

**University of São Paulo
“Luiz de Queiroz” College of Agriculture
Center of Nuclear Energy in Agriculture**

**The importance of storytelling in shaping attitudes towards jaguars
(*Panthera onca*) and parallels with folklore of non-indigenous
traditional communities of the Central Amazon Basin**

Jacob Daniel Charters

Dissertation presented to obtain the degree of Master
in Science. Area: Applied Ecology

**Piracicaba
2019**

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Science Degree in Zoology

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EPIGRAFE

"E, se bem que seja obscuro
Tudo pela estrada fora,
E falso, ele vem seguro,
E, vencendo estrada e muro,
Chega onde em sono ela mora.
E, inda tonto do que houvera,
A cabeça, em maresia,
Ergue a mão, e encontra hera,
E vê que ele mesmo era A Princesa que dormia."

Fernando Pessoa

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RESUMO

A importância da narrativa e da comunicação verbal na formação de atitudes em relação às onças-pintadas (*Panthera onca*) em comunidades não indígenas tradicionais da Bacia Amazônica Central

Grandes carnívoros podem provocar fortes emoções nos humanos e compreender os mecanismos de formação das atitudes voltadas aos carnívoros selvagens é fundamental para o planejamento de estratégias de mitigação que se destinam a mudar atitudes negativas. No Brasil, a maioria das pesquisas sobre conflitos entre humanos e carnívoros teve foco nas percepções em relação as onças quando estas estavam associadas à predação de rebanhos domésticos. Em regiões onde não há produção pecuária ou esta é de baixa importância econômica, como em áreas da Bacia Amazônica, a caça de onças (*Panthera onca*) continua frequente, mas as razões para isto ainda são controversas. Este estudo foi realizado na cidade de Beruri, AM, e em quatro comunidades ribeirinhas ao longo do baixo rio Purus. Foram utilizados questionários semiestruturados e análises qualitativas para avaliar como as normas sociais e as interações entre pares (na forma de narração de histórias) influenciam as atitudes em relação as onças. Foram traçados paralelos entre como os encontros com onças (e outros animais selvagens) e o folclore regional permeiam as comunidades e são aceitos pelos residentes. Finalmente, a influência de fatores demográficos foram avaliadas. Os resultados mostram uma correlação negativa entre a atitude e o nível de crença no folclore. Esta tendência foi semelhante em todas as idades, independente de sexo, comunidade de origem ou relacionamento com o habitat. Compreender a importância da narrativa e da transmissão verbal de ideias entre pares em comunidades tradicionais não-indígenas é essencial para mudar as atitudes em relação à vida selvagem para fins de conservação. Este estudo destaca que as atitudes são geralmente robustas e não necessariamente baseadas em informações factuais. Assim, qualquer projeto de conservação deve olhar para além dos modelos tradicionais de educação ambiental e usar uma abordagem multifacetada para mudar as atitudes em relação aos carnívoros.

Palavras-chave: Conflito humano-vida selvagem; Folclore; Narrativa; Carnívoros; Comunidades tradicionais

ABSTRACT

The importance of storytelling and verbal communication in forming attitudes towards jaguars (*Panthera onca*) in non-indigenous, traditional communities of the Central Amazon Basin

Large carnivores often elicit strong human emotions. Given that most people will never have a significant encounter with wild carnivores implies that these attitudes are based on indirect influences such as media, education, social norms, and peer-peer interactions. Understanding the mechanisms of how people form attitudes towards carnivores is important for deciding mitigation strategies aimed at changing attitudes. In Brazil, most human-carnivore conflict research to date has investigated perceptions towards jaguars (*Panthera onca*) in association with the depredation of livestock. Where livestock absent, or of low economic importance, such as in many areas of the Amazon Basin, the rate of hunting of jaguars remains high, yet the reason for negative attitudes and acceptance of killing jaguars in these areas remains unclear. This study, conducted in the town of Beruri and adjacent four riverine communities along the lower Purus River, in the Brazilian state of Amazonas, uses semi-structured questionnaires and qualitative analysis to assess how social norms and peer-peer interactions- in the form of storytelling- influence attitudes towards jaguars. Parallels are made between how accounts of encounters with jaguars (and other wildlife) and regional folklore permeate the communities and are accepted by residents. Finally, the influence of demographic factors are assessed. Results show negative correlations between attitude and the level of belief in folklore. This trend was similar across age, sex, community, and relationship the surrounding habitat. Understanding the importance of storytelling and the verbal transmission of ideas between peers in non-indigenous traditional communities is essential for changing attitudes towards wildlife for conservation purposes. This study highlights that attitudes are often robust, and not based on factual information. Thus, any attitude mitigation projects should look past the traditional environmental education models, and use a multifaceted approach for changing attitudes towards carnivores.

Keywords: Human-wildlife conflict; Folklore; Storytelling; Carnivores; Traditional communities

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1. INTRODUCTION

Most people, throughout their lives, will have little first-hand contact with large wild carnivores, yet these animals have a tendency to elicit strong emotional responses, making their conservation a complicated, yet pressing issue (Kellert et al., 1996; Jacobs et al., 2014). Whilst generally regarded as being of high value on a global scale (Dickman, Macdonald and Macdonald, 2011), people who live in close proximity with large carnivores, are more likely to have negative attitudes, often based on the perceived threat to people, pets and/or livestock (Cavalcanti et al., 2010; Marchini and Macdonald, 2012; Engel et al., 2016). Negative attitudes and mistrust of carnivores often results in the persecution of these animals, and indeed, hunting, along with habitat loss and the loss of prey species are the biggest threats to the long-term existence of many carnivore species (Clutton-Brock, 2003; Treves and Karanth, 2003; Majić et al., 2011). This is the case for the Jaguars throughout much of their range, including Brazil (Weber and Rabinowitz, 1996; Rabinowitz, 2005; Cavalcanti et al., 2012).

Jaguars, like most wild felids, are naturally illusive and in low abundance. Thus, most people living in communities adjacent to jaguar habitat will have little personal experience with these animals, especially in dense forests habitats such as the Amazon or Atlantic Forest. Consequently, most people base their attitudes towards jaguars on emotion or information from outside influences such as the media, social norms and peer-to-peer interactions. Understanding the mechanisms of how people form attitudes towards jaguars is important for deciding mitigation strategies aimed at changing attitudes, more specifically, the acceptability of killing jaguars.

To date, most studies on human-jaguar conflict in Brazil have been conducted in rural areas such as the Pantanal (Rabinowitz, 2005; Zimmermann, Walpole and Leader-Williams, 2005; Marchini and Macdonald, 2012; Porfirio et al., 2016), the highly modified areas of Atlantic Forest (De Angelo, Paviolo and Di Bitetti, 2011; Engel et al., 2016, 2017) and the southern frontier of the Amazon Basin (Michalski et al., 2006; Marchini and Macdonald, 2012), that support both jaguars and large numbers of domestic cattle. These studies have shown mixed results when investigating the

influence that perceived threats to cattle have on local's attitudes towards jaguars. For example, Zimmermann et al. (2005) found no link between reported loss of cattle as a result of predation by jaguars and attitude towards jaguars. On the other hand, Marchini and Macdonald (2012) found that ranchers with higher perceived cattle losses due to predation by jaguars had more negative attitudes towards jaguars. Interestingly, perceived danger towards people was almost equally important as a predictor of negative attitudes towards jaguars in this study. Given that attacks by jaguars on humans are extremely rare (Neto, Neto and Haddad, 2011), this suggests that the perception of danger that jaguars represent to these farmers are indeed largely based on misguided beliefs and social constructs.

Even in areas where cattle are absent or of low economic importance, and thus, depredation does not play a factor in influencing attitudes, the hunting of jaguars still remains relatively common. For example, a study that interviewed hunters from 45 communities in the Tapajós–Arapiuns Extractive Reserve, in the state of Pará found that at least 32 jaguars had been killed in the reserve over a 10 year period. Santos (2009) suggested that the two species most at risk in the Sustainable Development Reserve Piagaçu-Purus ((RDS-PP), the reserve in which part of the current study is conducted) were the large carnivores, the anaconda and the jaguar (together with the puma). Although, hunters in these regions may consume the meat or use the skin of these species, in most cases the motivation for killing was fear or disdain. Cavalcanti et al. (2010) showed that fear of jaguars was higher in Amazonian frontiersmen than ranchers from the Pantanal that have more experience with jaguars. As many Amazonian non-indigenous settler communities are less than 100 years old (B. L. Barham and Coomes, 1994), residents of these areas are likely to have less cultural ties to jaguars than those from other parts of Brazil, and especially members of indigenous communities.

Before the arrival of European settlers, Jaguars and Central and South American Paleoindians had been co-existing for at least 13,000 years (A.C. Roosevelt, 2013). This is despite the fact that, particularly towards the end of this period, many

indigenous populations had reached considerably high densities. This coexistence has been attributed to the prominence of Jaguar symbolism and worship throughout all indigenous cultures (Shepard, 2014). For example, Mayan, Aztec and other Mesoamerican civilizations, associated the jaguar with power, nobility, courage and shamanic transformations, in which the most accomplished warriors could turn into jaguars (Saunders, 1989, 1998; Benson 1998). Jaguars also play an important role in shamanism in Amazonian indigenous cultures (Reichel-Dolmatoff, 1975), as well and having been credited for giving fire to the Kayapó people in the Central Brazilian Amazon (Turner, 2017). The positive attitudes associated with such beliefs appear to have outweighed any negative associations that may have been linked with fear and mistrust.

As well as narratives of sacred jaguars and shamanism, Paleoindians of the Amazon Basin, as with many pre-literate societies, used folklore and oral traditions in day-to-day life and to pass on information and moral values from generation to generation (Coelho, 2003; Ribeiro et al., 2015). In the absence of written word, such oral literature was a major factor in the long term success of these societies and was often used to emphasize the importance of sustainable use of resources. For example, one indigenous legend is the Curupira, a guardian of the forest, who pursues any hunter that kills more than he needs to feed his family (Smith, 1996; Cascudo, 2012, 2015). Other legends are thought to be recounts of megafauna that coexisted with earlier indigenous ancestors, with stories having been distorted by time, such as the Mapinaguri, a large hairy beast, possibly based on the Giant Sloth (*Megatherium* sp.) which was distributed throughout much of Brazil including the Amazon, and coexisted with the Paleoindians for several thousand years before going extinct (Oren, 2001; Steadman et al., 2005; Velden, 2016). This shows the importance of storytelling in traditional cultures, and although quite robust, these stories are susceptible to change over time.

During the early-to-mid 1900s, large numbers of workers from north-eastern and southern parts of Brazil, moved into the Amazon Basin following a period

of economic growth, driven by the rubber boom and the exploitation of other resources, as well as developmental projects supported by the Brazilian government (Smith, 1996). These frontiersmen spread throughout much of the Amazon, particularly along the rivers. They created small communities which also included members of indigenous tribes and decedents of Afro-Brazilian slaves, who had also been brought in to work in the fields and forests (Smith, 1996). From here forward, this paper will focus primarily on isolated riverine communities, known locally as “comunidades ribeirinhas” (and community members known as ribeirinhos), but many parallels could be made with other communities based on terra firme. Ribeirinhos adopted and adapted folklore from the three worlds (African, European and indigenous) (Cascardo, 2012, 2015), creating mythology and legends that still remain culturally important today. However, not all indigenous mythology seems to have been incorporated into modern-day riverine community life and there is little evidence that spiritual connections to jaguars are common place amongst community members (Cascardo, 2012; Barros, 2014; Pereira, 2015).

Thus, unlike indigenous communities who managed to live side-by-side for thousands of years with jaguars, members of Amazonian riverine communities are likely to be less tolerant of jaguars, as they have little cultural or spiritual affinity to these animals, and less accumulated experience and knowledge, even compared other regions of Brazil, such as “pantaneiros” (residents of the Pantanal). The current study area lies along the lower Purus River in the municipality of Beruri, and includes four small riverine communities and the town of Beruri. Two of the communities within this study area are situated within the Sustainable Development Reserve- Piagaçu-Purus, which allows the sustainable use of natural resources within the boundaries. The region is very isolated, underdeveloped with little contact with outsiders. Thus, as with pre-literate communities, verbal communication and storytelling still play an important role in passing information between community members, as shown by the continued prominence of folklore within these communities. Taking this into consideration, this study will investigate the parallels between the belief in local folklore, and verbal

narratives of jaguar encounters in how they are accepted by community members, and how the tendency to believe in folklore correlates with attitudes towards jaguars.

2. LITERATURE REVIEW

2.1 A Short History of the Amazon

The Amazon Basin covers an area of nearly 7,000,000 km² and is the largest continuous expanse of tropical forest in the world, and holds one in ten of all known species of plants and animals (WWF, 2019). The basin covers parts of Brazil, Peru, Colombia, Venezuela, Ecuador, Bolivia, Guyana, Suriname, and French Guiana (WWF, 2019) and was created around 10 million years ago when the Andes Mountains rose, forming a barrier changing the direction of the Amazon River, which had previously flowed from east to west (Costa et al., 2001; Bush et al., 2015). Around 7 million years later, the Panamanian land bridge was formed by oceanic volcanic activity leading to the Great American Interchange, in which wildlife dispersed between continents, further increasing biodiversity in South America (Marshall et al., 1982), 1982). Around 13,000 years ago, the first humans are believed to have arrived, crossing the Panamanian Land Bridge and spread throughout much of South America (A. C. Roosevelt, 2013).

These early settlers foraged the forests and rivers spreading throughout much of Amazon. Evidence from archaeological campsites and the surrounding forest plant community suggests that soon after arrival Paleoindians started to propagate important plant species such as herbs and fruiting palms and substituted their diet with small-medium sized fish, turtles and tortoises with remains of small mammals being rare and large fish (such as pirarucu (*Arapaima gigas*) and mammals being absent. The groups likely functioned in bands, which is considered to be the most primitive of societies (Roosevelt, 1999). Bands are generally family and extended family groups of around 25-100 people, nomadic or semi-nomadic hunter-gatherers, have no or little social hierarchy structure and the members have no specialized role. This style of semi-nomadic foraging continued for around 4,000 years and population densities remained low (Imazio da Silveira, 1994; Barnett and Hoopes, 1995). Over the next 4,000 years, there was a gradual shift to a more sedentary lifestyle, in which village sites were often settled around productive river sites with permanent high ground (Stahl, 2006; Oliver,

2008). Larger fish and medium-sized mammals began to become more common in the diet as did a higher reliance on forest horticulture of useful palm species and manioc as well as the use of slash and burn agriculture (Roosevelt, 1999; A. C. Roosevelt, 2013). It was long believed that this was the pinnacle of Paleoindian societal development and that the tropical forests could not support sophisticated or densely populated societies due to poor soils and hostile environmental conditions. Early archaeological studies and reports from most early European settlers supported the idea of small sparsely populated unsophisticated indigenous communities that had little influence on their surrounding environment (Steward, 1949; Meggers, 1954; Evans and Betty, 1960).

This idea of small frequently moving autonomous villages, which lacked socio-political complexity, reliant on either foraging or simple shifting cultivation economies, with minimal environmental impact began to be challenged as far back as the 1960s by (Lathrap, 1962; Denevan, 1966) but only began to become commonly accepted in the 1990s and 2000s (Viveiros de Castro, 1996; Whitehead, 1996; Neves, 1999; Roosevelt, 1999; Erickson, 2003; Heckenberger et al., 2007). Far from being virgin, pristine forest, the Amazon has been highly manipulated by the Paleoindians and many plant species such as açai and the Brazilian nut are found in much higher densities than should occur naturally (Brondizio, 2004). Sites of man-made black soils and large networks of trails connecting trenched village sites (Figure 1) suggest that in many regions throughout the Amazon Basin indigenous communities were large and sophisticated urbanized forest networks (Pärssinen, Schaan and Ranzi, 2009). Indeed, Francisco de Orellana, the first European to sail the length of the Amazon River in 1541-1542 reported to have seen large advanced civilizations flourishing along the Amazon River, in fact, the Amazon River was named after the Greek mythology of female warriors after Orellana's fleet was involved in skirmishes with warring tribes of indigenous that reportedly had women warriors. Orellana returned for a second to the Amazon in 1546 where much of his crew were killed by Indians and he later died of illness and exposure (Peet, 2006). Current estimates of pre-European indigenous

populations currently vary between 6-10 million people (van Solinge, 2010; Woods, Denevan and Rebellato, 2013).

