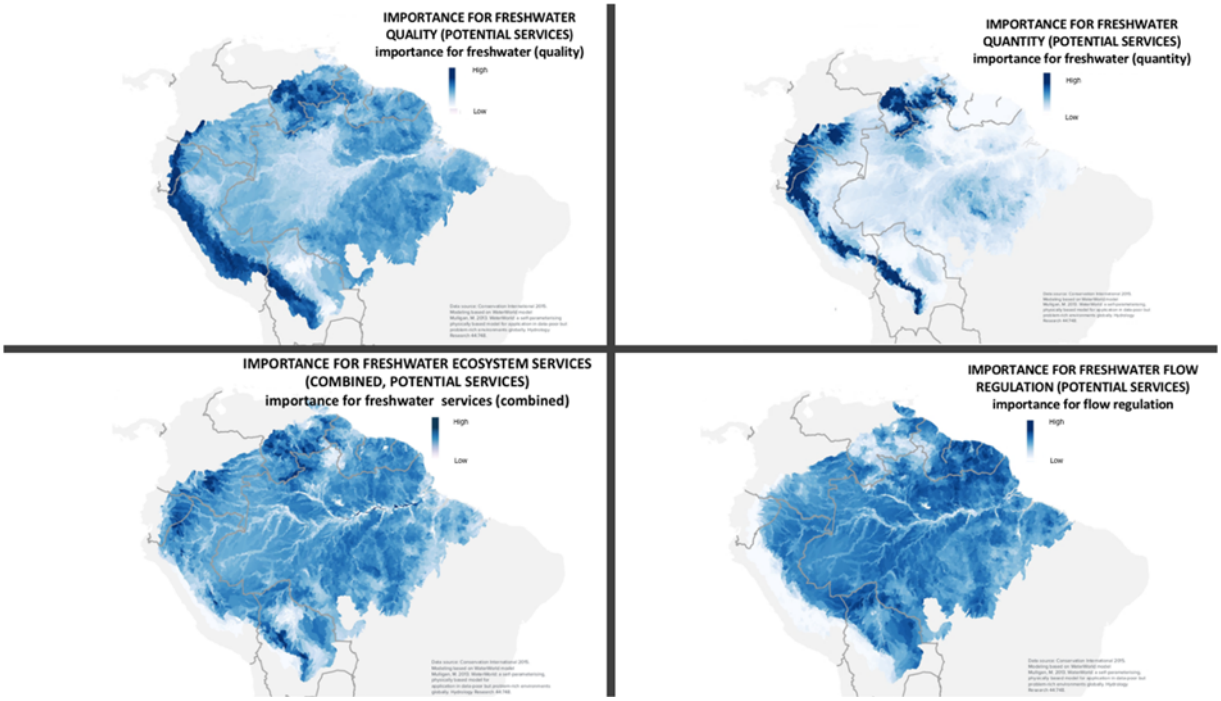
For the people living in the Amazon, rivers are routes that connect villages and urban centers, and sources of water for hydration, hygiene, and food. For instance, rivers facilitate access to wild açaí palm trees (*Euterpe* spp.) and enable cultivation that can generate US$ 60 to 300 million a year (Brondizio, 2008; Trevisan *et al.,* 2015). Fish play an important role in the diet of Indigenous peoples of the Amazon by providing protein and other essential nutrients such as omega-3 fatty acids, vitamin D, and iron (Neugarten *et al.*, 2015; Youn *et al.,* 2014). However, due to constraints, such as difficulty in accessing certain places because of topography and/or because sites are located within PAs or ITs, in-depth knowledge on freshwater fish species and their distribution is severely lacking for the basin (Jézéquel *et al.,* 2020). While more than 2,400 fish species have been recorded in the Amazon Basin (e.g., Almeida *et al*., 2001; Coomes *et al.,* 2010; Cotta, 2015; Gram, 2001; Jézéquel *et al.,* 2020; Moreau & Coomes, 2007; Reis, 2003) the total number remains unknown and is certainly much greater.

2.1.1.2. Freshwater. Freshwater (< 500ppm dissolved salts) provisioning is also an important ecosystem service of Amazonian riverine ecosystems (Keeler *et al.,* 2012). At different levels, freshwater quality and quantity influence biogeochemical and ecological processes that govern biodiversity, ecosystem productivity, and human well-being (Albert *et al.*, 2021) (Figure 4). While some have the misconception that water quality is also an ecosystem service, there is a need to reinforce its importance as a contributor to the many benefits humans derive from it. Water quality is not a service itself but is a contributing factor to various services that require abundant healthy waters (e.g., human health) (Keeler *et al.,* 2012). Here, I focus on the concept of water quality from the point of view of chemical and physical properties that are relevant for human consumption

(drinking water), irrigation, and fish farming. It is important to recognize that many ecosystem services that humans rely on from freshwater bodies require high quality water. Treating water for drinking is expensive and often impractical from a logistical point of view in remote areas of the Amazon Basin. Scientists often consider the Basin to be a natural machine that maintains water quality through its intertwined riparian zones of small streams that spread into the forest in all directions. This complex system plays a central role in the functioning of the forest as it filters and regulates the flow of terrestrial life, and buffers the flow of water during high and low discharge seasons (Castello *et al,* 2011; Marengo & Souza Junior, 2018; Naiman & Décamps, 1997).

Figure 4

Amazon Freshwater Quality, Quantity, Ecosystem Services and Flow Distribution



Note. From Neugarten, R., Ceotto, P., Acero, N., Coutinho, B., Flores-Gutierrez, R., Hierholzer, M., Kasecker, T., Koenig, K., Ledezma, J., Pinheiro, R., Turner, W., Wright, T., Amado, N., Bernard, C., Encomenderos, I., Martinez, C., Marhe, S., Martinez, M., Mendoza, E., & Troëng, S. (2015). *Mapping Essential Natural Capital in Amazonia: Identifying important places for biodiversity and ecosystem services*. https://doi.org/10.13140/RG.2.2.19848.93446

Water quality varies considerably within the Amazon Basin. Harald Sioli, a German limnologist, classified rivers of the Amazon Basin into three main types based on natural differences in water color and quality (Sioli, 1950; Vammen & Vaux, 2019; Venticinque *et al.,* 2016): (1) whitewater rivers (e.g., Amazonas, Madeira, and Juruá rivers), which have approximately neutral pH and are rich in suspended sediments and nutrients from the erosion of the Andes; (2) blackwater rivers (e.g., Negro, Jaú, and Tefé rivers), which are acidic (low pH), rich in dissolved organic carbon due to humic acid from the decomposition of organic matter, and poor in sediment and nutrients; and (3) clearwater rivers (e.g., Tapajós, and Xingu rivers), which have moderately low to neutral pH, and few nutrients, suspended sediments and dissolved organic carbon. Since these types of rivers have quite different physio-chemical properties, they make distinct contributions to regional flows in terms of quantity and velocity, and to the amount and type of material suspended in or dissolved in these flows, which ultimately cause differences in biodiversity metrics such as species richness and composition (Janzen, 1974; Sioli, 1968; Vammen & Vaux, 2019).

The main cause of water quality degradation in the Amazon Basin is probably mining, which has dumped huge amounts of mercury and silt into rivers (Binsztok & Carneiro, 2015; Pfeiffer & Lacerda, 1992; Malm, 1998). Although mercury exists naturally at very low amounts, the anthropogenic increase in environmental concentrations has made mercury the sixth most toxic substance in the world (Nascimento & Chartone-Souza, 2003). The effects of mercury on biodiversity and human health is extremely worrying because it can volatize and remain in the atmosphere for months and spread far from its source of generation (Silva *et al.,* 2006). Mercury is also a heavy metal that accumulates along food chains, reaching levels of particular concern in carnivorous fish that are widely consumed by people (Faial *et al.*, 2015). Hair samples from traditional Amazonian communities have revealed mercury concentrations above the safe levels recommended by the World Health Organization and can potentially cause neurological syndromes, fetal underdevelopment, and cardiovascular system failure (Guallar *et al.*, 2002; National Research Council, 2000; Virtanen *et al.,* 2005).

The integrity of the hydrological cycle is of vital importance to Amazonian forests. Amazonian forests recycle around one-half of the rain that falls in the Amazon Basin; the other half is collected in streams and rivers and flows to the ocean (Goulding *et al.,* 2003). The transboundary nature of the Amazon Basin is of fundamental importance to the region. If the Andes cease to accumulate snow, the entire hydrological cycle of South America will be affected. Changes in the hydrological cycle would also influence the "flying rivers" phenomenon (Nobre, 2014). The entire hydrological cycle is a phenomenon of interconnectedness. The Andean highland also delivers sediments to downstream rivers, which become very rich in sediments (Goulding *et al.,* 2003). Land-use change also influences these patterns by decreasing evapotranspiration on the land surface and increasing runoff, river discharge, erosion, and sediment fluxes from the land surface, changing the hydrological, geomorphological, and biochemical states of streams (Coe *et al*., 2011).

2.1.1.3. Fishery. Fishing in the Amazon Basin has generated up to $200 million annually and employed a labor force of around 200,000 fishers (Tundisi *et al*., 2014). Amazon fish production consists of 60% subsistence fishing, followed in turn by commercial fishing, sport fishing and ornamental fish farming (Ruffino, 2014). Despite the socio-economic importance of these fisheries, the fishery industry in the Amazon Basin is severely threatened by global warming (Barletta *et al.,* 2010; Neugarten *et al*., 2015), illegal fishing practices (Castello *et al.*, 2011; Neugarten *et al,* 2015; Petrere, 1996), and habitat loss and modification (Val *et al.,* 2016). The construction of dams, mainly for hydroelectric power, is another great threat to the Amazon fish industry (e.g., Fearnside, 2014; Latrubesse *et al.,* 2017; Santos *et al.,* 2020) due to the blocking of longitudinal migration routes. This is especially critical for giant catfishes, which are critical to the economy and livelihoods of traditional riverine and Indigenous peoples (Branco *et al.,* 2014; Hurd *et al.*, 2016). Relatively modern dams (1990s onward) include fish ladders to provide safe passage for migratory fish (Clay, 2019). However, these ladders were specifically designed for salmonids (Roberts, 2001), which do not occur naturally in the Amazon Basin, and are unlikely to be effective for Amazonian species (Pelicice *et al.,* 2015).

Essentially there is a mismatch between fish species and mitigation technology. Therefore, dam construction represents has a pronounced impact on the biology and development of fish populations in the Basin. This, in turn, is likely to deeply impact the provisioning of food sources and local communities. There is no substitute for a FFR, and fish ladders have been used as an argument to permit dam development, despite of the mismatch. Thus, fish ladders are not a viable solution for mitigating the impacts of dams on the Amazonian fish fauna.

2.1.2. Ecosystem services of the Amazon: opportunities

The Amazon Basin is a vast region that sustains rich biodiversity with low human density outside a few large urban centers (e.g., Manaus, Belém). The freshwater ecosystem of the Basin has captured the attention of the world over the years through many studies and expeditions since the 18th Century naturalists (Alho *et al*., 2015; Junk *et al.*, 2007; Kümin, 2007). Its biodiversity, freshwater, social diversity, ecosystem services and importance to humanity have been reported countless times, yet much remains to be done regarding its proper conservation and sustainable use (Castello *et al.,* 2011). Geographical barriers make research at a regional scale still challenging. Collaboration among States and scientists is one way to overcome this lack of regional data.

For proper conservation of Amazonian World Heritage Sites (sites of outstanding universal value), research is needed for most of the Amazon Basin territory, cultures, and biodiversity. These valuable places protect a fraction of the different ecosystems in the Amazon Basin such as várzeas, igapó and, lakes, and the included biodiversity (UNESCO, n.d). The Central Amazon Conservation Complex, encompassing Anavilhanas National Park, one of the world's largest river archipelagos, is an example of World Heritage Site (Figure 5). While many studies have been conducted, they are insufficient to give a complete understanding of the species diversity and the systems functioning for instance, due to the difficulties imposed by the region, thus these areas represent significant sites to protect and conduct further studies.

Figure 5

Anavilhanas National Park

Note. Anavilhanas is a World Heritage Site, a Ramsar site and a Biosphere Reserve (Ramsar, n.da). Photo Credit: Hélio de La Peña.

Until recently, the sustainable use of natural resources has not been the main concern of many government agendas in the Amazon. The literature (e.g., O'Neil, 2011; Raworth, 2012; Stuart *et al.,* 2020; Victor, 2010) and an Oxfam report on development and humanitarian policy issues indicate that current economic policies have failed to create inclusive and sustainable economic growth (Raworth, 2012). Governments continue to rely on economic statistics, such as the Gross Domestic Product (GDP), and push the boundaries of natural capital while not considering social and environmental costs (Raworth, 2012). Economic integration schemes (e.g., IIRSA) have been pressing for years to use the natural resources of the Amazon, while jeopardizing ecosystem services towards an irreversible tipping point (Nobre *et al*., 2016).

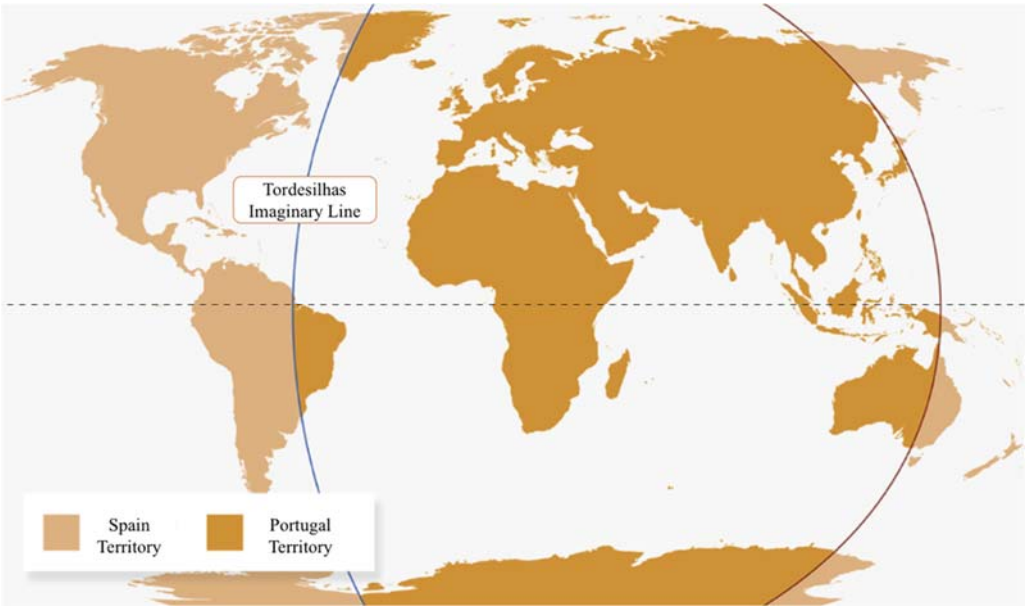
2.2. Regional Integration

2.2.1. Colonization and Frontier Expansion

The "discovery" of the so-called "New World" in the 16th Century led to European colonization of the newly found continent through Portuguese and Spanish maritime expansion. The Treaty of Tordesillas, signed by the two countries in 1494, partitioned authority of the colonial territory — Spain taking possession of west and Portugal the east, the latter eventually becoming Brazil (Tanzi, 1976). The agreement established an imaginary line off Africa's west coast 370 leagues west of the Cape Verde Islands demarcating Portuguese property (Alemán, 2020) (Figure 6).

Figure 6

The Treaty of Tordesillas



Note. The Treaty divided the newly-discovered lands outside of Europe between Portugal and Spain. Source: Adapted from Maps on the Web (2020).

Although an established agreement of demarcation of the territory between the two crowns was settled, the geography and resources to occupy the land under Spanish domain were crucial to guide future of colonization (Ardaya *et al.,* 2021). Spain not only had less diverse actors during the

process of colonization in the region (mostly missionaries and a few soldiers) in comparison to Portugal (e.g., troops, allied natives, private traders, etc.) but also the Andes mountains were a formidable geographical barrier for expeditions (Ardaya *et al.,* 2021). Over a course of years, Portugal saw opportunities to dispute the geographic boundaries and expand its frontiers further to the west throughout the mid-18 Century (Ardaya *et al.,* 2021). The geopolitical context experienced by the two crowns facilitated the signing of the Madrid Treaty in 1750. The Treaty defined a new territorial organization for the South American continent, ending territorial disputes and replacing the Treaty of Tordesillas, which was no longer respected in practice (Chaves, 2014). The Madrid Treaty was the initial step towards the borders seen today in South America.

The first expeditions in the South America after European arrival occurred circa 1540 and were planned by the Portuguese to explore the coastline while Spaniards explored the Andes (Ardaya *et al.,* 2021; Imazon, n.d). With time, the Portuguese demonstrated more interest in the Amazon Forest due to concerns of potential English, French and Dutch invasions (Imazon, n.d). This fear of international invasion persisted until recent times in Brazil, when the government ruled under the claim of "*integrar para não entregar*" (integrate to not deliver) throughout the dictatorship period of 1964 – 1985. However, discourse by the Brazilian government regarding possible foreign invasion served as a catalyst of “recent” expeditions and developments in Amazon Basin during the 1960’s (Imazon, n.d; Toledo, 2012).

The Amazon River itself gained a reputation for difficult navigation due to the many unsuccessful attempts to navigate upstream, confrontational Indigenous groups, and difficulties to access food (Barreto, 2008). Expeditions continued to take place throughout the Amazon for many years. Struggles with navigation, the lack of instantly exploitable wealth, and the belligerent population did not motivate Spain or Portugal to colonize quickly after the first expeditions of discovery (Barreto, 2008). Many myths, such as El Dorado, a city full of gold, lured conquistadors to their death in the Amazon Basin (Marshall, 2019).

The economic system during the colonial period was grounded on mercantilism, for which precious metals were the drivers of prosperity; thus, governments highly fomented their accumulation (Rojas, 2017). In search for this wealth and power, Europeans brought to South America mass decimation, acculturation, homogenization of Indigenous people, territorial displacement, slavery, disease, and many other negative influences described in documents and books over history. The harms that colonizers caused to the "discovered" land never stopped being perpetuated. The reasons and enthusiasm to dive deep into the Amazon Basin 500 years ago continue the same today. Once conquerors, who were always guided by gold, personal glory, and gospel (Arango, 2012; Ardaya *et al.,* 2021), found wealth, they started exploiting not only the forest and its resources but also Indigenous peoples and the Africans that were brought to the Amazon Basin as slaves. As curiosity about the Amazon Basin increased around the middle of the 18th Century, expeditions for mapping and other purposes began to take place (Furtado, 2013). These activities led to frontier expansion from coastal areas into the Amazon, albeit in different stages from one Amazonian country to the next.

In its essence, "frontier expansion" centers on the idea of controlling new areas in the peripheries that hold more natural resources to supply the shortfall in settled and commodified zones (Becker, 1988; Cleary, 1993; Holanda, 2005; Ioris, 2018; Lombardi & Carmo, 2019; Turner 1921). The phenomenon is also known as the 'law of scarcity-abundance' in that scarcity in central areas leads to a movement to conquer borderlands that hold more resources (Ioris, 2018). The evolution of the current socio-economic system of capitalism is based on accumulation by frontier-making and continued accumulation over time. It was not until circa 2005 when the idea of the frontier expansion was brought to light regarding the colonial process of advancing borders in South America (Holanda, 2005; Lombardi & Carmo, 2019). Nonetheless, the concept originated in 1921 with the work of Turner (1921) to comprehend how the settlement of the United States influenced the nation-building process. Since then, many authors have built on the definition and studied the

field to describe the population dynamics that are influenced by alterations to land use and cover (e.g., Becker, 1988; Cleary, 1993, 2001; Holanda, 2005; Ioris, 2018; Lombardi & Carmo, 2019).

The history of various episodes of frontier expansion in South America resemble that of the western US. The pursuit of wealth and the expansion of western frontiers over Indigenous homelands in search of development opportunities and the conversion of Indigenous people to Catholicism characterized a period in both the northern and southern hemispheres. The asymmetries in both regions stem from the fact that Native Nations in the North American Southwest lived and employed farming practices long before Europeans arrived, dating back to roughly 2000 BCE (Johansen, 2005). For example, ancient Pueblo people (e.g., Hohokam in Arizona) managed their land to benefit agriculture by the implementation of prosperous irrigation techniques (Hill *et al.,* 2015; Rice, 1998). In the early to mid-19th Century, federal and state governments of the US fomented the invasion of Indigenous lands with the purpose of exploiting natural resources, repeating the chronicles in the Global South (Bair *et al.,* 2020).

For the resource exploitation activities, such as mining, agriculture, and industries, to take place in the arid western US, dams were necessary to provide water and energy to the population and economic sector (Bair *et al.,* 2020; Davis, 1997). Although water is a critical resource in the western US for survival and played a key-role in the expansion movement (Bair *et al.,* 2020), in the Amazon Basin, water is crucial to provide paths of navigation in the depths of the forest. This natural resource was a basic condition for the governments of both places to move their development machines in route to economic power. Even though both governments offered land and basic infrastructure, the occupation of the Amazon Basin was uncoordinated.

Today, the region of the Amazon Basin in the Brazilian state of Mato Grosso is the perfect example of this frontier expansion (Figure 7). This ecosystem has come under pressure due to the rapid advance of commodities production (mainly cattle and soy). Over the last two decades, soy fields have been replacing cattle ranching in the state (Picoli *et al.,* 2020). The recent boom in commodities production has increased foreign interest in the region (Flexor & Leite, 2017). To

accommodate these economic activities, there have been many interventions such as deforestation (Gollnow *et al.,* 2018), fires (Rossi & Santos, 2020), and infrastructure to transport goods (e.g., highway BR-319) (Dros, 2004; Ferrante *et al.,* 2020a). These developments jeopardized the rivers of the Xingu sub-basin by changing the hydrological cycle (Rizzo *et al.,* 2020) and degrading water quality with agrochemicals (Pignati *et al.,* 2018). These commodity-driven activities have led the Amazon Basin to become a carbon source (Gatti *et al.,* 2021) while also endangering the livelihoods of 16 tribes that live in the Xingu Indigenous Territory as well as those of the surrounding population (Velasquez *et al.,* 2010). Notably, at the time when the Xingu Indigenous Territory was created, the headwaters of the Xingu basin were intentionally left outside the IT, leaving them vulnerable to these stressors (Velasquez *et al.,* 2010). Even though the state of Mato Grosso experienced an increase in GDP per capita in recent years, the number hides a track of social inequality and environmental degradation (Ioris, 2018). Increased growth, not only in Mato Grosso but also in the entire Amazon Basin, is not a synonym for development (Morán, 1983).

Figure 7

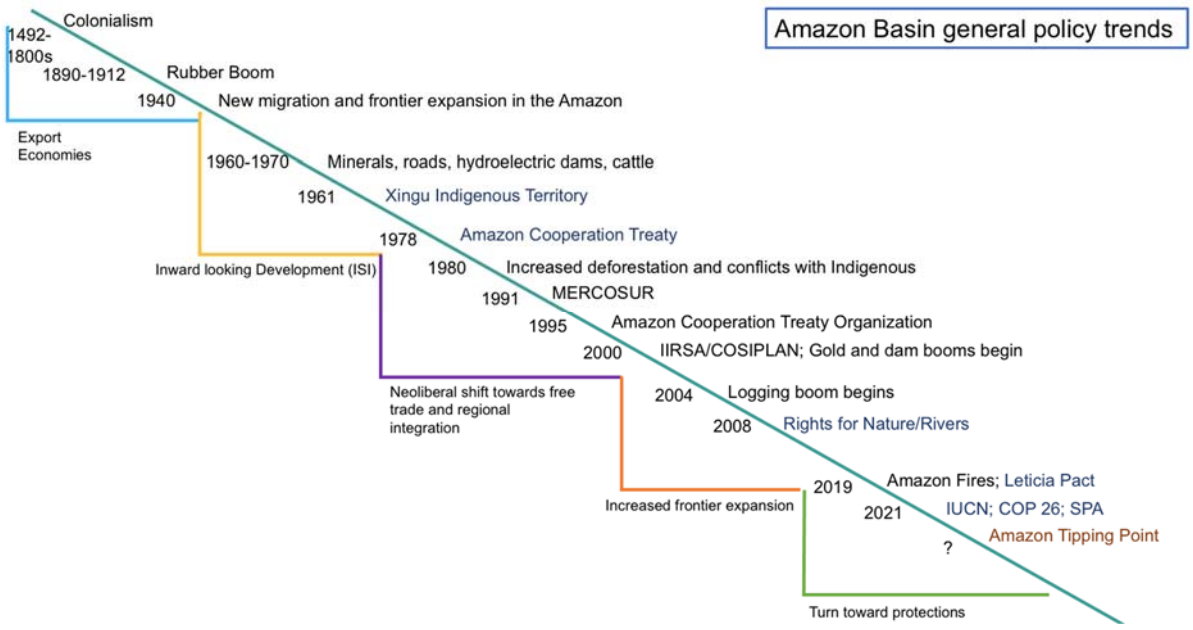
Amazon Fishbone Pattern

Note. Fishbone pattern of deforestation in the Amazon Basin due to greater deforestation closer to roads and rivers. Source: Mongabay (2020).

The history of the Amazon Basin since European arrival can be seen as the provisioning of resources for the acquisition of wealth (Figure 8). Colonization and neocolonization usually do not consider forests, rivers, and people as biodiversity components. Humans are degrading the Basin by expanding frontiers in seek of new areas to develop all sorts of activities. In doing so, they are also employing "frontier accumulation", where a cascading effect of such activities is noticed (Borges, 2019). For instance, hydropower dam projects are usually related to other sectors, such as agribusiness and mining (Borges, 2019), leading to a cascading effect for the Amazonian ecosystem and the services that it provides, which may lead to an irreversible tipping point.

Figure 8

Amazon Basin Timeline



Note. Some periods and policies are highlighted here.

2.2.2. Latin America Regional Integration Roadmap

European colonization has traces in cultural, economic, and political spheres in South America countries that have lasted until current days. The history in the southern hemisphere is still distinguished by commodity exports, owing that to their location along coastlines, lack of effective interaction between countries, and lack of suitable infrastructure inside the region (Myint, 1958; Padula, 2010). Despite the continent's huge geological obstacles, such as the Andean mountains and the depths of the Amazon Forest, South America is rich in transboundary rivers that connect the continent (CAF, 1998; Padula, 2010). More than navigation, rivers are important natural resources exploited strategically by the States. Control of water determines control of the economy and political power. Governments are always trying to integrate to increase their trading powers and grow economically. Governments view the Amazon as a vast territory full of natural resources that can be exploited and a barrier to trade due to dense forests and geographical barriers; hence infrastructures are necessary to attend the market demands.

To comprehend the rationale behind regional integration theory in South America, we must first define the term and the cycles that led to regional integration to reach the current model, which is fueled by neoliberal principles. Neoliberalism is a popular concept and has been defined in different ways across time (e.g., Bakker, 2013; Ganti, 2014; Harvey, 2005; Ong, 2006; Treanor, 2005). For Harvey (2005), neoliberalism is an institutional structure characterized by private property, deregulation, and free trade. The term "Free Trade Area" (FTA) refers to a collection of countries that have agreed to eliminate tariffs on most commodities imported and exported between them. The FTA's goal is to promote trade between the nations involved, as well as to strengthen economic reforms, improve governance, energize their private sectors, and boost market confidence (Feinberg et al., 2005). Neoliberal approach in sum has “commodified” nature and inserted it within a market. This is relevant in the Amazon context because the integration of Amazon countries into socio-economic blocks allows them to form relationships and create circumstances for the economy to dynamize and intensify in a globalized world. As a result, it is evident why and how Amazon countries are forming socio-economic blocs to trade commodities and export natural resources.

A great definition of regional integration is given by Karl Deutsch, a social and political scientist. Deutsch defined the phenomena as a process for the creation of secure communities, which can be stated as an 'integrated' group of people within a territory (Haas, 1970). When focused on economic aspects, the integration processes differ by the level of commitment of the parties in the agreement. The integrationist processes were divided into three stages: the first, known as 'first regionalism,' occurred in Europe between 1950 and 1960 and served economic interests. The goal was to bring economies together and boost regional growth. With the conclusion of the Cold War in 1980, the second wave of regionalism began. Aside from economic factors, historical, social, and cultural political considerations were factored into the integration process' design. The third regionalism, based on emerging countries, began in 1990. Investments, international security norms, political stability, social welfare, and other issues were all matters of regional integration respect (Carvalho, 2009).

On a worldwide scale, the dollar became dominant in the late 1970s; the Soviet Union and the communist bloc were dismantled in the late 1980s; with the United States' subsequent unipolar leadership, neoliberalism became prominent (Padula, 2010). At the same time, European integration is fading and its progress in South America is slow (Padula, 2010). However, the integration emerged on a huge scale around the world, particularly in Latin America, in the 1980s and especially in the 1990s, remaining within the scope of neoliberalism and its impulses towards pro-market economic liberalization measures (second regionalism) (Padula, 2010).

According to Balassa's (1961) classification, cited by Celli Junior (2007), when dealing with regional economic integration, five stages may be established: (1) FTA would be the first and simplest, by which countries eliminate tariff and non-tariff barriers in order to favor the circulation of goods among them (North American Free Trade Agreement – NAFTA is an example); (2) After Free Trade Zone is configured the Customs Union, where countries adopt a Common External Tariff, economic policies are harmonized (Mercado Común del Súr - MERCOSUR, is an example); (3) The following stage is the Common Market, in which the free movement of people, services, capital, and

labor is established (the Mercado Común Centro-Americano - MCCA and The Caribbean Community – CARICOM are examples); (4) The fourth stage is the Economic Union, which establishes the harmonization of national laws that relate to previously integrated areas. This stage is solely exemplified by the European Union (EU); (5) Total Economic Integration is the fifth and last stage, in which the policies of integrated countries are considered and fully implemented (Celli Junior, 2007). On broad scales, regional political-economic blocs can cooperate and integrate with each other according to the level of interdependency or lack of it when the trading States are analyzed (Celli Junior, 2007). Cooperation usually stands out only for joint actions on specific topics while integration is more intense, and its mechanisms are more complex. All integration presupposes prior cooperation actions (Celli Junior, 2007).

In Latin America, the integrationist ideas are relatively old but were mainly expressed in practice by Simón Bolívar in the 19th century, who tried to implement the first regional integration schemes in search of resistance to European recolonization. His attempts failed but were a milestone in history and International Law (Fawcett, 2005). In the Cartagena Manifesto of 1812, Bolívar expressed one of the first philosophical political thoughts in the Americas and shared the idea that the continent needed to unite in a strong and solid entity against the royalties (Lynch, 1983). Around 1815, Bolívar wrote the Charter of Jamaica, in which he made clear his desire to unify the administrative units and form the American States, despite recognizing integration difficulties (Carvalho, 2002). In 1826, after several attempts, Bolívar organized the Panama Congress, known as the first official step in an effort to consolidate the regional integration in Latin America (Mace, 1988). Its goal was to show the Ibero-American people the need to unite against a common enemy: the abandonment of Latin America by the other nations (Carvalho, 2002). The Treaty of Union, League and Confederation, signed at Panama Congress was never implemented and the Congress was not successful (Mace, 1988).

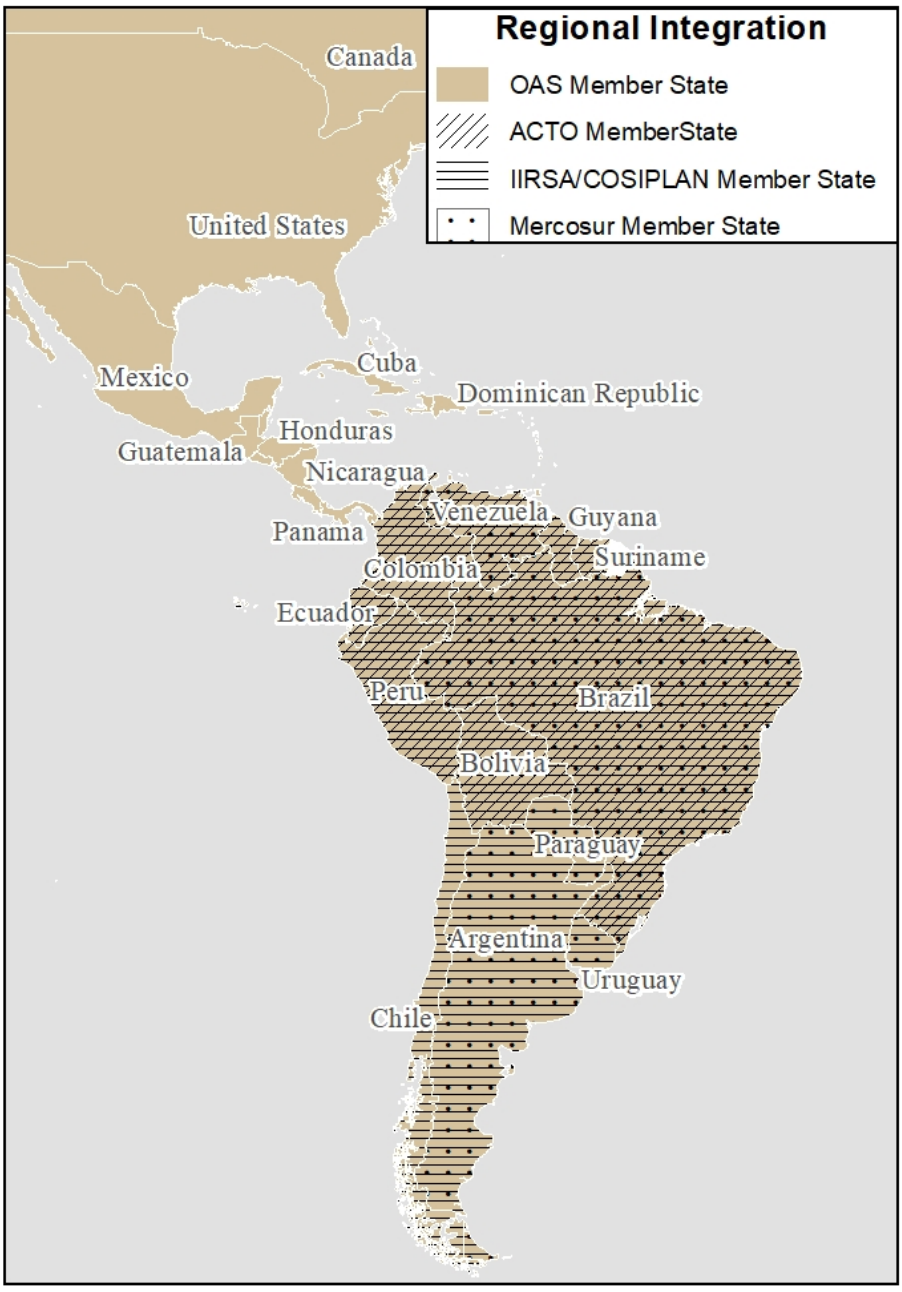
After the Panama Congress, several other events tried to solidify the Bolivarian ideas without achieving success; nevertheless, they were responsible for initiating an integrationist

process in Latin America (Carvalho, 2002). The end of the colonizers' threat gave rise to a new stage in the region, highlighting then an intergovernmental relationship (Carvalho, 2002). In 1889, the 1st International Conference of American States was held in Washington D.C, and after that, countless others were held where the States discussed topics of different natures, giving rise to the formation of a Pan-American system (Carvalho, 2002; 2009). These Conferences were the forerunners of the continent's great diplomatic gatherings, with the main goal of uniting American nations through political and economic strengthening, starting with 19 nations in the First Conference and increasing to 21 republics by the Ninth Conference in Bogota in 1948 (Dulci, 2008). After World War II, the States demonstrated a desire to build a relationship based not only on political integration, but economy among the American countries, especially the Latin States. To promote continental solidarity and ensure sovereignty and economic cooperation, the Organization of American States (OAS) was created at the Bogotá Conference in 1948 (Carvalho, 2002).

The integration process was the result of a complex phenomenon of regional and international relations among States, which built dependency and developed the economic market. The region was turned to neoliberal ideas. One of the most significant of these was the concept of FTA (Carranza, 2002; Perry & Berry, 2016) . Integrationist processes are not frequent and change according to regional characteristics and other elements such as political, social, and economic features (Carvalho, 2009). As integrationist ideas were launched and their foundations solidified, agreements in Central and South America began to take shape. Among them were the Central American Common Market; Caribbean Community; Latin American Free Trade Association; Group of Three 3G; Southern Common Market (MERCOSUR), and several others. Today, some influential integration and cooperation blocs play an important role in the Amazon basin and will be discussed in the next section, namely: OAS, MERCOSUR*, Iniciativa para a Integração da Infraestrutura Regional Sul-Americana* (IIRSA) and Amazon Cooperation Treaty Organization (ACTO) in South America, thus influencing the Amazon Basin and European Union (EU), that has trade relations with Amazon countries (Figure 9).

Figure 9

Selected Regional Integration and Cooperation Schemes



2.2.2.1. Integration Procedures

2.2.2.1.1. Organization of American States. The Organization of American States (OAS) is the world's oldest regional organization. The OAS was founded in 1948 when the Charter of the OAS was signed in Bogotá, Colombia, and went into effect in December 1951 (OAS, n.da). After that the

Charter undergone through some amendments (OAS, n.da). All 35 independent States of the Americas are a member of the organization and OAS also granted permanent observer status to 69 States, as well as to the EU (OAS, n.da). The Inter-American Court of Human Rights is an autonomous legal institution of OAS whose objective is to interpret and apply the American Convention. In accordance with the American Convention, the Court mainly exercises three functions: (I) contentious, (II) the power to issue provisional measures, and (III) the advisory function. Not all the American States are signatories of the Convention. Only Bolivia, Brazil, Colombia, Ecuador, and Peru are members as Amazon countries. Venezuela in 2012 presented an instrument of denunciation of the American Convention on Human Rights to the Secretary-General of the OAS. The denunciation took effect on 2013 (OAS, n.db). The Court acted in many violation rights for Indigenous case in Amazon countries (e.g., Case of the Xucuru Indigenous People and their members against the Federative Republic of Brazil; Provisional Measures regarding Colombia: Matter of Pueblo Indígena de Kankuamo) and recently the Court made recommendations to Brazil for violations against Indigenous peoples and the "marco temporal" (change in ITs demarcation) (OEA, 2021). Thus, OAS it is a powerful regional organization that may act in favor of those, such as Indigenous people or riverside communities that play a crucial role in protecting the Amazon Forest and its rivers.

2.2.2.1.2. Amazon Cooperation Treaty Organization. Amazonian “re” occupation became a central piece of Brazilian government agenda. The rivers, opera houses, theaters, journals, public markets in Manaus were one of the reminders of the potential that Amazon could reach (Fuccille, 2015; Hetch, 2011). The glory conquered in the economic cycles of spices (XVI century) and rubber (XIX – XX centuries) and then backlashed by the Second World War turn out to be once again the focus of attention (Fuccille, 2015). Under the discourse of the need to develop, expand its territory, occupy the land, and integrate the region, the Brazilian military regime (dictatorship) proposed a geopolitical project for the Amazon (Bomfim, 2010).

