Speaking with the River: Embodied Encounters and Local Values of the Río Peñas Blancas in Response to Potential Hydroelectric Development in South-Pacific Costa Rica

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ABSTRACT

In Costa Rica, the state's decision to approve the construction of two private hydropower dams along the Peñas Blancas River is being called into question by local residents and non-governmental agencies who caution against the environmental, socio-cultural, and economic implications of constructing multiple dams along a potable and highly biodiverse river system. To explore these various concerns, I conducted research with 36 primary participants (including residents, peasants, conservationists and student youth) within the Alexander Skutch Biological Corridor (ASBC) in the south-Pacific region of Costa Rica. The primary objective of this research was to understand how local knowledges can inform state policy—particularly with regard to how environmental impact studies are conducted and written. In addition, by considering how the river itself is assembled from organic, geophysical, material, social, discursive, and technological components, this thesis offers alternative ways of envisioning freshwater that do not adhere to the dominant representations found within current policy. The study finds that the river is indistinguishable from the components that generate its quantity and quality, indicating that the effective conservation of the river's water is integrally tied to and dependent on the protection of the conditions and elements that generate its flow.

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FOREWORD

My area of concentration within my Plan of Study explores different understandings of freshwater and their contributions to how this element is used and managed in the Neotropics. I am particularly concerned with how beliefs and values with respect to freshwater become embedded within distinct environmental positions that converge, or conflict within water and energy politics to inform decisions about freshwater access, allocation, and conservation. Moreover, I consider how these distinct environmental knowledge systems are mediated by power relations to become unevenly embedded within the rules and regulations that govern freshwater. I additionally explore how these rules and regulations operate in association with local beliefs and practices to constitute a region's particular hydro-social conditions and the lived bodily-realities of its water dependents.

Throughout this degree, I have considered these aspects of freshwater through the frameworks of environmental anthropology and political ecology. Together, these disciplines emphasize a changing nature to the dominant ways of understanding freshwater and valuing its capacities. With the future uncertainties of global climate change, population growth, and freshwater extraction for industry, increasing concerns about a global water crisis have become prominent in the language used by state and non-state actors to warrant this element's control. I have experienced such control through numerous initiatives aimed towards citizens to self regulate our individual consumption: "don't leave the faucet running, don't water gardens or wash cars in a drought". However, these initiatives often do not account for freshwater's primary consumer: industrial/commercial industry.

While water scarcity has become a largely naturalized condition within politics, theorists such as Lyla Mehta argue that the notion of scarcity is "usually socially mediated and the result of sociopolitical processes" that tend to "naturalize its anthropogenic dimensions"; prompting the need to distinguish between the material forms of scarcity that are increasingly and unevenly felt by water dependents, and the relative forms of scarcity that are generated by its industrial users (Mehta 2011:372). Extending from this, I borrow anthropological methods and theory to consider alternative ways of understanding freshwater conservation within mountain communities in Costa Rica, where residents contest dominant perceptions of water scarcity and freshwater management. Within this thesis, I expand upon the components within my Plan of Study (with regard to freshwater knowledges, uses, and management approaches) to envision alternative ways of understanding freshwater that bring its own agency to the forefront of its study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ASADA	Management Associations of Community Aqueducts and Sewers
AYA	Institute of Aqueducts and Sewers
CABEI	Central American Development Bank for Economic Integration
CoBAS	Association for the ASBC
ECODES	Conservation Strategy for Sustainable Development
GABI	Great American Biotic Interchange
ICE	Costa Rican Institute of Electricity
MAG	Ministry of Agriculture and Livestock
MINAE	Ministry of Environment and Energy
MINAET	Ministry of Environment, Energy and Technology
SETENA	National Environmental Technical Secretariat
SIEPAC	System of Electrical Integration for the Countries of Central America
SINAC	National System of Conservation Areas
STICA	Ministry of Agriculture and Livestock
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
WHO	World Health Organization

LIST OF ABBREVIATIONS

ASBC	The Alexander Skutch Biological Corridor
CCR	Canada Costa Rica Company
CNP	National Production Council
EIS	Environmental Impact Study
EPA	Environmental Protection Agency
GHG	Greenhouse Gases
IDB	International Development Bank
IMF	International Monetary Fund
ITCO	the Colonization and Land Law
ITCZ	Intertropical Convergence Zone
Ka	Thousand Years Ago
MASL	Metres Above Sea Level
MEP	Ministry of Education
MOPT	Ministry of Public Works and Transport
MRV	Movimiento Rios Vivos
MSP	Ministry of Public Security
MW	Megawatts
PH PB	PH Peñas Blanquitas
PPP	Plan Puebla Panama
TSC	Tropical Science Center
WB	World Bank
WCD	World Commission on Dams

1 INTRODUCTION

1.1 An Introduction to the Study

In south-Pacific Costa Rica, the state's decision to approve the construction of two private hydropower dams along the Peñas Blancas River is being called into question by local residents who caution against the environmental, socio-cultural, and economic implications of constructing multiple dams along a potable and highly biodiverse river.

The concerns expressed by these residents bring attention to the local implications of water privatization, and their resistance efforts are advancing community-based strategies to protect the national status of freshwater as a public resource (as per Water Law N° 11). Pursuant to these issues, this thesis explores local residents' beliefs, practices and use strategies with respect to freshwater that offer alternative approaches to sustainable water management in the Peñas Blancas watershed. Moreover, it also offers several recommendations for future project assessments that incorporate local perspectives.

1.2 Costa Rica's Watersheds

The Republic of Costa Rica has a total geographical area of 51,100 square kilometers (km2) and covers one third of one percent of Earth's landmass. Although roughly equal in size to the province of Nova Scotia, Costa Rica contains more species biodiversity than Canada and the United States combined. This relatively limited geographic space is inhabited by nearly four percent of Earth's biodiversity with many species clustering in proximity to protected areas which collectively compose 26 percent of the country's total landmass (Gonzalez-Maya et al. 2015:1). Included among the conditions that facilitate this biodiversity are Costa Rica's many unique ecosystems which thrive in variable climatic conditions, elevations, high annual precipitation rates, and with the prevalent availability of surface freshwater. As an aside, Costa Rica has a total of 217 natural water bodies that encompass 40.5 km2 of area within the country (Guzmán-Arias and Calvo-Alvarado 2013:53). These freshwater sources are situated within "34 national watersheds" (Ibid) each of which contains additional rivers, creeks or subterranean springs. However, while Costa Rica has a plentiful amount of freshwater, this water is not distributed evenly throughout the country and only a limited quantity is potable.

Figure 1: Map of Costa Rica
(Wikipedia 2006[1987])

1.2.1 **National Freshwater Availability**

Costa Rica contains a substantial amount of available freshwater to maintain its population equal to 26 221 cubic metres (m3)/person per capita in 2005 (Guzmán-Arias and

Calvo-Alvarado 2013:53). However, only a limited amount of this water is potable, causing water shortages to be a growing reality for those living in proximity to Lake Arenal, the Tempisque-Bebedero River (Ballestero-Vargas 2013:19), and in other regions within the north-Pacific Province of Guanacaste. In addition, the combined effects of industrial water pollution and over-exploitation continue to affect residents located south of Guanacaste within the Tárcoles River Basin, which supplies water to the country's three most densely populated cities: San Jose, Alajuela, and Heredia (Ballestero-Vargas 2013:18).

Moreover, the country's water insecurity is expected to intensify due to the growing demands of an increasing population coupled with anthropogenic climate change (Datta et al. 2015:2). In anticipation of this shortage, water rationing has already been implemented in some urban neighbourhoods; while conservation strategies, aimed towards reducing household water consumption, are being explored in research studies with the participation and support of state actors and multi-national lending institutions such as the World Bank[1].

1.2.2 **The Water/Energy Nexus**

Despite the objectives of such strategies, the reduction of individual and household water consumption is not a long-term solution for national water security. This is because, according to 2005 estimates, household freshwater consumption (in addition to tourism, industry and agribusiness) collectively accounted for only 6.8 percent of the country's total freshwater withdrawals (Guzmán-Arias and Calvo-Alvarado, 2013:53). The country's total withdrawals were equal to an estimated 22 cubic kilometres (km3) or 20 percent of the total available water volume of 113 km3 (Ibid).

In comparison, 21.2 percent of water withdrawn in Costa Rica in 2005 was used by the agricultural industry; while the vast majority—approximately 72 percent—was used to generate power (Ibid). This latter percentage is estimated to have since escalated to as high as 94 percent (Alpizar Rodriguez 2014:171). The energy sector's privileged access to freshwater allocations points to the state's preference for public, followed by private, hydropower dams which collectively generate "over 80% of the nation's electricity" (Lindo 2006:298). This reveals that the country's water politics is intricately tied to energy politics; a direction which has

[1] Governmental organizations, in collaboration with World Bank funded research groups, generated water conservation strategies that focus on reducing household water consumption by enforcing behavioral interventions. This is discussed within a 2015 study that was performed in Belén, Costa Rica (see: Datta et al. 2015)

expanded throughout the past several years to the northern tributaries of the expansive Térraba Watershed, the largest of the country's national watersheds.

1.2.3 Dam Projects within Pérez Zeledón

Costa Rica's energy direction is especially visible within the south-Pacific municipalities of Pérez Zeledón, Buenos Aires, and Coto Brus where 18 dams—most of which are independently funded by private companies—are in different stages of the state's review process. Of these dams, ten projects alone are planned for construction along every primary river that descends from the southern slope of the Cordillera de Talamanca mountains which cuts through Pérez Zeledón and Buenos Aires (Álvarez Mora 2013). Among these proposed dam projects are PH Peñas Blanquitas I (PHPB I) with 8650 kilowatts (kW), and PH Peñas Blanquitas II (PHPB II) with 3816 kW, both to be developed by the company Hidroeléctrica Buenos Aires (Ibid).

To begin project development, this company was required to submit an Environmental Impact Study (EIS) to the National Environmental Technical Secretariat (SETENA) during the dam's planning phase (Lindo 2006:302). This EIS required approval before further development would be permitted. In line with this requirement, SETENA approved the construction of PHPB I and PHPB II in 2013 along each of the two northern branches that unite to form the Peñas Blancas River (herein referred to as the Río Peñas Blancas or, simply, as 'the river').

1.3 An Introduction to the River

The Río Peñas Blancas is fed by sister tributaries that carve into the southern ridge of the Cordillera de Talamanca; a mountain range which longitudinally divides Costa Rica's Pacific and Caribbean slopes (Guzmán-Arias and Calvo-Alvarado 2013:54). The Río Peñas Blancas' north-western tributary flows from 3,110 meters above sea level (MASL) and extends for approximately 10.82 kilometers (km) (Hidroeléctrica Buenos Aires 2013:38-39) as it crosses through Chirripó National Park before entering York University's Las Nubes (i.e.: The Clouds) Forest Reserve. From Las Nubes, the river passes through wetlands, secondary jungle, cattle pasture, forest patches and agricultural lands that compose Santa Elena's eastern properties. Meanwhile, the smaller Río Peñas Blanquitas also begins within the perimeters of Chirripó National Park at 2,470 MASL, and extends for a length of 7.30 km as it passes through the town of Montecarlo, located north-east of Santa Elena (Ibid).

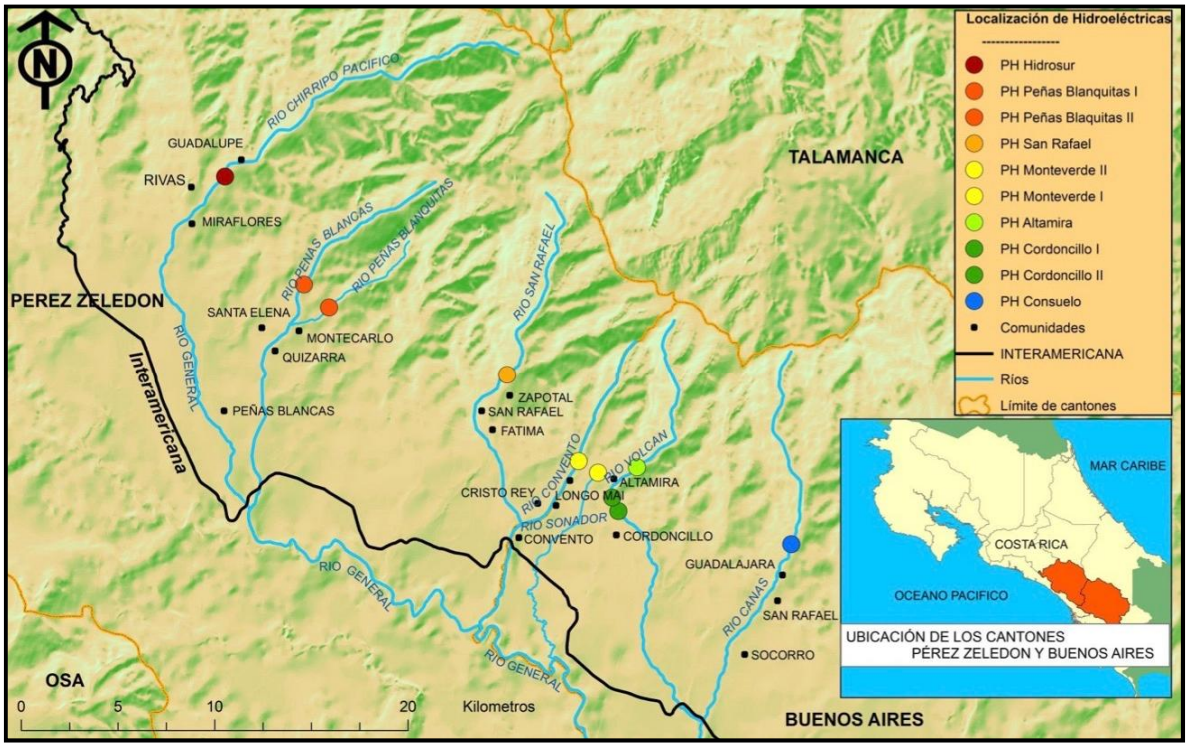

Figure 2: Map of Proposed Dam Sites
A map of the proposed sites for ten private hydroelectric dams in the municipalities of Pérez Zeledón and Buenos Aires. The two orange dots (left of center) represent PHPB I and II. (Espinoza and Villalobos 2013).

Just below central Montecarlo, near the coordinates of (9.35750°, -83.61208°) at an elevation of 786 MASL, the smaller Río Peñas Blanquitas meets with its larger north-western tributary, the Río Peñas Blancas. These tributaries combine their waters to expand the Río Peñas Blancas which then enters the southern edge of the community of Quizarrá and circles the eastern perimeter of Los Cusingos, a 78 hectare Tropical Bird Sanctuary currently managed by the Tropical Science Center. From there, the river's flow passes through the towns of San Fransisco and Peñas Blancas as it enters the General Valley and into the larger Rio General (General River). The enlarged Río General then continues on to receive the flows of the Cordillera de Talamanca's additional primary rivers that together enter the Rio Térraba (Térraba River). These combined waters then pass through "the brackish mangrove ecosystems of world importance in the Térraba-Sierpe Mangrove Reserve" (Montoya and Martinez 2015:5) before filtering into the Pacific Ocean.

1.3.1 **Movimiento Rios Vivos**

Figure 3: Movimiento Rios Vivos

(L) Members of Movimiento Rios Vivos protest in San Pedro de Pérez Zeledón (Movimiento Rios Vivos *In* Facebook 2016); (R) Logo (Movimiento Rios Vivos *In* Facebook, 2015).

The PHPB I and II projects are planned to be constructed between 730 and 840 MASL—just before the two rivers' point of flow convergence (Hidroeléctrica Buenos Aires 2013:38-39). These projects will redirect 90 percent of the river's water away from the riverbed and into a dam reservoir. SETENA's approval of these development projects in 2013 prompted opposition the same year from community members from the nearby towns of Quizarrá, Montecarlo, and Santa Elena, as well as from national and international environmental experts and dam critics, alike.

These actors and activists mobilized with the goal to protect the Río Peñas Blancas and, in solidarity with other communities throughout Pérez Zeledón, Buenos Aires, and Coto Brus, founded the regional social movement Movimiento Ríos Vivos (i.e.: The Living Rivers Movement) in 2013. The aim of this movement is to reduce the country's dependence on hydropower in favour of other green energy alternatives by revealing the social, economic and environmental consequences of hydropower technology as well as the inadequacy of current EIS standards to effectively assess and disclose this information. As such, their concerns emulate the arguments of an international group of dam critics, including: human rights groups, lawyers, the World Commission on Dams (WCD), environmentalists, scientists, experts, and private citizens who emphasize the many social and ecological consequences of hydropower technology (McCully 2001; Strang 2013; Bakker 1999; Lindo 2006; Fletcher 2010).

The local chapter of this larger movement contains a diverse membership, including community residents, farmers, teachers, lawyers, artists, housewives, students, local organizations such as the Organization for the Alexander Skutch Biological Corridor (CoBAS),

the local women's organization (AMACoBAS), regional aqueduct councils (called ASADAs), and institutional supporters such as York University and the National University of Costa Rica.

1.3.2 **Implications of Dam Development**

Many critics point to the overwhelming data that dams have a propensity to cause "flooding of natural habitat, loss of terrestrial wildlife[…] deterioration of water quality, downriver hydrological changes, [impacts on] fish and other aquatic life, [and the release of] greenhouse gases" (Ledec and Quintero 2003:4-7). Moreover, studies conducted by the WCD determined that dams emit "greenhouse gases (GHG) from reservoirs due to rotting vegetation and carbon inflows from the [water] catchment" and further estimate that "the gross emissions from reservoirs may account for between 1% and 28% of the global warming potential of GHG emissions" (WCD 2000:75). In addition to these environmental consequences, social implications of dam construction include: involuntary displacement of communities and loss of cultural property (Ledec and Quintero 2003:4-7), destruction to local economies (WCD 2000), and the loss of location-specific cultural sites and social customs (McCully 2001). Similar claims are provided by scholars of and experts in hydropower generation within Costa Rica who have observed numerous consequences from dammed rivers, such as: the eradication of [terrestrial] and aquatic biodiversity (Lindo 2006), the reduction of fish stream assemblages (Anderson et al. 2006), changes to water sedimentation levels, flooding, river fragmentation, and the dewatering of rivers downstream (Anderson et al. 2008).

Furthermore, an investigation by the School of Sciences at the University of Costa Rica (2014) also determined that dam reservoirs release methane emissions; the level of which is modulated by "several environmental parameters, both chemical and physical[2]" (Fernández Mena 2015:77). Building on these findings, McCully (2001) argues that tropical reservoirs are especially destructive, and "can have a [global] warming impact up to 66 times greater than that of a gas plants [and] gross emissions that can be possibly greater than the thermal alternatives" (xxxvi). McCully also notes that some tropical forest reservoirs can contribute to climate change "even more than fossil fuel-burning power plants [that] produce an equivalent amount of electricity" (2001:141). In the case of this project, local concerns about the potential

[2] Among these noted parameters are "soil temperature, water table levels, the concentrations of chlorophyll and total solids, which show positive correlations with methane fluxes measured in the dam reservoirs of Costa Rica" (Fernández Mena 2015:77).

consequences of PHPB I and II are exacerbated by the anticipated removal of up to 90 percent of the river' s flow quantity; a measurement that was determined within the EIS document for the PH Peñas Blanquitas I and II projects.

1.3.3 **The Minimum Flow Standard**

Of particular concern within the two environmental impact studies is the projects' designated flow standard, which refers to the minimum quantity of water flow "necessary to maintain water quality and the survival of dependent ecosystem varieties" (Burchi 2007:7). Although "no formal legislation for setting minimum in-stream flow standards [currently] exists in Costa Rica", it is recommended that "small dam projects leave a compensation discharge that corresponds to 10% of [the river's] average annual flow" (Anderson et al. 2006:398).

In adherence to this standard, the EIS for the PH Peñas Blanquitas I calculates the Río Peñas Blancas' available annual flow to be 2.981 cubic metres per second (m3 /s). From this total, equal to 2981 litres per second (l/s), the minimum flow standard is projected to reduce the river's flow to 298.1 l/s; with the western branch accounting for 202 l/s, and the eastern Río Peñas Blanquitas contributing the additional 96.1 l/s (Hidroeléctrica Buenos Aires 2013:1).

As the proceeding figures indicate, the anticipated 90 percent reduction of the river's flow would certainly impact the communities of Santa Elena and Quizarrá, which are both located in the projects' Area of Direct Influence (Luffman 2014:14), as well as the community of Montecarlo. This is because the projects would require the removal of water from what is potentially several kilometers of the riverbed by redirecting it to a regulation reservoir with a capacity to hold 48,300 m3 of water. The reservoir's captured flow would then be channeled to a powerhouse and released along the river's left bank further downstream (Hidroeléctrica Buenos Aires 2013:13).

1.3.4 **Water Grabbing or "Enclosure of the Commons"**

The local communities along the river are not in need of additional electrification; thus suggesting that the electricity generated by PHPB I and II would be exported from the region. As such, it appears that the projects are conducting a subtle form of water grabbing; defined as "a situation where powerful actors are able to take control of, or reallocate to their own benefits, water resources already used by local communities or feeding aquatic ecosystems on which

their livelihoods are based" (Mehta et al. 2012:197). The process of water grabbing "shares much in common with resource grabs and enclosures of the commons", which are achieved through the utilization of strategic mechanisms to "appropriate and convert resources into private goods [through] processes of commodification, privatization and large-scale capital accumulation" (Franco el al. 2014:4).

However, the river's enclosure is obscured in the EIS documents in which the environmental, socio-cultural, and economic implications of both hydropower projects are not substantially explored. Instead, the introductory statements within the EIS' for PHPB I and II claim that the projects are a benefit to the country, due to their respective contributions of 8.7 MW (Hidroeléctrica Buenos Aires 2013:2) and 3.8 MW (Hidroeléctrica Buenos Aires II 2013:9) of renewable energy that will help reduce the country's oil bill and its carbon emissions into the atmosphere (Hidroeléctrica Buenos Aires 2013:2).

1.4 Hydropower as a 'Clean' Energy Source

The choice to focus the country's energy plan on hydroelectric power described within the EIS' is justified by the state in terms of the environmental advantages of using dam technology, generally considered by the industry to be a source of 'clean' energy that produces zero greenhouse gas emissions (Fletcher 2010; McCully 2001). Moreover, hydropower technology is represented within state documents as a non-consumptive user of freshwater due to the assumption that the flows that are captured in the reservoirs of dams are released back to the main water channel further downstream (Dolezal et al. 2013:46; Ballestero-Vargas 2013:18), thus reincorporating it into the hydrological cycle. At the same time, this national energy direction also supports Costa Rica's global reputation as an environmental leader and its international commitment to become the first carbon neutral nation in the world by 2021 (Fletcher 2013:155). Thus PHPB I and II projects are vital to Costa Rica's ability to achieve its international promises and domestic plans and, as such, hydropower development is the state energy priority—with the construction of new large and small scale dams being promoted as a national strategy to reduce the country's dependence on 'non-renewables' (Hidroeléctrica Buenos Aires 2013:2) as well as a way to help expand the country's energy grid.

1.4.1 Hydropower and the Costa Rican Energy Grid

In Costa Rica, the Institute of Electricity, or Instituto Costarricense de Electricidad (ICE), maintains a monopoly over the distribution of the national energy supply by retaining the authority to administer and allocate water resources for energy generation (Cover-Ruiz et al. 2009:3). This state organization produces an estimated 82 percent of the country's total generated hydropower (Guzmán-Arias and Calvo-Alvarado 2013:55). The additional 18 percent is generated by private companies (Ibid) that can, according to Law 7200 (amended in 1995), legally produce up to 30 percent of the total domestic energy generated (Lindo 2006:303). However, these private companies are required to sell all energy produced back to the ICE, and thus have helped the country to achieve a near "complete national rate of electrification: 99.2 percent [in 2010]" (Hernández et al. 2013:162).

However, dam proponents note that "the country uses only 1,408" (Guzmán-Arias and Calvo-Alvarado 2013:55) Megawatts (MW) of its available hydropower potential, estimated to be between 4,963 MW (Hernández et al. 2013:162) and 6,663 MW (Guzmán-Arias and Calvo-Alvarado 2013:55). This purported power potential, coupled with the legal increase of private participation in hydropower generation, is prompting national efforts to expand the dam sector to untapped water sources; with a notable preference for the development of three public large scale[3] dams in the near future, including El Diquis (with 623 MW), to be completed in 2018 at the mouth of the Río Térraba, Río Pacuare (with 167 MW) in 2019, and Río Savegre (with 200 MW) in 2020 (Guzmán-Arias and Calvo-Alvarado 2013:56). In addition to these projects, there is national interest to expand private small to medium sized diversion dams[4] into the south-Pacific region of the country where there remains a surplus of undammed rivers.

1.5 Making Initial Contact (Project Formation)

I was motivated to consider this research direction during my participation in the Las Nubes Project (a program within York University's Faculty of Environmental Studies). As an institutional member of Movimiento Rios Vivos (MRV), members of the Las Nubes Project

[3] Large scale dams are generally defined as structures "measuring 15 metres or more" (McCully 2001:4).
[4] "In Costa Rica, virtually all small hydropower plants operate as run-of-the-river water diversion dams, where water is diverted from a river to generate electricity and then returned to the main channel downstream. These types of dam projects result in substantial flow reductions (often for several kilometers) between the water diversion site and the downstream water return" (Anderson et al. 2006:398).

facilitated my engagement with the movement by introducing me to its websites[5] from which I obtained regular updates about local efforts to halt the PHPB I and II projects. These updates—which included of a combination of text, photos, and videos—altered my understanding of the dam projects in favour of the movement's objectives.

I also received access to professional correspondences between my supervisor, Dr. Felipe Montoya, participants within MRV, and Costa Rican government officials. The requests made within these emails to halt the dam projects prompted me to consider what factors informed the project's approval in spite of major local opposition: a direction of inquiry which led me to obtain the projects' EIS documents[6] (2013). The depictions of the river within these documents, as an untapped energy resource, were supported by the argument that the projects would help to meet the country's carbon neutrality goal by 2021 (Hidroeléctrica Buenos Aires 2013:7). Comparing this assertion against expert claims that tropical dam reservoirs emit a substantial amount of carbon, prepared me to consider contradictory ideas and beliefs about the Río Peñas Blancas. These varied positions, which operate concurrently, inspired me to explore the uneven political and economic mechanisms with which certain beliefs and representations predominate over others to inform state management procedures and local decisions about freshwater allocation.

1.5.1 **My Positionality and Research Objectives**

This research focus engaged with my positionality as a female graduate student with a personal appreciation—bordering on reverence—for lakes, rivers, and other water bodies as well as a personal objective to work with communities to address resource extraction issues. I was also supported by York University scholarships, and a Canadian passport which privileged my crossing of national borders. In addition, my Central American heritage and intermediate Spanish language skills compelled me to conduct research in the Neotropics, a decision that was further motivated by my additional, although problematic, delight to encounter the ecological and cultural 'exotic'. At the same time, my position as a funded researcher within the Las Nubes Project motivated me to comply with the project's mandate to support local conservation efforts by engaging with residents from Santa Elena, Montecarlo and Quizarrá.

[5] https://www.facebook.com/riosvivosmovimiento/ and https://www.facebook.com/unidosporlosrios/
[6] Upon reviewing the EIS', it was clear that a significant portion of the documents provided favourable justifications for dam development, while discussions of its ecological, cultural, and economic implications at the local level were significantly omitted.

These three communities, in addition to the Las Nubes Project's student eco-campus, are all situated along the two primary branches of the Río Peñas Blancas.

The decision to conduct research within these communities was also informed by my impartial objectives to: document community concerns about the Río Peñas Blancas; consider how local understandings of the region's freshwater can supplement the projects' initial EIS's; and, suggest how these understandings might contribute to future freshwater policy with regard to hydropower development.

In adherence with Luffman (2014), I do not discredit dam technology altogether (7-8) since national dams supply electricity to the same communities in which dam development is being opposed, in addition to having powered the recording devices and technologies that I depended on throughout this research. Instead, I propose a more rigorous application process in order to decrease dam development in a bid to diversify the country's energy grid, a necessary direction to protect the country's potable freshwater supply. To do this, I framed several initial areas of inquiry.

1.5.2 **Research Questions**

This research was guided by several initial questions: (i) how do community residents' experiences and encounters with local freshwater sources contribute to their beliefs and values with relation to freshwater; (ii) how do these understandings and values operate in conjunction with Costa Rica's freshwater policies and procedures to inform local water-use practices; and, (iii) how do these local values and state objectives inform residents' associations with, or attitudes towards, hydropower development along the Río Peñas Blancas?

These questions were not intended to limit the boundaries of my research project. Rather, they were formulated as tentative entry points with the recognition that my focus could be expanded or redirected upon once entering the field. Pursuant to these goals, by presenting research that took place within the Peñas Blancas Watershed from April to August 2016, this thesis seeks to supplement three incomplete areas of research within the projects' initial EIS'.

1.6 An Outline of the Study's Objectives

What creates the river's flow? For an economy that depends on the river's steady freshwater flow, what generates its flow must be accounted for. It can be further reasoned that the local residents who interact with the river as part of their daily routine may have an experiential understanding of the river's flow (such as its quality and quantity) that differs from the data presented in the EIS reports.

To consider what generates the river's flow, I begin the following chapter with the methodologies that I used to collect local data, followed by a theoretical approach that is rooted in the work of vital materialist, Jane Bennett. In relation to exploring the components that generate the Río Peñas Blancas' flow, I also consider where the river's flow *goes* and what this flow *does* in order to consider the implications of reducing the river's flow down to ten percent (as national policy advises).

I also ground this study in poststructuralist literature to extend beyond the traditional good/bad debates that often characterize dam disputes by considering the relations between local issues and larger national and transnational processes within water and energy politics. These topics emphasize that current conditions of the river are not a-historical; rather, they are contemporary extensions of earlier processes such as frontier expansion, the green revolution, the neoliberalization of *nature* through eco-tourism, and the recent carbon economy within Costa Rica, to name a few. Finally, to explore the various elements, phenomena, processes, and events that affect the river's flow, I rely on local narrative accounts, field notes as well as primary sources and secondary documents.

I will organize this thesis' data and conclusions into three chapters that explore the environmental; socio-cultural; and, political-economic dimensions of the Rio Peñas Blancas. These chapters are structured to resemble two of the EIS' primary categories—including the "Description of the Biological Environment" (55) and the "Description of the Socio-Economic Environment" (63) directly surrounding the river—in order to offer contributions to each of the EIS' required categories. I will end each chapter with the conclusions of both the findings and recommendations that may contribute to future policy and practice relating to the river's use and management. However, to analyze the Rio Peñas Blancas in the context of hydropower development, I initially focus my study within the projects' Area of Direct Influence.

2 METHODOLOGIES

2.1 Bounding the Field Site: The River within the ASBC

Between Las Nubes and Los Cusingos, the Río Peñas Blancas acts as a buffer zone down the length of the Alexander Skutch Biological Corridor (ASBC)[7], a geopolitical status that was ascribed to the region in 2005[8] as a collaborative partnership between York University, the Tropical Science Center and several local organizations (Rapson et al. 2012:38). Specifically, the ASBC is composed of a patchwork of private residences, farmsteads, protected areas, forest trails, public spaces, community buildings, and schools which are crisscrossed throughout by additional rivers, subterranean streams, creeks, and water drains. The composition of the ASBCs permanent population is equally as varied and diverse, with a bi-annual stream of new tourists.

2.1.1 Participant Composition

The research for this thesis was undertaken with 36 primary participants: 17 (47 percent) women and 19 (53 percent) men. Thirty-five (97 percent) of the participants live within the ASBC [see Appendix A]. Included among them are Costa Rican nationals (i.e.: Ticos) some of whom grew up in the region or moved to the area in recent decades; and many of whom identify as 'campesinos' (i.e.: rural peasants) who manage small to medium scale farms. Also included among the participants were: residents who had previously migrated to New Jersey (USA) to save money before returning to resettle in the corridor; and, "extranjeros" (predominantly Western expatriate residents) some of whom reside in the ASBC seasonally as 'snow birds' and others who permanently live year round in the corridor. In addition to campesinos, extranjeros, and various local residents, this study included other participants who professionally work or self-identify as conservationists. Table 1 below provides a summary of the participant composition according to gender and the locations in which the interviews took place.

In addition to these 36 primary participants, I also conducted research with 28 student youth from the community of Santa Elena. For the purpose of this paper, all of these participants will herein be referred to as locals, residents, or conservationists.

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[7] The official perimeters of the ASBC extend beyond these three selected communities, and contain the additional communities: Santa Marta, Santa Maria, San Ignacio, San Francisco and Trinidad (Canet Desanti 2005:vii). However, my research is focused primarily within the communities that are situated in closest proximity to the Río Peñas Blancas and with members who have been most vocal about PHPB I and II.

[8] The ASBC "began to take form in 1998 and was formally established in 2005" (Rapson et al. 2012:38).

Community Name	Females	Males	Total
Santa Elena	8	11	19
Quizarrá	5	3	8
Montecarlo	3	2	5
San Fransisco	1	1	2
Cedral		1	1
Longomai		1	1
Gender Totals	17	19	36

Table 1: Participant Composition

While not limiting my research findings, it is valid to note that while these residents comprised the majority of my research participants; they do not represent the full diversity of the corridor's inhabitants. To elaborate, there are numerous individuals and groups who migrate to the region such as Nicaraguan day laborers who temporarily reside and work during the coffee and sugarcane harvesting seasons. In addition to these Nicaraguan laborers are some "indigenous Ngöbe people who have settled" (Grundy 2015: 20) within the ASBC permanently. Thus, the socio-economic divide between community residents widens during heightened times of labour demand, and even moreso when the ASBC also hosts a new flux of foreign visitors[9] each year including biologists, ornithologists, researchers and students from York University and from around the world. In addition, youth groups (primarily from the provinces of Ontario and Quebec) conduct farm work to learn about local agricultural practices through exchange projects that are organized by the region's coffee co-operative, CoopeAgri.

2.1.2 **Participant Recruitment**

As previously noted, I conducted research within the ASBC between April and August, 2016. The initial few weeks were foundational to the direction of this study. This is because my initial participants were enlisted from a contact sheet of MRV members that I had received earlier from my supervisor. These members, and additional residents who I met through personal introductions or word of mouth, were invested in promoting a dam-free river, a direction that I was receptive to explore further. Soon after, I was introduced to additional residents through snowball sampling.

This entry point altered the data that I collected in favour of the perspectives of MRV members and other residents with an affinity for the movement's initiatives. Moreover, I was

[9] Many of these visitors opt to remain with local families through home stays, and I suspect that residents' familiarity with the regular mobility of temporary visitors prompted my entrance into the community, and my local home stay, to be considered somewhat standard.

invited to conduct more interviews than I actually managed to complete; this interest perhaps due to the local significance of the issue as well as the already integrated position of the Las Nubes Project within MRV and in the corridor. With that said, my interactions with dam proponents were infrequent at best[10], despite occasionally being informed by participants about community members who were in favour of the PHPB I and II dams. While this emphasizes that there are diverse opinions among residents regarding the dam projects, my initial associations prompted me to embrace the project of engaging primarily with individual allies, organizational members, and supporters of MRV.

2.2 My Engagement in the ASBC

Throughout this research, my engagement in a variety of local events and activities (either by invitation or as a volunteer photographer) proved to be fruitful networking opportunities in becoming familiar with residents, as well as to enlist additional research participants. These opportunities included: a quinciañera[11], several birthdays, a wedding, a temazcal (i.e.: ritual sweat lodge), a Catholic pilgrimage, several evening masses, the Alexander Skutch Festival, the ASBCs student Environmental Festival, a birthday celebration in honour of Dr. Alexander Skutch, a night hike by headlamp through the Las Nubes cloud forest reserve, and a lecture organized by MRV for visiting international scholars and students.

Moreover, I regularly attended internal meetings and events with CoBAS (i.e.: the central organization for the ASBC), the women's organization for the ASBC (AMACOBAS), and the Aqueduct Council of Santa Elena (ASADA). I also built meaningful friendships with local residents and often engaged in coffee visits, get-togethers, dances, communal meals, social visits as well as accompanied neighbours on their errands and family visits both within and outside of the ASBC.

In addition, I became involved as a part of the network that engages in local affairs through my collaboration with various residents and organizations to plan and facilitate community activities, including: a community day hike with the local ASADA to acquaint

[10] This may be due to the projects' transparent unpopularity among local residents and organizations, causing dam proponents to be less publicly vocal. At the same time, I do not wish to homogenize the perspectives of residents into a dichotomy of dam supporters versus dam critics. Rather, I was interested to tease apart participants' different rationales and perspectives that informed their engagements with the river and with respect to the local water dispute.
[11] Quinceañera is a common ceremony throughout Latin America that marks the 'coming of age' of a girl on her 15th birthday.

residents with the source of Santa Elena and western Quizarrá's potable water[12]; a guided morning hike on July 30th through Las Nubes and several of its microclimates; and, an environmental conference the day prior at the Lillian Meighen Wright Centre that was made possible with the collective efforts of two fellow Master's students and many participating organizations and residents within the ASBC. Through these various engagements, I enlisted several participants for my initial walking interviews and for my later semi-structured interviews.

2.3 Walking Interviews

The ASBC's boundaries provided an initial, and somewhat arbitrary, perimeter for my field site because the principal protagonist of this research is the river's freshwater: a mobile 'flow' resource that evades "land based preconceptions of fixity" (Chen et al. 2013:8). As a result, I found the idea of envisioning the river as a single independent water source to be problematic and I did not want to assume that residents' direct interactions with the river's flow, contained between two banks, represented their most frequent or significant encounters with its waters.

With this in mind, I conducted 28 walking interviews for which I visited homes, farmsteads, pastures, protected parks, jungle and cloud forest trails, the river and several tributaries, and water supply infrastructure within the ASBC. Moreover, I accompanied participants during their daily interactions with freshwater bodies as well as with local flora, fauna, technologies, etc. I also supplied a camera[13] to participants and requested that they document what they considered to be significant environmental resources (in terms of what they regularly encounter and depend on). This method of inquiry was intended to resist influencing or controlling the types of relationships with water that were discussed by participants.

These walks generally occurred between six in the morning and three in the evening with one participant per interview. Exceptions were granted in specific cases when I was invited to accompany two or more people for a particular activity such as to hike to ASADA water tanks or to swim in a local river. The average walking interview length was thirty minutes to three hours, with some as short as 40 minutes and others lasting for six hours or longer. The interviews were extended if I was invited to take a participatory role in residents' chosen daily activities. These

[12] This water comes from a series of captured mountain springs at the southern edge of Chirripó National Park.
[13] My initial objective was to return with the videos and photos to use them in interview elicitation, however they became primarily used for transcribing.

activities included hiking excursions along the local rivers, monitoring tubes, tanks, and aqueduct infrastructure, conducting agricultural work (primarily with corn, cacao, coffee and sugarcane), and collecting plant samples in the ASBC's northern cloud forest for local conservation efforts. On several occasions, I was invited to accompany a participant on additional walking interviews; however, for the purposes of this research, multiple walking interviews with a single participant are recorded as a single interview.

2.3.1 **Limitations of Walking Interviews**

Since my walking interviews were primarily performed in open air, the weather and climate were constant factors that determined their feasibility. The region's prominent rainfalls interrupted interviews on numerous occasions by making walking routes hazardous or inaccessible. While I initially regarded such factors as inconvenient to data collection, I eventually considered rain to be one of the significant factors that shaped my research process; participant's whereabouts in their selected interview locations, and therefore the data that I collected.