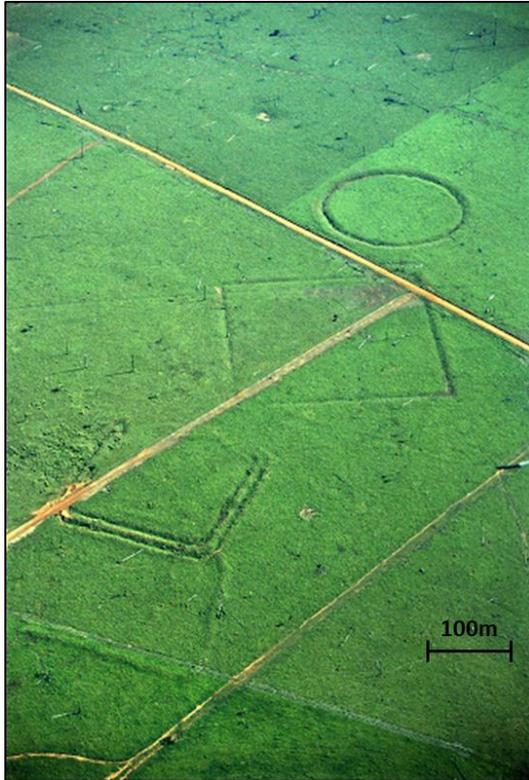


Figure 1. Remnants of indigenous villages on deforested land at the Fazenda Colorada site in the Amazon rainforest, Rio Branco area, Acre. Site dated c. AD 1283 (Pärssinen, Schaan, and Ranzi 2009). Photo: Sanna Saunaluoma.

It would be almost another hundred years before another Spanish led expedition would enter the Amazon Basin in 1637, which found sparsely populated indigenous communities, which led many to believe that he had largely exaggerated much of the tales. This contradicts current evidence from paleontological sites and population density estimate, as well as the observations of Orellana as written in his chronicles (Levy, 2011) and it is likely that during the decades after the first exposure to the European explorers, illnesses such as smallpox and the common flu spread throughout the region. Over the coming decades Europeans continued to invade the

Amazon, spreading diseases and warring with indigenous peoples until, in some areas, up to 90% of the population had been wiped out (Meggers, 1984).

Over the next several hundred years the Amazon was divided into the territories of what is now Peru, Bolivia, Colombia, Ecuador, Venezuela, Guyana, Suriname and French Guiana with Brazil claiming around 60% of the vast rainforest area. Over the next several hundred years, Europeans settled and slowly expanded along the rivers throughout the Amazon, erecting Catholic missions, opening up land for agriculture or exploiting forest and mineral resources for extractivism (Block, 1994; Cleary, 2001). However, the population remained quite low until 1876 when the first major economic boom of the region, which lasted over 30 years, and was driven by the discovery and the international demand for latex produced from the native rubber tree (B. L. Barham and Coomes, 1994; Burke, 2018). During this period, the cities of Belem and Manaus became economic and cultural hubs within the region and there was substantial growth in the population, driven mostly by settlers from the drought-ridden north-east Brazil such as the state of Ceara and Bahia. The demand for Brazilian rubber declined when a number plantations propagated from smuggled seeds were established throughout British controlled Malaysia, Sri Lanka, and parts of Africa (B. Barham and Coomes, 1994; Coomes and Barham, 1994). A second short-lived rubber boom occurred in Brazil as a result of Japan taking control of the Asian rubber plantations during the Second World War from 1942-45, which saw a further surge in the regional population as tens of thousands of workers moved into the Amazon from other parts of the country (Coomes and Barham, 1994).

There have since been a number of boom and bust periods that have encouraged the migration of people into the Amazon from other parts of Brazil such as the south and the north-east in order to extract resources such as gold, diamonds, animal products such as furs and meat, fish, wood, fruits, and Brazil nuts (Smith, 1976; Cleary, 1990; Hecht and Cockburn, 2010). Like other parts of Brazil, albeit on a smaller scale, slaves of African descent were brought in to work in agriculture, collect resources and work in mines (Smith, 1996). Also, during this time, government-backed

colonization schemes built thousands of kilometres of roads and major highways that would connect major cities, not only allowing movement between cities but for the first time making large scale land clearing and agriculture viable, attracting rich landowners (McNeill, 1986; Leite et al., 2011). The influx of settlers and slaves from different areas of Brazil, along with the members of the indigenous groups created diverse communities of people of mixed races, known as Caboclos, intertwining indigenous, afro and western style cultures with different stories, customs, and religious and spiritual beliefs.

2.2 Ribeirinhos - Life on the Water

Amazonian Ribeirinho communities are ethnically and culturally diverse, made up largely of members of indigenous communities, descendants of African slaves, Portuguese and Spanish colonialists, and more recent settlers from other parts of Brazil (Smith, 1996). As the name suggests, the Ribeirinhos (which means those that live on the river) have a close relationship with the river, which is their lifeblood, supporting them with fish and river game and supplying their agriculture with water and nutrients. Communities are scattered across the many thousands of kilometres of rivers and their tributaries that make up the Amazon Basin and are often the main (or only) means of travel between communities and cities. Inter and intra-seasonal variation in water level in the Amazon can be immense, with a difference in water levels between wet seasons (which peaks April-June) and dry seasons (which peaks September-October) being around 15 meters in the Rio Negro, measured at the port of Manaus (Amazonwaters.org, 2019). This extreme and sometimes unpredictable fluctuation in water levels can make life complicated. Even though most houses along the rivers are built high up on the river banks, often on stilts, the water level may flood much of the community during extremely wet wet-seasons. Conversely, during the dry season, when the river retreats, ribeirinhos may be forced to walk several hundreds of meters down muddy banks to reach the waters' edge, in order to access boats, collect water and delivered supplies and to swim and bathe.

In order to deal with these huge fluctuations in water levels, the resilient ribeirinhos have adapted houses to float on top of the water, anchored by adjustable cables that allow them to ensure that the house stays floating along the river bank as the water level rises and falls. These wooden houses are built on top of large (>1 meter in diameter) tree trunks of old fallen trees, which offer an extremely stable floating base, with the main floors being raised around a meter above the water level (Figure 2 B). The river functions as sewerage disposal with toilets often being either a simple hole in the house floor or a flushing toilet that empties directly into the river below. Worryingly, the same river is used for bathing, with the "bathing area" often being a section of flooring (inside the house), or platform on the side of the house, at water level. Baths are usually taken with a bucket directly from the river. Notably, toilets and bathing areas are usually placed at the opposite ends of the house in hopes of reducing the likelihood of contamination. In many cases, this is likely for naught, as in all but the smallest communities, the river bank will be lined with dozens of flutuante houses using the river in this way. Water pollution from raw sewerage becomes particularly problematic during the dry season when the river recedes and there is less water to flush out the sewerage, making it more concentrated.

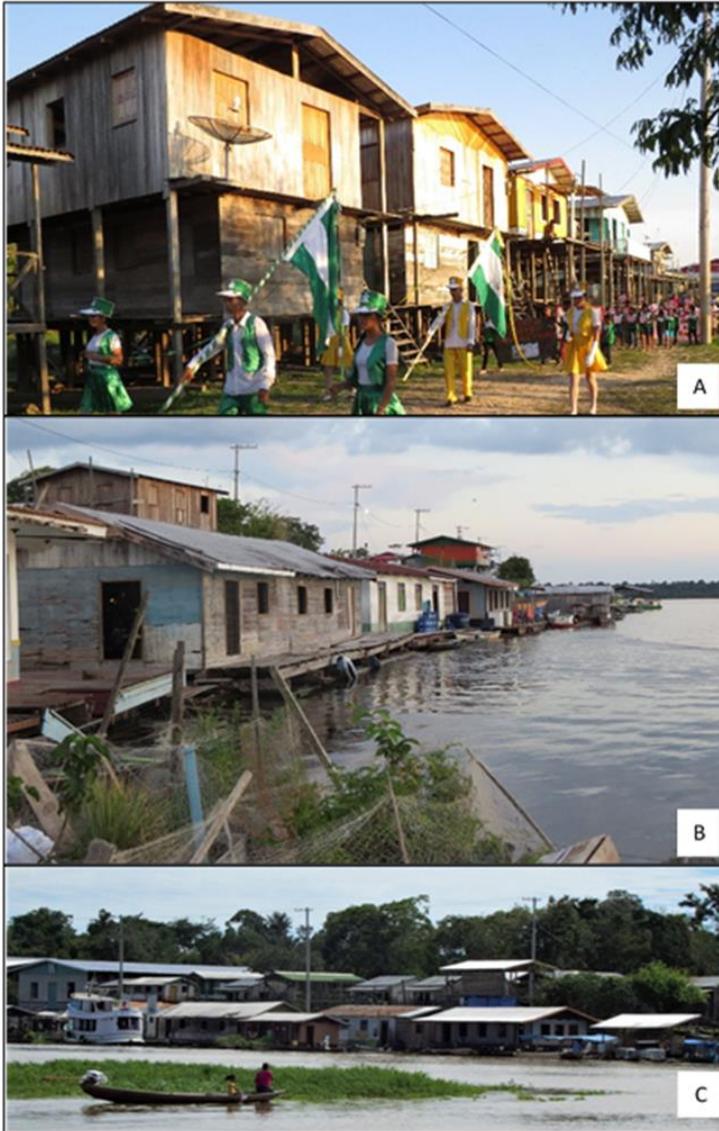


Figure 2. a) Houses on stilts built along the bank of the Cuiuanã River, the highest area of land in the region. Photo taken during annual parade by school students of the community. b) A line of floating houses (flutuantes) in the riverine community of Cuiuanã. In the foreground is a small floating garden. Behind the floating houses are houses built on stilts on land that seasonally becomes flooded. c) Riverine community on the outskirts of Beruri, Purus River. Photos (Jacob Charters, 2018).

In the absence of roads in many regions, the rivers are the highways of transport for people and supplies of all kinds. Large wooden boats (recreios) with up

to 4 levels are the main mode of bulk transport throughout the Amazon. These boats chug slowly up and down the lengths of the main rivers carrying cargo and passengers. A trip from the city of Belem in the east of Para, for example, takes five days to reach Manaus, a journey of around 1,600km. Whilst traveling in these large open-sided boats, passengers sleep and spend most of the time in hammocks that are arranged by each person, and hang from the roof. There may be hundreds of people and hammocks on these boats and space can be quite tight (Figure 3 D).



Figure 3. A) Young girl travelling between floating houses in the community of Itapuru, lower Purus River using a locally made canoe and oar. B) A typical boat used by “ribeirinhos” for fishing and trading, towing a aluminium dinghy and wooden canoes. C) Port of Manaus. In the foreground is two larger aluminium dinghies (lanchas) with high powered motors. In the background are large passenger “recreios” (right) and smaller high powered “lanchas” (left) used for high-speed travel. D) Hammocks on a recreio on-route to Beruri.

Within the communities, the main form of river transport for short distances are canoes (Figure 3 A), either in the form of a “dugout” which is made from

a single piece of wood from a tree trunk, or made from wooden planks. The dugouts were originally made for hunting Amazonian river manatees (*Trichechus inunguis*) as these boats are able to glide through the water generating little water disturbance due to their smooth hulls), or made from wooden planks. Ribeirinhos use these boats for small scale fishing and hunting aquatic game species such as ducks, capybaras, turtles, cormorants and until the recent past, manatee. They may also use the canoes to silently patrol along small rivers or flooded forests hunting land-based or arboreal game such as deer, peccary, paca, tapir and some of the larger monkey species along the river banks or forest canopy. Whilst hunting, or traveling short distances hand-made wooden oars will be used, whilst a small single cylinder 5-7 horsepower engine with an extended axel and propeller will be used for longer trips and when silence is not a priority. These are typically Honda engines, which are favoured for their low cost, reliability, and simplicity.

Other common boats that are used in the Amazon Basin are the larger wooden canoes (~7 meters) that are also often built locally and which are used for fishing on larger scales. These deep sided canoes can carry larger nets and more fishermen and supplies, although these boats are generally quite slow, as they are usually powered by the same simple single cylinder Honda engines as the smaller canoes, albeit with a slightly bigger engine capacity.

For community members who can afford them, aluminium dinghies with larger capacity outboard engines (15-200 horsepower) are preferred for travel between communities as they are quick and stable on the water. However, for people living on simple means, these boats are comparatively expensive to buy and expensive to run, as they can use a lot of fuel. In the smaller communities, fuel is often sold in one-litre reused, soft-drink or water bottles (at R\$4.50-R\$5.00 per litre at the time that this research was conducted), often from general stores, often on a flutuante. In fact, due to the logistics and transport costs, most food products that are brought in from outside the region are relatively expensive or very limited. Food products that are brought in must be non-perishable or have a long shelf life. Usually, only fresh produce

that is grown on the often limited agricultural land in the local region is available. For this reason, the ribeirinho diet relies heavily on fish protein, which is abundant and readily available for most residents of riverine communities.

The Amazon Basin is one of the most biodiverse and productive water systems in the world for freshwater fish species, with 2,320 known fish species, including 1,488 that are endemic (Abell et al., 2008; Goulding, 2013; Winemiller et al., 2016). Of these, around 20 species make up over 80% of the commercial catch in the Amazon. These are mostly schooling or migrating fish that are able to be caught in large quantities. In some areas, commercial species such as the Pirarucu (*Arapaima gigas*) (which is considered the largest freshwater fish in the world) and the Tambaqui (*Colossoma macropomum*) and sadinhas (*Triportheus sp.*) have been continuously overfished for years, with little management or oversight from governing bodies (Queiroz, 2000; Castello et al., 2009). Conservative estimates for the state of Amazonas, suggest that around 80,000 tons of fish are harvested from the rivers, lagoons, and tributaries every year for the commercial market (Batista et al., 2000; Saint-Paul et al., 2000; Junk, 2001; Gandra, 2010). Unlike for the commercial sector, subsistence fishing for the ribeirinhos is far less selective in fish choice, with over 90 fish species are commonly eaten within riverine communities (Smith, 1996; Saint-Paul et al., 2000).

Part of the reason for the heavy reliance on fish in the diet of ribeirinhos in Amazonas is that available land designated for agriculture is limited and planting and harvesting are carried out using hand labour, particularly in areas dominated by flood plain forests with little terra firme (Silva, 2006; Neves, 2009; Fraxe, Pereira and Witkoski, 2011). This means that locally grown crops are often planted on the flood plains and river banks as the water recedes, giving a tight window of time for the crops to grow and be harvested. Thus, crop species may be limited to fast-growing species such as mandioca, beans, and corn, which also play an important role in the ribeirinho diet.

“Roças” are ancient systems of land cultivation in the Amazon, which have been used for centuries by traditional populations, being predominantly annual crops

and subsistence is characterized by the cultivation of small areas of less than two hectares, which are burned and planted (Kitamura, 1993, 1994; Moran, 1993).

The plots are usually planted with annual crops and cultivated for some period (usually two cycles, depending on the quality of the soil) before being left to rest and recover from impoverished soils and invasive weeds (do Nascimento and Martins, 2006; Castro et al., 2009).

The practice of cutting and burning small plots as a system of preparation of the area for agriculture is a means of generating a reasonable crop in forested areas with poor soils. The plots are then abandoned and allowed to recover, creating a mosaic of agricultural plots, primary forest, and secondary forest patches (Moran, 1993).

Among the species of cultivated plants present in roças, tubers are probably the most domesticated in the lowlands of South America, among them mandioca (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), taioba or taiá (*Xanthosoma sp.*), Ariá (*Maranta lutea*), araruta (*Maranta arundinacea*), caer (*Dioscorea alata*) among others (Martins, 2005; Silva, 2006) (Martins, 2005). Other crops that make up this system are rice, maize beans, pineapple, cashew, banana, peanuts, and fruits.

Mandioca is a particularly important crop in many areas of the Amazon, as it is used to create Farinha; a dry grainy carbohydrate that is eaten with almost every meal. To make Farinha, the mandioca tuber is peeled and washed, and then the white mandioca is placed in a mechanical processor which turns it into a fine pulp. The pulp is then compressed in a large press to remove the water and slowly dried over a very large pan over a fire, where it is constantly stirred with a wooden ore (Figure 4.). This process is extremely labour-intensive and time-consuming. Usually, the whole family is involved. The Farinha is stored in large barrels to last the family for the rest of the year, and excess is sold.



Figure 4. Family drying farinha from manioc in the community of Cuiuanã.
Photo: Jacob Charters, 2017.

As well as fishing, hunting is an important part of life in isolated communities. Whilst the hunting of native wildlife is illegal in Brazil, there exists a law that states:

LEI Nº 9.605 de 12 de Fevereiro de 1998

Art. 37 "Não é crime o abate de animal, quando realizado:

I - em estado de necessidade, para saciar a fome do agente ou de sua família

(it is not a crime to hunt animals when it is done out of necessity to sustain one's family).

In some regions, government-backed sustainable-use reserves allow its residents to hunt (and fish) for subsistence purposes. In other regions, hunting is conducted illegally, including in national and state reserves and puts ever-increasing pressure on native populations of game animals and causes many knock-on effects such as loss of prey for large carnivores (Wolf and Ripple, 2016) and a lack of seed dispersers for native forest plants (Brodie et al., 2009).