Still during the dictatorship (1964 - 1985), under the presidency of Ernesto Geisel, Amazon Basin governments began a process of collaboration. Low population density in the rainforest, a

shortage of human resources to assist development, and the need to increase conversation among Basin states were some factors that led Brazil to propose the Amazon Cooperation Treaty (ACT) in 1978 during the military period (Carvalho, 2009). The treaty was signed by all the Amazon States (except French Guiana), later giving rise to the Amazon Cooperation Treaty Organization (ACTO) (Carvalho, 2009; Toledo, 2012). The creation of the organization is also a symbol of the Member States' concerns to establish their sovereignty and protect the Amazon's resources (Toledo, 2012). The organization aimed for the sustainable development of the region, advancing its economy, politics, and social equity (ACT, 1978). According to ACTO, they foster collaboration, sustainable development, and the well-being of Amazon residents to reduce current asymmetries between and within Member Countries. ACTO has a Permanent Secretariat (PS/ACTO) and through this body the organization exchanges knowledge, cooperates and implements joint actions among the Member States to comply with the directives of the Amazon Cooperation Treaty (ACT). The working areas spread over different themes, such as conservation of natural resource; infrastructure and transport; knowledge management and information exchange; Indigenous peoples and other tribal communities; institutional, financial and legal strengthening; regional health management; emerging themes and tourism (ACTO, n.d).Nonetheless, besides the limited literature on ACTO, scholars believe that the organization lack dynamism, presenting many periods of inertia (Vital & Quaglia, 2020).

As the ACT is a framework agreement by nature (*pactum de contrahendo*), all the States need to indicate a desire to cooperate in the same agenda. Some argue that the role of ACTO in conservation, especially of water resources, should be revised to tackle more specific regional environmental needs and encompass scientific perspectives (e.g., Latrubesse *et al*., 2017; Tigre, 2019) while it remains limited by its scope and under Foreign Relations Ministry coordination (ACT, 1978). ACTO also has room to improve its engagement with stakeholders, so contributing to a more participatory decision-making process, as well as its dialogue with other regional integration programs (e.g., IIRSA) and foster its own promotion (Silva, 2006). According to Zevallos (1993), it is

incredible that in a country (Brazil) where the Amazon is so vital, people do not see the relevance of the treaty, and that knowledge of the treaty is limited to a tiny group of individuals. Despite the diplomatic constraints and low prestige of the organization, ACTO promotes assessments in the region. One recent evaluation of the region is a document that aimed to have a regional vision of water resources, strengthen public water management institutions in the involved countries, and pilot experiences that have been implemented on research for further studies and monitoring of water. The first conclusion of the assessment is that there are 50 factors that negatively affect water resources in the basin and nine out of 50 needs to be prioritized (Appendix A). Significant among them are water contamination, deforestation, and biodiversity loss (OTCA, 2016).

2.2.2.1.3. MERCOSUR. The Treaty of Assunción established Mercosur in 1991, in which Argentina, Brazil, Paraguay and Uruguay are the official members (Venezuela adhered later and Bolivia is in the process of accession) (Mercosur, n.d). Mercosur is likely to be the group of countries with the most disparate dimensions in the world and that intended to form a Customs Union (Baumann & Mussi, 2006). The moment of its formation was favorable for regional integration in South America. MERCOSUR was encouraged by political and economic conditions thirty years ago, mostly due to the rise of globalization and integration movements. The collective will to transcend previous rivalry, based on physical proximity and ideological assumptions with shared political and moral ideals, should be underlined among the events that shaped the trading bloc (Seitenfus, 1992). Baumann & Mussi (2006) pointed that in the first years of its formation, MERCOSUR countries already shown an increase in GDP, with exception of Paraguay. By the time Venezuela joined the group, it accounted for 75% of South America GDP (Menezes, 2007).

MERCOSUR's scope goes beyond the integrationist economic policy sphere. In the Treaty of Assunción it is clear the intention of articulating an advance towards issues related to social equality and environmental protection (Blanco & Lin, 2001; Rocha *et al.,* 2005). Because the economic group preys on biomes rich in natural resources, such as the Amazon, environmental protections such as Environmental Impact Assessment (EIA) can be seen as the international cooperation organizations'

attempts to address problems associated with environmental factors related to development. In addition to the EIA, MERCOSUR adopted the "Environmental Agreement" in 2001 to promote more sustainable development and the execution of Agenda 21 directives (Queiroz, 2005; Rocha *et al.,* 2005). Nonetheless, problems such as intense concentration of income, adoption of exclusive development models and high levels of poverty in the MERCOSUR countries have contributed to negative impacts on the environment (Queiroz, 2005).

Indeed, MERCOSUR lost its strength in the last decade (Costa, 2019). In the last years, the trading and exports among the Member States decreased (Costa, 2019). The regional integration scheme is also facing threats from the EU that almost boycott Brazilian products due to mismanagement of the Amazon besides all the environmental safeguards (Rajão *et al.,* 2020). The European Parliament recently blocked any kind of arrangement in the ratification of the trade agreement between the blocs due to the mismanagement in the Amazon Forest (Chade, 2021). It is clear how trade among regional blocs is a powerful tool to address environmental protection while countries also seek for development.

2.2.2.1.4. Iniciativa para la Integración de la Infraestructura Regional Suramericana - Initiative for the Integration of Regional Infrastructure in South America (IIRSA). According to the integration theory, for the integration blocs to be viable it is necessary to develop physical infrastructures and increase transportation and telecommunication foundations (Celli Junior, 2007). Infrastructure needs to be in place and be sufficient to provide good conditions for the allocation of products and labor so productivity will be effective (Jaramillo & Lederman, 2006). Following the idea, IIRSA was conceived in 2000 by the Brazilian government of Fernando Henrique Cardoso and the Inter-American Development Bank to promote regional cooperation among twelve countries in the region, based on technical-financial assistance from large multilateral and national banks, to implement the continent's integration and development axes (Moraes, 2013). To achieve the proposed ideas of development axes across the territory, the project studies integrate infrastructure, international trade, and sites with high levels of natural resources (Moraes, 2013).

IIRSA was incorporated by Consejo de Infraestructura y Planeamiento (COSIPLAN) (Infrastructure and Planning Council) in 2008, which belongs to the Unión de Naciones Suramericanas (UNASUR) (Union of South American Nations) countries. IIRSA is a regional integration scheme that received increased attention from scholars and activists in the last few years due to the magnitude of the infrastructure plans, and its social and environmental consequences that are affecting the South America region (e.g., Perz *et al.,* 2010; Perz & Rojas, 2020; Van Dijck, 2013; Vilela *et al.,* 2020; Walker *et al.*, 2019).

The integrationist agenda includes roughly 560 projects. Of these, 70 are in the Amazon region (mostly infrastructure for airports, waterways, highways, hydropower, and ports). In the Andean headwaters', there are 65 projects and 20 in the Guyana Shield (COSIPLAN, n.d). The construction of several highways crossing the Amazon to provide flow of people and commodities is a project in progress to diminish the distance between the basin countries, to the ocean, and to facilitate access to European and Asian markets, favoring logistics and costs (Berg *et al.*, 2017; Verburg *et al.*, 2014; Vilela *et al.*, 2020). Some of them have strong effects on ecosystems, such as the Inter-Oceanic Highway, which causes road impacts from chemical pollutant runoff and stream sedimentation that undermine watershed integrity (Coffin, 2007; Vilela *et al*., 2020). The agreement also intends to expand the hydropower frontier with dams connecting transboundary rivers (McCormick, 2010; van Dijck & den Haak, 2007). Santo Antonio and Jirau dams, on the transboundary Madeira River (Bolivia) were directly associated with IIRSA and caused major socio-environmental impacts. Fearnside (2014), citing a proposal for a "motion of reference" on the Madeira dams to the National Council of the Environment (CONAMA) mentions that IIRSA "represents the old model of development based on large volumes of capital without, however, considering development as the result of interactions between local populations, [leading to] exclusion of the peoples of the forest, riverside dwellers and fisherfolk".

Although the Cosiplan Constitutive Plan addresses sustainable development in harmony with nature as one of its principles (COSIPLAN, 2013), according to the Economic Commission for Latin

America and the Caribbean, the countries face environmental problems that are jeopardizing their capacity to sustainable development. Those problems include loss of biodiversity and forests, over-exploitation of natural resources, soil degradation, and the exhaustion of fisheries' (ECLAC, 2014). IIRSA is jeopardizing Amazon ecosystem and studies now predict that the integrationist ideals are enough to get the forest close to a "tipping point", where damages are irreversible, and advances savannization (Salazar *et al*., 2007; Walker *et al.,* 2019). Thus, IIRSA plans must adequate the scale of its projects to adapt to the present conjuncture (Castro, 2019).

2.3. Political Ecology of Water Development Infrastructures

Political ecology is a lens through which people examine environmental questions. Wolf coined the term in 1972 to understand land use and resource ownership in the Swiss Alps (Robbins, 2012; Walker, 2005; Wolf, 1972). One of the most used definitions of political ecology is explained by Blaikie & Brookfield (1986) as a term that combines environmental issues with a broad definition of political economics. This involves the continually evolving dialectic between society and land-based resources, as well as within society's classes and groupings. Another broadly used definition given by Paul Robbins (2012) is that political ecology is the way to describe environmental change and marginalization to evaluate environmental issues using dependency theory. Dependence theory is a critical approach to explaining the economic and social development of different nations based on the idea of a dependency relationship between the global center and the global periphery (Machado, 1999).

An important dominant narrative in political ecology according to Robbins (2012) is the degradation and marginalization narrative that suggests, albeit counterintuitively, sustainability of local practice was decreased by attempts to improve production systems of local people, causing lower levels of equity in resource distribution. That happens due to transitions from systems that did not pose significant environmental harm to systems that tend to overexploit resources as state intervention and integration in regional and global markets soars.

The concept of territory is crucial in the analysis of this research. The concept is embraced by Boelens *et al.* (2016) through a political ecology lens in the investigation of hydrosocial territories as spatial arrangements of people, institutions, water flows, hydraulic technology, and the biophysical environment that revolve around water control. They contend that territorial conflicts entail wars over meaning, norms, knowledge, identity, authority, and discourses, in addition to natural resource battles. Therefore, territory encompasses human society interactions, hydrology, and politics (Karpouzoglou & Vij, 2017). In the case of the Amazon, it is very important that the analyses underpins hydrosocial territory once the human presence is a geological driver capable of modifying process in the freshwater ecosystem thus, not possible to be separated from it. To protect Amazon rivers, biodiversity actions must also focus where humans interact with nature.

Linton (2014) refers to water as a strategic resource exploited by humanity and utilized in a variety of ways and contexts. Most of the water development projects modified water flow and quantity, hence degrading the environment. Linton (2014) refers to these systems, in which water goes beyond its important role in biodiversity, as "modern water". As anywhere else in the world, even in the Amazon, where water is abundant, who controls water, holds power. Drawing on Boelens *et al.* (2016) concept of 'hydrosocial territories' and Schulz & Ioris (2017) research, in the Amazon context, water abundance is used in a political processes of contestation to be able to legitimize the unsustainable use of water (Schulz & Ioris, 2017). This implies that the development of water resources to the benefit of political and economic elites, such as hydroelectric power schemes, is legitimized (Schulz & Ioris, 2017).

The control of water and the ongoing process of water resources development by the economic elites of society leads to degradation of ecosystems and displacement of local communities across the Amazon. Amazon water infrastructure projects are usually supported by public-private association (mostly reliant on public funds and encouragement from governmental institutions) (Ioris, 2020a). The negative consequences of water projects in the Amazon reflect the

interaction between economic growth demands exerted by major political and economic centers and the region's specific geographical constraints (Ioris, 2020b).

For instance, under IIRSA, aside from dams, other planned water-related projects include waterways to create corridors to export commodities (Fearnside, 2014; Fearnside *et al.,* 2021). These infrastructure types are a whole system of water resources development encouraged by economic growth that in conjunction will provide freshwater, electricity, transportation, and other basic conditions to allow trade to become more efficient until arrive in its final market. Today, in the entire Basin there are more than 140 dams (that produce more than 1MW) (Latrubesse *et al.,* 2017). Yet, in the Andean headwaters alone, there are more than 160 proposed hydropower dams (see Anderson *et al.,* 2018; Fearnside *et al*., 2021; Latrubesse *et al.*, 2017; Winemiller *et al.,* 2016). The saga of dams led to a historical advocacy movement in Peru against more than 20 hydropower plants that were planned to operate in the Marañon river, a major free-flowing tributary of the Amazon. The environmental certification (a form for the company to comply with the process of operation) for the project expired and it can no longer be implemented (Grandez *et al*., 2020). Advocacy may lead to the dams (or other projects) not to be built by pressuring governments and other sectors of society. The same situation also occurred in the instance of Tapajós river in which many protests happened due to the proposed dams in Tapajós river that would perpetrate consequences in the ecosystem and for the Muduruku Indigenous tribe (Greenpeace, n.d; Walker & Simmons, 2018).

The cost of accommodating the neoliberal schema such as unnecessary dams is not limited to the environment. Construction of hydropower plants and canals results in a slew of human rights breaches. Dams have a tremendous impact on Indigenous people's social spheres (Doria *et al.,* 2018), especially in the Amazon, causing an increase in diseases including malaria (Keiser *et al.,* 2005), vector-borne illnesses, sex work, and sexually transmitted infections (Tallman *et al.,* 2020), as well as forced population displacement (Fearnside, 2015; Scudder, 2012; WCD, 2000). The International Labor Organization Convention 169, to which all basin countries have signed, aims to

provide some protection to Indigenous peoples in the face of environmental injustice by mandating free, prior, and informed consultation when actions such as dams may impact them (ILO, 1989). However, as with many other policies (e.g., Environmental Impact Assessments), these such safeguards are hardly applied (e.g., Fearnside, 2015; Ferrante & Fearnside, 2020; Millikan, 2014; Moreira *et al.,* 2019). Indeed, protections such as the environmental licensing (approval to operate) are being relaxed to facilitate infrastructure developments (Goodland, 2010; Gerlak *et al*., 2020; Ruaro *et al.*, 2021). The Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), which oversees evaluating environmental impact studies (EIAs) and issuing dam licenses, granted the installation licenses for Santo Antonio and Jirau dams even though many of the 'conditions' that had been established as prerequisites had not been met (Fearnside, 2014).

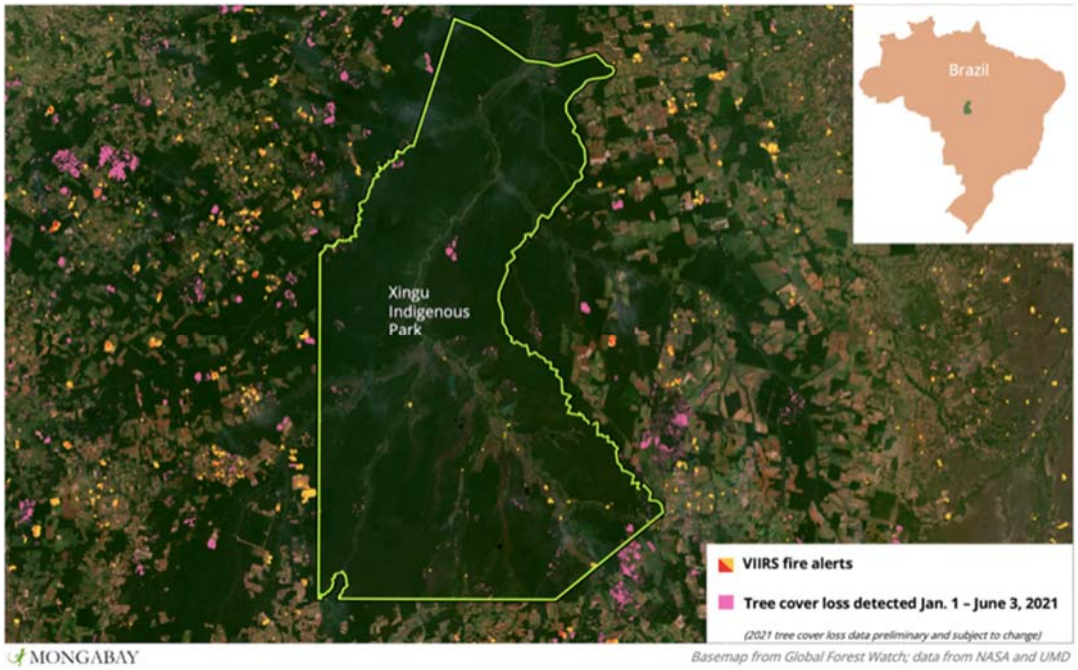
Dams and displacement have a long history in South America, particularly in Brazil, where governments, political parties, and private firms have sponsored massive dam projects to profit at the expense of Indigenous peoples (Millikan, 2014). Peru and Bolivia are also part of Brazil's scheme (Millikan, 2014; Moreira *et al.,* 2019). In 2010, Odebrecht, a Brazilian construction company, bribed Peru's government to build hydropower plans that were established in the agreement between the presidents of Peru and Brazil for the Andean-Amazon region on the Marañón River (Elbein, 2019). The Belo Monte Dam is another illustration of how, despite all the warnings on environmental disturbances, the dam was built with financing from the World Bank development policy loans channeled through Brazil's National Bank for Economic and Social Development (Fearnside, 2017). In the Xingu River (Brazilian Amazon), Belo Monte is an example of a massive infrastructure that displaced 25,000 people in the Altamira city, 18,000 traditional "ribeirinhos", flooded two ITs and decreased the flow of the river to twenty percent (Fearnside, 2017). In addition to the loss of environmental benefits, the reservoirs created habitat for malaria-bearing mosquitos bringing disease to the community (Keiser *et al.*, 2005).

The unnecessary ongoing dam construction in exchange of profit leads to a path in degradation in the ecosystem and Indigenous live. The role most Indigenous tribes play in

safeguarding the environment is argued to be the one of most effective barriers against deforestation and water degradation in the Amazon (Athayde, 2014; Dudley *et al.,* 2014; Fa *et al.,* 2020; Fernández-Llamazares *et al.,* 2021; Peres & Zimmerman, 2001; Nepstad *et al.,* 2006; O'Bryan *et al,* 2021; Pimm *et al.,* 2001; Schwartzman & Zimmerman*.,* 2005; Soares-Filho & Rajão, 2018). Indigenous people and their territories are under threat. Indigenous people see the forest, trees, rivers, and fish not as a resource but as a component of biodiversity (*see* Findlay, 2021). In the Xingu, one of the agriculture frontiers in the Amazon, the IT is responsible for the best conservation rates in the area buffering against deforestation at the frontier of agricultural expansion (Velasquez *et al.,* 2010) (Figure 10). In Brazil, Indigenous people have the right to permanent ownership of the land, and such a condition in theory makes the land inalienable and unavailable for any other type of use (Brasil, 1998). On the other hand, the laws that back up this Constitutional right to the Indigenous people are under constant attack, and most recently challenged by the Brazilian and other Amazon government political agendas (Carvalho *et al.,* 2019; Eichler & Bacca, 2020; Pelicice & Castello, 2021). The success of the permanence and Indigenous protection of these lands is constantly threatened by illegal mining, agribusiness, hydroelectric power plants, logging, and consequences derived from these activities such as deforestation and pollution (Barbosa *et al.*, 1998; Fearnside, 2015; Nepstad *et al.,* 2006; Walker & Simmons, 2018; Marques, 2021). Similar threats are faced in other Amazon countries, such as in Venezuela (Lozada, 2019). As a result, while Indigenous people within its territories have a high rate of conservation success, they are insufficient on its own to address protection.

Figure 10

Xingu Indigenous Territory



Note. The deep green in the middle of the picture is the Xingu Indigenous Territory, created in 1961. The surrounding areas are deforested with few remaining forests. From *Slash-and-burn clearing nears Indigenous park as Brazil's fire season ignites*. (2021, June 10). Mongabay Environmental News. https://news.mongabay.com/2021/06/slash-and-burn-clearing-nears-indigenous-park-as-brazils-fire-season-ignites/

Biodiversity Targets were set prior to the Convention on Biological Diversity (CBD) Strategic Plan for Biodiversity 2011–2020. The conservation of terrestrial and inland waters (rivers and lakes), as well as coastal habitats, known as Aichi Biodiversity Target 11 is one of the most important for freshwater. The Aichi targets for 2020 were more comprehensive set of individual targets. It aimed for the protection of 17% of inland water areas by 2020 (CBD, 2020). However, this goal was not achieved. This was an area-based target that looked at the entire area of the biome included in PAs; therefore, the river protection measure (by km) was irrelevant (this was a problem with Aichi Target 11 – it did not account for the fact that river protection in terms of area would not be efficient)

(Bastin *et al.,* 2019). In addition, most assessments of this freshwater target consider other inland water types, including lakes, wetlands, and other bodies of water, thus rivers are only a small part of the picture (Bastin *et al.,* 2019). Also, it is not common that rivers are inside PAs limits, they are usually left outside or used as boundaries (Abell *et al.*, 2017; Hermoso *et al.*, 2016; Opperman *et al.,* 2021). Even those that are contained within the PAs are still vulnerable to dam development (Opperman *et al.* 2021). Public administration usually considers a watershed as a natural and landscape feature instead of as a relevant natural resource to be protected (Fonseca, 2018; Tudinsi, 1998). As in some Amazon countries, protection policies lack durability and can be downgraded, downsized, degazetted (loss of protection), and reclassified (Anderson *et al.,* 2018; Golden Kroner *et al.,* 2019; Thieme *et al.,* 2020). The rivers are vulnerable to development if they are not being explicitly protected for their free-flow, biodiversity, and/or other ecosystem services.

Given the rise in global awareness to protect 80% of the Amazon (IUCN Resolution WCC_2020_Res_129) for the critical climate regulating and freshwater ecosystem services it provides and the trove of biodiversity it supports, there is a need to establish durable, effective river conservation strategies. As development projects in the basin are largely grounded in regional infrastructure integration schemes, such as IIRSA, effective conservation must be focused on the basin scale, transcending political borders to incorporate the entire region in a holistic approach to maintaining riverine ecosystem connectivity. Against that backdrop, this study aims to uncover the limitations and possibilities for establishing an Amazon basin-wide river conservation system. To do so, two research questions were asked - what socio-economic factors are degrading the integrity of riverine ecosystems in the Basin and what lessons can be learned from environmental governance in the Amazon to inform the creation of a basin-wide river conservation system. To answer these questions, an international survey was deployed (n=100) yielding both quantitative and qualitative data for analysis. The survey results were triangulated with discourse analysis of semi-structured interviews (n=28) and policy analysis. The combined results of this research aim to inform policy decision-making for achieving the IUCN Resolutions, CBD Post 2020 Global Biodiversity Framework,

the Sustainable Development Goal targets, or similar guidelines and to inform the creation of an Amazon Basin-wide conservation system.

3. Methods

The study was conducted in four distinct phases as detailed below. Approval to conduct this research was granted in July 2020 by the Northern Arizona Institutional Review Board under IRB ID 1617364-2.

3.1. Policy Analysis

Comparative policy analysis can help build theories and provide strategic advice and recommendations, among other benefits (Mayer *et al*. 2004). It also makes it is easier to understand the factors and processes that foment the emergence of policy trends and how countries can influence each other (Schmitt, 2012; Vogel & Henstra, 2015). Thus, this study analyzed national and regional environmental policies to identify those that set out to protect water resources and those that facilitate their development. These laws exist undern the scope of different legal frameworks in each country and, as such, vary from one place to another (Rosenfeld & Sajó, 2012).

Utilizing the "Constitute", a database of the world's constitutions that may be used for research and analysis to help in constitutional construction and to educate citizens (constituteproject.org, 2019), the Constitution of each Amazonian country was searched for the keywords "water"; "river"; "freshwater"; "ecosystem"; "conservation"; "environment"; "riparian" and "Amazon." Human Rights for Nature and for Rivers, as well as long-term policies, were assessed using Web of Science, Google Scholar, Google Search, and gray literature for the years 2000–2020. Other types of policies mentioned in the employed survey and interviews (see below) were evaluated later using the same methods. This strategy is critical for identifying legal gaps and successes, and how South American countries might influence one another regarding river protection. Lastly, judicial, scientific, and civil discourses were compared to uncover deficiencies in riverine protection.

3.2. Survey

Surveys represent useful tools to quickly and efficiently assess broad views of a sample population (Cobanoglu *et al.,* 2001; Drury *et al.*, 2011). They can also assess community perceptions, which can bring to light local values to inform management strategies (Bennett, 2016). To this end, an on-line international survey was created using Qualtrics survey software to understand how people perceive freshwater management and conservation across the Amazon Basin. The survey questions (n=37) spanned three different content themes: (i) Demographic Information; (ii) Natural Resources Development and Ecosystem Services in the Amazon Basin; and (iii) Policy Options for Riverine Governance. An opportunity was also given to provide personal contact information in case a respondent was willing to participate in a follow-up interview.

Deployed from July 2020 through August 2020, the survey focused on "experts" and members of local communities across all nine Amazonian countries. The survey was provided in English and in the two national languages of the Amazon Basin, Portuguese, and Spanish (Appendix B). The study adopted the Snowball Approach, a method that allows each surveyed person to suggest one or more additional respondents who may also have knowledge on the topic (Patton, 2001). To reach potential respondents, the deployment took place virtually via professional listservs (e.g., Amazon Dams Network, Programa de Pesquisa Ecológica de Longa Duração, Programa de Pesquisa em Biodiversidade) and personal social media networks. Targeted emails were sent to government agencies, non-profit organizations, academic institutions, environmental agencies, water resources managers, and fisher associations who were identified as having some involvement with the Amazon Basin. More than 400 people and institutions were contacted. Individuals received follow-up recruitment emails up to three times or until they confirmed the survey was submitted. One hundred (n=100) surveys were answered. The importance of the survey for this research was premised on gathering data from as many people as possible from across as many sectors with some professional or cultural relationship to the Amazon riverine ecosystem.

3.3. Semi-structured Interviews

Semi-structured interviews are useful because they give a true perception of a respondent's beliefs. This method is particularly advantageous since it allows for greater mobility in the interviewing process, as interviewers are not bound to the same set of questions. Furthermore, if a respondent's responses flow in multiple directions, a semi-structured interview style allows for minor adaptations (Kelly, 2010; Kallio *et al*., 2016; Packer, 2017). Thus, semi-structured interviews, consisting of 11 questions and done in the native language of the interviewee, were conducted with survey respondents who indicated an interest in participating in a follow-up interview (see Appendix C for the English version of these questions). The Snowball Approach was also applied to this group of interview participants (Patton, 2001). Twenty-eight semi-structured interviews were conducted between July and August 2020. Interviews were mostly conducted and recorded via Zoom and Skype and lasted an average of 60 minutes. These recordings were then translated and transcribed for analysis.

3.4. Data Analysis, Discourse Analyses of Semi-Structured Interview and Literature

Multiple methods to allow correlation among different data were employed in this study. Closed-questions for the survey were analyzed on Microsoft Excel and open-end questions from the survey and semi-structure interviews were analyzed with NVivo 12 qualitative data analytic software (AlYahmady & Al Abri, 2013). Discourse analysis, widely applied in qualitative research, was performed on the semi-structure interviews and open-ended survey questions. A. van Dijk (1985) argues that "the presupposition of such analyses is that ideologies of speakers or writers may be uncovered by close reading, understanding or systematic analysis, if language users explicitly or unwittingly express their ideologies through language and communication" (p. 135).

Based on the work of Glaser & Strauss (1967), "grounded theory" was applied to analyze the vast amount of data provided by respondents. Results were coded and separated into categories to form relationships (Glaser & Strauss, 1967; Bhattacherjee, 2012). After coding, interpretations and patterns were "grounded in" the revealed empirical results (Bhattacherjee, 2012). In NVivo, four

main codes were created to reveal common themes that emerged from the data and highlight their connections: (1) Natural Resources Management; (2) Resource Exploitation; (3) Governance; and (4) Environmental Values (Appendix D). These codes were created based on the most recurrent topics observed in a first general observation of the narratives and answers of the semi-structured interviews and open-ended survey questions. Thus, the discourses were "grounded in" the corresponding codes. After a deeper analyses, more codes were created *a posteriori.* The qualitative analysis was based on "reference" data in NVivo 12, that is, how many times the codes were used, as one code may be used more than once by the same respondent in different perspectives and to provide different information. Gray literature (e.g., news articles, websites, and reports) was used to inform this research and was also analyzed for the same discursive themes (Harris, 1981; Gee, 2004).

3.5. Limitations of the Study and Statement of Recommendation

Future studies need to build upon the survey and interviews and address the imbalance of participants, local and urban populations, and development entities. In addition, because this study had a limited time, Indigenous communities were not target. Technical knowledge documented in literature, survey and interviews is a representational bias that conflicts with Indigenous worldview. This research is aware of the need to recognize this limitation. The anthropocentric perspective may not align with the traditional and Indigenous people "cosmovision" or ecocentric values. Future researchers also need to dive deep into each country's national, state, and municipal policies and conservation projects that direct or indirect protects freshwater ecosystems, to understand the mechanisms and how this may contribute to the conservation strategy across scales.

4. Results

4.1. Demographics

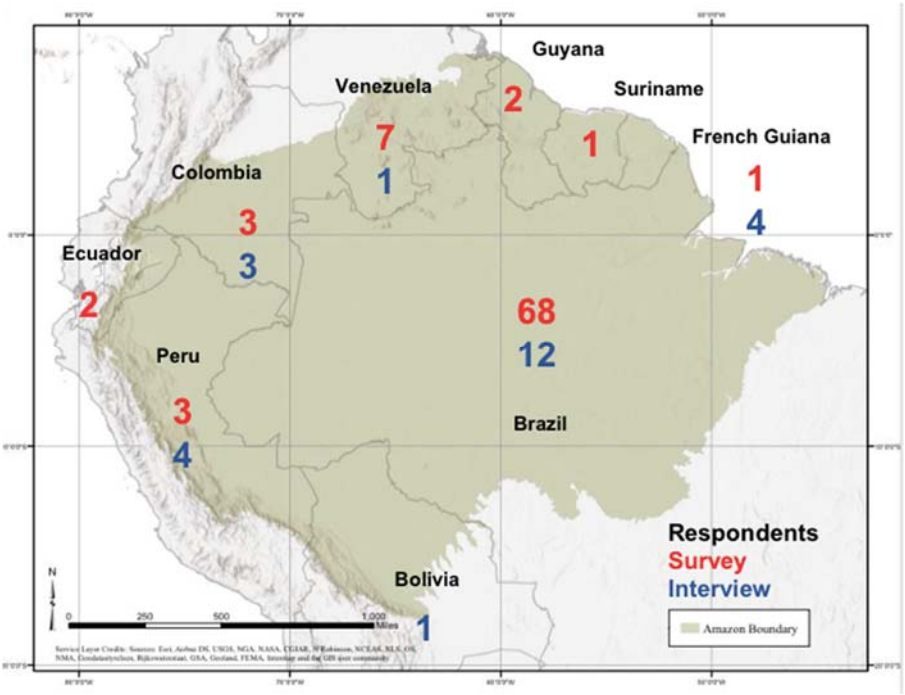
Survey responses and semi-structured interviews were unevenly distributed across Basin countries (Figure 11). Respondents for both methods were concentrated in Brazil. There were 68 survey respondents from Brazil, 19 from other Amazonian countries and 13 from non-Amazonian

countries but who worked/developed research within the Basin, for a total of 100 respondents. A similar pattern emerged for the semi-structured interviews, with 12 responses from Brazil, 13 from other Amazonian countries (Peru and French Guiana with four each, Colombia with three, and Bolivia and Venezuela with one each), and three from non-Amazonian countries, for a total of 28 semi-structured interviews. These are both people that work both in the Basin or working in the Amazon from elsewhere. Due to technical difficulties, and the SARS-CoV-2 (Covid-19) pandemic, it was not possible to conduct follow-up interviews with all intended sectors in the nine Basin countries. See Figure 12 for the distribution of survey responses and interviews across sectors.

The Amazon, Madeira, Negro, Purus, Solimões, Tapajós, and Teles Pires rivers were the most frequently mentioned rivers in responses to questions related to the river with which an individual respondent's work was associated (Figure 13).

Figure 11

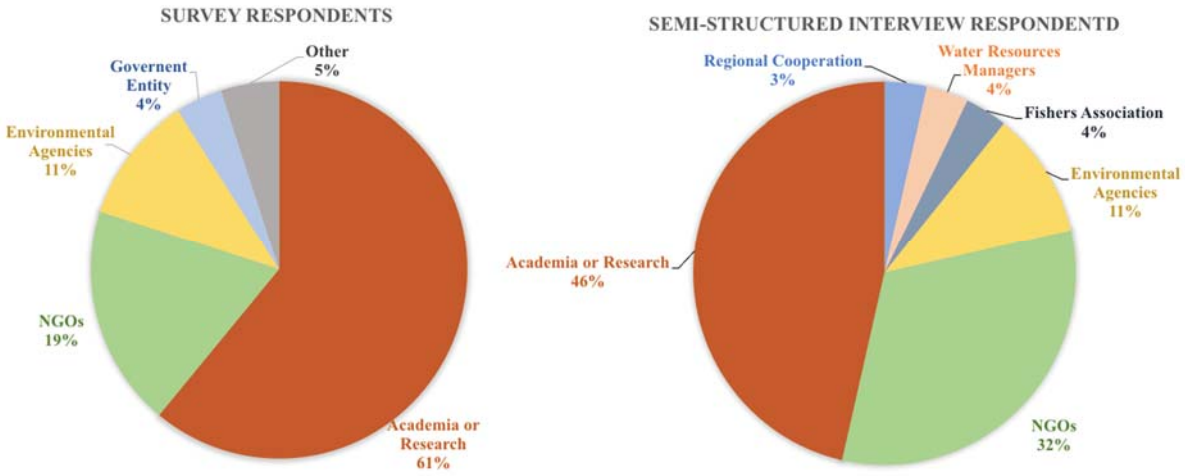
Geographic Distribution of Survey Responses and Semi-Structure Interviews Among Amazonian Countries



Surveys from countries outside the Basin (n= 13); Interviews from countries outside the Basin (n=3)

Figure 12

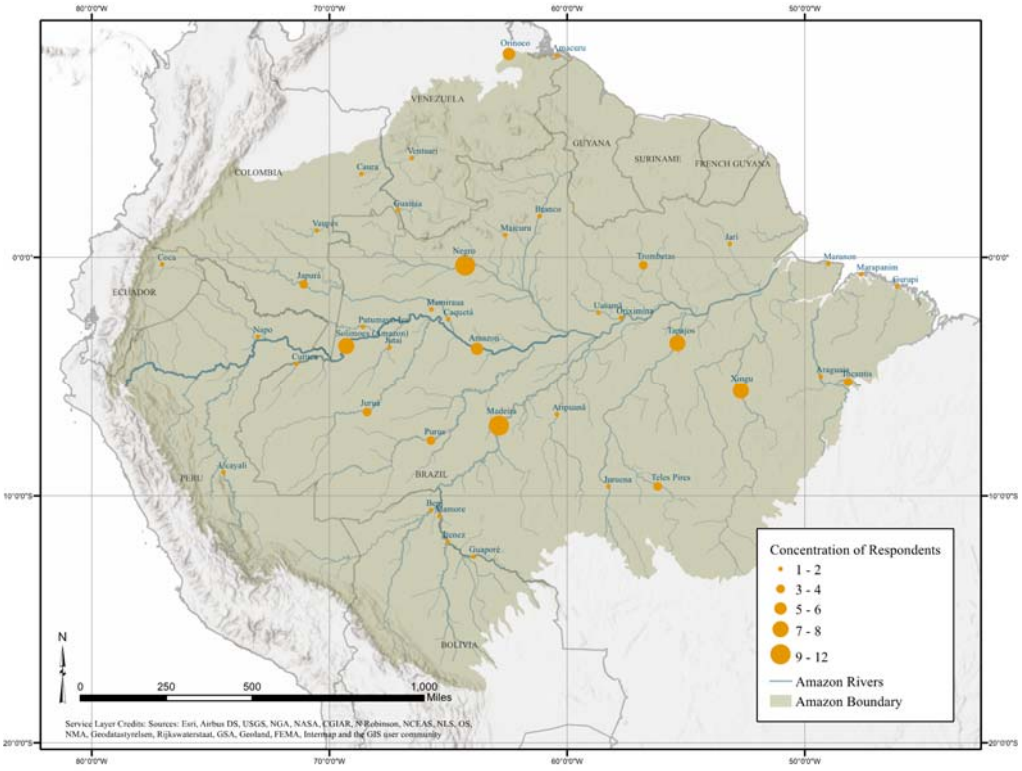
Stakeholder contributions to surveys and semi-structured interviews



Note. "Other" for surveys includes environmental consultors, employees of hydropower companies, photographers, and lawyers.

Figure 13

Geographic Distribution of Survey Respondents



Note. The rivers named here were mentioned the most in the survey as places where research or other activities of concern are taking place.

4.2. Drivers of degradation to Amazonian rivers

Several questions centered on trying to understand the drivers and degree of degradation in Amazonian rivers. Most respondents indicated that rivers are being degraded and that governments must act to find a solution. The level of riverine degradation in the place where respondents live or work was seen as moderate by most of respondents (n=60/60%). Thirty-five respondents indicated that rivers are being degraded at a fast pace (n=35/35%), while five (n=5/5%) did not agree that these ecosystems are suffering from the consequences of development and economic activities.

Respondents indicated that the activities that most affect riverine ecosystems relate to building of infrastructure in or close to river courses. Dredging, an activity that decreases water quality and alters the river floor, channel configuration and landscape, among other severe threats (Barletta *et al*., 2016; Lagasse, 1986), was the activity considered most damaging to rivers. Dredging may be associated with artisanal gold mining, since these miners dredge sediments from the riverbed and amalgamate fine gold particles with mercury (Hg), which enters the environment (Castello & Macedo, 2016). Dredging may also be associated with the construction of hydroways (Fearnside *et al.,* 2021). Following dredging, damming, with its associated reservoirs and transmission line infrastructure, was also considered a major contributor to the degradation of riverine ecosystems.

According to respondents, infrastructure is not the only activity to blame for riverine ecosystem degradation. Agriculture and ranching account for major sources of degradation, along with the associated fire and deforestation practices employed to expand regional agribusiness territory. Transportation infrastructure, such as paved roads and hydroways, for the transport of goods to market also contribute to river degradation.

Table 1

Resource Exploitation Activities that Threaten Riverine Ecosystems of the Amazon Basin (Quantitative Data)

Infrastructure Development	%	General Threats	%	Agribusiness	%
Dredging	79.39	Fire	72.02	Agriculture	66.73
Dams	78.26	Deforestation	71.14	Ranching	64.02
Paved Roads	73.42	Mining	67.03		
Hydroways	73.34	Pollution	64.00		
Reservoirs	71.10	Drug Trade	62.82		
Transmission Lines	57.58	Squatting	61.51		
Urban Development	56.78	Illegal Logging and Mining	58.76		
Unpaved Roads	56.74	Fishing	53.04		
Ports	47.40	Invasive Species	41.67		
Railroads	42.67				

Note. Survey respondents ranked (on a scale of 1–100 lowest to highest) the level of threat brought to riverine ecosystems of the Amazon Basin by infrastructure development, agribusiness, and other less formal activities.