Following each interview, I recorded the discussed topics in journal entries; however, these attempts to explore the river's dimensions felt insufficient. This was partially because participants often described the river's changes throughout the dry and rainy seasons—of which I would only be present to witness the beginning of the latter. Nevertheless, this inability to be physically present during those times were mitigated with sketches drawn during and after interviews to record fragments[14] that were suggestive of the river's associations.

With this, the fragmented data that I collected through interviews revealed that my attempts to account for the river's dimensions would always be incomplete. This insight is noted by Burrell, who emphasizes that research that deals with networks and associations is essentially an endless project that must be concluded with the strategic choices[15] of the researcher (2009:194). However, my methodology's requirement for mobility also proved to be problematic for some participants and made interview cancellations a potential concern

[14] As informed by Taussig, the river's dimensions did not "have to be explicitly recorded" through sketches as a completed whole "because it [fundamentally] cannot be completed" (2011:13). Given this, the types of data that I recorded would have certainly changed had my research been conducted during another seasonal cycle or over a longer stretch of time.

[15] In accordance with Burrell, my choices were informed by time/funding limitations and other factors such as prominent repetitions emerging within participant's responses—which Burrell considers to be an indication that it's time to move on (Burrell 2009:194).

whenever it 'wasn't a good day' to walk. Given this, it was evident that I needed an alternative option for such participants. This, coupled with the emergence of patterns within my walking interview data, prompted me to construct a second list of focused interview questions.

2.4 Semi-Structured Interviews

Following the walking interviews, and to supplement its data, I compiled a list of questions (see Appendix B) during additional supplementary semi-structured interviews. However, some of these topics were already explored within the participant's earlier walking interviews, indicating that a second visit with every participant was not practical[16]. Given this, I returned to 16 of my initial walking-interview participants where I felt that additional information was needed, and when an opportunity was presented.

I also conducted six semi-structured interviews with new participants who, for mobility, temporal, or occupational reasons, opted out of walking interviews. These sit-down, semi-structured interviews generally occurred in the participant's household or their workplace, and lasted between 40 minutes to two hours. In a few instances, more than one individual participated in a single interview session; such as the case of spouses, or a guardian and child.

Generally, the interview questions explored the following topics: how residents encounter and use various local water sources; if and when these uses are subject to change; what participants value most about local water sources; ways of determining water quality and ecosystem health; possible concerns about current or potential uses of water in the corridor; personal opinions regarding hydropower development plans in the region; and, concerns and recommendations with regard to state water policy and its enforcement in the region.

Additionally, as my research revealed new lines of inquiry and participants recommended that I visit individuals beyond the corridor, I decided to travel to additional eastern townships along the Cordillera de Talamanca such as Longomai and Cedral in order to speak with individuals who had a participating hand in forming the ASBCs council, CoBAS, and Rios Vivos. For these two focused interviews, as well as for two formal interviews with five members of the ASADA of Santa Elena, I asked questions that were specific to their areas of expertise. I

[16] The decision to opt out of a second interview was a reflexive project of how to best use my time given that a second interview would inevitably have generated additional relevant data.

also traveled to the country's capital San José to attend an environmental-festival where I became more familiar with national initiatives that operate within the ASBC.

2.4.1 Limitations of Semi-Structured Interviews

Semi-structured interviews were somewhat supplementary to earlier walking interviews, since many of the topics discussed were drawn from participants' memories rather than through actual sensory encounters with specific flora or fauna.

However, in terms of feasibility, the limitations that I experienced with this methodology were rooted in determining when to end a topic. In accordance with Burrell, the ASBC as a field site could not be cemented "once and for all in the early stages" (2009:184) of research. Rather, the field site was determined with some difficulty through an ongoing process of making strategic choices. Thus, these choices focused my attention on certain aspects of the river and its tributaries while omitting others. Specifically, some of the participants offered comments which I chose not to explore or include in my research. For example: one local noted that a pineapple company called *"Pindeco is slowly advancing into the corridor"* (Participant 12); another confirmed, *"there are monoculture pineapple farms and they have concessions for water at the south edge of the corridor… but they take from other rivers and are contaminating them"* (Participant 5); while, yet another participant expressed concerns regarding a CoopeAgri sugar processing plant further south along the Río Peñas Blancas because *"the river before reaching it and the river leaving from it are two distinct things"* (Participant 12).

As noted, rather than expand my research to include these concerns, for the sake of feasibility, I chose to bookmark them instead as possible future research foci. However, with that said, the identification of new questions and possible directions prompted me to constantly renegotiate the boundaries of my study and reselect the field site in which to conduct it.

2.5 Drawing and Discussions Workshops with Student Youth

Originally, I intended to facilitate three public workshops with local residents and use drawing as a methodological tool to encourage participants to visually express their beliefs, opinions, and potential concerns about community resources. However, after noticing that my early data disproportionately accounted for the perspectives of adults, I reformatted the

workshops to be directed towards local youth within the corridor. This decision was cemented after observing the frequent use of drawing, collage and other artwork that students displayed and presented in the Festival Ambiental (The ASBC's Environmental Youth Festival) in Quizarrá. During this festival, I was introduced to a representative from the local school of Santa Elena who agreed with my proposal to conduct research with their students. Moreover, they were enthusiastic about the idea of creating a painting with students. While I had brought a sheet of canvas and paints to the corridor, the school's representative countered that with the option to paint a mural on the support wall of the school's office instead. I agreed with enthusiasm, coupled with slight anxiety (as this wall was many times larger than my initial canvas and would become a permanent, public fixture in the town).

Throughout the following week, I facilitated three drawing and discussions workshops with a total of twenty-eight student youth. Each of these workshops was organized according to the students' class grade; with seven grade-four students in one workshop, ten grade-five students in another workshop, and eleven grade-six students in the final workshop. Each workshop lasted one hour. During these sessions, students were provided with paper and art supplies and asked (i) to draw what they consider to be their favorite or most important natural resource(s) that they encounter within the ASBC, and (ii) to draw or write any present or future concerns that they have about their selected resource(s).

After allowing students fifteen minutes to complete each of the two drawings, I collected these visual responses and used them to facilitate a thirty-minute long group discussion. These discussions offered student participants the opportunity to express their ideas to their peers and to reflect together upon future strategies to mitigate their concerns regarding the local environment. The structure of these workshops were modified versions of a similar methodology that was conducted by Felipe Montoya (2009) to explore "the opinions of the youth in Junquillal, Costa Rica regarding the quality of life in their community" (23).

2.5.1 **Community Mural Painting**

Figure 4: Mural at Santa Elena School
Photo by author, 2016.

Following these workshops, the responses of student participants were incorporated into the design for a community mural that further benefited from the involvement of students and staff from Santa Elena School, community residents, and additional artists. Financial and material supports were procured from the town's development council, Asociación de Desarrollo, and Los Cusingos Bird Sanctuary.

The completed mural measured roughly 1.7 metres high by 8 metres long and combined elements from the students' drawings, my own encounters and photos in the ASBC, as well as contributions from other community participants. In the end, the mural was both a platform for participants to express what natural resources they value within their communities as well as a social stage where meaningful conversations about local resource politics took place. In this sense, my experiences aligned with the assertion by "Marcus and Calzadilla [that] the preparation of one artistic installation [in this case a mural] can include[…] research methods: interviews, participant observation[…] and how the exhibition can be seen and understood by a wider spectrum of" (Krstić 2011:72) the community audience.

2.5.2 **Limitations and Challenges of Drawing and Discussion Groups with Student Youth**

For the initial workshops, I found the one-hour time frame to be tight. I planned to allow fifteen to twenty minutes for the drawing segment, and 40 to 45 minutes to facilitate group

discussions. However, students requested that equal time be given for both activities, which resulted in the discussion portion feeling rushed. This issue was partly resolved as students took the opportunity while painting the mural to share their beliefs and opinions about their selected resources.

Keeping students focused on group discussions was also a challenge at times as some participants became distracted by non-participating classmates. This was especially the case with one workshop which demonstrated to me that, should I facilitate future workshops of this sort, it may be better to plan it in a more focused setting, and before rather than after a student snack break.

To ensure the safety of students while they painted, I set the rules that any roughhousing or misuse of supplies would disqualify a student from painting for the remainder of that day. On one occasion, I felt obligated to impose this rule[17] and it revealed to me the need to recruit an additional monitor for any future projects of this nature. This move would also be fruitful in terms of collecting data, as some opportunities to initiate further conversation with students were cut short due to the logistics of monitoring students, painting, and helping to mix paint colours.

Another aspect of working with young children was experienced when some students' paintings stretched into creative fantasy as the mural progressed, particularly when younger students opted to paint Pokémon creatures[18] rather than biota that they encountered in the corridor. I welcomed these illustrations all the same because they revealed the extending nature of the ASBC: a small mountain community in Costa Rica that is networked into global culture. But some of these paintings did not pass the aesthetics tests of older artists who hastily covered the rougher pieces the next morning.

2.6 Transcribing and Coding

After completing my field work, I translated and transcribed all notes and digital interview recordings, particularly those that I had collected during walking interviews. While my initial objective was to encourage participants to use a camera to document the relevant resources

[17] I felt obligated to ask two participants to return to class after they began to create splatter art on their classmates.
[18] The virtual game Pokémon Go was a new release during this research, with several community buildings operating as "PokéStops" where gamers could collect the game's creatures.

that they encountered and to use this resultant data as a way to initiate semi-structured interviews, the vast majority of participants preferred not to use the camera. This deviation from the initial planned methodology resulted in a shift in the data's utility—from a tool for interview elicitation to a supplemental data source that I referred to throughout my transcribing and coding process.

Of particular use were the visual and sound recordings that played back elements that participants were simultaneously describing "in the act of sensing" them—a feature which Merchant (2011) claims is not achievable through "traditional' qualitative methodologies of interviewing or surveying" (55). However, while this data helped elaborate particular details, the elements documented were also disruptive and made some moments of dialogue difficult to understand and transcribe (particularly in recordings that captured the sounds of rushing water, heavy rain, birds, and insects).

Once this process was completed, all qualitative data was organized and categorized with 'Open Coding' within NVIVO. Each code was organized according to open themes with particular attention given to patterns in topics, words, and phrases. Moreover, given the nature of my project (to draw coherent links between elements of the river's flow), I looked for relations, themes and overlaps between different events and phenomena that participants discussed. As an important observation, these relations were not always initially evident and therefore the relations that were identified in the data as relevant were informed by the same theoretical framework that guided the entire study.

3 THEORETICAL FRAMEWORK

3.1 Treating the Río Peñas Blancas as a "Subject"

Since the river's management and allocation are sources of local and national contention, it would be inaccurate to treat the Río Peñas Blancas as a passive object of study. Instead, its unique capacity to generate electricity has affected the desires of geographically disparate groups and individuals (including myself), revealing the need to treat the Río Peñas Blancas as a participating subject with its own narrative in the local disputes.

Pertinent to this, I break with the classical Liberalist tradition of conceptualizing non-human nature as passive and inert by treating freshwater as a 'subject,' *within* this study rather than an 'object' *of* study. Within the following chapters, the Río Peñas Blancas is not reduced to an inanimate resource that provides transparent means to human action (Pyyhtinen and Tamminen 2011:140), but is rather an animate and agentive element that is capable of causing an 'affect' or impact, regardless of human intervention.

This understanding aligns with a growing shift in academic literature (i.e.: the Nonhuman Turn) that fosters a critical and theoretical *turn* of attention towards 'nonhumans'—what are commonly considered to be 'things', such as "animals, affectivity, bodies, organic and geophysical systems, materiality [and] technologies" (Grusin 2015:vii). In practice, this has generated a variety of works that extend the "prevailing modes of subjectivity in new direction[s]" (Connolly 2013:400) by accounting for the sociality and social capacities of nonhumans (otherwise referred to as more-than-humans), such as: mushrooms (Tsing 2013), mosquitoes (Mitchell 2002), dogs (Haraway 2003), honeybees (Kosek 2010), and glaciers (Cruikshank 2005), to name a few. However, while nonhumans also retain the capacity to produce actions or generate 'affects' within social phenomena these abilities have "traditionally been [overlooked] in Liberal systems of meaning and cultural practices" (Stark and Roffe 2015:3) that privilege the political figure of the 'human'.

As a result, theorists of the Nonhuman Turn reject the nature/culture binary, and its underlying assumption that humans are uniquely capable of generating social action by removing the categorical dualisms that have historically classified humans versus nonhuman entities with such terms as the living and non-living, "the organic and inorganic, the animate and the inanimate, and the classical opposition between subject and object" (Stark and Roffe

2015:3). Moreover, their works engage with a dialectic that reimagines the nonhuman world as lively, self-organizing and animate; thus generating the need to re-consider what constitutes, and what expresses, agency (the capacity to generate effects) and liveliness.

3.1.1 *Turning* Away from Classical Perceptions of Agency

By proposing that nonhumans are active participants in making the world, theorists within the Nonhuman Turn reject the anthropocentrism[19] and human exceptionalism[20] that are embedded in Western Liberal philosophical, political, legal, and scientific traditions. Rather than accepting human supremacy as innate to the natural order, their works reveal that the prioritization of human intentions above the capacities, politics, and rights of nonhumans is an historico-political project (i.e.: the *Anthropos)* that emerged, in part, from classical Greek philosophy (Kirksey and Helmreich 2010:548). This became embedded in dominant-culture through the rise of Cartesian philosophy[21], and Newtonian physics[22] in the seventeenth century (Coole and Frost 2010:7; Mickey 2014:5; Barad 2003:813).

In collaboration with other ideologies, these traditions of the Enlightenment advanced essentialist and deterministic representations of an inert, and centrally governed, material world by attributing agency strictly to humans and/or God. In accordance with this logic material objects, or 'things', were parceled into the category of "solid, bounded [occupants of] space[...] whose movements or behaviours are predictable, controllable, and replicable [under] fundamental and invariable laws of motion" (Coole and Frost 2010:7-8). This understanding continues to inform the ways in which 'things', such as water, are understood and appropriately used.

The belief that 'things' express predictable and measurable behaviours is represented within the language of legal tools, including state policy. This is demonstrated within the EIS' for PHPB I and II, according to which the construction of the two dams are conditional upon leaving

[19] Anthropocentrism is the belief that human beings are the most important of Earth's entities.
[20] Human Exceptionalism argues that humans are unique from other entities, in part due to our capacity to generate language and culture.
[21] Rene Descartes' Cartesian philosophy forwards the concept of *cogito* that privileges the human mind for generating rational thoughts about, and coordinated actions upon, an otherwise passive and malleable world (Coole and Frost 2010:8; Shaviro 2015:32).
[22] Newton's Laws of Physics postulate that "material objects are identifiably discrete; they move only upon an encounter with an external [organizing] force or agent, and do so according to a linear logic of cause and effect" (Coole and Frost 2010:7).

ten percent of the Río Peñas Blancas' initial flow. However, the document's measurement of potential flow capture is contingent on the river's flow quantity remaining stable for the foreseeable future[23]. Should the river's 'measurable' flow conditions change, on the other hand, both its energy potential and additional capacities would certainly be affected.

3.1.2 **The Rights of Non Humans**

The resulting perception that humans live in a world composed of inert things continues to affect the ways in which we both engage in and relate to nature; in large part, by underpinning capitalist logic that treats nonhuman natures as subordinate to human desires (Coole and Frost 2010:8; Mickey 2014:5). This subordination of nonhuman 'things' is increasingly naturalized to expand human desires to what are increasingly termed, 'resources'. As the implications of this world view exacerbate global conditions, namely through capitalism's growing contribution to anthropogenic climate change, Earth's sixth mass extinction, and "the large-scale destruction of ecological communities" (Kirksey and Helmreich 2010:549), some contemporary theorists are calling for renewed attention to human and nonhuman relations in the Anthropocene[24] in a bid to challenge human privilege and to incorporate nonhuman natures as subjects of politics (Kirksey and Helmreich 2010; Connolly 2013).

One approach to challenge human exceptionalism is to revisit the question of what constitutes agency (the ability to affect) by considering how the power to create effects occurs at the atomic scale. This is because dated understandings of the atomic behavior of 'matter', specifically the inertia and lifelessness of the matter that composes non-human 'things', remain central to economic reasoning. To some contemporary theorists, the dominant depiction of 'matter' as inert and lifeless is established upon an outdated representation of atomic behavior that "stabilize[ed] over time [to form] its own cultural script" (Herzogenrath 2009:3). This recognition is prompting interdisciplinary interest in contemporary theory about atomic-behaviour, in order to shift the dominant representation of matter to renew socio-natural relations.

[23] The river's flow standard is also measured according to its proximate rainfall and climatic characteristics. However, these measurements are rough estimates at best, since the company's calculations are based on data collected in 1992 from rain stations that were located outside of the study region (Hidroelectrica Buenos Aires 2013:36).
[24] The Anthropocene is a term used by climate researchers to describe what may possibly be the current "epoch in Earth's history" (Kirksey and Helmreich 2010:549).

3.2 Engaging with Matter

Throughout the recent past, developments within the discipline of physics have altered traditional conceptions of 'matter'—postulated to be that which contains mass—and informally referred to as the atomic 'stuff' that composes both things and beings. To elaborate, the discovery within particle physics of the "fundamental constituents of matter" that resulted in the terminology of "forces, charges, waves, virtual particles, and empty space" (Coole and Frost 2010:12) reveal atomic-matter to operate upon unstable and self-organizing principles. At the same time, the developments of mathematical Chaos and Complexity Theory undermined "the idea of stable and predictable material substance, hastening a realization that our natural environment is far more complex, unstable, fragile, and interactive than earlier models allowed" (Coole and Frost 2010:13).

These developments have generated the revelation that matter's behaviour is far from the 'passive state of equilibrium' that was postulated by classical physicists such as Newton (Herzogenrath 2009:6; Coole and Frost 2010:12-13), rendering invalid its earlier depiction as "the raw material for the creative activit[ies] of humans or God" (Bennett 2010:xiii). Instead, these discoveries reveal that matter operates upon chaotic and self-organizing principles. As a result of current global conditions, the essential need to shift the dominant understanding of 'matter' has facilitated new avenues for material 'realists' [25] to forward conceptual and metaphorical representations of material reality that do not presuppose its central governance (Herzogenrath 2009:3; Coole and Frost 2010:92).

3.2.1 Vital Materialism

Following these developments, various material realists now consider the macro scale elements that we encounter throughout our daily lives—such as insects, phones, wires, wind, lamps, chemicals, trees, humans, and water—and the micro scale quantum-atomic world that constitutes us, to be equally composed of *relations* (Coole and Frost 2010). This theoretical direction has opened the doors for *vital* or *new* materialists who, through their points of departure, engage with various political and ethical concerns that emerge when one accounts for the relationships that compose Earth's matter.

[25] 'Realists' are ontological philosophers who "grant reality full autonomy from the human mind, arguing that to base an ontology on the distinction between the observable and the unobservable betrays a deep anthropocentrism" (DeLanda 2009:25).

Included among these theorists is Jane Bennett (2010) who rejects the “habit of parsing the world into dull matter (it, things) and vibrant life (us, beings)” (vii) by calling for a ‘vital materialism’ that envisions “vitality [to be] installed in energy/ matter complexes from the start” (Connolly 2013:400). For Bennett, ‘vitality’ invokes the acknowledgement that the *agentive* capacities of things (i.e.: their capacities to ‘produce effects’) do not only “impede or block the will and designs of humans but also act as quasi agents or forces with trajectories, propensities, or tendencies of their own” (2010:viii), an occurrence which Bennett describes as “thing power” (2010:xvi). In considering the affects that nonhumans create, Bennett engages with the question of how thing power is constituted.

3.2.2 **The Agency of Assemblages**

By extending agency to nonhumans, Bennett expands upon the traditions of Assemblage pioneered by Gilles Deleuze and Félix Guattari (1980) and Affect forwarded by Spinoza, by arguing that agency (traditionally considered a human capacity) is neither produced entirely by humans or nonhumans; rather, agency is generated through the collective effects of human and nonhuman assemblages (2005:445).

Assemblages here refer to “ad hoc groupings of diverse elements [and] vibrant materials of all sorts” (Bennett 2010:23) that include: “humans and nonhumans; animals, vegetables, and minerals; [and,] nature, culture, and technology” (Bennett 2005:445). These assemblages are constantly being shaped, materially and discursively, through emergent “historical and circumstantial” (Ibid) processes. Moreover, they operate as "living, throbbing confederations that are able to function despite the persistent presence of [internally conflicting] energies" (Bennett 2010:23) that “exceed and confound [their] coherence” (Bennett 2005:445).

Despite their collective propensities to assemble, Bennett doesn’t envision these elements, or ‘actants’ as defined by Latour, to create equivalent effects (2005:446). Instead, “some actants have sufficient coherence to appear as entities; others, because of their great volatility, fast pace of evolution, or minuteness of scale, are best conceived as forces” (Bennett 2005:446-447). While these “individual entities and singular forces each exercise” (Ibid) unique agencies, their collective effects can also generate emergent capacities that are “distinct from the sum of the vital force of each [component] considered alone" (Bennett 2010:24). This is

referred to as the “agency of assemblages: the distinctive efficacy of a working whole [variously composed of] somatic, technological, cultural, and atmospheric elements” (Bennett 2005:447).

Inspired by Bennett’s (2005) study about the restricted movement of energy during the North American Blackout in 2003, I treat the Rio Peñas Blancas’ freshwater as, in essence, a flowing resource that is “always going somewhere” (451). This capacity to *flow*, which I propose is the Rio Peñas Blancas’ *agency of assemblage,* is generated by a multiplicity of entities and forces that collectively compose the river’s water and alter its movement.

3.3 An Introduction to the River’s Flow

To begin, the river’s freshwater is composed of an atomic assemblage of two hydrogen atoms and one oxygen atom (i.e.: H2O); a constitution that becomes altered upon its contact with a variety of other material properties such as minerals, salts, chemicals, bacteria, and other components that water collects, dilutes and carries within its flows.

Figure 5: Las Nubes Forest
Looking northward along the Río Peñas Blancas on the Las Nubes forest trail. Photo by author, 2016.

Freshwater’s material state can also be modified through its interaction with an assemblage of planetary, geophysical, and meteorological conditions that alter the water’s temperature and induce it to shift between the gradients of: liquid (water), solid (ice), and gas (vapour) within the hydrological cycle. Yet the river’s absorption and dilution of these elements, as well as its transformations, may require the water’s initial movement, indicating that the

proto-assemblage of the water's composition cannot account for the river's propensity to flow. Given this, I will briefly explore the forces and processes that generate the river's dominant flow aspects.

As previously mentioned, the Río Peñas Blancas is fed by sister tributaries that are located in the far Western reaches of the Térraba Watershed. These tributaries carve into the central-Pacific ridge of the Cordillera de Talamanca Mountains. The river's larger northwestern branch spills from a glacial lagoon within Valle de Los Conejos (Rabbit Valley), beginning at 3110 MASL before flowing down the southern facing slope of the mountain Cerro Chirripó. With a summit that reaches approx. 3819 MASL (Chaverri Polini 2008:17), Cerro Chirripó composes the highest elevated segment of southern Central America. Moreover, its glacial lagoon that feeds the Río Peñas Blancas was noted by one participant to be*…"small, around 500 m2, but it never dries because water* [as rain] *arrives there all year"* (Participant 19). Moreover, *"the lagoon is surrounded by underbrush with no large trees, but that's because of wildfires"* (Participant 19) that previously levelled some of its surrounding vegetation. From this elevated region containing low vegetation, the river flows down the Pacific slope of the Cordillera de Talamanca.

The high altitude and steep terrain of Cerro Chirripó send the river rushing energetically as it follows the path of gravity [see Figure 6]. Moreover, the river's characteristic icy cold temperature and rapid movement are also features that inspired the river's name el Rio Peñas Blancas (i.e.: Small White Rapids/Hills) among the region's hunters and settlers in the early 20th century. These qualities, which distinguish the river's flow, are generated by tectonic, geomorphic and climatic forces that lifted the country's land bridge (or isthmus) from the ocean during earlier epochs, thereby adjoining the continents of North and South America.

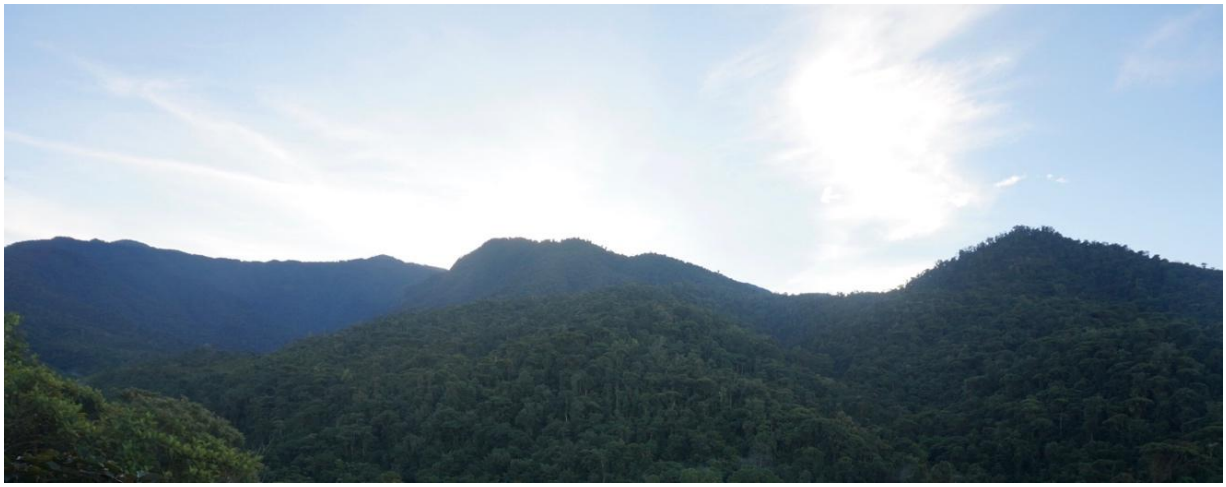

Figure 6: Cordillera de Talamanca
Photo taken from Chirripó Vistas in northern Santa Elena looking east along the Cordillera de Talamanca. Photo by author, 2016.

3.3.1 The Geomorphic Formation of the Cordillera de Talamanca Mountains

The Cordillera de Talamanca mountains span 175 kilometers (Marshall 2012:27) and longitudinally divide Costa Rica's Pacific and Caribbean slopes (Guzmán-Arias and Calvo-Alvarado 2013:54) as they cross into western Panama. This mountain range was generated by tectonic shifts that are believed to have caused a series of volcanic islands to be carried northeast "into the narrowed oceanic gap between the Chortis block[26] and northern South America" (Savage 2002:817) from approximately 36 to 23 million years ago (Ma) (Meza Ocampo 2014:23). The heat from this process likely generated additional underwater volcanoes around 22 Ma (Ibid), which emerged from the ocean around 15 to 6 Ma as "a series of islands" (Escobar 2008:35-36) that began to form what is now southern Nicaragua, Costa Rica and Panama.

Moreover, the eastward moving Cocos Ridge collided with the Caribbean Plate and began to be subducted beneath western Costa Rica around 8 Ma (Abratis and Wörner 2001:128), generating tectonic uplift along the central island chain. Throughout the Pilocene-Pleocene (between 4.5 and 3.5 Ma), large volumes of extrusive rock that composed this uplifting crustal mass were stripped off, exposing intrusive rock that solidified beneath Earth's surface (Marshall 2012:98; De Boer et al. 1995:37; Chaverri Polini 2008:45).

[26] The Chortis block composed the plate of what is now Honduras and northern Nicaragua.

The continued uplifting of these collective layers generated the rugged heights of the Cordillera de Talamanca mountains and made them impenetrable by subsurface magma; suspending the emergence of any “large strato-volcanic complexes” (De Boer et al. 1995:37). Over time, this process lifted the mountain range into the highest “elevated segment of the Chorotega volcanic arc” (De Boer et al. 1995:37) that constitutes the central spine of the Panama Isthmus. While the mountain’s altitude and rocky slope affect the angle and thus force of the Río Peñas Blancas, the river’s flow cycle is also generated by the global transfer of moisture.

3.3.2 **Changes to Ocean and Air Currents**

The Cordillera de Talamanca emerged along the central isthmus as this land bridge fully divided the Pacific and Atlantic oceans. The Panama Isthmus’ relatively small closure caused enormous changes to deep ocean circulations beginning around 4.6 Ma (Haug and Tiedemann 1998:673), by preventing the circulation of warm Atlantic water to the Pacific Ocean [see Figure 7] around the equator (Marsh and Kaufman 2013:604). The resulting changes to equatorial warm-water circulation are believed to have accelerated the northward transfer of moisture and **“**the further cooling of the global climate” (Penna 2010:30).

Through this oceanic division, the warm saline waters of the powerful Gulf Stream were redirected into the North Atlantic Current (Marsh and Kaufman 2013:604), thereby generating storm paths that transported “warmer [water and] humid air to central Canada and northern Europe” (Penna 2010:30; Haug and Tiedemann 1998:673). Over time, this redirection helped shape the “North Atlantic Deep Water formation” through which “the evaporative cooling of surface waters” (Haug and Tiedemann 1998:673) accelerated the transfer of moisture northward (Alvarado and Cárdenes 2016:55). Throughout the following millennia, this transfer is believed to have generated ice-age conditions (Haug and Tiedemann 1998:674) as “heavy snow accumulations [gradually] exceeded summer melt” (Penna 2010:30). Moreover, the emergence of northern ice sheets reduced global temperatures and prompted some elevated areas of the South Pacific region to undergo glacial and interglacial periods throughout “the past 500,000 years” (Escobar 2008:36).

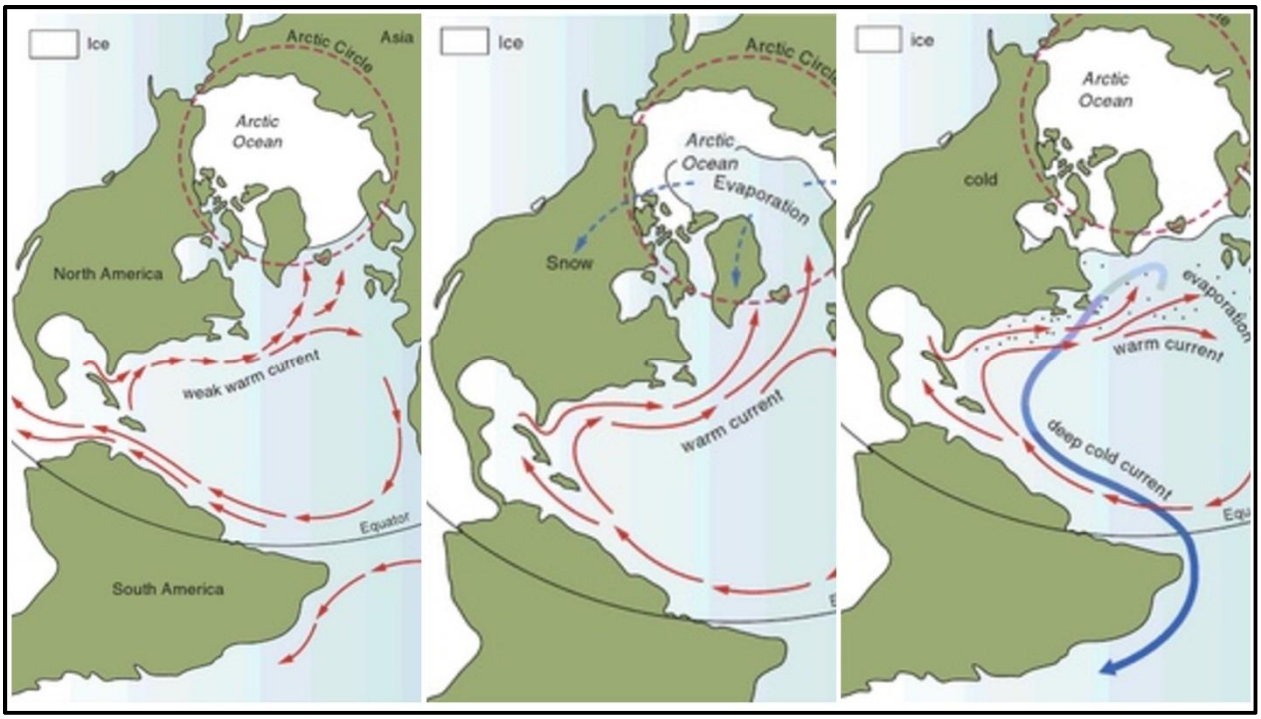

Figure 7: The Transfer of Moisture, Panama Isthmus
(L) Prior to the closing of the Panama Isthmus, warm saline waters from the Atlantic Ocean flowed into the Pacific along the equator, "leaving the northern Atlantic cold" (Marsh and Kaufman 2013:604); (Center) Following the closure, the redirected Atlantic current "warmed the northern Atlantic and Arctic oceans" (Ibid), generating ice melt, water vapor, snow accumulations and, finally, glaciations; (R) The redirected Atlantic current prompted evaporation, "ocean cooling, atmospheric cooling, and initiation of the Ice Age" (© Marsh and Kaufman 2013:604-605)

3.3.3 Glaciation of the Talamanca Mountains

While the precise dates are not known, during the Upper Pleistocene (Chaverri Polini 2008:45) emerging cold fronts generated snow falls that accumulated along the Cordillera de Talamanca's highest peaks to form several small glaciers (Horn 1990:289). Beginning at elevations from around 3,100 meters to 3,400 meters above sea level (Alvarado and Cárdenes 2016:55; Chaverri Polini 2008:45), the last of these glaciations is estimated to have "affected the country between ca. 18 and 11" (Alvarado and Cárdenes 2016:55) thousand years ago (ka).

As it receded, this final glaciation left moraines (rock deposits), tarns (small mountain lakes) and lake sediments that are revealed by radiocarbon dating and sediment stratigraphy to have been deposited before 10 ka, revealing that the region was "ice-free throughout the Holocene" (Horn 1990: 81). The release of these glacial waters generated water-rich ecosystems where they collected, and their flows also circulated the precipitous montane-climate. More than 30 of these glacial lakes continue to scatter the elevated segments around Cerro Chirripó where glaciers once carved into the mountain's massif (Chaverri Polini 2008:63;

Horn 1990:289), one of which supplies the Río Peñas Blancas with its icy cold water and clear flows. However, the quantity of these flows are also modulated by weather phenomena that supply rainfall to the Cordillera de Talamanca during the wet season, and retain water from spilling down its steep south Pacific slope (De Boer et al. 1995:36) during the dry season.

3.3.4 **Seasonal Changes**

With Cerro Chirripó rising at its summit, the Cordillera de Talamanca altered regional air currents by generating an atmospheric bridge through which the Atlantic climate (particularly the northeast and southeast trade winds[27]) could greatly influence the tropical Pacific (Xie et al. 2007:3914). From late May until June, humid air currents from the equator meet with the northeast trade winds and rise to create an Intertropical Convergence Zone (ITCZ) above the country, which initiates the rainy season (Chaverri Polini 2008:55). The Cordillera de Talamanca's elevated slopes catch these warm Atlantic air currents that would otherwise rise unimpeded to the ITCZ; forming condensation bands above 2000 MASL (Canet Desanti 2005:28) and generating a "strong influence of orographic precipitation" (Guzmán-Arias and Calvo-Alvarado 2013:54). This orographic influence occurs when moisture crosses over the Caribbean mountain slope, where it generates cloud cover and increased precipitation as it passes along the Pacific slope (Canet Desanti 2005:28).

This process supplies the Pacific slope with peak rainfall between September and November (Ibid), which decreases after December when the Pacific slope becomes influenced by the southeast Pacific trade winds (Chaverri Polini 2008:55-56). This shift prompts the humid "Northeast [Atlantic] Trade winds [to be] retained on the Caribbean slope" (Guzmán-Arias and Calvo-Alvarado 2013:54), causing only the country's "Pacific slope [to experience] a dry season between December to April" (Ibid) during which its rivers and creeks shrink, and groundwater diminishes. Yet, this orographic variability, in concert with "climatic and topographic[…] extremes", the mountain's "variations in slope aspect", and its altitudinal temperature gradients have generated "extraordinarily diverse microclimates, vegetative cover and soil types" (Marshall 2012:4) that change upon elevation. These microclimates also facilitate the region's exceptional ecological diversity, with some inhabitants linked to genetic predecessors that entered the region by passing through the Panama Isthmus from North and South America.

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[27] The orientation of these eastern trade winds are determined by the ITCZ which shifts on the orbital rotation of Earth's axis—the tilt informs whether the northern or southern trade winds pass across and converge along the equator.

3.3.5 **The Great American Biotic Interchange**

The 'closing of the Panama Isthmus[28] transformed the ecology of the Americas by enabling biotic dispersal between Nearctic "North America, a continent intermittently connected to Eurasia", and Neotropical South America, "an island continent [in isolation] from most of the rest of the world for over 50 million years" (Leigh et al. 2013:2). As the Isthmian link alternated between opening and closing in response to fluctuating ocean levels, waves of flora and migrating fauna gained successive access to uninhabited areas (Savage 2002:835-836). Known today as the Great American Biotic Interchange (GABI), the land bridge (which formed around 3 Ma) was rapidly colonized by northern plains grasses which generated expansive savannah (Leigh et al. 2013:6).

Among the North American species to access these plains were "tapirs, deer, horses, pumas, canids, bears, [several] rodents" (Kappelle 2016:5) and additional species that were likely geographically closer to the mouth of the land bridge (Webb 1991:269). Having been tested by "innumerable competitors and predators from Eurasia", these and other northern species may have had a potential competitive advantage over their South American counterparts that "evolved in isolation [with] far less effective carnivores" (Leigh et al. 2013:7). Moreover, some Nearctic descendants have since invaded the high tropics, including: white tailed deer, jaguars, ocelots, ant-eaters, armadillos (Meza Ocampo 2014:31), and pumas; all of which inhabit the Cordillera de Talamanca, and several of which are now declared endangered species. However, after forests began to replace the isthmian savanna over 1 Ma (Leigh et al. 2013:18), the Neotropical forests of South America colonized the isthmian region.

While this likely prevented northern "late-arriving grazers [such] as bison, antelopes and mammoths from reaching the grasslands and open woodlands of South America" (Leigh et al. 2013:7); it also facilitated the northward migration of southern species of monkeys and sloths, as well as "birds, bats, and land mammals as far as southeast Mexico" (Leigh et al. 2013:18). Given the colonization of forests, Neotropical species gradually predominated in the Cordillera de Talamanca, however successive waves of migration into the uprising mastiffs have generated many species unique to this mountain range.

[28] This Isthmus alternated between opening and closing in response to fluctuating ocean levels (Savage 2002). While the date remains uncertain, its permanent closure is estimated to have occurred anywhere from 2.7 to 1.8 Ma (Leigh et al. 2013:13; Kappelle 2016:5).

3.3.6 **Species Diversification along the Cordillera de Talamanca**

During the Pliocene (ca. 5-2 Ma) the Panama Isthmus contained coastal lowlands and a "rapidly rising upland region that formed [a] montane barrier [with] 2,000 m in altitude" (Savage 2002:829). As the continuing uplift of this mountain range exposed "unoccupied ecological niches" (Savage 2002:835), various organisms became divided onto the Isthmus' three lifting highland ranges (Savage 2002:830), most centrally the Cordillera de Talamanca.

This highland was later colonized by broad-leaf rain forests and accompanied by avian, terrestrial, and aquatic species, with an abundance of herpetofauna (amphibians and reptiles) and avifauna (birds). According to Meza Ocampo (2014), these rising mountains then acted as barriers against the dispersal of plants and animals that were adapted to colder climates or non-tropical habitats (32). Moreover, "the [subsequent] alternation of glacial and interglacial periods" along the mountain summits "fragment[ed] and reunifi[ed] the neotropical forests" (Escobar 2008:36), ultimately releasing new inhabitable areas to previously divided groups. This is believed to have functioned as a "'motor of speciation,' thus explaining [the] high degree of diversity" (Escobar 2008:36-37) and substantial differentiation among genera/taxa.