2.3 Sustainable Development Reserve

Part of the current study area lies within a large reserve (Reserva de Desenvolvimento Sustentável Piagaçu-Purus ()) that promotes conservation utilising residents of small local communities to patrol the boundaries of the reserve in return for access to natural resources based on a quota system.

Sustainable development reserves are protected area units that aim to preserve the natural environment within its borders whilst promoting the sustainable and responsible use of natural resources by those that inhabit the area. Historically, natural resources have played an important role in the social and economic development of the Amazon region. However, these reserves are often extremely isolated, cover vast areas, and in many cases have in the Amazon, have pre-established non-indigenous communities within its borders. This means that any attempts to manage poaching and illegal exploitation of resources would be extremely difficult, expensive and almost certainly doomed to fail (Nepal and Weber, 1995).

The first Sustainable Development Reserve (RDS) to be created in Brazil was RSD Mamirauá, This conservation unit was first established as a direct result of a request sent in 1985 by biologist José Márcio Ayres and photographer Luis Cláudio Marigo to government (at the time, the agency responsible was the SEMA - Special Secretariat for the Environment), in order to protect endangered populations of Bald-Headed Uakari monkeys (*Cacajao calvus*) (Queiroz, 2005). In response to the biologist's proposal, SEMA created the Mamirauá Ecological Station in 1986, and it was transferred to the administration of the State of Amazonas, which received it through Decree No. 12.836 on March 9, 1990, in which expanded its limits, totalling 1,124,000 ha (Queiroz, 2005). The Ecological Station is a category of management of conservation units with complete protection, which prohibits people from living within the park borders. The restrictions of this category of management were not feasible as there were already a number of ribeirinho communities spread throughout the area. After a number of years of collaboration and negotiations with stakeholders, the Mamirauá Ecological Station

was changed to become categorized as the first Sustainable Development Reserve (Queiroz, 2005).

The group of researchers realized that without the participation of the local population, both in the management of resources and in the management of the area, the conservation unit would not be viable in the long term. For this reason, according to the proposal at the time, people would continue to have the right to reside in the area and use local natural resources, provided they comply with the rules of the management plan and comply with the zoning system that was developed for the unit. Importantly, the approach to management was to be based on the combination of scientific knowledge and traditional knowledge. A strong research program was implemented both to provide subsidies locally for the regulation of the management plan norms as well as the basis for influencing public policies at the regional and national levels. The main characteristic of the RDS model that was created was the participative management allied to scientific research.

This conservation model, in which the residents of the conservation unit work in conjunction with institute officials to i) use resources in a sustainable manner (for both subsistence and small-scale commercial purposes); and ii) minimize the illegal extraction of natural resources e.g. poaching (by people who do not live within the reserve) by conducting regular patrols; has been so successful that this model has been expanded and replicated throughout Brazil. As of 2015, there were 36 RDS units in the country (oeco.org, 2019).

2.4 Oral Literature in Traditional Amazonian Communities

The word "oral literature" is somewhat of an oxymoron; with "Oral" meaning spoken and "literature" referring to the written word. Although pre-literate societies lacked the means to physically record important, detailed knowledge and information, they were able to accumulate thousands of years' worth of knowledge via rich and varied oral traditions—such as folklore, proverbs and the performance of

ceremonial dance and songs —that effectively constitute oral literature (Madden, Bryson and Palimi, 2006).

For pre-literate indigenous cultures, oral literature and verbal communication were the most important means of passing on information. Indeed, throughout the vast majority of our existence, the ability to write and record detailed information was absent (Schmandt-Besserat, 1982), yet we were able to develop quite sophisticated cultures with an in-depth knowledge of the surroundings, by passing on information from generation to generation through oral communication (Madden, Bryson and Palimi, 2006). Information on where to gather seasonal food, how to fashion a weapon, battle tactics, tribal structure, and moral values could be passed on using dance, songs or storytelling. Within traditional indigenous societies, such as the Australian Aborigines, native Papuan New Guineans, and Paleoindians, these forms of oral literature are very ritualistic, and there is great importance on maintaining their consistency over time.

Of course, oral literature, in particular, storytelling, is not the same as having a piece of text in a book that does not change over time. Stories can be influenced by life experience and personal beliefs of the storyteller, details can be changed, forgotten, left out or added. Even small changes to a story can accumulate across time as the story is passed from person to person until the final story has little in common with the original (Nadel, 1937). This may be more common in areas where stories are not practiced or officially seen as a means of passing information. The difference in storytelling culture between the indigenous and ribeirinhos is that storytelling was deeply culturally important and ceremonies were taken seriously, whilst for the ribeirinhos, although verbal communication is the principal means of passing information, storytelling is not treated with great importance and storytelling rituals may be rare.

A literature review for the distribution of each folklore is provided in the appendix (1).

2.5 Mythology and legends of the Lower Purus River

Legends and mythology are omnipresent within the culture of Amazonian communities, whether native indigenous or ribeirinhos (Casculo, 2012). When the Europeans arrived in the Amazon in the early 1500s the densely populated tribal communities had been sustainably managing their resources for thousands of years. Without written text to objectively record information, history and moral doctrines, Amazonian Paleoindians, like most pre-literate societies, used ceremonial dance and storytelling to pass important information, cultural identity, and moral codes from generation to generation (Coelho, 2003; Machado et al., 2019). It has been shown that storytelling can be quite a robust form of passing information, demonstrated by the consistency in which some stories have been maintained across time and space. In many indigenous cultures, such as indigenous Australians, passing on stories to the children is taken very seriously, and often adolescents must demonstrate their knowledge by performing it in front of community members, as part of a rite of passage ceremony before they can be considered as adults (Ross, 1986).

Folklore: is any traditional story, custom or belief that is passed down between generations by word of mouth.

Myths: are stories that are generally considered to be true within the culture in which it told and usually involves mythical or supernatural beings or spirits, and generally depict a far off time in the distant past when the world was different from today.

Legends: are stories that are considered to be true, that describe a time in the less distant past and usually involve a human hero or heroine.

Folktales: are popular stories often told to children either in jest, or as small lessons in morality or etiquette, but is not to be taken seriously. Folktales will not be included in this study.

Following are descriptions of myths and legends that were encountered in the study region of lower Purus River during this research.

2.5.1. Cobra Grande

Probably one of the most wide spread of the Amazonian legends is the Cobra Grande (Cobra Grande), a snake that grows up to 30-200 meters in length (depending on the region) and with the circumference of a 200 litre oil barrel (Smith, 1996; Aculdade, Epartamento and Rograma, 2007). In reality, Green Anacondas, the largest species of snake in South America (and the heaviest in the world) rarely exceed 5 meters although there have been unverified reports of snakes growing up to 11 meters. Anaconda researcher Jesus A. Rivas who has captured and measured over one-thousand green anacondas, has stated that he does not believe that this species can grow over 6 meters and that most estimates of snakes in the wild are drastically over-estimated due to fear the fact that the snake is usually curved or coiled (Rivas, Ascanio and Muñoz, 2008; Anaconda.org, 2019).

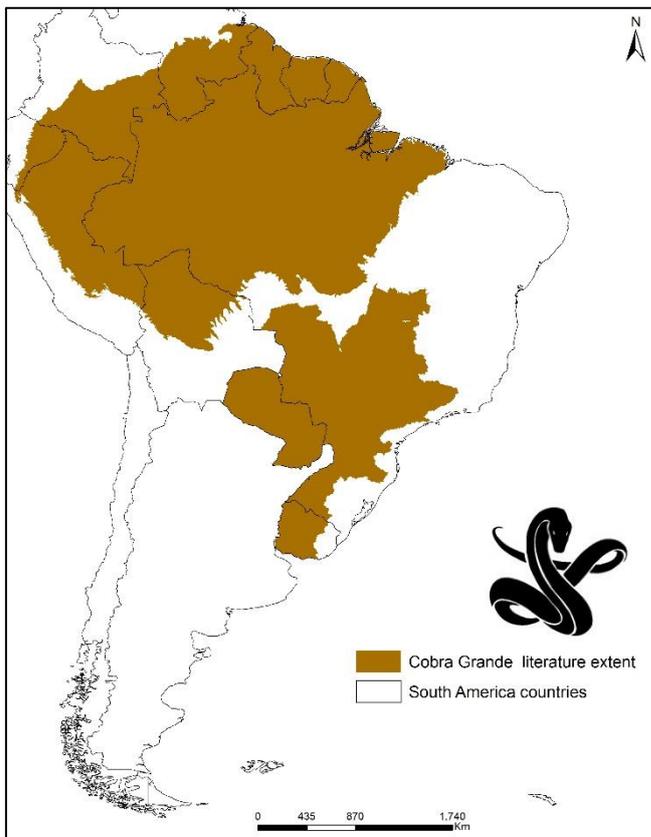


Figure 5. Extent of Cobra Grande by literature.

Like many legends of the Amazon, the cobra grande, also known as Boiunan, is rooted in indigenous culture and is common throughout the Brazilian,

Guianese, French Guianese and Surinamese Amazon (Figure 5) (Gongora, 2007; Santos, 2009; Tol, 2014). Throughout Peru, Bolivia, Colombia, Venezuela, and Ecuador for example, the Cobra Grande is known as Yacumama in the indigenous language of Quechua and translates to “the mother of rivers”. The Yacumama is deemed responsible for having created many of the meandering rivers that are present throughout the Amazon (Gow, 1994; Whitten Jr, 2016). There is also a version of a Cobra Grande from the Pantanal where it is known as the Minhocão ((de Souza, dos Santos and Fontes, 2007)). Interestingly, the Australian aboriginals have a similar explanation for the creation of much of their landscape, with the Rainbow Serpent being attributed to creating the rivers and the mountains in many regions (Radcliffe-Brown, 1926; Taçon, Wilson and Chippindale, 1996). Legends and deities involving Cobra Grandes in Amerindian cultures were present as far north as Central Mexico where the Aztecs worshiped a giant feathered snake god named Quetzalcoatl (Florescano, 2002) (Figure 6).

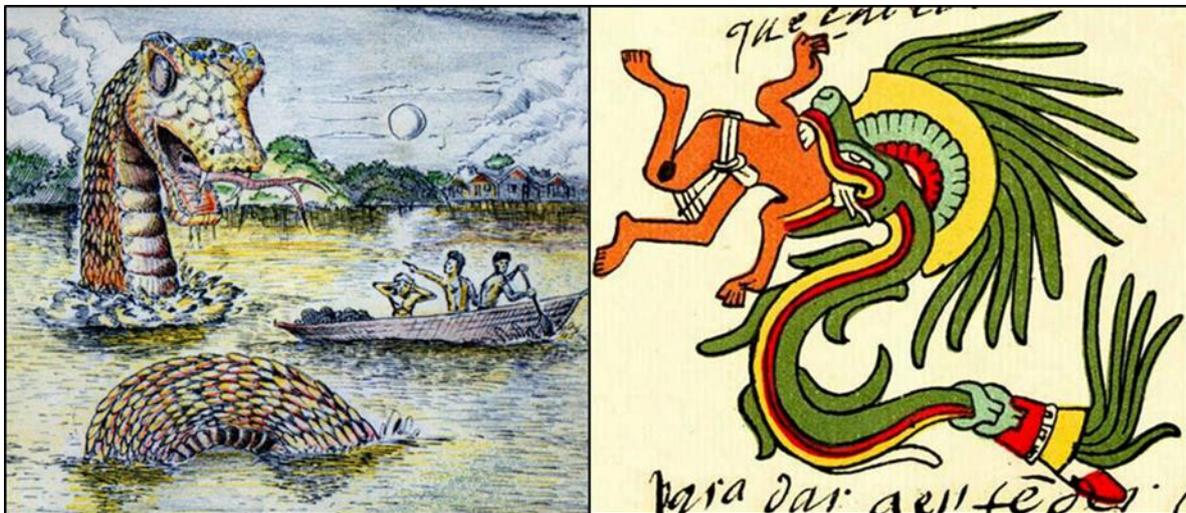


Figure 6. a) Illustration of the Cobra Grande of the Amazon. b) Illustration of the Quetzalcoatl of the Aztec culture.

The origin of the cobra grande may change depending on the region and the individual. Some believe that the Cobra Grande is just an extraordinarily large specimen of the anaconda or boa constrictor that has moved to the deep water to

support its huge size. Others believe that it is a separate species. Others say that the Cobra Grande were people that changed into snakes. She gave birth to two twin children who were born with the appearance of snakes. The boy received the name of Honorato (or Norato); and the girl, Maria Caninana (Caniana is a species of large non-venomous snake (*Spilotes pullatus*) (Smith, 1996; Cascudo, 2012). Frightened by the appearance of her offspring, she decided to throw them into the river. The difference between the siblings' personalities was notorious. That is, while Honorato had a good heart and always visited his mother, Maria, in turn, held a grudge and never visited her. Because of her temperament, Maria was always scaring the population and the animals, or even shipwrecks. His brother, who was the opposite, did not like his actions at all. So, tired and sad with his sister's actions, he decides to kill her to put an end to the suffering of many people. Some versions report that on full-moon nights Honoratus acquired the human form and could walk the earth. However, when the full moon passed he would return to his life in the rivers. The legend of the Cobra Grande is so ingrained in Amazonian culture that even in large towns such as Itacoatiara in the state of Amazonas, there legend of a Cobra Grande that lives in a burrow below the local town Catholic Cathedral (Figure 7) (Chaves, 2013).

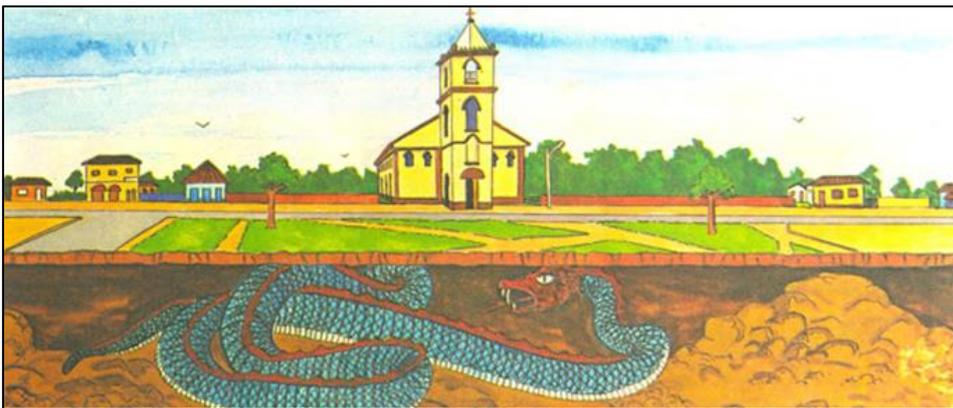


Figure 7. Illustration of the legend of the Cobra Grande below the Catholic Cathedral in the City of Itacoatiara.

2.5.2 Fogo Fátuo and Boitatá

When biomatter decomposes in environments with an absence of oxygen such as marshlands, lagoons or slow-moving rivers, phosphine (PH₃), diphosphane (P₂H₄), and methane (CH₄) gasses are produced, which, when released into the air may become oxidized and combust spontaneously to producing a flame of different colours (blue, white, yellow) depending on the chemical composition of the gasses (Figure 9B) (Edwards, 2014). This phenomenon has sparked the imagination of people around the world, with many different cultures telling stories of luminescent spirits or beings that hover above the water or land. Different folklore stories that are based on the strange and sudden appearance of the floating light have been recorded in Australian indigenous communities (known as the Min Min light) (Moravec, 2003), various regions of Britain, (known as the will o'wisp, fairy fire, Pixy-light or friar's lantern) (Edwards, 2014), Bangladesh (known as the Aleya) (Pandey, 2009), Japan (known as the Hitodama) (Opler, 1950) and India (known as the Chir batti) (Bane, 2016) to name a few.

Throughout the Amazon and other parts of South America this phenomenon caused by decaying biomass at the bottom of slow-moving tributaries or lagoons, or in boggy forest areas, is the likely basis of at least two well-known legends; the Fogo Fátuo, which is a spirit that appears in the form of a flame floating above the water or marsh (Figure 9B); and the Boi-tatá which is a large flaming snake (Figure 9A) (Machado et al., 2019). In the indigenous Tupian language (a family of language made up of over 70 distinctive languages), which, "boi" means snake and "tata" means fire (Pereira, 2015).