The results differed from open-ended survey responses. Along the questionnaire open-ended questions, mining, agribusiness, and dams were the predominant narratives and identified as the biggest threats to rivers when discussing resource exploitations activities. As for the semi-structured interviews, dams were mentioned the most (Table 2). The three most mentioned exploitation activities were the same for both methods. When asked about further threats, respondents simply repeated the same hazards, demonstrating an obvious lack of policy to protect the basin.

Table 2

Resource Exploitation Activities that Threaten Riverine Ecosystems of the Amazon Basin (Qualitative Data)

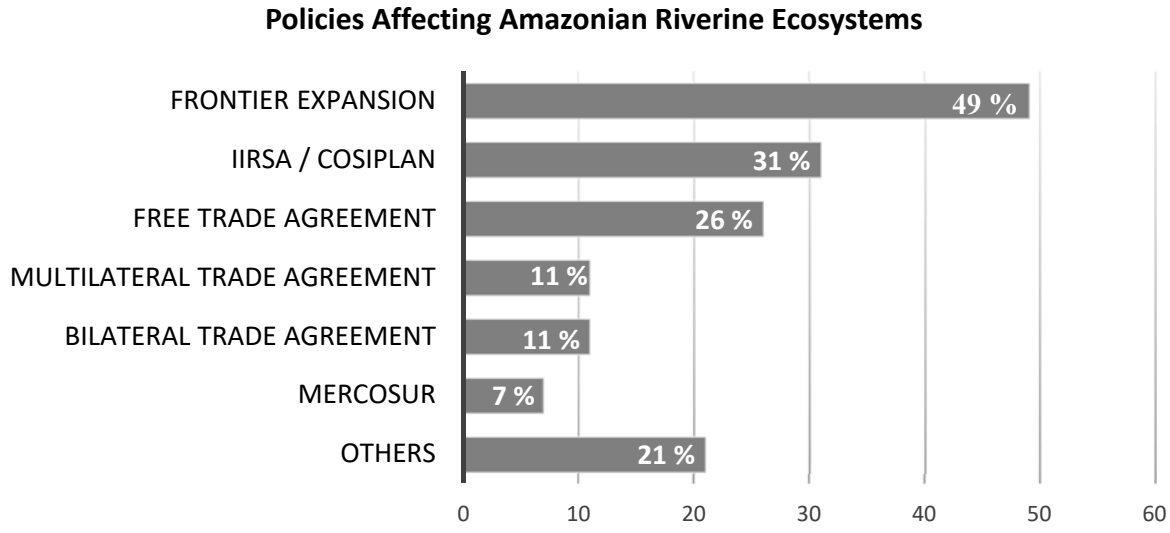
Activity	Open-ended Survey (%)	Interview (%)
Mining	29	26
Dams	18	35
Agribusiness	19	12
Others (e.g., Roads, Ports, Hydroways, Hunting, Fishing)	34	27

Note. Respondent discourses that were coded as "Resource Exploitation" by NVivo. See "Others" on Appendix D under category "Resource Exploitation".

National and regional economic development policies were also identified in the survey responses as drivers of riverine degradation (Figure 14). Expanding national frontiers into the undeveloped parts of the Amazon Basin along with the regional agreements between South American countries for infrastructure development and planning identified as COSIPLAN/IIRSA, were considered by the respondents as the main policy drivers of degradation in the Amazon Basin. Other national policies that are drivers include energy development, mining, agribusiness, gas, and oil.

Figure 14

Policies Affecting Amazonian Riverine Ecosystems (Quantitative Data)



Note. Survey respondents (n=95) indicated several national and regional economic development policies as drivers of degradation to Amazonian riverine ecosystems. Others include energy development, mining, agribusiness, gas, and oil.

4.3. Perceived impediments to implementing policy and conservation needs

Lack of scientific knowledge and data, and lack of monitoring of illegal activities in the forest (85% each) are, according to respondents, on closed-ended survey the barriers for conservation strategies. The lack of determination from governments to implement such practices to conserve these water bodies was also pointed out as a great impediment (76%) (Table 3).

Table 3

Impediments to River Conservation (Quantitative Data)

Lack of	**%**
Scientific Knowledge and Data	85.36
Monitoring	85.37
Political Will	76.26
Governance	71.83

Enforcement	71.50
Environmental Lobby	71.26
Environmental Institutions	69.90
Awareness	67.49
Funding	67.37
Cooperation Between Countries	67.20
Environmental Policies	66.22
Surveillance	62.96
Civic Engagement	60.25
Fines	53.81
Social Will	52.07
Proximity to Rivers	46.95
Other	76.50

Note. Survey respondents ranked on a scale of 1-100 with 1 being the least and 100 being the highest-level impediments conservation of Amazon riverine ecosystems.

When considering aspects of governance, dismantling and flexibility of environmental agencies and laws (31%), lack of political will (15%) and lack of enforcement of existing rules in each country's jurisdiction (15%) were highlighted in respondent's discourse as the primary limiting factors in open-ended survey questions for the effectiveness of conservation efforts. On the other hand, for the interviews, the lack of implementation and enforcement (24%) was a recurrent theme. Besides the fact that many regulations are not enforced, sometimes they are in the governments agenda but lack funds or only produce their effects when regulated by another norm that does not exist yet (for example some norms in Brazilian Constitution). Awareness and knowledge on the Amazon Basin (18%) and not sufficient existing regulation (15%) were also considered by the interviewees to be causes of why riverine conservation does not advance in the region (Table 4).

Table 4

Impediments to River Conservation (Qualitative Data)

Impediments	**Survey %**	**Interview %**
Dismantling and Flexibility	31	5
Lack of Political Will	15	8
Lack of Enforcement	15	12
Lack of Implementation and Enforcement	12	24
Lack of Awareness and Knowledge	9	18
Lack of Regulation	7	15
Environmental Agenda	4	0
Lack of Funding	4	4
Lack of Civic Engagement	2	14
Lack of International Support	1	0

Note. The most common sub-codes under "Governance". This represents, in percentage, how often each sub-code was mentioned to address the general feeling during open-end survey and semi-structure interviews towards riverine governance in the Amazon Basin.

Most of survey respondents (n=76) stressed that a balance between riverine resources and development must be established by the government. Some respondents (n=23) aim for the entire preservation of the rainforest, whereas the idea of rivers being exploited by country's government was pointed out by only one respondent. To achieve this path, while there are many barriers to conservation, respondents also indicated viable policy solutions (Table 5). According to survey respondents, Integrated River Basin Management (IRBM), which is a combination of water resource planning and management, sustainable development, and strategies (Bandaragoda & Babel 2010; Evers, 2016) has a high chance of succeeding in conserving freshwater in the Amazon (86%). The framework emphasizes the value of collaboration and partnerships, as well as community

participation, long-term sustainability, a holistic approach, and planning and monitoring to coordinate water, land, and related resources in a river basin (International River Foundation, n.d). For this research, hereafter I will use only the term Integrated Water Resources Management (IWRM) as many of the times they are used as synonyms. Meanwhile, creating regional river conservation systems (82%), such as the US Wild and Scenic Rivers Act (WSRA) (that is implemented at a national level), could also be a powerful policy tool to be used to safeguard the water bodies. This type of legislation aims to establish a balance between dam construction and river conservation by protecting rivers or stretches of rivers from dams (Perry *et al.,* 2021). Wild and Scenic Rivers (WSR) served as a policy model for other jurisdictions (e.g., Canada – Canadian Heritage River System) (*see* Perry *et al.,* 2021). Many policy options were ranked for their feasibility. Other policies exemplified by respondents would be for instance payment for ecosystem services and finance investments.

Table 5

Potential River Protection Policies (Quantitative Data)

Policy Type	**%**
Integrated River Basin Management	86.93
Regional River Conservation System	82.82
Protected Area or National Parks	80.29
Constitutional Law Protection	79.42
Transboundary Treaty	75.45
Provincial Law	73.84
Rights for Nature or Rivers	72.22
Regional Tribunal for the Environment	71.92
Anti-Dam Law	69.20

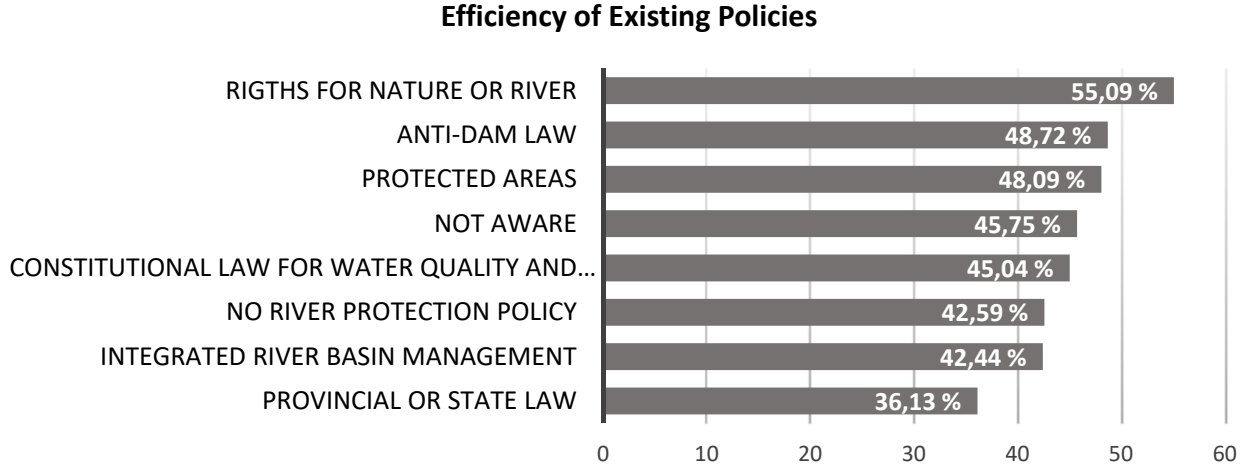
Other	96.55

Note. Closed-end ranking question to assess the level the policies must protect riverine ecosystems. Survey respondents ranked on a scale of 1-100 with 1 being the least and 100 being the highest-level potential river protection policies.

Nevertheless, the status of conservation within some of these policies are not high according to respondents. These laws exist not only in Amazon countries but are spread across the world and likely, countries from where respondents outside the Basin are referring to. Rights for Nature or River (n=82) only exists in three Amazon Basin countries (but it does exist in many other jurisdictions) (Perry *et al.,* 2021). Even though only three out of nine Amazonian states provide Rights for Nature and Rivers, respondents believe that this law is the only one that addresses a more complete range of protection, yet, not high enough (55%). While anti-dam laws (n=84) do not exist in the Basin countries' region (see Perry *et al*., 2021), PAs (n=86) do occur, and both present an average efficiency according to respondents. IRBM (n=80), Constitutional Laws (n=88), and state or provincial laws (n=76) presented a low level of protection. For less than half (n=47) respondents, they do not believe there are policies that truly safeguards rivers. A few respondents (n=20) were unaware of the efficacy of these policy(-ies) in the Amazon Basin. This demonstrates that respondents have some reservations and there are some gaps in each policy that must be overcome (Figure 15).

Figure 15

Efficiency of Existing Policies (Quantitative Data)



Note. Average from 0 to 100% of how each respondent perceive the policy in case the same exists in their country. Respondents from survey ranked according to what they believe.

A policy analysis of existing riverine protections in the Basin also demonstrated in more detail the possibilities within each countries jurisdiction (Table 6). The analyses revealed that there are no explicit protections for connectivity in any countries yet, however, since 2008, a new policy that bestows human rights to nature has emerged in the region with specific focus on rivers. Bolivia, Colombia, and Ecuador are the only Amazon countries to address nature and river Rights (give nature and river a 'personhood' status) (constituteproject.org, 2019). Ecuador was the first country in the world to establish environmental Rights explicitly in its national Constitution (Ecuador, 2008). Colombia acknowledged the Rights of the Colombian Amazon in 2018 and is working to build a set of jurisprudence across the country that recognizes the rivers personhood (Castro, 2020). Bolivia is dedicated to protecting "Pachamama," or Mother Earth. Because rivers are part of the ecosystem, governments address riverine protection under the umbrella of Rights for Nature. It is understood that this policy can be used to stop dams should a project be proposed in a designated corridor (Perry *et al*., 2021). This policy aligns with Indigenous world views that humans are not separated from nature and is rapidly expanding in territories with large Indigenous populations (Ferreira,

2013). There is an initiative to get Rights of Rivers implemented in the Marañon River, an important tributary of the Amazon (International Rivers, 2021).

Two Basin countries with large Indigenous populations also revealed a more ecocentric value. Constitutional Law analysis of the "Constitute Project" (constituteproject.org, 2019) revealed that only Bolivia deals with water as a transboundary natural resource in need of protection. This finding uncover a gap in appreciation within South America Constitutions of the transboundary nature of the Basin and the urgent need for a holistic approach. Ecuador is famed for its "ecological constitution", which ensures the Amazon's long-term sustainable development (Ferreira, 2013). The Constitutions of the other Amazon Basin countries place a utilitarian emphasis on nature and freshwater (constituteproject.org, 2019).

In some cases, the areas protected at a national level such as national park also have another layer of protection, such as Ramsar site. The Ramsar Convention on Wetlands is an intergovernmental agreement that establishes a framework for national and international action to conserve and wisely utilize wetlands and their resources. There are currently 2,433 Ramsar sites across the world with 86 of those sites located in Amazon countries, though not necessarily in the Amazon biome or with rivers running through it. Except for Guyana, Amazon countries are signatories of the Ramsar Convention. Ramsar sites are intended to foster the conservation and wise use of the world's wetlands, and therefore have the potential to safeguard rivers. The world's largest Ramsar site, for example, was established on the Negro River in Brazil in 2018.

Another world "seal" of recognition for the outstanding value of these sites' natural and cultural heritage is the World Heritage Site (WHS). WHS adds importance to a PA. The Central Amazon Conservation Complex in the Brazilian Amazon is the largest PA in the Basin, and it is home to a diverse range of wildlife. Varzea, igapó forests, and lakes ecosystems are all encpossed by the WHS. The site is located at the confluence of the Negro and Solimões Rivers, these are major tributaries of the Amazon. In addition, safeguards endangered animals such as the huge arapaima

fish, black caiman, and two kinds of river dolphin (UNESCO, n.d). In the Putumayo-Içá Basin, there is an international initiative to manage rivers using the IWRM.

Table 6

Policy Analysis

Country	Rights of Nature (Rivers)	Constitution	Other
Bolivia	Law of Mother Earth (2009)	Avoid actions that cause damages to freshwater ecosystems or diminish flow; safeguard transboundary waters (2009)	Ramsar Sites: Rio Blanco, Rio Matos, Rio Yata
Brazil			Ramsar Sites: Cabo Orange National Park, Viruá National Park, Anavilhanas National Park, Rio Negro, Mamirauá, Rio Juruá, Guaporé Biological Reserve, Amazon Estuary and Mangroves

		World Heritage Site: Central Amazon Conservation Complex
Colombia	Rights for Colombian Amazon (2018); Rio Atrato Basin 2017; Magdalena, Coello, Combeima, Cocora, La Plata Rivers (2019)	Ramsar sites: Complejo de Humedales de la Estrella Fluvial Inírida, Complejo de humedales Lagos de Tarapoto, Reserva Biológica Limoncocha World Heritage Site: Chiribiquete National Park – "The Maloca of the Jaguar"

Ecuador	Rights of Nature (2008) Vilcabamba River Constitutional Court upholds Natures Right and prohibit mining and resource exploitation activities within Los Cedros Reserve (2021)	Sustainable development of Amazon (2008)	Ramsar sites: Reserva Biológica Limoncocha, Complejo de Humedales Cuyabeno Lagartococha Yasuní, Complejo Llanganati, Sistema Lacustre Lagunas del Compadre, Sistema Lacustre Yacuri, Complejo Llanganati
Peru	Marañón River (2021 Amicus Curiae)		Ramsar sites: Complejo de humedales del Abanico del río Pastaza, Reserva Nacional Pacaya-Samiria World Heritage Site: Manú National Park, Historic Sanctuary of Machu Picchu

Venezuela	World Heritage Site: Canaima National Park
Basin-Wide or Subbasin	IWRM: Putumayo-Içá Basin (Brazil, Colombia, Ecuador, Peru)

Note. Only Bolivia, Colombia, and Ecuador address Human Rights for Nature or River; there is a lack of Constitutional protection for freshwater in the region and French Guiana, Guyana, Peru, Suriname, and Venezuela do not present any high-level legal instrument to protect riverine ecosystems.

Constitutional laws, survey and interviews narratives were subject of discourse analyses (Appendix E). Such analyses might be regarded as the study of "speech" and texts, according to Wetherell *et al.* (2001). It is a set of tools and theories aimed at examining everyday language use. Such process began with the decision of unit record (the texts), context and refer to the frequency with each word or sentence related to each theme on NVivo and how often appeared in the transcribed texts. The narratives were evaluated according to the theoretical framework and the specific questions of the present research. The table in the Appendix present a few of the comments collected for the research. A color-coding theme created to be used as the “environmental values” for each comment revealed that all the three used categories for environmental values emerged (anthropocentric, ecocentric and technocentric values). In a broadly definition, values are goals, that may vary in importance, and serve as guiding principles in people’s lives (Schwartz, 1992).

The anthropocentric value was more evident in the discourses and brings to light the perception of the value of nature because of the material importance it provides for humans. Although many of these respondents also stressed the need for sustainability and sustainable

economic development, the convictions and objectives professed by them are a tenuous line between anthropocentric perspective and ecocentrism. Nonetheless, ecocentric worldviews value nature by its intrinsic characteristics (Thompson & Barton, 1994). Ecocentric values are starting to spread across the Basin. This can be noticed on the Andean Constitutions and some subtle discourses of respondents. Technocentric perspectives, on the other hand, are also like anthropocentrism in a way that man holds scientific knowledge about nature, and humans can dictate environmental processes through technological means, under the premise that science's goal is to conquer and dominate nature's forces (Barbosa-Fohrmann *et al.,* 2016). Although very important to establish the trade-offs for conservation needs in the Amazon, respondents did not hint technology as much during the discourses displayed in the table.

Only 14% of the survey respondents were familiar with ACTO. Thirty-two percent (33%) considered themselves somewhat familiar, while the majority (53%) had never heard about the organization. Even though most respondents were not aware of ACTO existence, for those who assessed the possibility of ACTO being revised to incorporate a conservation system for the Amazon, a large number (55%) regarded it as a good possibility, 12% did not know how to evaluate such opportunity, and 7% did not believe in the amendment of the organization to protect rivers.

The same can be said for COSIPLAN/IIRSA, for which 60% of respondents were unaware of the regional integration system, 30% were only vaguely aware of it, and only 10% had heard of it. For those who consider that COSIPLAN/IIRSA may be amended to incorporate riverine protections (57%), justifications are based on the fact that there are infrastructure projects and alternatives more suitable for the Amazon context. The regional integration also needs to be updated to the new political and social directions in the region. For those who did not stress that it might be updated, justifications are that COSIPLAN/IIRSA has directives to meet development objectives for regional and global economic interests. Thus, river conservation and protection have not been considered in COSIPLAN/IIRSA plans (10%). The majority (33%) did not have an opinion on the matter.

Nearly all (98%) of respondents of the online questionnaire agreed that is important to implement conservation strategies focused on riverine ecosystems. However, not even half (47%) consider that Amazon countries would be willing to participate in a basin-wide conservation system focused on rivers. Of the remaining respondents, 17% did not stress it was possible at all and 36% were unsure. For both survey respondents and interviews, the need for a conservation system was attributed to the need to protect the provisioning of ecosystem services (56%/35%), to increase human well-being (35%/30%), and to preserve the Andes-Amazon connectivity (9%/35%).

From their headwaters to their deltas or confluences with other rivers, Amazonian rivers have very different traits ecologically and in terms of ecosystem services thus this determines how they are managed. The headwaters are critical for the protection of water quantity and quality, (unique/specialized) endemic species restricted to headwaters, while downstream reaches are critical for biodiversity and regulatory and landscapes functions, among other things (Harrison *et al.,* 2016). As a result, while upstream is critical for river structure and consistency, most direct-use resources are downstream. Most people understand that to protect both the upstream and downstream reaches of a river, it must be considered holistically. This is in keeping with the reality of biodiversity protection.

5. Discussion

The Amazon Basin exemplifies how, despite a recognition that for sustainable use of water economic, social, and ecological needs must be addressed, economic development grounded in a growth agenda continues to supersede the other two equally as important aspects of integrated water resource management. Perhaps unlike any other place on earth, the Amazon is one region that demands collaboration across scales and sustainable decision-making and management to ensure that it can continue to provide vital ecosystem functions before it is too late. As a local and global regulator of climate, major purveyor of freshwater, and home to a diverse array of species, protecting connectivity in its rivers will at once mitigate the climate, freshwater, and biodiversity

crises. To understand what the limitations and possibilities of the coordinated protections across scales suggested by Cid *et al.* (2021) might be (see Figure 3) to protect river connectivity, I first needed to understand what socio-economic factors are degrading the integrity of riverine ecosystems in the Amazon Basin. With that information, I asked, what lessons can be learned from environmental governance in the Amazon to inform the creation of a basin-wide conservation system. In large scale perspective, the limitations, and possibilities that each country face is different; However, they also share many commonalities.

In summary, bodies of literature of freshwater protections, Amazonian regional integration, political ecology of water resources development, and IWRM brought the perception of how some selected sectors of society benefits from water resources developments and how they benefit from the lack of environmental protections and political will at the expenses of other groups (e.g., constructure companies such as Odebrecht profit during dam building without complying with EIA and incur detrimental costs to Indigenous people and local communities in addition to the environment). Thus, policies that degrade the environment give power to a few groups of people. The governments and private sectors have a utilitarian ethic towards the environment in which they acknowledge its existence just to benefit humans. The neocolonial pursuits drive frontier expansion and frontier accumulation across the Basin in a route for resource exploitation in search of wealth and power, reducing the integrity of the Amazonian riverine ecosystems and affecting the Amazonian communities.

My findings provide support for the contention that, in general, the degradation of Amazonian rivers are inexorably linked to national and regional economic development agendas, which also operate as indirect drivers of degradation (see also Pelicice *et al*., 2017). For instance, commodity production are the main reason for the conversion of rainforests to huge fields for agribusiness and other activities (Curtis *et al.,* 2018), which in turn affect the water bodies. Specifically, a complex combination of activities (e.g., agribusiness, hydropower dams, and mining), mostly pushed by the abovementioned policies (e.g., national agendas and free trade, frontier

expansion and regional integration under the umbrella of neocolonialism) are the driving factors leading to Amazon riverine degradation. National motivations of development and growth are this way facilitated by regional economic and infrastructure implementation schemes.

The necessity for the Basin countries to coordinate regionally and adopt a single strategy may be one that takes opportunity to "pull the pieces" from other policies to lay down a roadmap and implement the Basin-wide conservation system, as evident in respondents' discourse, literature, and global guidelines. There are already conservation mechanisms implemented across the Basin. Rivers need explicit protections for their connectivity and ecosystem service integrity. It is possible to build on existing protections in the Amazon and elsewhere to incorporate more riverine safeguards. Focusing on an integrated, coordinated strategy for conservation across scales is necessary for applying and enforcing protections. The literature shows that as much as IWRM sets out the framework for water resources management, it often lack attention to the environment. While it does not take into consideration the ecological components and the intrinsic value of nature, towards a more technocentric or ecocentric perspective, there is hope to fulfill the ecological conservation needs.

IWRM and Regional River Conservation Systems then are one of the viable options that the Basin countries may adopt in this route to protect its remaining FFRs and unique biodiversity repository. I here support the findings of this research also with respondent's quotes (IV, for interviewee and SR for surveyed participants) as they also relate to literature. A discourse analysis grounded on the themes created from the surveys and interviews (see *method* and *results* section) was compared with the literature.

Even though the results are for the entire Amazon Basin countries, Brazilian participants accounted for more responses in the questionnaire and interviews. Otherwise, Brazil represents 60% of the Amazon, more publications or research are done in Brazil; and hence one could argue for some bias in the study. Despite the likely bias, I consider the results and analyses representative.

5.1. Frontier expansion and regional integration: drivers of river degradation

The activities taking place at the national scale are related to the regional agenda of frontier expansion and regional integration. These are also areas of "frontier accumulation" (Borges, 2019), in which one activity relies on the other and leads to a cascading degradation on riverine ecosystems. A frontier is translated, among many features, by its resource's extraction and economic production (Ioris, 2021). These activities are also fueled by each country's discourse on how to develop the nation. Frontier expansion has been taking place in the Amazon for at least 500 years. The role of interiorizing or occupying and conquering the frontier to bring development to the nation, led to the creation of multiple settlements inside the forest. Brazil, more than any other Amazon Basin country, encouraged the expansion beyond its frontier. Ecuador followed a similar colonial and frontier growth trajectory, aided by fiscal governmental incentives and land availability (Viteri-Salazar & Toledo, 2020). For these areas to be viable, the government also promotes roads and river channelization to give colonizers access to newly opened lands. These infrastructural advancements contribute to increased deforestation and the degradation of riverine ecosystems. In addition, environmental disturbances are strongly connected to distance to paved and unpaved roads, followed by distance to navigable rivers (Browder *et al.*, 2008; Barber *et al*., 2014; Bax *et al.*, 2016; Sauer, 2018; Zalles *et al.*, 2021).

Deforestation is the catalyzer for many other resource exploitation activities. The activity, in combination with fire is widely used to clear the land (Benatti, 2003; Hetch, 2011; Sauer, 2018). Thus, there are areas of similarity in the categories of the present research, e.g., deforestation, fires and agribusiness, or deforestation and illegal logging. The former is a product of the latter – in other words, one can expect that the high values in the results for these categories to be correlated with each other. Deforestation results in the loss species, and of many ecosystem services and changes in the hydrological cycle, which are crucial for the Basin and South America. Land use change affects the hydrological patterns, resulting in lower rainfall, evapotranspiration, and precipitation, as well as a longer dry season, implying a shift to savanna vegetation to the east of the Basin (Lovejoy & Nobre,

2018; Sampaio *et al.*, 2019; Rizzo, 2020). Between 1985 and 2020, the conversion of the forest for agribusiness resulted in a 57% drop in the water surface in the state of Mato Grosso do Sul, Brazil, which is in the forefront of agriculture frontier (MapBiomas, 2021). Land use change raises local temperatures and frequently affects the headwaters of rivers and springs, which can contribute to river and lake siltation (MapBiomas, 2021). If current deforestation patterns continue, savanna may spread across the region, as well as imply shifts in the flying river phenomenon in the continent (less rainfall).

To tackle the levels of deforestation across the globe and help the countries to meet global environmental guidelines and maintain the ecosystem services, the Glasgow Leaders Declaration on Forest and Land Use was signed by 133 countries (COP 26, 2021). The agreement promises to end all deforestation, including illegal ones, by 2030 (COP 26, 2021). Of the Amazon countries, Bolivia, French Guyana, and Venezuela are not part of the agreement yet (COP 26, 2021). However, it is very significant that Brazil signed it in face of the high levels of deforestation in the Brazilian Amazon in the last years (Cruz *et al.,* 2021; Oliveira *et al.,* 2021). The commitment of Brazil to end deforestation under the presidency of Jair Bolsonaro contradicts how his government deal with the environmental governance in the last years. The Glasgow Declaration also brings a strong international trade "tool". Not only the exporting countries need to reduce deforestation, but also the buyers need to inspect their chains. This is very relevant when discussing the Amazon context. For instance, not only Brazil or other Amazon country need to address deforestation in the rainforest but also China, United States, and the European Union as greatest importers.

Rivers in the Amazon have always served as transportation routes. Today, extensive engineering is expanding the rivers to facilitate the movement of large container ships to transport goods on the market. The implementation of river channelization that comes along with frontier expansion drives major detrimental consequences in riverine ecosystems (Fearnside *et al*., 2021). These projects typically results in morphological changes in rivers, drop in freshwater species and water quality (Dutta *et al.,* 2018). Peru has ambitions to build the "Hidrovía Amazonica" to assist the

development of the Peruvian Amazon by facilitating river transportation, shipping, and reducing costs (Cohidro, n.da). The project developed by the State of Peru, in partnership with a Chinese company, Synohidro Corporation, aims to connect the Amazon, Huallaga, Marañón, and Ucayali rivers by dredging and building dams, canals, dikes, and levees. Thus, transportation by water will be integrated between Peru, Ecuador, Colombia, and Brazil (Cohidro, n.d). China is funding many of these infrastructures in the Amazon since it is partner in several free trade agreements and aim to cut transportation costs.

Amazonian countries also encourage the construction of roads to promote transportation hubs for commodities exports while lowering costs. Roads, especially in the Amazon, may act as dams and impact seasonal streams causing ponding along the road and preventing the flow of aquatic species (Fearnside *et al.,* 2021). In addition to the environmental impacts, if a highway building is not well-coordinated, it will result in massive population growth that the public sphere will be unable to accommodate; and likely will lead to deforestation (Moran, 2016). Precarity in health system, lack of sanitation, food availability, education, and increase in violence are just a few of the social negative consequences (Moran, 2016). Infrastructures are important for a variety of reasons, not the least of which is to transport goods. Transportation as means of basic living condition is also crucial for communities to succeed (Nepstad *et al.,* 2002; Tritsch & Le Tourneau, 2016). Increased traffic flow following the construction of roadways in the Amazon translates how people use roads (Perz & Rojas, 2020). However, unplanned highways cause disruption to the Amazon as they penetrate to its undeveloped frontiers, contributing to runoff into the watershed, increasing habitat loss, fragmentation, and aiding induced fires and exotic species invasion (Laurance *et al.,* 2014; Perz & Rojas, 2020).

As pointed out by one of the interviewers, the public's perception of development varies, "*for the settlers, the sense of progress is the forest on the ground. What they dream of is a giant pasture full of cattle, in the settler's mind, the field is cleared and filled with animals. Wealth, for them, is cattle*" (IV I). Nonetheless, all the agribusiness, exploitation activities and infrastructures at

the frontier are in fact perpetrating the displacement of Indigenous peoples, local community and destruction of ecosystems and the biodiversity and services they support (Ferrante *et al.,* 2020a; 2021; Ferrante & Fearnside, 2020; Velasquez *et al*., 2010). This also represents the standpoint of the majority of participants in the study, as they see that "*PAs and ecological corridors are not respected at all, on the contrary, there is no work with producers, farmers, to demonstrate the importance of these areas, the function of these areas which are protected by law for the waters of the Amazon and at the same time has no punishment, if someone deforest it, go unpunished*" (IV II).

In the last decades (1970-2021) the frontier expansion agenda has intensified, especially in Brazil (Browder *et al.,* 2008; Ferreira & Salati, 2005). The Amazon region has historically served as a locale for the rubber, rice, cassava, coffee, banana, and other agricultural activities. As populations grow and industrial farms seek to expand operations due to rising commodity prices in international markets, soybeans and cattle ranching expands into the frontier areas of Bolivia, Brazil, Colombia, Ecuador, Peru, and Venezuela (Tritsch & Le Tourneau, 2016; Veiga *et al*., 2002). Some countries such as Brazil have policies that aim to break the advance of monoculture and deforestation in its frontier by implementing the Legal Reserves (Law 12.651/2012). Legal reserves tries to ensure that private properties need to maintain 80% of the native forest in the Brazilian Amazon. The law has sparked fierce discussions among farmers, who want the freedom to utilize their land as they see fit, regardless of environmental implications (Metzger, 2001). By conserving these areas, farmers are also helping to maintain water quantity and quality. However, slash-and-burn sites are peaking. There has been significant forest fragmentation because of commodity price scenarios, political discourse, and dismantling of the national environmental agenda (Pelicice & Castello, 2021; Verburg *et al*., 2014). Erosion, agrochemicals, and water quality degradation flow over the basin because of frontier pressure (Metzger et al., 2019).

Presently, there seems to be a lack of concern for the rivers in the agricultural sector. However, one interview participant stated that "*the agricultural sector will embrace the cause when exports get embargoed due to environmental issues and when water is lacking to irrigate crops. It is*

not only a lack of rain or prolonged drought, but these issues also change the hydrological regime of the rivers and with less water running, the decreases in flow, is when conflict [between local community, agribusiness and industrial sector] starts" (IV I). A backlash in international trade is already a reality to prove how trade law might address forest and river disturbances. Due to environmental deregulation and deforestation in Brazilian Amazon, the European Parliament's blocked on the ratification of a trade agreement between the EU - MERCOSUR (Chade, 2021).

These increased pursuits can be attributed to COSIPLAN/IIRSA. Launched in 2000, IIRSA was designed to integrate the communication, transportation, and energy infrastructure of South American countries. IIRSA was incorporated into COSIPLAN in 2008 likely in search of greater institutional support. The regional integration project aims to unite the Atlantic and the Pacific Ocean taking advantage of its river systems (Charity *et al.,* 2016; Prudente, 2013). While the effort of neoliberal origins, COSIPLAN/IIRSA, aims to enhance Pan-Amazonia integration through infrastructure projects, it fragments forest habitats, destroys river ecosystems, and allows colonization of the land by occupying ITs and PAs. The development of gray infrastructure is a priority over the proper conservation and management of green infrastructure. PAs, for instance are downgraded (decrease in legal restriction), downsized (decrease in size of a PA) or degazetted (loss of legal protection for an entire PA) (Golden Kroner *et al.,* 2019; Thieme *et al.*, 2020) to remove this protection that are barriers to development (in terms of dam development), particularly in Brazil. Most of the participants also agree that "*there is a very clearly articulated strategy to develop the Amazon Basin, which is IIRSA, but no comparable strategy to conserve the globally significant biodiversity of the Basin or ensure that this biome is capable of continue to provision ecosystem services to its residents and the world"* (SR I). Thus, "*IIRSA's vision is oriented towards infrastructure development and monitoring. Incorporating the protection of Amazonian rivers may contradict this vision"* (SR II).

The largest development bank in America, Banco Nacional de Desenvolvimento Econômico e Social (BNDES), is primarily supporting COSIPLAN/IIRSA programs. BNDES plays a vital role in

financing COSIPLAN/IIRSA projects, many of which cause socio-environmental harm because they lack adequate protections for the environment (Branford, 2016). China adds up to the spotlight of these investments by playing a major role supporting these plans and taking the place of the usual multilateral agreements (e.g., Gerlak *et al*., 2020). Many cases of financial support and social environmental degradation can be related to these actors – BNDES, IIRSA and China. Allegations of environmental degradation and Indigenous rights violations by a Chinese-backed oil business in the Bolivian Amazon brought attention to the consequences of Chinese finance in the region (Praeli, 2018). The history replicates in other countries across the Basin, especially when it comes to hydropower construction (*see* Gerlak *et al*., 2020).

The degradation of the Amazon rivers then can be seen as a translation of natural resource exploitation, in which natural assets are exported through free trade or other market agreement to overseas countries, targeting economic growth. Whilst other South America regional agreements such as MERCOSUR focused on increase of trade and growth, they lack means of transportation and energy generation and distribution (Souza, 2015). COSIPLAN/IIRSA came to fill the gap and facilitate the flow of goods, which also adds to the rapid deterioration of the Basin. COSIPLAN/IIRSA is in its route to facilitate the Amazon tipping point (Nobre *et al.*, 2016; Walker *et al.*, 2019). The Interoceanic highway implemented in 2010 increased deforestation and fires in surrounding areas of the road in Peru and Brazil (Crezee, 2017). This can be viewed as a significant contributor to savannization, which will have negative consequences on the hydrological cycle.

I do recognize the improvement that infrastructures in place may bring for local populations. However, smart designs could decrease the negative effects of such projects (Kileen, 2017). Vilela *et al*. (2020) evaluated the social and environmental costs of roads in Brazil, Colombia, Peru, Ecuador, Bolivia, and elsewhere, and noticed that some highways are not beneficial once they incur large environmental costs and provide minimal socioeconomic advantages. According to their estimates, only 12% of the proposed roads for the Amazon would deliver most of the potential economic benefits for the forest (77%), which they refer to as "smart roads" (Vilela *et al*., 2020).

Arguably the backbone of COSIPLAN/IIRSA and the countries' national agenda, along with transportation foundations, is the interconnected energy grid that aims to power industries across the region (Kileen, 2017). To expand energy generation, governments in the Amazon encourage the construction of hundreds of dams and transmission lines across the Basin (Anderson *et al.,* 2018; Castello & Macedo, 2016; Forsberg *et al.,* 2017; Golden Kroner *et al.*, 2019; Latrubesse *et al.*, 2017). This is especially critical in Brazil, where the hydropower boom is directly linked to policy manipulation (Millikan, 2014; Walker & Simmons, 2018). Bribery, illegal election campaign financing, engineering schemes, and erroneous environmental licensing are only a few of the pieces of the puzzle (Ioris, 2020b). The Lava Jato ("Car Wash") case around hydroelectric plants and corruption interfered in Peruvian political sphere, when Brazilian corporations (e.g., Odebrecht) bribed Peruvian government officials in exchange for the concession and construction of four dams in the Marañón river (Israel & Herrera, 2020).

The hydropower expansion is critical. Despite evidence to the contrary (Latrubesse *et al.*, 2017) a large portion of the population still believes that water is the natural resource that provides energy at better cost-benefits, under the "green-energy" discourse (Atkins, 2020; Atkins & Hope, 2021). This green energy discourse includes the greenwashing of hydropower as a clean, renewable source of energy (Brandford & Torres, 2017; International Rivers, n.d). However, studies show that in addition to the loss of connectivity, and the associated detriments to river ecosystems, reservoirs produce greenhouse gas emissions (Gunkel, 2009; Mayer *et al*., 2021), increase terrestrial habitat fragmentation and directly suppress vegetation and directly impact biodiversity. Moreover, studies indicate the unnecessary need for dams in the Basin. The rejection of dam construction can be justified by the likely transition to a sustainable energy matrix comprised of solar and wind energy sources (Chaudhari *et al*., 2021; Faria & Jaramillo, 2017; Latrubesse *et al*., 2017; Fearnside, 2020; Prado *et al.,* 2016). Brazil and Peru are examples of countries with great geothermal, solar, and wind potential (Latrubesse *et al*., 2017). Thus, the justification to promote economic development in a more sustainable fashion by using dams may be a false pretense to exploit water resources. In the

case of Peru, the planned dams would only generate an energy surplus (Sarmiento, n.d). In the instance of the Belo Monte dam, in the Xingu River, a study suggests that most of the local community first believed in the project's necessity until they noticed the ramifications and its negative consequences (Mayer *et al.,* 2021). While developing countries push for hydroelectricity, wealthy countries now face dam removals, having learned from the effects of dammed rivers on the environment (Moran *et al.,* 2018).

Many of the existing proposed dams in Brazil were part of a military-era project that was abandoned decades ago (Moran, 2016). As highlighted by a participant in this study, "*in 1983, the government began to discuss a project called Kararaô. In 1984, the Minister Andreazza traveled to Altamira with Eletronorte's president, and an Indian lady from the Xingu brandished her machete in the face of Eletronorte's president and said: if you come and install the dam here, I will cut your head off. The project was shelved. You can have an idea of what happened. This project was renamed Belo Monte and is still active today. The same project in the same location. It is even worse because the design was different at that time but building the dam in Xingu River was always a dream... and the dream turned into a nightmare. It is a bad nightmare, it cost a fortune, and it does not work*" (IV III). If there is an absence of regulation to end these projects, there is always a possibility of these rivers stop flowing since it can always be executed.