As a result of the region's diverse climatic features, abundance of freshwater, and rising elevation, the cloud forests that today cover the Cordillera de Talamanca are regarded as one of the four most endemic[29] ecosystems within the country's mainland (Kohlmann et al. 2010:513). Today, the Talamanca Mountains are home to a recorded "215 species of mammals, 250 species of amphibians and reptiles, 115 species of fishes, and 560 species of birds", while also representing "one of the most diverse and species-rich places in Central America for vascular plants" (Evans 1999:122). Insect species are also abundant, with many having evolved co-dependent relations with other flora or fauna.

These diverse conditions also made the region capable of supporting human inhabitants, and indigenous communities such as the Bribris, Cabecares, and Borucas used an ancient network of trails for communication and trade between Cerro Chirripó's Pacific and Atlantic slopes (Chaverri Polini 2008:27). In fact, evidence of ancient human settlements continues to be unearthed throughout the river's direct region, generally as clay pottery shards that surface in

[29] Endemism refers to the restricted and unique existence of a species within a particular ecological space or geopolitically defined region. With regard to the latter, "it turns out Costa Rica is a country with moderate endemism… due to the fact that [its] important ecosystems", such as the cordillera's montane forests, "are shared with neighbouring countries" (Kappelle 2016:6) such as Panama.

local fields or construction sites; and, as vibrant petroglyphs carved into boulders that decorate local properties[30]. While the Río Peñas Blancas is said to have remained protected by the Pacific's expansive barrier of dense tropical conditions, these conditions became breached throughout the past century, when the country's frontier expanded into the mountainous periphery and levelled many the region's old-growth forests. The Río Peñas Blancas was an essential agent in this change: first, by providing the local ecological conditions that attracted early hunters and settlers; and second, by facilitating settler expansion and the social and agricultural practices that followed.

Figure 8: Talamanca Cloud Forest

Photo was taken looking north-east over the Cordillera de Talamanca Cloud Forest, one of the county's biodiverse and endemic '*hot spots'.* Photo by author, 2016.

3.4 Conclusion: Forces and Processes that Generate the River's Flow

The river's cold water and fast flow are generated by an assemblage of forces such as: gravity, plate-boundary tectonics, Earth's rotation, global air and ocean currents, and their resulting seasonal changes. However, these elements and forces that provide the river with its water have not remained stable. Instead, their effects and pace of evolution has been subject to change over time, with some shifts causing exponential effects that continue to transform the river. The tectonic-shifts that continue to lift the Cordillera de Talamanca affect the elevation, direction, and angle of its water flows gradually. Moreover, the release of new rocks to the mountain's surface also changes the bends of the river that collects them. The mountain's unique seasonal changes and orographic potential also contribute variably to the river's shifting

[30] While these early inhabitants, and the region's later-arriving colonists, certainly affected the forests and rivers that they encountered, I opted to exclude such histories and colonial encounters with the intention of further exploring these topics in future research.

flow quantities. However, these various contributors are also contingent upon the elements that generate them.

The various processes and forces that contribute to, and assemble the river's flow (such as climatic conditions), are themselves composed of diverse parts that contain proto-assemblages (including water/ H_2O). Because these assembled factors, and their proto-assembled components, collectively generate the river's capacity to flow, it would be problematic to assume that the river's flow could be accurately determined. As Bennett suggests, this is because the agency of an assemblage (i.e.: the river's capacity flow) cannot be "governed by a central power" (Bennett 2005:445): as "no one [member] has sufficient competence to determine consistently the trajectory or impact of the group" (Bennett 2010:24). Rather, elements and forces that contribute to the river's flow form "a web with [a...] topography" that unequally distributes power "across the assemblage" (Bennett 2005:445), an orientation with implications for the river's flow standard.

In short, given that the factors that generate the river's flow are largely unstable, the idea of a flow standard that envisions the river's freshwater quantities to be stable (as outlined in the EIS) should be closely scrutinized. I further argue in the following chapters that this flow instability is escalating as the factors that contribute to the river's flow are increasing exponentially through globalization and due to the effects of anthropogenic climate change.

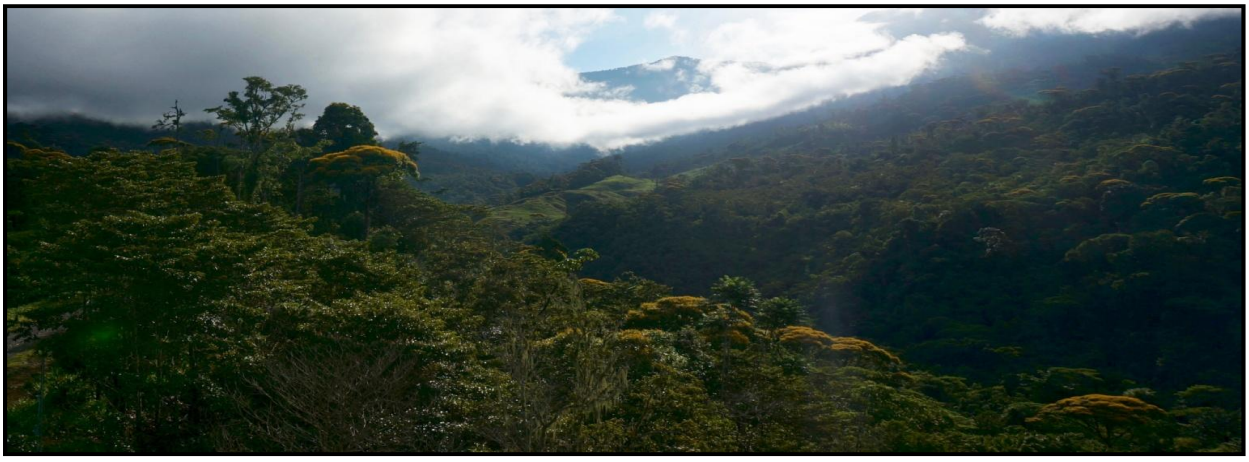

Figure 9: Cordillera de Talamanca
Photo taken looking north-west on the Cordillera de Talamanca. The trees with yellow canopies are called Mayo's (known for turning this colour in May). They grow best *"20 meters or so from rushing water"* (Participant 34) and below them the forest's depression reveals the river. Photo by author, 2016.

3.4.1 **Following the Flow**

In the following chapters, I explore how the river's hydrological flow has become increasingly modified by the 'global flows' of people, things, capital, technologies, CO2, knowledge, and other material and discursive elements. To account for these 'global flows,' I focus my research within a strategically situated single site as advocated by Marcus (1995), while considering the particular multi-sited and global processes that, either tangibly or intangibly, contribute to the river's conditions within the ASBC. For this, I apply Marcus' technique of "following" to trace the river's circulations as its water flows into the study region, and branches out through different contexts to form multi-sited relations (1995:106).

To elaborate, within the following chapters, I treat the Río Peñas Blancas as multiply situated by *following* its flows as they become temporarily ordered within: meteorological occurrences, including cloud formations, rainfall, and floods; geophysical bodies such as subterranean streams, creeks, and rivers; within the organic bodies of diverse flora, fauna and other biota; and, through aqueduct infrastructure such as tubes, pipes, water catchments, and water tanks. However, this project takes on an expanded meaning when I trace the river's 'multiple embodiments' as it "presses out of [its] current [material] configuration and enter[s] into new compositions of self" (Bennett 2005:447): as discourse and capital. This tendency, which Bennett refers to as the 'power of expression', expands my research to some of the river's multiple embodiments that extend into political and economic spheres. However, I will begin the following chapter by introducing the river's ecological dimensions within the ASBC.

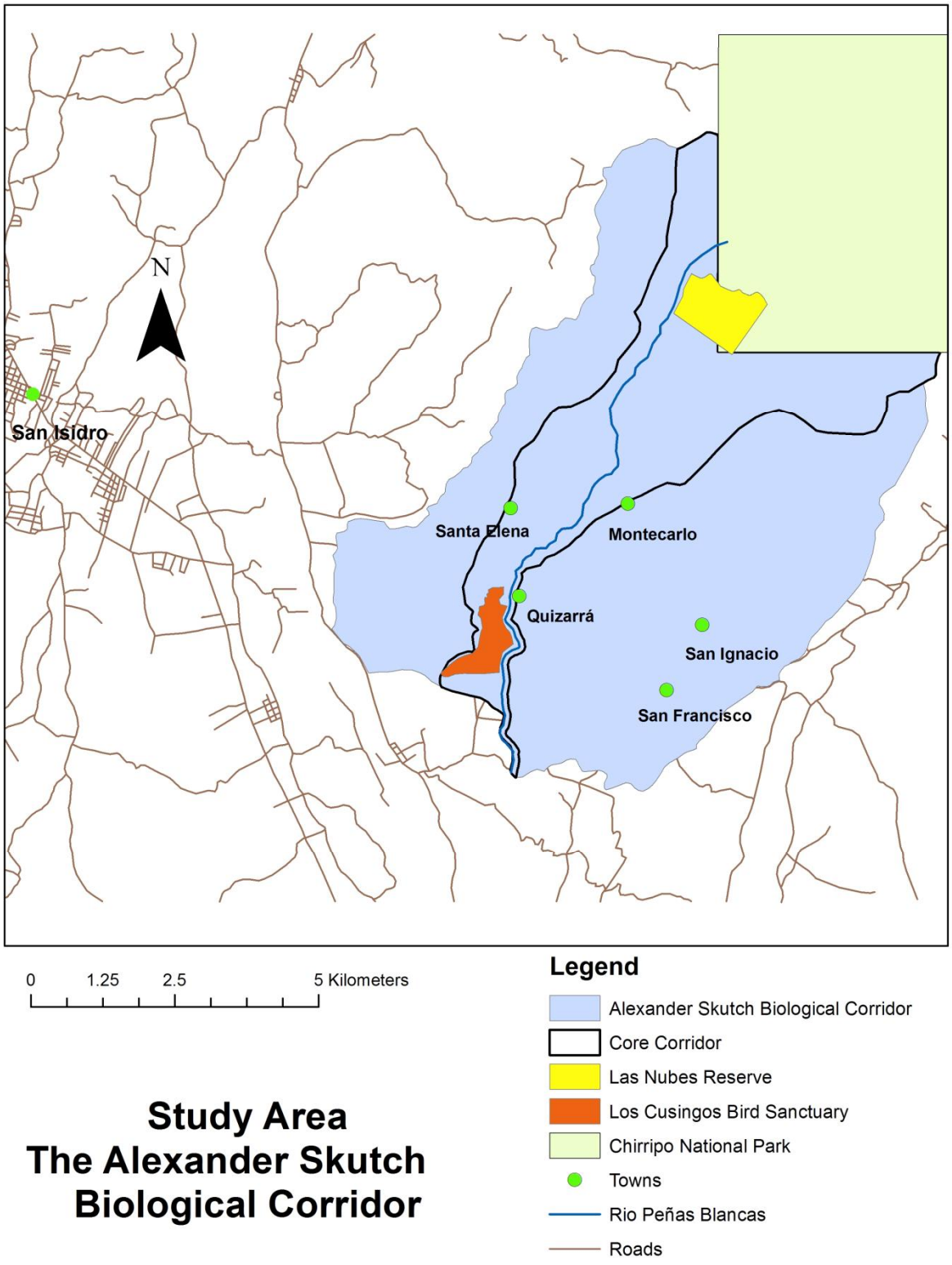

Figure 10: Map of the ASBC
The river crosses directly through the Alexander Skutch Biological Corridor (Rapson 2008:6).

4 The River's Ecological Dimensions

4.1 Introduction

Water is essential to the proliferation of life. It provides vitality to flora, fauna and other organic matter, and its flows and flushes circulate the physical composition of all biota. Human bodies demonstrate this constitution: the flows and circulations of freshwater compose and sustain the human anatomy. As expressed by Astrida Neimanis (2013), "my body—like yours—primarily comprises water[...] my existence as a body of water is a biological fact" (24). However, this constitution is not unique to humans but instead connects humans with "other human, animal, vegetable, geophysical and meteorological bodies" (Ibid) in our shared relations with water. This mutual dependence reveals a deeply embedded source of connection: "*we are all bodies of water*" (Ibid).

Yet, the water that composes and flows *within* organic bodies remains there only temporarily before its release. Throughout this chapter, I explore how the Río Peñas Blancas' water also circulates a boundless network of contact *between* organisms as it navigates diverse bodies and connects them with environments in "complex relations of gift, transfer, theft, and debt" (Chen et al. 2013:12). In particular, I follow the river's boundless circulations as they entangle humans and nonhumans in shifting material interactions with "other animal, vegetable and planetary bodies that[…] course through, replenish, and draw upon [each others'] bodies as their wells" (Neimanis 2013:31). During the region's early years of settlement, human dependence on the river's organisms was a primary requisite for the settlement and growth of local communities. I therefore begin this chapter with local accounts about the Río Peñas Blancas and its contributions to community formation and to local processes of ecological change.

In considering the accounts of local residents and conservationists, supported by primary and secondary research, I follow the river as it circulates proximate organic bodies to explore how the river's flow is central to regional species abundance (human and nonhuman). However, freshwater circulations, and the bodies that access them, are constantly shifting, revealing the need to explore the historical and circumstantial processes, conditions, and discourses that continue to affect the river's flow interactions: such as frontier expansion, the sustainable development framework, and the neoliberalization of *nature*. As such, I explore local narrative accounts that are informed by sensory experiences, various scientific projects (some

of which are imported through state and local educational initiatives), as well as legal frameworks and disciplinary measures. This is followed by a discussion of the larger ethical implications of capturing the river's flow and redirecting it away from its current dependents.

By considering the ecological dimensions of where the river's flow *goes*, I also explore what its water *does* to elaborate upon the implications of removing the river's potential to circulate proximate bodies. Finally, I consider how these findings in combination with local concerns might contribute to improving current policy and practice with relation to dam development, while offering research findings and recommendations to supplement the data provided within the initial Environmental Impact Studies for PHPB I and II.

4.1.1 **Settlement along the River in the Early Twentieth Century**

Freshwater access and availability facilitate species abundance—a primary requisite for human settlement and community growth. In accordance with this principle, the towns of: Quizarrá[31] (alt 750 m), Santa Elena (alt 800 m) to its northwest, and Montecarlo (around 850 m) to its northeast developed along the Río Peñas Blancas' sister branches before and after their convergence. As one local community member reported, the river's wildlife first attracted early hunters who accessed its banks beginning in the early 20th century. However, *"these communities really started to develop in the 1930s and the 1940s, in association with 'Tierra Libre del Estado'* [i.e. Free State Land]*"* (Participant 27); legislation that granted land titles to nationals under the condition that they remove forests to develop agriculture.

During these early years of community formation, the region's first 'campesinos' (i.e.: self sustaining peasants) found the area to be densely forested, and as one participant noted, *"they settled near creeks or another water source"* (Participant 9), many of which supplied water to the largest nearby river, the Río Peñas Blancas. Moreover, this river became essential to families who promptly cleared land along its banks to access freshwater for domestic consumption, as well as to extract the timber and mud required to build housing structures. At the same time, these new settlers also consumed the riverbank's native flora and fauna. As Ines notes, "the forest provided subsistence [to] the majority of Costa Ricans" around this time, and "subsistence hunting and fishing were integral elements in their relationship[s] with nature" (Isla 2015:117).

[31] Dr. Alexander Skutch recorded that the town was "named after the timber trees of [the same] name that grew in the surrounding forests" (1992:136).

However, in addition to sustaining the aquatic and terrestrial protein staples for campesinos during community settlement, the region's prevalent freshwater, in the form of rainfall, also supported their initial subsistence crops, which included "beans, corn, rice, bananas, cassava, [and other] vegetables" (Villanueva and Arias 2010:25), as well as produce destined for the market such as coffee and sugarcane. As the communities began to grow, the river's cleared banks also became essential to the increasing numbers of cattle herds that accessed the river for consumption. While the Rio Peñas Blancas continued to sustain the region's many colonizing bodies, the river and its adjacent forests—home to diverse terrestrial and avian populations—also became prominent participants in ecological preservation during early community formation.

4.2 The River's Contribution to Early Conservation

At the same time as the Río Peñas Blancas provided for campesino settlement, the river's ecology also attracted foreign naturalists who settled along its western bank. In 1928, American botanist (and future ornithologist) Dr. Alexander Skutch arrived in the town of Rivas to look for land to purchase in which to study the local ecology. He later returned to observe a tract of land in nearby Quizarrá. As Skutch described, "the very diversity of the terrain broken by escarpments and waterways[…] made it delightful to the naturalist" (1992:139).

After encountering polluted rivers during his travels throughout Central America, Skutch found that the Río Peñas Blancas "displayed all the symptoms of exuberant vitality" (1992:192). As Skutch later wrote, "the Pena Blanca[…] ran clear and pure[…] woodland and river together invited me to come and stay, to live healthily where the earth itself was healthy" (Ibid). With this, Skutch obtained a total of 78 hectares through two instalments along the western side of Quizarrá beginning in 1941, and promptly hired local builders to construct a modest wooden farmhouse and a small farm overlooking the river. This farm was maintained through annual negotiations[32] with campesino families (Skutch 1992:288), and Skutch lived off the small income that was generated through his participation in the local economy[33]. Later joined by his wife, and

[32] One participant recounted that as a boy, he and his family would travel to the Skutch farm every March to plant corn; under the agreement that half the annual yields would remain on the farm while the additional half would go to the participant's family (Participant 8). As Skutch confirms in his memoire, they "went into partnership on the annual crops with [a] hired man" who contributed labour in exchange for "half of the harvest" (Skutch 1992:288).
[33] As Skutch recorded, "we sell the corn that we formerly fed to the chickens and buy eggs and milk" (Skutch 1992:290) in addition to selling chickens and cows.

fellow naturalist Pamela Lancaster, they lived together in the riverside property for more than 60 years, which they eventually named ‘Los Cusingos' after its prominent toucan resident “the endemic Fiery-billed Aracari” (Montoya and Martinez 2015:6).

As a self-proclaimed ‘naturalist’, Skutch spent his later life “meticulously stud[ying] the life histories of a variety of tropical birds, and research[ing] many different plants” (Evans 1999:20) that inhabited his 78 hectare riverine property. In fact, throughout his research, Dr. Skutch identified 307 bird species[34]: of which 171 are resident to the area and 136 are migratory, accounting for 35 percent of the country’s total known bird species (Canet Desanti 2005:7). Henderson noted that these regional species studies were “one of the earliest advances for conservation” (2002:3) in Costa Rica, and were certainly the earliest species lists conducted along the Río Peñas Blancas. Moreover, Skutch compiled these and other studies “in over 200 journal articles and a dozen books on topics ranging from ornithology and botany to tropical conservation and philosophy” (Evans 1999:20).

To support the river’s vast ecology, Skutch left the cleared northeastern edge of his property adjacent to the Río Peñas Blancas to regenerate with the aid of terrestrial seed dispersers[35]. This reforestation effort initiated a significant shift towards the enclosure of forests for conservation along the river’s length. However, while Los Cusingos remained a protected forest fragment, synchronous to the deforestation that was occurring in close proximity, Skutch was able to maintain its condition due in part to the financial and dietary stability provided by the family farming practices that were happening around it, the river that sustained these practices, and the organisms that prompted the forest's regeneration.

4.2.1 **Deforestation along the River**

Within a memoire published in 1992, Skutch described that during his early years of residence in the 1940s, the panorama visible beyond his farm contained “the huge, sprawling[...] mass of El Cerro de la Muerte in the northwest [and] the rocky summits of Chirripó in the north” (Skutch 1992:221). The northern Cerro Chirripó was also noted to be “green, darker on the high,

[34] However, Skutch also observed a decline in some bird species throughout the preceding decades.
[35] Skutch later recorded that, “from the back of the house, the naked, unbroken skyline was bleak and foreboding [so] I planted a few trees, but I chiefly permitted spontaneously sprouting seedlings to grow up[…] soon there were hundreds of flourishing young guava trees, from seeds distributed in the droppings of cattle and horses[…] little by little I had an open grove of fruiting Guava trees which[…] provided nourishing food for the cattle and ourselves” (Skutch 1992:221).

precipitous slopes, where I am pleased to see that many square miles of ancient forest still lie untouched by the axe, [and] lighter in the foreground, which is covered with coffee plantations, cane fields, pastures, and resting fields overgrown with dense thickets" (Ibid).

In the following decades, these emerging patchworks of farmland fractured the river's forested banks as waves of incoming families entered from "the interior valley of El General" (Villanueva and Arias 2010:5). This valley, which served as the nearest center for commerce, was "intensively colonized after World War II" (Ibid) with the construction of the Pan-American, or InterAmerican, Highway that connected El General with the country's capital San José in 1946 (Villanueva and Arias 2010:19). This road development facilitated a trend of upward settlement that intensified the region's ongoing logging process (Ortiz Imalch 2014:15) and virtually depleted the Río Peñas Blancas of tree cover along its settled banks.

The rapid felling of ancient forests along the river continued throughout the 1960s and 1970s in order to make way for new agriculture, particularly coffee and sugarcane cash crops, as well as to generate new pastures for herds of cattle. As a result, Skutch later recounted that in the 1970s the destruction of forests was "particularly striking in this valley" and only "in the central vastness of the Cordillera de Talamanca[…] does the wilderness remain intact" (1992:337). In fact, Skutch stated that "one of the largest remaining tracts of forest in the valley is that of a hundred acres or so on this farm" (1992:337). As scholars confirm, deforestation throughout this time nearly cleared the Pacific side of Costa Rica of primary forests which remained only in the highest elevations of the Cordillera de Talamanca (Cole-Christensen 1997; MINAET 2012:7).

Skutch later expressed his concerns that "this logging caused disconnection between patches of forest [and provoked] a negative impact on biodiversity and wildlife migration" (Ortiz Imalch 2014:15). Moreover, the displacement of native species with colonizing flora (such as cash crop agriculture) redirected rainwater away from the forests that once occupied these soils. At the same time, crop production also required new technologies and harvesting methods that depleted many of the river's freshwater sources both above and below ground.

4.2.2 Sugarcane Production and Groundwater Depletion in the Mid to Late 20th Century

According to residents' accounts, the removal of forests along the river significantly affected the ground's capacity to retain moisture, while also causing long-term depletions to groundwater levels. As one local explained, *"trees are important for maintaining an areas' water supply"* (Participant 8) because they capture rainfall on their leaves, from which it takes *"lots of time for droplets to reach the soil and be absorbed… but since the mountain was more clear-cut during past decades, there weren't trees left to capture the rainwater"* (participant 8) that would instead land on the ground directly. As a result, *"the ground hardened and became compacted and didn't allow rainwater to enter the soil as easily"* (Participant 33). Moreover, the reduced shade of crops exposed the soil to the sun, thus leaching the ground of its moisture content and its spongy capacity to absorb rain. At the same time, Evans noted that the effects of deforestation would have also resulted in "riverbank erosion, heavy soil compaction (from cattle), and soil sterility" (1999:43) in Costa Rica and, thus, throughout the region. However, these effects also extended to the areas' groundwater that surfaced through natural springs.

As one local reported, in 1962 at the age of 15, *"I came to work on the first sugarcane plantation close to* [what is now] *Las Nubes,* where *there were numerous spring wells…but deforestation changed the area into pastures, and this diminished the levels of* [nearby] *groundwater springs until they were dry"* (Participant 8). Moreover, the recuperation of groundwater was noted to be a very slow process, *because "the rain that falls in Chirripó could take 30 years to filter below ground"* (Participant 8) As a result, *"it took 20 years"* for only some of that water to return - *"it takes a lot of time"* (Participant 8).

In addition to the effects of deforestation on groundwater, the production of sugarcane crops also introduced controlled burnings as a method for harvesting. As one local recalled, *"I remember flying with a friend from San José, and I remember there were so many burns, it was hard to fly with all the smoke, smoke in all directions… before you'd see everything covered in smoke in March… here people still burn*" (Participant 5), though reportedly not as often now. However, one participant described how this process continues to be followed by some campesinos in the dry season: *"in the summer they have to cut the sugar cane to harvest it… without needing tons of work, what they do is they burn it so it's easier to cut, but this is very bad because it removes land from animals, practically from the borders of forests… and the*

fumes enter the forest and animals respond... the burning of sugarcane greatly affects bird species and mammals" (Participant 33).

Indeed, the combined effects of deforestation, freshwater reduction, and controlled crop burnings fragmented the habitats that had been occupied by the region's fauna: a process that very likely affected the "population dynamics of its inhabitants" since many local species have since been discovered to "attitudinally migrate, seasonally or daily" with some species requiring "continuous forests at different altitudes to continue with the dynamics of their populations" (Canet Desanti 2005:2). Additionally, the river's increasing "forest fragmentation [may have] allow[ed] hunters to access previously inaccessible parts of forests", therefore causing great impacts on the local ecology such as "the loss of wildlife species and populations as well as declines in [their] abundance" (Maguire 2017:7).

However, despite noticeable changes to local forest cover and groundwater availability, the regional process of deforestation "was grounded in a widespread belief in abundance theory," defined as a "pattern of thinking in the 1960s and 1970s" that was based on the belief that Costa Rica "had more than enough resources and that no [resource] shortages would develop" (Evans 1999:43-44). In line with this was the belief that "forests were only impediments to development [meanwhile] deforestation[...] was seen as an 'improvement' to the land [and] a giant step towards modernization" (Evans 1999:44). This belief extended to the Río Peñas Blancas and its tributaries, with one elder participant noting that as a young student, *"I learned that water is an inexhaustible resource"* (Participant 27). This early belief that freshwater is *"eternal"* (Participant 16) was shared by two other residents, the second of whom explained that while living in San Isidro as a child, *"there was an abundance of water, so nobody talked about not having it, because everyone thought it was infinite"* (Participant 5).

However, this national perspective started to shift in the 1970s after a politically connected group expressed their growing concerns about the larger national rate of deforestation that was estimated to have reduced Costa Rica's total forested land cover from more than 50% to 29% between 1950 and 1986 (Chomitz et al. 1999:157-158). With a total removal of approximately "50,000 hectares [of old growth forest] per year between 1950 and 1984" (Ortiz Imalch 2014:15; Isla 2015:49), this was one of the highest global rates of deforestation (Ibid). To slow this process, the country's early environmentalists initiated state conservation efforts to protect its remaining forests and the waterways that carved through

them.

4.2.3 **The Emergence of Chirripó National Park**

The expansion of the northern frontier along the Río Peñas Blancas was legally halted on July 29, 1975 when the forested reaches of its twin branches became incorporated within the newly formed Chirripó National Park. Initially encompassing 43.700 hectares[36], the park gained legal protection under the 1969 Ley Forestal (Forest Law #4465) that established national parks as "off-limits to forestry and agriculture" (Evans 1999:49). The emergence of this park initiated a top-down approach to resource management along the river that made locals legally accountable to state regulation. In short, this made the river's northern expanse *"no longer accessible to farms… it's protected, so you can't cut trees"* (Participant 8). Additionally, the regional fauna came under the protection of the country's earlier Wildlife Conservation Law of 1956 (Ortiz Imlach 2014:31), thereby prohibiting the hunting practices that were common along the river.

The formation of Chirripó National Park was originally motivated by a team of mountaineers from the University of Costa Rica who began lobbying in 1972 for its protection after climbing to the summit of Cerro Chirripó in 1971 (Chaverri Polini 2008:43; Evans 1999:96). These mountaineering-enthusiasts considered conservation to be an important approach to "preserving the mountain's variety of ecosystems" (Evans 1999:96) including: *paramo* grasses, glaciated valleys, high-altitude oak forests, (Ibid) and elevated cloud forests. Moreover, these forests were recognized as vital to "a network of watersheds" in the south-Pacific region with energy-generating capacities, and the mountain's water-richness and potential to generate electricity "helped[...] sell the idea of converting the area into a national park" (Ibid).

This direction was then spearheaded by an environmentally oriented, and politically connected, circle whose vocal concerns about the national rate of deforestation motivated the state to establish the country's first tourism office several years earlier in 1969 in a bid to shift the national economy away from deforestation and towards 'green tourism'. Under the management of the office's newly appointed Director of National Parks Services, Mario Boza, and functionaries including Alvaro Ugalde and Sergio Salas among others (Chaverri Polini 2008:42), this office was faced with trying to expand conservation in the mid 1970s during a

[36] The park would later expand in 1982 to include a total of 50.150 hectares (Chaverri Polini 2008:40-41).

time of restricted nation finances. As Boza elaborated, the biggest challenge during these early years “was breaking out of the vicious circle between the need to develop a system of national parks and the lack of resources for doing so” (1993:240), prompting the National Parks Services to request support from national and international donors which they began to procure in 1972 with their “first grant from the World Wildlife Fund” (WWF), and additional support from Mrs. Karen Olsen[37], as well as from “scientists and people with international prestige [in vocal support] of conservation” (Boza 1993:241).

Yet, while this office continued to receive international support throughout the following decades, the state regarded conservation as an economic instrument and a viable strategy to ‘improve’ populations and environments. This occurred after the country’s deforestation rate in combination with national geopolitical and financial crises compelled Costa Rica to open its doors to foreign creditors throughout the 1980s and 1990s.

4.2.4 **The River and La Amistad**

In 1979, Costa Rica was confronted with a crippling economic crisis due to “overextended loans from international banks” (Evans 1997:109), and responded by “unilaterally suspend[ing] all payments on its $2.7 billion foreign debt [and high] debt service of $335 million” (Isla 2015:37). Under the direction of president Rodrigo Carazo, the country’s refusal[38] to return “one of the highest per capita external debts in the world—approaching $3.5 billion by 1990” (Isla 2015:49), prompted the International Monetary Fund (IMF) to prohibit Costa Rica from obtaining additional loans (Isla 2015:37). This 1981 debt crisis, in combination with the country’s growing ecological crisis and pressures from a geopolitical dispute with Nicaragua, opened the country to international financial organizations such as, “the International Development Bank, and international private investors” (Ortiz Imalch 2014:56; Isla 2015:38) as well as the United States Agency for International Development (USAID) that began to operate “as a direct agent in the political economy and ecology of Costa Rica” (Isla 2015:48).

With the involvement of these organizations, and despite the era’s economic challenges, international contributions including loans and private donations ensured that the country’s conservation efforts continued during these years. These efforts materialized nearing the end of

[37] Mrs. Karen Olsen (of Danish descent) was the country’s First Lady from 1970 to 1974 (Boza 1993:241).
[38] Costa Rica remains the only country to have kicked out the International Monetary Fund (Evans 1999:111).

President Carazo's administration in April 1982, when the state founded what Carazo described as the "pride of the nation[…] the International Park of Friendship, La Amistad" (Evans 1999:121), comprised of "approximately 500,000 acres of tropical wilderness in the [Cordillera de] Talamanca" (Evans 1999:121) with forests that also extend into Panama. Unique to Central America, this international protected park "nearly doubled the size of the entire national park system" (Ibid) in Costa Rica, and was promptly "declared a World Biosphere Reserve by UNESCO" (Ibid) for its extensive ecological diversity.

La Amistad's protected status as an UNESCO World Heritage Site also extended to the reserve's adjoining conservation areas (Ibid). This included Chirripó National Park, thus incorporating the northern tributaries of the Río Peñas Blancas and re-establishing the northern frontiers of the towns of Santa Elena and Montecarlo with an expansive protected area, the largest and one of the most biodiverse in Central America. Consequently, conservation initiatives along the Río Peñas Blancas escalated throughout future decades, as 'sustainable development' discourses became embedded in national policy.

4.3 Sustainable Development

The nation's shift towards conservation expanded "during the Arias administration", after a 1987 report by the UN World Commission on Environment and Development, otherwise known as the '*Brundtland Report'* inspired a national conference the following year which translated to "Conservation Strategy for Sustainable Development [39] (ECODES)" (Isla 2015:49). With the objective to "evaluate past economic development strategies and to propose new ones" (Ibid), ECODES reframed national processes of deforestation (once regarded as necessary to modernization) to be a consequence of economic development (Ibid).

As a proposed solution, "a reconfiguration of Costa Rica's territory through neoliberal [and colonial] conservationist concepts of enclosure and preservation prevailed as top priorities", generating the emergence of the National System of Conservation Areas (SINAC), a decentralized agency "under the supervision of the Ministry of Natural Resources, Energy and Mines" (Isla 2015:50). This agency, which combined the "ministries [of] Forestry, National Parks and Wildlife," (Ibid) became responsible for overseeing both private and state owned protected

[39] As Quesada noted, "the project was consolidated [with] the economic support and cooperation provided by the International Union for the Conservation of Nature, WWF-US, the conservation foundation, Conservation International, the Nature Conservancy, and local organizations" (Isla 2015:49).

areas, and at the same time it embedded private agents, international actors, and environmental 'experts' in the daily management of the country's natural resources (Isla 2015:50; Ramírez Cover 2011:12).

In accordance with Goldman (2001), the involvement of USAID, international conservation scientists, and environmental organizations in creating "national property rights laws, redesign[ing] state agencies, and redefin[ing] localized production practices based on new global norms, transform[ed] conventional forms of state power, agency, and sovereignty" (500). In short, ECODES decentralized state control over the country's protected territories and environmental initiatives, and imported "new global forms of legality and eco-rationality that fragmented [and] stratified" this new environmental state as well as "state actors, and state power" (Goldman 2001:500). Moreover, the eco-rationality that was imported became rooted in an uneven scale of environmental valuation.

4.3.1 **Green Neoliberalism and Environmental Valuation**

Costa Rica's adoption of conservation as a sustainable development strategy prompted its economy to implement what scholars such as Isla refer to as "the first green neoliberal project" (2015:26), making it the primary example of a transnational neoliberal model that has been "entering an ecological phase" (Escobar 1996:326) since throughout the 1980s and 1990s. According to this model, environmental resources became incorporated in the international market as "new political [and] economic domains of calculation" (Goldman 2001:501) that would be best managed if "capitaliz[ed] and treat[ed] as commodit[ies]" (Escobar 1996:328).

To measure this capital potential, the Costa Rican state and "non-state actors sought to 'improve' conditions of nature and populations by introducing" what Goldman (2001) refers to as "new cultural/scientific logics for interpreting qualities of the state's territory" (501). In accordance with this, "a hegemonic discourse of ecological difference[…emerged], defining some 'qualities of territory' as degraded, and others as necessary instruments for the improvement of populations, states, and natures" (Ibid). To ensure their economic potential, the country's natural resources and their regions were assigned both intrinsic and instrumental values (Chomitz et al. 1998:3).

In adherence to this model, the intrinsic values that were assigned to resources represented the 'existence value' or "notional willingness-to-pay for [the] preservation [of specific

resources] by the world's population, present and future" (Ibid). Meanwhile, the instrumental values represented the percentage of national income that could be collected through "both ecotourism and bioprospecting[40] opportunities" (Ibid). In fact, both of these resource valuations centered on the protection of what became newly termed 'biodiversity' (Ibid). As Escobar elaborates, the concept of biodiversity conservation "did not exist before 1980" (2008:277), but emerged from conservation biology. In order to mitigate the national loss of species, the term was soon used to articulate "a master narrative of biological crisis" (Escobar 2008:277) following its dissemination in 1992 at the Earth Summit in Rio de Janeiro. Within this context, scientists and environmental 'experts' became new authorities in determining the different values of the country's resources, and defining which areas were most suitable for conservation protection.

4.3.2 **The Role of Expert**

As Escobar argues, the idea "that nature and Earth can be 'managed' is a historically novel assertion" (Escobar 1996:328) for which the application of management strategies requires nature to first be 'known'. In order to claim knowledge, resource conservation is founded upon the tools, technologies and work of scientific experts that are believed to be "separate from management and policy" (Goldman et al. 2011:3). In this way, scientific knowledge that is treated as 'objective truth' works in collaboration with "political and economic prerogatives" (Goldman et al. 2011:2) to manage environments. However, the potential for such objectivity has become critiqued by an expanding group of social theorists, including Goldman, Nadassdy, and Turner (2011) who argue that "the production of environmental knowledge is shaped by management goals and directives as well as widely circulated ideas about society and [the] environment" (3). As such, how "applied research agendas are established, funded, pursued, and evaluated shapes the production of environmental knowledge" (Goldman et al. 2011:2).

In Costa Rica, and particularly along the Río Peñas Blancas, the dissemination of scientific ways of knowing through the involvement of environmental experts in state conservation began in the 1970s: when Boza first assembled a team of scientific experts with intimate familiarity of Costa Rica's environments to conduct the 'badly needed pilot study of potential [national] park site(s)" (Evans 1999:84). This team was comprised of members of the

[40] These bioprospecting initiatives included: carbon sequestration, aimed to reduce "atmospheric concentrations of carbon dioxide" (Chomitz et al. 1998:3), watershed protection to reduce water spill over to ensure "potential electricity generation at run-of-river hydroelectric plants; [and,] ecotourism and scenic values" (Chomitz et al. 1998:4).

Centro Científico Tropical (i.e.: The Tropical Science Center) (TSC), established as a private consulting firm in 1962 “by three American biologists—Leslie Holdridge, Robert Hunter, and Joseph Tosi” (Evans 1999:26; Henderson 2002:3). The TSC offered to direct the study and included among the team’s “personnel Dr. Alexander Skutch to perform the ornithological research and Dr. Leslie Holdridge to document tree speciation and ecological community structures” (Evans 1997:138); an alliance that would have lasting implications for conservation along the Río Peñas Blancas.

In order to determine the values of the nation’s ecological zones, the state turned to a philosophical-scientific classification system that was first published in the field study of Dr. Holdridge and his coworkers titled Forest Environments in Tropical Life Zones (1971). This work provided the first “full [assembled] overview of all Costa Rica’s vegetation formations and their structure and composition” (Kappelle 2016:7) by envisioning “the environment as a system” (Harris 1973:187) composed of different bioclimatic land areas called ‘Life Zones’.

4.4 Lesley Holdridge’s ‘Life Zones’ Classification

Holdridge’s Life Zones Model, which built upon “forest stand data collected in 1964-1966” (Helmer and Brown 2000:506), considers fluctuations and distributions of annual temperature and annual precipitation to be “the principal determinants of global vegetation[41]” (Meza Ocampo 2014:40). Of the 116 life zones that Earth was classified to contain, Holdridge “identified twelve distinct life zones in Costa Rica”, and eight in the Cordillera de Talamanca, “based on [average annual] temperature, rainfall, evaporation, humidity, and elevation[42]” (Evans 1999:4). Of particular significance was Holdridge’s observation that “the luxuriance of [a life zone’s] vegetation increases as water becomes increasingly more abundant in the form of precipitation” (Holdridge 1966:84). In other words, “with more available [water], more vegetation can grow on a given unit of area with a correspondingly greater transpiration” (Ibid) potential.

For Holdridge, transpiration refers to the capacity of vegetation to release the water vapours absorbed through their roots into the atmosphere through their stomata (Ibid).

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[41] According to this model, the “vegetation in each zone has a physiognomy and a particular structure that can be seen to emerge when similar bioclimatic conditions exist” (Meza Ocampo 2014:40) in different global regions.

[42] Moreover, Holdridge determined that water availability not only depended on “precipitation and [atmospheric] moisture [content alone], but also [on] the water holding capacities of different soils” (Holdridge 1966: 85), topographic and atmospheric elements (such as the contact between clouds and mountain slopes), and their effects on drainage.