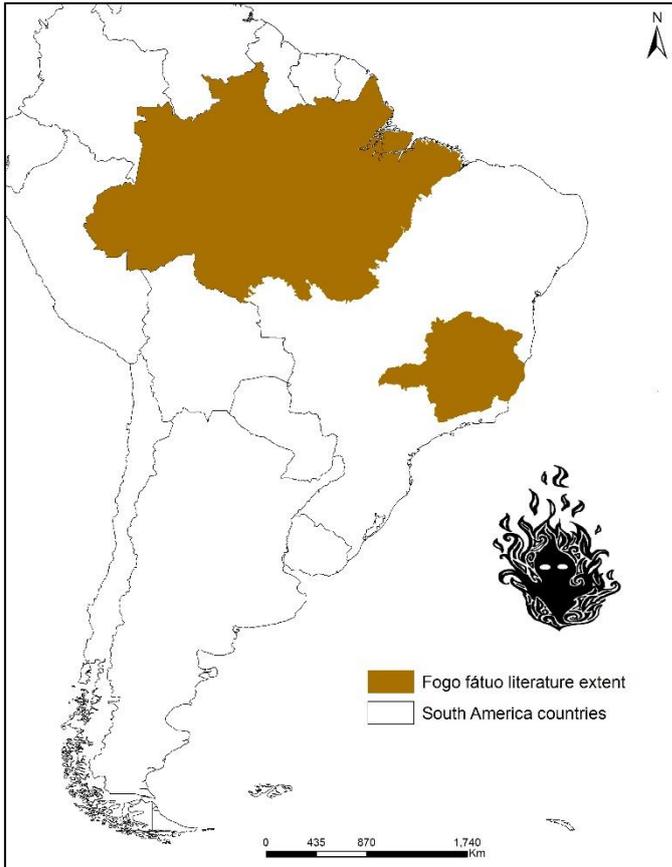


Figure 8. Extent of the Fogo Fátuo based on literature.

The Boitatá, also known as the “Fogo que corre” (the fire that runs) is an indigenous legend that is found from the South-Eastern Amazon to the pampas (where it is known as the protector of the pampas) region of southern Brazil (Figure 8) (Casculo, 2012). It is to be almost blind during the day, but has perfect night vision and is said to be the last remaining species of Cobra Grande that survived from ancient times when many species covered the earth. This creature is said to ward off those who wish to set fire to the pampas or forest, by making them blind, crazy or even killing the perpetrator. The person must not run or the snake will give chase and kill them. Instead, they must shut their eyes and not breathe until the snake passes. The fire of the snake is said to be magic and does not burn the forest or grass, nor does it heat the surrounding water when it moves through the water. In 1560, Father (Padre) Jose de

Anchieta noted that for the indigenous, the Boitatá is one of the most feared creatures in their culture (Machado et al., 2019).

The Fogo fátuo is a more benign spirit that appears above the water of forest floor in throughout the Amazon, although it may try to attract curious passers-by or follow fishermen into dangerous situations as they pass in their boats (Casculo, 2012).

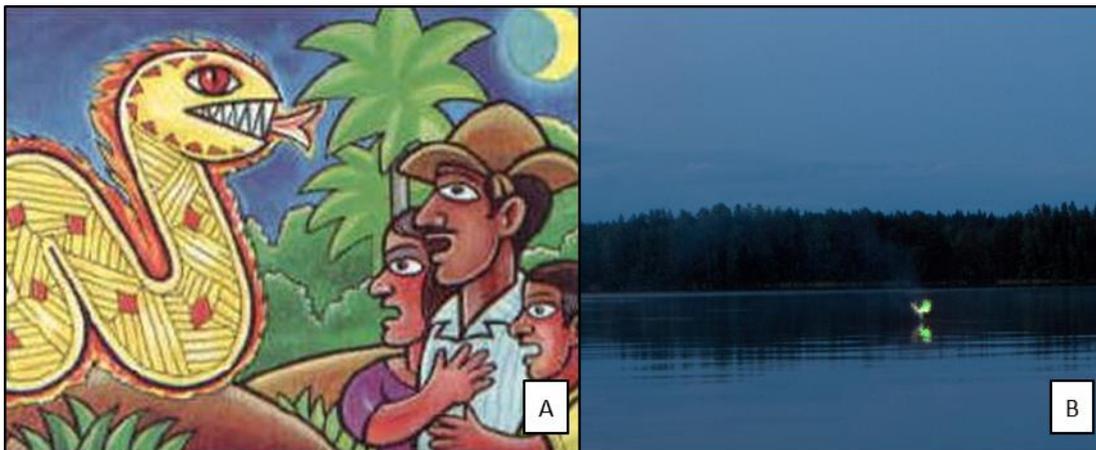


Figure 9. A) Illustration of the Boitatã of the north-east of Brazil. Picture. B) A photo of a gaseous release of methane and prosthine from decomposing biomatter combusting spontaneously over the water surface. Photo: Tuohirulla (2006).

2.5.3. Curupira and Caipora

Unlike the cobra grande and fogo fatuo mentioned above that have similar legends throughout the world, the Curupira and Caipora are quintessentially South American Indian legends. The Curupira has heroic attributes as a protector of nature. Father José de Anchieta made the first records about the legendary Curupira in 1560, which proves that he was already known in Brazil since the pre-Columbian period as an entity that loves the forest. This mythical being is a folkloric originating from Tupi-Guarani ("curu" comes from the word curumim, which means boy or child + "pira",

meaning "body", boy's body). His heroic attributes undergo local variations, and is found throughout the Amazon, as well as the state of Espírito Santo (Figure 10B) (Coelho, 2003; Cascudo, 2012; Tol, 2014).

The Curupira is a supernatural being who inhabits the woods and instills fear and terror into the Indians or ribeirinho hunters, and demands something in return to leave them alone, imposing laws to limit the destruction of forest life (Smith, 1996). He can appear in a hominid-like form with small with long, thick, scruffy red hair, green teeth that shine like emeralds, and feet and legs that face backwards that he uses to confuse hunters who may stumble upon his tracks; or he can turn himself into an animal, such as a peccary or forest deer, to get close to hunter. One of the characteristics of the Curupira is its fondness to perform tricks on the hunters, such as, imitating animal noises, confusing the hunter dogs to put them off the trail of game animals or making the hunters become disoriented and walk in circles until they are lost deep in the forest, sometimes never to be seen again (Smith, 1996). He may also shake trees whilst hunters are perched above the ground on pre-made platforms in which they sit and wait for game animals to pass below, usually attracted by salt or some other type of bait. If a hunter comes across a freshly fallen tree and sees that the wood is not rotten and there has been no strong wind, he knows that it must be the Curupira who is warning the hunter of his presence and that he must not hunt in that area. The Curupira can also put curses on hunters such as making them unable to successfully hunt again. Hunters can avoid these tricks with offers of tobacco upon entering the forest during hunts (Smith, 1996; da Câmara Cascudo, 2015).

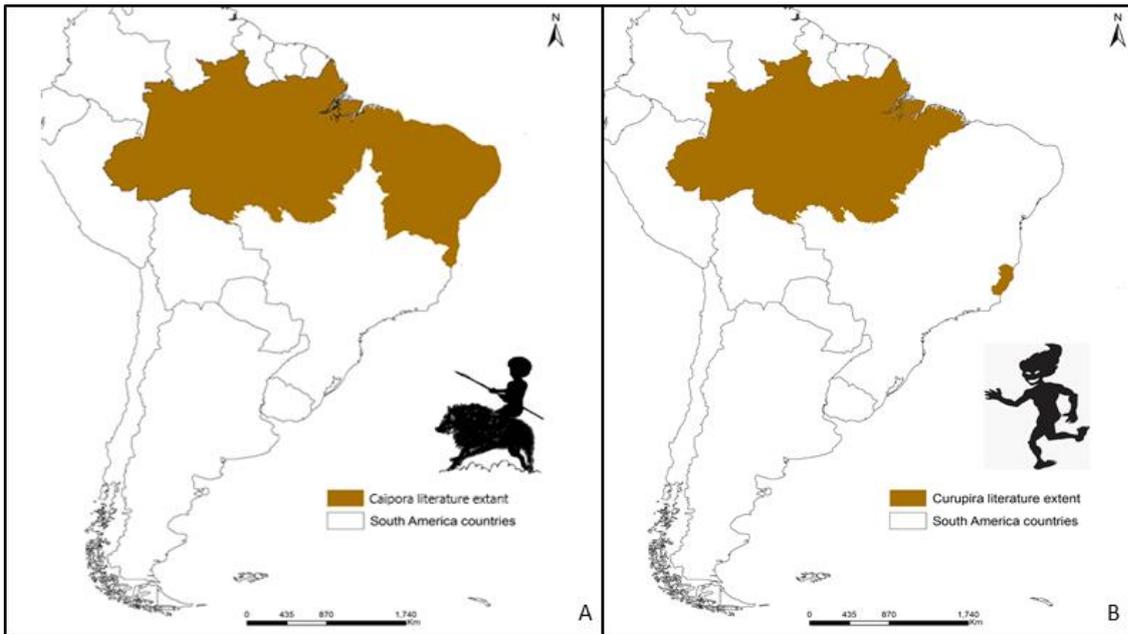


Figure 10. Literature extent of (A) Caipora and (B) Curupira.

In the indigenous culture, there is also a hierarchy, in which there is a lower world inhabited by Anhangá, a god of the bad, while the Curupira has the function of protecting the forest and the animals against the destructive action of the men, being recognized like "mother of the forest". It is worth mentioning that the Curupira is an entity that is male, albeit, with some feminine attributes, who cares, protects and defends the nature like "mother" (Smith, 1996). Hunters who remember to offer tobacco and only hunt enough to sustain themselves and their family do not need to fear the Curupira, and in fact, he can be very generous and ensure that thoughtful hunters never come back from a hunt empty handed. However, those who hunt excessively, or for fun, or those who purposely kill immature game animals or females that are pregnant or with offspring, will suffer the consequences of the Curupira's meddling (Smith, 1996).

The Caipora or Caapora, which in Tupi-Guarani means "caa" - bush and "pora" - inhabitant, is very similar in physical and behavioural attributes to the Curupira and is more common in the north-east of Brazil but the story does appear throughout the Amazon (Figure 10A). In some cases the Caipora is female, and unlike the Curupira, does not have feet facing backwards (Tol, 2014).

2.5.4. Matim

The Matim, also known as Matim-tapêré, Matim-tapirera, or Matintaperera, is a legend that is widespread throughout the Brazilian Amazon and is probably the story that has the most variations (Figure 11) (Smith, 1996; Cascudo, 2012). Generally, the Matim is depicted as a poor elderly woman who turns into a blackbird, sometimes an owl, but in other cases, the Matim is portrayed as an old man, or shaman (Smith, 1996).

One version tells the story of a young lady named Matim many many years ago who was known for her bright and friendly personality and her love for smoking tobacco. However, her husband as an angry, jealous man and a heavy drinker, and they would often fight. One night, when she was pregnant with their first child, the husband arrived home drunk and started yelling and fighting with her. They argued and the husband ended up killing his wife. However, she was protected by a spirit, which allowed her to survive as an old woman during the day and a small owl during the night. As Matim liked to smoke, the old lady, dressed in long, ragged dark clothes knocks on the doors of people's houses asking for tobacco. If the person refuses, she returns during the night and leaves the foetus of her dead child at the front door. She also knows when a family member is sick and will appear beside the house in owl-form and 'hoots' (sings) outside the bedroom window (Pereira, 2015).

Another version features a small black bird that sings during the day "tin-tin-ting" and is considered as a bad omen. Smith (1996) reports a story of two hunters who whilst walking through the forest see an elderly figure in the shadows of a large tree in the distance. When the hunters asked the man to identify himself, he let out a high pitched whistle. One hunter fired upon the man, and the figure vanished. The hunters returned home, the whistling followed them and the noise continued through the night as they tried to sleep. Then an invisible-shadowy force flung one of the hunters from his hammock, before going outside and attacking the dogs, but the men dared not follow the Matim outside to investigate (Cascudo, no date).

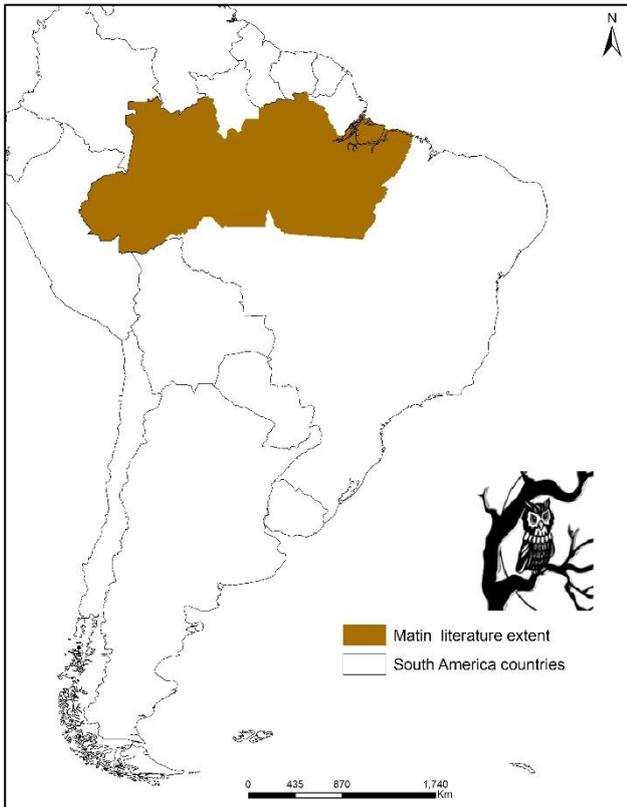


Figure 11. Literature extent for Matim

The legend of the *Martim-tapêré* is specifically reported to have featured in the culture of a number of different tribes. However, there is richness of different indigenous legends involving people who turn into singing birds, shaman-characters who mysteriously play the flute unseen in the adjacent forest, or invisible spirits that like to torment and harass their victims, and some of these may have been combined and altered and manifested into a legend under a single name (Cascardo, 2012).

This appears to also be the case for the *Saci Pererê*, which is a caboclo legend of an African-caboclo boy with one leg who smokes a pipe and lived in the forest and liked to scare and play pranks young children (Cascardo, 2012). For example, the indigenous legend of *Jaci Jaterê*, which literally translates to part of the Moon, is unique among his brothers not to possess a monstrous appearance (Goulart, 2014). He is usually described as a man of small stature, or perhaps a child, and sometimes with blue eyes. It has a distinct appearance, sometimes described as beautiful or charming,

and carries a magic stick or staff. He leaves the forest and goes through the villages looking for children who do not rest during the siesta. Although he is naturally invisible, he shows himself to these children and those who see his staff fall into trance or become cataleptic. Some versions say that these children are taken to a secret place in the forest, where they played until the end of the siesta, eventually receiving a magic kiss that returns them to their beds, without memory of the experience. This shows how storytelling is very fluid and can be largely influenced by time and likely manipulated the personal experiences of the storyteller, and may also suggest that many ribeirinhos may be very quick to place any unfamiliar sound or disturbance which causes anxiety under the vague umbrella of the legend of the Matim.

2.5.5. Homem Boto

Homem Boto, also known as the enchanted dolphin, is a pink dolphin that, at midnight, especially during community festivals or parties, exits the water and turns into a handsome, well-groomed, (usually blonde haired) man with a white dinner coat and hat. He is very charismatic, a good dancer and is known to use his charm to try and seduce the prettiest girl in the village. If a young girl was to fall unexpectedly pregnant, especially after a party, surely it was the work of the charming Homem Boto. This legend and its variations found throughout the Amazon Basin including Brazil (Santos, 2009; Cardoso, 2018), Peru (Cruz and Simões, 2014), Bolivia (Yañez, 1999) and Colombia (Figure 12) (Pedrosa, 2013).

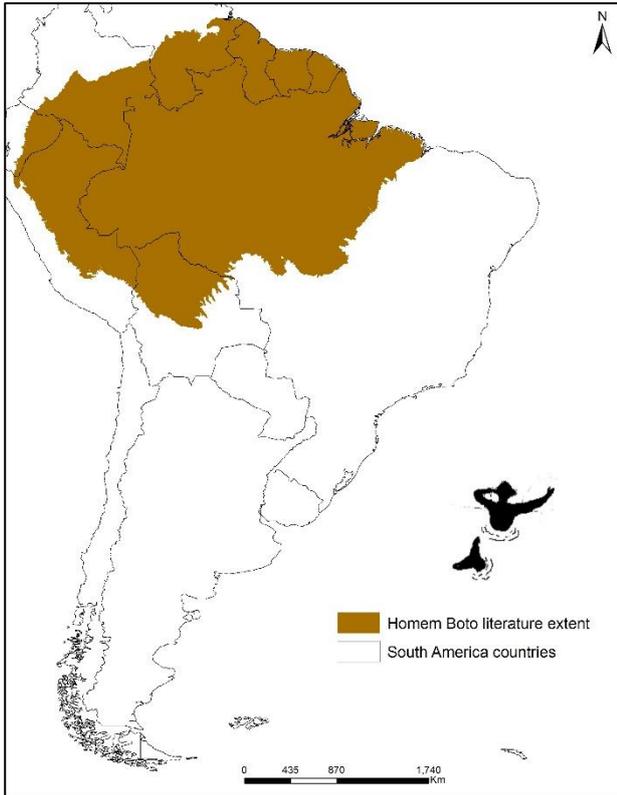


Figure 12. Literature extent Homem Boto.