According to another participant and following the news and scholars, it is suggested that "*the rivers in the Amazon have been looked at like an economic resource before ecological one. For a long time, we have only seen the growing interest in the construction of dams, the use of this hydraulic force for the construction of dams and the generation of energy*" (IV IV). This reflects why there are so many planned dams in the region, despite the awareness of the river's role in fisheries and other ecosystem services. Although rivers are often not appreciated as a component of biodiversity, the value of global freshwater ecosystem services has been estimated at $4 trillion per year, with the estuary mouths of rivers and floodplains accounting for most of it (Costanza *et al.,* 2014; Darwall *et al.,* 2018). As the Amazon Basin stands out on the world stage for freshwater

ecosystem services, the value of its rivers are certainly outstanding and the utilitarian view and use of them must be overcome.

All these energy-generating dams will have an influence on rivers' free-flowing courses, which are necessary for aquatic species to thrive (Vasconcelos *et al.,* 2021). Dams truncate FFRs, affecting species movement and resulting in fish losses and food insecurity (e.g., Gravena *et al.,* 2014; Santos *et al*., 2018; 2020). In the Madeira River, its headwaters are in the Bolivian Andes, and then the river flows into Brazil (Goulding *et al.,* 2003). With over 1000 fish species identified to date, this is a biodiversity-rich location that plays a critical role in the region's fisheries (Doria *et al*., 2012; Santos *et al.,* 2020). According to Santos *et al.* (2020) the Santo Antônio and Jirau Dams, built by the Brazilian government and associated with IIRSA projects, diminished fish production by 39% (Fearnside, 2014; Santos *et al.,* 2020). This means that yearly, fish quantity (production) (e.g., weight or number) has fallen, reflecting what has occurred in the environment because of hydropower dam impacts, both directly on fish populations and indirectly on the surrounding ecology, habitats, and fluviometry. This decline, however, is not limited to output; as a result, the economics of local communities has declined by about 40%, as has the most important source of protein for the people (Santos *et al.,* 2018, 2020). River dolphins, an endemic species to the Amazon, were trapped by the dams (Gravena *et al.,* 2014) and migratory fishes are no longer being observed in the Bolivia segment (Van Damme *et al.,* 2019).

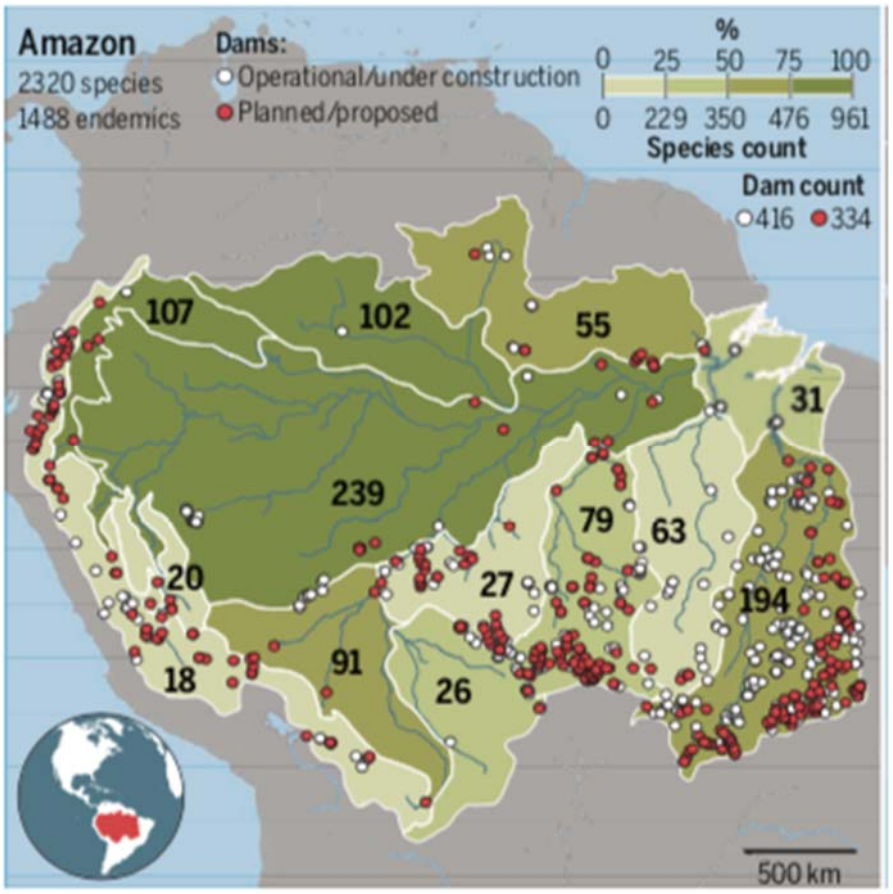
An interviewer also noticed the effects of dams in this river (Madeira): "*in Bolivia we only have hydroelectric plants in the upper part. In the other regions the dams are smaller. In the Madeira River, the dams cut off the migratory flow, and affect the dynamic of the river. These hydroelectric plants are not ours, they are Brazilian, the Jirau and Santo Antônio dams. It has monitoring that shows that there are reductions, mainly of "dourada" [Brachyplatystoma rousseauxii], which is the largest migration, migration of more than a thousand km at the headwaters and created a significant reduction of it, and also of other species*" (IV V). The dourada no longer swim upstream. It is likely that soon this fish will become extinct in Bolivia (Van Damme *et al.*, 2019), "*although this fish*

was not important for fishing practices in that region, it is a fish that is lost and end up in local extinction. In Peru, in the Amazon region, even in Brazil, this is a very important fish economically" (IV VI). Due to the transboundary nature of the Basin, the debate between Brazil and Bolivia over the dams in the Madeira River illustrates the critical necessity for basin-wide dialogue.

Around 100 dams of all sizes operate in the Amazon, and hundreds of different sizes dams are planned dams to be built in the future (see Anderson *et al*., 2018; Couto, 2021; Fearnside *et al* 2021; Latrubesse *et al*., 2017; Winemiller *et al.,* 2016) (Figure 16). In the Andean headwaters alone, there are 142 existing dams or dams under construction and 160 proposed hydropower facilities (Anderson *et al*., 2018). The threats caused by dams are identified in the countries that concentrate them: Bolivia, Brazil, Ecuador, and Peru (Mello Théry, 2019). Some worrying consequences are already predicted by many sources, whereas further evaluations of dam effects are needed (Anderson *et al.*, 2018; Latrubesse *et al*., 2017; Vasconcelos *et al*., 2021). Forsberg *et al*. (2017) for instance outlined that if only six out of the hundred hydroelectric plants proposed for the Andean region of the Amazon are built, it would interrupt the hydrological cycle and reduce by an average of 60% the amount of phosphorus and other nutrients in the Basin. Consequently, less nutrients would reach the lowlands and areas such as "várzeas" (floodplains). A participant explained that "*the costs of the projects in the Andes are more harmful than in the rest of the Basin as they have more disturbances potential. They are the headwaters; they are very sensitive areas where the sediment and flow originates. There are many impacts in the rest of the Basin as well, however, when downstream, the impacts are more related to the social and local biodiversity*" (IV VI). Similar studies by Latrubesse *et al*. (2017) and Anderson *et al.* (2018) assessed consequences of dam projects in the Basin and projections are that if more hydropower plants are built, it will result in the loss of river connectivity and cascading effects in the entire Amazonian ecosystem. Geomorphological, other hydrological, and climate alterations will add to current levels of disturbances.

Figure 16

Fish Diversity, Current and Future Small Hydropower Plants Planed for the Amazon Basin



Note. Winemiller, K. O., McIntyre, P. B., Castello, L., Fluet-Chouinard, E., Giarrizzo, T., Nam, S., Baird, I. G., Darwall, W., Lujan, N. K., Harrison, I., Stiassny, M. L. J., Silvano, R. A. M., Fitzgerald, D. B., Pelicice, F. M., Agostinho, A. A., Gomes, L. C., Albert, J. S., Baran, E., Petrere, M., … Sáenz, L. (2016). Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong. Science, 351(6269), 128–129. https://doi.org/10.1126/science.aac7082

The negative social impacts of dams have also been thoroughly established in published research and press reports (e.g., Athayde *et al*., 2014; Fearnside, 2020; Salisbury, 2016). Respondents also perceive the negative consequences of such projects, as for them, "*these projects cause large population displacements, and greater water demand for human consumption, food production, etc. There is a need to predict such impacts and ways to mitigate them*" (SR III).

Energy transmission lines from dams lead to detrimental consequences on forest connectivity and terrestrial species (e.g., deforestation, pollution, barrier, and edge effect) (Laurance *et al.*, 2009). Transmission line impacts are often overlooked, yet the region has roughly 40,000 km of transmission and distribution lines, 5.1% of which is within PAs and 10.3% of which overlaps with standing forest. As more dams are planned, these numbers are likely to rise by 2026 (Hyde *et al*., 2018). With an increase in the number of dams, problems linked with reservoirs, such as malaria and climate change, are also anticipated to worsen.

An interviewer shared the reality of energy distribution: "*look how absurd it was when I was in the Amazon doing research on the Santo Antônio hydropower project in Humaitá, 50 kilometers away from the hydroelectric facility. I was already upset with the situation there, as everyone was complaining that there was no fish, food, no agriculture, and then at my hotel the lights went out every day. Then I asked to my friend, "I don't understand, the electricity goes out here at the same time every day, yet the dam is only a year old." He stated that the electricity produced in Santo Antônio is directly transmitted to São Paulo as well as Rio de Janeiro. In other words, they are causing social and economic harm in the Amazon, and they (hydropower company and government) are unconcerned about Indigenous people or the environment"* (IV VII). The hydroelectric agenda creates room for companies to build while simultaneously downsizing PAs to accommodate dams and transmission lines (Gerlak *et al*., 2020; Golden Kroner *et al.,* 2019; Walker *et al.,* 2019), leading sometimes to an environmental injustice.

Studies to assess favorable sites for dams might be an alternative to mitigate ongoing impacts and protecting the unique biodiversity that usually live in those high potential areas offered by rapids and waterfalls (Vasconcelos *et al*., 2021; Winemiller *et al*., 2016). Vörösmarty *et al.* (2021) provided an examination of options to address water security issues by combining natural and engineering solutions in which they showed that future global water security may be accomplished by implementing policies that encourage a mix of green and gray approaches, as well as a strategic commitment to protect natural capital (Jain, 2021; Vörösmarty *et al*., 2021). In addition, it is

important to identify how to make existing dams more efficient rather than building new ones. Otherwise, the Amazon Basin will reach a point where, in the absence of a Basin-level plan, the ecosystem will begin to fail, resulting in major losses of resources and services. All of this is contingent on governments and institutions willingness to keep some corridors open. To build a conservation system, all these aspects need to be taken into consideration. An interviewer mentioned that *"… the central part of the Basin is very flat, and the river is very wide, it will hardly have significant changes. These rivers will probably always be open because they [governments and companies] have no interest and don't have the physical conditions to build and make major changes there*" (IV III). However, this is a major issue because, no matter how hard it will be to dam these wider rivers, to have a river conservation strategy, you must have a long-term and solid agreement that permits you to keep these corridors open from the headwaters to the estuary.

Some interviewees hinted that all rivers must be protected. Ideally the goal would be to have all rivers free-flowing as part of the strategy. But in practice that is not a viable solution. Humans also use and interact with water resources. That is why global guidelines, for instance the IUCN resolution WCC-2020-Res-129-EN, is calling for the protection of 80% of the Amazon instead of 100%. Thus, instead, the river conservation strategy must focus on where the most important areas are that can be kept free flowing – and to minimize the impact of fragmentation elsewhere, by choice of dam location and dam design, for instance. The reality of the conservation strategy will need to optimize tradeoffs.

In theory, there are environmental safeguards incorporated into the COSIPLAN/IIRSA agreement. For example, in the statute of COSIPLAN (2013) the signatory countries stated that is their specific objective to build infrastructural networks for physical integration, considering sustainable social and economic development standards, and conserving the environment and its ecosystem (COSIPLAN, Article 4, 2013). Yet, COSIPLAN/IIRSA infrastructures are built perpetuating socio-environmental degradation and sometimes no economic return (e.g., Kanai, 2016; Pieck, 2015; Walker *et al.,* 2019). These are projects that do not even respect the minimum standards of the ILO

Convention 169, nor the standard expectations of environmental accountability typical of most EIAs (e.g., Ferrante & Fearnside, 2020; Sousa Junior & Reid, 2010; Walker & Simmons, 2018). A survey participant noted, "*river conservation and protection have not been considered in IIRSA plans, but it should be an underlying mandate and consideration of all their development projects. Until there is a governing/regulatory authority for IIRSA/COSIPLAN to enforce/uphold environmental policy considerations, and until there are incentives for conservation initiatives which can compete for incentives for development it will be hard to make changes in IIRSA/COSIPLAN*" (SR IV).

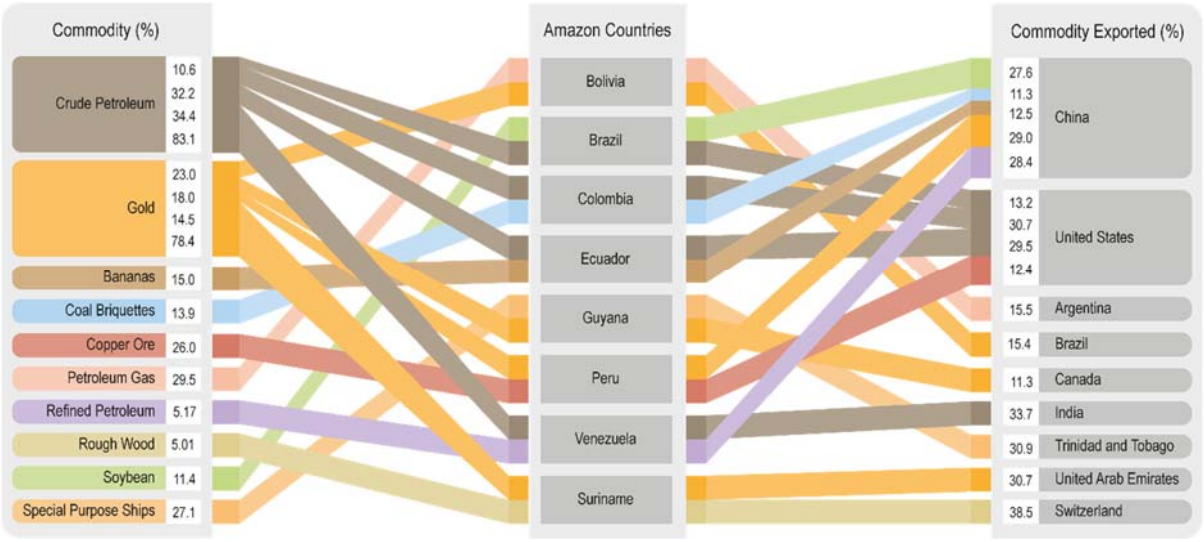
Once the roads and energy infrastructure are in place, mining operations can expand. Mining, like any other activity, is beneficial to society if done responsibly. However, the Amazon Basin is deeply threatened by all sorts of mining practices (e.g., underground, surface) done both legally and illegally. Miners are searching for bauxite (aluminum ore), diamonds, gold, sand, among other minerals. While the region has a long history of mining, increasing gold prices in 2000 sparked a boom in the industry, leading to a new mining era (Asner *et al.*, 2013; Castello & Macedo, 2016). Mining in Venezuela has a (non) management policy that allows "mafias" to exploit minerals in the region under extreme circumstances. The situation got worse in the last five years by the Orinoco Mining Arc (*Arco Minero del Orinoco*) initiative implemented by Venezuelan President Maduro under the Decree 2.248 (Lozada, 2019), and aims to attract around 135 international mining companies to the country to exploit a 110,00 square km area in a sensitive ecosystem that includes rivers, ITs and PAs (Lozada, 2019). The mining policy is an opportunity for illegal behaviors by the Venezuelan State and outlaws, while the State benefits from the sale of gas to mining sites and the sale of legal and illegal mining products to overseas countries (Rendon *et al*., 2020). The situation is clearly observed in the following statement by one survey respondent: "*for 21 years, the extractivist policy of Chávez and Maduro governments has threatened the region's resources. Chávez conceived the Orinoco Mining Arc and had in his plans the fluvial interconnection with the entire south*" (SR V). For Venezuela, natural resources are used for economic gain reinforcing once more the utilitarian and anthropocentric ethic of one of the Amazonian's government.

Likewise, mining is a threat in other Basin countries (Asner & Tupayachi, 2017; Cremers *et al.*, 2013; Matlaba *et al.*, 2017; Pasha *et al.*, 2017; Pérez-Escobar *et al.*, 2018). Brazil, Peru, and Guyana are some of the countries that face socio-environmental consequences from mining. Besides deforestation (Sonter *et al.,* 2017); mercury pollution (Faial *et al*., 2015; Silva *et al.,* 2006); deleterious effects on ichthyofauna which alter community structure and destroy ecosystem services provided by freshwater fishes (Azevedo-Santos *et al.,* 2021); legal and illegal mining are other activities that force exploitation inside ITs and PAs boundaries (Asner & Tupayachi, 2016; Ferrante & Fearnside, 2019). The recent boom in the gold prices during the SARS-CoV-2 (COVID-19) pandemic (Koh & Baffes, 2020) exacerbated the levels of miner invasions in Brazilian Amazon, where 72% of mining between January and April 2020 occurred inside ITs and PAs (Gonzaga, 2020). For a respondent with knowledge on Colombian Amazon, "*some areas in Colombia are far from traditional development regions, thus they are quite abandoning to their own, including the human communities living there. This situation of State absence is propitious to the establishment of irregular groups that take advantage by invading the territory with illegal activities from mining to drug trafficking*" (SR VI).

Hence, a myriad of human activities affect Amazonian aquatic ecosystems in different ways. The regional and trade agreements are the main drivers of export activities in the Basin, with China and US as the biggest trade partners (Figure 17). China has an important role as investor in many of the Basin infrastructure plans. These commodities require gray infrastructures to be extracted and exported in a cost-efficient process. Understanding how these activities push the frontier and how they are pushed by the socio-economic system leading to the degradation of flowing rivers and standing forests is urgently needed to lead the region into a long and solid process of conservation and sustainability. As mentioned, "*depending on the country/state, some threats are more prevalent and stronger than others...The cumulative and synergistic impacts of these drivers on ecosystem services are not well-understood*" (SR VII).

Figure 17

Amazon Basin Countries Resource Exploitation Activities



Note. The top 2 commodities exported from each country and the top 2 trade partners from 2019. Source: Adapted from OEC * Missing information for French Guyana.

5.2. Perceived impediments to implementing policy

In addition to the physical drivers of degradation there are other limitations to conservation that need to be considered. Although the territory is extensively studied by academics and institutions all over the world, there is still a deficit in scientific knowledge, data, syntheses, and awareness that may be addressed and then shared throughout the Basin. The reason why there is a knowledge deficit in the Basin is probably the vastness and the barriers to conduct research in the territory. These knowledge barriers are noted by participants as well, as they mentioned that the Basin has "*insufficient data on aquatic ecosystems and biodiversity hotspots; political focus on terrestrial ecosystems to the exclusion of any concern with riverine systems, including in the national protected areas systems and allocation of funds for conservation; lack of understanding and consideration of the potential role of protected areas in freshwater ecosystem protection; lack of awareness that freshwater biomes have been the most impacted of all systems by biodiversity loss;*

insufficient mainstreaming of environmental considerations into water resource development" (SR VIII).

Nonetheless, the first of its kind, the Science Panel for the Amazon (SPA) was created, like Intergovernmental Panel on Climate Change (IPCC), in a critical moment for the Amazon rainforest. In face of the current mismanagement of the forest under the umbrella of most Amazon countries jurisdictions, around 200 scientists united to produce a complete report of intrinsic features of the region and propose solutions. Among them, solutions related to science and knowledge such as promoting management based on scientific evidence; real time monitoring, harnessing new technologies. One of the targets proposes that the "sustainable development of the Amazon must explore options based on an innovative, standing-forest bioeconomy; sustainable infrastructure; sustainable management of the Amazon River, its tributaries and floodplains; and sustainable protection of freshwater fisheries" (Science Panel for the Amazon, n.d).

This knowledge and data gap must be filled since it can add pressure on Amazonian States and governments to act. Due to the density, geographical barriers imposed by the forest and waterways, it is assumed that some research may lack feasibility. An example of gap in data is the spatial distribution of freshwater fish species, which is very deficient in the Basin (Jezéquél *et al*., 2020). The Amazon Fish project for instance aims to address this lack of information in a transnational collaborative effort to complete a database (Jezéquél *et al*., 2020). Although it is useful to have new or more data to help identify priorities for protection, or optimize approaches, it is important to not undertake that lack of data is the only barrier to conservation. In many cases NGOs and decision makers generally know what and where are the problem and threats (e.g., dams, mining, dredging, overfishing) and how to address them. Data are useful to inform awareness campaigns and as pointed by an interviewee, conservation policies, because "*it is not possible to conserve what we still do not know*" (IV IV).

Another point highly stressed in literature and by participants is the lack of freshwater regulation in the Basin countries. While a few believe that besides "*at the national level there are*

policies for the management of riverine ecosystems, such as plans for the management of river Basins and micro-basins and the declaration of "Ramsar" protected areas" (IV X), the majority consider that Amazon has "*insufficient data on aquatic ecosystems and biodiversity hotspots; it has political focus on terrestrial ecosystems to the exclusion of any concern with riverine systems*" (IV XI). This is also hinted by another respondent who understands that governments lose opportunities to protect freshwater ecosystem inside protected areas framework. This participant stated that: "*if you look at the existing conservation polygons in Bolivia, when you see on the map it looks like Protected Area, when you see in the zoom, they are gaps, empty. These gaps are rivers, these gaps are limits of Protected Areas. There is no level of protection as they are in the middle. A river needs protection, when illegal activity takes place, nothing is protected, and it is important to note that some places are more sensitive than others*" (IV V).

There is an unequal and inconsistent consideration of freshwater in relation to terrestrial ecosystems inside PAs. Many conservation strategies and PAs in the Amazon leave behind the opportunity to booster freshwater biodiversity, as said, "*we have several conservation units, protected areas, that we had to evict in an area for the construction of a hydroelectric plant and there was a National Park in the Amazon where the main scenic attraction was a waterfall and the waterfall was outside the National Park because it obeyed the design of the river*" (IV XII). Rivers have a history of use as boundaries for PAs. A possibility of why this might still happen is the lack of awareness of water as a driving force for all the other living beings to thrive inside a PA. Also, the fact that for many, river conservation strategies might not be as appealing as protecting terrestrial ecosystems (Castello, 2021). The adoption of freshwater protected areas (FPAs), i.e., areas where the conservation focus is on aquatic ecosystems (see Saunders *et al*., 2002), could help advance the freshwater agenda, whereas standards PAs sometimes may serve somewhat as a limiting factor in protecting rivers from fast degradation.

Monitoring and enforcing regulations in the rainforest is also challenging due to the density of the Amazon, its geographical barriers and made even more difficult due to the installed

corruption (e.g., Venezuela and Brazil). Reductions in funding for environmental agencies and a dismantle of environmental institutions adds to the problem (Crouzeilles *et al.*, 2017; Fernandes *et al*., 2017; Pelicice & Castello, 2021; Pereira *et al.,* 2020; Mega, 2020). In recent years, the news, scientists, and civil society have called attention to a reversal in Amazon's protection in order to facilitate commodities activities (Azevedo-Santos *et al.,* 2020; Escobar, 2019; Diele-Vegas *et al.*, 2020; Ferrante & Fearnside, 2020; Pelicice & Castello, 2021; Rajão *et al.*, 2020; Valente, 2019). Respondents agree that Brazilian Amazon "*has flexible laws, decreased public participation and civil society participation in decision-making spaces and committees, promoted flexibilization of licensing policies, cuts and reforms in agencies of environmental protection, cuts in FUNAI's budget, the national agency for Indigenous affairs, and fired and changed staff working in these agencies. The dismantling of Brazilian environmental agencies is part of the current government's plans.*" (IV XIII). For the time being, Brazil has cut the number of environmental inspectors and has halted financing for fire prevention (Mega, 2020). Ricardo Salles, Brazil's former environment minister, and Eduardo Bim, the former president of IBAMA, the Brazilian Institute of Environment and Renewable Natural Resources, are being investigated for illicit timber shipments to foreign countries (Abdalla, 2020). This is all facilitated by some of the Amazon president's discourse, mostly Jair Bolsonaro, that aim to exploit the forest and its resources in exchange of economic advantage (Figueira *et al.*, 2021; Menezes & Barbosa Junior, 2021). While this situation in Brazil is well-known, other Amazon countries are also expanding the frontier in unsustainable ways.

Some respondents mentioned that *"Brazilian government nowadays became one of the main drivers of degradation in the region"* (SR IX) and "*the government is actively inciting illegal squatting and forest destruction through dismantling of law enforcement, denial of forest disturbances (especially forest fires and illegal logging), incentives of forest destruction by hate speech and conversion of illegal areas into titled properties*" (SR X). These behaviors are arguably driven by a political strategy to promote the economy and has detrimental effects for riverine ecosystems.

Someone brought to attention an agreement among the Basin countries and political behaviors of the State's representants: *"today, the Leticia Pact is often mentioned. It took place here in Leticia, Colombia. It was a meeting between all the Amazon countries. The agreement is to value and respect the autonomy of each State, economically speaking, and promotes cooperation to seek new financial resources in multilateral treaties or international cooperation. President Bolsonaro did not attend. He watched by teleconference. Venezuela was the only country that did not come"* (IV XIX). This clearly shows a lack of interest of both countries to address the Amazon current levels of degradation and South America environmental issues in a coordinated manner. Also, it contributes to Bolsonaro's denial of the necessity to mitigate environmental degradation (Ferrante *et al*., 2020b). The absence of Brazilian president was also noticed during the COP 26. The Brazilian president actions provide farmers and commodities exploiters with the assurance that they will not be punished for the environmental damage they incur in hastening river degradation. In an interview for a journal, a Brazilian scientist mentioned that "when you have the head of state, the most powerful man in the country, pretty much telling people to go deforest and what is illegal today will be legal tomorrow, then it's very hard" (McCoy & Pessoa, 2021). Such behaviors from the government end make it harder to overcome the barriers of degradation in the Amazon.

To tackle the lack of governance, pointed by literature and respondent's discourse, build awareness on the importance of riverine ecosystems, and inform all stakeholders on the necessity and how to protect these ecosystems are crucial. In addition, awareness in combination with capacity building will be the initial steps to shape the conservation system and step away from the utilitarian value riverine resources and implement command and control actions.

5.3. Possibilities for riverine protection

Now that the barriers to the conservation system are stablished, it is necessary to understand what lessons can be learned from environmental governance in the Basin to inform the creation of a basin-wide conservation system. The explanation for an Amazon Basin-wide conservation system under the respondents' discourse was revealed under the theme "natural

resources management", in which participants made clear that such strategy is urgently needed due to the importance of its riverine connectivity, the provision of ecosystem services and to the need to conserve the rivers for posterity. Although participants are aware of the importance to conserve the Basin, the some of them brought to the discourse an anthropocentric value in which the Amazonian rivers need to thrive for the purpose of keep providing resources for today and future generations.

As mentioned, there is a lack of enforcement of environmental protection policies, especially those that pertain to freshwater resources. Degradation of freshwater resources is often collateral damage of developments that are in the river corridor. For example, mining activities upstream or off-stream often lead to the pollution of rivers through chemical or sediment runoff. To resolve this problem under the conservation aspect, there needs to be more regulation and enforcement of mining practices that mandate reclamation of mining sites and contaminated waters. Mines could be prohibited in river corridors or within a certain distance of rivers that exhibit critical conservation needs and priorities. A trade-off for a more sustainable source of energy such as wind and solar is also feasible to address dam related problems. In case governments try to pursue a hydropower agenda, corridors must be chosen so socio-ecological important rivers keep flowing. These are strategies that must be considered to protect rivers from development activities.

There is a growing awareness of the need for freshwater protection and this awareness should proceed faster. In the IUCN Congress (2021), some resolutions to protect the Amazon and/or rivers were presented. As noticed in the "Introduction" section, one of them is IUCN Resolution WCC_2020_Res_129. Nonetheless, the resolution does not call for explicitly protection of rivers and it is very important to ensure that freshwater components are bring into its implementation. Stakeholders need to guarantee that these 80% of the Amazon to be protected encompasses the conservation of all existing ecosystems in the Basin. Another resolution, WCC-2020-Res-015-EN, on 'cooperation on transboundary fresh waters to ensure ecosystem conservation, climate resilience and sustainable development', is also urging better adopting of the UN Watercourses Convention. The Convention is an Integrated Water Resources Management framework. It is the first global

framework on freshwater and world only global framework on transboundary rivers (see Loures, 2014). All the Amazon Basins countries are IUCN members, they should be guided by these resolutions to mitigate the fast pace of freshwater degradation.

When asked what kind of protection policies they thought would be beneficial for the Amazon, survey respondents signaled that taking an integrated approach to water resource management in the Basin is important to address the conservation needs and that a regional river conservation system could be created (see table 5). As the region continues to integrate economically and through infrastructure (e.g., IIRSA), it must address the lack of policies that protect water resources and rivers specifically. Amazon may also take lessons from the region to expand the successful examples across the Basin and from other parts of the world that have already gone through their economic transitions from the secondary (extraction and refining) to tertiary sectors (sales and service), namely the US and Europe. These regions already absorbed how hydropower and other resource exploitation activities directly and indirectly leads to socio-environmental consequences. In the next subsections I will explain better each of these possibilities as I trace an initial roadmap for the Amazon conservation system taking lesson from - the European Union Water Framework Directive; US Wild and Scenic Rivers System; and Putumayo-Içá basin (examples of Integrated Water Resource Management) as well as Protected Areas, Ramsar sites, World Heritage sites and Rights for Rivers. Taken together, these are all components of IWRM if properly applied. Drawing from these experiences, I here propose a conservation system as a possibility to maintain the integrity of the Amazon rivers and its ecosystem services avoiding its tipping point.

5.3.1. European Union Water Framework Directive (EUWFD)

The European Water Framework Directive (EWFD), a policy directive that demands integrated management for its success stemmed from Integrated Water Resources Management (IWRM). IWRM "is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in

an equitable manner without compromising the sustainability of vital ecosystems" (Agarwal & Global Water Partnership, 2000, p. 22).

IWRM framework was created to address three aspects of Basin governance: economics, social, and environmental (UN-Water, 2007). In theory, IWRM seeks to achieve a balance between human resources and ecosystem protection (Agarwal & Global Water Partnership, 2000; Perry, 2021). The framework and strategy understand that complementary parts of a successful water resource management system must be established and enhanced at the same time.

While IWRM brings an overall perspective of integrated management, Integrated River Basin Management (IRBM) covers the development and management of all-natural resources within a river basin, especially brings a focus on ecosystem functioning maintenance (Bandaragoda & Babel, 2010). Both concepts have been used in the same context in the past, yet IWRM has become the more popular (Bandaragoda & Babel, 2010). IRBM promotes long-term sustainability, emphasizes cross-disciplinary cooperation of water, land, and related resources in a river basin, watershed, or catchment. IRBM emphasizes the importance of ecosystem function and transdisciplinary cooperation among different stakeholders and sectors (policies, decisions, costs) (International River Foundation, n.d). The main distinction between the two frameworks is IRBM's spatial and ecosystem orientation, which emphasizes river basins (and sub-basins) as natural hydrological units within which sustainable water resource management can be organized (Jones *et al.*, 2006). Hence, it provides a perspective of the necessity of integration across scales, paying attention to the hydrological unit (Jones *et al.*, 2006). If IWRM was applied in the true meaning of its definition, then it would completely embrace IRBM. The problem is that IWRM is usually only applied without sufficient attention to "the sustainability of vital ecosystems" (Jeffrey & Gearey, 2006).

IWRM is widely applied worldwide. On the other hand, IWRM is also the source of many criticisms. Some argue that the environmental pilar of the framework lacks attention. Sometimes IWRM focuses only on water as a commodity and sometimes is an instrument to implement other (unethical) agendas (Giordano & Shah, 2014). Other reviews consider how IWRM was developed by

“experts” water professionals concerned with efficiency, such as economists (Ward, 2009). In this perspective, water is seen out of its socio, cultural, and environmental contexts (Linton, 2014). Another criticism regards the lack of attention to connectivity (Schäfer, 2021; van Rees *et al*., 2021).

The EU's Water Framework Directive is a model for IWRM strategy that works in an integrated regional governance structure. The early water legislation in the European continent was regarded fragmented in terms of objective and means (EU, n.d). Decision makers concluded that a better model was to manage according to the river basins, which are the natural geological and hydrological units - instead of according to administrative or political boundaries (EU, n.d). Today, European Member Parties are legally binding with EWFD, and the framework has been incorporated into national legislation with deadlines; noncompliance results in the member states' failure (sanctions) (Aubin & Varone, 2004). The policy framework is enforceable by the EU governing body yet is implemented at the State level by national environmental agencies. Scholars stress that some considerations need to be considered, while the policy protects water quality, quality, and biodiversity, it has no explicit protections for maintaining connectivity (Schäfer, 2021). Taking lessons for the Amazon and the advance of hydropower frontier in the Basin, the connectivity protection is of utmost importance.

Following Schäfer (2021), the non-attention in river barriers is the reason why EU rivers still did not meet the EWFD's standards and objectives. The gap in regulations, could be overcome with policies such as the Wild and Scenic Rivers System (Schäfer, 2021). By the time IWRM was created most of European rivers were dammed and diverted. Nonetheless, the Amazon still holds many FFRs and the implementation of such framework in the Basin is an opportunity to safeguard these corridors and underpin many of the recent global guidelines for the Amazon and freshwater protection.

If applied across the entire Amazon, the IWRM would fill most of the needs and challenges of the Basin. The framework would bring solutions and encourage not only governments, but also local populations, Indigenous people, riverbank communities and farmers to orient themselves

towards a sustainable development while embracing a shift in paradigm of anthropocentric values. This is an opportunity to accept green investments towards a sustainable Amazon, build awareness, capacity and empower stakeholders. As mentioned by an interview respondent, "*it will be necessary to find a balance between new financial income, and preservation of the environment, local cultures, and the authenticity of the landscapes*" (IV XX). IWRM could aid in the establishment of a bottom-up governance in water resources, involving all parties (see Agarwal & Global Water Partnership, 2000; Sabatier et al., 2005) and in the optimal or at least rational use of rivers. In addition, by collaborating with Indigenous, traditional, and local communities, their perceptions of river and environmental conservation can also be integrated within the conservation system to empower them.

International funds such the ones formed during COP 26 (DW, n.d) can help manage the framework by supporting Indigenous management and be used to support a conservation system that would provide the tribes and local communities capacity over the rivers. Together, these might advance to bring an ecocentric perspective while taking into consideration that Indigenous people and Indigenous territories are one of the greatest examples of biodiversity conservation (Fa *et al.,* 2020).

5.3.2. Wild and Scenic Rivers System

To fulfill the ecological conservation needs, survey respondents suggested taking lessons from the US National Wild and Scenic Rivers System, the world's first river conservation system to create similar system in the Amazon Basin. IWRM was conceived in the United States in the 1960s and first took shape in the form of the Water Resources Planning Act that planned for the best use for the rivers (Perry, 2021). Among other results, this policy led to the creation of river basin commissions of stakeholders and decisionmakers and influenced the creation of the Wild and Scenic Rivers Act of 1968 (Perry, 2021). This system was created with IWRM principles in mind and aimed to strike a balance between conservation and development needs after US dam frontier expansion (Perry *et al.*, 2021).

The policy framework protects the free flow of rivers that are significant and possess at least one Outstandingly Remarkable Values (ORV) (or ecosystem services) (e.g., recreation, scenic, culture, wildlife) in the river or river segment and its riparian area (Perry, 2017). Rivers may be classified as wild, scenic, or recreational according to the characteristics of the region (Moire *et al.,* 2016). Wild and Scenic Rivers (WSR) halts the construction of any kind of barriers that diminish the river's free-flowing character, at least within the designated WSR extent (Moire *et al.,* 2016). Peru is considering the creation of National River Conservation System based on such policy, as mentioned by an interviewee when he pointed that "*we are working with several initiatives to replicate the US Wild and Scenic Rivers Act, but they are not yet implemented. I believe that this model in the Amazon would be ideal*" (IV XVI).

However, comparable issues that PAs face, in terms of subjecting the PA to outside threats, are faced by WSR, as dams can still be implemented downstream or upstream of the protected sites and affect the hydrological regime (Opperman *et al*., 2021). In the USA, WSR currently protects 226 rivers or river segments across the country (Perry *et al*., 2021). The model inspired seven other States to adopt similar policy structure (New Zealand, Canada, Norway, Finland, Sweden, Spain, Mexico) (see Perry *et al.,* 2021). Future designations within WSR are already considering the entire basin.

The system depends on federal agencies to identify and catalog rivers that are free-flowing, with at least one ecosystem service that is regionally or nationally significant, and that has high water quality or the ability for that water to be restored. When rivers are protected, the riparian area can also be protected to ensure the integrity of the river-based ecosystem services (Perry, 2021). Once designated, a comprehensive management plan is created for the protection and enhancement of the ORVs (Perry, 2021). When the policy was first created, 8 rivers of conservation concern were instantly designated, and a list of eligible rivers was created. More rivers get added to the system after suitability studies are conducted (National Wild and Scenic Rivers System, n.d). Rivers protected in the system cannot be degraded and any development activity proposed within

the protected area must undergo an environmental impact assessment to make sure that it will not degrade the rivers free-flow or ecosystem services. In the Amazon, as the Basin that spans nine countries, such policy implementation will require a coordination across borders to be effective.

5.3.3. The Putumayo-Içа basin

The Amazon Water Initiative aims to promote a view of the Amazon Basin that values the region as an in integrated terrestrial and freshwater system. The initiative aims to protect the Amazon's ecosystem services so that human population, wildlife, and the habitats that rely on it can thrive (Amazon Waters, n.d). Within the IWRM framework, some of the goals of Amazon Waters are to address environmental implications of infrastructure developments and industries; improve the management of aquatic landscapes; and improve and management of fisheries production (Amazon Waters, n.d). The basin approach is not meant to be a standalone endeavor; rather, it is meant to support other large-scale activities in the region. For instance, through the vision of the initiative, the recognition of three Ramsar sites in the region in 2018 was supported. They also contributed to the exercise of updating priority areas for conservation in the region (Venticinque *et al.,* 2016) and currently the initiative has contributed with support in two other projects: Rede Ciência Cidadã Para Amazônia (Citizen Science Network for the Amazon) (https://amazoniacienciaciudadana.org/pt/home-pt) and Cuenca Putumayo-Içá (https://cuencaputumayoica.com/proyecto/?lang=pt-br).