Holdridge further noted that in “wet tropical forests, only a few consecutive days without rain causes considerable leaf fall from evergreen species [as a] way of reducing transpiration” (Holdridge 1966:90) and retaining moisture for longer. By the trees’ patterns of action, Holdridge determined that as a general rule, “it appears that transpiration is a relatively rapid process” since the trees’ contain “many mechanisms for reducing the movement of water vapor out from the leaf” (Ibid). Holdridge further explained that “since the translocation of water up through the plant stem of the leaf is primarily produced by transpiration, the speed of transpiration must be controlled within a species by the availability of water in the soil” (Ibid). Moreover, the plant’s transpiration capacity would in turn contribute to a process known as evapotranspiration, what Holdridge noted was a “hypothetical quantity”, yet which still “merits more consideration” than its simple definition as “a function of solar energy on the earth’s surface” (Holdridge 1966:92) that causes evaporation.

This relationship between vegetation and freshwater, in combination with the capacity of canopies to retain groundwater with their shade, demonstrated that the drying of soils can reduce the transpiration capacities, as well as the canopies, of local vegetation. In exchange, the reduction of transpiration would reduce the levels of moisture released into the air, prompting possible temperature increases, vegetative losses, and thus water reductions. While Holdridge’s model became used internationally, to varying success, its applicability to tropical montane regions has caused it to remain enshrined in Costa Rican national policy and ecological studies. Moreover, Holdridge’s Life Zones model became factored into new initiatives along the Río Peñas Blancas after his organization, the TSC, purchased the 48 hectare estate Los Cusingos from Dr. Alexander Skutch in 1993[43] (Canet Desanti 2005:5).

4.4.1 **Los Cusingos and Las Nubes**

The TSC purchased ‘Los Cusingos’, formally renamed ‘the Neotropical Bird Sanctuary Los Cusingos’ (Ibid) with international financial assistance in 1993 and promptly transformed the farm’s small fields into gardens overlooking the river. The TSC also restored the Skutch dwellings, opening them as museums to tourists and as public space for the community. In accordance with Holdridge's Life Zones Classification System, 50 percent of Los Cusingos was

[43] While the TSC owned the property, Skutch remained living there until his passing in 2004.

classified to contain very rare primary[44] Premontane Wet Forest, composing "one of the largest remaining tracts of forest in the valley" (Skutch 1992:337; Baggio 2001:152); and one of the only remaining examples of this Life Zone in the country. This Life Zones model has since become integrated in community operations through the discourses of conservationists and Los Cusingos employees.

According to one conservationist, the characteristics of this Life Zone are noted to be *"its high degree of rainfall, because here it rains around 3,000 to 4,000 millimeters annually"* (Participant 33). In addition to conservationists, a nearby resident described Los Cusingos as *"the last of this forest relict: this micro-type of forest is here, in and around Los Cusingos we'll say, and it is called a 'conservation base' because it is unique and is not represented in a single* [national] *park, so it's important to conserve it"* (Participant 12). While the ecology within Los Cusingos began to draw tourists and local support, the biodiversity to the north of Los Cusingos also attracted international interest later that same decade.

Forest conservation within the region expanded in 1998 when "124.37 hectares of Costa Rican rainforest", referred to as Las Nubes (i.e. The Clouds), and located at the southern perimeter of Chirripó National Park, just six kilometers upriver from Los Cusingos, "was donated to York University's Faculty of Environmental Studies (FES) by Toronto philanthropist Dr Woody Fisher"[45] (Baggio 2001:153). According to Holdridge's model, the forests contained within Las Nubes are categorically different from the premontane forests that extend past Los Cusingos. Rather, the forests of Los Cusingos were noted to continue along an "altitude belt that stretches from 1000 to 2000 metres (with an average temperature of 24° Celsius), before transitioning to elevated Montane forests between 2000 and 3000 metres (with an average temperature of 12° Celsius (CoBAS 2005:37). Given this, the forests contained in Las Nubes were classified as Montane Rain Forest under the Life Zones classification system" (Baggio 2001:153), since the region "*receives more rain and defines a different Life Zone…and this means that the species can also change"* (Participant 33).

As a result, one conservationist described the Río Peñas Blancas—that flows between these two parklands—as a *zone of transition.* As stated*, "you can't simply say that this forest is*

[44] Primary forest means that it has not generated from forest that was cleared—it is the direct remnants of earlier forest generations (i.e.: old growth).
[45] Doctor Fisher and other donors such as the Lambert family and Howard Daugherty all contributed to York University's Faculty of Environmental Studies (FES), and their funded grants for students facilitated my opportunity to research in Costa Rica.

Premontane Wet Forest, because for example here [in Los Cusingos] *it's very humid premontane forest…but if we go up to Las Nubes where York University is, the forest transitions and that is where the rainforest* [and] *cloud forest begins*" (Participant 33). In order to preserve their respective Life Zones, and facilitate species movement between these fractured forests, the emergence of Las Nubes initiated a collaborative partnership between the TSC and York University's FES with the agreement to maintain the Río Peñas Blancas as a biological corridor between the two parklands. However, this direction also required the support of local communities with land such as fields and pastures that intersected with the river and its respective forests.

4.4.2 **Environmentalism and Campesino Culture**

As the national economy expanded into ecotourism, the government sought new ways to ensure that private land owners would comply with state objectives. In short, the country's government hoped to manage the population by way of "compel[ling] individuals to internalize social values and norms by self-regulat[ing] their behaviour in ways consistent with the state's goals" (Fletcher 2010:175). However, national discourses about environmental sustainability and conservation were a far reach from the extractive nature of the local customs and state initiatives that were promoted less than a decade prior. As one local explained, in the 1980's *"people didn't respond to changes to laws and people still hunted animals and palm trees were cut in the mountain* [to extract] *palm hearts"* (Participant 16) an edible local delicacy during Easter. However, the change towards a conservation mentality "*happened gradually here, slowly, and it started with growing awareness*" (Participant 5). According to participants, this awareness developed and became disseminated in several ways, through: formal educational initiatives; community engagement and mobilization; and, collaborative partnerships between community members, the TSC, and York University.

As Boza elaborated, state educational initiatives "occurred in 1973 when nature conservation—specifically national parks—was added to the official biology curriculum for the final two years of high school studies" (Boza 1993:242). In addition to the incorporation of "education about the environment in schools", one participant also explained that the *"women assimilated to environmentalism more because men worked in the fields and it's difficult to protect resources like the river that you're extracting from for things like agriculture"* (Participant 27). However, as environmental education became important to families (especially to women

and children), community concerns about the local ecology became vocal and, in one instance, motivated resistance against an extractive industry approved by the state.

As one participant explained, *"environmentalism in the region emerged with the defense of trees 18 years ago"* in Chirripó National Park, after *"the state permitted tree companies to enter the mountain… this permission was illegal, so local community members blocked the road with their bodies"* (Participant 12). One participant of this tree protection effort added that *"locals were worried, so they attached a wire that ran across the road… this stopped the trucks from passing, and the company eventually had to leave and cut somewhere else"* (Participant 16). With residents becoming increasingly receptive to conservation initiatives, through the combined effects of environmental education in schools and community mobilization, local events aimed towards environmental education were initiated within the region.

In particular, the emergence of the Environmental Festival[46], an *"educational event for the local schools* [that] *started over 10 years ago"* (Participant 27), incorporated communities, private interests, and government groups such as the National System of Conservation Areas (SINAC), the Development Association, AMUQ, the AMACoBAS women's' association, and the TSC in public outreach. This collaboration generated the festival as a platform to extend environmental awareness to additional community members, and likely prompted residents to become more receptive to the Western conservationism that had become increasingly imported to the region by eco-tourists. As one participant noted, *"we still haven't achieved the level we want to be at, but for example, with Los Cusingos here—the people started to see that it brings tourism, it brought extranjeros… and people know that when an extranjero comes, they generally come for the nature—and that started to bring awareness to people"* (Participant 5). With this, the number of ecotourists began to escalate shortly after the Environmental Festival was founded in 2004, which coincided with the emergence of the Alexander Skutch Biological Corridor.

4.5 The Emergence of the ASBC

Within the ASBCs Project Plan, a biological corridor is defined as "a geographical area, usually privately owned, whose function is to provide connectivity between protected areas,

[46] This festival is one of many that are organized within the ASBC aimed towards environmental education.

landscapes, ecosystems and natural habitats" (Canet Desanti 2005:16). Moreover, they are intended to "enable migration and [the] dispersion of flora and wildlife, and ensur[e] the conservation and maintenance of the biota and their habitats, in addition to [their] ecological and evolutionary processes" (Ibid).

In effect, the creation of the ASBC was described as *"a social and personal process that included the participation of members from* [the municipality's coffee cooperative] *CoopeAgri, the TSC, Los Cusingos, ASUCUENCA[47]"* (Participant 27) and York University, among others. This effort grew to incorporate new community organizations including *"AMACoBAS, community bakery-cooperatives, and rural tourism agents"* (Participant 27). Through their collective engagements, the ASBC (and its central organizing council CoBAS) was established in 2005.

The technical process of defining the corridor's limits, which stretch from 750 MASL in Quizarrá to 3820 MASL in Cerro Chirripó (Canet Desanti 2005:19), occurred the year prior through the activities of the corridor's environmental institutions, with the use of GIS and satellite images to determine the region's ecological conditions. Moreover, a local described the community role in determining corridor perimeters to be a *"fast process, they aren't straight lines… they follow the shape of resources"* (Participant 27). In particular, the Río Peñas Blancas operated as the ASBCs principal feature, with the corridor extending to incorporate the river's additional tributaries. This has defined the ASBC as a "fluvial [biological] corridor because it incorporates [and concentrates on] the watershed of the Río Peñas Blancas" (Canet Desanti 2005:19).

Moreover, the ASBC continues to operate as an initiative to: recover the last relics of the country's tropical seasonal evergreen forest; restore connectivity between fragmented conservation areas and forest patches with La Amistad Biological Reserve; facilitate the migration and dispersion of flora and fauna by using the river as the central migration corridor; foster shared sustainable development initiatives with other regional organizations; and, encourage community participation in the development of the ASBC (Canet Desanti 2005:5). Yet throughout the following years, independent and privately funded conservation initiatives also emerged along the Río Peñas Blancas.

[47] ASUCUENCA is a local agricultural council that monitors the land and water uses of commercial industries.

4.5.1 **The Emergence of Chirripó Vistas**

As the river's unique Life Zones attracted the international interest of eco-tourists, its regional biodiversity also appealed to Western conservationists and real estate developers who purchased Santa Elena's pastured outskirts at the foot of the Las Nubes forest. As one participant noted, the *"CCR, the Canada-Costa Rica Company"* (Participant 13), purchased the overgrown pastures at the foot of Chirripó National Park through the collective funds of 19.5 shares in order to develop properties. With the support of foreign investors, these overgrown areas were promptly converted into Santa Elena's northern-outlying neighbourhood of Chirripó Vistas, catered towards permanent and seasonal North American residents with an affinity for *nature* and *sustainable living*. This cheery, gated community stretched the economic divide within the ASBC and became characterized by manicured lawns and panoramic montane views; all protected by night-time security.

Included among this neighborhood's earliest wave of residents were some 'self taught' conservationists who generated a 'green' micro-economy by hiring local Ticos to reforest their tracts of property along the north-western bank of the Río Peñas Blancas. However, this initiative was reported to have been largely experimental since reforestation within "abandoned [pasture] is different from normal secondary succession" (Reforestation Record for Vistas de Chirripó 2014). This is because many rainforest and cloud forest tree species are incapable of germinating below grass or invasive trees[48] with dominating canopies (Ibid). The process of grass removal therefore involved the cutting of grass with a weedwacker, and the application of fertilizers (Ibid). During the early stage of this initiative, "42 species [with] 70+ individual" (Ibid) trees were planted. However, as the project progressed the planting of "three important genera that are widespread and common in Costa Rican forests" (Ibid) took central stage: Ficus, Inga, and Cecropia.

4.5.2 **Reforestation along the River (and Species Mutualism)**

According to numerous participants, the reforestation of the Río Peñas Blancas was not attributed to human efforts alone; but is rather the collective result of human and non-human

[48] Melastomacae, a dominant tree species, had invaded the region's abandoned pastures, prohibiting other species from germinating on the ground over which a "grass environment [also] casted its shade" (Ibid). However, the decision to remove these trees was not shared by all conservationists, which revealed that reforestation, while performed to promote biodiversity, was also a platform for disagreement and divergent ecological and scientific 'truth' claims among members and residents of the ASBC.

processes that include the trees themselves, the insects that pollinate them, the animals that distribute their seeds, and the river that sustains both the flora and fauna.

Figure 11: Reforestation
A conservationist inspects the progress of this secondary forest's canopy that has grown through reforestation efforts. From there the forest transitions into older growth jungle. Photo by author, 2016.

To elaborate, the first selected species, Ficus (colloquially known as Figs) was noted to be a keystone species in the Neotropics, "because of their staggering [and unpredictable] fruiting" (Reforestation Record for Vistas de Chirripó 2014). Unlike many other fruit trees, Ficus trees—which either grow as "cilamates" by emerging from the ground, or as "higuerones" (i.e. 'stranglers') that land as seeds on established plants and creep up to the canopy and down to the forest floor—can flower at unpredictable times meaning that "some figs are available during periods of the year when nothing else is fruiting" (Ibid). This makes Ficus trees essential to many of the region's frugiverous[49] species of birds (such as tanagers) and fruit eating species of monkeys (such as white-headed capuchins), birds, bats and many mammals. In concert with this, such Ficus trees also depend on mammals and birds to disperse their seeds in scat and guano (Participant 19; Participant 34), thus facilitating the expansion of their large canopies as more seeds germinate and the forest expands. As one conservationist explained*, "a few planted trees can create a species rich area that can greatly expand the forest"* (Participant 34).

[49] Frugiverous is defined as: when the entirety of an animal's diet consists of fruit.

At the same time, this same conservationist emphasized that Ficus trees participate in an astounding display of "plant-insect mutualism" whereby *"many fig species have their own species of pollinating fig wasp"* (Participant 34). Due to their co-evolution, "the absolute dependency of the fig on its wasp and vice versa bodes ill for figs in forest fragments" (Reforestation Record for Vistas de Chirripó 2014) since the fig wasp requires extensive habitat. For this conservationist, the restoration of fig wasp habitat was noted to be yet another reason to reforest along the Río Peñas Blancas (Participant 34). Moreover, along the river's northern banks, it was further noted that Ficus' roots are "extremely important for holding onto soil and halting ground erosion" (Reforestation Record for Vistas de Chirripó 2014). According to one participant, *"near the edge of the* [Río] *Peñas Blancas, you can see more roots than earth… they* [Ficus trees] *keep rivers in place"* (Participant 34). These roles were also noted to extend further downriver as well. As one member of Los Cusingos noted, Ficus and Sota Caballo trees are *"really central to this ecosystem* [because] *they give food to the animals…* [and] *these trees depend on an ecosystem with lots of water"* (Participant 1).

In addition to the 24+ species of figs that were planted as a part of this reforestation effort, Inga trees of the Fabaceae family were also planted for their roles in nitrogen fixation. To elaborate, Fabaceae was described by a participant in reforestation to be "the most important plant family in the Neotropics due to the symbiotic relationship that legumes have with nitrogen fixing bacteria [which] gives a big advantage to trees" rooted in tropical soils that are "shallow and leached from heavy rainfall" (Reforestation Record for Vistas de Chirripó 2014; Participant 34). As such, they facilitate additional trees' access to nutrients. Finally, the third species selected was the rapidly growing Cecropia trees. While regarded as an invasive species elsewhere, Cecropia are native to the Neotropics, and their rapid growth rate and tendency to attract wildlife make them "an obvious choice to plant [for participants]" (Reforestation Record for Vistas de Chirripó 2014). It was further explained that Cecropia trees are also dispersed by "mammals (especially sloths, bats, and other arboreal mammals), [and] birds in [their] scat and guano" (Ibid), thus re-emphasizing the socio-natural conditions of the reforestation project. Yet, the essential roles that fauna provide for the generation of forests was not only emphasized by conservationists, but proved to be a central theme within many interviews.

Figure 12: Strangler Fig

(L): A strangler fig along the riverine trail. As one local record explained, “the place on a strangler fig where the fig seeds germinated is easy to deduce: it is where roots go down and branches go up” (Reforestation Record for Vistas de Chirripo 2014), revealing that what appear to be separate trunks are part of the same enormous root system. Photo by author, 2016.

Figure 13: Bromelias
(Below): Bromelias and moss retain pools of moisture on the west bank of the Río Peñas Blancas along the rainforest trail. It was noted in interviews that the region’s bird species, the resplendent “*quetzals need water from bromelias, not creeks, to make up for a fatty avocado diet”* (Participant 1). Photo by author, 2016.

4.5.1 **Co-Dependent Ecologies**

Throughout this research, numerous participants emphasized the codependence between freshwater, flora, and fauna. As one participant in Montecarlo noted, *“everyone talks*

about the importance of water, that we couldn't live without water, that's true, but we would not have water if it wasn't for the trees" (Participant 5). This was further expanded on: *"river ecosystems are codependent on trees on either side"* which is also supported by animals such as "*river otters*[50]*; they eat fish then transfer these nutrients to the forest"* (Participant 12). As another participant noted*… "every bird and every puma is necessary, it's the importance of the forest: all the animals… in their excrement, the seeds are distributed* [and] *birds are extremely important for this, so the flora and fauna is indispensable"* (Participant 20). In short, residents revealed that "*the water can't exist if there isn't forest"* (Participant 20); however, without seed dispersers, many forest members do not expand.

With this in mind, it was through the collective efforts of community foresters (who have planted close to a total of 16,000 trees), the technologies they used, the trees themselves (with their productive fruitings), the insects that pollinated them, and the fauna that distributed their seeds, that lush secondary forest canopies have emerged along the river's northwest bank and continue to stretch inland. Moreover, the damp conditions that these forests provide through their transpiration has ensured that many trees within this rainforest Life Zone host additional ecosystems of lychin, bromelias, orchids and vascular plants that survive on their trunks and branches, with many plants visibly rooted on host-trees, as well as in the forest's soil [see Figure 13].

The collective transpiration potential of this diverse vegetation was described by another participant in the reforestation process who noted that "*you can see it here: even when it's not raining, you see evaporation coming out of the forest… and you go down there [to the river] and see the plants-and there's water coming out of the leaves… and it hasn't rained but the leaves are dripping wet"* (Participant 32). The experience of observing increased freshwater retention was also expressed by one local Tico who explained,

> *When I was younger the area was made up of pure pasture, and I saw less water in almost all water bodies because there wasn't as much forest. but now there's more effort to reforest, especially with the entrance of extranjeros—now it's pure mountain. Because of this more water flows in the winter and summer—and this change has happened within the past 13 years* (Participant 19).

[50] While the elusive tropical river otter has not been photographed in the ASBC, there continue to be accounts of its sighting (Butera 2016) stretching back to the experiences of Dr. Alexander Skutch encountering them while bathing in the Río Peñas Blancas (Skutch 1992:198). As another participant mentioned, "*I have never seen a river otter, but they say that they're here!*" (Participant 13).

In short, as a result of the forest's shade and moisture retention, the Río Peñas Blancas remains protected from the Sun, and its flows sustain the regional ecology, including species that have participated in the river's northern reforestation. As a conservationist explained, *"the most valued body of water in this area is the river, it's the biggest—spectacular, it maintains the area*" (Participant 33).

Figure 14: Cloud Forest Vegetation

(L) Bromelias, lychin and stranglers cover trunks and branches in the cloud forest above Montecarlo.

(R) Moisture is retained below canopy along the rain forest trail near Las Nubes. Photos by author, 2016.

4.6 Animal Sightings along the River

As noted by locals, reforestation along the Río Peñas Blancas has caused several changes to the ecology as incoming organic bodies were incorporated into the region's freshwater flows. Specifically, it diversified the Río Peñas Blancas' ecosystems as the forests captured rainfall and renewed surrounding groundwater levels. These groundwater sources collected in a nearby plateau that was previously pasture and replenished a small stretch of high altitude wetland that continues to be fed, according to one participant, by, *"spring wells on the* [nearby] *properties… there's one on our property, but these wetlands are all obviously being fed by springs, so they're all along here"* (Participant 32). As another participant noted... *"it's good for the wildlife and everything, but it's hard to walk through them year round because it's too wet, and the insects here are very stubborn"* (Participant 13).

While a pest for some, another participant reflected fondly on its dependent flora: "*this wetland just gets filled with white orchids"* (Participant 30). In addition to hosting insects and flora, this emergent wetland and its connecting pools of water were also noted to host many amphibians. According to another participant, *"in Las Nubes there are many water sources, and many spring wells where there's a lot of life, we have found very many species of frogs here and further down the river where there's also wetlands"* (Participant 9). Expanding from this, a central theme throughout these interviews was the greater potential for observing species closer to the Río Peñas Blancas. As one participant commented, "*close to creeks and rivers are more biodiverse*" (Participant 1). Another local reported *seeing "coati, jaguarundi, and larger cats while maintaining the paths along the river"* (Participant 19).

The river's potential to support life within this region was further elaborated upon by a Chirripo Vista's resident who noted that many *"streams here have very different plants, animals, birds to learn in this small area… we've had friends visit and say, 'we go to parks up north and spend $35 to go walking and see animals,* [but] *here you're doing it in your front yard!"* (Participant 13). This same participant further noted that *"from the time we started* [reforesting] *to the time now, we see probably three to four times the wildlife, and we don't have Los Cusingos nearby*"[51] (Participant 13).

Moreover, along the river's eastern tributary, the Río Peñas Blanquitas, another local noted observing the return of species that had not been seen since the time of commercial deforestation:

> *Imagine, for 30 years you didn't see mountain or water and many things, and even now you can see some of these impacts. But now people don't cut the mountains, so this has caused a shift to the climate… now it's fresher here when before it was hotter. Before, the river's banks had no trees, and now the river's edges have a lot of trees… the species have also generated the ecosystem, and so with these trees you see species returning now that haven't been seen. There were once toucans here, because my dad told me stories that he saw them, but it's only six or seven years ago that they showed up, so this return of species also helps the ecosystem* (Participant 20).

In addition to the diversity encountered within these northern secondary forests, riverine biodiversity was noted to extend southward down the corridor, where additional Ticos also

[51] Increased sightings might not demonstrate an increase in species populations, as animals may have migrated to the region due to the loss of their habitats elsewhere. However, this does reveal that the local ecology contains the elements necessary to support regional biodiversity.

contributed to the ASBCs reforestation initiative. While reflecting on the natural regeneration of forest abutting the river's west bank, one resident of eastern Santa Elena expressed his pleasure in seeing *"monkeys, ocelots and other animals feeding on fruit trees near the river"* (Participant 16). Similarly, to the southeast of Los Cusingos, along the western side of Quizarrá, another participant described seeing "*a nest of motmots*" carved into the river's edge; the king-fisher which *"flies low on the river"*; and, thick neck storks which were described to "*make Jesus lizards go running up the [nearby] tree[s]"* (Participant 35). Additional species that were often observed include white-headed capuchin *"monkeys, lizards and* [especially] *iguanas: I've seen the iguanas swim in the river a bunch of times… [also] big morph butterflies use the river as a path—they love when the sun hits the river… they go up and down it in the morning"* (Participant 35). The shared aesthetic appreciation for local riverine biodiversity was therefore expressed by numerous residents including local Ticos, professional and informally trained conservationists, as well as extranjeros. Moreover, these local accounts of riverine biodiversity have become further supported by data generated from species monitoring initiatives led by FES and the TSC.

4.6.1 **Environmental Research: Camera Traps and Species Monitoring**

With global environmental initiatives becoming increasingly directed towards biodiversity conservation in an effort to monitor and manage species decline, the use of environmental tools and strategies to record species within the ASBC has become a priority among the region's research institutions. To elaborate, for the last several decades, researchers and scholars from York University, the TSC, the University of Costa Rica, and members from numerous national and international institutions have visited the Río Peñas Blancas to research the regional biodiversity. The collective nature of these studies, and the technical capacities and instruments of the institutions involved (such as GPS, GIS, computer equipment, and numerous cameras), have facilitated an ongoing and collective project along the river. Among the corridor's central initiatives is a motion camera trap study that generated approximately 1000 wildlife photos with the use of nine camera traps within the ASBC between 2012, 2013, and 2014 (Dicarlo et al. 2015). These traps were installed down the length of the central corridor and along the river's banks and revealed that terrestrial animal movements along the river extend into protected areas, farms, pastures and on private properties.

Figure 15: Camera Trap Images

(Top L to R) white tailed deer [*Odocoileus virginianus*]; ocelot [*Leopardus pardalis*]; puma [*Puma concolor*].

(Bottom, L to R) Central American agouti [*Dasyprocta punctate*]; whitenosed coati [*Nasua narica*]; northern tamandua [*Tamandua Mexicana*]

From this study, sixteen terrestrial mammal species were detected including the "common opossum [*Didelphis marsupialis*], common grey foureyed opossum [*Philander opossum*], lowland paca [*Cuniculus paca*], Central American agouti [*Dasyprocta punctate*], ninebanded armadillo [*Dasypus novemcinctus*], tayra [*Eira barbara*], ocelot [*Leopardus pardalis*], whitenosed coati [*Nasua narica*], collared peccary [*Pecari tajacu*], puma [*Puma concolor*], striped hognosed skunk [*Conepatus semistriatus*], northern raccoon [*Procyon lotor*], coyote [*Canis latrans*], tapeti [*Sylvilagus brasiliensis*], northern tamandua [*Tamandua Mexicana*], and red tailed squirrel [*Sciurus granatensis*]" (DiCarlo et al. 2015: Pt 3). Moreover, pumas have also been documented traveling within Los Cusingos. As one park member mentioned:

> *With the mammal inventory, the most important species are the pumas and the ocelots, and here the puma has been recorded on cameras that York University passed to us—and that has helped quite a bit—it has given us some great data. So that indicates that there are available food sources. They have water, food, forest: revealing that it's good… as an indicator species, it reveals the ecosystem to be stable* (Participant 33).

Figure 16: Puma

Pumas have been documented by camera traps both within Los Cusingos and within the cloud forests surrounding Las Nubes, suggesting that they navigate between these fragmented forest areas (Las Nubes Project 2013).

This park member further noted that the *"animals need water… they use the rivers as biological corridors to pass through… the puma and other mammals probably travel up the Río Peñas Blancas to other forest fragments* [and] *they also go to the water to wait for fish"* (Participant 33). In addition to the puma, deer populations are also recorded regularly and it was elaborated that *"the deer is a national symbol because of the hunting that has happened… a lot of deer have been hunted… so to show that there's deer here is important*" (Participant 33).

Additionally, York University students and ASBC residents continue to generate participatory species lists through their research. For example, Grundy (2014) compiles a list of locally encountered flora, which includes: 150 food plants; 94 medicinal plants; 197 ornamental plants; 92 fruits; 74 lumber trees; and several other miscellaneous varieties documented (93-110) in the ASBC. Meanwhile, Luffman (2014) includes an independent species count, having observed: six frogs and toads; two other amphibians; four lizards; and, three snakes along the river (23-25). However, such biodiversity also attracts the wildlife trade and hunters, and Maguire (2017) includes a species list of animals hunted within, and trafficked from, the area (41). In addition, members of Los Cusingos and biologists from the University of Costa Rica

conduct regular species counts. During my stay, I was invited to participate in one of these initiatives with a small group of biologists.

During this excursion, we hiked between 8:00 to 10:00 pm in the Las Nubes jungle and cloud forest trails along the river, and documented the species that we encountered. Among them were: the helmeted iguana [*Coritophanes cristatus*]; an undetermined species of lizard [*Anolis aquaticus*]; the legler's stream frog [***Ptychohyla legleri***]; the tink frog [*Diasporus diastema*]; the emerald glass frog [*Espadarana prosoblepon*]; the robber frog [*Craugastor cruentus*]; a second species of robber frog [*Craugastor fitzingeri*]; an additional species of Craugastador (yet to be determined); and, the harlequin toad [*Atelopus varius*] to name a few[52]. It had been previously noted through interviews that the presence of amphibians are good indicators of the river's health because they are sensitive to changes in temperature and humidity, with some species, such as the emerald glass frog, being noted to "*rely on freshwater for reproduction*" (Participant 1).

One indicator species of particular importance that we encountered was a critically endangered (and nationally threatened) species—the harlequin toad [*Atelopus varius*] often unique to montane regions. As Luffman further noted, this "species lives on the margins of shallow, rapid streams, [being] possibly one of few remaining within Costa Rica" (Luffman 2014:24). Upon its discovery, several biologists gasped and alternated turns balancing on a steep overhang above the Río Peñas Blancas to document the small toad… I could not resist doing the same [see Figure 17].

[52] Species identification was performed by using fieldwork photos that were taken during the night hike, and courtesy of participants in a York University herpetofauna list project, yet to be published.

Figure 17: Herpetofauna

(Top L) A Leglers Stream Frog clings to flora more than a meter above ground.

(Top R) Emerald Glass Frogs are known for their translucent skin, revealing their organs beneath.

(Bottom L) Biologists take turns documenting the Harlequin Toad.

(Bottom R) Harlequin Toads are prized for illegal trafficking, and the Los Cusingos director advised not to share its image directly on social media or have its exact location revealed.

4.6.2 **Seasonal Changes and Freshwater Access**

While residents noted observing more wildlife near the Río Peñas Blancas where its forests had been restored, this increase in sightings was also noted to be a potential consequence of animals' reduced access to the river's adjoining creeks and tributaries. This was due to annual seasonal changes that affect water availability. As one local explained, *"the creeks dry up by 90 percent in the dry season… from the end of November until May"* (Participant 1). As a result, *"condensation and evaporation aren't the same* [so] *when creeks dry, trees dry and affect a lot of connected plants"* (Participant 1) in different ways. Moreover, while some species of plants, such as several orchid varieties, were noted to offset these changes by improving their water retention capacities (Participant 1), many species of fauna do not share this capacity to adjust to freshwater reductions.

With this said, one resident noted that animals depend on this river *"especially during the dry season when connecting creeks dry up"* (Participant 4). A member of Los Cusingos further explained that *"species need water, if they don't have it they migrate to other areas to look for water, causing a whole ecosystem to be potentially destroyed… for example, here we have the pumas and for us, if the puma wasn't here, it would be really bad, because they maintain an ecosystem" (Participant 33).* Given this interdependence, *"when creeks dry up many* [animals] *migrate closer to the river… the rivers and creeks are for migration*" (Participant 33). The

presence of the Río Peñas Blancas, and its available water was therefore emphasized to be essential to the ecology of Los Cusingos since *“animals continue to live in this park during the dry season, probably by going to the Río Peñas Blancas, where it doesn’t* [fully] *dry”* (Participant 33).

Other community members also emphasized this point*, “the* [Central American] *agouti and deer come here* [to the river], *iguanas, they all come to drink here… in summer there is less water so you can see more* [animals] *here”* (Participant 9). Two additional residents from Quizarrá confirmed that, *“in the dry season, animals travel from here to the river”* (Participant 11; Participant 7), *“especially when smaller creeks and other water sources dry out”* (Participant 7). Similarly, one San Fransisco resident to the south of Quizarrá noted that *“in the dry season there is less water so you can see more animals coming to the river”* (Participant 9). The reduction of freshwater in the ASBC was attributed to extreme seasonal changes, exacerbated by the effects of climate change (to be explored further in Chapter 6). Moreover, these and additional accounts revealed locals’ deep appreciation for the Río Peñas Blancas, describing it to be the central source of life for the regional flora and fauna. Specifically, throughout interviews, descriptions of residents' deep appreciation for the river’s water were emphasized, with many likening the river to a vein that flows through the ASBC, supplying life to the region’s diverse dependents.

4.7 The River as a Hydrocommons

Throughout this research, numerous locals provided representatons of the river’s water as a flowing life source by using such descriptions as:

*“Water is life” (*Participant 3; Participant 5; Participant 10; Participant 14).

“Rivers are the veins of the world” (Participant 12; Participant 34).

“Creeks and springs are the blood of the river” (Participant 27).

“Water has no price it is the lifeblood of our veins” (Participant 3).

“Without water, we are nothing” (Participant 8).

“Without water there is no life, *and closest to the river there are many species of animals… birds, amphibians”* (Participant 19).

“Water is everything… I noticed here, you put a seed down and boom it grows” (Participant 17).

*“All water is indispensable for terrestrial and aquatic life and the survival of species—you can find unique species here—water signifies life” (*Participant 1).

*“The river has to be preserved, for flora and fauna… the flora need good water to live, and fauna too. By maintaining the river, you maintain the flora and fauna—and they are important” (*Participant 19).

In accordance with Strang, within the ASBC, local understandings of the co-dependence of riverine species appeared to ground “ethical ideas about relationality that reframe human-environmental interactions in egalitarian terms” in ways that “acknowledge the agentive powers of non-human species and things” (Strang 2013:163). In short, while some conservation initiatives were aimed towards recording and categorizing the independent species encountered, emphasis throughout interviews was placed on how species bodies affect and interact with each other. In this sense, species were generally referred to in the context of their relationality with other species of flora and fauna, demonstrating that biodiversity was envisioned as the result of a riverine ecology that is quintessentially co-constituted.

As one local reported, *“there is always a food chain… and these species depend on each other also... it’s codependence… there are no independent species”* (Participant 1). Moreover, in the context of riverine management, this watery entanglement “challenges pretensions to discrete individuality” (Chen et al. 2013:12) and encourages a relational approach to freshwater access that considers how all bodies “reside within and as part of a fragile global hydrocommons” (Neimanis 2013:27). The fragility of this hydrocommons was regarded as a central concern by some community members. As one local expressed, *“water needs to be protected for the future… it’s like the animals of the mountain, there’s concern that the youth will not be able to experience these rivers because the environment wasn’t protected well enough” (Participant 21).* In this context, the importance of the river to the biological composition of local species revealed how the river’s flows not only provide a deep source of connection between organic bodies across space, but also through time.

Since the river’s initial release from its glacial embodiment, it has been constantly shifting through its collection of additional flows from rainfall and groundwater. Yet the river’s changing flow, while extending beyond its direct channel, has in one sense remained part of a ‘closed’ hydrological system. As Neimanis elaborates:

> Our planet neither gains nor relinquishes the water it harbours, but only witnesses its continual reorganization and redistribution. The water that temporarily composes and

> sustains [any body] brings with it a history that is at least 3.9 billion years old (Neimanis 2013:31).

In taking a vital materialist approach, the river's ability to facilitate the emergence of biologically diverse communities extends the future promise of "inaugurat[ing] new life, and also the infinite possibility of new communities" (Chen et al. 2013:12) on the blue planet. This infinite potentiality and deep vitality link all past, present and future life into what Neimanis describes as an interdependent "aqueous gestational milieu" (2013:30). Thus, I argue that the river and its milieu (past, present, and future) are central to the social identities of those who reside within the ASBC.

The early campesinos who initially settled within the region and whose livelihoods directly depended on the river's ecology in combination with the philosophies and knowledges imported by Western naturalists, scientists, and the more recent entrance of international eco-tourists and conservationists, have embedded in local discourse and practice a sense of collective identity, and environmental appreciation that is unique to the corridor's residents. In this sense, the corridor's many ecosystems, and the river that materially connects them, are not reduced to the inanimate backdrops upon which human settlement has occurred. Rather, local accounts of the river reveal its flowing circulations to be life-giving, as well as constituted by socio-technical-natural components that extend to the discourses, technologies, and organisms that have uniquely affected the river's material conditions. Yet these shifting interactions have also prompted exchanges between bodies.

Over time, the river's associations shifted from the bodies of native species and biota, into the region's colonizing bodies that included, but were not limited to, domesticated crops, livestock, and human populations. With relation to this, the collective accounts of residents conveyed a vision of interconnectedness and shared inter-dependence, whereby the river became inseparable from the bodies that its flows encounter and vice versa. I base this conclusion upon the work of Ortiz Imalch who determined that the identities of campesinos within the ASBC "delay the appropriation of the individualism that is [at] the core of neoliberal philosophy" (2014:82), a vision that has become exceedingly visible through the community's collaborative response to hydropower development plans along the Río Peñas Blancas.

However, I add that the river and its 'gestational milieu' including flora and fauna, are themselves participants in constituting the material conditions of local communities, as well as

the identities of its residents. Given this, the flows of the Río Peñas Blancas also inform what are regarded as *appropriate* uses of water that ensure its collective, and continued, access for humans and non-humans, alike. Moreover, these notions of the river as a collective resource are taking precedent over the capacities that the river could otherwise provide in terms of its hydropower potential. As one participant stated, "*without water, there is no life for animals, plants, or birds… you can live without electricity"* (Participant 20). This acknowledgement highlights some of the additional areas of concern for local residents in terms of the potential consequences of PHPB I and II, should they indeed be constructed along the Río Peñas Blancas and Río Peñas Blanquitas.

4.7.1 **The River and Hydropower**

> Rivers provide import and export corridors for nutrients, sediment and living organisms; their blockage with hydro-electric dam projects may prove as damaging as [the] blockage of an artery [within] a human body *(*Luffman 2014:21).

Throughout this project's interviews, the most common concern voiced by campesinos, conservationists, and local residents with respect to the river was the anticipated redirection of 90 percent of the Río Peñas Blancas' flow quantity. Yet, when participants voiced the reasons behind their concerns, the primary one was the impact that the flow reduction would cause to local organisms (especially flora and fauna). As one resident noted, *"dams are very bad for the environment and the flora and fauna of the area in general"* (Participant 19). The particular implications of such dam development were elaborated on by one resident who noted that *"water would be removed—and lots of trees would die because water would collect in a holding tank where trees currently are… the water would contaminate the ground"* (Participant 22). This concern was in response to the EIS which confirmed that "during the construction process some work areas will be stripped of their vegetative cover and be exposed temporarily to erosion by rainwater and passing runoff" (Hidroeléctrica Buenos Aires 2013:16). This was followed with the promise that project areas would be later revegetated using native plants. However, as previously described, the loss of forest cover might impact groundwater or moisture levels, thus reducing these areas' capacities to sustain vegetation.

In addition to the removal of local vegetation *"if the dam is put here then the water quality will be less pure, and not good for the animals*" (Participant 9). This concern was coupled with additional factors like seasonal changes. As one local reported, *"in the rainy season there's lots of water, but in the summer, it almost goes dry. And when does the ICE want electricity? In*

the dry season, but at that time there's almost no water here, and if they take away 90 percent of the water then that leaves nothing" (Participant 5). This concern was echoed by another local who noted that "*I'm not an expert in these issues, but I'm aware that impacts on the environment and other things will happen to this area with a dam… I don't need to be a biologist for that…"* (Participant 5). As a result,

> *The people here are not willing to let them happen because the projects would leave a very small flow, it would take away a lot of water. And this river maintains the biological corridor, Los Cusingos, all those places are maintained by the river… the animals that cross the corridor drink from this river, trees, flowers, everything that depends on this water would be destroyed* (Participant 11).

Another local expressed that the dams "*would dry out everything because it's totally destructive... nature needs that water… what's left, 10 percent? Imagine, a desert!*" (Participant 25). Expanding on this point, the local ecology's tendency to alter upon slight changes was also noted as a concern by one participant who stated that:

> *If we enter into agreement, they will remove 90 percent of the river. And they say the energy is clean… clean for fish and for trees, but… it isn't clean energy like it's said to be. Only a change in temperature here can completely affect an ecosystem. It can kill fish… also, who will measure 10 percent? It's a number that was taken from… I don't know where, but it would affect us terribly* (Participant 20).