When he is his dolphin form he will also pursue women that are paddling alone in a canoe, especially if the woman is menstruating. In some regions, the women are advised that should use bruised cloves of garlic to repel the dolphin, either tied to their body, or in the canoe. One can also stab the point of a knife into the wood of the canoe and leave it there whilst traveling to scare the dolphin (Tol, 2014).

Like most legends listed in this paper, the Homem Boto has origins in indigenous mythology although with some obvious influences from the European and African peasant cultures, such as the blonde hair, white hat and jacket, and in some versions he will even drink cachaça whilst dancing at parties. The legend is widespread and well known throughout the Brazilian Amazon, even joked about with affection by city dwellers in Manaus.

2.5.6. Mapinguari

The Mapinguari is also an indigenous legend and tells of an Indian who found the secret for eternal life, but the price he paid was that he was transformed into a large grotesque and putrid smelling beast, with a craving for eating people. This giant creature stands 4-6 meters in height, is covered in coarse black hair with white patches and has depending on the region, has either a second large mouth on his chest or stomach, or has three mouths, with two being under each armpit (Casculo, 2012; Gonzaga, 2013; Machado et al., 2019). The Mapinguari lives in caves and is mostly restricted to “terra firme” in the Amazon (Figure 13) (although the story does also appear in the north-east of Brazil), where he preys upon those hunters of forest workers collecting rubber, Brazil nuts or other resources. After surprising a chosen victim, the Mapinguari can easily carry a full grown man under his arms, eating him piece by piece as he walks, but his favourite part is the head. Unlike most indigenous legends or myths, the Mapinguari is irrational and bloodthirsty and is not considered as a protector of the forest (Cruz and Simões, 2014).

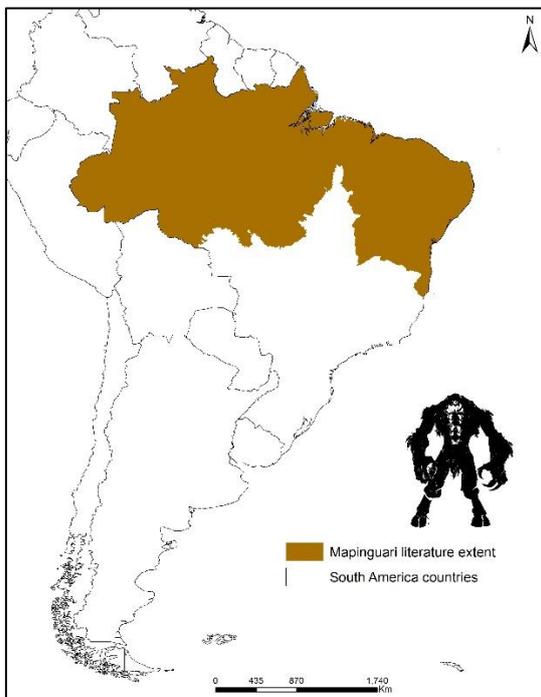


Figure 13. Literature extent Mapinguari

Possible explanations for the creation of this legend could be the mistaken identity of either a Speckled Bear (Figure 14B) (*Tremarctos ornatus*) that has descended from the Andes Mountain forests and adapted to the humid lowland forests, or that the story has persisted from the age in which giant sloths (*Megatherium* sp.) roamed South America 10,000 years ago (Figure 14A) (Steadman et al., 2005; Fiedel, 2009). If either explanation was proven to be the actual basis of the mythology, it would show just how powerful and important spoken word is in indigenous and isolated communities such as the ribeirinhos. The occurrence of a Speckled Bear in the Amazon would be a rare anomaly and surely be isolated to areas that fringe the large mountain range. For such a story to spread throughout much of the vast Amazon Basin, it shows the importance of verbal communication in these communities. Likewise, if the origin of the Mapinguari was ever proven to be based on the prehistoric Giant Sloth, the story was passed on and manipulated for thousands of years is truly impressive.



Figure 14. A) Illustration of the Giant Ground Sloth (*Megatherium* sp.) and B) a Speckled Bear (*Tremarctos ornatus*), two species that may have given rise to the legend of the Mapinguari.

Other examples of legends that resemble long-extinct megafauna have been recorded in indigenous cultures throughout the world. Such impressive animals are likely to have been either important food sources for the tribal groups that coexisted with these animals or, potential predators. As these species became increasingly rarer, eventually becoming extinct, it is plausible that the stories became increasingly embellished as it was passed from generation to generation. In Australia, the Bunyip (which translates to "river demon") is a large swamp-dwelling creature of Aboriginal mythology. Although the description of the Bunyip changes between regions (Holden and Holden, 2001), there are notable similarities to a species of extinct marsupial which was about the size of a hippopotamus and had large incisor teeth and was likely semi-aquatic. In Maori mythology in New Zealand, the Pouakai is a monstrous man-eating bird, that resembles the Haast's eagle (*Hieraetus moorei*) which died out around 600 years ago (Beattie, 1918; Hart and Reed, 1964), and in North America, stories of large, hairy, tusked animals that resemble woolly mammoths exist in indigenous storytelling (Faye, 2001). This emphasises the potential robustness of storytelling as a means of passing information from generation to generation of long periods of time in pre-literate cultures.

2.5.7. Mula/Cavalo Sem Cabeça

The Mula Sem Cabeça (headless mule), as its name suggests, is a headless mule with fire coming out of its neck. This legend is one of the few Brazilian folklores that is not based on or related to an indigenous legend. However, like most legends, this story has many variations. Legend has it that when a woman had desires for a priest or even marries him, she would suffer from a curse that would turn her into a mule, with fire coming out of her neck (Cascudo, 2012).

His curse on Thursday night makes the young woman turn into the mule, running through the woods, attacking everything that appears ahead and setting fire. This creature has horseshoes of gold and silver, and although it does not have a head, it is possible to hear its loud whinny or the moaning sound of woman. Some versions

of the legend say that the creature is attracted by the gleam of people's teeth and nails, so anyone who sighted it should lie face down on the floor, hiding their face and hands.



Figure 15. Literature extent of the Mula Sem Cabeça

Only when the cock crows for the third time on Friday morning does the headless mule become a young woman, exhausted and full of marks and scratches. Then she stays in her form until she arrives next Thursday, when the curse again turns her into a mule without a head, making her pay for her sins. Some variations of the legend tell that the woman who slept with her boyfriend before the wedding can also be bewitched, becoming the headless mule (Vasconcellos, 2000). Regardless of the variation, this legend worked as a way of controlling women. Out of fear of the curse, they would maintain their chastity and would look upon the priests only as a representative of God, and not as a man. This folklore has been registered in

throughout the North-East, the Western Amazonian states, and central and southern Brazil (Figure 15)

2.2.8. Onça d'Água

The Onça d'Água also known as the Tapir Nymph or Tapirê-iauara (which translates to water-dwelling tapir in the Tupi language) is a jaguar-like creature around the size of a cow, with a water-proof thick reddish coat, large floppy ears (like a Brahman cow) (Figure 17) and a thick foul stench (Smith, 1996). Although the Tapirê-iauara is less well known than some of the other legends like the Fogo-Fátuo or Cobra Grande, stories of this creature are spread widely throughout the Brazilian Amazon, as well as Colombia, Venezuela, Peru and Ecuador (Figure 16) where different versions may have the front limbs of a jaguar, with hooved back legs like that of a cow /horse, or all four legs hooved or webbed feet of an otter or duck. He lives in lagoons, channels or slow moving rivers, and thus is especially feared by fishermen or hunters in canoes after turtles, ducks, capybaras or other game animals that can be shot from the tops of the flooded forest trees (Smith, 1996).

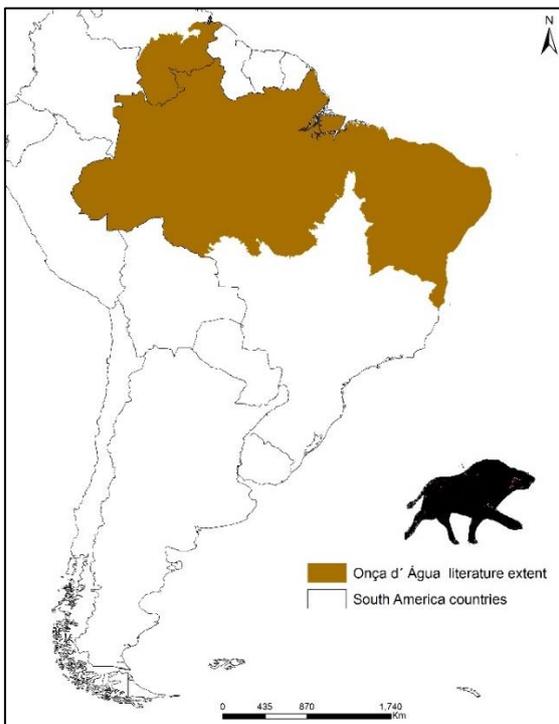


Figure 16. Literature extent of the Onça d'Água

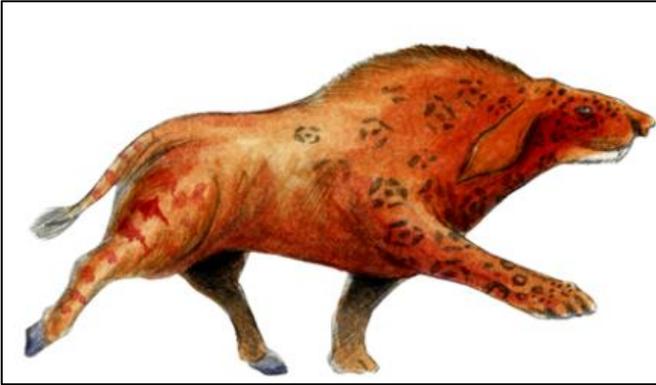


Figure 17. Illustration of Onça d'Água

The smell of the Onça d'água is said to be so strong that from a distance it can induce nausea, and if it gets close, the victim may be overcome by the odour to the point where they may lose consciousness or even die. As well as being ghastly foul smelling, the Tapirê-iauara is also feared for its aggression and ability to hypnotise its victims. Luckily, they are unable to climb trees and Smith (1996) reported a number of stories of fishermen climbing trees to escape the Tapirê-iauara. The diet of the Onça da água consists of caimans, capybaras, fish, in particular tambaqui and piranhas, and people. Fishermen throughout the Amazon, warn of not burning fish scales in the fire or leaving fish for too long in the canoe as such acts.

2.5.9. Juma

There is very little published information on a legend known as Juma and it appears to be isolated to a few areas within the state of Amazonas and Pará (Figure 18), particularly with the Munduruku tribe, whose territory lies along the Tapujós River, where the states of Pará, Amazonas and Mato Grosso meet. The Juma is described as giant indigenous warrior, "able to carry a man under his arm as if he were a cutia (agouti (*Dasyprocta* sp.)). The giant Indian walks the forest protecting it against hunters and outside intruders, armed with a borduna, which is a heavy wooden bat traditionally used in tribal wars and armed combat (Gonzaga, 2013).

A number of news outlets from Manaus and other regional cities reported a float (alegoria) that was used during the Boi Garantido festival in the city of Parantins in eastern Amazonas state, in which Juma tends to be quite a regular feature of the yearly festival. The float depicted a monkey-like man, who was portrayed as the guardian of the Amazon forest that attacks hunters. Interestingly, Juma was a warring and cannibalistic tribe who were aggressive toward indigenous tribes, as well as any European settlers and ribeirinhos who dared to enter into their territory. They belonged to the groups from the Tupi-Guarani linguistic family, called Kagwahiva. In the eighteenth century, the Juma probably had a population between 12,000-15,000. They migrated from the Upper Tapajós River to the Madeira River. The Juma always defended their territory and in 1869 reportedly killed a couple of extractive workers. They were considered anthropophagous and ferocious. They attacked another group of workers in 1959, which drove the ribeirinhos from the municipal of Canutama on the Purus River to retaliate and try to exterminate the Juma tribe, but were prevented by police (Peggion, 2003).

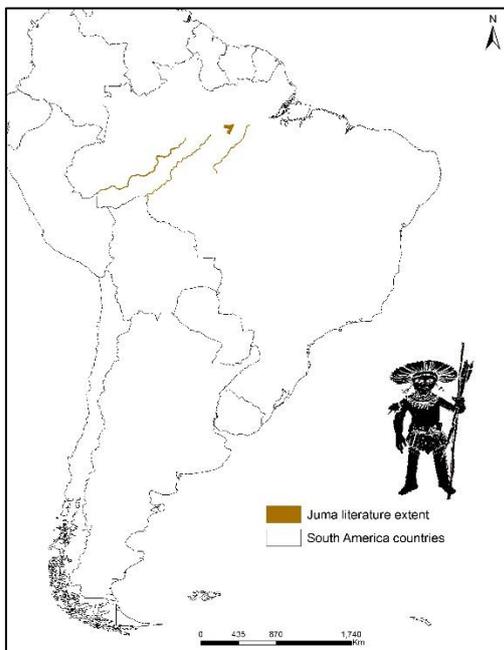


Figure 18. Literature extent of Juma

After successive massacres and the invasions by the rubber tappers, the population was reduced to a few dozen in the 1960s. In 1964 a rubber worker, Orlando França, wanting to take sorghum and chestnut from Pará of the territory killed 60 Indians. The survivors fled to Joari Creek, a tributary of the Içuã River. At this time SIL missionaries, the Abrahamson couple arrived and the Juma helped them learn their language. The last of the Juma tribe lived in the region of the Açuã River in the state of Amazonas. They were transferred to the village of Jamarý with the Uru-eu-wau-wau tribe in the state of Rondonia in 1998. In 2002 there were five remaining ancestors of the Juma tribe, one father, three daughters and one granddaughter were granted access to return to their tribal grounds in 2012.

The following excerpt (pib.socioambiental.org) is from the story of the origin of the Jarawara tribe from the Purus River:

"Os Juma, inimigos dos Jarawara, invadiram inesperadamente a aldeia e mataram todos para comer, pois eram canibais. Apenas uma jovem escapou e para não ser pega, colocou o seu sangue menstrual em uma flecha e em sua axila, e fingiu-se de morta. Um homem Juma, passando, reparou na beleza da menina e pensou consigo mesmo que se ela não estivesse morta, a levaria para ser sua esposa. Ele então percebeu que tinha esquecido a sua faca (feita de taboca) e gritou para um de seus companheiros trazê-la, o que ele não fez, pois estava muito ocupado cortando e carregando as inúmeras vítimas. Para verificar se a menina tinha realmente falecido, o Juma a bateu com um pau, escutou suas batidas cardíacas e colocou um pedaço de capim em suas narinas. A jovem não reagiu em nenhum momento.

Convencido, ele a cobriu de paus e foi buscar sua faca. Assim que ela ouviu os passos dele ao longe, jogou no mato os paus podres que a cobriam, saiu correndo e se escondeu dentro do buraco de um pássaro, em uma árvore. Ao retornar, o Juma foi incapaz de achá-la, e depois de um longo tempo a sua procura, resolveu ir embora. A jovem então saiu do buraco e foi andando pela floresta, onde encontrou dois animais mortos e farrados no pé de uma árvore, que ela então subiu. Um homem chegou carregando diversos macacos mortos, pois ele havia saído para caçar antes do massacre. Ela gritou lá de cima da árvore para chamar sua atenção, mas ele não quis olhar. Ela contou que os Juma tinham matado todo mundo, e só tinham sobrado eles dois.

Descendo da árvore, a jovem falou para o homem ir buscar a linha de algodão que ela havia tecido e a farinha branca (iawa) que estavam sobre sua rede. Chegando na aldeia, ele pegou a linha e a farinha e já de saída gritou: "tem alguém aí?". Um Juma respondeu: "está faltando um". Ele saiu correndo até onde estava a jovem e os dois continuaram andando na floresta. Ela fez duas redes com os fios de algodão e depois prepararam o jantar. A jovem casou-se com o homem e ambos ficaram morando escondidos dos Juma. Tiveram vários filhos, e quando estes cresceram, o pai explicou-lhes que eles deveriam se casar com suas próprias irmãs, o que eles fizeram. Todos tiveram muitos filhos e seu povo cresceu novamente."

Notably, the Jarawara tribe from the same river as the current study, recounts a story of the Juma tribe, attacked them and killed all their people except for one girl. She later married a Juma tribesman and had many kids, and over generations, reformed the Jarawara tribe. The legend of the Juma may be connected with the story of this warring tribe.