The Putumayo-Içá basin spanning Brazil, Colombia, Ecuador, and Peru is being targeted for new management through the integrated water resource management framework. The project is expected to last at least five years (Cuenca Putumayo-Içá, n.d). In 2020 the four countries were granted $12,844,037 USD by the Global Environment Facility (GEF) to implement integrated watershed management in the region. The project, that has World Bank as the lead institution, is awaiting its final approval. The proposed plan outcomes for the basin can be summarized in four components: (1) providing information and knowledge of the basin in different disciplines and generating knowledge between countries; (2) favor and strengthen the relationship between the

states and the population that inhabits the basin to favor governance in the region; (3) take concrete actions to reduce chemical contamination; (4) regional sustainable water activities associated with shared aquatic resources. When discussing this plan, one respondent said: "*the lowlands of the Putumayo-Içá basin, which is shared by the four countries, are of interest to everyone, there are many fish and aquatic fauna. So, we can work on sustainable management and actions for the conservation of fish, pirarucu, turtles, aquaculture, pisciculture, mainly between Colombia and Ecuador and flora products such as andiroba (....) it will not be the solution to all the problems, but I hope that we will have a shared language, a lesson in conservation, and work shared between the four actors (the four countries), respecting the State, academia, and research. I dream of this*" (IV XV).

The Putumayo-Içá basin project brings awareness to tackle river related problems within the IWRM framework. As evidenced in a response, the transboundary river basin management can increase dialogue between communities that depend on the rivers but also reside in different jurisdictions *"... the Indigenous communities of the rivers of Colombia and Peru have limited dialogue, although they are only separate 3 km apart. Why? Only because of public policies in the country, where there is a treaty through the corresponding Ministry and Peru has another treaty. Each one has its own Ministry. Despite having its center in the same territory, they do not take the measures to make common decisions on natural resource management"* (IV XV). The project offers optimism and could serve as a model for other Amazon sub-basins, if not the entire Basin.

Today, most sustainable management experiences in the Amazon are local, such as the *Pirarucu Management*. Freshwater legislations are fragmented within each country's jurisdiction. Thus, one body of regulation or framework to really focus on the protection of rivers is necessary. An integrated approach that focus on a holistic management would address most problems in the Basin related to connectivity, water quality, quantity, and biodiversity, because "*it is not possible to treat the conservation of a river in a disconnected way between upstream and downstream, it is an integrated and interdependent system*" (SR XI). As said, "*a river that has its headwaters protected,*

may have its bed contaminated, may be empty of fish and may be full of sandbanks preventing navigation. In other words, it is necessary to think about the whole, including the forest as well" (SR XII). Respondents are aware of the urgent necessity of an integrated management and the benefits from it (see Abell & Harrison, 2020; Leal *at al.,* 2020). Because of a substantial concentration on non-flooded forests, lack of basic ecological data on aquatic ecosystems, and the Amazon Basin's political complexity, IWRM had not been employed in the Amazon before (Águas Amazônicas, n.d.). Now the region is advancing with Águas Amazônicas Initiative and Putumayo-Içá basin management.

5.3.4. In a route to instantly protect some of the Amazon rivers

5.3.4.1. Constitutions and Rights for Rivers. Some rivers in the Amazon Basin already present some sort of protection, even thought that not explicitly for connectivity. Most South America Constitutions address an anthropocentric perspective in relation to nature and rivers. These official documents (Constitutions) bring a predominant vision that nature must be protect but for the use of human beings and for the constant provision of ecosystem services. Nature, in most of these documents, is not yet valued as subject of rights.

Nonetheless, since 2008, two Basin countries, Ecuador, and Bolivia, with large Indigenous populations established a more ecocentric constitution. These are plurinational States that understand the importance to acknowledge the socio-ecological diversity of their societies to contribute and shape the construction of their nations (Ferreira, 2013; Giffoni *et al.,* 2020). Colombia is also advancing in this agenda. The Colombian Supreme Court of Justice declared the Amazon as a subject of rights. In theory, the Amazon as a subject of rights should help the Amazon fight environmental degradation and prosecute individuals who harm the rainforest. So far, the Colombian Amazon still faces many fires and deforestation (e.g., Clerici *et a*l., 2020; Murad, & Pearse, 2018).

These three Basin countries are also the only ones that gives protection to nature and rivers (see Perry *et al.,* 2021). It is understood that this policy can be used to stop dams should a project be proposed in a designated corridor. Rivers, once granted with such protection are understood to have

"personhood" (see table 6). There is an initiative to get Rights of Rivers bestowed on the Marañon in Peru and has the potential to be implemented elsewhere in the Basin (International Rivers, 2021). In Brazil, the first-time the term "river's right" came in judicial case was in a Public Civil Action in which the Federal Public Ministry of Pará was the interested party, in 2011, claiming to interrupt the construction of the Belo Monte Dam in the Xingu River (Ferreira, 2013). Yet, the protection in not yet implemented in the country.

A respondent noted that "*if Bolivia, Peru, Ecuador and Colombia manage to build and improve this [Rights for Nature and Rivers], it is already a big step forward because the main problems that we have today in terms of hydrology threats are happening for the most part in the Andean region, actually with Brazilian financing*" (IV VI). Going back to the discussion about recognizing the importance of empowering Indigenous and local communities as managers in the conservation system, other Basin countries also have significant Indigenous and traditional population in the forest. Maybe by the fact that some of them live without an easy access to the big cities, such as in Brazil, these populations do not have the proper "space" to speak and to be heard. Now is the chance to give them this power and learn from them how they have been conserving and managing these ecosystems in a sustainable fashion.

5.3.4.2. Protected Area, Ramsar Sites, World Heritage Sites, and Campaigns. Other rivers that already have some degree of protection are the ones that flows inside PAs, Ramsar sites and World Heritage sites. As far as it is a great possibility for biodiversity protection, PAs still need to encompass rivers as a biodiversity component vital for the other forms of life to succeed. It is very important to consider where a PA will be established in the context of dam locations, *"if you have all the dams up there [in the Andes], it is useless to have Protected Areas in the lowlands because the hydrological regime will change and will be so pronounced that the river will no longer have its functions, and this is the big problem once for the establishment of a strategy for riverine conservation you need a long-lasting agreement that allows these river corridors to remain free so that you have them open from the headwaters to the estuary*" (IV III). Hence, strategic locations for

PAs requires dialogue among the States (Harrison *et al.*, 2016). Nonetheless, a few PAs do protect some rivers, as is the case for Jaú National Park, in the Brazilian Amazon, which encompasses 450km of Jaú river protecting its the black water ecosystem (ISA, n.d).

In some cases, the areas protected at a national level such as a national park or conservation units also have another layer of protection or recognition at the international level such as Ramsar sites and World Heritage Sites. These layered protections help to raise awareness about the special conservation values of the protected areas. By gaining world recognition, any degradation receives global criticism. Wetlands makes 14% of the Amazon ecosystem (Venticinque *et al.,* 2016). The Ramsar Convention uses a broad definition of wetlands, which also include rivers (Ramsar, n.d). In 2018, Brazil designated three Ramsar sites under the Convention (Juruá River: site 2362; Amazon Estuary and its Mangroves: site 2337, and Negro River: site 2335). The one of the last conservation efforts in the area before the possession of Jair Bolsonaro as president. A surveyed participant mentioned that "*since 2008, Brazil worked the implementation of an agenda focused on the recognition of Ramsar Sites in the region, which led in 2018 to the recognition of 3 important sites: Marajó, Rio Negro and Juruá, as well as the updating of priority areas for conservation and management in the Amazon, which gave an important focus to aquatic environments and Amazon rivers. These processes were led by the MMA (Brazilian Environmental Ministry), but since the change of government, little progress has been made in their development.*" (SR XII).

In addition, a few PAs in the Basin also bring a World Heritage Site recognition, which means that the site is distinguished for its natural or cultural significance. The Central Amazon Conservation Complex for instance is one of the largest PAs that encompasses different Amazonian freshwater ecosystems, including important Amazon tributaries such as the Solimões and Negro rivers (UNESCO, n.d).

Rivers that are subject of campaign, although do not have protection, holds support from society. Examples are Marañon river, in Peru, an important tributary of the Amazon, and the Tapajós river, in the Brazilian Amazon, as abovementioned on the Political Ecology section. In the US Wild

and Scenic Rivers System eight rivers were the first ones to be designated, as in that case, the Amazon Basin conservation system can already start granting protection for some rivers. Rivers already protected through national policies such as PAs, ITs, or rights of rivers and those that have international designations such as Ramsar or World Heritage status could be instantly added to the system given they have already been identified for their conservation significance. Rivers where dam development and other degrading activities are currently being contested through protection campaigns such as the Marañon could also be instantly added.

5.3.4.3. Building a conservation system roadmap*.* First, acknowledging that respondent's discourse were mostly grounded on utilitarian and anthropocentric values, I do recognize that results could have been different if the research was also supported by interviews and surveys provided by the Indigenous and traditional communities. Although most of the given perspective prays for a sustainable Amazon, implementing the conservation system may be an opportunity for expanding the intrinsic value of nature. The necessity for standing forest and flowing rivers is not only for ecosystem services provisioning but because humans and nature are intrinsically connected. This is a chance to balance the utilitarian ethics and development with conservation needs. Nonetheless, today the support for rights of nature is more evident than years ago.

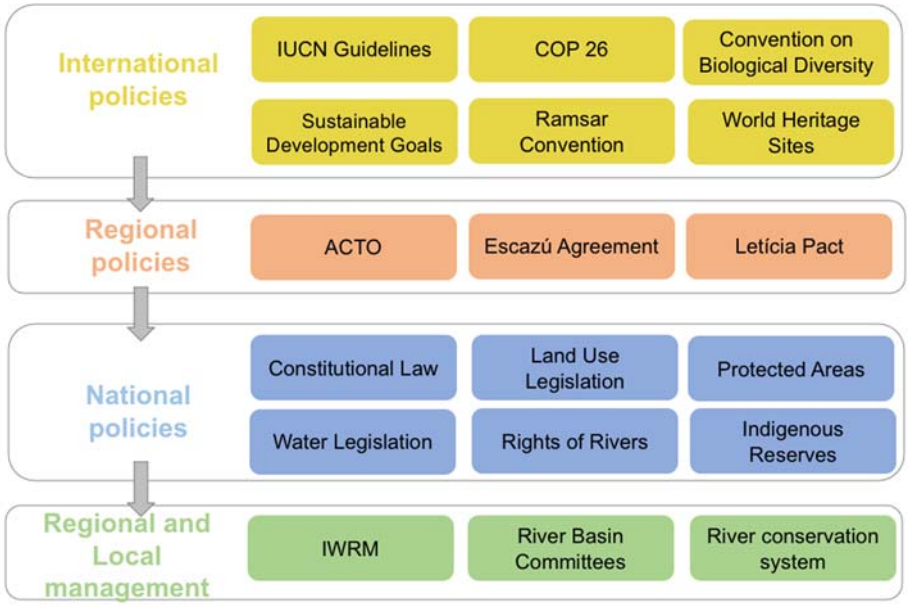
Summarizing, despite all the knowledge about the need to protect the Amazon ecosystem, as the Basin countries integrate and develop, they still ignore the need to preserve the forest and rivers. This is the main limitation uncovered by this research. By not protecting the Amazon and its ecosystem services governments are risking accelerating the process and reach the tipping point. But lessons were also uncovered by environmental governance in the Amazon Basin to inform the creation of a conservation system. There are experiences from around the world that need to be taken into consideration. In the United Stated, they realized by damming and diverting their rivers that they were risking water quality, quantity, and freshwater biodiversity. Thus, a policy framework was established to balance development and conservation needs. The history in the Amazon, if all those planned dams are to be built, will soon resembles the one vivid by the United States. In

Europe, rivers were so dammed and diverted that today, almost none of the European rivers flows free.

The solution therefore is to move away from the perception of Amazon as a frontier for resource and economic development and establish a more sustainable approach. According to IWRM, the economic, social, and ecological components need to be considered. Nevertheless, the ecological axes is usually overlooked. For this reason, going back to Cid *et al.* (2021), and taking lessons on their research, legislation and regulations at all levels may help mitigate the loss of connectivity (Figure 3). From the laws and regulations suggested by them, some apply in the Amazon Basin context that may also be relevant to face the current scenario of freshwater degradation and may be used to carry on in the establishment of a conservation system for riverine protection (Figure 18). There is a potential to build on existing policies across scales to achieve conservation goals.

Figure 18

Legislations and Regulations in the Amazon Context to Mitigate Amazon Connectivity Loss



Note. Adapted from: Cid *et al* (2021).

First, drawing on global calls and financing mechanism, a conservation system can be designed and funded that would function like the Wild and Scenic Rivers System but for the Amazon Basin. Using the UN Watercourse guidelines for transboundary cooperation, a European Union Water Framework Directive like policy could be created that would be applied at the national level but enforced at the supranational or regional level by the Amazon Cooperation Treaty Organization. The abovementioned rivers on section 5.3.4.a and 5.3.4.b that already have some sort of protection (Rights for River, PAs, ITs, Ramsar sites, World Heritages sites and rivers object of campaigns) could already be protected within this system.

Drawing on results and ongoing studies conducted by the Science Panel for the Amazon more rivers of conservation concern can be added in the future. The management plan could be designed by subbasin commissions to facilitate the management and they could cooperate across boundaries to identify conservation priorities and strategies. Each countries environmental ministry, national park system, or other environmental entity as well as Indigenous communities and local NGOs could be responsible for the co-management of rivers designated within the system. In this sense, co-management of sub-basin agencies that empower Indigenous leaders, traditional communities, as well as those who live along the rivers would ensure greater enforcement and cooperation for achieving conservation goals.

These are just initial possibilities that will allow to bring a broader perception of the intrinsic value of the Amazon. The conservation system brings possibilities to implement sustainable approaches, such as - the use green infrastructure as part of a management plan; to build capacity - provide jobs in the conservation system so locals can become rangers to manage and monitor the rivers; to build awareness, including the standpoint of people directly affected by dams.

5.4. Future Research

A study specifically focused on the FFRs in the Amazon for the purpose to create a Basin-wide system has not been yet developed. To create such system, it is necessary to identify where are these open corridors, the biodiversity hotspots, fisheries, spawning habitats, sites that are critical for

economic activities, understand how development can be designed, where are the areas that still can maintain the ecological. River conservation system requires management, capacity, enforcement and so far, this is a limitation in the Amazon reality.

6. Conclusion

Building a road map for a more sustainable Amazon region is critical and urgent. As the biggest watershed in the world, Amazon contributes with around 17% of water that reaches the oceans. Even though the provisioning and cultural services offered by the Amazon in comparison to other regions across the globe are available to a smaller population due to the density of the region, Amazon people extremely rely on these services so that they are called by many as the "water people." Their lives are extremely connected to the river and its flood pulses. Supporting (e.g., water cycling) and regulating services (e.g., carbon sequestration) are critical at local and global scale and now, jeopardized due the intense land use that is accumulating its effects since European arrival. The threats rivers incur in are even more exacerbated in the last decades, due to neocolonialism.

In this research, discourse from stakeholders who engage with the Amazon rivers overlapped with literature discourse and are in line with the most recent global guidelines, frameworks and agreements that try to achieve a path towards a solution to protect nature, such as the Glasgow agreement, Leticia Pact, Science Panel for the Amazon, and IUCN Resolutions. Even that most of respondents pray for sustainability and conservation of the rainforest, the research demonstrated that the majority want to conserve the Amazon, but the rationale is still grounded in an anthropocentric perspective. However, the mindset in the Global South is changing. Advance have been made in ecocentric and technocentric values. This brings opportunity once the Basin finds itself in the exact moment to implement conservation plans due to the risk of losing its connectivity by large numbers of hydropower and waterways in addition to the tipping point.

Existing protections can be expanded and layered to achieve conservation goals across scales if the political will exists and capacity is built. Taking lessons from IWRM strategies both in the Basin and abroad, can serve in the creation, application, and enforcement of coordinated protection strategies including the adoption of a Wild and Scenic-like river conservation system.

While Putumayo-Içá basin is already a reality between Brazil, Colombia, Ecuador and Peru countries, lessons must be learned from this sub-basin project to be further scale up in aspects that the management makes Putumayo-Içá experience successful. This five-year project, created in the face of the disturbances in the Basin (e.g., overexploitation, water quality degradation, deforestation), targets two main components that were identified to the face of the Putumayo-Içá basin limitations to thrive. These components are (1) strengthening governance and capacity for informed decision-making and (2) undertake key actions for integrated management of aquatic resources.

The current political scenario does not seem favorable for an agenda that protects the Amazon flowing rivers and its forest, mostly in Brazil. But trade law can come as an aid to force countries to change the behaviors in forest and rivers management, as reported here that the new COP 26 agreement establish that not only export but import countries should not deforest. Brazil is the country that could probably initiate the dialogue since it holds most of the territory of the Basin. The country also has the longest border, share its border with most of the other countries (except Ecuador), and is one of the biggest economies in South America. Not to mention that besides Brazil encompass the largest portion of Amazon biome, it is located downstream in relation to the majority headwaters. Hence, if the dams in the Andes or other infrastructures are to be built, it will deeply affect Brazilin Amazon. My suggestion does not dismiss the possibility of other country to hold the same position and start a discussion to protect the region.

The importance of cross-border connectivity cannot be overstated. All the Amazon's elements are interconnected: geology, forest and flooded habitats, rivers, biodiversity and, importantly, local communities. These ecosystems occupy a portion of it, varying depending on the

season: periodic flooding, drought, etc. This dynamic is unique, of huge complexity, and must be safeguarded. That is why the Amazon's freshwater habitats are strategic in terms of transboundary operations, scale and beneficial to create long-term bases in the region. In this sense, social inclusion must be factored in the freshwater conservation plan. The protection of the Amazon and its sustainable use is complex but changes still exist to save it to future generations, primarily to those that inhabit its territory. Otherwise, given the pace of deterioration of the Amazon biodiversity and ecosystem services, a call for an urgent union of all direct impacted people and other stakeholders around the globe to rethink activities and energy matrices in an intelligent manner is mandatory. The time is now to act to avoid the tipping point and guarantee the rivers keep flowing.

References

Abdalla, J. (2019). Environment Minister and president of IBAMA are targeted in Federal Police operation. Brasil de Fato. Retrieved October 11, 2021 from https://www.brasildefato.com.br/2021/05/20/environment-minister-and-president-of-ibama-are-targeted-by-federal-police-operation

Abell, R., & Harrison, I. J. (2020). A boost for freshwater conservation. *Science*, *370*(6512), 38–39. https://doi.org/10.1126/science.abe3887

Abell, R., Allan, J. D., & Lehner, B. (2007). Unlocking the potential of protected areas for freshwaters. *Biological Conservation*, *134*(1), 48–63. https://doi.org/10.1016/j.biocon.2006.08.017

Abell, R., Lehner, B., Thieme, M., & Linke, S. (2017). Looking Beyond the Fenceline: Assessing Protection Gaps for the World's Rivers. *Conservation Letters*, *10*(4), 384–394. https://doi.org/10.1111/conl.12312

About the Amazon. (n.d.). Retrieved November 1, 2021, from https://wwf.panda.org/discover/knowledge_hub/where_we_work/amazon/about_the_amazon.cfm

Agarwal, A. & Global Water Partnership. (2000). *Integrated water resources management*. Global Water Partnership.

Agostinho, A. A., Gomes, L. C., Veríssimo, S., & K. Okada, E. (2004). Flood regime, dam regulation and fish in the Upper Paraná River: Effects on assemblage attributes, reproduction, and recruitment. *Reviews in Fish Biology and Fisheries*, *14*(1), 11–19. https://doi.org/10.1007/s11160-004-3551-y

Albert, J. S., Destouni, G., Duke-Sylvester, S. M., Magurran, A. E., Oberdorff, T., Reis, R. E., Winemiller, K. O., & Ripple, W. J. (2021). Scientists' warning to humanity on the freshwater biodiversity crisis. *Ambio*, *50*(1), 85–94. https://doi.org/10.1007/s13280-020-01318-8

Alemán, E. (2020). *Latin American Politics* (1st ed.). SAGE Publications. https://us.sagepub.com/en-us/nam/latin-american-politics/book241527#description

Alho, C. J. R., Reis, R. E., & Aquino, P. P. U. (2015). Amazonian freshwater habitats experiencing environmental and socioeconomic threats affecting subsistence fisheries. *Ambio*, *44*(5), 412–425. https://doi.org/10.1007/s13280-014-0610-z

Almeida, O. T., McGrath, D. G., & Ruffino, M. L. (2001). The commercial fisheries of the lower Amazon: An economic analysis. *Fisheries Management and Ecology*, *8*(3), 253–269. https://doi.org/10.1046/j.1365-2400.2001.00234.x

AlYahmady, H. H., & Alabri, S. S. (2013). Using NVivo for Data Analysis in Qualitative Research. *International Interdisciplinary Journal of Education*, *1*(1032), 1–6. https://doi.org/10.12816/0002914

Amazon Cooperation Treaty. (n.d.). *OTCA*. Retrieved October 29, 2021, from http://otca.org/en/project/amazon-cooperation-treaty/

Amazon Waters. (n.d). *Manejo de Bacias*. Retrieved October 29, 2021, from http://pt.aguasamazonicas.org/a-iniciativa/manejo-de-bacias/

Amazon Waters. (n.d). The Initiative. Retrieved October 29, 2021, from http://amazonwaters.org/the-initiative/

Anderson, E. P., Jenkins, C. N., Heilpern, S., Maldonado-Ocampo, J. A., Carvajal-Vallejos, F. M., Encalada, A. C., Rivadeneira, J. F., Hidalgo, M., Cañas, C. M., Ortega, H., Salcedo, N., Maldonado, M., & Tedesco, P. A. (2019). Fragmentation of Andes-to-Amazon connectivity by hydropower dams. *Science Advances*, *4*(1), eaao1642. https://doi.org/10.1126/sciadv.aao1642

Anderson, E. P., Osborne, T., Maldonado-Ocampo, J. A., Mills-Novoa, M., Castello, L., Montoya, M., Encalada, A. C., & Jenkins, C. N. (2019). Energy development reveals blind spots for ecosystem conservation in the Amazon Basin. *Frontiers in Ecology and the Environment*, *17*(9), 521–529. https://doi.org/10.1002/fee.2114

Anderson, K. E., Paul, A. J., McCauley, E., Jackson, L. J., Post, J. R., & Nisbet, R. M. (2006). Instream Flow Needs in Streams and Rivers: The Importance of Understanding Ecological Dynamics. *Frontiers in Ecology and the Environment*, *4*(6), 309–318.

Ansar, A., Flyvbjerg, B., Budzier, A., & Lunn, D. (2014). Should we build more large dams? The actual costs of hydropower megaproject development. *Energy Policy*, *69*, 43–56. https://doi.org/10.1016/j.enpol.2013.10.069

Antunes, A. P., Fewster, R. M., Venticinque, E. M., Peres, C. A., Levi, T., Rohe, F., & Shepard, G. H. (2016). Empty forest or empty rivers? A century of commercial hunting in Amazonia. Science Advances. American Association for the Advancement of Science. https://doi.org/10.1126/sciadv.1600936

Arango, J. J. V. (2012). Amazonia. Construcción y representación de un discurso cultural por los conquistadores españoles del siglo XVI. *Pensar Historia*, *1*, Article 1. https://revistas.udea.edu.co/index.php/pensarh/article/view/17830

Ardaya, Z. L., Cuvi, N., & Mombiola, A. G. (2021). *Peoples of the Amazon and European colonization (16th-18th centuries)* (Chapter 9; Report of the Science Panel for the Amazon (2021), p. 63). The amazon we want. https://www.theamazonwewant.org/public-consultation-on-the-draft-of-the-report-of-the-science-panel-for-the-amazon/

Asamblea Constituyente, E. (2008). Constitución de la República del Ecuador. *M. ASAMBLEA CONSTITUYENTE, CONSTITUCIÓN DE LA REPUBLICA DEL ECUADOR*.

Asner, G. P., & Tupayachi, R. (2016). *Accelerated losses of protected forests from gold mining in the Peruvian Amazon*. *12*(9), 094004. https://doi.org/10.1088/1748-9326/aa7dab

Asner, G. P., Llactayo, W., Tupayachi, R., & Luna, E. R. (2013). Elevated rates of gold mining in the Amazon revealed through high-resolution monitoring. *Proceedings of the National Academy of Sciences*, *110*(46), 18454–18459. https://doi.org/10.1073/pnas.1318271110

Athayde, S. (2014). Introduction: Indigenous Peoples, Dams and Resistance. *Tipití: Journal of the Society for the Anthropology of Lowland South America*, *12*(2), 80–92.

Athayde, S., Duarte, C. G., Gallardo, A. L. C. F., Moretto, E. M., Sangoi, L. A., Dibo, A. P. A., Siqueira-Gay, J., & Sánchez, L. E. (2019). Improving policies and instruments to address cumulative impacts of small hydropower in the Amazon. *Energy Policy*, *132*, 265–271. https://doi.org/10.1016/j.enpol.2019.05.003

Athayde, S., Shepard, G., Cardoso, T., van der Voort, H., Zent, S., Rosero-Peña, M., Zambrano, A. almeyda, Cuvi, N., Surui, G., & Larrea, D. (2021). Critical interconnections between the cultural and biological diversity of Amazonian peoples and ecosystems (Chapter 10; p. 68). The amazon we want. https://www.theamazonwewant.org/public-consultation-on-the-draft-of-the-report-of-the-science-panel-for-the-amazon/

Athayde, T. (1933) Introdução a Economia Moderna. Civilização Brasileira: Rio de Janeiro.

Atkins, E. (2020). Contesting the 'greening' of hydropower in the Brazilian Amazon. *Political Geography*, *80*, 102179. https://doi.org/10.1016/j.polgeo.2020.102179

Atkins, E., & Hope, J. (2021). *Contemporary political ecologies of hydropower: Insights from Bolivia and Brazil*. https://doi.org/10.2458/JPE.2363

Aubin, D., & Varone, F. (2004). The Evolution of European Water Policy. In I. Kissling-Näf & S. Kuks (Eds.), *The Evolution of National Water Regimes in Europe: Transitions in Water Rights and Water Policies* (pp. 49–86). Springer Netherlands. https://doi.org/10.1007/978-1-4020-2484-9_3

Azevedo, S. G., Sequeira, T., Santos, M., & Nikuma, D. (2020). Climate change and sustainable development: The case of Amazonia and policy implications. *Environmental Science and Pollution Research*, *27*(8), 7745–7756. https://doi.org/10.1007/s11356-020-07725-4

Azevedo-Santos, V. M., Arcifa, M. S., Brito, M. F. G., Agostinho, A. A., Hughes, R. M., Vitule, J. R. S., Simberloff, D., Olden, J. D., & Pelicice, F. M. (2021). Negative impacts of mining on Neotropical freshwater fishes. *Neotropical Ichthyology*, *19*. https://doi.org/10.1590/1982-0224-2021-0001

Azevedo-Santos, V. M., Frederico, R. G., Fagundes, C. K., Pompeu, P. S., Pelicice, F. M., Padial, A. A., Nogueira, M. G., Fearnside, P. M., Lima, L. B., Daga, V. S., Oliveira, F. J. M., Vitule, J. R. S., Callisto, M., Agostinho, A. A., Esteves, F. A., Lima-Junior, D. P., Magalhães, A. L. B., Sabino, J., Mormul, R. P., … Henry, R. (2019). Protected areas: A focus on Brazilian freshwater biodiversity. *Diversity and Distributions*, *25*(3), 442–448. https://doi.org/10.1111/ddi.12871

Bair, L., Chief, K., Colombi, B., Melis, T., & Perry, D. (2020). Tribes and water management in the Colorado River, US. In J. Laufer, E. E. Marques, A. C. S. Simone Athayde, & A. D. A. Zagallo (Eds.), *Rivers, Lands and Cultures: Learning from the Tocantins Social-ecological System* (pp. 106–127). Editora Fi. https://doi.org/10.22350/9786587340197

Bakker, K. (2013). Neoliberal Versus Postneoliberal Water: Geographies of Privatization and Resistance. Annals of the Association of American Geographers, 103(2), 253–260. https://doi.org/10.1080/00045608.2013.756246

Bakker, K., & Morinville, C. (2013). The governance dimensions of water security: A review. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, *371*(2002), 20130116. https://doi.org/10.1098/rsta.2013.0116

Bandaragoda, D. J., & Babel, M. S. (2010). Institutional development for IWRM: An international perspective. *International Journal of River Basin Management*, *8*(3–4), 215–224. https://doi.org/10.1080/15715124.2010.496707

Barber, C. P., Cochrane, M. A., Souza, C. M., & Laurance, W. F. (2014). Roads, deforestation, and the mitigating effect of protected areas in the Amazon. *Biological Conservation*, *177*, 203–209. https://doi.org/10.1016/j.biocon.2014.07.004

Barbosa, A. C., Silva, S. R. L., & Dórea, J. G. (1998). Concentration of Mercury in Hair of Indigenous Mothers and Infants from the Amazon Basin. *Archives of Environmental Contamination and Toxicology*, *34*(1), 100–105. https://doi.org/10.1007/s002449900291

Barbosa-Fohrmann, A. P., da Silva, C. A. P., & Escobar, C. V. do A. (2016). Ecological ethics: Reflections on human action on nature. Revista de Estudos Constitucionais, Hermenêutica e Teoria Do Direito, 8(3), 366–374. https://doi.org/10.4013/rechtd.2016.83.09

Barletta, M., Cysneiros, F. J. A., & Lima, A. R. A. (2016). Effects of dredging operations on the demersal fish fauna of a South American tropical–subtropical transition estuary. *Journal of Fish Biology*, *89*(1), 890–920. https://doi.org/10.1111/jfb.12999

Barletta, M., Jaureguizar, A. J., Baigun, C., Fontoura, N. F., Agostinho, A. A., Almeida-Val, V. M. F., Val, A. L., Torres, R. A., Jimenes-Segura, L. F., Giarrizzo, T., Fabré, N. N., Batista, V. S., Lasso, C., Taphorn, D. C., Costa, M. F., Chaves, P. T., Vieira, J. P., & Corrêa, M. F. M. (2010). Fish and aquatic habitat conservation in South America: A continental overview with emphasis on neotropical systems. *Journal of Fish Biology*, *76*(9), 2118–2176. https://doi.org/10.1111/j.1095-8649.2010.02684.x

Barreto, C. (2008). Entre mistérios e malogros: Os primeiros contatos com ameríndios da Amazônia. *América, Contacto e Independencia*, 110–121.

Barreto, C., & Machado, J. (2001). Exploring the Amazon, explaining the unknown: Views from the past. *Unknown Amazon: Studies in Visual and Material Culture*, 232–251.

Bastin, L., Gorelick, N., Saura, S., Bertzky, B., Dubois, G., Fortin, M.-J., & Pekel, J.-F. (2019). Inland surface waters in protected areas globally: Current coverage and 30-year trends. PLOS ONE, 14(1), e0210496. https://doi.org/10.1371/journal.pone.0210496

Baumann, R., & Mussi, C. (2006). Mercosul: então e agora. Revista Brasileira de Comércio Exterior, n. 88, jul.-set. 2006, p. 4-24.

Bax, V., Francesconi, W., & Quintero, M. (2016). Spatial modeling of deforestation processes in the Central Peruvian Amazon. *Journal for Nature Conservation*, *29*, 79–88. https://doi.org/10.1016/j.jnc.2015.12.002

Becker, B. K. (1988). Significância contemporânea da fronteira: Uma interpretação geopolítica a partir da Amazônia Brasileira. In C. Aubertin (Ed.), *Fronteiras* (pp. 60–89). UNB/ORSTOM. https://core.ac.uk/download/pdf/39867905.pdf#page=58

Belletti, B., Garcia de Leaniz, C., Jones, J., Bizzi, S., Börger, L., Segura, G., Castelletti, A., van de Bund, W., Aarestrup, K., Barry, J., Belka, K., Berkhuysen, A., Birnie-Gauvin, K., Bussettini, M., Carolli, M., Consuegra, S., Dopico, E., Feierfeil, T., Fernández, S., … Zalewski, M. (2020). More than one million barriers fragment Europe's rivers. *Nature*, *588*(7838), 436–441. https://doi.org/10.1038/s41586-020-3005-2

Benatti, J. H. (2005). A soja na Amazônia e o ordenamento territorial. In *A geopolítica da soja na Amazônia* (p. 334). Museu Paraense Emílio Goeldi. https://www.alice.cnptia.embrapa.br/bitstream/doc/902551/1/AgeopolsojaAmazonia.pdf

Bennett, N. J. (2016). Using perceptions as evidence to improve conservation and environmental management. *Conservation Biology*, *30*(3), 582–592. https://doi.org/10.1111/cobi.12681

Bentham, J. (1789). *An Introduction to the Principles of Morals and Legislation* (E. J. H. Burns & H. L. A. Hart, Eds.). Athlone Press.

Berg, C. N., Deichmann, U., Liu, Y., & Selod, H. (2017). Transport Policies and Development. *The Journal of Development Studies*, *53*(4), 465–480. https://doi.org/10.1080/00220388.2016.1199857

Best, J. (2019). Anthropogenic stresses on the world's big rivers. *Nature Geoscience*, *12*(1), 7–21. https://doi.org/10.1038/s41561-018-0262-x

Bhattacherjee, A. (2012). *Social science research: Principles, methods, and practices* (Second edition). Anol Bhattacherjee.

Binsztok, J., & Carneiro, M. (2015). Integração Nacional, Desenvolvimento Capitalista e Projetos Modernizantes na Amazônia: Retrospectiva e perspectiva de despojos da Mineração Rio do Norte—PA. *Revista NERA*, *28*(18), 14. https://doi.org/10.47946/rnera.v0i28.3993

Blaikie, P. M., Brookfield, H. C. (1987). Land Degradation and Society Methuen, London

Blanco, M. M., Mazzini, S. A., & Link, D. (2001). *Uma análise comparativa das legislações fitossanitárias dos países do Mercosul*. CREA/RS.

Boelens, R., Hoogesteger, J., Swyngedouw, E., Vos, J., & Wester, P. (2016). Hydrosocial territories: A political ecology perspective. *Water International*, *41*(1), 1–14. https://doi.org/10.1080/02508060.2016.1134898

Boers, N., Marwan, N., Barbosa, H. M. J., & Kurths, J. (2017). A deforestation-induced tipping point for the South American monsoon system. *Scientific Reports*, *7*(1), 41489. https://doi.org/10.1038/srep41489

Bomfim, M. (2008). *A américa latina: Males de origem*. https://books.scielo.org/id/zg8vf

Bomfim, P. R. de A. (2010). Fronteira Amazônica e Planejamento na Época da Ditadura Militar no Brasil: Inundar a Hileia de Civilização. *Boletim Goiano de Geografia*, *30*(1), 13–33. https://doi.org/10.5216/bgg.v30i1.11191

Borges, L. R. M. (2019). Conflitos territoriais e políticas públicas na Amazônia brasileira: A construção de hidrelétricas a partir do Programa de Aceleração do Crescimento. In Geografia e geopolítica da América do Sul: Integrações e conflitos | Portal de Livros Abertos da USP (pp. 272–287). https://doi.org/10.11606/9788575063552

Branco, P., Segurado, P., Santos, J. M., & Ferreira, M. T. (2014). Prioritizing barrier removal to improve functional connectivity of rivers. *Journal of Applied Ecology*, *51*(5), 1197–1206. https://doi.org/10.1111/1365-2664.12317

Brandford, S. (2016). BNDES: a bank loans billions to tame South America's wild waters. Mongabay. Retrieved June 3, 2021, https://news.mongabay.com/2016/03/bndes-a-bank-loans-billions-to-tame-south-americas-wild-waters/

Brandford, S., & Torres, M. (2017). *Is Brazil green washing hydropower? The case of the Teles Pires dam*. https://news.mongabay.com/2017/01/is-brazil-green-washing-hydropower-the-case-of-the-teles-pires-dam/

Bresser-Pereira, L. C. (2017). The two forms of capitalism: Developmentalism and economic liberalism. *Brazilian Journal of Political Economy*, *37*, 680–703. https://doi.org/10.1590/0101-31572017v37n04a02

Brondízio, E. S. (2008). The Amazonian Caboclo and the Açaí Palm: Forest Farmers in the Global Market. *Advances in Economic Botany*, *16*, iii–403.

Browder, J. O., Pedlowski, M. A., Walker, R., Wynne, R. H., Summers, P. M., Abad, A., Becerra-Cordoba, N., & Mil-Homens, J. (2008). Revisiting Theories of Frontier Expansion in the Brazilian Amazon: A Survey of the Colonist Farming Population in Rondônia's Post-Frontier, 1992–2002. *World Development*, *36*(8), 1469–1492. https://doi.org/10.1016/j.worlddev.2007.08.008

C169—Indigenous and Tribal Peoples Convention, 1989. (2007). http://www.ilo.org/jakarta/whatwedo/publications/WCMS_124013/lang--en/index.htm

CAF (1998). Los ríos nos unen: Integración Fluvial Sudamericana. Caracas: CAF.

Callède, J., Cochonneau, G., Alves, F., Guyot, J.-L., Guimarães, V., & De Oliveira, E. (2010). Les apports en eau de l'Amazone à l'Océan Atlantique. *Revue des sciences de l'eau / Journal of Water Science*, *23*(3), 247–273. https://doi.org/10.7202/044688ar

Callède, J., Guyot, J., Ronchail, J. L., Hote, Y., Niel, H., & Oliveira, E.-S. (2004). Evolution du d'ebit de l'Amazone à Obidos de 1903 à 1999. *Hydrological Sciences Journal*, *49*, 85–98.

Callisto, M., Solar, R., Silveira, F. A. O., Saito, V. S., Hughes, R. M., Fernandes, G. W., Gonçalves-Júnior, J. F., Leitão, R. P., Massara, R. L., Macedo, D. R., Neves, F. S., & Alves, C. B. M. (2019). A Humboldtian Approach to Mountain Conservation and Freshwater Ecosystem Services. *Frontiers in Environmental Science*, *7*, 195. https://doi.org/10.3389/fenvs.2019.00195

Carranza, M. E. (2002). Neighbors or Partners? Nafta and the Politics of Regional Economic Integration in North America. *Latin American Politics and Society*, *44*(3), 141–157. Cambridge Core. https://doi.org/10.1111/j.1548-2456.2002.tb00217.x

Carvalho, D. F. R. de. (2009). *O Tratado de Cooperação Amazônica no contexto dos processos de integração regional: Da unidade fragmentada à unidade integrada* [Pontificia Universidade Católica de Minas Gerais–PUC/MG]. http://www.biblioteca.pucminas.br/teses/Direito_CarvalhoDF_1.pdf

Carvalho, L. A. de. (2002). Os procesos de integração econômica regional da União Européia e do MERCOSUL: Breve abordagem histórico-evolutiva. *Scientia Iuris*, *5*(0), 59–92. https://doi.org/10.5433/2178-8189.2002v5n0p59

Carvalho, W. D., Mustin, K., Hilário, R. R., Vasconcelos, I. M., Eilers, V., & Fearnside, P. M. (2019). Deforestation control in the Brazilian Amazon: A conservation struggle being lost as

agreements and regulations are subverted and bypassed. *Perspectives in Ecology and Conservation*, *17*(3), 122–130. https://doi.org/10.1016/j.pecon.2019.06.002

Castello, L. (2021). Science for conserving Amazon freshwater ecosystems. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(5), 999–1004. https://doi.org/10.1002/aqc.3615

Castello, L., & Macedo, M. N. (2016). Large-scale degradation of Amazonian freshwater ecosystems. *Global Change Biology*, *22*(3), 990–1007. https://doi.org/10.1111/gcb.13173

Castello, L., McGrath, D. G., & Beck, P. S. A. (2011). Resource sustainability in small-scale fisheries in the Lower Amazon floodplains. *Fisheries Research*, *110*(2), 356–364. https://doi.org/10.1016/j.fishres.2011.05.002

Castello, L., McGrath, D. G., Hess, L. L., Coe, M. T., Lefebvre, P. A., Petry, P., Macedo, M. N., Renó, V. F., & Arantes, C. C. (2013). The vulnerability of Amazon freshwater ecosystems. *Conservation Letters*, *6*(4), 217–229. https://doi.org/10.1111/conl.12008

Castro, C. J. C. (2020). Amazônia Colombiana como sujeito de direitos: Sentença da Corte Suprema de Justiça da Colômbia. In *Direitos da Natureza: Marcos Para a Construção de uma Teoria Geral* (1st ed., pp. 69–80). Casa Leiria. https://doi.org/10.29327/524851.1-5

CBD. (2020). Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets. Secretariat of the Convention on Biological Diversity. https://www.cbd.int/sp/

Celli Junior, U. (2007). Teoria geral da integração: Em busca de um modelo alternativo. In *Blocos econômicos e integração na América Latina, África e Ásia*. Juruá.