Despite the seasonal changes to water availability, the region's water richness compared to other regions of the country was noted to be a central factor for attracting hydropower developers. As outlined by one participant:

> *With climate change, we aren't going to have a reduction like in other places in Central America, so this zone is special for hydropower. Because we have important protected areas, La Amistad and Chirripó, so all of the mountain is protected and it produces lots of water… on top of that, climate change isn't affecting us here as much as in the north, like in Guanacaste* (Participant 12).

At the same time as the river's minimum flow standard generated concerns, additional aspects of the dams' environmental impact studies were also cited as cause for alarm. In particular, one resident further argued that the effects of a dam would not be nearly as contained as the EIS suggested:

> *The EIS claims that it will take a small segment of the river, but this is an ecosystem and ecosystems move freely in rivers. Mobile fish travel up and downstream; fish in different seasons swim, they pair, they reproduce in high parts. But the company pretends that there's only 3 species of fish here. They don't give importance to endemic species… for example, the river has endemic unique species and it must be protected* (participant 12).

With this in mind, the existence of an endemic species of fish unique to the river was highlighted by several participants. As one local argued*, "the company lied about the consequences of the dams in the state Environmental Impact Studies! In reality there are many fish in the Río Peñas Blancas, including one species only found in this river… an endemic fish species,* [so] *the project would mean the fishs' extinction"* (Participant 11). As an additional resident confirmed, *"hydropower is destructive; it takes away the water, and kills the environment… we have endemic fish species here"* (Participant 5).

Throughout these interviews, little else was known about this endemic species[53], and it became apparent that the fish was not valued for its aesthetic or charismatic appeal given that no one reported to having knowingly encountered it. Rather, the species had become a symbol for the river's characteristic capacity to support unique life. Given this, emphasis on the fish's endemism became used as a central argument to protect the river, and at the same time this species' absence from the EIS documents became regarded as evidence of the inadequacy of current EIS standards. For these participants, the documents' omission of the river's unique life revealed issues with the current standards for conducting and writing environmental impact studies as well as with the state's current approval process.

4.8 Conclusions

As local accounts reveal, company assessments of the river's ecology began in 2013 when representatives of Hidroeléctrica Buenos Aires began to document local species to inspect what organisms could be potentially affected by PHPB I and II. Yet, the company's activities within the community were purposefully obscured from the majority of its residents, thus reducing local involvement in contributing to the company's species list. Later the same year, the company presented their species list to SETENA, as required by state policy; however, the document only highlighted a minute fraction of the species that local residents are aware exist and migrate along the river.

Once this document became accessible to the public, it was discovered that within the project's area of direct influence, a total of "19 forest species, 10 terrestrial fauna species, 31

[53] This endemic species of sardine, known as *Bryconamericus terrabensis,* was initially encountered and reported in the research of Fabricio Pardo (2014:4).

species of birds, 3 species of fish and no endemic species" (Hidroeléctrica Buenos Aires 2013:58,67) were noted to exist. As one resident elaborated:

> *When they discussed fauna they only mentioned 10 species. And the 10 most common species of fauna—but if one analyzes the technical studies of the ASBC, they find that here there's a huge quantity more. We have a high percentage of national biodiversity in fauna species in particular. And if we look at York University studies, we see species here that are in danger of being extinct: felines and ocelots, bush dogs, coypu river rats—So they make these invisible in the study* (Participant 12).

As such, the company's list records a mere fraction of the species groups noted within the 2005 technical study for the design of the ASBC which records an estimated 414 species of birds, 133 species of mammals [and] 251 species of butterflies" (Canet Desanti 2005:41) which inhabit the ASBC. Moreover, of the 10 species of fauna listed by the company, Luffman (2014) elaborates that "all but one" of the ten "are considered pests", a status that is generally assigned to species with "a propensity for survival in anthropocentric environments" (15). Moreover, Luffman suggests that "the nature of the animals presented lends a particular character to the dam projects", in which the majority presented are "at best common and at worst actively undesirable" in terms of state valuation, thus "improving the approval prospects of the dam project" (Ibid). The company's inadequate account of local biodiversity reveals that the standard for collecting species data operates in a way that favours company objectives.

As one resident explained, *"the EIS said the dams wouldn't cause much harm because the studies are done by the same companies that want to develop the projects… because the state doesn't have the economic resources, personnel or technical capacity to do the studies"* (Participant 5). But due to this conflict of interest, *"the study can present false information… for example the study here offered a picture of the river* [to show its ecology], *but this wasn't an honest picture—it looked more like a pasture from Guanacaste"* (Participant 5). Another participant also noted that the company… *"said lots of lies… they needed authorization to do the projects, so they recorded that the river didn't have many trees, it didn't have fish… they took pictures of the river surrounded by pasture… so they lied"* (Participant 11). These omissions are notably apparent when one considers the species data collected by York University and the TSC. As one local explained,

> *York is involved: they know about the species and have the photos, and these aren't things that I'm just saying, this is evidence collected by York… so this gives benefits… the locals don't have the scientific knowhow to support these ideas. I think it will help us with our fight to defend the Río Peñas Blancas and Río Peñas Blanquitas* (Participant 5).

Yet despite the accessibility of this and other ecological research within the region, state policy does not require that these documents be taken into account. As one local highlighted,

> *They [companies] don't report the biological studies that are done in the zone. they only walk around* [the river] *and they say… this this this and done. They don't review the literature: they don't review the state's knowledge, they don't review investigations, they don't review technical studies, they don't review proposals like for the ASBC, they don't revise project plans and diagnostics for protected areas like Chirripo and Los Cusingos. I, without being a biologist, know that I could take that information and enter these areas and find very interesting things biologically. But they do absolutely none of that. When one revises the EIS of* [the dam project] *Hidrosur, in* [the neighbouring] *Río Chirripó, they are very similar… they just use a different name* [but] *they put the same information for each place* (Participant 12).

With this in mind, it becomes clear that new assessment requirements should be incorporated within future EIS standards. In particular, a locally compiled bibliographic list of previous ecological research and species data within a project's intended area should be formally taken into consideration prior to, and throughout, the EIS assessment processes. However, the functionality of this strategy is limited to actors with formal training in species counts—this not only reveals an area in which policy may discredit locals who use colloquial language to refer to species—but also highlights an area for improvement through collaborative research between institutions and locals resisting dam development, both within the ASBC and elsewhere. Should researchers agree to provide training to community residents, it may be fruitful to initiate community based species lists and species monitoring initiatives that residents may continue to contribute to independently. Moreover, given the already integrated use of communication technology within the ASBC, digital platforms to share this data could also make these records accessible to local residents, in addition to providing physical copies within the community's library Casita Azul. However, it should also be noted that technical species lists do not fully account for the ways in which biodiversity is understood and represented at the local level, prompting areas for future collaborative research that not only categorically distinguish between species, but also focus on their *relationality* i.e. their co-dependence.

Additionally, the required participation of formal (perhaps elected) community representatives in an initial species count would also increase the transparency of project assessments since those conducting the study often obscure their engagement in the community to manipulate data. Finally, the species data collected should also be made publicly accessible to the community prior to the project's approval process. With this said, it is important

to emphasize that additional approaches to protect riverine ecology against hydropower development are being considered by other researchers in Costa Rica.

In fact, to forego SETENA's EIS process and to encourage riverine protection, a future initiative has developed in Costa Rica as part of the Citizen's Water Law Initiative to establish a biodiversity category for rivers that would restrict their access against industrial economic development. The initial draft proposal for this initiative, which is based on a policy enacted by U.S. congress in 1968 "to protect those rivers that had not already been affected by dams or other construction" (Schramski et al. 2009:3.0), would provide legal protection for rivers "on a case-by-case basis" through their assignment of one of three primary classifications: Wild river areas (Prístinos)[54], Scenic river areas (Escénicos)[55], and Recreational river areas (Recreativos)[56].

While a future biodiversity status may offer rivers additional legal protection (should local communities favour this direction), the proposal also acknowledges the limitations of this direction in its final notes, where it states that "if we look only at the river channel and ignore the watershed, there is absolutely no guarantee that the freshwater ecosystem will be conserved in the longer term" (Schramski et al. 2009: 4.4). In short, the effects of hydropower dams due to the mobility of a river's flow will enter adjoining riverine systems [see Figure 18] as well as their associated ecosystems. This acknowledgement requires a more radical shift of understanding to an extended-relational account of the river's flow, a direction which I will explore in the following chapter.

[54] Wild rivers are described as "rivers or sections of rivers that are free of impoundments and generally inaccessible except by footpath, with watersheds or shorelines essentially undeveloped, waters unpolluted, and with a resource extraction regime that poses a minimal and reversible degree of impact" (Schramski et al. 2009: section 4.1).

[55] Scenic river areas are defined as "rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely wild and shorelines largely undeveloped, but accessible in places by roads, and with a resource extraction regime that poses a minimal and reversible degree of impact" (Schramski et al. 2009: section 4.2).

[56] Recreational rivers are noted to be "rivers or sections of rivers that are readily accessible by road, that may have minimal development along their shorelines, that may have undergone some impoundment or diversion in the past, and with a resource extraction regime that is compatible with the values of recreational river areas" (Schramski et al. 2009: section 4.3).

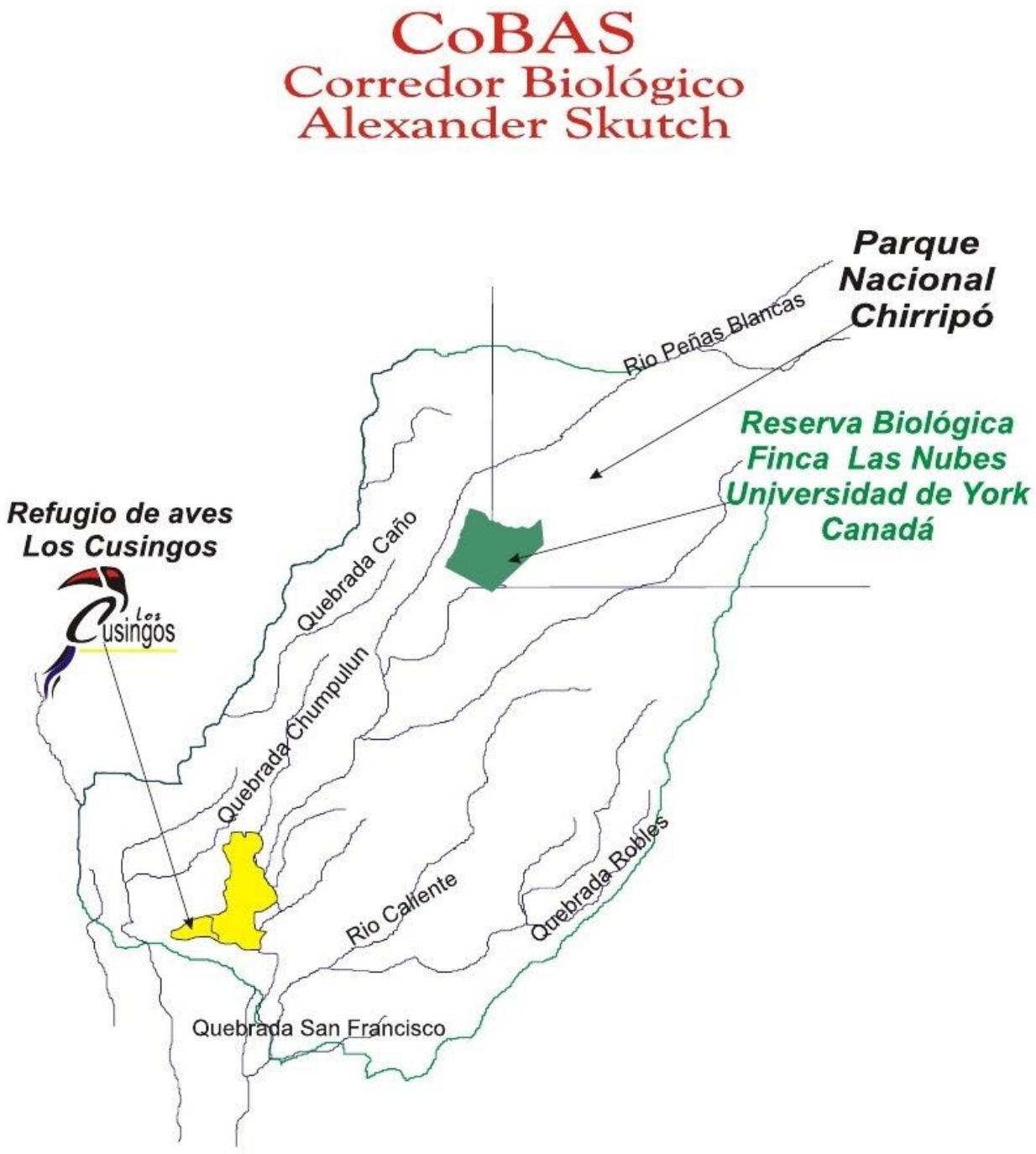

Figure 18: Map of ASBCs Watershed
(Above) The river connects to numerous creeks and tributaries which help to define the perimeters of the ASBC (CoBAS 2016).

5 The River's Socio-Cultural Dimensions

5.1 Freshwater as Social

In addition to composing and sustaining organic bodies, freshwater also contributes to the genetic and social behaviours of organic communities. This is partly due to the fact that freshwater environments, climates, and material conditions become absorbed and released by vegetation. As Holdridge explains, freshwater dependent vegetation "enter[s] intimately into the living processes" of its initial and eventual consumers (humans and nonhumans alike), and one could reason that "the activities of animal organisms must [therefore] have a direct relation with the climatic distribution of water" (Holdridge 1966:84). Given this, many species live and move in accordance with available freshwater, indicating that their habits, behaviours and migratory traditions are closely associated with water availability and access. These proximate relations with freshwater make organic communities susceptible to experiencing water's shifting characteristics over time.

Since many organisms live in proximity to freshwater, their close relations and encounters with water allow its shifting qualities to engage and interact with the sensory receptors of proximate bodies. However, these initial moments of interaction with water occur before their effects are perceived through a body's sensory receptors; and before emotion and will are assigned to the body's experiences. Rather, the initial moments of freshwater's interaction with variable and variably shifting elements (including living organisms), generate what some theorists describe as '*affects'.*

5.1.1 Freshwater Affects and Sensory Encounters

In Vibrant Matter, Bennett's focus on affect is rooted in "a Spinozist notion of [the term], which refers broadly to the capacity of any body [to engage in] activity and responsiveness" (Bennett 2010:xii). In turn, Bennett "equate[s] affect with materiality", thereby extending this power of interaction to "organic and inorganic bodies, natural, cultural [and technical] objects [that are] *all* affective" (Ibid)

In considering the Río Peñas Blancas to be, as Bennett suggests, "social[...] in the sense that" as a flowing body, it is "continuously affecting and being affected by other bodies" (Bennett, 2010:21), this paper considers how the river's capacity to produce *affect* is experienced by proximate organisms and how they in turn interact with the river. Deleuze

expands on this point by citing that the power of a body to affect other bodies includes a 'corresponding and inseparable' capacity to be affected; "there are two equally actual powers, that of acting, and that of suffering action, which vary inversely one to the other, but whose sum is both constant and constantly effective" (Bennett, 2010:21).

Moreover, Van Alpen argues that since affect occurs through "interaction, one can say that the transmission of affect is social in origin, but biological and physical in effect*"* (2008:23). That is to say, in the case of organisms, interactions with water are not purely experienced through a body's independent cognition. Rather, cognition occurs as the result of an organism's social interactions with the waters that initially act upon the organism's body. In short, the Río Peñas Blancas interacts with proximate organisms and through their affective encounters; the river prompts particular social and biological behaviours in different species bodies.

As the river's freshwater interacts with diverse organisms, the *affects* and thus effects of these interactions are encountered through the unique sensory receptors of its various consumers. For some species, freshwater can affect a body's biochemistry and can prompt biological behaviours such as migration. As one conservationist noted*, "water can genetically change animals"* (Participant 1). Many avian species demonstrate this constitution, since some *"birds genetically have a map for migration when born, and additionally they map out water sources*, [but] *this information may be lost, and* [can] *affect them biologically when these sources, such as water, or food trees, change into something they aren't familiar with… the rivers are very strong like that"* (Participant 1). In such cases, visceral experiences with water (that contribute to knowledge and memory) and biological processes are co-constituted in species bodies.

In addition, freshwater not only triggers biological behaviours, but also facilitates species mobility during migration. For example, mature Pacific salmon along Canada's Pacific coast demonstrate this watery-constitution. As these northern species navigate to upstream spawning sites, it is believed that the freshwater which they enter triggers chemical changes in the brain that helps them to recall their earlier "imprint[s] of the chemical composition of the natal streams" (Ramenofsky 2010:195) which they experienced as smolts. Comparatively, several fish species within the Río Peñas Blancas are "*diadromous*, [meaning] *they travel to the ocean and spend parts of their lives* [there], *and then part of their lives in freshwater"* (Participant 12).

One such species is the machin (a high altitude brook trout) and the most common species encountered by contemporary fishers in the Río Peñas Blancas. For those who consume the machin, it could be reasoned that the biological effects of different waters that the fish interacts with can also extend to affect the senses, such as taste, of its consumers. As one participant explained, *"the other day I had a friend bring me some machin to fry up, and they had the flavour of the ocean, not of a freshwater fish, and that's why"* (Participant 12). However, it can also be understood that the fish body and the human species body do not share comparable visceral experiences of the waters that pass between them.

While the river's flows can generate visceral experiences in species bodies, these experiences are certainly encountered differently by each species' body due in part to the distinct sensory realities that each body experiences, and the sociality that informs their perceptual worlds. As noted by theoretical biologist Jakob von Uexkull, who considered the subjectivity of nonhuman species, "everything a subject perceives belongs to its *perception* world [*Merkwelt*], and everything it produces, to its *effect* world [*Wirkwelt*]" (2010:42). These two worlds, of perception and production of effects, form one closed unit, the environment" (Ibid).

By providing the example of a tree, and the tree's various uses by its many hosts, Uexkull (2010) argued "that research on environments proves first and foremost the inconstancy of objects, which change their form as well as their meaning in every [species'-perceived] environment" (197). As Uexkull further wrote, "It remains only to show[…] that even the constancy of matter is an illusion [since] the properties of the matter of an object are dependent on the sensory spectrums of that subject" (2010:197). These spectrums extend into "electromagnetic, acoustic, and olfactory spectra" (Lorimer 2007:916) that each species is uniquely capable of experiencing. In regard to this, it is important to mention that the Río Peñas Blancas, through its capacity to generate affects, also contributes to the perceived environments of the many species bodies that encounter and reside within its flows. In this sense, the Río Peñas Blancas is central to the composition of an infinitude of species-perceived social worlds; with the human-social representing just one of the river's experienced realities.

5.1.2 **Freshwater and Human Affects**

Given humans' biological dependence on freshwater, communities often aspire to live and move in proximity to this element; making human senses susceptible to the shifting

characteristics of the freshwater's flows; what may be considered abstractly as the freshwater's 'behaviours'. According to Deleuze and Guattari, "human affect systems are somatic and bodily [and] operate autonomously and automatically, independent of cognition, emotion, will, desire, purpose, intention, or belief—all conventional attributes of the traditional liberal humanist subject" (Grusin 2015:xvii). In this sense, humans attribute their meanings and emotions as responses to the affects of non-human matter, such as the river, interacting with them. Furthermore, the effects of these interactions are limited by the physical capacities of the humans who experience them. As Lorimer noted, "all humans are warm-blooded mammals[…most] humans are bipedal[…] land dwelling, diurnal, and ocular centric (but in possession of five senses)" (2007:916). Given this, the river's shifting qualities engage the sensory receptors of local human residents (Hastrup 2013:60) to affect one's sight, hearing, taste, touch, and smell (Orlove and Caton 2010:404).

At the same time, sensory experiences are also "mediated through social products and [cultural] practices" (Ibid) that characterize perceptions and ideas about the waters that people "come to identify with, or [by which they] are touched and moved in different ways" (Chen et al. 2013:8). Given that embodied experiences are mediated through social understandings, access to the river's water "can mark the boundaries of groups and communities" (Orlove and Caton 2010:404) and peoples' experiences with its flows may indicate possible distinctions of age, class, gender, racial identity, and ethnicity (Orlove and Caton 2010:410).

These deep social meanings of water are represented and valued in diverse ways and can shift over time as a river's hydric-conditions, that affect human bodies and behaviours, also change. In the following section, the changing river is not only considered a central component to the sociality and social practices of families who visit its flows, but its own capacity to cause affects reveals the river to be an active participant in community making. At the same time, social interactions with the material properties of the river are generative to its meanings and appear within diverse representations that attest to the agentive capacity of its flows. I therefore consider how, since community settlement, the Río Peñas Blancas' shifting characteristics have become reflected in the ways in which the river is understood and valued by local residents.

Moreover, I consider how these shifting characteristics also contribute to the social behaviours and practices of local residents that inform what are considered to be meaningful and appropriate interactions with the river's flows. Of particular significance were local reports of

the river's reduction in size and increasingly erratic behaviour throughout recent decades. As such, I will explore several processes that have contributed to this flow reduction, such as the green revolution and climate change. Finally, I will explore the social implications of these changes with regards to cultural practices and values of local residents.

5.2 The River's Social Relations with Early Campesinos

In the early 20th century, the Río Peñas Blancas was reportedly very large, fast flowing and frigid. In fact, the early hunters who accessed the region referenced these elements as sources of comparison when they encountered additional water bodies. One community elder recounted a tale that was shared with him by one of the region's first settlers. According to this account:

> *Early hunters went walking in the forest to find animals… they were already familiar with the cold temperature of the Río Peñas Blancas, but they soon came across an unfamiliar river and discovered its water to be different. "This river is warm" they noted. Soon after passing it, they came across another unfamiliar, and slightly smaller river. "This river is warm too!" they proclaimed, and the names Río Caliente (the Hot River) and Río Calientillo (the little Hot River) have remained to this day* (Participant 27).

Despite these rivers' comparatively smaller size to the Río Peñas Blancas, local accounts reveal that the territory's additional water bodies in the early 20th century were large and very powerful. According to one participant, *"my dad arrived in San Isidro in 1935, and* [he] *recounted that he needed to have courage to cross the rivers* [on his way] *from San Isidro* to [its exterior] *Jilguero on horseback in the dry season…* [now] *they're just creeks, but they couldn't be crossed… now you can cross them easily, you can just pass them walking, and* [at] *any time of the year"* (Participant 5). These rivers' powerful features continued into the mid-20th century, and the memories of long time residents demonstrated that all the *"rivers in the area were much bigger and stronger"* (Participant 15). The Río Peñas Blancas was particularly *"huge, three to four times bigger than* [it is] *today"* (Participant 16), and the river's characteristically powerful flow, mediated by the river's rocky channel, was emphasized in early writing. As Skutch described:

> In the river bed the boulders[…] gave the stream its wild beauty, creating the rapids and the white foaming waters that revealed the current's vital force. They were strings on which the rushing waters played their ceaseless tune, low and soothing when the stream was shrunken in the dry season, but when torrential rains fell on the hills, [they rose] to a fierce insistent roaring, with overtones of deep rumbling as of distant thunder, caused by

> the rolling and shifting and striking together of the boulders in the channel (Skutch 1992:192).

Indeed, the mediation between heavy downpours, the river's force, and its rocky structure prompted local apprehension and informed residents' interactions with its flows. As Skutch further observed:

> The stretch of river that borders Los Cusingos offers no large pools for swimming. During most of the long wet season, the current is so strong that a swimmer is in danger of being dashed against one of the many rocks that encumber the channel. Moreover, the coldness of water that rushes down from chill mountain heights discourages long immersion (Skutch 1992:194).

Given these conditions, recreational swimming in the river was not commonly practiced in the early to mid-twentieth century, prompting other forms of recreation to be essential to local relations with the Río Peñas Blancas.

5.2.1 **Early Recreation along the River**

Given its size and fast current, the Río Peñas Blancas was regarded with caution among locals, but *"people could fish in it"* (Participant 16), prompting fishing excursions to be common recreation along its length; with local stocks supplying an essential source of protein for early residents. As Skutch wrote, "when I first knew the Peñas Blanca River, it contained fish of fair size[… the] lads sometimes caught these fish with a baited hook[… w]ith their simple anglers equipment, they had most bites when the river was swollen and turbid from the afternoon downpours" (Skutch 1992:203).

However, this activity of fishing was not equally practiced among residents, and one female participant reported that *"women went to the river less, I was warned by my mother that it was dangerous, [and] this was common with women"* (Participant 15); making the river a predominantly masculine space at that time. In addition to fishing in the Río Peñas Blancas, its many adjoining creeks and tributaries were also larger and abundant with fish stocks, providing *"big fish too! like a foot long!"* (Participant 15), and young boys and men *"fished in the creeks"* where the water was *"much more powerful* [than today but] *less dangerous than the river"* (Participant 15).

The large size of these water bodies was attributed to the region's constant rain cycles. To elaborate, local water bodies reportedly *"never went dry throughout the year* [since]

historically it rained more constantly", even during the dryer months (Participant 15), thus replenishing local groundwater reserves. Consequently, given their safer currents and proximity to homesteads, creeks were primarily used by women for domestic activities like bathing, the washing of clothes, as well as to supply water to domesticated animals. In describing her experiences as a young girl in Santa Elena, one participant explained that *"more time was spent by the streams* [than the river] *but even that was rare"*; however, she remembers learning *"to swim in the creeks—the larger of which were primarily used"* (Participant 15). At the same time as the Río Peñas Blancas' force dissuaded popular recreation within its currents, its exceptionally pure water, demonstrated to locals through its visible clarity and taste, also made it an ideal source for collecting potable water for the consumption of campesino families and herds of cattle.

5.2.2 **The River's Purity and Early Domestic Uses**

In the early 1950's, one local resident explained that *"the river provided water to my family for everything… I would walk 200 metres to collect water in barrels even though there were wells closer to home"* (Participant 16). Another participant also noted that water for domestic uses could be accessed *"through wells on the property"* (Participant 15); however, her mother was concerned for her family's safety, so the *"children would go to the nearby creek and collect water directly from its source spring"* (Participant 15). This selection was made because the mother *"preferred its very pure water [since] there was no need to boil it to drink and cook with"* (Participant 15) at the time.

Additional domestic uses of the river were also common with one participant recounting that during the 1960s the river was "*depended on for bathing* [and] *tubs of* [its] *water would be collected for domestic use 12 times a day"* which was described as a *"very tiring process,*" since her family *"didn't have barrels to collect rainwater"* (Participant 25). This same participant noted that later as a teenager, she and her *"entire family would go to bathe and swim in the* [river's adjoining] *creek Chupulum",* as well as *"clean dirty laundry on* [its] *rocks, where there was less current"* (Participant 25). However, by the early 1970's the quality of some local waters had diminished, with one participant stating that by the early 1970s the *"water from the creek behind* [her family's] *house had to be boiled for domestic uses"* (Participant 15). A similar experience was confirmed by another participant who noted that in the mid 1950s when he *"first saw the Río Peñas Blancas and Blanquitas their water was even purer, but in the 1960s and 70s the*

owners of the land changed and pastures expanded… the local [creeks] *collected pollution and* [this] *flowed to the rivers"* (Participant 27). These observations were supported by additional residents who associated the river's changing quality and its resulting shifts to local social behaviours, with the advent of the green revolution.

5.3 The Green Revolution and River Relations

As freshwater flows between bodies and regions, it brings different users and their particular uses of water into contact. This is due to the fact that impacts on one section of a river can travel to other watery regions and be felt by downstream users. For the Río Peñas Blancas, expansion of commercial farms for the production of coffee and sugarcane cash crops in the 1960s and 1970s introduced new logics of agricultural productivity that extended to the local uses of soils and freshwater. Specifically, the increasing use of agrochemicals was established with the introduction of sun-tolerant varieties of coffee in the 1960s (Ortiz Imalch 2014:102). One participant explained that this shift began when *"the Ministry of Agriculture and Livestock, known* [at the time] *as STICA*[57]*, developed*" (Participant 12). During this time,

> *They* [extranjeros] *came to produce fertilizer and agrochemicals, and began to sell them to other countries*… [and] *they established offices all over Costa Rica that consisted of agronomers to show campesinos how to use agrochemicals—and the people learned very well, for that we are* [its] *biggest* [global] *consumers* (Participant 12).

As a result, this participant elaborated, *"we have a culture here very* [much] *in favour of agrochemicals… everyone knows that first you apply herbicide to burn and remove weeds, then after the herbicide, a pre-emergent herbicide so the seeds of those weeds don't grow, then after that you plant your crops, and then you apply other selective herbicides" (Participant 12).* As a result of this, *"within campesino culture if someone says to use 30 grams of chemical, they use 60 grams of chemical to ensure it works well. double or triple—it's the same with insecticide, with everything, so our campesinos are experts"* (Participant 12).

According to Isla, this high level of agrochemical use increased after 1981 when the nation entered a debt crisis and was financially obligated to increase the applications of pesticides and fertilizers to intensify agricultural productivity (Isla 2015:46). In fact, Isla notes that according to "Ramirez and Maldonado, between 1981 and 1984, Costa Rica consumed

[57] This is an abbreviation for the Inter-American Technical Service of Agriculture Cooperation.

2,251,400 metric tons of fertilizers; in 1985, pesticide imports increased to 12 million kilograms; and by 1988, imports had decreased to 8.4 million kilograms owing to an increase in internal production" (Isla 2015:41).

To increase the use of chemical applications within the region, these applications first required the mixing of chemicals and, as one local revealed, *"you need clean water from the creek to mix with herbicide or the spray won't work"* (Participant 22). Another local recounted that *"before, water was taken away from the creeks to mix herbicides in spraying pumps"* (Participant 16). While less common today, this practice continues according to another local who described how "*spring water is used to mix with agrochemicals in the rainy season, when the water rises and* [one] *doesn't have to go too far to fill the pumps"* (Participant 25). In addition to extracting creek water, the practice of tossing used "*chemical containers into the water"* (Participant 25) increased and one local reported that *"anybody using sprays, would just throw the gallons into the water… that was a bad thing in Costa Rica, they weren't disposing them right"* (Participant 32). The resulting effects of agricultural runoff that entered creeks was further compounded by the direct use of explosives in local water ways, that would together have a lasting impact on the river and its tributaries as well as on their aquatic ecosystems.

5.3.1 **Fishing and Chemical Use**

Throughout the decades from the 1960s to the1980s, explosives were regularly released into waterways, as locals' reliance on chemical use expanded into other forms of social practices such as fishing. This occurred despite the emergence of the "Wildlife Conservation Law of 1956 (revised in 1961) that declared fish and other 'wildlife' to be "part of the 'renewable natural resources of the country [and] of fundamental interest to the public" (Evans 1999:57) to preserve. As Skutch recorded:

> The practice of exploding [chemical] bombs in the river to kill the fish became more frequent, [and] the larger [fish] all but vanished. Although this wasteful method of fishing was illegal, no one seemed to respect the law. Chlorate for making the bombs and rolls of fuse for setting them off were part of the stock of many country stores (Skutch 1992:203).

While Skutch sought to prevent this behaviour on his property, "it was a futile endeavour; the poachers merely crossed to the opposite shore to set off their explosives, and the result was precisely the same—depletion of the stock" (Skutch 1992:204). These sentiments were shared by a participant who reported that the use of *"poison is very bad, if you put poison in the river at*

high altitudes then it flows down… it's terrible" (Participant 12). Despite their noticeable effects on the river's fish populations, the use of chemicals was likely compounded by what one local described as a cultural disinterest for fish species. In his words… *"sloths are charismatic; fish aren't charismatic, nobody says 'what a lovely fish', people don't feel as much sympathy for the fish"* (Participant 12).

The reduction of fish in the Río Peñas Blancas was also attributed to the emergence of commercial sugarcane production. This development also prompted the later construction of an industrial *"sugar refinery in* [the town of] *Peñas Blancas—[it's] located at the end of the corridor but it still has an impact on the species of fish that migrate, because it converts the river into a cork by creating a venomous area where many species probably die"* (Participant 12). While the river's large fish populations were soon depleted, the reduction of fish species in local creeks became even more prominent and numerous locals reported that*… "now there are far fewer fish in the river and* [they] *are virtually non-existent in the streams"* (Participant 15). Another resident noted that the nearby Río Caliente, otherwise known as Río Salitre, *"was* [once] *full of fish and shrimp, but there's almost nothing now"* (Participant 20). Despite the depletion of fish stocks in creeks and smaller tributaries, the ability to still practice fishing within the Río Peñas Blancas was described to be one aspect that made the river *"beautiful because the water is very pure and there's a lot of different fish"* (Participant 22). Having previously fished in the river *"for muchakas, machines, mojarras and barbudos further down"*, this same participant later added *"I don't really do that now, but others do"* (Participant 22).

Other participants highlighted the fact that fishing continues to be practiced despite legal restrictions prohibiting the activity; however, the use of chemicals is no longer custom. To elaborate, there are *"various types* [of fish] *that are prohibited to catch, and you can't use chemicals, dynamite, or large nets in rivers, so* [now] *what you need is a license…but nobody gets one…its formally illegal, but informally legal because the whole world does it"* (Participant 12). As confirmed by another participant, *"here everyone fishes"* (Participant 31).

This practice was observed by one Chirripó Vistas resident who noted that "*Ticos come up here on the weekends with their fishing rods and they call trout machin… they're little brook trout and Ticos will catch 10 or 11, near where there's white water bubbling. and they'll use a line and a hook, and they'll dig out a grub from the side of the river and hook it on and catch lots of machin"* (Participant 32). However, it was also noted that *"the fish they catch aren't always*

too big" (Participant 13). Notwithstanding, the sentiment that fishing was becoming less practiced was also noted by locals, and one participant stated, *"I use the river for fishing, but not too much"* (Participant 19). Another local explained that *"before, people fished more… but now technology has kids more focused on other things"* (Participant 25). As an aside, this may also be due to the increase in private fish tanks that supply several families in the corridor with protein. As one local explained, *"the* [nearby] *creek is for utility and recreation... it's useful in the sense that it leads into a small pool two to three meters wide, and in it the family stocks a variety of fish... they are a primary protein source... they are put there in May, and fed until they're harvested seven months later... but not everyone uses tanks"* (Participant 11).

While some of the river's fish populations have recovered from the earlier use of chemical bombs and extractive fishing, the region's creeks and smaller tributaries remain depleted, due in part to the introduction of plastics and other synthetic materials that became introduced from the nearby San Isidro as it developed as an urban center to service frontier peripheries.

5.3.2 **Littering and Freshwater Pollution**

As commercial farming increased throughout the region, particularly for the production of sun-tolerant coffee and sugarcane, this interrupted campesinos' once diverse cultivation of subsistence crops and prompted their increased dependence on the nearby urban center San Isidro to supplement this reduction with purchased goods. In turn, the increased demand for goods in the valley's peripheries introduced synthetic materials such as plastics into the daily lives of local residents and, as one local explained, the "*garbage* [that] *a municipality brings—all of that goes to the rivers"* (Participant 12).

Moreover, the state's absent infrastructure for managing the disposal of local wastes meant that alternative forms of disposal were practiced throughout the 1980s. In particular, the tossing and burning of garbage was common. As one local explained, *"before I was more prone to throwing garbage, but then garbage removal infrastructure entered with more personnel and we could remove garbage appropriately… before we would burn it*" (Participant 19). One local noted that now *"there's a garbage truck that comes by every Monday and you have to pay them to remove the garbage"* (Participant 18).

Despite this service, additional residents noted that not all locals have reverted from the practice of disposing their wastes in the ASBC. As one Montecarlo resident explained, *"I walk through my area every day, and every day I'm picking up garbage… in my farm just below town, I fish out plastics and water bottles from the creek… the world is full of plastics"* (Participant 5). This participant attributed these issues with the local coffee economy... *"with the coffee harvests, and from the sugar refinery, the community receives economic benefits… and people buy more in grocery stores, people buy appliances… because it's the only season of the year when they receive this money"* (Participant 5). As such, local litter was attributed to *"stores in San Isidro* [that] *give out plastic bags… the contamination needs to stop… they need to offer bags from recycled materials… here people throw garbage into the river"* (Participant 5).

Due to this practice, creeks are the most vulnerable waterways. As noted by one local, *"the creeks are dirty because they pass along the sides of the roads with waste and thrown garbage"* (Participant 23). One such creek that was commonly noted was Quebrada de los Chanchos' (i.e.: Pig Creek), to the west of the corridor. As one local explained, the creek *"has changed over the years…before, people could drink from it, bathe in its swimming holes, wash clothes in it, and use it for cooking... but now, people dump garbage in it such as dirty clothes, plastics, and litter* [and] *this has affected the creek's water quality… now I wouldn't bathe in it"* (Participant 14). Local concerns were also expressed about additional creeks, and one local reported that *"the water of La Areppa got dirty from garbage"* evident because *"the water is darker"* (Participant 23).

In addition to these water bodies, Creek Chupulum, a direct tributary of the Río Peñas Blancas, was also reported to have become contaminated. As one local described, *"people throw garbage, clothes, and old shoes in Chupulum… this is a big cause of contamination* [and] *the water is a different quality now... plastic bags and umbrellas also enter the creeks, and it's the people who live close to the creeks who do this, but it's gotten better"* (Participant 25). At the same time, increasing concerns were expressed about Ticos who live outside of the corridor who enter the ASBC to dispose of their garbage bags along the corridor's borders, in proximity to its creeks and other water sources. As one critic of this practice explained,

> *People come to throw garbage here, so they don't have to pay, but they are contaminating the area with products and jars with toxic liquids, and animals break into this and eat it… so they* [volunteer cleaners] *look through the garbage to find bills and names, and with this it's easier to confront the person… but they will deny dumping it, by*

> *claiming that someone else took out their trash, so you can also denounce them to MINAE, who regulates the environment, and they will hand out a fine* (Participant 2).

As one volunteer in local cleanups stated, "*it's annoying when you are working to clean the area and others are messing it up… because these aren't people from here, or from Quizarrá or from Montecarlo. They come from other areas to do it… these people say 'I'm not going to pay', so they get in the car and go"* (Participant 18). Despite these activities, the contamination of local waterways with the disposed waste of ASBC residents was noted to have "stabilized" (Participant 5); however, the affects of these activities continue to inform how locals interact with these water sources.

As one local explained, *"the other day my wife and I went to a swimming hole near Creek Chupulum [and] it didn't look like there was life there, the water was cloudy"* (Participant 12). Furthermore, *"the boys no longer swim there because when they do, they get skin problems"* (Participant 31). These changes to creeks have *"affected people's access to recreation"* (Participant 12). However, at the same time, new recreational areas developed along the Río Peñas Blancas after it became more accessible due to the the reduction of its flow. As one local stated, *the "Río Peñas Blancas is cleaner and colder, people try not to throw garbage in the river, but it's not the same at other creeks"* (Participant 23).

5.4 The River's Reduced Area of Recharge

As the cultivation of cash crops increased local dependence on synthetic materials within the corridor, the intensive land clearing that was required to prepare soils for crop production, in addition to the agrochemicals applied throughout crop growth cycles, had lasting impacts on the region's soils and its subsurface freshwater quantities. As one local expressed, within her land *"the quality of soil has decreased... it's less healthy and it's harder to maintain the fruits and vegetables at the house... this is due to pesticide use*" (Participant 7). One additional resident observed that *"the quality of land has decreased* [from] *agrochemicals and garbage... now coffee doesn't grow the same" (Participant 11).* In fact, the potential reduction of soil quality prompted one resident to prohibit chemical spraying on his property close to its trees, since *"that is destructive to the ground"* (Participant 5).