2.6 Exaggerated Stories, Chinese Whispers, and Biased Memories

Joseph Conrad (author of *Under Western Eyes*) "words, as is well-known, are the great foes of reality" (1963).

This study also attempts to investigate how accounts of experiences with Jaguars and other potentially dangerous animals travel through and between communities, and how these stories may influence an individual's attitudes towards these animals. As with folklores, that often change between regions, over time or even between individual people, stories of real events (or alleged real events) are equally susceptible to modification, manipulation, and adaptation. An experiment made by Bartlett (1995) using methods similar to that of the child's game of Chinese' Whispers (Telefone sem Fio) (albeit more sophisticated), whereby research volunteers in England were asked to read an unfamiliar story based on American Indian folk-lore which was to be re-narrated the next day and again a number of months later. What Bartlett found was that each person modified aspects of the story to fit closer to their individual world

view (canoes became boats, hunting seals changed to fishing, etc.). Such changes grew overtime until arriving at a story that was more comfortable and familiar to the storyteller.

In the examples in these experiments, although the stories often changed significantly, the storytellers were giving an honest recount of how they remembered the story to be. Personal experiences and pre-existing ideas influenced not only the wording and characters but in some cases, also the main message or lesson of the story. A similar study by Nadel (1937) asked young males from two different Nigerian tribes to recount a story and found that cultural differences had the biggest influence on how the story was retold.

Even actual memories of real events are often not consistent within groups. A study by Welzer (2010) that looked into how family members narrated previous family events found that they were often inconsistent, and riddled with controversial and incoherent statements. These effects were further magnified when a younger member was asked to re-narrate a story that a member from the older generations had previously told them. It is likely that the younger family member could not relate to many of the details that had happened to the family member in the distant past. These details become distorted and influenced by the storyteller's perception of reality. The story can become substantially modified, even though the story teller is still telling the truth, or at least their version of it. Notably, this has parallels with the folklores mentioned above that had indigenous based details modified to fit the realities of ribeirinho culture. Also, details may be forgotten and either left out or filled in with new details.

Re-narrations of real events are often greatly influenced by not only the situation and setting in which that event occurred, but also the mental state or feelings the person experienced during the event or encounter (Campion-Vincent, 1992; Welzer, 2010; Strange and Takarangi, 2015). Highly stressful or dramatic events may lead to anxiety and cognitive distortion. This may also be the case for relatively benign events if the person who experienced it becomes anxious due to pre-existing fear or

preconception. People who are afraid of snakes often greatly overestimate the size of snakes when asked to recount their personal encounters (Anaconda.org, 2019). Likewise, someone who is afraid of a jaguar may magnify or misinterpret the encounter in a way that justifies their feelings of anxiety. For such situations, the person recounting the event may not realise they are exaggerating the story.

Of course in some cases, the storyteller may purposely embellish the story to gain attention or to entertain the listener. As Mark Twain (author of *The Adventures of Huckleberry Finn*) once said, "Never let the truth get in the way of a good story". There are many reasons for which somebody may choose to exaggerate about an event like gaining attention or social acceptance (Cole and Beike, 2018). The temptation to tell more attention-grabbing stories is further increased when we are in front of groups of peers (Banerjee, 2000). Interesting or fantastic stories are also more memorable and thus more likely to be maintained in the collective or individual memory for a given person, group or community (Cahill and McGaugh, 1995; Kaye and Jacobson, 1999).

2.7 Attitudes and Attitude Change

As attitudes are an important precursor for behaviour, this study conducted interviews in order to measure attitudes towards jaguars. First off, the definition of attitude needs to be established. The following are three definitions of attitude:

1. *"An attitude is a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related."* (Allport, 1935, p. 810).

2. *“Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour.” (Eagly and Chaiken, 1993, p. 1)*

3. *“Attitude is a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object.” (Fishbein and Ajzen, 1977, p. 6)*

For this study, a combination of the three definitions will be used in that attitude is

- a) A major influence on behaviour
- b) Can be measured to show negative or positive attitudes
- c) A learned predisposition

There are many things that may influence attitudes, and for the rest of this paper, the focus will be on attitudes towards carnivores, in particular, Jaguars. Large terrestrial carnivores have the ability to polarize public opinion as they have the ability to generate positive feelings of awe and intrigue by some, and disgust, fear, and stress in others (Marchini and Macdonald, 2012; Flykt et al., 2013; Jacobs et al., 2014). It seems that these attitudes are generally formed early on in life and may be quite resistant to change (Kaltenborn, Bjerke and Vittersoslash, 1999; Petty and Brinol, 2010), with negative attitudes most often being centred around mistrust and the fear of attack on people, pets or livestock (Hook and Robinson, 1982; Browne-Nuñez and Taylor, 2002; Marchini and Macdonald, 2012; Engel et al., 2016). Studies have shown that precursors for fear towards carnivores can be multifaceted, with socio-demographics (Kaczensky, Blazic and Gossow, 2004; Cavalcanti et al., 2010), education (Mech, 2019), knowledge and personal experience of large carnivores (Browne-Nuñez and Taylor, 2002; Ericsson and Heberlein, 2003), influence from peers and social norms (Dickman et al., 2013), or of living in areas with presence of large carnivores (Bath, 1987 in Varley and Brewster

1990; Karlsson and Sjöström, 2007) having been shown to influence attitudes towards carnivores.

For biologists and conservationists aiming to mitigate the persecution of jaguars, there are four main categories of intervention proposed by studies on human-carnivore conflict: information and education (Espinosa and Jacobson, 2012; Glikman et al., 2012), exposure to animal and habitat (Johansson and Karlsson, 2011), collaboration and participation (Majić et al., 2011; Madden and McQuinn, 2014), and financial incentives or deterrents (Hazzah, Borgerhoff and Frank, 2009; Baruch-Mordo et al., 2011; Treves, NAUGHTON-TREVES and Shelley, 2013). However, studies that have investigated the long-term effectiveness of such mitigation programs are scarce and sometimes contradictory (Johansson et al., 2016).

One of the most commonly proposed actions to counter negative attitudes towards carnivores is the implementation of education programs, despite the idea of the knowledge-deficit model having been criticised by a number of studies as being ineffective (Schultz, 2002; Davies, 2008; Nisbet and Scheufele, 2009; P. Wesley Schultz, 2011; Simis et al., 2016). Schultz, a leading social psychologist states "results of psychological studies have shown consistently that increasing knowledge through education (alone), whether related to health, safety or conservation, does not change behaviour" (Schultz, 2001), arguing that motivation is the driving force in behavioural change.

Another commonly proposed mitigation technique is exposing the population in question to the wildlife in question, in this case, carnivores. Exposure to animals is commonly used in therapy for people who have phobias of animals such as, spiders (Öst, Salkovskis and Hellström, 1991) and snakes (Andersson et al., 2013), and such treatments with small animals have shown to be successful. Equivalent techniques aiming to change negative attitudes towards large carnivores, are- for obvious reasons- probably not viable in most cases, and may be dangerous and thus, counterproductive. A possible compromise could be exposed in the form of zoological park visits, incorporating education and exposure to carnivores. However, the effect of zoos in

changing visitors' attitudes is highly debated in the literature (e.g. Falk et al., 2007, in rebuttal to Malamud, Nobis and Broglio, 2010), and is likely minimal, with only short term positive impacts at best. Another possible opportunity for exposure for community members may be the inclusion of local community members during carnivore monitoring programs. Such programs would do best to strategically select community leaders and influential community members in order to maximise the chances of infiltration of positive perceptions towards the study animal.

Community participation and collaboration programs have become increasingly popular in conservation and can provide the motivation for community members to become more accepting of educational materials that are combined with this type of mitigation plan (Zimmermann, Wabakken and Dötterer, 2001; Johansson et al., 2012). Including the public in decision making, providing new experiences and a sense of ownership of conservation projects aids to increase trust in authorities and has been shown to be successful in mitigating the persecution of carnivores, although not necessarily through change in attitudes at community level (Meguro and Inoue, 2011; Espinosa and Jacobson, 2012).

Financial incentives aim to mitigate the motivation to persecute carnivores by offering monetary compensation for losses incurred by acts of depredation by carnivores, or for maintaining carnivore friendly habitat (Amy J Dickman, Macdonald, and Macdonald, 2011; Johansson et al., 2016). These programs are usually short-term (usually due to limits in funding) and often combined with educational and participation initiatives. While financial incentives are not likely to genuinely change attitudes towards carnivores, it has been shown in some cases to eliminate the principal motivation of persecution of carnivores, loss of income (Nyhus et al., 2003; Maclennan et al., 2009; A. J. Dickman, Macdonald, and Macdonald, 2011).

However, these programs can come at a significant financial cost and are not applicable in areas where depredation of livestock is not present. In such cases, fines and enforcement may be used to deter the killing of carnivores. There are few studies on the effectiveness of enforcement as a means reducing the persecution of

carnivores, John, Mai and Pei (2015) showed that the perceived likelihood of being caught, and social opinion influenced the continued poaching of African wildlife. However, increased enforcement programs run the risk alienating the public and exacerbating negative attitudes to both carnivores and conservationists. Also, the logistics of implementing enforcement programs in large or isolated areas is expensive and often unfeasible.

2.8. Jaguars of the Amazon

Like all South American felids, relatives of the jaguar migrated into South America from the north around 2.7 million years ago, where they soon spread out to cover much of the continent, including the Amazon Basin (Marshall et al., 1982; Carrillo et al., 2015). With the arrival of the Paleoindians around 13,000 years ago, although many species of mega-fauna became extinct (Borrero, 2009), there is no evidence of any significant declines in populations or reduction in distributions of jaguars (Tôres et al., 2008). That jaguars and indigenous Amazonian populations were able to coexist for nearly 13,000 years is quite noteworthy, especially when taking into consideration the upper estimates population densities of up to 10 million people towards the end of this period and the fact that many other species of mega-fauna were lost.

Jaguars featured heavily in indigenous culture and their folklore (Saunders, 1989, 1998, 2013; Gow, 1994; Benson, 1998; Wright, 2016) and this no doubt played a role in the coexistence between the indigenous and Jaguars (Do Monte, 2009). Some of the more famous examples come from Central America, where the Aztecs believed that jaguars could travel between the spiritual world and the real world. They were also seen as symbols of strength and bravery and only the bravest warriors and kings could wear the pelts of a jaguar. For example, for the Kayapó people that are found throughout Pará and Mato Grosso, it is believed that fire was given to them by jaguars (Banner, 1957; Giannini, 1991). Shamans, who are spiritual leaders of Tupi-Gurani people, could turn into jaguars and would become jaguars when they died. Such beliefs seemed to have been effective in making it less acceptable to kill jaguars,

supported by the long term coexistence between Paleoindians and Jaguars (Gow, 1994; Wright, 2016).

After the arrival of the Europeans, and the subsequent colonization of much of the Amazon, jaguar numbers drastically declined throughout the 20th century. An estimated 180,000 jaguars were killed between 1904-1969 in the Central-Western Amazon alone, as well as millions of their prey such as peccaries, deer, capybara and caiman, all up, around 23 million animals representing 20 species (Smith, 1976). Since the ban on all non-subsistence hunting in 1967, populations of these animals have begun to recover, though illegal hunting still remains a threat to jaguars in many areas including reserve units.

3. OBJECTIVES

The primary objective of this study was to use quantitative and qualitative research techniques to better understand the basis of attitudes towards jaguars in non-indigenous, traditional, riverine communities in the Central Amazon Basin, with a particular focus on the importance of verbal communication and storytelling in the role of cultural transmission of attitudes and theoretical parallels with traditional Amazonian folklore.

More specifically, the study aimed to test the hypothesis that there is a negative correlation between the propensity to believe (and/or fear) entities from local folklore stories and attitudes towards jaguars in non-indigenous tradition communities of the Amazon Basin. Demographic factors such as sex, age, area of residency will also be examined.

4. METHODS

4.1 Study Area

4.1.1 Beruri

This research was conducted within the large and sparsely populated municipal of Beruri which is around 180km (223 km by boat) south-west of the state capital of Manaus (Figure 19). The municipal extends from the mouth of the Purus river around 200km (linear) to the south and encapsulates around 28% (223,735 ha) of the 834,245 hectare Sustainable Development Reserve Piagaçu-Purus (Reserva de Desenvolvimento Sustentável Piagaçu-Purus in Portuguese (RDS-PP).

The town of Beruri was established in 1938 and became the main city of a new municipal by the same name in 1983. This period had followed two decades of increased development in the Amazon with the project "Operation Amazon" which created the Transamazônica Highway (BR-230), Belém-Brasília (BR-010) and the Manaus-PR-319) which were completed in 1972, 1974, and 1976 respectively (Smith, 1996). Manaus and its surroundings were also beginning to increase industrial development as a result of being declared a tax free zone in 1967. This was created to incentivize private investment and was later extended to the Western Amazonian states of Acre, Rondônia, and Roraima - as well as the cities of Macapá and Santana in the State of Amapá. This attracted thousands of people from other regions of Brazil, many of whom ended up settling in regional municipals such as Beruri, which can only be reached by boat.

The town currently has a mixed race population of around 13,000 predominantly young people, with over 70% being under the age of 29 years (IBGE, 2018). This pyramid-shaped age-demographic is common in under-developed regions and countries due to the high birth-rate and low life expectancies compared to more developed areas. Indeed, like most isolated Amazonian municipals, Beruri is considered

to be poorly developed, with low indices for per capita income, education, and health (IBGE, 2018).

Official employment counts of the municipality of Beruri is just 1.4% of the population (equating to 267 people), most of which likely reside in the town of Beruri. This figure demonstrates the importance of non-official work, and that the town is sustained by an economy based on the extraction of resources such as fish and forest products and small scale agriculture. The town also acts as a central point for the provision of goods and services for regional communities. Although the Beruri is not connected to any towns by road, there are around 23km of cleared roads that spread through the forest behind the city that lead to a number of cleared agricultural plots, with the biggest being a 125 acre pasture. Smaller lots of cleared agricultural lands sporadically line the side of the dirt roads. Residents of Beruri, use these lands to grow small-scale crops and raise some livestock and are likely entrance points for hunters to enter the forest to illegally hunt native wildlife.

Despite not being situated within proximity to the Purus-Piaguçu Sustainable Development Reserve, game meat, supplied by illegal hunting and bushmeat market, still makes up a considerable part of the "Beruriense" diet. Most mornings, the main street of town is lined with vendors selling, not only fish and local vegetable and fruit produce, but also bushmeat from a wide array of species like: freshwater turtles, forest deer, peccary, paca, coati, tapir, native ducks and curassow (locally known as the Mutum) (Deus, Mazurek and Venticinque, 2010). This is carried out openly with little attempt to hide from local enforcement agencies and seems to be accepted as part of the culture.

Like most residents of the Amazon, and Brazil in general, religion plays a major role in the society of Beruri, and there are many churches throughout the town. As of 2015, around 57.1% of the population considered themselves as practicing Roman Catholics, whilst around 35.1% considered themselves as Evangelists (IBGE, 2018). The small city port, which was finished in 2013 services the municipals 19,000 people, especially those of communities placed along the Purus River (IBGE, 2018). For

example, fish merchants buy hundreds of kilograms of ice to fill large compartments below the recreios before potentially travelling hundreds of kilometers up the Purus River to buy fish, which will then be taken back to the capital of Manaus to be sold. The town has a number of boat building yards, which utilize wood collected in the region. There is a large diesel-powered electricity plant in the middle of the town, which supplies energy to the town and a number of adjacent riverine communities. At the time of this study, this generator was in the process of being moved to the community of Itapuru and a new larger generator was in the final stages of being built.

4.1.2. Itapuru

Itapuru is located within an extensive area of várzea on top of a high bank that stays above water year-round. Itapuru is the biggest of the riverine communities that were surveyed in this study, with a population of around 400 people, and is located the furthest up-river from the town of Beruri, around 70km. The community was founded in 1911, making it one of the oldest ribeirinho communities in the region, with the main economic activity at this time has been the production of firewood. Between 1911 and 1934 rubber and fishing were the next most important commercial resources in the region followed by Brazil nuts, and mallow (*Sida sp.*) and Juta (*Corchorus sp.*) (which were grown for fiber), the latter two acquiring greater importance from the 1940s (Deus, Mazurek and Venticinque, 2010). Fishing and Brazil nuts have always been important resources for trade throughout the decades of occupation of the region and remain so today.

Itapuru is also arguably the most developed of the riverine communities in this study, having been connected with permanent electricity for over five years. There is a school with five permanent teachers and a medical clinic with three nurses. These facilities also service the surrounding area, with students coming from other smaller neighboring communities to attend classes. As there is no risk of flooding, most of the wooden houses in this community are built on land above the flood zone, either

directly on the ground or raised on small stilts of around one meter. There are two churches in the community, Catholic and Evangelical.