Chade, J. (2021). Por Amazônia, deputados europeus bloqueiam acordo com Brasil -. UOL Notícias. https://noticias.uol.com.br/colunas/jamil-chade/2021/10/20/por-amazonia-deputados-europeus-bloqueiam-acordo-com-brasil.htm]/

Charity, S., Dudley, N., Oliveira, D., & Stolton, S. (2016). *Living Amazon Report 2016: A regional approach to conservation in the Amazon*. WWF Living Amazon Initiative, Brasília and Quito. http://assets.worldwildlife.org/publications/889/files/original/LIVING_AMAZON__REPORT_2016_MID_RES_SPREADS.pdf?1465588596&_ga=1.221153819.2028824827.1466267170

Chaudhari, S., Brown, E., Quispe-Abad, R., Moran, E., Müller, N., & Pokhrel, Y. (2021). In-stream turbines for rethinking hydropower development in the Amazon basin. *Nature Sustainability*. https://doi.org/10.1038/s41893-021-00712-8

Chaves, O. R. (2014). América portuguesa: Do Tratado de Madri ao Tratado de Santo Ildefonso. Revista Territórios e Fronteiras, 7(2), 218–234. https://doi.org/10.22228/rt-f.v7i2.352

Cid, N., Erős, T., Heino, J., Singer, G., Jähnig, S. C., Cañedo-Argüelles, M., Bonada, N., Sarremejane, R., Mykrä, H., Sandin, L., Paloniemi, R., Varumo, L., & Datry, T. (n.d.). From meta-system theory to the sustainable management of rivers in the Anthropocene. *Frontiers in Ecology and the Environment*, *n/a* (n/a). (https://doi.org/10.1002/fee.2417)

Clay, C. H. (2019). *Desing fishways and other fish facilities* (2nd ed.). CRC Press. https://www.routledge.com/Design-of-Fishways-and-Other-Fish-Facilities/Clay/p/book/9780367449261

Cleary, D. (1990). *Anatomy of the Amazon Gold Rush.* Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-11247-0

Cleary, D. (1993). After the Frontier: Problems with Political Economy in the Modern Brazilian Amazon. *Journal of Latin American Studies*, *25*(2), 331–349.

Cleary, D. (2001). Towards an Environmental History of the Amazon: From Prehistory to the Nineteenth Century. *Latin American Research Review*, *36*(2), 65–96.

Clerici, N., Armenteras, D., Kareiva, P., Botero, R., Ramírez-Delgado, J. P., Forero-Medina, G., Ochoa, J., Pedraza, C., Schneider, L., Lora, C., Gómez, C., Linares, M., Hirashiki, C., & Biggs, D. (2020). Deforestation in Colombian protected areas increased during post-conflict periods. *Scientific Reports*, *10*(1), 4971. https://doi.org/10.1038/s41598-020-61861-y

Cobanoglu, C., Moreo, P. J., & Warde, B. (2001). A Comparison of Mail, Fax and Web-Based Survey Methods. *International Journal of Market Research*, *43*(4), 1–15. https://doi.org/10.1177/147078530104300401

Coe, M. T., Latrubesse, E. M., Ferreira, M. E., & Amsler, M. L. (2011). The effects of deforestation and climate variability on the streamflow of the Araguaia River, Brazil. *Biogeochemistry*, *105*(1), 119–131. https://doi.org/10.1007/s10533-011-9582-2

Coffin, A. W. (2007). From roadkill to road ecology: A review of the ecological effects of roads. *Journal of Transport Geography*, *15*(5). https://doi.org/10.1016/j.jtrangeo.2006.11.006

COHIDRO. (n.d.). *ABOUT US* – Retrieved October 29, 2021, from http://www.cohidro.com.pe/en/cohidro/

Constituição, B. (1988). *Constituição da República Federativa do Brasil*. Senado Federal: Centro Gráfico.

Constitute. (n.d.). Retrieved October 29, 2021, from https://www.constituteproject.org?lang=en

Coomes, O. T., Takasaki, Y., Abizaid, C. B., & B.L. (2010). Floodplain fisheries as natural insurance for the rural poor in tropical forest environments: Evidence from Amazonia. *Fisheries Management and Ecology*, *17*(6), 513–521. https://doi.org/10.1111/j.1365-2400.2010.00750.x

COSIPLAN. (2013). *Estatuto*. http://www.iirsa.org/admin_iirsa_web/Uploads/Documents/cosiplan_estatuto.pdf

COSIPLAN. (n.d.). *Cartera de Proyectos*. Retrieved October 29, 2021, from http://iirsa.org/Page/Detail?menuItemId=32

Costa, W. M. (2019). Crise da integração e tendências geopolíticas na América do Sul. In Geografia e geopolítica da América do Sul: Integrações e conflitos | Portal de Livros Abertos da USP (pp. 16–34). https://doi.org/10.11606/9788575063552

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253–260. https://doi.org/10.1038/387253a0

Costanza, R., de Groot, R., Sutton, P., van der Ploeg, S., Anderson, S. J., Kubiszewski, I., Farber, S., & Turner, R. K. (2014). Changes in the global value of ecosystem services. *Global Environmental Change*, *26*, 152–158. https://doi.org/10.1016/j.gloenvcha.2014.04.002

Cotta, J. N. (2015). Contributions of local floodplain resources to livelihoods and household income in the Peruvian Amazon. *Forest Policy and Economics*, *59*, 35–46. https://doi.org/10.1016/j.forpol.2015.05.008

Couto, T. (2021). Pequenas hidrelétricas na Amazônia são insustentáveis, ineficientes e quase sempre injustificáveis. National Geographic. Retrieved december 1, 2021 from https://www.nationalgeographicbrasil.com/meio-ambiente/2021/10/pequenas-hidreletricas-na-amazonia-sao-insustentaveis-ineficientes-e-quase-sempre-injustificaveis

Creeze, B. (2017). *Interoceanic Highway incites deforestation in Peru, threatens more to come*. Mongabay. Retrieved June 2, 2021, from https://news.mongabay.com/2017/11/interoceanic-highway-incites-deforestation-in-peru-threatens-more-to-come/

Cremers, L., Kolen, J., & de Theije, M. E. M. (Eds.). (2013). *Small-scale Gold Mining in the Amazon. The cases of Bolivia, Brazil, Colombia, Peru and Suriname*. CEDLA.

Crouzeilles, R., Feltran-Barbieri, R., Ferreira, M. S., & Strassburg, B. B. N. (2017). *Hard times for the Brazilian environment. Nature Ecology and Evolution*. Nature Publishing Group. https://doi.org/10.1038/s41559-017-0303-7

Cruz, D. C., Benayas, J. M. R., Ferreira, G. C., Santos, S. R., & Schwartz, G. (2021). An overview of forest loss and restoration in the Brazilian Amazon. New Forests, 52(1), 1–16. https://doi.org/10.1007/s11056-020-09777-3

Cuenca Putumayo-Içá. (n.d.). Nossas novidades. Retrieved October 29, 2021, from https://cuencaputumayoica.com/nuestras-noticias/?lang=pt-br

Curtis, P. G., Slay, C. M., Harris, N. L., Tyukavina, A., & Hansen, M. C. (2018). Classifying drivers of global forest loss. Science, 361(6407), 1108–1111. https://doi.org/10.1126/science.aau3445

Daily, G. C., Polasky, S., Goldstein, J., Kareiva, P. M., Mooney, H. A., Pejchar, L., Ricketts, T. H., Salzman, J., & Shallenberger, R. (2009). Ecosystem services in decision making: Time to deliver. *Frontiers in Ecology and the Environment*, *7*(1), 21–28. https://doi.org/10.1890/080025

Daily, G. C., Söderqvist, T., Aniyar, S., Arrow, K., Dasgupta, P., Ehrlich, P. R., Folke, C., Jansson, A., Jansson, B.-O., Kautsky, N., Levin, S., Lubchenco, J., Mäler, K.-G., Simpson, D., Starrett, D., Tilman, D., & Walker, B. (2000). The Value of Nature and the Nature of Value. *Science*, *289*(5478), 395–396. https://doi.org/10.1126/science.289.5478.395

Daly, H. E., & Farley, J. C. (2010). *Ecological economics: Principles and applications* (2nd ed.). Island Press.

Darwall, W., Bremerich, V., De Wever, A., Dell, A. I., Freyhof, J., Gessner, M. O., Grossart, H.-P., Harrison, I., Irvine, K., Jähnig, S. C., Jeschke, J. M., Lee, J. J., Lu, C., Lewandowska, A. M., Monaghan, M. T., Nejstgaard, J. C., Patricio, H., Schmidt-Kloiber, A., Stuart, S. N., … Weyl, O. (2018). The Alliance for Freshwater Life: A global call to unite efforts for freshwater

biodiversity science and conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *28*(4), 1015–1022. https://doi.org/10.1002/aqc.2958

Davis, C. (1997). Introduction: The Context of Public Lands Policy Change. In C. Davis (Ed.), *Western Public Lands and Environmental Politics*. Westview Press.

de Groot, R. S., Wilson, M. A., & Boumans, R. M. J. (2002). A typology for the classification, description and valuation of ecosystem functions, goods and services. *Ecological Economics*, *41*(3), 393–408. https://doi.org/10.1016/S0921-8009(02)00089-7

Deinet, S., Scott-Gatty, K., Rotton, H., Twardek, W. M., Marconi, V., McRae, L., Baumgartner, L. J., Brink, K., Claussen, J. E., Cooke, S. J., Darwall, W., Eriksson, B. K., Garcia de Leaniz, C., Hogan, Z., Royte, J., Silva, L. G. M., Thieme, M. L., Tickner, D., Waldman, J., … Berkhuysen, A. (2020). *The Living Planet Index (LPI) for migratory freshwater fish: Technical Report*. World Fish Migration Foundation. https://worldfishmigrationfoundation.com/wp-content/uploads/2020/07/LPI_report_2020.pdf

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R. T., Molnár, Z., Hill, R., Chan, K. M. A., Baste, I. A., Brauman, K. A., Polasky, S., Church, A., Lonsdale, M., Larigauderie, A., Leadley, P. W., van Oudenhoven, A. P. E., van der Plaat, F., Schröter, M., Lavorel, S., … Shirayama, Y. (2018). Assessing nature's contributions to people. *Science*, *359*(6373), 270–272. https://doi.org/10.1126/science.aap8826

Diele-Viegas, L. M., Pereira, E. J. de A. L., & Rocha, C. F. D. (2020). The new Brazilian gold rush: Is Amazonia at risk? *Forest Policy and Economics*, *119*, 102270. https://doi.org/10.1016/j.forpol.2020.102270

Dijck, P. van. (2013). *The Impact of the IIRSA Road Infrastructure Programme on Amazonia*. Routledge. https://doi.org/10.4324/9780203084021

Dijk, T. A. V. (1985). Handbook of Discourse Analysis. *Discourse and Dialogue*.

Dirzo, R., & Raven, P. H. (2003). Global State of Biodiversity and Loss. *Annual Review of Environment and Resources*, *28*(1), 137–167. https://doi.org/10.1146/annurev.energy.28.050302.105532

Doria, C. R. da C., Athayde, S., Marques, E. E., Lima, M. A. L., Dutka-Gianelli, J., Ruffino, M. L., Kaplan, D., Freitas, C. E. C., & Isaac, V. N. (2018). The invisibility of fisheries in the process of hydropower development across the Amazon. *Ambio*, *47*(4), 453–465. https://doi.org/10.1007/s13280-017-0994-7

Doria, C. R. da C., Ruffino, M. L., Hijazi, N. C., & Cruz, R. L. da. (2012). A pesca comercial na bacia do rio Madeira no estado de Rondônia, Amazônia brasileira. *Acta Amazonica*, *42*, 29–40. https://doi.org/10.1590/S0044-59672012000100004

Dros, J. M. (2004). *Managing the soy boom: Two scenarios of soy production expansion in South America* (p. 65). AIDEnvironment. https://wwfeu.awsassets.panda.org/downloads/managingthesoyboomenglish_nbvt.pdf

Drury, R., Homewood, K., & Randall, S. (2011). Less is more: The potential of qualitative approaches in conservation research. *Animal Conservation*, *14*(1), 18–24. https://doi.org/10.1111/j.1469-1795.2010.00375.x

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C., Naiman, R. J., Prieur-Richard, A.-H., Soto, D., Stiassny, M. L. J., & Sullivan, C. A. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews*, *81*(02), 163. https://doi.org/10.1017/S1464793105006950

Dudley, N., Groves, C., Redford, K. H., & Stolton, S. (2014). Where now for protected areas? Setting the stage for the 2014 World Parks Congress. *Oryx*, *48*(4), 496–503. https://doi.org/10.1017/S0030605314000519

Dulci, T. M. S. (2008). *As conferências panamericanas: Identidades, união aduaneira e arbitragem (1889-1928)* [Text, Universidade de São Paulo]. https://doi.org/10.11606/D.8.2008.tde-30112009-110850

Dutta, V., Sharma, U., & Iqbal, K. (2018). Impact of river channelization and riverfront development on fluvial habitat: Evidence from Gomti River, a tributary of Ganges, India. *Environmental Sustainability*, *1*, 167–184. https://doi.org/10.1007/s42398-018-0016-0

DW (n.d). COP26: World leaders back deal to end deforestation by 2030. Retrieved December 5, 2021, https://www.dw.com/en/cop26-world-leaders-back-deal-to-end-deforestation-by-2030/a-59689957

ECLAC. (2014). CEPAL. Unasur, un espacio de cooperación e integración para el desarollo. Santiago de Chile. CEPAL. Retrieved April 14, 2020 http://www.cepal.org/es/publicaciones/37353-unasur-un-espacio-de cooperacion-e-integracion-para-el-desarollo

Eichler, J., & Bacca, P. I. (2020). Contemporary forms of cultural genocide in the natural resource sector: Indigenous peoples' perspectives from Bolivia and Colombia. *Canadian Journal of Development Studies / Revue Canadienne d'études Du Développement*, *0*(0), 1–19. https://doi.org/10.1080/02255189.2020.1796601

Elbein, C. (2019). Of concrete and corruption: Resistance kills Andes Amazon dams. Mongabay. Retrieved June 2, 2021, https://news.mongabay.com/2019/01/of-concrete-corruption-peoples-resistance-kills-andes-amazon-dams/

Ellis, E. C., Pascual, U., & Mertz, O. (2019). Ecosystem services and nature's contribution to people: Negotiating diverse values and trade-offs in land systems. *Current Opinion in Environmental Sustainability*, *38*, 86–94. https://doi.org/10.1016/j.cosust.2019.05.001

Escobar, H. (2019). Amazon fires clearly linked to deforestation, scientists say. *Science*, *365*(6456), 853–853. https://doi.org/10.1126/science.365.6456.853

Evers, M. (2016). Integrative river basin management: Challenges and methodologies within the German planning system. *Environmental Earth Sciences*, *75*(14), 1085. https://doi.org/10.1007/s12665-016-5871-3

Fa, J. E., Watson, J. E., Leiper, I., Potapov, P., Evans, T. D., Burgess, N. D., Molnár, Z., Fernández-Llamazares, Á., Duncan, T., Wang, S., Austin, B. J., Jonas, H., Robinson, C. J., Malmer, P., Zander, K. K., Jackson, M. V., Ellis, E., Brondizio, E. S., & Garnett, S. T. (2020). Importance of Indigenous Peoples' lands for the conservation of Intact Forest Landscapes. *Frontiers in Ecology and the Environment*, *18*(3), 135–140. https://doi.org/10.1002/fee.2148

Faial, K., Deus, R., Deus, S., Neves, R., Jesus, I., Santos, E., Alves, C. N., & Brasil, D. (2015). Mercury levels assessment in hair of riverside inhabitants of the Tapajós River, Pará State, Amazon,

Brazil: Fish consumption as a possible route of exposure. *Journal of Trace Elements in Medicine and Biology*, *30*, 66–76. https://doi.org/10.1016/j.jtemb.2014.10.009

Faria, F. A. M., & Jaramillo, P. (2017). The future of power generation in Brazil: An analysis of alternatives to Amazonian hydropower development. *Energy for Sustainable Development*, *41*, 24–35. https://doi.org/10.1016/j.esd.2017.08.001

Fawcett, L. (2005). The Origins and Development of Regional Ideas in the Americas. In L. Fawcett & M. Serrano (Eds.), *Regionalism and Governance in the Americas: Continental Drift* (pp. 27–51). Palgrave Macmillan UK. https://doi.org/10.1057/9780230523029_2

Fearnside, P. (2020). Hidrelétricas e povos tradicionais: 1 – Resumo da série. Amazonia Real. Retrieved October 1, 2021, from http://philip.inpa.gov.br/publ_livres/2020/Hidreletricas_e_povos_tradicionais-Serie_completa.pdf

Fearnside, P. M. (2014). Impacts of Brazil's Madeira River Dams: Unlearned lessons for hydroelectric development in Amazonia. *Environmental Science & Policy*, *38*, 164–172. https://doi.org/10.1016/j.envsci.2013.11.004

Fearnside, P. M. (2015). Amazon dams and waterways: Brazil's Tapajós Basin plans. *Ambio*, *44*(5), 426–439. https://doi.org/10.1007/s13280-015-0642-z

Fearnside, P. M. (2016). *Greenhouse gas emissions from Brazil's Amazonian hydroelectric dams*. *11*(1), 011002. https://doi.org/10.1088/1748-9326/11/1/011002

Fearnside, P. M. (2017). Belo Monte: Actors and arguments in the struggle over Brazil's most controversial Amazonian dam. *DIE ERDE – Journal of the Geographical Society of Berlin*, *148*(1), 14–26. https://doi.org/10.12854/erde-148-27

Fearnside, P., Berenguer, E., Armenteras, D., Duponchelle, F., Mosquera Guerra, F., Jenkins, C., Bynoe, P., García-Villacorta, R., Macedo, M., Val, A., & Almeida-Val, V. (2021). Drivers and impacts of changes in aquatic ecosystems Chapter 20 Amazon Assessment Report 2021 (pp. 305–343).

Feinberg, R. (2005). Review of Integrating the Americas: FTAA and Beyond; Free Trade and the Environment: Mexico, NAFTA, and Beyond [Review of *Review of Integrating the Americas: FTAA and Beyond; Free Trade and the Environment: Mexico, NAFTA, and Beyond*, by A. Estevadeordal, D. Rodrik, A. M. Taylor, A. Velasco, & K. P. Gallagher]. *Foreign Affairs*, *84*(2), 163–163. https://doi.org/10.2307/20034315

Fernandes, G. W., Vale, M. M., Overbeck, G. E., Bustamante, M. M. C., Grelle, C. E. V., Bergallo, H. G., Magnusson, W. E., Akama, A., Alves, S. S., Amorim, A., Araújo, J., Barros, C. F., Bravo, F., Carim, M. J. V., Cerqueira, R., Collevatti, R. G., Colli, G. R., da Cunha, C. N., D'Andrea, P. S., … Pillar, V. D. (2017). Dismantling Brazil's science threatens global biodiversity heritage. *Perspectives in Ecology and Conservation*, *15*(3), 239–243. https://doi.org/10.1016/j.pecon.2017.07.004

Fernández-Llamazares, Á., López-Baucells, A., Velazco, P. M., Gyawali, A., Rocha, R., Terraube, J., & Cabeza, M. (2021). The importance of Indigenous Territories for conserving bat diversity across the Amazon biome. *Perspectives in Ecology and Conservation*, *19*(1), 10–20. https://doi.org/10.1016/j.pecon.2020.11.001

Ferrante, L., & Fearnside, P. M. (2019). Brazil's new president and 'ruralists' threaten Amazonia's environment, traditional peoples and the global climate. *Environmental Conservation*, *46*(4), 261–263. https://doi.org/10.1017/S0376892919000213

Ferrante, L., & Fearnside, P. M. (2020). Brazil threatens Indigenous lands. *Science*, *368*(6490), 481–482. https://doi.org/10.1126/science.abb6327

Ferrante, L., Andrade, M. B. T., & Fearnside, P. M. (2021). Land grabbing on Brazil's Highway BR-319 as a spearhead for Amazonian deforestation. *Land Use Policy*, *108*, 105559. https://doi.org/10.1016/j.landusepol.2021.105559

Ferrante, L., Gomes, M., & Fearnside, P. M. (2020a). Amazonian indigenous peoples are threatened by Brazil's Highway BR-319. *Land Use Policy*, *94*, 104548. https://doi.org/10.1016/j.landusepol.2020.104548

Ferrante, L., Leite, L., Silva Junior, C. A., Lima, M., Coelho Junio, M. G., & Fearnside, P. M. (2020b). *Brazil's biomes threatened: President Bolsonaro lied to the world*. Nature Portfolio Ecology & Evolution Community. http://natureecoevocommunity.nature.com/posts/brazil-s-biomes-threatened-president-bolsonaro-lied-to-the-world

Ferreira, A. M. M., & Salati, E. (2005). Forças de transformação do ecossistema amazônico. *Estudos Avançados*, *19*, 25–44. https://doi.org/10.1590/S0103-40142005000200003

Ferreira, M. A. (2013). Pacha Mama: Os Direitos da Natureza e o Novo Constitucionalismo na América Latina. Revista de Direito Brasileira, 4(3), 400–423. https://doi.org/10.26668/IndexLawJournals/2358-1352/2013.v4i3.2644

Figueira, J. E. C., Santos, F. R., Drumond, M. A., Massara, R. L., Ribeiro, M. C., & Fernandes, G. W. (2021). We Can't Breathe! The urgency for an ethical sustainable social-environmental policy for a downgrading Brazil. *Amazônia Latitude Review*, *27*. https://amazonialatitude.com/2021/06/15/the-urgency-for-an-ethical-sustainable-socio-environmental-policy-for-brazil/?fbclid=IwAR0evne0j4w_IyLY7w4Tn1c-8TpfKw3HiCSqPc1QGwmePKlpX7i_w6YRDU8

Findlay, A. (2021). Climate mitigation through Indigenous forest management. *Nature Climate Change*, *11*(5), 371–373. https://doi.org/10.1038/s41558-021-01042-5

Flexor, G., & Leite, S. P. (2017). Land Market and Land Grabbing in Brazil during the Commodity Boom of the 2000s. *Contexto Internacional*, *39*, 393–420. https://doi.org/10.1590/S0102-8529.2017390200010

Fonseca, R. (2018). *Status da gestão das bacias hidrográficas em Florestas Nacionais da Região Amazônica. Tese de Doutorado* [Universidade Federal de Minas Gerais]. http://hdl.handle.net/1843/BUOS-B78KHF

Forsberg, B. R., Melack, J. M., Dunne, T., Barthem, R. B., Goulding, M., Paiva, R. C. D., Sorribas, M. V., Jr, U. L. S., & Weisser, S. (2017). The potential impact of new Andean dams on Amazon fluvial ecosystems. *PLOS ONE*, *12*(8), e0182254. https://doi.org/10.1371/journal.pone.0182254

Forslund, A., Renöfält, B. M., Barchiesi, S., Cross, K., Davidson, S., Farrell, T., Korsgaard, L., Krchnak, K., McClain, M., Meijer, K., & Smith, M. (2009). *Securing Water for Ecosystems and Human Well-being: The Importance of Environmental Flows*. http://hdl.handle.net/10535/5141

Fuccille, A. (2015). Amazônia e Defesa Nacional: Um olhar a partir da perspectiva brasileira. *PAIAGUÁS: revista de estudos sobre a Amazônia e Pacífico*, *1*(2), Article 2. https://desafioonline.ufms.br/index.php/revpaiaguas/article/view/2127

Furtado, J. F. (2013). Mapping Mythical and Imaginary Places in d'Anville's Carte de l'Amérique Méridionale. *Journal of Earth Science and Engineering*, *10*, 714–721.

Furtado, L. G., Leitão, W., & Mello, A. F. de. (1993). *Povos das águas: Realidade e perspectivas na Amazônia*. Museu Paraense Emílio Goeldi. https://repositorio.museu-goeldi.br/bitstream/mgoeldi/777/1/POVOS%20DAS%20AGUAS%201993%20ALENCAR.pdf

Gallice, G. R., Larrea-Gallegos, G., & Vázquez-Rowe, I. (2019). The threat of road expansion in the Peruvian Amazon. *Oryx*, *53*(2), 284–292. https://doi.org/10.1017/S0030605317000412

Ganti, T. (2014). Neoliberalism. Annual Review of Anthropology, 43(1), 89–104. https://doi.org/10.1146/annurev-anthro-092412-155528

Gatti, L. V., Basso, L. S., Miller, J. B., Gloor, M., Gatti Domingues, L., Cassol, H. L. G., Tejada, G., Aragão, L. E. O. C., Nobre, C., Peters, W., Marani, L., Arai, E., Sanches, A. H., Corrêa, S. M., Anderson, L., Von Randow, C., Correia, C. S. C., Crispim, S. P., & Neves, R. A. L. (2021). Amazonia as a carbon source linked to deforestation and climate change. *Nature*, *595*(7867), 388–393. https://doi.org/10.1038/s41586-021-03629-6

Gee, J. P. (2004). *An Introduction to Discourse Analysis: Theory and Method* (2nd ed.). Routledge. https://doi.org/10.4324/9780203005675

Gerlak, A. K., Saguier, M., Mills-Novoa, M., Fearnside, P. M., & Albrecht, T. R. (2020). Dams, Chinese investments, and EIAs: A race to the bottom in South America? *Ambio*, *49*(1), 156–164. https://doi.org/10.1007/s13280-018-01145-y

Giffoni, J. F., Almeida, M. S. M. D., Rios, M., & Oliveira, V. H. D. (2020). Paradigma dos Direitos da Natureza. In *Direitos da Natureza: Marcos para a Construção de uma Teoria Geral* (pp. 15–27). Casa Leiria. https://doi.org/10.29327/524851.1-1

Giordano, M., & Shah, T. (2014). From IWRM back to integrated water resources management. *International Journal of Water Resources Development*, *30*(3), 364–376. https://doi.org/10.1080/07900627.2013.851521

Glaser, B. G., & Strauss, A. (1967). The discovery of grounded theory: Strategies for qualitative research. *Chicago: Aldine*, 284.

Glasgow Leaders' Declaration on Forests and Land Use. (2021). UN Climate Change Conference (COP26) at the SEC – Glasgow 2021. https://ukcop26.org/glasgow-leaders-declaration-on-forests-and-land-use/

Golden Kroner, R. E., Qin, S., Cook, C. N., Krithivasan, R., Pack, S. M., Bonilla, O. D., Cort-Kansinally, K. A., Coutinho, B., Feng, M., Martínez Garcia, M. I., He, Y., Kennedy, C. J., Lebreton, C., Ledezma, J. C., Lovejoy, T. E., Luther, D. A., Parmanand, Y., Ruíz-Agudelo, C. A., Yerena, E., … Mascia, M. B. (2019). The uncertain future of protected lands and waters. *Science*, *364*(6443), 881–886. https://doi.org/10.1126/science.aau5525

Gollnow, F., Hissa, L. de B. V., Rufin, P., & Lakes, T. (2018). Property-level direct and indirect deforestation for soybean production in the Amazon region of Mato Grosso, Brazil. *Land Use Policy*, *78*, 377–385. https://doi.org/10.1016/j.landusepol.2018.07.010

Gonçalves, A. C. T., Cunha, J. B. C., & Batista, J. S. (2018). *O gigante amazônico: Manejo sustentável de pirarucu = The amazing giant: sustainable management of Arapaima (Pirarucu)*. Instituto de Desenvolvimento Sustentável Mamirauá. https://www.mamiraua.org.br/documentos/4163f5aaff5d05e1a9e1804bb5e06307.pdf

Gonzaga, D. (2020). Illegal mining threatens the Amazon and exposes Indigenous Peoples to COVID-19. Greenpeace. Retrieved September 2, 2021, https://www.greenpeace.org/international/story/43837/mining-yanomami-munduruku-amazon-forest-indigenous-covid-19/

Gonzales, J. (2019). Amazon's giant South American river turtle holding its own, but risks abound. Mongabay Environmental News. https://news.mongabay.com/2019/12/amazons-giant-south-american-river-turtle-holding-its-own-but-risks-abound/

Goodland, R. (2010). Viewpoint—The World Bank versus the World Commission on Dams. *Water Alternatives*, *3*(2), 384–398.

Goulding M, Barthem R, Ferreira E. (2003) The Smithsonian Atlas of the Amazon. Library Congress Cataloging, 251 pp

Gram, S., Kvist, L. P., & Cáseres, A. (2001). The Economic Importance of Products Extracted from Amazonian Flood Plain Forests. *AMBIO: A Journal of the Human Environment*, *30*(6), 365–368. https://doi.org/10.1579/0044-7447-30.6.365

Grandez, P., Mora, C., Ramírez, P., Palao, L., & Monteferri, B. (2020). *Analysis of the environmental legal status of the Veracruz and Chadin 2 Hydroelectric Projects in the Marañon River* (p. 45). Sociedad Peruana de Derecho Ambiental (Peruvian Society of Environmental Law). http://maranonwaterkeeper.org/news/new-report-maranon-dam-certifications-expired-action-by-government-required/

Gravena, W., Farias, I. P., da Silva, M. N. F., da Silva, V. M. F., & Hrbek, T. (2014). Looking to the past and the future: Were the Madeira River rapids a geographical barrier to the boto (Cetacea: Iniidae)? *Conservation Genetics*, *15*(3), 619–629. https://doi.org/10.1007/s10592-014-0565-4

Greenpeace. (n.d.). Greenpeace Joins the Munduruku to Protest Damming of Tapajós RiverMunduruku protestam contra hidrelétricas no Rio Tapajós. Greenpeace USA. Retrieved November 16, 2021, from https://www.greenpeace.org/usa/news-worth-celebrating-megadam-heart-amazon-cancelled/greenpeace-joins-the-munduruku-to-protest-damming-of-tapajos-rivermunduruku-protestam-contra-hidreletricas-no-rio-tapajos-5/

Grill, G., Lehner, B., Lumsdon, A. E., MacDonald, G. K., Zarfl, C., & Liermann, C. R. (2015). *An index-based framework for assessing patterns and trends in river fragmentation and flow regulation by global dams at multiple scales*. *10*(1), 015001. https://doi.org/10.1088/1748-9326/10/1/015001

Grill, G., Lehner, B., Thieme, M., Geenen, B., Tickner, D., Antonelli, F., Babu, S., Borrelli, P., Cheng, L., Crochetiere, H., Ehalt Macedo, H., Filgueiras, R., Goichot, M., Higgins, J., Hogan, Z., Lip, B.,

McClain, M. E., Meng, J., Mulligan, M., … Zarfl, C. (2019). Mapping the world's free-flowing rivers. *Nature*, *569*(7755), 215–221. https://doi.org/10.1038/s41586-019-1111-9

Guallar, E., Sanz-Gallardo, M. I., van't Veer, P., Bode, P., Aro, A., Gómez-Aracena, J., Kark, J. D., Riemersma, R. A., Martín-Moreno, J. M., Kok, F. J., & Heavy Metals and Myocardial Infarction Study Group. (2002). Mercury, fish oils, and the risk of myocardial infarction. *The New England Journal of Medicine*, *347*(22), 1747–1754. https://doi.org/10.1056/NEJMoa020157

Gunkel, G. (2009). Hydropower – A Green Energy? Tropical Reservoirs and Greenhouse Gas Emissions. *CLEAN – Soil, Air, Water*, *37*(9), 726–734. https://doi.org/10.1002/clen.200900062

Haas, E. B. (1970). The Study of Regional Integration: Reflections on the Joy and Anguish of Pretheorizing. *International Organization*, *24*(4), 606–646. https://doi.org/10.1017/S0020818300017495

Harris, Z. S. (1981). Discourse Analysis. In Z. S. Harris & H. Hiż (Eds.), *Papers on Syntax* (pp. 107–142). Springer Netherlands. https://doi.org/10.1007/978-94-009-8467-7_7

Harrison, I. J., Green, P. A., Farrell, T. A., Juffe-Bignoli, D., Sáenz, L., & Vörösmarty, C. J. (2016). Protected areas and freshwater provisioning: A global assessment of freshwater provision, threats and management strategies to support human water security. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *26*(S1), 103–120. https://doi.org/10.1002/aqc.2652

Harvey, D. (2005). The Neoliberal State. In *The Neoliberal State*. Oxford University Press. https://doi.org/10.1093/oso/9780199283262.003.0007

Hecht, S. B. (2011). The new Amazon geographies: Insurgent citizenship, "Amazon Nation" and the politics of environmentalisms. *Journal of Cultural Geography*, *28*(1), 203–223. https://doi.org/10.1080/08873631.2011.548500

Hermoso, V., Abell, R., Linke, S., & Boon, P. (2016). The role of protected areas for freshwater biodiversity conservation: Challenges and opportunities in a rapidly changing world. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *26*(S1), 3–11. https://doi.org/10.1002/aqc.2681

Hill, J. B., Lyons, P. D., Clark, J. J., & Doelle, W. H. (2015). The "Collapse" of Cooperative Hohokam Irrigation in the Lower Salt River Valley. *Journal of the Southwest*, *57*(4), 609–674.

Holanda, S. B. D. (2005). *Caminhos e Fronteiras* (1st ed.). Companhia das Letras. https://www.companhiadasletras.com.br/detalhe.php?codigo=10490

Houghton, R. A., Skole, D. L., Nobre, C. A., Hackler, J. L., Lawrence, K. T., & Chomentowski, W. H. (2000). Annual fluxes of carbon from deforestation and regrowth in the Brazilian Amazon. *Nature*, *403*(6767), 301–304. https://doi.org/10.1038/35002062

Hurd, L. E., Sousa, R. G. C., Siqueira-Souza, F. K., Cooper, G. J., Kahn, J. R., & Freitas, C. E. C. (2016). Amazon floodplain fish communities: Habitat connectivity and conservation in a rapidly deteriorating environment. *Biological Conservation*, *195*, 118–127. https://doi.org/10.1016/j.biocon.2016.01.005

Hyde, J. L., Bohlman, S. A., & Valle, D. (2018). Transmission lines are an under-acknowledged conservation threat to the Brazilian Amazon. *Biological Conservation*, *228*, 343–356. https://doi.org/10.1016/j.biocon.2018.10.027

I.P.C.C. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (No. AR6). Cambridge University Press. In Press. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

I.U.C.N. (XXXXc). *IUCN World Conservation Congress Marseille. List of Motions*. https://www.iucncongress2020.org/assembly/motions

Imazon. (n.d). Linha do tempo: Entenda como ocorreu a ocupação da Amazônia. Retrieved October 29, 2021, from https://imazon.org.br/imprensa/linha-do-tempo-entenda-como-ocorreu-a-ocupacao-da-amazonia/

Integrated River Basin Management. (n.d.). *International River Foundation*. Retrieved October 29, 2021, from https://riverfoundation.org.au/our-programs/integrated-river-basin-management/

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. (2019). *Summary for policymakers of the global assessment report on biodiversity and ecosystem services*. Zenodo. https://doi.org/10.5281/zenodo.3553579

International Rivers (IR). (may). *Greenwashing Dams. A critique of the hydropower Saustainability Assessment Protocol (HSAP*. https://www.internationalrivers.org/wp-content/uploads/sites/86/2020/05/hsapfactsheet2013.pdf

International Rivers. (2021). Press Release | Coalition of International Organizations Files an Amicus Curiae Brief Calling for the Recognition of the Intrinsic Rights of the Marañón River in Peru. https://www.internationalrivers.org/news/international-coalition-rights-of-the-maranon-river-in-peru/

Introduction to the EU Water Framework Directive—Environment—European Commission. (n.d.). Retrieved October 29, 2021, from https://ec.europa.eu/environment/water/water-framework/info/intro_en.htm

Ioris, A. A. R. (2018). Amazon's dead ends: Frontier-making the centre. *Political Geography*, *65*, 98–106. https://doi.org/10.1016/j.polgeo.2018.05.011

Ioris, A. A. R. (2020a). Socioecological economics of water development in the Brazilian Amazon: Elements for a critical reflection. *Ecological Economics*, *173*, 106654. https://doi.org/10.1016/j.ecolecon.2020.106654

Ioris, A. A. R. (2020b). Amazon Development and the Political Economy of Water. *Caderno de Geografia*, *30*(3), 348–348. https://doi.org/10.5752/P.2318-2962.2020v30nesp3p348

Ioris, A. A. R. (2021). Origem e evolução de fronteiras socioespaciais. In Fronteiras do Desenvolvimento na Amazônia: Agroculturas, Histórias Contestadas, Novas Alteridades (pp. 17–39). Editora Appris.

ISA. Parque Nacional do Jaú | Unidades de Conservação no Brasil. (n.d.). Retrieved November 16, 2021, https://uc.socioambiental.org/pt-br/arp/593

Israel, A., & Herrera, R. J. (2020). The governance of Peruvian energy transitions: Path dependence, alternative ideas and change in national hydropower expansion. *Energy Research & Social Science*, *69*, 101608. https://doi.org/10.1016/j.erss.2020.101608

IUCN. (2021). The IUCN Red List of Threatened Species. Version 2021-3. https://www.iucnredlist.org. Downloaded on [02 February 2021].