Concerns about soil contamination were also expressed by a local conservationist who noted that that Dr. "*Lesley Holdridge conducted studies about the capacities of land use with*

regard to groundwater levels [i.e.] *the 'Water Table'"* (Participant 33). As they further explained, *"the water table is* [situated] *below ground level, so if I dig a hole and stick a pole into the ground, where it reaches the water represents the water table"* (Participant 33). Holdridge's colleague, *"Joseph Tosi determined that if the water table is very high, then the area is very vulnerable to contaminants"* (Participant 33). As a result, the *"area close to the Río Peñas Blancas contains a higher water table* [since] *it's an area that receives lots of rain"* and therefore *"is likely a very vulnerable area"* (Participant 33).

This vulnerability also means that the water table is susceptible to diminishing the region's steady supply of freshwater due in part to the affects of frequent rainfalls on areas devoid of forests. In the previous chapter of this study it was noted that the rain that forests collect with their leaves "*filters bit by bit into the ground and further on*" (Participant 8), therefore supplying *"the ground* [with] *moisture, which then filters to the river" (Participant 33)* through groundwater springs. However, "*in comparison, when the trees are cut, the water filters down into the ground directly, or gets flushed away as surface water"* (Participant 33). As another local confirmed, *"where the trees are cleared, it's as if the water falls on cement and slides off... so where it falls and rushes, it isn't absorbed"* (Participant 8) into the ground. While some concern was expressed about groundwater contamination, the tendency of surface water to flush away was noted by numerous residents to be increasing, in part due to the drying effects of agrochemicals and crop burnings as well as the crop structures themselves that facilitate soil compaction under heavy rain falls.

To elaborate, *"different plants contribute differently to this* [soil] *compacting process—for example, coffee has roots that grow down to hold onto the soil and* [spread] *out to collect rainwater,* [meanwhile] *sugarcane's shallow roots mean that dirt compacts and hardens below"* (Participant 3). In addition, some crop production within the corridor is generated within mixed and shade growth environments while other forms of cultivation are most commonly mono-crops, demonstrating that different cultivations unevenly contribute to the hardening of soils. This was supported by another conservationist who noted that *"water tables can tire below ground… in many places where there was once lots of water escaping every year, now there's no water… this is happening here* [in Los Cusingos], *in various spots"* (Participant 1).

This process indicates that where rainwater once collected in the ground and was gradually released through springs*, "the ground* [has since] *hardened and won't allow water to*

enter as easily" and this is "lowering the aquifer's 'recharge area'" (Participant 33). By this, the participant explained that between Las Nubes and Los Cusingos, the Río Peñas Blancas passes through its recharge area... "*so what happened is that historically this in-between area had forest, and the ground maintained its spongy ability to soak in moisture, so the creeks never truly dried"* (Participant 33). However, now that farms and *"pastures have been made, the water doesn't filter, so when it rains this water rushes downhill and floods the river all at once, leaving the recharge areas with low water levels"* (Participant 33). In short, this has reduced the stable quantity of groundwater that the river had previously received, for kilometers of distance along its recharge area, thus diminishing the river's once characteristically powerful flow quantity and making it more accessible to local residents.

5.4.1 **The River and Human Migration**

As the reduction of groundwater depleted riverine tributaries, thus shrinking the Río Peñas Blancas, and the local creeks became increasingly contaminated with chemical runoff, the once formidable river became more accessible to families for recreational swimming, particularly during the dry season. With this, the Río Peñas Blancas and Río Peñas Blanquitas became increasingly visited sites for human migration, especially throughout the summer months and on holidays such as Easter, New Years and birthdays. As one participant stated, *"the Río Peñas Blancas and Río Peñas Blanquitas are important for recreation"* (Participant 20). Another participant noted, *"I mainly use* [the river] *for recreation with family and friends… it's the same with the rest of the town—a lot of people go to the river to bathe"* (Participant 19). In fact, certain locations that contain 'pozas' (i.e.: swimming holes) were noted to be especially *"popular*… [including] *near Playa Verde",* the eastern district of Santa Elena, where "*there are two main points* [see Figure 17] *where many people from Montecarlo and Santa Elena go to swim"* (Participant 19). Also, "*because everyone knows each other and permits entrance* [to their] *lands, these swimming holes are essentially public"* (Participant 19).

This participant further noted that *"throughout the week we go mainly with friends, but on Sundays is when families go, aunts, uncles, nephews, entire families"* (Participant 19). This was reported to be common practice, particularly as a form of social bonding for family members and friends. As cited, *"here in Costa Rica it's the custom to go to rivers in the summer… you see this throughout the country… people come to where there are swimming holes with water"* (Participant 19). This observation was also made by another participant closer to Chirripó Vistas

who noted that mainly on Saturdays and Sundays*, "especially in December, January and February, the road gets busy around here* [as] *Ticos come up and park and go down to the river… they have a swimming hole here* [that's kept] *clean so Ticos have access to it—it's serious recreation"* (Participant 32). This account was also shared by another participant who stated that *"before seven in the morning, you'll have truckloads of Ticos going by, mainly on summer holidays when kids are out of school… so they will pull up and park and have picnics in* [a neighbour's] *corral"* (Participant 13).

The river's importance to community youth for recreation was also emphasized. As one resident of Quizarrá noted, *"when my friends and I were teens we would go to a clearing on the edge of the road near a cliff: the spot had a 'bejuco'—like a vine but very thick—and we would come after school and swing on it over the river"* (Participant 11). However, this participant remembered observing "kids go to the river with their families more often in the 1990s during her upbringing. As she further explained,

> *Parents used to take their children to the river after work… because the majority of adults in the area depended on subsistence agriculture—food was grown mainly for the home. The farming schedule also meant that work ended around 2:00, giving parents enough time to return home and take their kids to the river.* [However] *the economy has changed and parents spend more hours working… rather than ending* [work] *in the afternoon on their farms, people often work downtown* [i.e.: in San Isidro]*... they come home later and there's less time to take kids to the river"* (Participant 11).

This was expanded upon by community youth from the School of Santa Elena, many of whom noted that they do not get to visit the river as much as they would like or as much as they did before they began attending school. In fact, the river, Los Cusingos, and Las Nubes were described to be the most valued areas of their community, despite only visiting the river once or twice a year with their families.

Given these factors, the river appeared to be most regularly visited by community elders, retired residents, and especially by those who live in close walking distance to its banks, including extranjeros—revealing both an economic and generational divide in terms of residents' uneven capacities to access the river. Of these participants, many described experiencing a healing component when visiting the river, and the feelings of calmness and relaxation were noted to be primary motivations for their regular visits. As one elder noted, *"I value the river for peace and meditation…* [for] *the sound of the river and the rain… it's like eating, you need all your senses to enjoy it"* (Participant 5). A similar opinion was shared by another long time

resident in San Francisco who would visit the Río Peñas Blancas with his partner… *"we come to the river for sightseeing, education and for tranquility, it calms us down… it's meditative"* (Participant 9). Another resident in Santa Elena noted that the river "*helps get rid of mental stress… when I have issues I go to bathe, and I come out de-stressed… I go with my children and my mother in law"* (Participant 23).

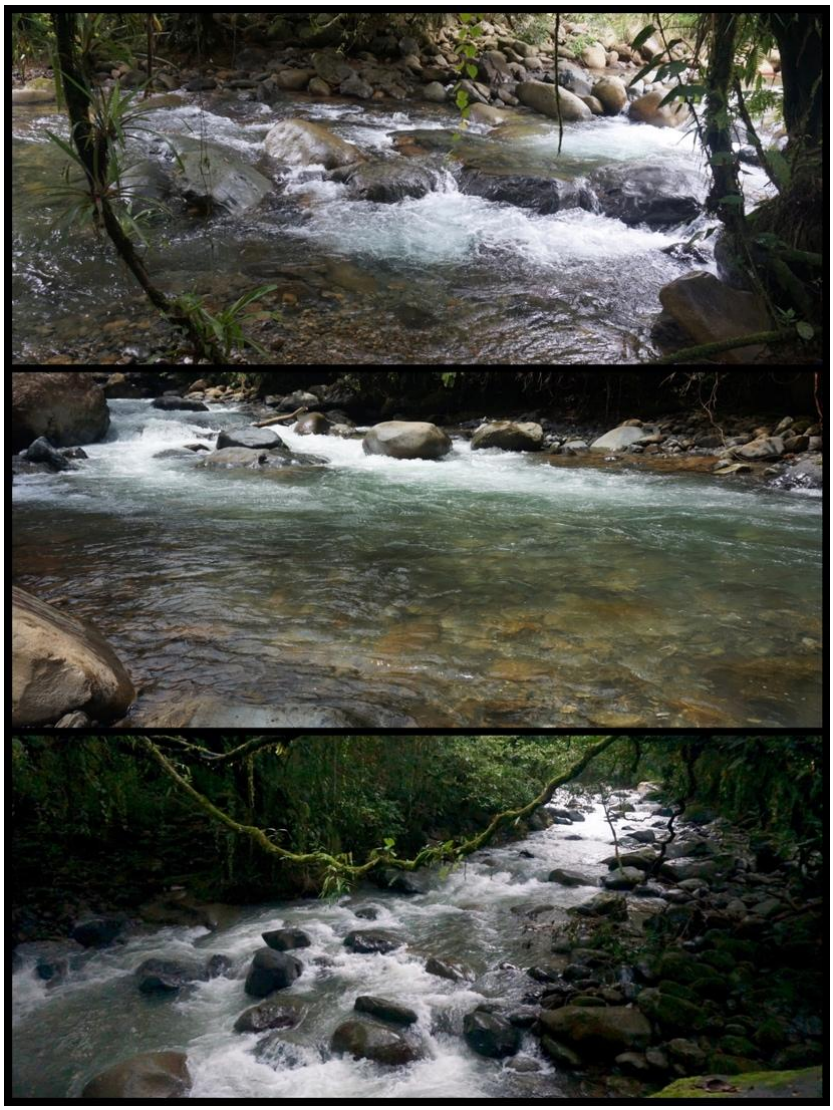

Figure 19: Recreational Spaces

(Top) Known as La Junta, this swimming hole along the Río Peñas Blanquitas is often frequented by retired locals and their families for recreation, meditation, and relaxation.

(Centre) This popular swimming hole along the Río Peñas Blancas in Playa Verde is well known among the communities, with an enclosed area ideal for young swimmers.

(Bottom) A little past Los Cusingos is a stretch of the expanded river where families go for picnics and recreation in the summer. Photos by author, 2016.

Additionally, some participants described feeling health benefits while being submerged in the river. As one Montecarlo resident explained, the river's "*water is clear and full of oxygen… it relaxes the skin and muscles*" (Participant 29). Similarly, it was explained that *"the water brings oxygen, it's lovely to feel* [its] *freshness in the dry season—it's healthy"* (Participant 25). Another resident added that her visits to the Peñas Blanquitas are important "*for exercise and to bathe"* (Participant 28). These experiences suggest that the river offers health benefits to those

who visit its flows—a direction which may provide future opportunities to researchers in terms of exploring the river through eco-health approaches. In summary, these collective reports introduce a central aspect of the river's power to act upon and *affect* the human senses, in turn impacting residents' various emotional responses towards the shifting river.

5.5 The Living River

Social and visceral experiences with the Río Peñas Blancas are generative to its meanings and appear within diverse representations that attest to its flows' agentive capacities. These capacities are sensed predominantly through the river's associated visuals and sounds that are attributed to its rapid movement. As one resident explained, "*the movement and the sound is the most relaxing part because not all rivers are like it"* (Participant 9). One participant described experiencing the river as "*serenity*" and expressed his fondness for "*going down and listening to the river, sitting on a rock and watching the river flow by"* (Participant 32). Moreover, local experiences with the river through sounds were not restrictive to the freshwater, but instead extended to additional organisms that were, in their own ways, also drawn to the *Río Peñas Blancas*. As one participant elaborated*, "when you hear the river it's just relaxing* [and] *the wildlife sounds are phenomenal… and in the rainy season when I wake up… it's just nice* [to] *come here to walk and look... at the nature, I love it"* (Participant 13). Additionally, one resident described his experiences with water sources as "*inspiring… it's the sound of relaxation with the biodiversity in and out of the river"* (Participant 1).

The river's increasing capacity to generate sounds during the rainy season was also emphasized. As one resident noted, *"when there's a lot of water, you can hear the Río Peñas Blancas very strongly… it's super beautiful* [though] *it scares me… the water falls very quickly here…* [and the] *canyon is big and steep and echoes the sound strongly… I feel proud and blessed to have this water*" (Participant 21). Another participant also attributed the river's characteristic sounds to increasing rainfall*…"in the rainy season it's really loud… this one time we had three days with seven inches of rain in a row, we woke up and it was really really loud… we love it, it's why we're here"* (Participant 13).

The sound of the river was also noted to engulf the senses when nearby, and one resident described that he enjoys "*hearing the power of the river and how it drowns out all sound"* (Participant 5). Comparatively, another resident described the feeling of being near the

river as "*the silence of the river… because it silences everything out*" (Participant 16). At times, the river was also conveyed as an animate character. As one resident explained, the river makes him feel "*more balanced… all my life I've been accustomed to hearing rain at night,* [and] *when the river is very big, it's like something living is there"* (Participant 20).

The river's capacity to grow and shape its surroundings was also emphasized, with many bends and banks having changed their shape and angles over time. As one local described, *"you can see that the river is cutting against this tree that sticks out and* [is] *wearing it away (expanding the river body)—it works away at the soil that the roots cling to, destabilizing it"* (Participant 9).

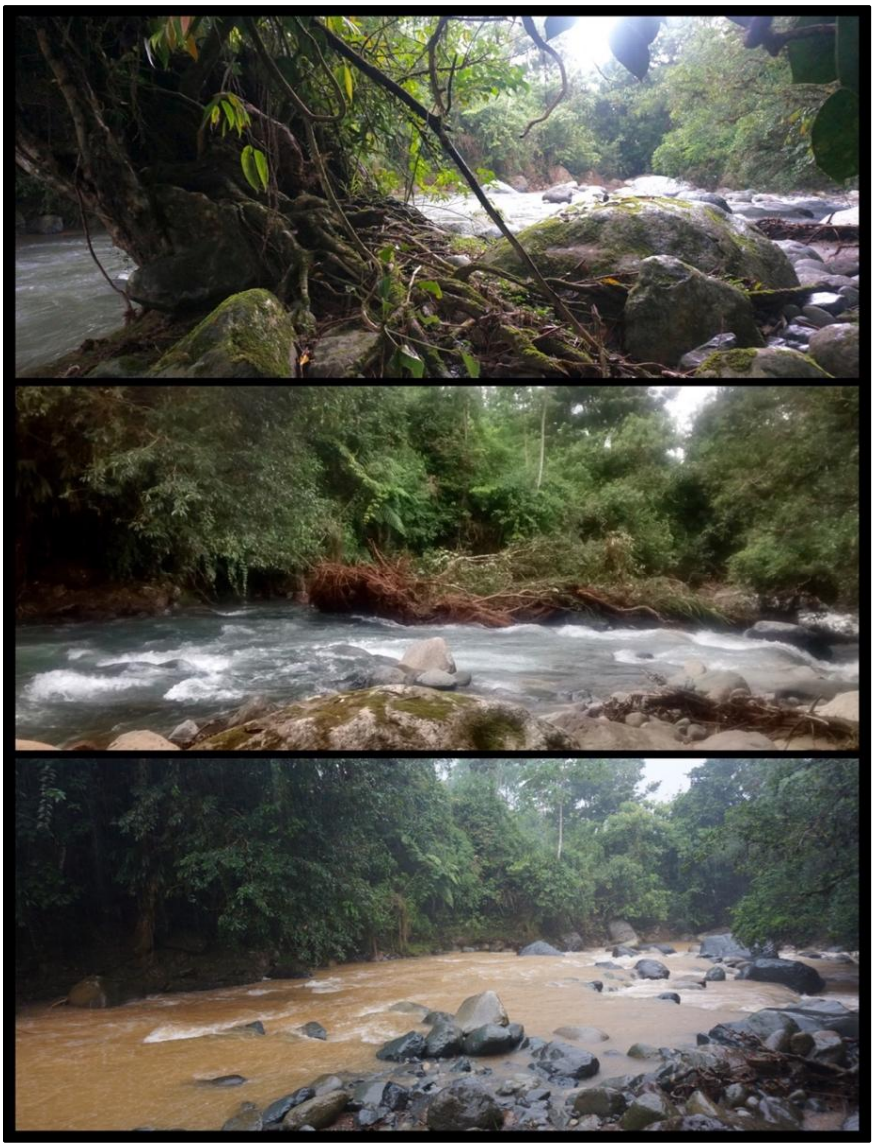

Figure 20: The River's Shifting Characteristics

(Top) This tree had remained a fixture for many years, however heavy rainstorms dislodged its roots over time.

(Centre) Within 72 hours of taking the first photo, the tree had been uprooted and was carried a short distance to the river's east bank.

(Bottom) Upon returning two months later, the tree had been washed away, and the river's colour had changed as it collected sediments. Photos by author, 2016.

On one occasion, I was invited to observe a process of change after a participant suggested that I return to his property along the river's west bank. The heavy rainstorms from the previous night had uprooted a tree that was of particular importance to this campesino, washing it downriver in a matter of days [See Figure 18]. During our previous interview he had leaned against this tree's trunk and told me *"I often stay here for hours"* (Participant 9). His laments for this loss emphasized that the river's animism is not always idealized, but can also cause aggravation and frustration and behave counter to human desires. Such challenges also occurred during particular climatic events such as *"Hurricane Caesar seven years ago, because when it rains really hard, the río makes more noise... it's water rose and even took down a bridge"* (Participant 28). The river's capacity to generate these effects were also noted to be changing, *"it's a lot more active now… it grows larger now that it rains more heavily"* (Participant 9). Such changes were frequently attributed to climate change.

5.5.1 **Climate Change and the River's Rain Patterns**

The river's capacity to destabilize elements is compounded by the increasing prevalence of heavy rainfalls. One resident described that when she was younger, *"the dry season wasn't nearly as dry, and now, it also rains more than ever"* (Participant 11). As another local noted, "*historically rainfall was more constant here... throughout our two months of dry weather, rain was still common*" (Participant 15). A member of the ASADA of Santa Elena attributed this to rising cloud formations along the mountain slope.

Figure 21: Shifting Climatic Conditions
Clouds roll in from the valley and pass above the pastures that abut the Río Peñas Blanquitas north of Montecarlo. Yet, these cloudy conditions remained only temporarily, unlike their permanence decades before. Photo by author, 2016.

As one ASADA member noted, "*when I was a small child, I remember that just above the entrance to the Las Nubes campus, it used to be very foggy... the clouds would lower here, it was only clouds, this area was full of clouds... and you couldn't even make fire because it wouldn't burn... but as people started cutting the mountains, the heat started rising, pushing the clouds* [up]" (Participant 8). Another resident added that *"current weather patterns are intensifying these issues; the clouds along the other side of the General Valley are too low for water to evaporate into rain... instead, the water is pushed into Cerro Chirripó where it rains harder than it used to"* (Participant 3). As one conservationist reported,

> *This is characteristic for a tropical country. The winds are changing with climate change, and precipitation is changing, and this is also changing the Life Zones... even in places that are seeing the same amounts of precipitation. But in earlier times, the rain fell slowly daily... now there passes numerous days without rain, then there are days when it rains super hard—the quantity of rain is essentially the same then and now, but it used to rain more slowly* (Participant 1).

In comparison to these earlier steady rainfalls, *"now the hard rains are very notorious, and around here it's become prolonged"* (Participant 5). Another local considered this evidence that *"climatic changes have been occurring: water used to rain and move gently and longer, but now it rains very hard for a short time… this leaves the soil to compact and harden"* (Participant 3). Given this, one local noted that after the mountain was *"clear-cut during past decades, there weren't trees left to capture the rainfall… instead, more water would go rushing down to the rivers with fewer things to capture it"* (Participant 8), at times, by first making their way through the river's adjoining creeks. With less forested barriers to contain the river's flow,

> *The water can escape to the sides more easily... also, the gaps created in the canopy allow rain to fall harder into this area, and its force when it meets with the creek has enough power to uproot trees. This intensifies the problem and the water seeps into other areas. Further down the creek, water often flows onto roads* (Participant 11).

In addition to collecting debris, this powerful current also wears away at rocks and sediments as it is directed by gravity, which "*change the colour of the river's water to yellow and brown"* (Participant 9). However, as a Chirripó Vista's resident explained, *"we don't see the water change colour too much up here… it collects the colour as it goes further down, down, down... and we call it Río Chocolat because it just turns brown, its soil washing off the mountain"* (Participant 32). However, especially heavy rainstorms were noted to have magnified effects, particularly when the flows from creeks and outflow converged in the riverbed to generate a phenomenon unique to elevated rivers, known by locals as the 'Cabeza de Agua.'

5.5.2 **Cabeza de Agua**

Throughout interviews, numerous locals described the river's sociality with regards to a phenomenon that many call "Cabeza de Agua" (i.e.: The Water Head). As one local explained, *"when it's raining heavily further up the mountain, sometimes a huge wave can come surging down the river, collecting and tossing rocks and earth around"* (Participant 7). This can also *"flood areas along its sides when there's a Cabeza de Agua... when it's raining, and raining and raining, the river grows a lot, and collects things like rocks from its rock beds, which can cause flooding"* (Participant 2). In addition to destabilizing *"rocks, it changes the river bends, and it can actually carry boulders downriver"* (Participant 9).

In fact, the river's sound—as it makes contact with boulders and unstable rocks during this phenomenon—was also emphasized by extranjeros who were not accustomed to using the name, Cabeza de Agua; but who instead named the river's habit of moving boulders "the tumble". This is because when the wave comes, *"something makes you look up, the rocks go tumbling"* (Participant 35). It was noted by another local that the sounds that this process generates *"can be heard from the house!"* (Participant 9) several yards away.

The Cabeza de Agua was regarded with caution among locals, with some residents interpreting the river's material changes as signals to determine its safety. For one local, the river's changing colour was a sign not to swim, since *"when it rains the water gets dirty and it's dangerous to enter because the river rises and it can take somebody"* (Participant 24). Another local mentioned that he enjoys watching the Cabeza de Agua, but with constant vigilance and *"from the sidelines where it's safe"* (Participant 16). As one local reported, she used to go to the river more often but *"can't right now* [during the rainy season] *because of the Cabeza de Agua"* (Participant 23), despite never having encountered one.

Some locals also emphasized the danger of this phenomenon by recounting stories of Cabeza de Aguas elsewhere and their ability to take life. In fact, one such phenomenon occurred (with national news coverage) during my research for this paper and was highlighted by study participants as a demonstration of the river's force. As one participant explained, "*In Guanacaste yesterday, a Salvadoran family was swept away by a Cabeza de Agua and they passed away"* (Participant 16). Meanwhile, another local shared stories of a Cabeza de Agua killing tourists in Liberia (Participant 22) earlier the same year. Such concerns about the river's force, coupled with the erratic spurts of heavy rainfall, have now provoked caution among locals

as well as provide an ongoing narrative regarding environmental change and resultant sporadic events.

While certain climatic conditions such as heavy rainfall and discolouration of the water offer indications for potential flash floods, because of the possible danger of a Cabeza de Agua, some locals avoid swimming in the Río Peñas Blancas throughout the rainy season. Given this, recreation tends to occur more during dry months thus supporting the notion that the river can affect social activities and behaviors within the corridor. This idea is supported by academics who have explored oral traditions with respect to other freshwater bodies including glaciers. For example, Cruikshank argues that "we need to enlarge spaces for local knowledge by taking into account those generative sources of meaning that make no sharp separation between changing biophysical worlds and changing social worlds" (Cruikshank 2005:257). Moreover, "despite our best efforts since the Enlightenment to convince ourselves that modernity enables us to firmly distinguish nature from culture, [Bruno Latour, among other theorists] insist, we have never accomplished this feat" (Ibid).

As an example, within ethnographic research about diversion dams in Queensland, Strang explores the "concept of 'living water'[... that] manifest[s] in multiple animistic ideas about the environment" (Strang 2013:162). Strang further notes that animistic understandings of water "flow readily across cultur[es] and appear in diverse… traditions as the essence of spirit and sociality" (Ibid). Following this, local understandings of the river's powerful, and at times disruptive, capacities reveal "water['s] formative role in[...] promoting ideas, such as those about living water, that draw imaginatively on [its] perceived qualities" (Strang 2013:163). Moreover, "these animisms of 'living water'" reveal the material environment and its processes to have agentive forces "that happen without human intervention and also happen *to* humans" (Strang 2013:164).

These agentive forces, and their impacts on the human senses, generate meanings that inform appropriate hydro-social relations. Yet, it is these same relations that are obscured in current legal standards that envision the river to be bounded, measureable, and thus knowable to the realms of economics and politics. What appears to be vital is the inclusion of local knowledge and everyday experiences with the river in order to develop a more holistic understanding of its social reality as a force that confounds human understanding. This observation points to a possible area for improvement within current EIS policies which currently

both omit the variability of riverine flows and exclude alternative and local ways of *knowing* the river by neglecting to include a specific category for exploring the river's socio-cultural dimensions within local communities. As such, place based accounts of the river are both warranted in terms of 'knowing' the river as well as essential should the forms of sociality that contribute to the river's flows, as well as the flows themselves, continue to occur.

5.6 Conclusions

Throughout the 20th and 21st centuries, local towns have emerged and expanded in proximity to the Río Peñas Blancas, prompting community residents to be continuously susceptible to the river's shifting qualities. Residents reveal that these embodied experiences with the river's flows are contributive to its meanings and values among local community members. The absence of including these meanings and values became especially evident during the dam dispute when the river's commercial value was emphasized and assigned legal precedence by the state. This generated a hegemonic politics that excluded the knowledge of those who were most aware of the implications of interfering with the river's capacity to produce social affects through 'flow'. Without including the voice of those most vulnerable to the consequences of rapid anthropogenic change to the river, future planning could continue to lack an important element: local embodied knowledges. With this, I will explore several primary concerns among locals with respect to the dam disputes to make comparative values and knowledges of the river more explicit.

In 2013, the hydropower company Hidroeléctrica Buenos Aires was legally required to purchase sufficient property in which to develop PHPB I and II. However, this effort met local resistance that thus revealed a central difference in community versus company values of the river. As one local emphasized, *"the company representatives tried to enter the region and walk along the riverbank to take* [its] *measurements during the early stages of development... but people from the community came out and restricted their movement"* (Participant 16). For some properties, *"a fence was used to keep out hydropower dam agents who* [had previously] *trespassed"* (Participant 16). This participant further noted that *"a few months later, company representatives came to try to offer me a* [real estate] *contract—I crumpled it up and they started accusing me of not understanding the river's value"* (Participant 16). This reveals the gulf between the company and some local's evaluations of the river. As noted by one local resident, *"without water, there is no life. It has a very very high value… I would not exchange the water*

for all the money in the world" (Participant 21). This common understanding became clear through additional interviews that revealed the company's attempts to acquire property rights from locals.

During the project's initial stages, the company began *"looking for land to purchase because they need land close to the river to construct there, and they would offer a lot of money… so they talked to people… and some did make a deal, but the majority didn't permit them to continue with the project*" (Participant 11). As another local resident confirmed, *"landowners up-river refused to sell their land* [despite] *the extremely high prices offered by the hydropower companies"* (Participant 2).

This local opposition to land sales revealed that the river was largely regarded as a shared resource; meaning that the potential issues that would be generated by the dams represented a collective concern, especially for those downriver. Evidently, the company's attempts prompted a sense of communal responsibility for the river's flow among those who depend on it. As one local elaborated, *"those with lands that adjoin the river have the capacity to use water in a way that affects how people can access water downstream... in this way, hydropower companies try to access a certain point to divert water from that section… this means that those downriver lose their ability to access what was once a central water source"* (Participant 2).

Notwithstanding this concern, not everyone refused the company's offer. To clarify, one local stated that this was because *"some people don't know the true value of things... the company went after campesinos within the area and offered them a great price for land... so some people did sell their land to make some income... the peoples' need for this income is why the company picks these places"* (Participant 11). While local refusals to sell land was an initial strategy to halt dam development, concerns about the company's monetary resources was also expressed by some residents who characterized the company's purchase of land for high prices to be a form of bribery: a company tactic to ensure local support. This was reportedly due to bribery being a prevalent strategy elsewhere, in which *"some people come to an area and say 'here's 1,000 dollars... that pays for your silence... because this still happens to people"* (Participant 3). However, with an insufficient quantity of land purchased for project development, and with few locals willing to sell property to the company, agents began looking further north to access the river closer to Chirripó Vistas.

As one resident explained, *"the guys canvassed houses, and were knocking on doors to ask if they could go across people's lands, and our neighbour talked to them and said they need to go to the property homeowner's association of Vistas de Chirripó... but they didn't... even if they offered each of us half a million dollars, it's not happening... we wouldn't give up our land for that, and the university will never let it happen on the other side of Las Nubes*" (Participant 32). Yet, four properties (titled PB1-13, PB1-14, PB1-15, and PB1-16) composing a total of 318.74 hectares were acquired from local residents. The company plans to use this land as the primary site for dam construction (Hidroeléctrica Buenos Aires 2013:8).

Another important local concern revolved around the company's conflict of interest in terms of generating the actual data reported in the EIS. Specifically, given that data for the proposal to build the dams was actually collected by the company, locals expressed concern that only some of the potential consequences of construction were included. As one local emphasized,

> *The problem with the study is it's for the convenience of the company: SETENA accepts the study that the company provides... SETENA* [approves] *the company's presentation, and because of this the company can easily manipulate data by presenting that they informed the community, they can give a list of participants at informative meetings or interviews to* [show] *that locals supported it or not... then they give the data to SETENA and show how they performed the study, which is easy to manipulate. they look for people to favour them—and pay someone from the* [community's] *development association with favour in the community to gain votes for the dam* (Participant 26).

In short, the company's strategy of 'purchasing' access rights to the river reinforces the river's valuation as only a marketable good—a perspective which predominates within state regulations. According to Linton, these "ways of imagining, representing, and materializing water might be considered hegemonic when alternative kinds of water" knowledges, such as those of marginalized peoples, "are made out to be less legitimate, or when they are so overshadowed that they become invisible" (Linton 2010:11). Yet this invisibility is framed within the categorical organization of the EIS document, in which the definition of the river's socio-economic dimensions, ignores and thus denies the knowledges that do not adhere to this strict categorical structure. As demonstrated, one such omission is the river's tendency to change its flow quantity, and the extent to which such change occurs.

Notwithstanding this important omission, within the EIS the company justified the projects by presenting the dams to be compatible with the region's hydrological regime. To elaborate, the company acknowledged that due to the "the mountainous barrier of the Cordillera de Talamanca to the north, and its oceanic influence", the region receives a rainfall regime that greatly contrasts with the rest of the country. However, the EIS presented this seasonal heterogeneity to be favourable to dam development, by stating that "the dry period is very favorable and short, with a humid tropical climate and rainfall all year round" Hidroeléctrica Buenos Aires 2013:35). However, this data was based on annual measurements of rainfall taken from one particular station that was located outside of the study region (Ibid). In short, the company's accounts of the river's flow characteristics were inadequate given that the data collected demonstrated a stable measurement of rainfall. Thus, what was presented as favourable by the company was regarded as a central concern by community members.

For locals, the prospective generation of hydropower energy during the dry moths was not only objectionable, but implausible. As one local explained,

> *Dams can't be constructed on rivers like this, because these rivers are small and in the summer they don't produce much… so, for example, with Diquis the river is enormous, so especially in the summer it offers lots of water and it benefits the country. But these rivers are small, so the energy they produce doesn't make much of a difference, because electricity is needed in the summer and these rivers won't produce much. So it should not be permitted for dams to be constructed along this type of river* (Participant 11).

In addition to these issues, the downstream effects of dams were also a key concern, with one local stating that the EIS *"said that the dam wouldn't affect communities downriver... but it would fully remove its flow—especially in the summer dry season*" (Participant 7). Similarly, the effects of climate change were entirely omitted from the EIS document, despite local evidence that substantial reductions to the river's flow have occurred throughout the past decades due to the combined effects of anthropogenic behaviour and climatic variability.

To explain, the Río Peñas Blancas is a mobile flow resource, meaning that impacts to a river are not restricted to a single location. Yet, the EIS treats the river as a static and contained resource and states that the use of land in preparation for a dam—such as deforestation—would not cause harm downstream. However, local accounts reveal that even the removal of tree cover in one region can have exponential effects to the ecology further below, such as groundwater levels, especially when considering the effects of downstream flow cycles. As Luffman emphasizes, the constant flow of water rapidly cycles elements, nutrients and bacteria

downstream. In contrast, the water contained in a reservoir “simply sits[...] immobile and bathed in sun”, and can cause the water to become “depleted of the oxygen restored by the motion of the forest” (2014:39). At the same time, a reservoir’s water “heats to a higher temperature” prompting the “bottom of a reservoir [to] become deprived of oxygen” (Luffman 2014:39). This reveals that when released, the quality of a reservoir’s water is reduced significantly, and can compound ecological crises further downstream. In fact, these affects are not restricted to the river’s banks, since its flows extend into the bodies of proximate flora and fauna. Should the reduced quality of water be unable to sustain organic bodies downriver, participants stated that this could potentially reduce the ecological capacities to recharge the river’s flows.

Altogether, this evidence points to the importance of taking into consideration the potential scenarios of future climate change within EIS standards. This could be accomplished by measuring a river’s level of resilience by taking into consideration the various components that generate a river’s flow as well as by producing a record of how current uses of water are affecting its availability. However, this would require a radical (albeit necessary) shift of perspective which, specifically in the case of the Río Peñas Blancas, would thus result in a more holistic characterization of the river as unbounded, fluid and constantly mobile that maintains, and is maintained by, the elements which it encounters.

Following this logic, future studies of potential impacts cannot be restricted to the limited segment of river along which a dam is proposed to be built. Rather, environmental impact studies should be conducted along the entire river as well as adjoining tributaries and the larger water bodies into which the river flows. Moreover, EIS standards should extend legal concerns to the conditions of the forests which supply the river with its water, as well as environmental impacts to these forests should a river be redirected away from local flora. Moreover, the cumulative effects of multiple dams along a single riverine system must be properly researched, a requirement which still remains absent from EIS standards (Anderson et al. 2008:409).

Yet, currently policy standards operate by at times reducing a river’s freshwater to the scientific abstraction of H2O (Linton 2010). To elaborate, the material capacities of water are generally attributed to the “dynamic chemical changes that underlie biological and ecosystem flows” (Strang 2013:162). However, Linton argues that this chemical abstraction does “not constitute the fundamental reality of water” (2010:4); but, instead represents the socio-political processes by which scientific knowledge is produced and represented. This points to the need

to extend legal authority to include alternative and local ways of knowing water and valuing ecosystem changes, in order to satisfy Article 50 of the constitution, which promises to provide and ensure to all of its citizens the right to a "healthy and ecologically balanced environment" (Lindo 2006:301).

As applied to the Rio Peñas Blancas project, local accounts reveal that the river's flow is something interactive, in constant change, and beyond human measurement. Yet, while such visions of water's animism appear to be tempered in the discourse of modern industrial societies, since "the reductive process of commodifying water may seem to exclude a view of it as a 'living kind[...] these meanings persist in concepts of wealth, generative power and economic vitality" (Strang 2013:162). In short, despite the river's animism being repressed in industrial discourse, Strang emphasizes that there remains "a subtext about protecting life and generative capacities through the control of water" (Ibid).

Within the following chapter, I will explore how these life giving capacities have in turn generated the region's socio-economic dynamics, while at the same time how notions of water quality through measurements of the river's 'purity' are informing new systems of freshwater management within the ASBC. Extending from this, I will consider dominant political and economic discourses with respect to freshwater and rivers, and how they inform hydro-social relations within the ASBC and throughout the country.

6 The Río Peñas Blancas' Political-Economic Dimensions

6.1 Freshwater as Political-Economic

Freshwater provides many un-substitutable biological and social needs, revealing that its control and management are matters of common concern that are "implicated in contested relationships of power and authority" (Bakker 2012:616). As a result, the management of freshwater is intimately connected to political and social power, because its control can facilitate the "intensification of social domination" (Chen et al. 2013:6). However, a community's restricted access to this resource is not always the result of external powers imposing dominion over their occupied territories, nor have such freshwater disputes been restricted to historical events of heightened social control. Rather, one needs only to look within any contemporary state-system to observe how the control of water is experienced differently between social bodies and actors. These uneven power dynamics reveal how water distribution generally reflects deeply embedded social inequalities. At the same time, inequitable allocations of potable freshwater (in terms of quality and quantity) often implies the prioritization of certain state objectives above others and reveals the complex dynamic between issues of social justice and economic development (Orlove and Caton 2010).

In part, this is due to the fact that freshwater, while biologically and culturally essential, is also indispensable to economic development since it facilitates industrialization and urbanization (Bakker 2003:40). Specifically, freshwater's capacities are utilized both directly and indirectly for the production of agriculture, livestock, oil, energy, products, raw materials, plastics, and to sustain the labouring human bodies that are essential for capital production. In short, this reveals that the biological consumption of potable freshwater is necessary to ensure the productive capacities of a nation's labour force. With this, water regulations first emerged as Costa Rica began to adhere to a "distinct form of power" that developed throughout the twentieth century, which theorists refer to as 'governmentality'.

To elaborate, this governmentalized model involved the "emergence of the modern state, the political figure of 'population,' and the constitution of the economy as a specific domain of reality" (Nilsson and Wallenstein 2013:38). In accordance with this, the Costa Rican Executive Decrees No.33850 and No.30043-S declare that "the state has the responsibility to guarantee the well-being of the citizens, without impeding unnecessarily the conditions of

competitiveness for the development of the country" (Executive Decree No. 33850 and No.30043-S). With this in mind, Costa Rica's shift towards industrial modernization demanded that the maintenance of their workers' health would require the application of regulations and management procedures that consider the bodies of its subjects, and the water that these bodies consume, to be under state regulation.

6.1.1 **Freshwater and Biopower**

First referenced in Michel Foucault's History of Sexuality, the state's regulatory expansion into the body, termed 'biopower', reveals that sovereign models of social control transformed throughout modernity as they moved away "from the right to *take* life or *let* live" (1978:138)—and shifted instead towards the right to, *make* life and *let* die. To elaborate, Foucault postulates that in classical governance sovereign powers, later restricted to sovereign rulers, had the right to sanction the life or death of its domestic threats and foreign rivals (Foucault 1978:135; Rabinow and Rose 2006:196). However, this "power over life evolved" (Foucault 1978:139) starting in the seventeenth century, when "the disciplines of the body and the regulations of the population" (Ibid) became the priority of many institutional actors and disciplines that formally deployed "numerous and diverse [biopolitical] techniques" (Foucault 1978:140) to calculatedly manage their subjects' lives. In short, this new paradigm saw "life and politics combined to form a 'biopolitics'" (Nilsson and Wallenstein 2013:73-74).

Biopower's highest function is therefore two-fold: to center the body as an 'anatomo-political machine', to be managed and disciplined in ways that optimize the human's production capacities in society as well as their docility and integration into the economy (Foucault 1978:139); and, the "regulatory control [of] the population focusing on the species body" (Rabinow and Rose 2006:196) and its mechanics of life; including the biological processes of "propagation, births and mortality, the level of health, life expectancy and longevity, with all the conditions that can cause these to vary" (Foucault 1978:139). Following this, the management of freshwater became one of the primary issues of biopolitical concern, prompting "the experience of modernity [to be] intimately and viscerally associated with water" (Bakker 2012:617). In adherence to this, the management of its freshwater supplies became a state priority, and prompted the formation of the country's earliest water laws.