Some sections of the forest that do not flood during wet season have been cleared for crops and grazing cattle, whilst the rest of the agriculture is conducted exclusively in the dry season along the river banks and dried flood plains. This means that the growing period is short and limits crop selection. The most common crops being mandioca, especially along with the flooded areas, and various varieties of bananas (Deus, Mazurek and Venticinque, 2010). Although Itapuru is on the opposite side of the Purus Rivers as the RDS-PP, its residents have access to a section of lagoons and tributaries within the conservation unit in which they can collect fish and hunt for subsistence purposes. A small number of male residents participate in patrolling the reserve. Small teams of volunteer guards remain stationed at the entrance to the lagoon inlets, where they will stay for a week in a purpose-built flutuante house within the reserve and after the week, another team will take the place. The four teams circulate, meaning that each person will only need to work for one week per month. The community members who contribute their time to patrols are then able to participate in harvesting commercial fish that will be sold, and the earnings are divided between guards. Fish quotas for harvests are allocated annually for each community by the Piaguçu Institute (Queiroz, 2000; Deus, Da Silveira, and Py-Daniel, 2003; Amaral, Torres and Peralta, 2014) based on findings from yearly population monitoring programs.

Like much of the region, hunting and the consumption of bushmeat plays an important part of life in Itapuru. A study by Terra and Silveira (2007) found that over 50 species of vertebrates are hunted within the RDS-PP conservation unit. Hunters use open-sight hunting rifles, calibers 16-32, although the 20 caliber is most popular as it is big enough to kill large animals such as tapir and jaguars, whilst also being small enough to not destroy the body (and meat) of smaller target species such as paca and coati. Whilst "carne de caça" (game meat) only makes up less than 2% of the overall diet – compared to fish which makes up around 12%- this represents a considerable

impact on the local populations of wildlife species. For example, de Mattos Vieira, von Muhlen and Shepard, (2015) found that over a two year period, in just five communities, 951 individual animals were killed from 30 species (13 species of mammals, 10 reptiles, and 7 birds). Within this list, spotted pacas (*Cuniculus paca*) were the most hunted with 175 individuals, followed by White-lipped peccary (*Tayassu pecari*), Black-bellied whistling-ducks (*Dendrocygna autumnalis*) and Collared peccaries (*Pecari tajacu*) with 154, 117 and 103 individuals taken from each species respectively. Four pumas (*Puma concolor*) and one Ocelot (*Leopardus pardalis*) were also killed during this survey period (Benchimol, von Mühlen, and Venticinque, 2017).

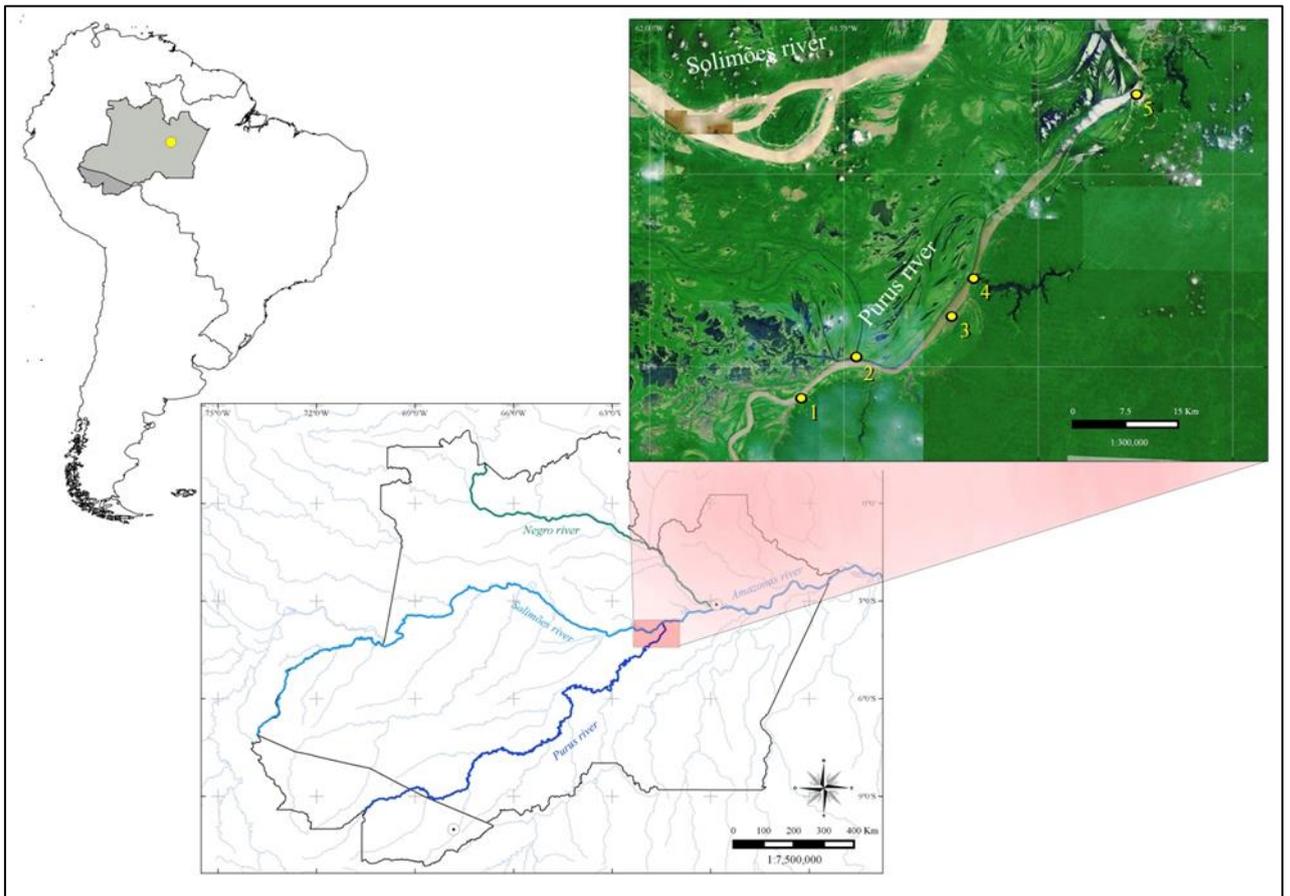


Figure 19. Map of study area, lower Rio Purus, in the state of Amazonas, Brazil. Yellow numbers represent study communities, 1- Itapuru, 2- Cuiuanã, 3- Ubim, 4- Surará, 5- Beruri.

4.1.3. Cuiuanã

Cuiuanã is slightly smaller in population to Itapuru, is 59km from Beruri, with also around 350 people, and is the only surveyed community that lies within the borders of RDS-PP. The community lines both sides of the Cuiuanã River, which flows into the Purus River. The area is a huge flooded forest plane and for this reason, Cuiuanã is predominantly made up of flutuantes and is known as one of the largest “comunidades flutuantes” in the region. The northern side of the river bank is lined with houses, around 6 small churches from different sects of the Catholic and evangelical religions and a large school. A small medical clinic with a single nurse is based on a small flutuante. Although the houses, the school, and churches that are built on the land are built high up on stilts, in years of exceptional wet seasons, these buildings become flooded. On such occasions, people living on land houses are forced to live with extended family in a flutuante, the school may be shut down for a number of months, and people can only move through the community by canoe. The community has had permanent electricity for the last 4 years, and before that, a large diesel generator was run for a few hours each evening. Small plots have been cleared behind the community and along the river bank for small agricultural plots, but these are smaller than that of Itapuru due to the lack of high land (terra firme). For this reason, a small number of residents keep pigs in floating enclosures by the side of their houses.

The residents of Cuiuanã have the closest relationship with the RDS-PP, having been designated a large network of highly productive lagoons and tributaries, and almost all of the men within the community work as volunteer guards (vigilantes). Teams of around ten men are stationed for a week at a time at a floating base at the mouth of the Caua River at the entrance to the lagoon network. Any fishing boats leaving the area are obliged to pass by the base to show their catch, regardless of what time of the day or night. Only residents of Cuiuanã, or those that have been granted permission by community leaders may fish and hunt within the area, and only for subsistence purposes, except of times of official harvest, where vigilantes work together to harvest quotas of commercial fish species like pirarucu and tambaqui, to

then share in the profits from the sales. Fish quotas may be in the hundreds of tons per year. For many residents, this may be their only official income for the year.

For residents of Cuiuanã, hunting is almost completely restricted to canoe, where they patrol the flooded forests and river banks for mostly aquatic or arboreal game species like turtles, ducks, cormorants, curassow (mutum) and monkeys. After fish, turtles are probably the most important game meat for Cuiuanã's residents, with each family being given a generous quota for harvest each year. Turtles are especially eaten during times of celebration.

During the mid-1900s, Cuiuanã was used as a base for hunters targeting Amazonian manatee (locally known as peixe-boi (*Trichechus inunguis*)) which, after years of prolonged hunting, were nearly driven to become locally extinct. Although, hunting became prohibited by law in 1967,

Lei nº 5.197 de 03 de Janeiro de 1967. Dispõe sobre a proteção à fauna e dá outras providências. Art. 3º. É proibido o comércio de espécimes da fauna silvestre e de produtos e objetos que impliquem na sua caça, perseguição, destruição ou apanha..”

...inadequate policing, due to a lack of investment and the vastness of the Amazon, meant that much of the hunting continued for many years after the law took effect. With the implementation of the RDS-PP in 2003, locals began to see the benefits of conservation and sustainable practices. “Desde que a RDS foi criada, a comunidade optou por não pescar mais o animal (peixe-boi). Agora, somos um grupo de aproximadamente 70 pessoas que se preocupam todos os dias com as medidas que temos que tomar para que as futuras gerações consigam ter esse animal também ” explained the president of Cuiuanã Francisco Freitas da Silva (Acritica, 2016). The increased presence of researchers and reserve officials and the fear of possible heavy fines (up to R\$5,000, which can be more than a year's wages for many ribeirinhos) or jail time for those caught killing manatee, has no doubt played a major role in the decreased hunting of these animals. Since the creation of the reserve, many residents have also become involved in a joint venture involving Instituto Nacional de Pesquisas da Amazônia (Inpa/MCTI), Instituto Piagaçu-Purus (IPI) and a Associação Amigos do Peixe-boi (Ampa) which has conducted tagging and monitoring as well as

reintroduction programs (INPA, 2019). This community-based conservation approach has shown to be successful, with the local manatee population continuing to increase (Alexandre de Souza et al., 2014).

4.1.4. Ubim

Ubim is the smallest and least developed riverine community and lies on the Purus around 41 km from Beruri and outside the boundaries of RDS-PP. The community is made up of less than 20 houses (<100 people), both floating and land-based, and is situated in front of a small, white water lagoon, of the same name. There are no schools, medical clinics or churches in the community and students must travel the 6km to Surará each day by boat to go to school or church. The community has had permanent electricity just over one year, which is supplied by powerlines that cut through the 41 km of forest from Beruri. Agriculture is mostly restricted to river banks and flood plains during the dry season, and there a few floating pens in which some residents raise pigs.

Given that the community lies outside of the RDS-PP borders, the residents of Ubim do not have the right to enter the conservation area to utilize its resources. Instead, they are confined to fishing the adjoining small lagoon and the adjacent stretch of the Purus river, which has been overexploited by both regional and commercial fisheries due to the lack of any type of control. Due to the comparatively small and resource-poor areas that are available to be fished, many of the male residents of Ubim have been caught fishing illegally in the RSD-PP and had their equipment (canoe, motor, fishing nets, etc.) confiscated. This equipment may be worth more than a years' worth of wages for many of these residents.

4.1.5. Surará

Surará also lies outside of the RDS-PP reserve on the Purus River and is the community that is closest to the town of Beruri, around 35km. The community has around 200 people, who live in both flutuante and land-based houses. There is a school,

with three full-time teachers, that receive students from Ubim and other small, neighboring villages. There are two churches, one evangelical, and one Catholic.

The community sits upon a high bank that remains above water year-round and backs onto the large black water Surará Lagoon. The area surrounding this lagoon is privately owned and residents are not legally permitted to fish or hunt there. Like the majority of the region, Surará is situated within an expansive area of floodplain forests, and there is a little area designated for permanent agriculture. Some residents have taken advantage of the cleared land below the power line network that connects Surará and Ubim to the power grid from Beruri. These powerlines follow a cleared path along the bank of the Purus River. Residents grow mandioca plants in these areas and help to keep the area free of vegetation regrowth that could damage the line network.

There is an entry point into a large system of lagoons and tributaries on the opposite side of the Purus River that is close to Surará, but this system is not within a conservation unit, and can also be accessed by fishermen from other communities, including Beruri. This lack of management means that this area has become overfished. A number of community members, who have seen the benefits that sustainable development reserves (RSD) can bring to the community in terms of fish security have been trying to work with the authorities to create a small RSD that could be managed by the residents of Surará, who like those of Ubim, currently have no secured fishing areas. Unfortunately, the geographical layout of the lagoon network in question has many entry points for fishermen to gain access, which means that patrolling the area would be impossible for a small community like Surará. As such, many of the community fisherman have little incentive to participate in the scheme.

Surará is also the community that is most influenced by Beruri. Many of the residents visit the town on a regular basis or have sent their children there to stay during school periods. Although Beruri is only 35km away, the slow-moving passenger boats take around 3-4 hours to make the trip.

4.1.6 Piagaçu-Purus Sustainable Development Reserve

Piagaçu-Purus Sustainable Development Reserve (RDS-PP) is a 834,245 hectare conservation unit made up of large floodplain (varzea) and terra firma forests, with around 44% of the Reserve being covered in lowland lakes. RDS-PP surrounds two indigenous reserves and is bordered by a biological reserve and national reserve, making a large mosaic of different conservation units. There are 57 communities within the RDS-PP, whose some 4000 residents sustain themselves with small-scale agriculture, extraction of forest resources, fishing and subsistence hunting (Deus, Da Silveira, and Py-Daniel, 2003). The region's climate is classified as tropical with significant rainfall throughout the year. Even the driest month receives at least 60mm of rainfall. The climate is classified as "Af" by the Köppen-Geiger system. The average annual temperature is 26.9 °C and precipitation averages 2261 mm.

4.2. Data Collection

4.2.1. Questionnaire Development and Interview Strategies

Throughout August and September 2018, residents of the riverine communities of Itapuru, Cuianã, Ubim and Surará, and the town of Beruri, were surveyed using structured questionnaires. This region was selected as unlike many areas in South America that have conflict with jaguars and pumas, this area has very little area dedicated to raising cattle, and thus, depredation by these predators should not be a major influence on local perceptions towards jaguars. The Amazon also has many well-documented folklores, mostly of indigenous origin, that play an important role in the ribeirinho culture.

Questionnaires were developed with the help of the school principal of Itapuru and pretested and modified to ensure that all the local folklore was included and the chosen vocabulary was clear and understandable for local residents. Where possible, a local resident accompanied the interviews in an assistant role, to ensure clarification when needed. In order to maximize the chance of gaining a representative data set for each community, all residents over the age of 18 were invited to participate

in the surveys which were usually conducted in the household or workplace of the interviewees.

As a principal focus of this study was to assess attitudes towards jaguars, a nine-item set of questions was developed. Therefore, three key aspects of attitude were chosen to be assessed: 1) affection/repulsion- based on physical and behavioural attributes (*e.g.* are jaguars beautiful/ugly), 2) perceived risk (are jaguars dangerous/not dangerous) and 3) acceptance of killing (it ok for hunters to kill jaguars: agree/disagree).

Shortly upon introductions and briefly explaining the project, the current researcher would briefly talk and show photos of personal hunting experiences controlling invasive species such as feral pigs (*Sus scrofa*) and feral goats (*Capra aegagrus hircus*) in his home country, serving to “break the ice”, and encouraging the interviewee to talk freely and openly about hunting and local culture. Establishing a comfortable and non-judgmental rapport between interviewer and interviewee is essential for obtaining honest responses, extracting the maximum possible information from each person, and minimalizing biases in the research (Doody and Noonan, 2013).

4.2.2. Itapuru

In 2017 (one year prior to the current study), I was involved in a month-long research campaign collecting small mammals from RDS-PP (see Abreu-Júnior, Charters and Percequillo, 2017). During this period, we stayed for 10 days in Itapuru, and contracted a number of local hunters to help us navigate the region and collect small mammal specimens. Ribeirinhos are notoriously receptive and the residents of Itapuru are no different. We quickly became well acquainted with many of the residents including some of the community leaders and other hunters. The community is particularly close-knit and many of the residents, young and old, meet most afternoons to play (or watch) volleyball in the community center. It was on this trip that I heard many stories of folklore and “dangerous” Jaguars and began to hypothesize the

importance of storytelling in isolated communities and possible implications for conservation.