IUCN. (n.d). Freshwater Biodiversity. Retrieved October 2, 2021, from . https://www.iucn.org/theme/species/our-work/freshwater-biodiversity

Jain, S. K. (2021). Providing water security in India by conserving and utilizing flood flows. Water Security, 14, 100105. https://doi.org/10.1016/j.wasec.2021.100105

Janzen, D. H. (1974). Tropical Blackwater Rivers, Animals, and Mast Fruiting by the Dipterocarpaceae. *Biotropica*, *6*(2), 69–103. https://doi.org/10.2307/2989823

Janzen, D. H. (2002). Neotropical restoration biology. In D. E. Lorey (Ed.), *Global Environmental Challenges of the Twenty-First Century Resources, Consumption, and Sustainable Solutions* (p. 312). Rowman & Littefield. https://rowman.com/ISBN/9780842050487/Global-Environmental-Challenges-of-the-Twenty-First-Century-Resources-Consumption-and-Sustainable-Solutions

Jaramillo, C. F., Lederman, D., Bussolo, M., Gould, D., & Mason, A. (2006). *Challenges of CAFTA: Maximizing the Benefits for Central America*. World Bank. https://openknowledge.worldbank.org/handle/10986/7127

Jeffrey, P., & Gearey, M. (2006). Integrated water resources management: Lost on the road from ambition to realisation? Water Science and Technology, 53(1), 1–8. https://doi.org/10.2166/wst.2006.001

Jézéquel, C., Tedesco, P. A., Bigorne, R., Maldonado-Ocampo, J. A., Ortega, H., Hidalgo, M., Martens, K., Torrente-Vilara, G., Zuanon, J., Acosta, A., Agudelo, E., Barrera Maure, S., Bastos, D. A., Bogotá Gregory, J., Cabeceira, F. G., Canto, A. L. C., Carvajal-Vallejos, F. M., Carvalho, L. N., Cella-Ribeiro, A., … Oberdorff, T. (2020). A database of freshwater fish species of the Amazon Basin. *Scientific Data*, *7*(1), 96. https://doi.org/10.1038/s41597-020-0436-4

Johansen, B. E. (2005). The Native Peoples of North America: A History. New Brunswick, NJ: Rutgers University Press.

Jones, T., Newborne, P., & Phillips, B. (2006). *Applying the principles of integrated water resource and river basin management – an introduction* (p. 136). WWF. https://wwfint.awsassets.panda.org/downloads/applying_the_principles_of_integrated_water_resource_and_river_basin_management_aug_06_ver.pdf

Junk, W. J., Soares, M. G. M., & Bayley, P. B. (2007). Freshwater fishes of the Amazon River basin: Their biodiversity, fisheries, and habitats. *Aquatic Ecosystem Health and Management*, *10*(2), 153–173. https://doi.org/10.1080/14634980701351023

Kallio, H., Pietilä, A.-M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: Developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, *72*(12), 2954–2965. https://doi.org/10.1111/jan.13031

Kanai, J. M. (2016). The pervasiveness of neoliberal territorial design: Cross-border infrastructure planning in South America since the introduction of IIRSA. *Geoforum*, *69*, 160–170. https://doi.org/10.1016/j.geoforum.2015.10.002

Karpouzoglou, T., & Vij, S. (2017). Waterscape: A perspective for understanding the contested geography of water. *WIREs Water*, *4*(3), e1210. https://doi.org/10.1002/wat2.1210

Keeler, B. L., Polasky, S., Brauman, K. A., Johnson, K. A., Finlay, J. C., O'Neill, A., Kovacs, K., & Dalzell, B. (2012). Linking water quality and well-being for improved assessment and valuation of ecosystem services. *Proceedings of the National Academy of Sciences*, *109*(45), 18619–18624. https://doi.org/10.1073/pnas.1215991109

Keiser, J., Castro, M. C. D., Maltese, M. F., Bos, R., Tanner, M., Singer, B. H., & Utzinger, J. (2005). Effect of irrigation and large dams on the burden of malaria on a global and regional scale. *The American Journal of Tropical Medicine and Hygiene*, *72*(4), 392–406. https://doi.org/10.4269/ajtmh.2005.72.392

Kelly, S. E., Bourgeault, I., & Dingwall, R. (2010). Qualitative interviewing techniques and styles. In *The SAGE handbook of qualitative methods in health research* (pp. 307–326). SAGE Publications. https://dx.doi.org/10.4135/9781446268247.n17

Killeen, T. J. (2007). *A Perfect Storm in the Amazon Wilderness: Development and Conservation in the Context of the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA*. Center for Applied Biodiversity Science (CABS). Conservation International. https://doi.org/10.1896/978-1-934151-07-5.4

Koh, W. C., & Baffes, J. (2020, July 27). Gold shines bright throughout the COVID-19 crisis. https://blogs.worldbank.org/opendata/gold-shines-bright-throughout-covid-19-crisis

Kümin, B. (2007). *Expedition Brasilien. Von der Forschungszeichnung zur ethnografischen Fotografie*. Benteli. https://www.froelichundkaufmann.de/landschaftsbaende/expedition-brasilien-von-der-forschungszeichnung-zur-ethnografischen-fotografie.html

Lagasse, P. F. (1986). River Response to Dredging. *Journal of Waterway, Port, Coastal, and Ocean Engineering*, *112*(1), 1–14. https://doi.org/10.1061/(ASCE)0733-950X(1986)112:1(1)

Latrubesse, E. M., Arima, E. Y., Dunne, T., Park, E., Baker, V. R., d'Horta, F. M., Wight, C., Wittmann, F., Zuanon, J., Baker, P. A., Ribas, C. C., Norgaard, R. B., Filizola, N., Ansar, A., Flyvbjerg, B., & Stevaux, J. C. (2017). Damming the rivers of the Amazon basin. *Nature*, *546*(7658), 363–369. https://doi.org/10.1038/nature22333

Latrubesse, E. M., Stevaux, J. C., & Sinha, R. (2005). Tropical rivers. *Geomorphology*, *70*(3–4), 187–206. https://doi.org/10.1016/j.geomorph.2005.02.005

Laurance, W. F., Clements, G. R., Sloan, S., O'Connell, C. S., Mueller, N. D., Goosem, M., Venter, O., Edwards, D. P., Phalan, B., Balmford, A., Van Der Ree, R., & Arrea, I. B. (2014). A global strategy for road building. *Nature*, *513*(7517), 229–232. https://doi.org/10.1038/nature13717

Laurance, W. F., Goosem, M., & Laurance, S. G. W. (2009). Impacts of roads and linear clearings on tropical forests. *Trends in Ecology & Evolution*, *24*(12), 659–669. https://doi.org/10.1016/j.tree.2009.06.009

Leal, C. G., Lennox, G. D., Ferraz, S. F. B., Ferreira, J., Gardner, T. A., Thomson, J. R., Berenguer, E., Lees, A. C., Hughes, R. M., Mac Nally, R., Aragão, L. E. O. C., Brito, J. G., Castello, L., Garrett, R. D., Hamada, N., Juen, L., Leitão, R. P., Louzada, J., Morello, T. F., & Barlow, J. (2020). Integrated terrestrial-freshwater planning doubles conservation of tropical aquatic species. *Science*, *370*(6512), 117–121. https://doi.org/10.1126/science.aba7580

Limburg, K. E., & Folke, C. (1999). The ecology of ecosystem services: Introduction to the special issue. Editorial. *Ecological Economics*. https://doi.org/10.1016/S0921-8009(99)00008-7

Linton, J. (2014). Modern water and its discontents: A history of hydrosocial renewal. *WIREs Water*, *1*(1), 111–120. https://doi.org/10.1002/wat2.1009

Lombardi, T. N., & Carmo, R. L. do. (2020). Frontier in Brazil, global patterns and local impacts. *Carta Económica Regional*, *125*, 47–77. https://doi.org/10.32870/cer.v0i125.7795

Loures, F. R. (2014). The UN Watercourses Convention in Force: What's in it for Aquatic Ecosystems. In *Saving Freshwater Fishes and Habitats* (6th ed., pp. 12–17). IUCN SSC/WI Freshwater Fish Specialist Group. http://www.iucnffsg.org/wp-content/uploads/2014/09/Sept.-FFSG-Newsletter.pdf

Lovejoy, T. E., & Nobre, C. (2018). Amazon Tipping Point. *Science Advances*, *4*(2), eaat2340. https://doi.org/10.1126/sciadv.aat2340

Lozada, J. R. (2019). The Orinoco Mining Arc: A historical perspective. *Gold Bulletin*, *52*(3), 153–163. https://doi.org/10.1007/s13404-019-00261-1

Lynch, J. (1983). *Sim´on bolivar and the age of revolution* (Vol. 10). University of London, Institute of Latin American Studies. https://sas-space.sas.ac.uk/3532/1/B48_-_Simon_Bolivar_and_the_Age_of_Revolution.pdf

Mace, G. (1988). Regional Integration in Latin America: A Long and Winding Road. *International Journal*, *43*(3), 404–427. https://doi.org/10.2307/40202547

Macedo, M., & Castello, L. (2015). WWF Living Amazon Integrated Approaches for a More Sustainable Development in the Pan-Amazon. In D. Oliverira & S. Charity (Eds.), *State of the Amazon: Freshwater Connectivity and Ecosystem Health*. WWF: Living Amazon Initiative.

Machado, L. T. (1999). A teoria da dependência na América Latina. Estudos Avançados, 13, 199–215. https://doi.org/10.1590/S0103-40141999000100018

Malm, O. (1998). Gold Mining as a Source of Mercury Exposure in the Brazilian Amazon. *Environmental Research*, *77*(2), 73–78. https://doi.org/10.1006/enrs.1998.3828

Mapbiomas Brasil. *Superfície de água no Brasil reduz 15% desde o início dos años 90*. (n.d.). Retrieved November 1, 2021, from https://mapbiomas.org/superficie-de-agua-no-brasil-reduz-15-desde-o-inicio-dos-anos-90

Marengo, J. A. (2006). On the hydrological cycle of the amazon basin: A historical review and current state-of-the-art. *Revista Brasileira de Meteorologia*, *21*(3), 1–19.

Marengo, J. A., & Souza Junior, C. (2018). *Mudanças Climáticas: Impactos e cenários para a Amazônia* (p. 33). ALANA.

http://www.oamanhaehoje.com.br/assets/pdf/Relatorio_Mudancas_Climaticas-Amazonia.pdf

Marengo, J. A., Tomasella, J., Soares, W. R., Alves, L. M., & Nobre, C. A. (2012). Extreme climatic events in the Amazon basin. *Theoretical and Applied Climatology*, *107*(1), 73–85. https://doi.org/10.1007/s00704-011-0465-1

Marques, A. (2021). Distant drivers of deforestation. *Nature Ecology & Evolution*, *5*(6), 713–714. https://doi.org/10.1038/s41559-021-01420-4

Marshall, M. (2019). Finding the real El Dorado. *New Scientist*, *241*(3213), 26–29. https://doi.org/10.1016/S0262-4079(19)30119-8

Martini, P., Duarte, V., Arai, E., & Moraes, J. (2008). Metodologia de Medição das Extensões dos Rios Amazonas e Nilo utilizando imagens MODIS E GEOCOVER. *Proceedings of the XIII Latin American Remote Sensing Symposium*.

Matlaba, V. J., Mota, J. A., Maneschy, M. C., & Filipe dos Santos, J. (2017). Social perception at the onset of a mining development in Eastern Amazonia, Brazil. *Resources Policy*, *54*, 157–166. https://doi.org/10.1016/j.resourpol.2017.09.012

Mayer, A., Castro-Diaz, L., Lopez, M. C., Leturcq, G., & Moran, E. F. (2021). Is hydropower worth it? Exploring amazonian resettlement, human development and environmental costs with the Belo Monte project in Brazil. *Energy Research and Social Science*, *78*. https://doi.org/10.1016/j.erss.2021.102129

Mayer, I. S., van Daalen, C. E., & Bots, P. W. G. (2004). Perspectives on policy analyses: A framework for understanding and design. *International Journal of Technology, Policy and Management*, *4*(2), 169–191. https://doi.org/10.1504/IJTPM.2004.004819

McCormick, S. (2010). Damming the Amazon: Local Movements and Transnational Struggles Over Water. *Society & Natural Resources*, *24*(1), 34–48. https://doi.org/10.1080/08941920903278129

McCoy, T., & Pessoa, G. S. (2021). Brazil, once a champion of environmentalism, grapples with new role as climate antagonist. Washington Post. https://www.washingtonpost.com/world/2021/11/02/brazil-cop26-deforestation-bolsonaro/

MEA. (2005). Millennium ecosystem assessment. Ecosystems and human well-being, Washington, DC.

Mega, E. R. (2020). 'Apocalyptic' fires are ravaging the world's largest tropical wetland. *Nature*, *586*(7827), 20–21. https://doi.org/10.1038/d41586-020-02716-4

Mello-Théry, N. A. (2019). Amazônia: Atores e instituições regionais e nacionais. In Geografia e geopolítica da América do Sul: Integrações e conflitos | Portal de Livros Abertos da USP (pp. 253–271). https://doi.org/10.11606/9788575063552

Menezes, R. G., & Barbosa Jr., R. (2021). Environmental governance under Bolsonaro: Dismantling institutions, curtailing participation, delegitimising opposition. *Zeitschrift Für Vergleichende Politikwissenschaft*, *15*(2), 229–247. https://doi.org/10.1007/s12286-021-00491-8

MERCOSUR. (n.d.). En pocas palabras. Retrieved November 1, 2021, from https://www.mercosur.int/quienes-somos/en-pocas-palabras/

Metzger, J. P. (2001). Effects of deforestation pattern and private nature reserves on the forest conservation in settlement areas of the Brazilian Amazon. *Biota Neotropica*, *1*, 1–14. https://doi.org/10.1590/S1676-06032001000100003

Metzger, J. P., Bustamante, M. M. C., Ferreira, J., Fernandes, G. W., Librán-Embid, F., Pillar, V. D., Prist, P. R., Rodrigues, R. R., Vieira, I. C. G., & Overbeck, G. E. (2019). Por qué o Brasil precisa de suas Reservas Legais. *Perspectives in Ecology and Conservation*, *17*(3), 104–116. https://doi.org/10.1016/j.pecon.2019.09.001

Mill, J. S., & Sher, G. (2002). *Utilitarianism (Second Edition)*. Hackett Publishing.

Millikan, B. (2014). The Amazon: Dirty dams, Dirty Politics and the Myth of Clean Energy. *Tipití: Journal of the Society for the Anthropology of Lowland South America*, *12*(2), 134–138.

Moire, K., Thieme, M., & Opperman, J. (2016). *Securing a Future that Flows: Case Studies of Protection Mechanisms for Rivers* (p. 24). World Wildlife Fund and The Nature Conservancy. http://assets.worldwildlife.org/publications/936/files/original/WWF_River_Protection_Report.pdf

Moraes, M. (2013). *IIRSA: ¿UM NOVO PROJETO PARA A AMÉRICA DO SUL?* http://www.lamericas.org/cgi-bin/wxis.exe?IsisScript=phl82.xis&cipar=phl82.cip&lang=por

Moran, E. F. (2016). Roads and dams: Infrastructure-driven transformations in the brazilian Amazon. *Ambiente & Sociedade*, *19*, 207–220. https://doi.org/10.1590/1809-4422ASOC256V1922016

Moran, E. F. (2019). The Dilemma of Amazonian Development. Routledge.

Moran, E. F., Lopez, M. C., Moore, N., Müller, N., & Hyndman, D. W. (2018). Sustainable hydropower in the 21st century. *Proceedings of the National Academy of Sciences*, *115*(47), 11891–11898. https://doi.org/10.1073/pnas.1809426115

Moreau, M.-A., & Coomes, O. T. (2007). Aquarium fish exploitation in western Amazonia: Conservation issues in Peru. *Environmental Conservation*, *34*(1), 12–22. https://doi.org/10.1017/S0376892907003566

Moreira, P. F., Gamu, J. K., Inoue, C. Y. A., Athayde, S., da Cal Seixas, S. R., & Viola, E. (2019). South–South Transnational Advocacy: Mobilizing Against Brazilian Dams in the Peruvian Amazon. *Global Environmental Politics*, *19*(1), 77–98. https://doi.org/10.1162/glep_a_00495

Murad, C. A., & Pearse, J. (2018). Landsat study of deforestation in the Amazon region of Colombia: Departments of Caquetá and Putumayo. *Remote Sensing Applications: Society and Environment*, *11*, 161–171. https://doi.org/10.1016/j.rsase.2018.07.003

Myint, H. (1958). The "Classical Theory" of International Trade and the Underdeveloped Countries. *The Economic Journal*, *68*(270), 317–337. https://doi.org/10.2307/2227598

Naiman, R. J., & Décamps, H. (1997). The Ecology of Interfaces: Riparian Zones. *Annual Review of Ecology and Systematics*, *28*(1), 621–658. https://doi.org/10.1146/annurev.ecolsys.28.1.621

Nascimento, A. M. A., & Chartone-Souza, E. (2003). Operon mer: Bacterial resistance to mercury and potential for bioremediation of contaminated environments. *Genetics and Molecular Research: GMR*, *2*(1), 92–101.

National Research Council. (2000). Toxicological effect of methylmercury. Washington, DC, USA: National Academy Press.

National Wild and Scenic Rivers System. (n.d). Retrieved December 5, 2021, https://www.rivers.gov/national-system.php

Nepstad, D., McGrath, D., Alencar, A., Barros, A. C., Carvalho, G., Santilli, M., & Vera Diaz, M. del C. (2002). Frontier Governance in Amazonia. *Science*, *295*(5555), 629–631. https://doi.org/10.1126/science.1067053

Nepstad, D., Schwartzman, S., Bamberger, B., Santilli, M., Ray, D., Schlesinger, P., Lefebvre, P., Alencar, A., Prinz, E., Fiske, G., & Rolla, A. (2006). Inhibition of Amazon Deforestation and Fire by Parks and Indigenous Lands. *Conservation Biology*, *20*(1), 65–73. https://doi.org/10.1111/j.1523-1739.2006.00351.x

Neugarten, R., Ceotto, P., Acero, N., Coutinho, B., Flores-Gutierrez, R., Hierholzer, M., Kasecker, T., Koenig, K., Ledezma, J., Pinheiro, R., Turner, W., Wright, T., Amado, N., Bernard, C., Encomenderos, I., Martinez, C., Marhe, S., Martinez, M., Mendoza, E., & Troëng, S. (2015). *Mapping Essential Natural Capital in Amazonia: Identifying important places for biodiversity and ecosystem services*. https://doi.org/10.13140/RG.2.2.19848.93446

Nobre, C. A., & Borma, L. D. S. (2009). 'Tipping points' for the Amazon Forest. *Current Opinion in Environmental Sustainability*, *1*(1), 28–36. https://doi.org/10.1016/j.cosust.2009.07.003

Nobre, C. A., Sampaio, G., Borma, L. S., Castilla-Rubio, J. C., Silva, J. S., & Cardoso, M. (2016). Land-use and climate change risks in the Amazon and the need of a novel sustainable development paradigm. *Proceedings of the National Academy of Sciences*, *113*(39), 10759–10768. https://doi.org/10.1073/pnas.1605516113

O'Bryan, C. J., Garnett, S. T., Fa, J. E., Leiper, I., Rehbein, J. A., Fernández-Llamazares, Á., Jackson, M. V., Jonas, H. D., Brondizio, E. S., Burgess, N. D., Robinson, C. J., Zander, K. K., Molnár, Z., Venter, O., & Watson, J. E. M. (2021). The importance of Indigenous Peoples' lands for the conservation of terrestrial mammals. *Conservation Biology*, *35*(3), 1002–1008. https://doi.org/10.1111/cobi.13620

O'Connor, J. E., Duda, J. J., & Grant, G. E. (2015). 1000 dams down and counting. *Science*, *348*(6234), 496–497. https://doi.org/10.1126/science.aaa9204

OAS. (n.da). *OAS - Organization of American States: Democracy for peace, security, and development* [Text]. http://www.oas.org/en/about/who_we_are.asp

OAS. (n.db). *Press Release. IACHR Deeply Concerned over Result of Venezuela's Denunciation of the American Convention* [Text]. https://www.oas.org/en/iachr/media_center/preleases/2013/064.asp

OEA. (2021). *A CIDH reitera sua preocupação com a tese jurídico do "marco temporal" no Brasil e seu impacto sobre os direitos humanos dos povos indígenas e tribais*. Retrieved November 1, 2021, from https://www.oas.org/pt/cidh/jsForm/?File=/pt/cidh/prensa/notas/2021/219.asp

OEC - The Observatory of Economic Complexity | OEC. (n.d.). OEC - The Observatory of Economic Complexity. Retrieved November 2, 2021, from https://app-bee.oec.world/en

Oliveira, B. F. A, Bottino, M. J., Nobre, P., & Nobre, C. A. (2021). Deforestation and climate change are projected to increase heat stress risk in the Brazilian Amazon. *Communications Earth & Environment*, *2*(1), 1–8. https://doi.org/10.1038/s43247-021-00275-8

Opperman, J. J., Shahbol, N., Maynard, J., Grill, G., Higgins, J., Tracey, D., & Thieme, M. (2021). Safeguarding Free-Flowing Rivers: The Global Extent of Free-Flowing Rivers in Protected Areas. *Sustainability*, *13*(5), 2805. https://doi.org/10.3390/su13052805

OTCA – Organización del Tratado de Cooperación Amazónica, P. (2016). *Estrategia Regional para la Gestión Integrada de los Recursos Hídricos de la Cuenca Amazónica.* (p. 205). Organización del Tratado de Cooperación Amazónica (OTCA). http://otca.org/wp-content/uploads/2021/02/Programa-de-Acciones-Estrategicas-PAE.pdf

OTCA. (n.d.). ABOUT US - Retrieved October 29, 2021, from http://otca.org/en/about-us/

OTCA. (n.d.). How we work? - Retrieved October 29, 2021, from http://otca.org/en/how-we-work/

OTCA. (n.d.). Working Areas. Retrieved October 29, 2021, from http://otca.org/en/working-areas/

OTCA.(n.d). What we do? Retrieved October 29, 2021, from http://otca.org/en/what-do-we-do/

Overton, I. C., Smith, D. M., Dalton, J., Barchiesi, S., Acreman, M. C., Stromberg, J. C., & Kirby, J. M. (2014). Implementing environmental flows in integrated water resources management and the ecosystem approach. *Hydrological Sciences Journal*, *59*(3–4), 860–877. https://doi.org/10.1080/02626667.2014.897408

Packer, M. J. (2017). *The Science of Qualitative Research*. Cambridge University Press.

Padula, R. (2010). *Integração Regional de infraestrutura e Comércio na América do Sul nos Anos 2000: Uma Análise Político-Estratégica*. COPPE/UFRJ.

Pasha, S., Wenner, M., & Clarke, D. (2017). *Toward the Greening of the Gold Mining Sector in Guyana: Transition Issues and Challenges*.

Patton, M. Q. (2002). *Qualitative Research & Evaluation Methods*. SAGE.

Pelicice, F. M., & Castello, L. (2021). A political tsunami hits Amazon conservation. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(5), 1221–1229. https://doi.org/10.1002/aqc.3565

Pelicice, F. M., Azevedo-Santos, V. M., Vitule, J. R. S., Orsi, M. L., Lima Junior, D. P., Magalhães, A. L. B., Pompeu, P. S., Petrere Jr, M., & Agostinho, A. A. (2017). Neotropical freshwater fishes imperilled by unsustainable policies. *Fish and Fisheries*, *18*(6), 1119–1133. https://doi.org/10.1111/faf.12228

Pelicice, F. M., Pompeu, P. S., & Agostinho, A. A. (2015). Large reservoirs as ecological barriers to downstream movements of Neotropical migratory fish. *Fish and Fisheries*, *16*(4), 697–715. https://doi.org/10.1111/faf.12089

Pereira, E. J. A. L., Ribeiro, L. C. S., Freitas, L. F. S., & Pereira, H. B. B. (2020). Brazilian policy and agribusiness damage the Amazon rainforest. *Land Use Policy*, 92, 104491. https://doi.org/10.1016/j. landusepol.2020.104491

Peres, C. A., & Zimmerman, B. (2001). Perils in Parks or Parks in Peril? Reconciling Conservation in Amazonian Reserves with and without Use. *Conservation Biology*, *15*(3), 793–797. https://doi.org/10.1046/j.1523-1739.2001.015003793.x

Peres, C. A., Emilio, T., Schietti, J., Desmoulière, S. J. M., & Levi, T. (2016). Dispersal limitation induces long-term biomass collapse in overhunted Amazonian forests. *Proceedings of the National Academy of Sciences*, *113*(4), 892–897. https://doi.org/10.1073/pnas.1516525113

Pérez-Escobar, O. A., Cámara-Leret, R., Antonelli, A., Bateman, R., Bellot, S., Chomicki, G., Cleef, A., Diazgranados, M., Dodsworth, S., Jaramillo, C., Madriñan, S., Olivares, I., Zuluaga, A., & Bernal, R. (2018). Mining threatens Colombian ecosystems. *Science*, *359*(6383), 1475–1475. https://doi.org/10.1126/science.aat4849

Perry, D. (2021). Legible Rivers, Resilient Rivers: Lessons for Climate Adaptation Policy from the Wild and Scenic Rivers Act. In J. Cassin, J. Dalton, E. Lopez Gunn, & J. Matthews, Nature-based Solutions and Water Security: An Agenda for the 21st Century. Elsevier. https://www.elsevier.com/books/nature-based-solutions-and-water-security/cassin/978-0-12-819871-1

Perry, D. M., & Berry, K. A. (2016). Central American integration through infrastructure development: A case study of Costa Rican hydropower. *Regions and Cohesion*, *6*(1), 96–115. https://doi.org/10.3167/reco.2016.060105

Perry, D., Harrison, I., Fernandes, S., Burnham, S., & Nichols, A. (2021). Global Analysis of Durable Policies for Free-Flowing River Protections. *Sustainability*, *13*(4), 2347. https://doi.org/10.3390/su13042347

Perry, D.M. (2017). [Re]framing the Wild and Scenic Rivers Act for Ecosystem Based Resilience and Adaptation.", International Journal of Wilderness, 18(2): 41-48. http://ijw.org/wp-content/uploads/2017/06/Dec2017a-IJW-Web.pdf

Perz, S. G., Cabrera, L., Carvalho, L. A., Castillo, J., & Barnes, G. (2010). Global Economic Integration and Local Community Resilience: Road Paving and Rural Demographic Change in the Southwestern Amazon. *Rural Sociology*, *75*(2), 300–325. https://doi.org/10.1111/j.1549-0831.2009.00008.x

Perz, S., & Rojas, R. O. (2020). Do Infrastructure Improvements for Regional Integration Increase Traffic Volume? The Case of the Inter-Oceanic Highway in the Southwestern Amazon. *Journal of Latin American Geography*, *19*(2), 243–264. https://doi.org/10.1353/lag.2020.0042

Petrere Jr, M. (1996). Fisheries in large tropical reservoirs in South America. *Lakes & Reservoirs: Science, Policy and Management for Sustainable Use*, *2*(1–2), 111–133. https://doi.org/10.1111/j.1440-1770.1996.tb00054.x

Pfeiffer, W. C., & Lacerda, L. D. (1992). Mercury from Gold Mining in the Amazon Environment—An Overview. *Quimica Nova*, *15*(2), 155–160.

Pickett, S. T. A., & Cadenasso, M. L. (2002). The Ecosystem as a Multidimensional Concept: Meaning, Model, and Metaphor. *Ecosystems*, *5*(1), 1–10. https://doi.org/10.1007/s10021-001-0051-y

Picoli, M. C. A., Rorato, A., Leitão, P., Camara, G., Maciel, A., Hostert, P., & Sanches, I. D. (2020). Impacts of Public and Private Sector Policies on Soybean and Pasture Expansion in Mato Grosso—Brazil from 2001 to 2017. *Land*, *9*(1), 20. https://doi.org/10.3390/land9010020

Pieck, S. K. (2015). "To be led differently": Neoliberalism, road construction, and NGO counter-conducts in Peru. *Geoforum*, *64*, 304–313. https://doi.org/10.1016/j.geoforum.2013.06.011

Pignati, M. T, Souza, L. C, Mendes, R. A, Lima, M. O, Pignati, W. A, & Pezzuti, J. C. B (2018). Levels of organochlorine pesticides in Amazon turtle (Podocnemis unifilis) in the Xingu River, Brazil. *Journal of Environmental Science and Health, Part B*, *53*(12), 810–816. https://doi.org/10.1080/03601234.2018.1505077

Pimm, S. L., Ayres, M., Balmford, A., Branch, G., Brandon, K., Brooks, T., Bustamante, R., Costanza, R., Cowling, R., Curran, L. M., Dobson, A., Farber, S., da Fonseca, G. A. B., Gascon, C., Kitching, R., McNeely, J., Lovejoy, T., Mittermeier, R. A., Myers, N., … Wilcove, D. (2001). Can We Defy Nature's End? *Science*, *293*(5538), 2207–2208. https://doi.org/10.1126/science.1061626

Prado, A., Athayde, S., Mossa, J., Bohlman, S., Leite, F., & Oliver-Smith, A. (2016). How much is enough? An integrated examination of energy security, economic growth and climate change related to hydropower expansion in Brazil. *Renewable and Sustainable Energy Reviews*, *53*, 1132–1136. https://doi.org/10.1016/j.rser.2015.09.050

Praeli, Y.S. (2018). Environment and rights founder in the wake of Chinese funding in Bolivia. Mongabay. Retrieved March 3, 2021, https://news.mongabay.com/2018/12/environment-and-rights-founder-in-the-wake-of-chinese-funding-in-bolivia/

Provoca. (2021). *Paulo Artaxo | #Provoca | 17/08/2021*. https://www.youtube.com/watch?v=nOk6PggIygc

Queiroz, F. A. de. (2005). Meio ambiente e comércio na agenda internacional: A questão ambiental nas negociações da OMC y dos blocos econômicos regionais. *Ambiente & Sociedade*, *8*, 125–146. https://doi.org/10.1590/S1414-753X2005000200007

Rajão, R., Soares-Filho, B., Nunes, F., Börner, J., Machado, L., Assis, D., Oliveira, A., Pinto, L., Ribeiro, V., Rausch, L., Gibbs, H., & Figueira, D. (2020). The rotten apples of Brazil's agribusiness. *Science*, *369*(6501), 246–248. https://doi.org/10.1126/science.aba6646

Ramsar. (n.d). Brazil designates two remarkable wetlands in the Amazon basin and the Pantanal. Retrieved November 2, 2021, from https://www.ramsar.org/news/brazil-designates-two-remarkable-wetlands-in-the-amazon-basin-and-the-pantanal

Raworth, K. (n.d.). *A Safe and Just Space for Humanity: Can we live within the doughnut?* Oxfam.

Reis, R. E. (2003). *Check List of the Freshwater Fishes of South and Central America*. EDIPUCRS.

Rendon, M. (2020). *Illegal Mining in Venezuela: Death and Devastation in the Amazonas and Orinoco Regions*. Center for Strategic and International Studies (CSIS). http://lib.ugent.be/catalog/ebk01:4100000011258849

Resende, F. M., Fernandes, G. W., & Andrade, D. C. (2014). *A perigosa deterioração dos serviços de ecossistemas*. *140*, 70–75.

Rice, G. (1998). War and Water: An Ecological Perspective on Hohokam Irrigation. *KIVA*, *63*(3), 263–301. https://doi.org/10.1080/00231940.1998.11758357

Rizzo, R., Garcia, A. S., Vilela, V. M. de F. N., Ballester, M. V. R., Neill, C., Victoria, D. C., da Rocha, H. R., & Coe, M. T. (2020). Land use changes in Southeastern Amazon and trends in rainfall and water yield of the Xingu River during 1976–2015. *Climatic Change*, *162*(3), 1419–1436. https://doi.org/10.1007/s10584-020-02736-z

Robbins, P. (2012). *Political Ecology: A Critical Introduction*. John Wiley & Sons.

Roberts, T. R. (2001). On the River of No Returns: Thailand's Pak Mun Dam and its Fish Ladder. *Natural History Bulletin of the Siam Society*, *49*(2), 189–230.

Rocha, E. C., Canto, J. L. do, & Pereira, P. C. (2005). Avaliação de impactos ambientais nos países do Mercosul. *Ambiente & Sociedade*, *8*, 147–160. https://doi.org/10.1590/S1414-753X2005000200008

Rosenfeld, M., & Sajó, A. (2012). *The Oxford Handbook of Comparative Constitutional Law*. OUP Oxford.

Rossi, F. S., & Santos, G. A. de A. (2020). Fire dynamics in Mato Grosso State, Brazil: The relative roles of gross primary productivity. *Big Earth Data*, *4*(1), 23–44. https://doi.org/10.1080/20964471.2019.1706832

Ruaro, R., Ferrante, L., & Fearnside, P. M. (2021). Brazil's doomed environmental licensing. *Science*, *372*(6546), 1049–1050. https://doi.org/10.1126/science.abj4924

Ruffino, M. (2014). Status and trends of fishery resources of the Amazon basin in Brazil. In *Inland fisheries evolution and management – case studies from four continents* (Vol. 579, pp. 1–20). FAO.

Russi, D., Brink, P., Farmer, A., Badura, T., Coates, D., Förster, J., Kumar, R., & Davidson, N. (2013). *The Economics of Ecosystems and Biodiversity for Water and Wetlands* (p. 84). Institute for European Environmental Policy (IEEP) & Ramsar Secretariat. https://www.cbd.int/financial/values/g-ecowaterwetlands-teeb.pdf

Sabatier, P. A., Focht, W., Lubell, M., Trachtenberg, Z., & Vedlitz, A. (2005). *Swimming Upstream: Collaborative Approaches to Watershed Management*. MIT Press.

Salazar, L. F., Nobre, C. A., & Oyama, M. D. (2007). Climate change consequences on the biome distribution in tropical South America. *Geophysical Research Letters*, *34*(9). https://doi.org/10.1029/2007GL029695

Salisbury, C. (2020). *A suspensa barragem na Amazônia trás biodiversidade e esperança aos povos indígenas*. https://brasil.mongabay.com/2016/05/suspensa-barragem-na-amazonia-tras-biodiversidade-esperanca-aos-povos-indigenas/

Sampaio, G., Borma, L. S., Cardoso, M., Alves, L. M., von Randow, C., Rodriguez, D. A., Nobre, C. A., & Alexandre, F. F. (2019). Assessing the Possible Impacts of a 4 °C or Higher Warming in Amazonia. In C. A. Nobre, J. A. Marengo, & W. R. Soares (Eds.), *Climate Change Risks in Brazil*

(pp. 201–218). Springer International Publishing. https://doi.org/10.1007/978-3-319-92881-4_8

Santos R. (2019). História econômica da Amazônia. 2nd ed. Editora Valer, São Paulo. 428 pp.

Santos, R. E., Pinto-Coelho, R. M., Drumond, M. A., Fonseca, R., & Zanchi, F. B. (2020). Damming Amazon Rivers: Environmental impacts of hydroelectric dams on Brazil's Madeira River according to local fishers' perception. *Ambio*, *49*(10), 1612–1628. https://doi.org/10.1007/s13280-020-01316-w

Santos, R. E., Pinto-Coelho, R. M., Fonseca, R., Simões, N. R., & Zanchi, F. B. (2018). The decline of fisheries on the Madeira River, Brazil: The high cost of the hydroelectric dams in the Amazon Basin. *Fisheries Management and Ecology*, *25*(5), 380–391. https://doi.org/10.1111/fme.12305

Sarmiento, J. I. (n.d.). *Sobreoferta de electricidad*. Remando Juntos. Retrieved October 29, 2021, from https://conservamos.org/rioslibres/

Sauer, S. (2018). Soy expansion into the agricultural frontiers of the Brazilian Amazon: The agribusiness economy and its social and environmental conflicts. *Land Use Policy*, *79*, 326–338. https://doi.org/10.1016/j.landusepol.2018.08.030

Saunders, D. L., Meeuwig, J. J., & Vincent, A. C. J. (2002). Freshwater Protected Areas: Strategies for Conservation. *Conservation Biology*, *16*(1), 30–41. https://doi.org/10.1046/j.1523-1739.2002.99562.x

Schäfer, T. (2021). Legal Protection Schemes for Free-Flowing Rivers in Europe: An Overview. *Sustainability*, *13*(11), 6423. https://doi.org/10.3390/su13116423

Schmitt, S. (2012). *Comparative approaches to the study of public policy-making*. Routledge Handbooks Online. https://doi.org/10.4324/9780203097571.ch3

Schulz, C., & Ioris, A. A. R. (2017). The Paradox of Water Abundance in Mato Grosso, Brazil. Sustainability, 9(10), 1796. https://doi.org/10.3390/su9101796

Schwartz, S. H. (1992). Universals in the content and structures of values: Theoretical ad- vances and empirical tests in 20 countries. In M. Zanna (Ed.), Advances in experimental psychology (Vol. 25, pp. 1–65). Orlando, FL: Academic Press.

Schwartzman, S., & Zimmerman, B. (2005). Conservation Alliances with Indigenous Peoples of the Amazon. *Conservation Biology*, *19*(3), 721–727. https://doi.org/10.1111/j.1523-1739.2005.00695.x

Science Panel for The Amazon. (n.d.). Retrieved November 16, 2021, from https://www.theamazonwewant.org/science-panel-for-the-amazon/

Scudder, T. T. (2012). *The Future of Large Dams: Dealing with Social, Environmental, Institutional and Political Costs*. Earthscan.

Seitenfus, R. (1992). Considerações sobre o Mercosul. *Estudos Avançados*, *6*, 117–131. https://doi.org/10.1590/S0103-40141992000300010

Shao, X., Fang, Y., Jawitz, J. W., Yan, J., & Cui, B. (2019). River network connectivity and fish diversity. Science of The Total Environment, 689, 21–30. https://doi.org/10.1016/j.scitotenv.2019.06.340

Shimabukuro, Y. E., Mello, E. M. K., Moreira, J. C., & Duarte, V. (1997). *Segmentacao e classificacao da imagem sombra do modelo de mistura para mapear desflorestamento na Amazonia*. INPE.

Shimabukuru, Y. E., Duarte, V., Santos, J. R., Mello, E. M. K., & Moreira, J. C. (1999). Levantamento de áreas desflorestadas na Amazônia através de processamento digital de imagens orbitais. *Floresta e Ambiente*, *6*, 38–44.

Silva, G. S., Jardim, W. F., & Fadini, P. S. (2006). Elemental gaseous mercury flux at the water/air interface over the Negro River basin, Amazon, Brazil. *Science of The Total Environment*, *368*(1), 189–198. https://doi.org/10.1016/j.scitotenv.2005.09.082

Sioli, H. (1950). Das wasser im Amazonasgebiet. *Forsch. Fortschr*, *26*(21/22), 274–280.

Sioli, H. (1968). Hydrochemistry and Geology in the Brazilian Amazon Region. *Amazoniana: Limnologia et Oecologia Regionalis Systematis Fluminis Amazonas*, *1*(3), 267–277.

Sioli, H. (1984). The Amazon and its main affluents: Hydrography, morphology of the river courses, and river types. In H. Sioli (Ed.), *The Amazon: Limnology and landscape ecology of a mighty tropical river and its basin* (pp. 127–165). Springer Netherlands. https://doi.org/10.1007/978-94-009-6542-3_5

Soares-Filho, B., & Rajão, R. (2018). Traditional conservation strategies still the best option. *Nature Sustainability*, *1*(11), 608–610. https://doi.org/10.1038/s41893-018-0179-9

Sonter, L. J., Herrera, D., Barrett, D. J., Galford, G. L., Moran, C. J., & Soares-Filho, B. S. (2017). Mining drives extensive deforestation in the Brazilian Amazon. *Nature Communications*, *8*(1), 1013. https://doi.org/10.1038/s41467-017-00557-w

Sousa Júnior, W. C., & Reid, J. (2010). Uncertainties in Amazon Hydropower Development: Risk Scenarios and Environmental Issues around the Belo Monte Dam. *Water Alternatives*, *3*(2), 20.