6.1.2 **Costa Rica's 'State Hydraulic' Water Laws**

In Costa Rica, legal emphasis relating to freshwater management "began when [the country] became an independent republic" (Cover-Ruiz et al. 2009:3) from Spain in 1821. Following this independence, liberal minded "legislators became concerned with passing a national water plan and national water law" (Ibid) that would efficiently regulate and manage water resources that were needed to sustain the country's primarily agricultural economy. This legal direction was achieved in May, 1884 with the emergence of Water Law N° 11, issued to "establish water as a public domain"[58] under municipal control and to provide an "order of preference" (Ibid) for the use of the nation's water resources. In accordance with this order, the supply of water to the population was noted to be of primary importance[59] (Alpizar Rodriguez 2014:59).

Expanding upon this water law of 1884 were "Articles 89 and 90 [which] ruled that the waters that flowed through public lands could be used by the public to drink, wash clothes, clean vessels or any objects, and provide water for horses and cattle" (Alpizar Rodriguez 2014:58). Furthermore, "the description of water as a public domain" (Cover-Ruiz et al. 2009:3) was reinforced with the establishment of the 1942 Water Law, currently still in effect as "the national water law of Costa Rica" (Ibid).

These customary water laws subscribed to what Bakker (2003) refers to as the "state hydraulic" (37) mode of water regulation, that remained the dominant model used in Costa Rica throughout much of the twentieth century. This model, which can be characterized by "near complete public control of water resources development" (Bakker 2003:40), conceived of drinking water as a 'public good' and observed "water management and investment in the water sector [to be] mechanisms of social legitimization [and modernization] of the state, while playing a supportive role in capital accumulation" (Bakker 2003:41). In short, this customary law envisions freshwater to be accessible to the 'collective commons' by "prohibit[ing] private ownership of water resources" (Kuzdas et al. 2014:206). This 'collective commons' ideology became embedded in the social philosophy of many freshwater users, including local residents along the Río Peñas Blancas.

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[58] This law outlined distinctions between different water sources, and declared the maritime zones, rivers, streams, springs and the rainfall that flows through channels and/ or public lands to be public domain (Alpizar Rodriguez 2014:57).

[59] The remaining order was noted to be: 2. the refining of railways 3. Irrigation, 4. use for navigation channels, 5. for benefits to coffee, mills and other factories, passing boats and floating bridges 6. for ponds, nurseries, or fish farms" (Alpizar Rodriguez 2014:59).

However, disputes are becoming acute within the region in response to a significant transformation to water management systems as they gradually shift from a 'state hydraulic' to what Bakker refers to as a "'market conservation' mode of water regulation" (Bakker 2003:37). At the same time, as biopolitical techniques have become enforced within the region, their incorporation of new technologies and scientific measurements in local freshwater management are imposing new logics of health and hygiene that at times confirm or contradict local place-based understandings of water purity. These aspects of freshwater are elaborated upon in the following chapter which explores the river's political-economic dimensions in order to consider how the Río Peñas Blancas has mediated, and has contributed to, shifting freshwater management approaches in the ASBC, most recently in relation to the PH Peñas Blanquitas I and II dam projects.

6.2 The Early Export Market

Throughout the early decades of the 20th century, the closure of European markets in correlation with the First World War prompted "Costa Rica[s] model of economic growth [to be] based on agro-export" (Villanueva and Arias 2010:20) with the United States representing the nation's primary buyer[60]. Of particular importance to national stability was the country's coffee export economy, with the market "reaching its peak between 1926 and 1927" (Ibid). In accordance with this model, the government "decided on a series of structural changes in pursuit of greater industrialization and non-agricultural export diversification" (Ibid). However, this model changed after the Great Depression, when "Costa Rica experienced a severe drop in revenues" (Ortiz Imalch 2014:25) due to the reduced demand for its primary exports.

With the collapse of the New York Stock Exchange on Wall Street in October 1929, the prices of goods fell as "supplies exceeded demand and the excessive [urgency for] credit [as well as] rising interest rates, rais[ed] the costs of goods and reduced international demand for [luxury] dessert products like Costa Rican-coffee, bananas, sugar cane and cocoa" (Villanueva and Arias 2010:20). Due to this, the Costa Rican government "decided on a series of structural changes" (Ibid) with the establishment of a new agro-export model that promoted diversification. However, a prerequisite for such exports was the expanded production and transportation of goods to the international market.

[60] In 1920, the United States reportedly accounted for 71 percent of Costa Rican export production (Villanueva and Arias 2010:20).

With the support of extensive loans from multinational lending institutions, the Costa Rican government facilitated new industrial initiatives such as the construction of the InterAmerican Highway. As noted in Chapter 5, this highway development led to accelerated colonization (Villanueva and Arias 2010:5; MINAET 2012:30) into the General Valley and its peripheries[61] in the south-Pacific region of the country. This development occurred in a push to expand the production of coffee, vegetables, pasture, and sugarcane primarily (Villanueva and Arias 2010:24-26), as well as to produce "crops for domestic consumption, [and] for the domestic market" (Villanueva and Arias 2010:26).

6.2.1 **The River and Frontier Expansion**

The construction of the InterAmerican Highway that connected the capital, San José, to the General Valley (which was completed in 1946) occurred to promote the colonization of new areas, an objective that was further promoted through government incentives and services to make unsettled peripheries more attractive to campesino populations. With this, Villanueva and Arias reveal that expansion into the Cordillera de Talamanca was facilitated by legislation, policies, and programs that became one of the hallmarks of the country's liberal era (2010:6-7).

To elaborate, during the highway's construction in the 1940s, President "Calderón-Guardia's administration launched a historical social reform that gave birth to the Costa Rican Welfare State" (Ortiz Imalch 2014:26), thus initiating a liberal era that would last a total of four decades. Concretely, this process involved infrastructural and services developments from the: Ministry of Busses and Public Transport (MOPT), Colonization and Land Law (ITCO), Ministry of Public Education (MEP), Ministry of Public Security (MSP), Ministry of Agriculture and Livestock (MAG), National Production Council (CNP) and Nationalized banking system that together consolidated frontier expansion and the formation of additional towns, including Santa Elena (MINAET 2012:30) and Quizarrá. However, beginning in the 1950s the country's population experienced accelerated growth, prompting the additional flux of many agrarian families from the Central Valley to its peripheries (Ibid).

Following the region's bourgeoning corporate and community structures, incoming settlers were pressured to colonize the forests that were above 800 metres to "plant coffee, vegetables, sugarcane, various tubers [and to clear] new pastures" (Ibid). With regard to the

[61] According to MINAET and SINAC, early settlement of the region generally occurred on the lower elevations (around 800 MASL) with little initial access to the higher forested areas of the mountain (MINAET 2012:30).

latter, locals described the region's available freshwater sources as a primary reason for the settlement of some incoming families. As one participant explained, *"there's a phrase that our elders used: a farm without a river isn't worth anything… because if you buy a property, it's often for cows and the cows need water… so when people first entered this area, they settled in proximity to water*" (Participant 9).

As an example, one participant recounted that his father moved to the region in 1951 with his parents and siblings. The participant's grandfather, who intended to purchase land, had initially *"looked elsewhere but conditions were too dry"* (Participant 15), so he purchased a tract of property along the western bank of the Río Peñas Blancas, whose *"water caused this development"* (Participant 15). At this time, the son explained, *"just a bit of pasture existed for cows and sugarcane, so my father and brother planted coffee, sugarcane and agriculture and cut more pasture to maintain 14 cows"* (participant 16). This cleared property, which was located in eastern Santa Elena a few kilometres north of Los Cusingos, was soon joined by additional campesinos. Thus, concurrent with the era's freshwater policies, the river became essential for supporting additional cattle herds. As this campesino participant added, these *"animals sometimes died and fell in rivers but* [this] *didn't hurt people much"* (Participant 16) since they would be quickly swept away, thus causing little concern for contamination.

In addition to supporting the region's early livestock, the Río Peñas Blancas also contributed to the development of export agriculture throughout the period of the green revolution. As explored in the previous chapters, the river collects its flows from various sources, including springs, creeks, and rainfall, revealing that the river cannot be distinguished from the elements that also compose it. With this, deforestation along the river's banks incorporated new flora and organic matter into the river's hydrological cycle, by prompting the redirection of rainfall that would otherwise supply local forests and their co-dependent freshwater tributaries (many of which feed the river). Instead, immeasurable quantities of the region's rainfall were redirected into local crops. As local residents explained, *"most crops rely on rainwater"* (Participant 2). With the resultant produce destined for the international market (primarily coffee and sugarcane), the flows of the Río Peñas Blancas expanded both nationally and internationally through an export economy that accounted for the river's early market value. This was further facilitated with the region's burgeoning commercial sugarcane farms and the entrance of the coffee cooperative, CoopeAgri.

However, while regional flows contributed to the relatively modest capital accumulation of local families, additional sources of freshwater were required to maintain the campesino populations that were contributing to the country's export market.

6.2.2 **The Installations of Regional Aqueducts**

As both Sojo and Cerdas Cruz suggest, between the late 1940s and mid 1970s under the presidencies of both Figueres and Francisco Orlich, the government was "committed to economic development and saw the transition to [state directed] industrialization and modernization as central to successful development programs" (Isla 2015:36).

As a result, Costa Rica was profiting from state initiatives that were "advised and promoted by the United Nation's Economic Commission for Latin America and the Caribbean (ECLAC)" with the aims to make Costa Rica more economically independent and "integrate Latin American economies more closely" (Isla 2015:36). To accomplish this, additional public infrastructure was required, and modernization projects soon became "financed by local institutions and external creditors such as the World Bank (WB) and the International Development Bank" (Garcia Sanchez 2012:7).

During the country's Welfare era, particularly in 1961, new autonomous institutions emerged including the National Aqueduct and Sewer Service, which promptly began to "undert[ake] the enormous task of building aqueducts and sewers" (Alpízar Rodríguez 2014:77; Dobbins 2013:37) to service the country's growing population. Specifically, in 1966 the Rural Aqueducts Program was initiated and communities formed part of the Administrative Boards of Aqueducts in Rural Areas to build and help manage this infrastructure (Alpízar Rodríguez 2014:79). In 1968, this effort extended to the peripheries of the General Valley when, according to Skutch, the first "community water system was installed [in] Quizarrá and Santa Elena" (1992:336). This was achieved with financial aid from "the International Development Bank, the United Nations, and the Costa Rican government," (Ibid) with labour provided by the emergent National Service of Aqueducts and Drains (AYA).

As Skutch described, by "laying two hundred yards of pipe, we connected with the pipeline that runs along the road beside our farm and brought to our house pure water from a spring more than three miles above us in the mountains" (Ibid). A local aqueduct member of

Santa Elena further elaborated that *"this aqueduct is very old… and at that time, AYA depended on one watertank high up to supply the small community… but later, control of the aqueduct chaged hands from the state to the community"* (Participant 8; Participant 6). This occurred during a time of economic challenges, *"when AYA didn't have funds for infrastructural needs or repairs, so power was given to the community so they could manage their funds and improve their water system"* (Participant 8). Yet, the development of additional aqueduct infrastructure was halted after the values of local agricultural products plummeted and the community, as well as the entire country, entered an economic crisis in the 1980s.

6.3 Economic Instability and the Local Agro-Economy

Costa Rica's economy entered an era of instability in 1981, during which small credit loans became "directed to thousands of peasant families living on small farms" (Isla 2015:42) throughout the country. To pay off national debts, IMF and World Bank stabilization policies demanded the intensification of production through the increased "application of agrochemicals which increased production costs" (Ibid) for campesinos, in addition to fouling local creeks. As one campesino participant explained, *"for agricultural countries… when negotiating with importers like the United States, there are usually requirements that producers must also use agrochemicals purchased from powerful countries… you have to have these contracts, and include these costs, and not have many regulations… you need to use money in a certain way"* (Participant 3). This type of negotiation is critized for being favourable to powerful importers that retain "control over production [despite their] indirect ownership" (Grundy 2014:37).

However, as Isla explains, these additional production costs were not subsidized by the government, ensuring that loans for campesinos demanded repayment "with revenue from subsequent harvests", and therefore making campesinos "more dependent on the politics of international agriculture" (Isla 2015:42). In short, *"agro-export changed industrial activities… the state does not offer help to small farmers"* (Participant 3). This made local, small-scale producers even more susceptible to international fluctuations in cost and demand for local produce—a vulnerability that heavily impacted the region's farmers.

At the same time as the country suffered an economic crisis, the global prices of coffee fell dramatically adding economic pressure to many of the country's indebted campesinos. In order to cope with these economic challenges, numerous residents within the corridor (primarily

young adults), left for the United States throughout the 1980s and 1990s and found work as illegal migrants in New Jersey, U.S.A. As a result, this created a migrant support network between these two regions (i.e.: New Jersey and the corridor).

As Ortiz Imalch (2014) confirms, many of these migrants transferred income that they saved in the United States to "their families at home in Costa Rica" (81), thereby retaining ownership of the agricultural lands to which many would eventually return during the following decade to establish their homes and maintain additional farms [62]. However, while migrant work supplemented some of the losses of local small-scale producers, the emergence of crop infestations in the 1980s continues to affect the quality and value of local coffee harvests up to the present day.

6.3.1 **Roya, Broca, and Coffee Instability**

According to Grundy, in the 1980s Costa Rica experienced its first outbreaks of rust fungus, or 'roya', a "pathogen caused by the [parasitic] fungus *Hemileia vastatrix*, [that] bind[s...] to a live host" to survive off the plant's "energy and nutrients" (2014:30). To elaborate, roya is "host-specific, meaning that it needs a specific type of plant in order to survive" (Grundy 2014:31) such as the regionally prevalent *Coffea arabica*. This disease caused sun-grown coffee crops with common genetic traits to be especially susceptible to roya, given the limited quantity of additional crops to "intercept or interfere with [its transfer between] coffee plants" (Grundy 2014:34) in mono-crop fields.

Figure 22: The Spread of Roya

A campesino lifts a coffee leaf to the light to reveal the spread of roya. Photo by author, 2016.

[62] It should be noted that during informal conversations, several locals noted their hopes to return to New Jersey to continue working, however this economic strategy may prove increasingly difficult under the current political climate surrounding illegal immigration to the United States.

As Grundy explains, the fungus first colonizes coffee leaves through their stomata, taking form “as a yellow ‘dust’ on the underside of leaves” (2014:31) before transforming to a shade of rusty orange [see Figure 22]. As one local explained, *“this rust disease… it takes all the leaves off so the plant can’t produce”* (Participant 13). To combat the infections of roya, campesinos within the region have continued to apply increasing quantities of agrochemicals on coffee crops, with one campesino reporting that *“pesticides are sprayed approximately five times a year however the plants are developing resistance and more spray is needed each time to produce the same effect”* (Participant 3). As another campesino confirmed, “*chemical use is necessary, we’re also replacing the veranillo coffee that is more susceptible to infestations”* (Participant 6).

In addition to roya, a small type of coffee beetle called 'broca'—that enters and ruins the coffee bean—was also noted to be affecting local harvests. As one resident noted, *“broca is a recent problem... before, the issues with infestations were all combated with pesticides, some of which are prohibited pesticides... though now there are systems for broca... they now have traps with pheromones that are attracting it”* (Participant 12). However, not all farmers have opted for this alternative pheromone method, and one resident described differences in harvests between their sprayed and other unsprayed crops noting that, *“we spray for roya and broca with insecticides, but many don’t, and one year we had two and a half times the average* [yields] *that other farmers had here”* (Participant 13). While not all local campesinos can afford the cost of frequent spraying, the chemical applications that some residents opted for caused the *“drying out* [of] *the soil and* [it] *entering the ground”*, prompting local *“waterways* [to] *receive pesticides as a result”* (Participant 3).

Despite increased agro-chemical usage, one local described an especially damaging outbreak of roya that *“destabilized us around two years ago... it affected a lot of the coffee harvests* [because] *the coffee bean wasn’t very good quality so we got a low price for our coffee... and that’s what caused the problem because for those who live off this, the roya was a problem!... but we have moved forward”* (Participant 18). Interestingly, the prevalence of roya has been associated with the region’s shifting climatic conditions, as seasonal extremes have become more pronounced—meaning that the same hydropogical system that sustains crops may also be generating insect infestations and the growth of fungus that together inhibit crop development.

As Grundy elaborated, climatic “changes have[...] added to the prevalence and strength of roya outbreaks”, whereby the accumulations of rainfall, in combination with warmer climates along higher montane altitudes are “affecting coffee crops and roya outbreaks” (2014:35). Yet, as climatic changes were noted to breed rust fungus, these changes were at the same time noted to also affect the direct development of coffee beans in varous ways. As one local explained, *“you want coffee to grow dry... it’s better to go for four days without rain as it blooms because if it rains, that knocks the blooms off… so you don’t wan’t a hard rain during February and March* [for winter coffee], *if you get a soft rain, it’s fine”* (Participant 32). In terms of coffee production, it was noted that “*luck has it these environmental changes are favorable to the region*” (Participant 3). As another campesino confirmed, “*climate change is visible here, it’s hotter, but in some ways that’s better for coffee”* (Participant 6). Despite this, given lower incomes received from coffee harvests, several residents who were interviewed expressed interest in selling property (i.e.: most often coffee fields), and sometimes with international buyers in mind. Notwithstanding, the primary strategy to mitigate coffee instability was through the diversification of household incomes.

6.4 Income Diversification

Numerous locals who took part in this study reported having confronted the combined pressures of international market instability, crop infestations, and the resulting fluctuations of coffee prices, through crop diversification. As one local explained, *“roya has harmed coffee here, so it’s better to diversify”* (Participant 3). While this campesino’s farm *“traditionally had just sugar cane and coffee for a while, now we have a little cacao, and we’re trying to introduce black pepper that is commercialized and sold to a company called Propica”* (Participant 3). This was also reported by another local who noted that, *“we have also started introducing black pepper to grow and sell… something other neighbours are doing also”* in addition to producing *“coffee, cacao, plantain and banana, sugar cane, vegetable gardens, and some medicinal plants"* (Participant 6).

With this said, some forms of agricultural diversification were noted to provide their own challenges, with one local explaining that, *“chocolate harvesting is a family activity done for extra cash: chocolate is high-quality here, but the cacao is also tackling an American-wide plague that is reducing its production throughout the continent”* (Participant 3). Similarly, the introduction of new fruit production was also noted to have temporal limitations… *“if the coffee*

stopped, and people tried diversification with mangosteen or peach palms… mangosteen fetches a good price here… but it takes eight years for the plant to produce, so people can't wait that long to get income" (Participant 5).

Figure 23: Diversified Crops

(L) Alcohol pools are distributed around the perimeters of a sugarcane field.

(R) Cacao is being grown to supplement household incomes. Photos by author, 2016.

The size of property was also highlighted as a mitigating factor, with one local turning to bananas as an alternative crop. As she explained, "*my idea is to grow some* [bananas] *and sell them but as part of our self-sustainability, not as a cash crop because we don't have enough crops or land for a cash crop of any kind*" (Participant 17), adding that, *"we have cojotes here, it's a big nasty ugly worm: the plantains have a lot more problems than bananas, so I have few plantains"* (Participant 17). The corridor's second most prevalent crop, sugar cane, was also noted to be *"susceptible to beetles in May*… [and] *to combat this, alcohol pools border the crops and are used to attract the males using female pheromones* [in order] *to kill males before they fertilize the females"* (Participant 3) [see Figure 23]. With various crop instabilities, chemical use was noted to be necessary. However, one local also stated that *"chemical use is causing only a little harm to waterways since there isn't too much agriculture going on—it's small, the ASBC economy is shifting from one of agriculture to one of home stays" (Participant 12).*

6.4.1 **The Services Economy and Women's Labour Value**

Since the ASBCs formation in 2005, increasing numbers of ecotourists and researchers have traveled to the region, opting to lodge in local home stays. This shift to a home stay

economy has been increasingly facilitated by the growth of eco-programs that are managed by both CoopeAgri and York University.

As one local described, this shift occurred following the formation of the corridor, when "*York University started bringing coffee away from the area to sell, so people saw the potential for a small residential market... but then certain community members saw the importance of promoting the corridor over coffee development"* (Participant 27). To elaborate, York University, in partnership with a collective of CoopeAgri coffee producers within the ASBC, had initiated a certified Fair Trade and shade-grown coffee program[63] that continued through 2005 (Sick 2008:199). However, with the development of a home stays initiative as well as a growing environmental awareness with the influence of environmental institutions, *"the coffee project didn't develop much because people took more interest in resource protection"* (Participant 27). This direction prompted the emergence of 'sustainable development' initiatives that were associated with the services industry, generating new occupational areas for locals, including a previously undervalued labour force: women. According to Grettel Baldizán and Francisco Guido Cruz, the labour of rural women during the 1980s,

> Could be divided into three main areas: (a) domestic workers coping with a lack of basic services, such as treated water, electricity and toilets, and child care and health care; (b) agricultural workers, maintaining the subsistence family unit while men went to work for a salary outside the home/and or outside the area, significantly increasing women's workday; and (c) seasonal agricultural salaried workers, with no social or economic benefits, and at a lower salary than men's (Isla 2015:43).

However, national sustainable development initiatives, particularly through ecotourism, prompted the emergence of new forms of employment through a bourgeoning service sector (Isla 2015:45). In particular, the home stay economy that emerged within the ASBC, whereby incoming ecotourists pay to remain with local families, thus resulted in the assignment of a labour value to traditionally gendered work such as cleaning, cooking, and home maintenance that had previously been unwaged labour that was invisible to the market.

This converted many women in the corridor into essential financial earners and increasingly important contributors to household incomes. This in turn has created openings for additional, albeit supplemental, forms of income through other offered goods and services. Of

[63] This Fair Trade coffee was exported through partnerships with Timothy's World Coffee, and continues to be sold by the Las Nubes Student Association at York University, revealing that my initial interactions with the corridor's elements (including freshwater resources) may have occurred through my consumption of the region's coffee.

those mentioned through interviews were: *“manicures, haircuts, dance classes, workout lessons”* (Participant 25*); “artisanry, paintings, embroidery*” (Participant 21); “*needlework, and weaving*” (Participant 2); and, “*jewelry making, and food and drink sales*” (Participant 30), to name a few. At the same time, the emergence of community organizations such as the women’s group AMACoBAS in 2004, has further organized local women into a Collective of diverse micro-enterprises. In addition to volunteering in numerous community events (such as the Environmental Festival, the Alexander Skutch Festival, and the Alexander Skutch Birthday Celebration in Los Cusingos), this collective organizes local fairs during which its members sell a variety of goods and services, often to extranjeros. With more visitors frequenting these events, ecotourism is diversifying the local niche market for corridor organizations such as AMACoBAS, especially in anticipation of increased home stays.

6.4.2 **The River and Eco-Tourism in the ASBC**

With the 2016 opening of York University’s Eco-Campus, the *Lillian Meighen Wright* Centre, and with the anticipated increase in student-visitors participating in York’s new Semester Abroad program beginning in 2017, several locals with financial means are investing in constructing cabins and open-air structures as a means to generate additional income. As one of these locals explained*, “the cabin is expected to bring income from student home stays or bird watchers”* (Participant 17). However, it is important to note that this expanded eco-tourism is also greatly dependent upon the river, as it remains the primary attraction for visitors.

As one participant within this cabin economy explained, *“we bring students to the Río Peñas Blancas because they prefer this river compared to Río Calientillo: they like the cold temperature, and they* jump in” (Participant 9). In fact, the river was also noted to be essential to the resident’s property, *“the river is special—it’s central to the environmental economy... I have a lot of forest, but without this river the forest isn’t too special—the river is special... I love to see it flowing and know that there’s fish inside, and that there are animals, and that you can bathe in it”* (Participant 9).

In addition to home stay structures, residents described other possible economic enterprises along riverine properties. As outlined by one local, *“the more water the better—if the water sources are big enough they could be used for an economic project, such as a restaurant,*

or a pool to sell tilapia, or a tourism center... because of this the Río Peñas Blancas is necessary to maintain the corridor, so it can't be taken away" (Participant 22). However, with the majority of riverine properties belonging to family inheritors as well as extranjeros and cattle farmers, the creation of houses for ecotourism is not a possible option for all corridor residents: thus creating potential for the market's monopolization.

At the same time, Las Nubes' geographical distance from neighbouring communities points to the possibility of expanding opportunities to additional locations throughout the corridor in the Las Nubes Project, thereby distributing accrued benefits to a larger number of corridor members. For example, experiential learning projects involving the rotation of student groups between different regions and itineraries could contribute to the diversification of incomes for families. However, this would require additional transportation[64] and could result in other ecological concerns. With that said, plans are currently in place for York's semester abroad initiative which will take place at the corridor's center and which will undoubtedly affect the area adjacent to the river. For example, one participant who also works within the Las Nubes Project noted that his responsibilities now include *"reforesting while also maintaining trails for all the students who want to go to the river* [adding that] *we are also working on a bridge to open another path that travels up*" (Participant 9) the northeastern riverbank. Clearly, the river represents an important source of community capital through home stays and related revenues, with my own participation in the home stay economy demonstrating this. However, the river's potential to generate capital for the state and for private industries have prompted other forms of commodification to take precedence over such local economic initiatives. In particular, the river and its adjoining waterways have become directly commodified through the emergence of national sustainable development initiatives, based on what Bakker refers to as the 'crisis control strategy'.

6.5 The Crisis Control Model and Market Conservation

At the same time as the corridor's freshwater maintains local economic projects, local uses of freshwater are becoming increasingly supervised and controlled at the state level. According to Bakker, freshwaters' unique importance to development as "an indispensable lubricant of industrialization and urbanization" (Bakker 2003:51) means that "water scarcity

[64] For example, additional transportation would result in increased CO2 emissions, environmental impacts to the local traversed ecology, and pollutants in the area.

represents a significant threat to continued capital accumulation" (Ibid). As a result, water scarcity remains "one of the most important [and common] 'bads'" (Ibid) that is framed within the sustainability discourse, whereby sustainable development projects are promoted as solutions to a growing global ecological crisis. Known as the 'crisis control strategy', and alternatively as the 'economy of repair', this discursive direction has reconfigured natural capital by first acknowledging the existence of an environmental crisis, and then by scrutinizing the contributions of prior industrial behaviour (Escobar 1996:326; Bakker 2003:51).

Specifically, it entails "a reconversion of modes of accumulation [that] valorizes rather than exploits nature" (Bakker 2003:51) by assigning resources what proponents argue to be their 'true' or 'full' monetary value. This dominant strategy therefore adheres to the logic that the market was the initial cause, and is at the same time the ultimate solution, to prior economic failures (Bakker 2003). Moreover, Escobar argues that this 'crisis control' strategy prompted the global launch of 'sustainable development projects' "in 1987 with the report of the World Commission on Environment and Development by the United Nations" (1996:327), before emerging again as a global political priority during "the [1992] United Nations Conference on Environment and Development, or Earth Summit, held in Rio de Janeiro" (Isla 2015:6).

As such, the commodification of freshwater is increasing with contemporary globalization, and is occurring within a larger resource paradigm that is variously described as 'green neoliberalism' (Goldman 2007), 'market conservation' (Smith 2007), and 'market environmentalism' (Bakker 2007), to name a few. This paradigm is founded upon the idea that the objectives of "economic growth, efficiency, and environmental conservation" can be collectively achieved by establishing "private property rights, employing markets as allocation mechanisms, incorporating environmental externalities [such as water] through pricing" (Bakker 2007:432), and by instituting formal pillars of neoliberalism such as "individual libert[ies], unencumbered markets, [and] free trade" (Harvey 2007:22). In this way, freshwater's incorporation into the market accomplishes what Harvey argues to be the primary aim of the neoliberal project: "to open up new fields for capital accumulation in domains formerly regarded off-limits to the calculus of profitability" (2007:35).

Since the 1990s, the continuation of neoliberal logics has transformed water management standards to a 'market conservation' mode of water regulation (Bakker 2003:37), which has involved dramatic institutional and organizational transformations through

“marketization: the introduction of markets or market-simulating decisionmaking techniques, and the participation of private companies and private capital in resource development, water supply, and wastewater treatment” (Bakker 2003:36).

This direction was especially influential throughout the state’s development process of a new water levy structure from 1995 to 2005, and particularly in 2002. During this time, the minister of MINAE “called for a cooperation of different institutions and organizations, [including] the Inter-American Development Bank, the National Fund for Forestry Financing and Global Water Partnership Central America” (Zeledón Calderón 2013:4). Through this cooperation, international monetary agencies had a direct hand in leading new national water projects and tasks, including: “an improvement of technical expertise; decentralization of their management; introduction of new monitoring and control systems [and] new areas of intervention, such as community education” (Ibid). In 2003, the Water Department of MINAE expaneded on this by preparing “the first draft of a decree that proposed the Environmentally Adjusted Levy for Water Use” (Zeledón Calderón 2013:5), an economic measurement system that would undergo several readjustments throughout the following years. The MINAE defined this new water tariffs system as:

> An economic instrument for the regulation and administration of water use that permits sufficient water availability for the reliable provision for human consumption and the socio-economic development of the country[...in] addition to generat[ing] economic resources for the long-term funding of sustainable water resources management in Costa Rica (Zeledón Calderón 2013:2).

In short, a monetary value was assigned to each water-using industry to compensate for the costs associated with and informed from managing, researching and protecting freshwater (Zeledón Calderón 2013:3). Included among these users were domestic consumers, who soon had to pay fees for their domestic water consumption. Under the regulation of AYA, the ASADA of Santa Elena *“developed as a committee with six positions, and changed* [the water] *from state control to the community*” (Participant 6). Moreover, funding to generate the aqueduct was achieved *“with events in the community... and that was in the [early 1990s]... then they began to use water meters”* (Participant 18). These water meters, which function as a *“measuring machine* [attached] *on each house”* (Participant 6), operates by calculating the total quantity of water that *“passes through the machine and marks the metres* [of] *water that are being used from the aqueduct, not from creeks or rivers or anything else”* (Participant 8). In short, the meter

transformed the value of water into a calculable commodity thus reducing the quantities of water that residents used through economic cost deterrents.

Following the installation of water meters, residential users were charged 100 colones per cubic metre of water (Participant 18). However, it was noted that "*every year the price has risen more*", to where now, "*the basic cost is 3,200 colones per month*" (Participant 6), with overuse costing "*100 colones for each metre, and 2,000 colones for 20 metres lost"* (Participant 6). Not surprisingly, these price increases have not been popular since notions of water use as a common right still prevails among the locals. Notwithstanding, the commodification of water in other areas of the country has resulted in some ASADA members' adaptation to this new commodification model. As one resident noted, *"last spring, locals were complaining about the price of water per metre squared. But they are undervaluing water… how much does a bottle of water cost in stores?"* (Participant 8). Evidently, the 'crisis control strategy/economy of repair' ideology has become embedded in local water policies that treat freshwater users as consumers and freshwater as a finite resource in need of market control.

6.5.1 **Freshwater's Multi-Body Politic**

Access to potable freshwater is essential for the maintenance of human health. At the same time, the collective use of water creates a "collective body politic" through which "vectors of disease and pollution" (Bakker 2012:619) can flow to jeopardize population health. These concerns were realized in "new scientific theories of disease transmission" (Bakker 2012:617) with the support of developments in microscopic technology and bacteriology (Ibid). Together, these developments changed "water assessment techniques—its properties, quality, risk to the human body—and water control technologies" (Ibid).

The implementation of such projects characterized the 'modernization of water', which replaced "local, place-based practices and perceptions" (Bakker 2012:617) of water quality in favour of a "more unified understanding defined by a 'scientific' analysis of its biophysical properties" (Bakker 2012:618). In fact, during the second half of the twentieth century, in particular between 1958 and 1983, state standards were informed by the Environmental Protection Agency (EPA) of the United States, as well as the International Standards for Drinking Water, established by the World Health Organization (WHO) in 1958, 1963 and 1971" (Mora Alvarado 2016:4). Given that this hygienic order was to be "maintained through

discourses, laws, and tacit as well as formal rules that reinforce certain ideas and meanings of water" (Linton 2010:9), this process required the creation of "new forms of governance, and newly emergent processes of state formation [to] administer water use [and supply] practices and [their assisting] technologies" (Bakker 2012:618). This was achieved through the conception of 'pure' or 'safe' water that was to be administered through the pervasive authority of experts, including hydrological-engineers, "economic experts, and others with privileged access to scientific truths about life" (Nilsson and Wallenstein 2013:63).

In 1984, the WHO established international standards to evaluate the quality of water for human consumption (Mora Alvarado 2016: section 3), which the state later replaced in 1997 following the formation of the country's first Regulation for the Quality of Drinking Water, through Executive Decree No. 25991-S (Mora Alvarado 2016: section 4). The most current regulations built on this decree in 2015, by instituting transitional decrees 39144-S and 39136-S-MINAE, which indicated that standards are to be replaced after three years.

According to the 2015 to 2017 standards, the decree's central aspects are: (4.1) operative control of freshwater which corresponds to regulating its parameters of turbidity, smell, taste and residual color using basic field equipment; (4.2) the performance of sanitary inspections in adherence to Water Safety Plans to identify potential risks for the watershed or water source, treatment system, storage tanks and water distribution network; (4.3) the measurement of potential pesticides and responding programs in case of emergency; (4.6) and, the inspection of the physico-chemical parameters (such as N2[65] and N3[66] characteristics) of water systems through comparisons between earlier and continuing records (Mora Alvarado 2016:sections 4.1-4.6). Moreover, these meanings and measurements have, as Linton suggests, become materially fixed "in the concrete engineering [of] infrastructural works that [generate] hydrosocial relations" (2010:9), which have extended throughout the ASBC.

6.6 Regional Aqueduct Installations

In 1990, the government sent engineers to the ASADA of Santa Elena to built additional aqueduct infrastructure for the growing town, prompting them to construct enclosures around

[65] N2 characteristics involve measuring freshwater: odour, taste, and residual chlorine as well as bacteria (such as fecal), turbidity, colour, conductivity, pH and temperature (Mora Alvarado 2016:section 4).
[66] N3 characteristics involve the measurements of: chlorides, hardness, sulfates, calcium, magnesium, sodium, potassium, zinc, aluminum, copper, nitrates, nitrite, ammonium, iron, magnesium, fluoride, hydrogen sulfide, arsenic, cadmium, cyanide, chromium, mercury, lead, antimony, and selenium (Ibid).

the Chinchillas springs located within several acres of property owned by the ASADA. However*, "the Chinchilla springs dried years ago... they were bad springs—they didn't contain much water and the water was acidic... it was affecting the teeth of the young people—so the engineers of AYA said to take them out of service, since there are better springs further up"* (ASADA). As another local noted, these springs *"weren't so far in the mountain*" and the ASADA searched further above for the next springs of "better quality" (Participant 18). Following this, "*we enclosed the four springs of San Martin, and those are still working... the four of San Martin give about six litres of water per second"* (Participant 36; ASADA).

However, as noted by one participant, the geophysical parameters of this project demanded the construction of additional infrastructure such as *"poles to mount cement tanks to fill with water in order to reduce the pressure of water on the aqueduct's iron tubes as it flowed downhill"* (Participant 18). To pay for this construction, locals provided an annual contribution of 100 to 200 colones and hosted local fundraising events (Participant 18).

As the community population continued to increase, *"not enough water escaped these springs to meet the demands of the growing town"* (Participant 8), thus prompting additional springs to be found and enclosed. This involved finding freshwater springs further north in the mountain and adjacent to the river, and redirecting their downhill flows away from forests and creeks and into new collection tubes. Yet, finding springs was described as *"a complicated process: it involves bringing cement, soil, and wood on horseback up the mountain... and it's hard to find new springs... we sometimes look for trickling water"* (Participant 6). This experience was verified by one aqueduct member from the neighbouring Montecarlo ASADA who recounted that his town's water *"comes from Chirripó* [and] *it took about five years to find the spring and test its quality in lab tests"* (Participant 20).

After encountering additional springs in the mountain, the ASADA of Santa Elena currently has in operation "*two springs of Juan Solis that give around four litres per second... and two in Las Nubes that together give about five litres per second"* (ASADA) [see Figure 24]. One other spring has been enclosed *"for water security* [given] *the lack of water in some springs"* (Participant 36). Regarding the two springs in Las Nubes, the water *"begins higher up and comes down with gravity... into a tank* [that] *collects water from these different springs and combines them to flow down*" (Participant 8). However, additional aqueduct infrastructure was required to make water collection more compatible with the region's flow characteristics.

Figure 24: Freshwater Springs and the ASADA

In order to clean the springs, an ASADA member opens the tanks and splashes the small pool of contained water. This mixes the sunken dirt with the fresh water that filters from the rocks, thereby flushing the dirt down the disconnected tubes. Photo by author, 2016.

From a large blue collection tank located within Chirripó Vistas, the downhill water pressure generated by the region's steep elevation is too powerful for the underground and subsurface tubes to withstand. Given this, the ASADA has channeled the spring water to *"flow and fill* [smaller] *tanks all the way down the mountain to reduce pressure from the tubes*... [and] *this helps to distribute water around Santa Elena and parts of Quizarrá"* (Participant 8). Before reaching community members, the application of chlorine tablets within the larger collecting tank has recently become a state law.

6.6.1 **Freshwater Chlorination**

Following the implementation of *"new government mandates from the Ministry of Health several years ago"* (ASADA), the Santa Elena ASADA was required to upgrade its blue collection tank with a new chlorination system. This system is cleaned on a weekly basis during which "*15 chlorine tablets are put into the tank through a depositing tube"* (Participant 8). For this process, law dictates that *"all tanks have to contain a certain water level... and must maintain a water balance, because if there's too much chlorine in too little water then that is bad for one's health"* (Participant 8). As this aqueduct member further noted, "*the chlorine must seep in bit by bit, and this happens gradually and* [is measured] *with numbers"* (Participant 8).

The numerical measurement used by the Santa Elena ASADA is intended to *"maintain an equilibrium for the volume of chlorine"* within the tanks' water, represented by a *"median*

score between four and six" (ASADA). To ensure that this equilibrium is maintained, *"three comparative tests need to be done every month" (ASADA).* In addition to conducting these monthly tests, the ASADA also stated that "*every six months they do an analysis with water samples in the laboratory in San José to find out the quantity of chlorine, lead, etc. Then, they do a report for the Ministry of Health and the AYA will say if levels are low or high" (ASADA).*

ASADA members also noted that they are responsible for paying for chlorine and other tests "*three times a year* [and shared that] *there are a lot of charges to the ASADA*" (ASADA). These tests are performed in part because *"there is a limit to the amount of chlorine that can be added* [and] *if you need to raise the chlorine, you need someone from the Ministry of Health to come and see what the problem is if the level doesn't seem right" (ASADA).*

However, despite these measurements, the ASADA recognized that this process does not ensure that the required level of chlorination is evenly distributed within the aqueduct water before it reaches its consumers. To elaborate, *"the water distributes the chlorine unevenly... the chlorine might settle at the bottom of a tank or tube with the water flowing above it... so there can be some areas with more chlorine... there should really be a turbine up in the high tank to mix the chlorine into the water"* (ASADA). The ASADA justified the use of chlorine by stating that *"there's no reason to suspect water for parasites or other health concerns"* (ASADA); however, at the same time members quickly acknowledged that nobody had ever become sick before chlorine had been applied to the ASADAs current springs. Notwithstanding, the introduction of new levels of chlorination within their treated water also contributed to the visceral effects felt by its consumers.