Souza, V. H. P. de. (2015). Integração territorial no Mercosul: O caso da IIRSA/COSIPLAN. *Sociedade & Natureza*, *27*, 21–36. https://doi.org/10.1590/1982-451320150102

Stokstad, E. (2014). The empty forest. *Science*, *345*(6195), 396–399. https://doi.org/10.1126/science.345.6195.396

Stuart, D., Gunderson, R., & Petersen, B. (2020). Overconsumption as Ideology: Implications for Addressing Global Climate Change. *Nature and Culture*, *15*(2), 199–223. https://doi.org/10.3167/nc.2020.150205

Tallman, P. S., Riley-Powell, A. R., Schwarz, L., Salmón-Mulanovich, G., Southgate, T., Pace, C., Valdés-Velásquez, A., Hartinger, S. M., Paz-Soldán, V. A., & Lee, G. O. (2020). Ecosyndemics: The potential synergistic health impacts of highways and dams in the Amazon. *Social Science & Medicine*, 113037. https://doi.org/10.1016/j.socscimed.2020.113037

Tansley, A. G. (1935). The Use and Abuse of Vegetational Concepts and Terms. Ecology, 16(3), 284–307. https://doi.org/10.2307/1930070

Tanzi, H. J. (1976). O Tratado de Tordesilhas e sua projeção. *Revista de História*, *54*(108), 533–541. https://doi.org/10.11606/issn.2316-9141.rh.1976.77814

The Ramsar Convention Secretariat. 2014. Sites and countries. Available at https://www.ramsar.org/sites-countries. Accessed January 17, 2021.

The Treaty for Amazon Cooperation. (1978). https://www.oas.org/dsd/Events/english/PastEvents/Salvador_Bahia/Documents/Amazonannexes.pdf

Thieme, M. L., Khrystenko, D., Qin, S., Golden Kroner, R. E., Lehner, B., Pack, S., Tockner, K., Zarfl, C., Shahbol, N., & Mascia, M. B. (2020). Dams and protected areas: Quantifying the spatial and temporal extent of global dam construction within protected areas. *Conservation Letters*, *13*(4), e12719. https://doi.org/10.1111/conl.12719

Thompson, G. S. C., & Barton, M. A. (1994). Ecocentric and anthropocentric attitudes toward the environment. Journal of Environmental Psychology, 14(2), 149–157. https://doi.org/10.1016/S0272-4944(05)80168-9

Tickner, D., Opperman, J. J., Abell, R., Acreman, M., Arthington, A. H., Bunn, S. E., … Young, L. (2020). Bending the Curve of Global Freshwater Biodiversity Loss: An Emergency Recovery Plan. *BioScience*. Oxford University Press. https://doi.org/10.1093/biosci/biaa002

Tigre, M. A. (2019). Building a regional adaptation strategy for Amazon countries. *International Environmental Agreements: Politics, Law and Economics*, *19*(4), 411–427. https://doi.org/10.1007/s10784-019-09443-w

Timpe, K., & Kaplan, D. (2017). The changing hydrology of a dammed Amazon. *Science Advances*, *3*(11), e1700611. https://doi.org/10.1126/sciadv.1700611

Tófoli, R. M., Dias, R. M., Zaia Alves, G. H., Hoeinghaus, D. J., Gomes, L. C., Baumgartner, M. T., & Agostinho, A. A. (2017). Gold at what cost? Another megaproject threatens biodiversity in the Amazon. *Perspectives in Ecology and Conservation*, *15*(2), 129–131. https://doi.org/10.1016/j.pecon.2017.06.003

Toledo, A. P. (2011). *Amazônia: Soberania ou internacionalização* (1st ed.). Arraes.

Treanor, P. (2005). Neoliberalism: Origins, theory, definition. http://web.inter.nl.net/users/Paul.Treanor/neoliberalism.html

Trevisan, A. C. D., Fantini, A. C., Schmitt-Filho, A. L., & Farley, J. (2015). Market for Amazonian Açaí (Euterpe oleraceae) Stimulates Pulp Production from Atlantic Forest Juçara Berries (Euterpe edulis). *Agroecology and Sustainable Food Systems*, *39*(7), 762–781. https://doi.org/10.1080/21683565.2015.1025461

Tritsch, I., & Le Tourneau, F.-M. (2016). Population densities and deforestation in the Brazilian Amazon: New insights on the current human settlement patterns. *Applied Geography*, *76*, 163–172. https://doi.org/10.1016/j.apgeog.2016.09.022

Tundisi, J. G., Goldemberg, J., Matsumura-Tundisi, T., & Saraiva, A. C. F. (2014). How many more dams in the Amazon? *Energy Policy*, *74*, 703–708. https://doi.org/10.1016/j.enpol.2014.07.013

Turner, F. J. (1921). The frontier in American history. New York: H. Holt and Company.

U.N.-Water. (2007). *Integrated Water Resourced Management*. https://www.un.org/waterforlifedecade/iwrm.shtml

UN Water Annual Report 2007 (p. 23). (2008). UNESCO World Water Assessment Programme. https://www.unwater.org/publications/un-water-annual-report-2007/

UNESCO. (n.d). Central Amazon Conservation Complex. Retrieved December 5, 2021, https://whc.unesco.org/en/list/998

Val, A. L., Fearnside, P. M., & Almeida-Val, V. M. F. (2016). Environmental disturbances and fishes in the Amazon. *Journal of Fish Biology*, *89*(1), 192–193. https://doi.org/10.1111/jfb.12896

Vammen, K., & Vaux, H. (2019). A General Overview of Water Quality in the Americas. In *Water Quality in the Americas: Risks and Opportunities* (pp. 15–18). The Inter-American Network of Academies of Sciences IANAS. https://ianas.org/wp-content/uploads/2020/07/02-Water-quality-INGLES.pdf

Van Damme, P. A., Córdova-Clavijo, L., Baigún, C., Hauser, M., Costa Doria, C. R., & Duponchelle, F. (2019). Upstream dam impacts on gilded catfish brachyplatystoma rousseauxii (Siluriformes: Pimelodidae) in the Bolivian amazon. *Neotropical Ichthyology*, *17*(4). https://doi.org/10.1590/1982-0224-20190118

Van Dijk, P., & deen Haak, S. (2006). *Troublesome Construction: IIRSA and Public-Private Partnerships in Road Infrastructure*. Cuadernos del CEDLA.

van Rees, C. B., Waylen, K. A., Schmidt-Kloiber, A., Thackeray, S. J., Kalinkat, G., Martens, K., Domisch, S., Lillebø, A. I., Hermoso, V., Grossart, H.-P., Schinegger, R., Decleer, K., Adriaens, T., Denys, L., Jarić, I., Janse, J. H., Monaghan, M. T., De Wever, A., Geijzendorffer, I., … Jähnig, S. C. (2021). Safeguarding freshwater life beyond 2020: Recommendations for the new global biodiversity framework from the European experience. *Conservation Letters*, *14*(1), e12771. https://doi.org/10.1111/conl.12771

Vasconcelos, L. P., Alves, D. C., da Câmara, L. F., & Hahn, L. (2021). Dams in the Amazon: The importance of maintaining free-flowing tributaries for fish reproduction. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *31*(5), 1106–1116. https://doi.org/10.1002/aqc.3465

Veiga, J., Tourrand, J., René, P.-C., & Piketty, M. (2002). Cattle ranching in the Amazon rainforest. *Anim. Prod. Aust*, *24*, 253–256.

Velasquez, C., Queiroz, H., & Bernasconi, P. (2010). *Instituto Sócio Ambiental (ISA). Fique por dentro: A bacia do rio Xingu em Mato Grosso*. Instituto Socioambiental; Instituto Centro de Vida. https://www.socioambiental.org/sites/blog.socioambiental.org/files/publicacoes/10395.pdf

Venticinque, E., Forsberg, B., Barthem, R., Petry, P., Hess, L., Mercado, A., Cañas, C., Montoya, M., Durigan, C., & Goulding, M. (2016). An explicit GIS-based river basin framework for aquatic

ecosystem conservation in the Amazon. *Earth System Science Data*, *8*(2), 651–661. https://doi.org/10.5194/essd-8-651-2016

Verburg, R., Filho, S. R., Lindoso, D., Debortoli, N., Litre, G., & Bursztyn, M. (2014). The impact of commodity price and conservation policy scenarios on deforestation and agricultural land use in a frontier area within the Amazon. *Land Use Policy*, *37*, 14–26. https://doi.org/10.1016/j.landusepol.2012.10.003

Veríssimo, T. C., & Pereira, J. (2020). *A floresta habitada: História da ocupação humana na Amazônia (2ª edição)* (2nd ed.). Instituto do Homem e Meio Ambiente da Amazônia (IMAZON). https://imazon.org.br/publicacoes/a-floresta-habitada-historia-da-ocupacao-humana-na-amazonia/

Victor, P. (2010). Questioning economic growth. *Nature*, *468*(7322), 370–371. https://doi.org/10.1038/468370a

Vilela, T., Harb, A. M., Bruner, A., Arruda, V. L. da S., Ribeiro, V., Alencar, A. A. C., Grandez, A. J. E., Rojas, A., Laina, A., & Botero, R. (2020). A better Amazon road network for people and the environment. *Proceedings of the National Academy of Sciences*, *117*(13), 7095–7102. https://doi.org/10.1073/pnas.1910853117

Vital, T.T., Quaglia, M.L.A. (2020) Gestão do tratado de cooperação amazônica/organização do tratado de cooperação amazônica sobre as bacias hidrográficas amazônicas. Cadernos eletrônicos, 2, 1-20.

Viteri-Salazar, O., & Toledo, L. (2020). The expansion of the agricultural frontier in the northern Amazon region of Ecuador, 2000–2011: Process, causes, and impact. *Land Use Policy*, *99*, 104986. https://doi.org/10.1016/j.landusepol.2020.104986

Vogel, B., & Henstra, D. (2015). Studying local climate adaptation: A heuristic research framework for comparative policy analysis. *Global Environmental Change*, *31*, 110–120. https://doi.org/10.1016/j.gloenvcha.2015.01.001

Vörösmarty, C. J., Stewart-Koster, B., Green, P. A., Boone, E. L., Flörke, M., Fischer, G., … Stifel, D. (2021). A green-gray path to global water security and sustainable infrastructure. Global Environmental Change, 70. https://doi.org/10.1016/j.gloenvcha.2021.102344

Walker, P. A. (2005). Political ecology: Where is the ecology? *Progress in Human Geography*, *29*(1), 73–82. https://doi.org/10.1191/0309132505ph530pr

Walker, R. T., Simmons, C., Arima, E., Galvan-Miyoshi, Y., Antunes, A., Waylen, M., & Irigaray, M. (2019). Avoiding Amazonian Catastrophes: Prospects for Conservation in the 21st Century. *One Earth*, *1*(2), 202–215. https://doi.org/10.1016/j.oneear.2019.09.009

Walker, R., & Simmons, C. (2018). Endangered Amazon: An Indigenous Tribe Fights Back Against Hydropower Development in the Tapajós Valley. *Environment: Science and Policy for Sustainable Development*, *60*(2), 4–15. https://doi.org/10.1080/00139157.2018.1418994

Ward, F. A. (2009). Economics in integrated water management. *Environmental Modelling & Software*, *24*(8), 948–958. https://doi.org/10.1016/j.envsoft.2009.02.002

WCD (World Commission on Dams). (2000). Dams and development—A new framework for decision making—the report of World Commission on Dams. WCD and Earthscan, London, 404 pp.

West, T. A. P., & Fearnside, P. M. (2021). Brazil's conservation reform and the reduction of deforestation in Amazonia. *Land Use Policy*, *100*, 105072. https://doi.org/10.1016/j.landusepol.2020.105072

Wetherell, M., Taylor, S. & Yates, J. S. (2001). Discourse Theory and Practice. London: Sage Publications.

Wild and Scenic Rivers Act (16 USC 1271-1287), no. 90–542, Senate and House of Representatives of the United States of America in Congress (1968). https://www.nps.gov/parkhistory/online_books/anps/anps_6f.htm

Winemiller, K. O., McIntyre, P. B., Castello, L., Fluet-Chouinard, E., Giarrizzo, T., Nam, S., Baird, I. G., Darwall, W., Lujan, N. K., Harrison, I., Stiassny, M. L. J., Silvano, R. A. M., Fitzgerald, D. B., Pelicice, F. M., Agostinho, A. A., Gomes, L. C., Albert, J. S., Baran, E., Petrere, M., … Sáenz, L. (2016). Balancing hydropower and biodiversity in the Amazon, Congo, and Mekong. *Science*, *351*(6269), 128–129. https://doi.org/10.1126/science.aac7082

Wolf, E. (1972). Ownership and Political Ecology. *Anthropological Quarterly*, *45*(3), 201–205. https://doi.org/10.2307/3316532

WWF. (n.d.). *Amazon people.* Retrieved November 1, 2021, from https://wwf.panda.org/discover/knowledge_hub/where_we_work/amazon/about_the_amazon/people_amazon.cfm

Yang, Y., Saatchi, S. S., Xu, L., Yu, Y., Choi, S., Phillips, N., Kennedy, R., Keller, M., Knyazikhin, Y., & Myneni, R. B. (2018a). Post-drought decline of the Amazon carbon sink. *Nature Communications*, *9*(1), 3172. https://doi.org/10.1038/s41467-018-05668-6

Youn, S.-J., Taylor, W. W., Lynch, A. J., Cowx, I. G., Douglas Beard, T., Bartley, D., & Wu, F. (2014). Inland capture fishery contributions to global food security and threats to their future. *Global Food Security*, *3*(3), 142–148. https://doi.org/10.1016/j.gfs.2014.09.005

Zalles, V., Hansen, M. C., Potapov, P. V., Parker, D., Stehman, S. V., Pickens, A. H., … Kommareddy, I. (2021). Rapid expansion of human impact on natural land in South America since 1985. Science Advances, 7(14). https://doi.org/10.1126/sciadv.abg1620

Zevallos, A. E. (1993). Da Amazônia ao Pacífico cruzando os Andes. *Estudos Avançados*, *7*, 117–169. https://doi.org/10.1590/S0103-40141993000100006

Appendix A

Cross-Border Freshwater Diagnostic Analysis

1. Priority Transboundary Problems in the Amazon Basin

PROBLEMAS TRANSFRONTERIZOS REGIONALES PRIORITARIOSDE LA CUENCA AMAZONICA	
1	CONTAMINACIÓN DE AGUAS
2	DEFORESTACIÓN
3	PÉRDIDA DE BIODIVERSIDAD
4	EVENTOS HIDROCLIMATICOS EXTREMOS
5	EROSIÓN, TRANSPORTE DE SEDIMENTOS Y SEDIMENTACIÓN
6	CAMBIO DE USO DEL SUELO
7	PÉRDIDA DE GLACIARES
8	GRANDES OBRAS DE INFRAESTRUCTURA
9	GESTION INTEGRADA DE RECURSOS HIDRICOS

2. Main Roots of Transboundary Problems in the Amazon Basin

PROBLEMAS	CAUSAS RAÍCES
Contaminación de aguas	Pobreza en comunidades y poblaciones locales
	Crecimiento demográfico y migración
	Centralismo del poder político y económico
	Escasa educación ambiental y cultura del agua
	Conflictos socio-ambientales y territoriales
	Escasas oportunidades de empleo en ciudades y localidades rurales
	Insuficiente innovación tecnológica

PROBLEMAS	CAUSAS RAÍCES
	Escasa capacitación y sensibilización de comunidades y poblaciones locales
	Escasa educación y cultura del agua
	Débil presencia del Estado en comunidades y poblaciones fronterizas
Deforestación	Crecimiento demográfico y migración
	Pobreza
	Deficiente política educativa
	Modelos macroeconómicos extractivos
	Conflictos socio-ambientales
Pérdida de biodiversidad	Migración y desplazamiento (forzoso o voluntario) de comunidades afectadas
	Crecimiento demográfico de centros urbanos
	Baja densidad demográfica en zonas de frontera
	Pobreza en comunidades y poblaciones locales
	Débil gobernanza para la conservación de la biodiversidad
	Prácticas culturales de corta y quema
	Escasa información de los derechos de las comunidades y poblaciones locales
	Escasa innovación tecnológica
Eventos hidroclimáticos extremos	Crecimiento demográfico y migración
	Pobreza
	Ausencia de planificación en el desarrollo
	Escasa educación ambiental
	El fenómeno El Niño
	Variabilidad climática y cambio climático
	Débil presencia del Estado en comunidades y poblaciones fronterizas
Erosión Transporte de Sedimentos y Sedimentación	Crecimiento demográfico
	Pobreza
	Geodinámica y cambio climático
	Escasos conocimientos
	Carencia de tecnologías
Cambio de uso del suelo	Crecimiento demográfico y migración
	Pobreza y desempleo
	Escasa capacitación y entrenamiento
	Escasa educación
	Escasa tecnología
Gestión Integrada de Recursos Hídricos (GIRH)	Pobreza y desempleo
	Modelos económicos
	Alienación cultural de la comunidades nativas
	Escasa información y data
	Escasa capacitación y entrenamiento
	Conflictos sociales
	Variabilidad climática y cambio climático
Pérdida de glaciares	Riesgos y vulnerabilidad por el cambio climático
	Geodinámica y fallas geofísicas
	Gases de efecto invernadero generado por la actividad industrial
	Desertificación
Grandes obras de infraestructura	Escasa planificación
	Crecimiento demográfico y migración
	Expansión urbana informal

PROBLEMAS	CAUSAS RAÍCES
	Modelos económicos extractivos
	Afectación a la seguridad alimentaria
	Pobreza
	Escasa educación, capacitación y entrenamiento
	Conflictos sociales y ambientales

From OTCA – Organización del Tratado de Cooperación Amazónica, P. (2016). *Estrategia Regional para la Gestión Integrada de los Recursos Hídricos de la Cuenca Amazónica.* (p. 205). Organización del Tratado de Cooperación Amazónica (OTCA). http://otca.org/wp-content/uploads/2021/02/Programa-de-Acciones-Estrategicas-PAE.pdf

Appendix B

Survey Questions

Section I Demographic Information

Q1 In what Amazon country are you based?

- Bolivia (1)
- Brazil (2)
- Colombia (3)
- Ecuador (4)
- Peru (5)
- Guyana (6)
- French Guyana (7)
- Suriname (8)
- Venezuela (9)
- Not based in an Amazon country (10)

Q2 If you are from another country, what country are you from?

_____

Q3 In the country you are based, in what city do you live?

_____

Q4 If most of your work related to the Amazon is not in the country where you are based, please state where you conduct your work.

_____

Q5 In what sector of society are you employed?

- [ ] Construction Industry (4)
- [ ] Economy/ Finance Entity/ Agency/Department/ Authority (6)
- [ ] Environment Entity/ Agency/ Department/ Authority (7)
- [ ] Environmental NGO (1)
- [ ] Indigenous Entity/ Agency/ Department/ Authority (8)
- [ ] Indigenous NGO (2)
- [ ] Local Government (9)
- [ ] Research/ Academia (3)
- [ ] Water Entity /Agency/ Department/ Authority (10)
- [ ] Other (11) _____

Q6 Which field best describes your area of expertise? Check all that apply.

- [ ] Biology (1)
- [ ] Ecology (2)
- [ ] Economics (3)
- [ ] Environmental Science (4)
- [ ] Geography (5)
- [ ] Geology (6)
- [ ] History (7)
- [ ] Hydrology (8)
- [ ] Law (9)
- [ ] Natural Resource Policy (10)
- [ ] Political Science (11)
- [ ] Sociology (12)
- [ ] Traditional Ecological Knowledge/ Indigenous Science (13)
- [ ] Other (14) _____

Q7 If you care to provide this information, what is the name of your employer?

_____

Q8 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Other (3) _____
- ○

Q9 What is your age group?

- ○ 18 - 25 (1)
- ○ 26 - 30 (2)
- ○ 31 - 35 (3)
- ○ 36 - 40 (4)
- ○ 41 - 45 (5)
- ○ 46 - 50 (6)
- ○ 51 - 55 (7)
- ○ 56 - 60 (8)
- ○ 61 + (9)

Section II Natural Resource Development and Ecosystem Services in the Amazon

Q10 If your work includes some focus on rivers in the Amazon, where does this work focus and what are your activities?

_____

_____

Q11 For the country where you do most of your work (as selected in Section I), please rank how much you think the government should exploit riverine resources for economic development.

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q12.A In general terms, if you think these **provisioning ecosystem services** (goods and benefits provided to society by the environment) exist in Amazon rivers, how important are they?

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Biodiversity ()	
Fiber & Fuel ()	
Food (e.g., fish and fruit) ()	
Freshwater Quality & Quantity ()	
Genetic Materials ()	
Other ()	

Q12.B In general terms, if you think these **regulating ecosystem services** (goods and benefits provided to society by the environment) exist in Amazon rivers, how important are they?

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Climate Regulation ()	
Erosion Control ()	
Hydrological Regimes ()	
Natural Hazard (Flood & Drought) ()	
Pollution Control & Detoxification ()	
Others ()	

Q12.C In general terms, if you think these **supporting ecosystem services** (goods and benefits provided to society by the environment) exist in Amazon rivers, how important are they?

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Biodiversity ()	
Nutrient Cycling ()	
Pollination ()	
Refugia ()	
Soil Formation ()	
Other ()	

Q12.D In general terms, if you think these **cultural ecosystem services** (goods and benefits provided to society by the environment) exist in Amazon rivers, how important are they?

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Aesthetic ()	
Recreation ()	
Spiritual ()	
Territory for Tribes ()	
Transportation ()	
Other ()	

Q13 Please, indicate the level of degradation that in your opinion, rivers in the Amazon are facing in the region where you work.

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q14 If you consider these types of development to be a threat to riverine ecosystem services, please rank according to your opinion, the level of threat in the region where you work.

Not Applicable

0 10 20 30 40 50 60 70 80 90 100

Agriculture ()	
Dams ()	
Deforestation ()	
Dredging ()	
Drug Trade ()	
Fisheries ()	
Forest Fires ()	
Hydrovias ()	
Illegal Extraction (logging & mining) ()	
Invasive/non-native species ()	
Mining (gold, oil, gems) ()	
Paved Roads ()	
Pollution ()	
Ports ()	
Ranching ()	
Railroads ()	

Reservoirs ()	
Squatting ()	
Transmission Lines ()	
Unpaved Roads ()	
Urban Development ()	

Q15 List here examples of any of these threats (provide as much information that you like).

_____

_____

Q16 What types of development policies do you consider to be a source of threats and/or degradation to Amazonian rivers?

☐ Bilateral Trade Agreements (between two countries) (1)

☐ Free Trade Agreements (2)

☐ IIRSA (Initiative for the Integration of the Regional Infrastructure of South America)/ COSIPLAN (3)

☐ Mercosur/Mercosul (4)

☐ Multilateral Trade Agreements (between multiple countries) (5)

☐ Territorial/ Frontier Expansion (6)

☐ Other (7) _____

Q17 During the current administration in the country where you work, has the government taken a development, conservation, or balanced approach towards the Amazon?

- ○ Conservation (1)
- ○ Development (2)
- ○ Both (3)
- ○ No significant approach to either (4)
- ○ Other (5) _____

For the following fill-in-the-blank questions, there may be many examples so please focus on those examples you feel are most important. You will have the opportunity to follow up with more details via future communication if you wish.

Q18 Please, if possible, describe with some examples the way the government of country where you work has been managing the Amazon.

_____

_____

Q19

How does this administration vary in its approach to Amazon governance from the previous administration? Please provide a description with examples of the previous government's initiatives related to activities in the Amazon region as they pertain to the condition of rivers in the region.

_____

_____

Q20 Please provide a description, with examples, of political, development, and/or advocacy initiatives related to activities in the Amazon as they pertain to the condition of rivers in your region.

_____

_____

Section III Policy Options for Riverine Governance

Q21 Do you think it is important to have a conservation strategy to protect riverine ecosystems in the Amazon?

○ Yes (1)

○ No (2)

Q22 Why do you think it is or is not important to have such a strategy for Amazonian Rivers?

_____

_____

Q23 If these policies exist in your country, rank how effective you think they are at protecting rivers.

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Constitutional Laws to protect water quality and/or quantity ()	
Integrated River Basin Management ()	
Laws prohibiting dam development ()	
National Parks and/or Protected Areas ()	
Rights of Nature/Rights of Rivers ()	
State/provincial laws protecting rivers ()	
No river protection policies exist ()	
I am not aware of any such policies ()	

Q24 If there is another river protection policy in your country not listed above, list it here with a brief description of its effectiveness and, if possible, include links to websites for more information.

_____

_____

Q25 If you feel there are obstacles to the efficacy of these policies, what are they? Please describe any examples. Your answer may be brief, and you can also note an appropriate reference where more information can be found.

_____

_____

Q26 Rank what you would consider the best approach to provide river protections. Score 100 for the approach that is most important, and then score all others relative to that, giving a ranking to every category (including "other") or mark as ‘Not applicable’.

	Not Applicable 0 10 20 30 40 50 60 70 80 90 100
Constitutional Laws aimed at protecting water quality ()	
Integrated River Basin Management ()	
Laws prohibiting the development of dams ()	
National Parks and/or Protected Areas ()	
National River Conservation System ()	
Regional tribunal to enforce environmental laws ()	
Rights of Nature/Rights of Rivers ()	
State/provincial laws protecting rivers ()	
Treaty between all the Amazon countries ()	
Other ()	

Q27 Do you think Amazonian countries would participate in a regional agreement for a basin-wide conservation system to protect certain riverine ecosystems that contain vital ecosystem services?

○ Yes (1)

○ No (2)

○ I do not know (3)

Q28 In your opinion, which factors would enable, and which factors would constrain such agreement (basin wide conservation system)?

_____

_____

Q29 How familiar are you with the Amazon Cooperation Treaty Organization (ACTO)?

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q30 Do you think the ACTO can be revised/amended to incorporate a conservation system for Amazonian River protections? Why or why not?

_____

_____

Q31 How familiar are you with the Initiative for the Integration of the Regional Infrastructure of South America (IIRSA)/COSIPLAN ?

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q32 Do you think IIRSA/COSIPLAN can be revised/amended to incorporate protection for Amazonian Rivers? Why or why not?

_____

_____

Q33 Do you think conservation is more important in headwaters reaches, downstream reaches, or both reaches when it comes to protected riverine ecosystems?

- ○ Headwaters (1)
- ○ Downstream (2)
- ○ Both reaches (3)
- ○ Conservation is not important (4)
- ○ I do not know (5)
- ○ Other (6) _____

Q34 Please explain your answer to the previous question.

_____

_____

Q35 Which of the following are the most important riverine components to protect? (Select all that apply)

☐ Biodiversity (1)

☐ Fisheries (2)

☐ Free-flowing (no dams) condition (3)

☐ Water quality (4)

☐ Other (5) _____

☐ Briefly explain your reasons for omitting any of the previous options (6)

_____

Q36 Rank all impediments that currently limit the conservation of Amazonian riverine ecosystems in your region. Score 100 for the approach that is most important, and then score all others relative to that, giving a ranking to every category (including "other") or mark as ‘Not applicable’.

Not Applicable

0 10 20 30 40 50 60 70 80 90 100

Lack of a strong environmental advocacy lobby ()	
Lack of civic engagement ()	
Lack of cooperation/trust between basin countries ()	
Lack of enforcement ()	
Lack of environmental institutions ()	
Lack of environmental policies ()	
Lack of fines for noncompliance with environmental laws ()	
Lack of funding ()	
Lack of governance oversight ()	
Lack of monitoring ()	
Lack of political will ()	
Lack of scientific knowledge/data ()	
Lack of social will ()	
Lack of surveillance ()	
Lack of understanding about Amazonian ecosystems ()	

Proximity to rivers ()	
Others ()	

Q37 If you are interested in participating in a follow-up interview, please provide your contact information below.

☐ Your preferred email address for correspondence (1)

_____

☐ Preferred phone number to reach you (2)

_____

☐ Preferred times and days to reach you (3)

_____

That completes the questionnaire. Thank you very much for your assistance! If you need more information, please contact: Stephannie de Souza Fernandes, School of Earth and Sustainability, Northern Arizona University, Phone (928) 707-3965, email: sdf94@nau.edu. Or if you have questions about your rights as a participant in this study, contact the Northern Arizona University Institutional Review Board (IRB) Human Protections Administrator at 928-523-9551 or by email at IRB@nau.edu.

Appendix C
Semi-Structured Interviews Questions

Personal Data and Background

1. What is your name?

2. Where do you live/work?

3. Who do your work for? What's your job title? How long have you worked in this position?

4. How did you get involved in river conservation/environmental management/ international organization?

5. Does your work intersect with the Amazon? If so, how?

Perceptions of the Amazon, freshwater conservation, and considerations for possible establishment of a basin wide system

1. Thinking of freshwater resources/ecosystem services please elaborate on why you think they are important, if you do? What freshwater resources/ecosystem services do you think are the most important in the Amazon?

2. Do you think that any of these resources that we discussed before are sustainably managed? What do you understand by "sustainable"? How are they managed? By whom?

3. Thinking about national and/or regional economic development, can you think of any particular agendas or projects that are impacting the integrity of Amazonian rivers and their ecosystems? If so, what are they and how do they function? Who supports them? As in what sector of society or the government is in support of these developments?

4. To your knowledge, is there any type of environmental safeguards that are meant to ensure that development impacts are mitigated or avoided?

5. Do you know of any regional economic agreement that safeguards the environment?

6. Are you aware of any policies that explicitly protect riverine ecosystems in any Amazon country If so, which policy is this?

7. Do you know of any protection policy that exists but is not effective? If so, which policy is it?

8. Do you think that a basin wide conservation system that protects certain rivers identified to be socially and/or ecologically significant would benefit the Amazon watershed? If so, what kind of policy structure could you imagine functioning here? Do you have any ideas?

9. How possible/feasible do you think it is for the cooperation of all nine Amazon basin countries to establish a basin-wide conservation system?

10. What social or political obstacles, if any, do you think exist for the cooperation and/or enforcement of all Amazon basin countries in such a system?

11. Is there anything else that you'd like to share about the rivers in the Amazon?

Appendix D

NVivo Codes

Resource Exploitation

- Deforestation
- Fire
- Mercury Pollution
- Sediment and Erosion
- Sewage Pollution
- Agribusiness
    - All activities
    - Crop Production
    - Ranching Cattle
    - Timber
- Energy – Dams and Transmission Lines
- Fishery
- Hunting
- Hydroways
- Illegal Actors
    - Armed Groups
    - Biopiracy Drug Trade
    - Squatting
- Mining
    - Bauxite
    - Diamonds
    - Gold

        - Not Specified
        - Oil and Petroleum
        - Sand and Gravel
    - Ports
    - Roads
    - Tourism
    - Urban Expansion

Natural Resources Management

- Basin System
    - Constrain
    - Enable
    - Importance
        - ◊ Conservation
            - Connectivity
            - Humankind
            - Provision ES
    - Not well explained
    - Regional Planning

Governance

- Behaviors
    - Awareness and Knowledge
    - Civic Engagement

        - Corruption
        - Dictatorship
        - Dismantling and Flexibility
        - Environmental Agenda
        - Fiscalization
        - Funds
        - Implementation and Enforcement
        - International Support
        - Lobby
        - Political Will
        - Political Ideology
        - Protection and Law

- Environmental Protection
    - Environmental Impact Assessment
    - Government Initiative
    - NGO or Local People Initiative
    - Protected Areas
    - Regional or Global
    - River Basin Committee

- Government Policies/Agreements
    - Global
        - ◊ Bi-Lateral Agreements
        - ◊ International Exploitation
        - ◊ Multilateral Agreements

- Local (municipal or state)
- National
    - ◊ Frontier Expansion
    - ◊ Other Policies
- Regional
    - ◊ Regional Cooperation
    - ◊ ACTO
        - No Information
        - Should be Revised
        - Should not be Revised
    - ◊ Other Agreements
    - ◊ Regional Integration
        - IIRSA
        - No Information
        - Should be Revised
        - Should not be Revised
    - ◊ Mercosur
    - ◊ Other
    - ◊

o Environmental Values

- Anthropocentrism
- Ecocentrism
- Technocentrism

Appendix E
Discourse analyses table

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Preamble of Constitution of Ecuador	"...liberation from all forms of domination and colonialism... we decided to build a new form of citizen coexistence in diversity and harmony with nature, to achieve good living, sumak kawsay; a society that respects, in all its dimensions, the dignity of people and communities..."			X
Preamble of Constitution of Bolivia	"... We take on the historic challenge of collectively constructing a Unified Social State of Pluri-National Communitarian law, which includes and articulates the goal of advancing toward a democratic, productive, peace-loving, and peaceful Bolivia, committed to the full development and free determination of the peoples....We found Bolivia anew, fulfilling the mandate of our people, with the strength of our Pachamama and with gratefulness to God"			X
Interview Respondent	"If Bolivia, Peru, Ecuador, and Colombia manage to build and improve this [Rights for Nature and Rivers], it is already a big step forward because the main problems that we have today in terms of hydrology threats are happening for the most part in the Andean region, actually with Brazilian financing"		X	X
Interview Respondent	"I think that if Amazon community (Indigenous, traditional and riverbank population] leads this [the conservation system] would facilitate the conservation plan"	X		
Interview Respondent	"Coming from a country extremely rich (petroleum) and watching that wealth was not used to ensure sustained development and capacity building, that would be an obstacle to avoiding traumatic, particular and corruption agendas, puts in my own a strong doubt of our human capacities to do our tasks properly and to guarantee future generations a better world."			X

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Brazilian Constitution, Article 225	"Everyone has the right to an ecologically balanced environment, a good for common use by the people and essential to a healthy quality of life, imposing on the Public Power and the community the duty to defend and preserve it for present and future generations"			X
Interview Respondent	"We are working with several initiatives to replicate the US Wild and Scenic Rivers Act, but they are not yet implemented. I believe that this model in the Amazon would be ideal"			X
Interview Respondent	"These programs, projects and conventions [international conventions, biodiversity conservation, sustainable development] particularly in our countries do not work because they lack a high priority"			X
Interview Respondent	"You just need somebody to push the conservation strategy, to call attention to how water resources are important. Now is the perfect time to settle the legislation in place. South America is rich in water resources. Now is the perfect time to set the rules to manage water and the last thing you want is a big company in Europe come and manage the water for you"	X		
Interview Respondent	"The Leticia Pact is often mentioned. It took place here in Leticia, Colombia. It was a meeting between all the Amazon countries.... President Bolsonaro did not attend. He watched by teleconference. Venezuela was the only country that did not come"			X
Interview Respondent	"Almost all of these Andean countries have their "backs" to the Amazon. They are very Andean economically and most of them are peaceful. They explore the resources of the Pacific Ocean such as fish. The logistic part is facing the Pacific, so they never saw the Amazon with great interest"			X

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Interview Respondent	"The rivers in the Amazon have been looked at like an economic resource before ecological one"			X
Interview Respondent	“If you look at the existing conservation polygons in Bolivia’s map it looks like Protected Area, but when you zoom in, there are empty ‘gaps.’ These gaps are rivers, these gaps are limits of Protected Areas. There is no level of protection. A river needs protection…”			X
Interview Respondent	"We have several conservation units, protected areas, that we had to evict in an area for the construction of a hydroelectric plant and there was a National Park in the Amazon where the main scenic attraction was a waterfall, and the waterfall was outside the National Park because it obeyed the design of the river"			X
Interview Respondent	"At the national level there are many policies for the management of riverine ecosystems, such as plans for the management of river basins and micro-basins; the declaration of “Ramsar” protected areas. However, there are particular economic powers that work as reassure for them not to be fulfilled. Then, these can be considered as paper parks"			X
Interview Respondent	"The Basin has "insufficient data on aquatic ecosystems and biodiversity hotspots; political focus on terrestrial ecosystems to the exclusion of any concern with riverine systems, including in the national protected areas systems and allocation of funds for conservation; lack of understanding and consideration of the potential role of protected areas in freshwater ecosystem protection; lack of awareness that freshwater biomes have been the most impacted of all systems by biodiversity loss; insufficient mainstreaming of environmental considerations into water resource development"			X

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Interview Respondent	"PAs and ecological corridors are not respected at all, on the contrary, there is no work with producers, farmers, to demonstrate the importance of these areas, the function of these areas which are protected by law for the waters of the Amazon and at the same time has no punishment, if someone deforest it, go unpunished"			X
Interview Respondent	"These projects [dams] cause large population displacements, and greater water demand for human consumption, food production, etc. There is a need to predict such impacts and ways to mitigate them."		X	
Interview Respondent	"For the settlers, the sense of progress is seeing the forest on the ground"		X	
Interview Respondent	"The agricultural sector will embrace the cause when exports get embargoed due to environmental issues and when water is lacking to irrigate crops"		X	
Interview Respondent	" Building the dam in Xingu River was always a dream and the dream turned into a nightmare. It costs a fortune, and it is not effective"		X	
Interview Respondent	"The costs of the projects in the Andes are more harmful than in the rest of the basin as they have more disturbances potential. They are the headwaters; they are very sensitive areas where the sediment and flow originates. There are many impacts in the rest of the basin as well, however, when downstream, the impacts are more related to the social and local biodiversity."		X	

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Interview Respondent	"These hydroelectric plants are not ours, they are Brazilian, the Jirau and Santo Antônio dams. It has monitoring that shows that there are reductions, mainly of “dourada” (Brachyplatystoma rousseauxii), which is the largest migration, migration of more than a thousand km at the headwaters and created a significant reduction of it, and also of other species"		X	
Interview Respondent	"Although this fish was not important for fishing practices in that region, it is a fish that is lost. If it is lost, its life cycle is close to a local endangered species. In Peru, in the Amazon region, even in Brazil, this is a very important fish economically."		X	
Interview Respondent	"They [hydropower companies and government] are causing social and economic harm in the Amazon, and are unconcerned about Indigenous people or the environment"		X	X
Survey Respondent	"This situation of State absence [in Colombia] is propitious to the establishment of irregular groups that take advantage by invading the territory with illegal activities from mining to drug trafficking"		X	X
Survey Respondent	"The government has flexible laws, decreased public participation and civil society participation in decision-making spaces and committees, promoted flexibilization of licensing policies, cuts and reforms in agencies of environmental protection, cuts in FUNAI's budget, the national agency for Indigenous affairs, and fired and changed staff working in these agencies. The dismantling of Brazilian environmental agencies is part of the current government's plans"			X
Survey Respondent	"Currently, there are no protected species of fish, so there is no mandatory external expertise on issues such as dams, mining, constructions"		X	X

Document	Comment	Theme		
		Management (Amazon Conservation System)	Resource Exploitation	Governance
Survey Respondent	"There is a very clearly articulated strategy to develop the Amazon basin, which is IIRSA, but no comparable strategy to conserve the globally significant biodiversity of the Basin or ensure that this biome is capable of continue to provision ecosystem services"			**X**
Survey Respondent	"IIRSA is oriented towards infrastructure development. Incorporating the protection of Amazonian rivers may contradict this vision"			**X**
Survey Respondent	"...until there are incentives for conservation initiatives which can compete for incentives for development it will be hard to make changes in IIRSA/COSIPLAN."			**X**
Survey Respondent	"One possibility to encourage governments and local populations to orient themselves towards sustainable developments would be develop green tourism"			**X**

Note.

Ecocentric Ethic and Ecological Value (Ecology and nature as central to Humans)

Anthropocentric Ethic and Utilitarian Value (Humans are not dependent on nature)

Technocentric Ethic (Technological developments can provide solutions to environmental problems)