6.6.2 **Water Purification versus Purity**

A central theme that related to the mandated use of chlorine was community members' collective preference for unchlorinated spring water given the health concerns that chorine is purported to cause to the human body. As one ASADA member explained, *"I have a friend who warns about chlorine and cancer... he said that for us as adults there isn't much issue but for the little ones, they can be affected... I don't know though… you need to know how much chlorine to use"* (ASADA). This concern was also expressed by another local resident who noted, *"it's obvious that chlorine is a chemical... it's bad for one's health, chlorine can also affect babies more because they have less tolerance... chlorine hurts the stomach, it affects flavour and other*

sensations so natural water without chlorine is preferred" (Participant 25). In addition to the concerns regarding potential effects of chlorine on the most vulnerable community members, the sensory effects (i.e.: taste) that chlorine generates have resulted in community opposition to its use.

As one ASADA member recounted, *"people are upset about the chlorine. They were saying that the water smells bad... but we talked with the engineer about it and they said no, the chlorine is cleaning all the tubes"* (ASADA). In addition to the smell, chlorine applications were also reported to affect the water's taste. As stated by one participant, "*in some houses, water tasted very different and some people were angry"* (Participant 6). Nevertheless, the ASADA was required to comply with these chlorine applications. As one local revealed, *"the truth is we didn't want chlorine because it's harmful and this is pure water, but AYA sets the laws so you can't mess with it… or AYA could come and take the aqueduct from the community and manage it themselves which would raise the price of water even higher!"* (Participant 18). Notwithstanding, given the choice, residents expressed their preference for unchlorinated tap water as noted by one participant who stated that, *"we are a good example of eco-people, we don't like to change things unless it's necessary"* (Participant 13).

Similarly, one member of Montecarlo's ASADA also confirmed that, *"after 15 years with no issues, adding chlorine was very drastic, but we legally had to"* (Participant 20). Despite this requirement, "*nobody liked the change because they preferred the water to be natural... they didn't like the flavor of chlorine, or the smell or taste"* (Participant 20). However, chlorine applications were justified according to this same local who added that, *"it's better to have chlorine than an epidemic..."* before quickly adding, *"though the springs don't have chemicals* [i.e. contaminants]*"* (Participant 20). Another Montecarlo resident also noted that previously, "*we had to boil the water to drink it, but we started using water from the aqueduct and* [while] *I prefer the water from the aqueduct because it's safer, the flavor without* [chlorine] *is better... we want to fight to take out the chlorine, but the law says it's necessary...I don't believe the* [unchlorinated] *water is harmful because the water comes directly from the spring"* (Participant 28).

The effects of chlorine are locally believed to both harm human health as well as affect the water's purity. As one participant revealed, *"the chlorine is used to kill bugs and parasites that can cause harm to one's health. But the opposite is true, if it's pure water, then there are no bugs to kill, so chlorine is harming the water"* (Participant 25). Altogether, these local concerns

reveal that state notions of purification and local definitions of purity are incompatible in the context of chlorine use in which biopolitical regulations with respect to population health are given legal precedence over local place-based notions of water quality. As such, some local residents referred to scientific measurements of water quality as supplemental analyses that confirmed what locals already felt certain about: that the aqueducts' springs, several of which had previously flowed down and fed into the riverine cycle as well as the river's main channels, demonstrated evidence of their purity through the particular interactions generated by their flows.

6.7 Indicators of the River's Freshwater Quality

While the state's notion of purified water has become enshrined in new policies and is administered by water experts with the use of labs and technological objects, it has resulted in a knowledge divide distinct from local notions of water purity (that are informed by place-based embodied experiences). In other words, local knowledge is partly generated 'in place' through visceral encounters with water that attribute to its meanings, whereas state regulations are imposed through a top-down model that operates by homogenizing freshwater systems in order to comply with a defined measurement model, such as the one used for chlorination. Yet, throughout the interviews, it became evident that residents' experiences with the river's flows, as interpreted through human senses, were not the only forms of evidence used by locals to determine the river's freshwater quality. Rather, the elements and organisms which its flow encountered (or did not encounter) revealed the river's purity to be affected and generated by the river's material relations.

To elaborate, the Río Peñas Blancas was described in numerous interviews to be *"abundant, very good... it's very pure"* (Participant 19). In fact, its purity was attributed to the same factors that generate the river's flows. For example, one local described the water to be *"90 percent healthy, it's super clean—the forests demonstrate this"* (Participant 21). At the same time, the absence of heavy chemicals in the river (i.e.: pollutants which affect the quality of other tributaries and creeks in the ASBC), was also noted to be a central factor in its purity. As pointed out by one participant, "*near the springs and along the rivers there isn't much contamination... people use chemicals yes, but this water comes from Cerro Chirripó, so there aren't many contaminants*" (Participant 21).

As noted by another participant, the *"Río Peñas Blancas is much cleaner because the river starts much higher in the mountain and passes farms with fewer cows... Río Calientillo on the other hand starts lower down* [and] *passes through much bigger farms so it's more contaminated"* (Participant 9). As outlined by another resident, *"when we walk to the top of Las Nubes, we stop and fill our water jugs right out of the streams and I don't even think about it… I don't put a pill in if the water's clean and clear… there are no cattle over there"* (Participant 32). This concern over cattle contamination of the water has informed local behaviours given that *"the Río Peñas Blancas is a very clean and pure river because it's close to the mountain* [and] *it's well protected. Before, people wouldn't worry if an animal died near the river, now they remove it quickly or don't allow domestic animals to enter it"* (Participant 16).

These behavioural changes were also inspired by state laws aimed at preventing bovine contamination of water sources. As an ASADA member confirmed, *"there are national laws that prohibit animals like cows from entering rivers directly... there are some cows contaminating the river but this issue has drastically improved since Chirripó Park developed"* (ASADA). As such, the formation of this park also affected the river's material conditions. As one local elaborated, *"because the river goes into Chirripó, a government protected park, I can't see this water source ever changing unless there was a mining operation but it's not going to happen so we're fortunate here*" (participant 32). Another local also noted that nearby and downriver, "*there are just cows and the animals of the forest* [and] *they aren't a problem"* (Participant 24).

In addition, several aspects of the river's flow behavior were identified as affecting its water quality. In particular, one participant stated that *"the water runs and runs clearly"* (Participant 28) while another participant added that *"when it's clear and flowing, it's got no pollution"* (Participant 13). In addition to emphasizing the river's movement, its dependent ecology was also used as an indication of its purity. As one local stated, *"there are no sources of contamination close... insects are indicators* [and] *some types mark the river's purity* [as well as] *the reproduction of many amphibians* [that] *also depend on water"* (Participant 1). Moreover, while the river was noted to have lost many larger fish over the past decades, some residents still described *"the Río Peñas Blancas* [to be] *clean with lots of fish"* (Participant 22). As another resident confirmed, *"you can visibly see that the river is clean... the life, the fish are indicators* [as well as] *the colour and smell of the water. At the sensory level, it all looks good and York studies also confirm this"* (Participant 12).

In a way, local accounts of riverine quality and its indicators extend from the notion that the river's quantity is generated by various elements. However, the elements that contribute to the river's quality are not strictly material since political and discursive factors were also noted to have restricted particular uses of its flows (from such activities as cattle ranching and mining), thereby affecting the river's flow quality. Thus, while residents measure the river's purity by using diverse indicators, the importance of conserving the river's purity gave voice to one common purpose amongst dam critics: that pure 'potable' water must be protected for the future.

6.7.1 **The River as Potable**

"Water is our greatest treasure—it keeps our bodies healthy. A person can go for months without eating much, without water they have only a week" (Participant 24).

"Water is the most valuable thing there is, it's priceless for one's health" (Participant 25).

Several of this study's participants commented on the increasing prevalence of water insecurity, particularly in the General Valley and in other parts of Costa Rica. As one local commented, rivers in the corridor *"are quite clean… this contrasts with Río General and communities on the other side of the valley that are virtually without water... they are now depending on* [delivered] *water tanks"* (Participant 3). As this resident further noted, *"there are places running out of water where it is denied to locals, but it's instead used to maintain golf courses for tourists… water access is a growing national concern"* (Participant 3).

Additionally, *"agrochemicals* [that] *have been drying the soil in Aguacate and in the northern provinces"* (ASADA) were also noted to be reducing national water availability. As one local added, in Guanacaste the aqueducts are attached to wells, *"but they've dug pretty deep and there isn't much left... so in some parts they use cistern trucks to get water and they bring water from other parts* [of the country] *such as San José. Guanacaste is the driest part because they cut down the trees and now there isn't water"* (Participant 8). As another resident noted, *"to the north of this country, we have friends with relatives… and they said that there are creeks and streams, and in 50 years they haven't seen them dry up... and now they've dried up… they're in a really bad drought up there... you go up there and there are no trees, it's flat"* (Participant 32). In short, the rate of freshwater depletion that has been occurring throughout the country is prompting greater dependence on freshwater deliveries from external sources, thus warranting the protection of potable water resources to supply the country's growing population.

In the ASBC, this recognition is prompting concerns about the need to protect the Río Peñas Blancas for future consumption, in part due to the reduced quality of other nearby tributaries. As one local noted, the *"creeks are important for agriculture because of their position... but the Río Peñas Blancas and Peñas Blanquitas have better quality water for human consumption so they're most important for the future"* (Participant 20). Another resident added, "*the Río Peñas Blancas is very important, because there you can predict to find the sources that supply a lot of water to the community of Peñas Blancas"* (Participant 24) located below the ASBC. Additional residents associated the flows of the springs that supply water to towns in the region with the river. As one local stated, *"the Río Peñas Blancas is our drinking water, our water supply for the whole community… that's the most important, it's where we get our water, from the springs at the top end of the river"* (Participant 32). Despite the springs' importance to the water supply, locals emphasized that their quantities are not consistent—thus emphasizing the need to conserve the river's main channel.

Although Santa Elena and Quizarrá receive their water from subterranean springs, residents noted that many local springs have dried within recent memory. As a result, residents emphasized that *"the river must be protected for security… because one day, if there are no more water sources* [i.e.: springs] *the river will be essential"* (ASADA). As another local confirmed, *"with the population growth that is expected within these communities, water security within people's homes is a serious concern*... [as is] *a dried up river"* (Participant 2). Extending from this, another resident stated that "*what is most needed is a new water law within congress... I don't know if most of them* [politicians] *treat water as an economic good… but it's a social good"* (Participant 5).

The argument that water should be prioritized for public benefit remains central to local resistance to hydropower development. As one local stated, *"when the company came, people here argued that without energy we'll live but without water we won't... nothing has more value than water"* (Participant 16). At the same time, locals assigned other economic values (related to agriculture and ranching) to the river. As one local explained, *"that's why there was a fight when the company wanted to put the dam here, the cattle ranchers downstream said 'this is the lifeblood of our ranches... what if we do go for an extended time in a drought... and we're not getting water for our cattle'?"* (Participant 32).

In addition, the river is critically important to maintaining eco-tourism*, "they want to build a dam on top of these rivers!... but that would eliminate the river... it would no longer be a river... but now, what is more economically valuable than the dam is* [the river's] *importance to students and tourists"* (Participant 9). This is because, "*the goal is to create a tourism project, so the dams would destroy both nature and the future economy… meanwhile a few company members would profit"* (Participant 27). Concern was also expressed that, in accordance with regulation, *"they* [the company] *would leave the community with ten percent of its river... Santa Elena would die, and other dependent towns also"* (Participant 21).

Given this, many residents associated the economic security of local communities with the continuation of the river's flow quantity and quality. However, when these conditions depend on additional elements and bodies, the protection of the river demands that conservation strategies extend to additional members of the river's flow assemblage. At the same time, many contributing bodies are biologically dependent on the flows that they absorb and consume, demonstrating the inter-relationality needed for the future security of the river.

Thus, this paper argues that notions of a collective right to access the river should inform local conceptions of economic stability, which, may not necessarily conform to the dominant economic frameworks that reduce the river to mere capital. Given this, the restriction of the river's flow channel represents a form of political control over the community's capacity to prosper economically and, as such, would reduce local living standards. As a result, the redirection of the river's flow away from local uses is equivalent to biopolitical control over the health and well-being of local residents, thus indirectly determining their right to life, or 'to *let die'* (Foucault 1978). To be clear, this control extends beyond human residents to include the bodies of the river's diverse organic dependents (such as insects, flora and fauna) that would be eradicated should the river's flow be reduced or redirected. This clearly demonstrated to locals the economic character of the dam dispute: that the benefits accrued from its development (that include the dissemination of the capital that it would produce) would not flow to community residents. In short, the river's importance to the current and future economy as well as to the health of the locals revealed additional implications with respect to the development of the dams, PHPB I and II.

6.8 Conclusions

"I don't like dams… I think that the rivers need to be protected because they are energy for our lives" (Participant 24).

Within the project's EIS, the company stated that hydropower dams would not interfere with traditional land use practices in the region given that currently the areas surrounding the project are primarily dedicated to agriculture (i.e.: coffee and sugarcane) and livestock. However, in addition to removing the source of water that is essential to downriver cattle farmers, the dams would also restrict alternative modes of income; particularly the region's expanding eco-tourism industry. This, combined with fluctuating crop instabilities which are exasperated by changing international prices for agricultural produce—a challenge that has been noted to have hit local campesinos especially hard in past decades—demonstrate that PHPB I and II would drastically reduce local residents' economic stability. The effects of climate change that are gradually shifting the region's water retention capacities further compound this vulnerability.

At the same time, not all community members would experience the economic effects of hydropower development in the same way. In reality, it would primarily affect residents who directly profit from the local eco-tourism and home staying industry. With local women representing some of the market's increasingly dependent earners, the gendered effects of establishing a dam must be considered in terms of its consequences to local economic stability. As a result, residents were skeptical of the company's claim that the local economy would profit from hydropower development.

To elaborate, the EIS for PHPB I and II emphasized that the dams would benefit the nearby communities during the construction and operation of the project through the creation of jobs. For example, the company stated that it would first employ approximately 100 locals during the dams' construction "to cover different specialties, such as engineers, surveyors, geologists, builders, carpenters, machine operators, construction laborers, mechanics, electricians, drivers" (Hidroeléctrica Buenos Aires 2013:16) and other miscellaneous roles. After construction, however, the number of positions is expected to decrease during the operational stage when fewer positions would be offered "for periods longer than 50 years" (Hidroeléctrica Buenos Aires 2013:2). Yet, when considering the current skill sets of corridor members, only a fraction of them are trained in construction and fewer still are certified

engineers, electricians, etc. Given this, most community members would be relegated to temporary manual labour positions thus limiting their employment opportunities.

Moreover, the company stated that through local employment during the construction of public roads, communities would be involved in "improving the quality of life for residents, who [would] inherit and benefit from this work... in addition to the dam being a potential tourist attraction that could lead to the establishment of shops and related services" (Hidroeléctrica Buenos Aires 2013:2). Yet, as one local argued, *"the company said they would have lots of work for a long time, but this was a false promise... they said they would fix the roads and increase tourism because lots of people will come to see the dams... but this isn't true… nobody is interested in seeing dams so they came with lots of lies to gain local support"* (Participant 11). As another local explained, *"if the projects get to the communities, then true, they will diversify the economy a little with the construction of roads and lights... but afterwards, the community is left with the consequences and the company gets the gains"* (Participant 3). The company's claims that locals would profit from the dams' construction reveal the company's lack of interest in community well-being. As one local noted,

> *In being self-critical, I can't be in agreement with the company... because these projects don't take into account the communities... maybe if it was for the necessity of national development but it's complicated to take the resource and sell it to another place. But water is a resource they can't take, yet they create the infrastructure and they take the money* (Participant 3).

This resident further stated that the *"politics are not there to help or support communities: the current system of development only functions to benefit the few… the issue is that people require transparency, but there is none... there is no transparency with this project"* (Participant 3). As another local revealed, *"the electricity generated would not go to the community... Costa Rica produces enough electricity... it's a strategy of the state to extract resources for state profit"* (Participant 11). Adding to this, another participant noted, *"we don't need more power, Costa Rica has a lot!... we must stop thinking about more dams"* (Participant 15). These quotes reveal local distrust with respect to the exporting of energy.

7 Hydropower Development and the National Economy

7.1 Hydropower Expansion in Costa Rica

Following the economic and oil crises of the 1970s, state-owned utilities in most Central American countries stopped receiving “loans from multilateral lending institutions," (Anderson et al. 2006:683) and began “a reform process [towards] capitalization and/or privatization" (Burgos 2007:9). As a result, Anderson (2013) argues that since the mid-1980s “Central America has experienced a proliferation of hydropower dams[...] that accelerated with the privatization of electricity generation in the 1990s” (4).

While energy supply remained in government hands within Costa Rica, new legislation (Law 7200) in 1990 made rivers available to private hydropower dams with a maximum capacity to generate 20MW (and to collectively generate 15 percent of domestic energy production), with the requirement that they sell all energy back to the ICE (Anderson et al. 2006:683; Lindo 2006). In 1995, this law was amended to increase the energy capacity to 50MW, allowing private companies to generate up to 30 percent of the country’s total domestic energy needs (Lindo 2006:303). Moreover, tariff adjustments that were instituted the same year reduced the costs that hydropower companies were required to pay for the use of surface and groundwater by nearly 95 percent (Zeledón Calderón 2013:7). This represented the greatest tariff adjustment among the eight major water-using industries and, at .12 colons per m3 of surface water, this located hydropower and aquaculture as the two least tariffed industries in the country; far below the 1.46 colons per m3 that many citizens were paying for domestic water consumption by 2005 (Zeledón Calderón 2013:7).

Following the legal increase of private sector participation, around 30 hydropower dams were constructed on Costa Rican rivers throughout the 1990s (Anderson 2013: 4); a direction that was cemented in 2007 when then-president Oscar Arias Sánchez publicly announced Costa Rica’s commitment to becoming “the world’s first carbon neutral [nation] by 2021” (Fletcher 2013:155). This declaration both initiated a carbon sequestration market, as well as expanded the country’s dependence on hydropower. This is because hydropower is highly promoted by industry advocates to be a “non-greenhouse-gas emitting technology [that can] mitigate global warming” (McCully 2001:141) by reducing national “dependence on fossil fuels” (Lindo 2006:298).

In short, hydropower (both public and private) in Costa Rica has become a 'sustainable development' strategy. In other words, the industry's 'green-washing' operates according to what Nilsson and Wallenstein refer to as "the doctrine of economic neutrality" (2013:59). Through this doctrine, economic 'facts' are presented as objective truths that are "universal and politically neutral" (Ibid). As "one of the most important ontological tenets of economic neoliberalism" (Ibid), this doctrine makes economic discourses hard to challenge since it requires "contesting economic truths" (Nilsson and Wallenstein 2013:66). As a result, the argument that hydropower contributes to the country's efforts to reduce carbon emissions obscures the real economic incentives that attract private companies and state actors to the nation's rivers.

To elaborate, the perceived sustainability of hydropower dams motivated their development throughout Central America following the 1992 Rio Summit, during which "development and environment were [first] linked together in Agenda 21" (Isla 2003:6; Isla 2015:4). As a result of this summit, the Plan Puebla Panama (PPP) —also known as the Mesoamerican Biological Corridor—was conceived as a regional project for Central American countries and was promoted as the ultimate 'sustainable development' strategy that would reduce poverty and ecological destruction throughout the region (Isla 2015:159). It was estimated that this plan would take ten to fifteen years to complete at a cost upwards of ten billion dollars. Eight governments including Mexico, Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama adopted the plan. Today, the PPP continues to be funded by international lending institutions such as the World Bank and the Inter-American Development Bank (IDB)" (Lindo 2006:299), with the aims to construct vast "interconnect[ed] transportation routes, industrial corridors and [various] infrastructure projects" (O'Neill 2004:4).

7.2 The River, SIEPAC and Plan Puebla Panama

Included among the largest of the PPP projects is the electrical agreement titled, System of Electrical Integration for the Countries of Central America (SIEPAC) (Pickard 2004:5; McElhinny 2004:15) aimed at enhancing "the reliability of electricity services, energy security and energy efficiency" (Burgos 2007:6) throughout the region. In reality, SIEPAC represents the "most advanced" PPP project "in terms of its institutional design and [its] allocation of funding" (McElhinny 2004:15) for the construction of 1830 km of 230 [Kilovolt] kV energy distribution lines between southern Mexico and Panama" (McElhinny 2004:15). Preparations for this

transnational energy grid have already begun to appear throughout Pacific Costa Rica.

As members of the ASADA of Santa Elena explained, *"there is an electrical network here that connects all of Central America and Panama and parts of Mexico... they have all the machines and everything ready and* [set it] *up… they just need to find rivers* [like the one here] *and attach the dams... because for them that's a big negotiation, it's going to move money" (ASADA).* As another local confirmed, the *"lines were expected to cross through this area* [and] *they were studying that* [option]… *but in the corridor, these lines would need to go through protected areas. Because of the challenges* [involved] *with crossing protected areas and also the resistance here, they found it easier to install the lines closer to the coast" (Participant 3). This participant further noted, "I don't know if the PPP is set to continue, but they have constructed towers and cables and the infrastructure… so I expect it's all set up" (Participant 3).*

It was also noted that *"private companies are participating with the state to export power to Nicaragua or Panama and other countries that* [currently] *use a lot of diesel... the PPP is also being supported by the national bank, Banco Central de Costa Rica"* (Participant 12). While not explicitly stated by policymakers or the projects' EIS, it became evident through local accounts that the energy that would be generated by PHPB I and II would certainly be destined for export through SIEPAC's energy grid. As one local stated, this is *"because, if you analyze our energy matrix, you'll see that we are at nearly full capacity of electrification, our capacity is above what is needed... so it's obvious that the electricity is for export"* (Participant 12). As another resident reiterated, *"Costa Rica has enough electricity, we don't need more… so they want to produce energy to sell to other countries... but we shouldn't allow the mistreatment of our environment for more money"* (Participant 11).

It should therefore be noted that PHPB I and II are not officially included as PPP projects, nor are the many additional dams that are planned for construction throughout Pérez Zeledón, Buenos Aires, and Coto Brus, due to SIEPAC members' apparent calculated strategy to obscure the project's controversial components (O'Neill 2004:5). One of the most internationally criticized aspects of SIEPAC is its erosion of national control over freshwater resources. To elaborate, critics of the PPP and SIEPAC contend that negotiations would overrule the rights of national governments to determine their energy decisions, despite the fact that the owners of the PPP's transmission lines would include nationalized organizations such as grupo ICE of Costa Rica (McElhinny 2004:15). This is because hydropower development

"almost always requires the involvement of foreign capital and expertise" (Bakker 1999:211), thus prompting the "dominance of international consultants, engineering firms, and capital providers" (Ibid) in hydroelectric development.

In short, while SIEPAC is promoted by financers as a strategic way to improve the region's electricity connectivity and telecommunications services in order to reduce regional poverty, SIEPAC actually operates as a 'sustainable development' strategy; one among many that is aimed at "ecological commodification, marketization and financialization" that dispossess communities of their local water resources and leads to the "deeper penetration of nature by capital" (Smith 2007:17). With so much capital invested in SIEPAC, one local expressed his interest in halting national hydropower development altogether as well as his concerns about increasing violence related to hydropower development,

> *My interest is that the national political system says 'no more hydropower', because to improve it is to say 'ok let's make the bad a little better'. I don't want that... hydropower dams should stop existing. It has been well demonstrated that hydropower has very powerful ecological and social impacts. In Central America, around ten people have been assassinated within the last several years with reasons having to do with hydroelectric power: in Honduras, in Guatemala, and in Mexico too (Participant 12).*

Not surprisingly, one local described the Movimiento Rios Vivos as *"an original movement, with people abroad as well... for security it has no leader"* (Participant 12). This participant further noted that,

> *This movement operates as a series of local members who work in local groups in different districts/ provinces to form a solitary network. When one community mobilizes, members from other communities come to their aid. For* [PHPB I and II] *people from all over,* [including the] *San José University, united with local groups... Rios Vivos does not have active meetings but when issues happen the community mobilizes, usually with 50 to 60 protesters* (Participant 12).

Moreover, the heterogeneity of corridor members in MRV was noted by one participant to be an essential advantage,

> *The groups that want dams are powerful. In comparison, we have other groups of agriculturalists, producers, students... we don't have as much power* [or] *economics as the other groups but we will continue fighting hard and, if people do not listen to us, we now have relations like York that can bring pressure and knowledge about issues of Costa Rica's environment to international attention* (Participant 5).

Members of Santa Elena's ASADA further emphasized the community's responsibility to defend the Río Peñas Blancas. According to members, *"change happens with us* [the

community], *by* [collecting] *more information from institutions of the state to help recuperate the towns… because we are campesinos and we receive very little information, and so this* [movement] *is one* [way]*"* (ASADA) to be informed. These ASADA members further stated that the community will *"not stop confronting all of the lies that the state says",* in part by helping *"new generations to continue challenging state lies... because to have state goals passed, all we have to do is say yes"* (ASADA). However, at the same time local MRV participants also expressed their difficulties in challenging the projects due to the economic privilege of the family proposing the dams.

To elaborate, Hidroeléctrica Buenos Aires *"is a consortium of companies under the head of Hernan Solis*", a member of *"one of the richest families in the country… and the legal representative of this project is Melida Solis, his daughter. Also, they have built 50 to 60 percent of the roads in the country so they started with roads and expanded as they grew into dam infrastructure" (Participant 12).* This participant's concerns extended to the transnational politics that facilitate water privatization since,

> *The Central American Bank for Economic Integration (CABEI) has funds for* [dam] *projects* [and] *project studies, so this benefits the hydropower companies* [because] *there is no investment risk for the company. They just show their faces, and they say 'ok I want to do a project,' and the bank goes, 'ok here's two million, five million, 10 million* [dollars] *to do all the initial studies that must be done: EIS', the Project Plans, the labour… they* [the companies] *aren't risking capital* (Participant 12).

Extending from this, companies reduce project costs by accepting capital from CABEI, as well as generate profit by exploiting a river's productive capacities. This is because a river's flows are not directly exchanged for capital, but are instead contained in reservoirs in order to provide the labour that is necessary to generate energy.

7.2.1 **The River's Labour Value**

In considering the Río Peñas Blancas' active role in supporting local communities, as well as the river's participation in the PHPB I and II dam dispute, it is necessary to explore the river's capacities that first attracted private developers to its waters. With this, within classical political economy, a commodified good is said to contain two basic properties: a 'use value'[67]

[67] For Marx, the 'use value' of a commodity was defined by its utility which "became a reality" through a commodity's quantifiable "use or consumption" (2011[1867]:27). Moreover, Marx stressed that substances of nature were "the

and a 'labour value'[68]. Upon sale, a commodity then receives an 'exchange value'; its accumulation represents a primary motivation for market suppliers. To ensure the maximum accumulation of financial capital, a commodity's production is generally performed through the 'law of substitution' by which capital will, if given equal options, select the cheapest source of labour/energy "adequate to sustaining [commodity] production at the prevailing level of competition" (Brennan 1997:180).

If a cheaper source of labour becomes available, it is generally selected to accumulate further capital. Within the Alexander Skutch Biological Corridor, the river's flow has the capacity to circulate within hydropower reservoirs and force the rotation of turbines that generate the energy required for capital accumulation. However, local resistance from both Movimiento Rios Vivos and its various allies within the ASBC, have generated a growing dialogue that has gained the political attention of both SETENA and the ICE. This outcry succeeded in achieving a temporary moratorium on both PHPB I and II, as well as all other hydropower dams that are planned in the municipalities of Perez Zeledón and Buenos Aires. Recently, this moratorium has ended yet as one local reported, *"the companies have halted the project"* until political conditions are favourable, or [until] *"they find another area... that's what they'll do, they'll keep moving until they find an area"* (Participant 12).

In searching for a river that is favourable for dam development, it is evident that rivers are considered interchangeable regardless of their material conditions should a favourable option arise. This strategic direction to accumulate capital is informed by philosophical and scientific discourses of the Enlightenment. That is to say, motivated by the objective of capital accumulation, the colonial economy reduced the costs of production by appropriating unpaid labour from slaves, women, and children as well as from non-human resources "such as forests, soils, or rivers" (Moore 2014:288). These inequitable commodity-relations have prompted a post-colonial legacy of exploitation that continues to burden repressed social actors within hegemonic patriarchy, namely: women, gender minorities, peasants, indigenous peoples, youth, and other marginalized groups who receive a reduced or insubstantial value for their labours (Isla 2015:9). Moreover, this inadequate compensation by capital has had an increasing

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source of all use-value[s]" (Brennan 1997:177). In contemporary labour theory, the use value is joined by a utility value.

[68] 'Labour value', on the other hand, constituted the "amount of [human] labour required to appropriate [the] useful qualities" (Marx 2011 [1867]:27) of a 'good'. It could be measured, according to Marx, by the commodities' "socially necessary labour time" that would be incurred as a processual "value in motion" (Smith 2007:16).

ecological dimension as new markets demand the productive capacities of environmental processes.

As elements and organisms have become further incorporated into the market, Brennan's feminist critique of Marx's labour theory argues that the presupposed human source of a commodity's 'labour value' is contingent upon a human-centric subject/object distinction (1997). As such, Brennan challenges this distinction by postulating that "labour/power is precisely energy," (Brennan 1997:179) revealing the shared affinity between human labour and what Brennan regards as animate and inanimate natural resources that are capable of releasing and adding energy to production processes, just "as humans can" (Ibid). However, just as human labour power requires time to be replenished (through sustenance and rest), elements such as water also have a "certain time of natural reproduction" (Ibid).

This necessary reproduction time is often unaccounted for by industry, causing freshwater's applications in production to exceed the time required for it to be replenished (Brennan 1997). As a result, the increasing use of water for industry impairs "capital's own conditions of reproduction; what James O'Connor [termed] 'the second contradiction'" (Escobar 1996:326) of capitalism. This reveals that industrial uses of freshwater are restricted by the material properties of the selected water source, and the conditions upon which it can be restored. It can therefore be reasoned that the river's commodification through labour over the river's life-giving qualities are what Lansing, Lansing and Erazo (1998) argue comes down to "which natural processes or habitats are counted as valuable [that in turn] depends very much on who does the counting" (2). This is a reminder that "'value' is not a measureable physical property, but a social construction" (2). This demonstrates the importance of expanding dominant ways of *knowing* rivers and freshwater beyond its provision of capital through its labour; a direction which the Río Peñas Blancas' dependents are fostering.

Within the ASBC, local understandings and values for the Río Peñas Blancas extend beyond the river's power to accumulate capital; as it circulates through the social bodies that also "exceed and confound" (Bennett 2005:445) its composition of quantity and quality. As local accounts collectively reveal, the river is a source of life that connects the region's organic bodies, its flows generate social behaviours and express a sociality that in many ways defines the corridor's cultural character. Moreover, the river sustains the local economy that has increasingly assimilated campesinos and other residents into the global market by both choice

and/or necessity. At the same time, these interactions have also fostered local appreciation for the elements that generate the river's capacity to flow; in other words, its agency of assemblage (Bennett 2010).

This thesis explored local ways of 'knowing' and 'valuing' the Río Peñas Blancas in response to the potential commodification and privatization of the river and its productive capacities for hydropower generation. By considering the river to be an actor within local disputes, this study examined how its flows generate and are at the same time generated by the bodies which the river encounters. With many locally *known* and *yet to be known* lives hanging in the collective balance of the river's continued capacity to free flow, it is evident that the continuation of the river's capacities is a deep and shared necessity.

For the river's human users, the adequate conservation of its freshwater for consumption therefore requires our acknowledgement of humans' biological dependence on other planetary bodies: animals, plants, organisms, geophysical spaces and material 'things' that also require water. This becomes explicit upon recognizing that the human body itself is not strictly *human* but is rather an assemblage of "nested aggregates of autopoietic systems" (Berressem 2009:66) that include "micro-organisms, cellular reactions, material artifacts, and natural stuff" (Coole and Frost 2010:1) such as water-dependent elements. Following this logic, the preservation of human life demands the release of freshwater from industry in order to also privilege the many watery relations that ensure and facilitate humans' ongoing access to water. Extending from this, the assembled elements that generate the *Río Peñas Blancas'* capacity to flow also help generate the material compositions of the river's consumers.

In exploring the Río Peñas Blancas' centrality to recent processes of frontier settlement, the green revolution, and the neoliberalization of nature, it becomes clear that the river is not a stable or contained force; but rather, that it extends beyond the human capacity of what can be *known*. This is in part due to the river's propensity to constantly change—encapsulated by time, and always in a state of emergence—which reveals the participation of infinite material elements and forces of which this study only managed to include: gravity, seasonal changes, Earth's rotation, the Sun, climates, elevations and additional elements such as wind, CO2, forests and their inhabitants, rocks, sediments, insects, livestock, crops, agrochemicals, plastics, metal tubes, humans, legislation, capital, economic theory, environmental discourses, measurement tools, energy grids, trade agreements, and communication technologies. This attests to the

sheer indistinguishable nature of the Río Peñas Blancas as an organic, geophysical, material, social, discursive, and technological opus. With this, I feel inspired to end this study with an enchanting ode to the Río Peñas Blancas that describes the river's continuously expanding milieu:

> *Forests are the living vestment of our mother Earth*
> *The deep plutonic rocks are her skeleton, the soil her tender flesh, the ocean her vast heart,*
> *the rivers her veins through which circulates her precious lifeblood.*
> *But the little babbling rills and the clamorous mountain torrents are her tongues,*
> *which sing ceaselessly to her multitudinous children, assuring them that in spite of her immense burden of years she is not only alive and well but still young and vigorous,*
> *quite able to support her varied progeny* (Skutch 1992:191)

8 FINAL CONCLUSIONS AND RECOMMENDATIONS

At the end of several sections of the paper, both conclusions and recommendations have been offered with the aim of providing further areas of policy and/or practice. As such, this section does not intend to duplicate the points already made throughout this paper; rather, below is a summary of some of the most important conclusions and recommendations found through this research.

Conclusions:

- *Local ways of understanding species biodiversity are not entirely compatible with the ways in which biodiversity is represented in state data, but rather reveal and emphasize the associations that exist between species.*

In other words, rather than the traditional species lists accepted by the state as part of required EIS documentation, local knowledge about residents' relations to resources is required. It is important to include the voices of local populations in order to ensure that a more holistic view—which is based on a more relational approach to biodiversity—is given legal authority throughout the EIS process.

- *Local participants do not envision the river to be fixed in place as a single water channel, but view the river to be receiving its water from various sources such as tributaries and rainfall.*

Rivers are not static, contained entities; rather, they are generated by various sources and their courses continue in various directions. The river's branches flow as rhyzomatic extensions both under and above ground, acting as the primary connection between the various ecosystems in the region.

- *The river's economic value for communities is rooted in its status as a public resource, and in the continuation of the river's capacity to free flow*.

The river sustains various local activities: its flows in the form of rainwater sustain agriculture, its currents sustain cattle and well as fish pools, the main channel and its associated ecosystems attract visitors and eco-tourists, and its springs provide potable water to community members.

Recommendations for Future EIS' Assessments:

- Companies should be legally obligated to include a compiled bibliographic list of previous ecological research and species data from within a project area (as provided by community residents) within the company's formal application to SETENA. This list of relevant works should also be submitted from a community council (perhaps the ASADA or another elected group) to SETENA directly in order to ensure transparency. [For additional information on this topic, see page 79 of this study]

- Local (perhaps elected) community representatives should be invited to participate in a meaningful way in generating the company's species list, and this data should be made publicly accessible prior to the project's approval process. [See page 79]

- While more conceptual in nature, socio-cultural values for rivers should be given legal weight (and their own category) within future EIS processes—perhaps as an extended obligation of Article 50 of the national Constitution. [See pages 109-110]

- Rivers with highly variable seasonal flow regimes (such as those in the south-Pacific) should be legally 'off limits' from hydropower development, due to their unstable capacities to generate electricity. In addition, the regional effects of climate change must be given legal weight within EIS assessments in order to determine a river's potential resilience to development. [See page 108].

- The concept of a flow standard is not sufficiently adequate to protect riverine ecosystems and should be either withdrawn from practice or legally expanded upon so as to include the various sources of water from which a river receives its flow (such as springs, creeks, rainfall, and nearby forest cover). In addition, the effects of a dam are not fixed; rather travel. Recognizing this, EIS' should therefore be required to assess the upstream and downstream impacts on the river, its adjoining watershed and tributaries, and its linked ecologies including surrounding forests and biodiversity. [See pages 108-109]

- The collective effects of multiple dams on a single riverine ecosystem has yet to be effectively researched in Costa Rica; thus, proposed projects of this nature should be halted until potential consequences have been thoroughly studied. [See pages 109]

- In addition to citing the primary sources of income for residents, studies should also consider the variables that are affecting the region's primary income generating activities in order to better measure a community's economic resilience to a given dam project. These effects should also be considered in terms of how they may unevenly impact different social groups and genders in the community. [See page 139]

Recommendations for Researchers:

- Species lists, while conventionally accepted in terms of making policy decisions, do not entirely account for the ways in which biodiversity is understood and represented at the local level. Therefore, I encourage future researchers to consider alternative approaches to species studies that incorporate local perspectives, such as participatory species lists that also include local knowledges. [See page 79]

- I encourage the continued exploration of new ways to promote sustainable research practices within the ASBC. This is especially important with the predicted increase of student visitors to the region in upcoming years. [See page 125]

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10 APPENDICES

10.1 Appendix A: List of Participants

Participant #	Gender	Community (of residence)
1	Male	Quizarrá
2	Female	Santa Elena
3	Male	Santa Elena
4	Female	Quizarrá
5	Male	Montecarlo
6	Male	Santa Elena
7	Female	Quizarrá
8	Male	Santa Elena
9	Male	San Fransisco
10	Female	Quizarrá
11	Female	Quizarrá
12	Male	Santa Elena
13	Female	Santa Elena (Chirripo Vista's)
14	Male	Santa Elena
15	Female	Santa Elena
16	Male	Santa Elena
17	Female	Quizarrá
18	Female	Santa Elena
19	Male	Santa Elena
20	Male	Montecarlo
21	Female	Santa Elena
22	Male	Santa Elena
23	Female	Santa Elena
24	Female	San Fransisco
25	Female	Santa Elena
26	Male	Longomai
27	Male	Cedral
28	Female	Montecarlo
29	Female	Montecarlo
30	Female	Montecarlo
31	Female	Santa Elena
32	Male	Santa Elena (Chirripo Vista's)
33	Male	Quizarrá
34	Male	Santa Elena (Chirripo Vista's)
35	Male	Quizarrá
36	Male	Santa Elena

10.2 Appendix B: Interview Questions

1. What is your age and principle occupation?

2. Can you please name the area(s) of the corridor where you spend most of your time? Please describe the activities that you do in these spaces.

3. Can you please list the bodies of water that exist within this space? (rivers, creeks, springs, wells, ponds, pools, lakes etc)

4. Can you please draw a rough map of your selected area and include the bodies of water listed above?

5. From your list, can you please explain what water sources are most important to you, and why?

6. Using this list, how do you use each of these bodies of water? (i.e. for recreation, agriculture, aquaculture, livestock etc.)

7. Do you use any water from these sources for domestic activities? Where does the water come from that you use inside of your home?

8. Does your use of these water sources change depending on the season? Please explain: Has your use of these water sources changed over time?

9. Which of your senses are most often affected by these water sources? How would you describe these experiences?

10. What do you most value about water?

11. How would you describe the quality of these water sources? What do you think are good indicators of the water's health?

12. Do you have any concerns about these water sources? Are there local uses of water that are destructive to these bodies of water?

13. What are your opinions about hydropower development in the region?

14. Have you heard of the movement Rios Vivos? What is your opinion about this movement?

15. Can you please list the water laws that apply to your selected area?

16. What is your opinion about current water laws and about how they are enforced?

17. What would you change about the current water laws?