Thus, a year later I contacted one of the community leaders, "Padre", and informed him of my interest in doing research in the community, after which he invited me to go and stay in Itapuru. Upon arriving in the community on father's day in 2018, I met with Faris (one of the hunters who had worked with us on the previous excursion) and I was promptly invited to celebrate with a meal of river turtle with him and his extended family. Over the next few days, I made an effort to reconnect with previous acquaintances and I quickly became accepted within the community, including playing volleyball during the afternoons. I also began to investigate the local folklores and develop the questionnaire. I conducted a number of interviews with initial questionnaires to further develop the questions and vocabulary in order to maximize the chance of obtaining the target data. I also used these interviews to practice my fluency in asking the set of questions. These surveys were not included in the final data.

I then began to conduct official surveys, starting with the people whom I had the closest relationships, after which I contracted one of the younger men (the younger brother of one of the hunters who had worked with us during the previous project) to present me to other members of the community to conduct further interviews. He would also help clarify some of the questions or cases of difficulties in understanding my accent (of which there were few), although he was given strict instructions to not lead the interviewee with any of the answers.

Institute Piaguaçu, which is the research body of the RSD-PP has had a strong presence in the area since 2003, with many biologists and environmental scientists conducting research in the area, particularly on commercial fish, turtles, and caiman. Given the financial benefits and secure populations of fish and game species that the reserve has brought, most residents see researchers in a positive light. This further facilitated interview participation. I stayed for two weeks conducting interviews before moving 11km down-river to Cuiuanã.

4.2.3. Cuiuanã

During the 2017 excursion, we had also stayed 8 days on the patrol base at the mouth of the Caua River with the guards (vigilantes). Whilst on the base, we were able to meet two teams of guard volunteers as they swapped shifts after around 4 days. Thus, we were able to meet and become acquainted with around 20 of the guards and become friends with a number of them. As always, the group was very welcoming. We also hired one of them to guide us to the best forest areas to collect specimens, and he presented us to his family and other community members during trips to the village community.

Upon return to Cuiuanã in 2018, I was invited to stay in the house of Bernie's family, a small floating house with 10 family members (Bernie's parents, 3 brothers, 4 sisters (one of which had a baby) and the boyfriend of one of the daughters). Bernie lived in a land-based house built on the adjoining bank with his wife and young son. I conducted the first interviews in Cuiuanã with the immediate and extended family members that were over 18 years and contracted one of the brothers to present me to members of the community, as well as be my transport for getting between floating houses to conduct interviews. He was given the same instructions in regards to not leading the interviewees, whilst still helping with any misunderstandings. At this stage of the year, the water was still quite high, but slowly falling in level. The river bank was around three meters above the water and the earth was dry and used as a footpath to get between houses, to school, and church.

The Piaguçu Institute has also long been conducting research in the area and, as with those from Itapuru, the community members had positive views towards researchers. I stayed for two weeks in Cuiuanã, before traveling the 18km to Ubim.

4.2.4 Ubim

As I had not been to Ubim during the 2017 excursion, I asked Bernie for some contacts of his friends that may be able to host me in Ubim. He assured me that a number of his friends would be happy to host me, so I got on the next boat and made

my way to the small community. Upon arrival at one of the floating houses (there are no ports or landing areas in "Comunidades flutuantes"), I asked for Mateus, who happened to be the same man who had greeted me. I explained that Bernie had recommended him to me, and explained the purpose of my visit and if there was anywhere available to stay in the community. He invited me, without hesitation, to stay with him and his family on their flutuante. He lived with his wife and her three children aged around 10, 12 and 18 years. As per usual, I conducted the first interviews with immediate and extended family members (who lived in the flutuante next door) and contracted the oldest son to present me to the community members.

Although residents of Ubim have had much less contact with researchers at the previous two communities, residents were still receptive and did not appear to be skeptical of my intentions. During the afternoon, the teenagers and young men would meet to practice football penalty shootouts. I would watch and talk to them about their experiences or stories with jaguars and folklore as well as their opinions on the RRDS-PP of which they are excluded from fishing within its borders. I stayed in Ubim for six days conducting interviews before moving onto Surará.

4.2.5. Surará

Given the short distance between Ubim and Surará (6km), the eldest son (who goes to school in Surará) took me by dingy and presented me to one of the community leaders. He invited me to stay in the community-owned house in which the teachers (who live in Beruri) reside during their time working in the community. The house was up on a high bank, next to the school, a small distance away from the rest of the houses. I interviewed the teachers first (although these were counted as being from Beruri), but as they were busy with classes they were unable to help me with interviews. Also, a lot of the young-middle aged men (the demographic who were most interviewed and contracted to assist with interviews) were away fishing for a week. Thus, I conducted the interviews alone. As I had had over one month of experience with interviews, I do not believe these interviews were overly affected, although it was a

harder to find people to interview, due to possible problems such as knowing which houses to try, times in which each person is most likely available, etc.

I conversed extensively with the teachers about my subject topics, and life in the remote Amazon, and befriended many of their students young and old. They invited me to give a (mostly symbolic) class on English and world geography (where Australia is in relation to Purus River) using a world globe. After this class, and the children having enthusiastically talked to their parents, presenting myself became easier. One of the students invited me to come and meet her pet monkey (macaco barrigudo (*Lagothrix cana*)), and whilst doing so I met and interviewed her grandfather who was a well-respected member of the community, further facilitating later interviews. After nearly a week in Surará the fishermen returned and I spent another five days conducting interviews with them.

4.2.6. Beruri

Whilst I was in Itapuru, I had asked for any contacts who may have been able to host me whilst I was in Beruri. One of the teachers in Itapuru gave me the contact of her brother who was refurbishing a *recreio* (large wooden boat) with the assurance that I could stay there whilst refurbishments were being conducted. I thus stayed on the boat and conducted interviews with the crew members. However, most were from neighboring communities and were too busy to accompany me during interviews. I would walk to the residential areas of the town, and knock on doors explaining my project and asking for interviews. Although most people were receptive and friendly, there seemed to be a clear difference between the town people and those from the communities, with people often appearing a little suspicious. Also, some residential suburbs were too far to walk, and I would have to get a motorbike taxi. These trips were done in the morning from 8 am, returning by 11 am due to the equatorial heat and the fact that many residents sleep after lunch. A second trip by moto-taxi would be done in the afternoon, leaving at 2-3pm and returning at around 5-6pm. After a little over a week, the boat was finished and I moved into a hotel and

befriended the hotel owner and conducted interviews with him and his wife. He also later invited some of the family friends to come and do interviews. Amazonian hospitality being as it is, I was then invited to a birthday party where I was introduced to more residents. I stayed in Beruri for 16 days in total conducting interviews.

4.3 Statistical Analysis

4.3.1 Attitude Towards Jaguars

In order to establish which items from the questionnaires best represented the attitudes of the ribeirinhos in relation to jaguars, Cronbach's Alpha reliability analyses were conducted. Items were excluded based on negative or consistently low inter-item correlations (<0.3), and "Alpha score if removed" table outputs until Alpha scores were higher than 0.8, which is classed as a good-to-very good reliability score (Bland and Altman, 1997; Ursachi, Horodnic and Zait, 2015). A factor analysis was then conducted on the selected items to ensure unidimensionality within the attitude scale (Gardner, 1995; Slocum-Gori and Zumbo, 2011). Prior to this, a parallel analysis was conducted with 1000 repetitions, to choose the appropriate eigenvalues to be used in the factor analysis, and also confirm the number of factors in the scale items (see O'Connor, 2000). The parallel analysis is an exploratory procedure that generates random data sets from the original data (similar to a bootstrap).

4.3.2 Folklore and Belief Scale

The belief scale was taken as a percentage based on a combination of how many folklores each individual had heard of, divided by how many of these folklores they believed, and were scared of:

$$\text{belief scale (\%)} = \frac{(\text{No. Believe legend} + \text{No. Scared of legend})}{(\text{No. Heard legend} \times 2)}$$

The aim of this scale was to assess extent to which each respondent believed and feared local folklore based on the percentage of the stories which they had heard. The two measurements of 'believe' and 'fear' were used to give a more robust measurement.

4.3.3 Hypothesis Testing

As independent data collected from questionnaires with items in Likert scale will in almost all cases be non-normally distributed (which was confirmed by assessing histograms of data), non-parametric analyses must be used (Zabih and Woodfill, 1994; Murray, 2013). To assess the correlation between continuous and ordinal data such as age, attitude, and belief in folklore, Spearman's rank correlation coefficient was used (Barua, 2013; Sedgwick, 2014).

Mann-Whitney tests were conducted to assess differences between dependent variables amongst on nominal variables such as sex, community and community type (see Bertram, 2007; De Winter and Dodou, 2010). Kendall's Tau analyses were conducted to assess the correlations between dependent variables and ordinal group variables such as age groups and time spent in forest/river as recommended by Cliff (1996). Analyses were conducted using SPSS 16 and R statistical software.

5. RESULTS

5.1 Demographics

Interviews were conducted with 162 residents over the two month period with ages varying between 18 and 81 years. Mean ages were 40.8 years of age for men, 37.7 for women and 40.0 years overall. The majority of the interviewees were male, with 120 men (73.6%) and 42 (26.4%) women choosing to participate in the study (figure 20). The number of interviews carried out in each river community- or town in the case of Beruri- reflects the size of the community and the constraints of the amount of time spent in the area, with the larger communities of Itapuru and Cuiana and the town of Beruri having similar numbers of interviews (42, 44 and 41 respectively) and the smaller river communities of Ubim and Surará fewer interviews (15 and 21 respectively) (figure 21).

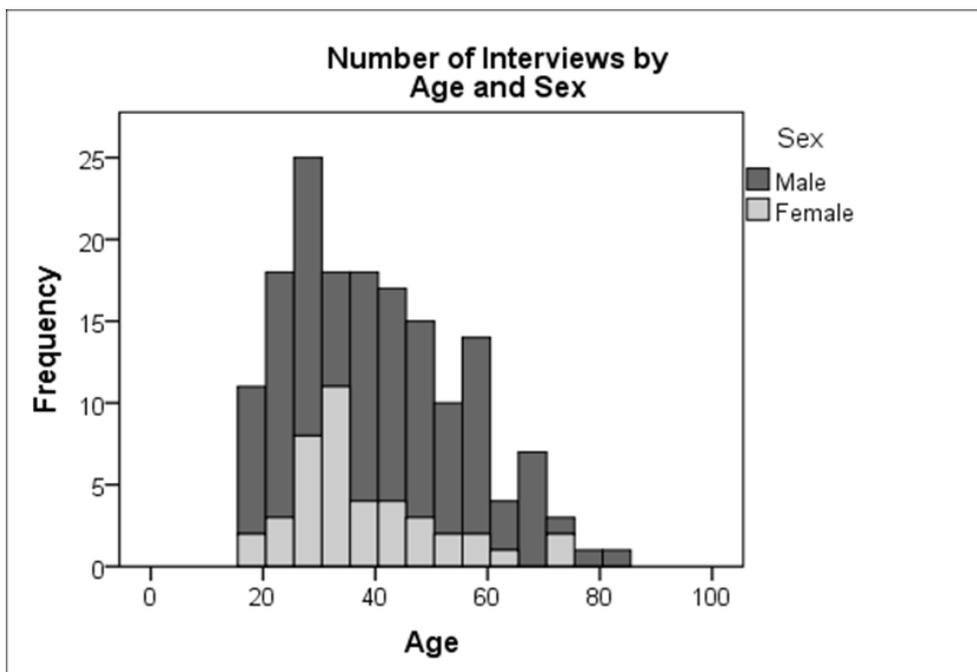


Figure 20. Histogram of respondents by age and sex with males in dark grey and females in light grey.

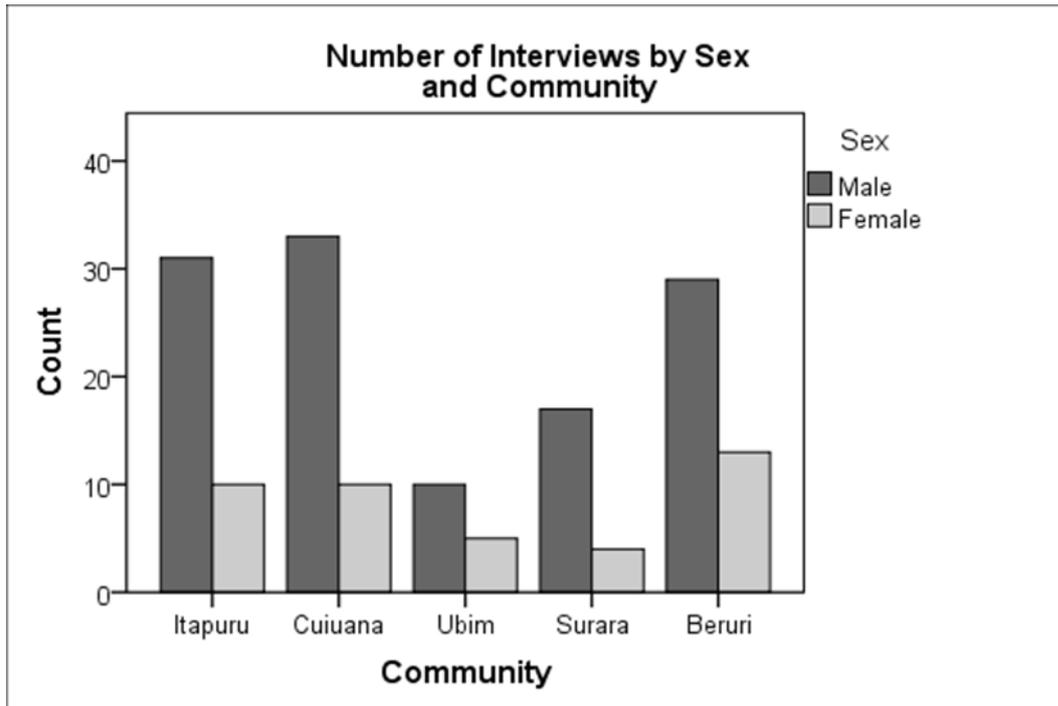


Figure 21. Histogram of respondents by community and sex with males in dark grey and female in light grey.

5.2 Relationship with the Environment

Only 45.6% of respondents indicated that they enter the surrounding forest on a regular basis (at least once per week), with 25.6% and 28.8% of respondents stating that they only enter the surrounding environment occasionally or rarely/never respectively. People tend to use the river less frequently, with only 35.2% of respondents stating that they swim or bath in the river on a regular basis with 24.1% and 40.7% declaring that they swim/bathe occasionally or rarely/never respectively (Figure 22).

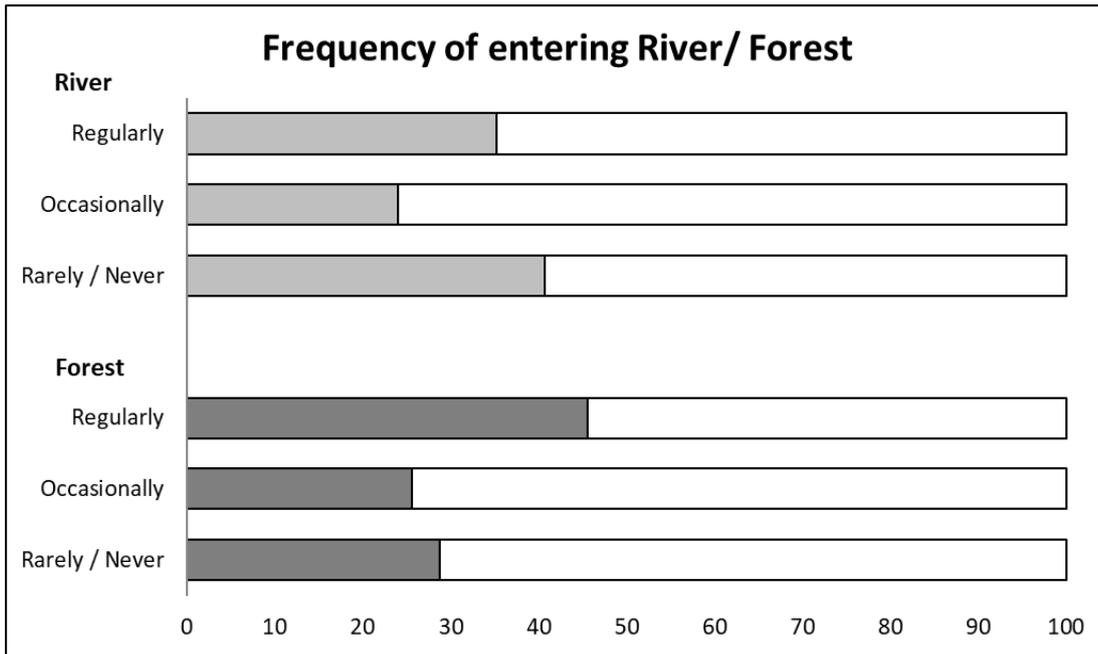


Figure 22. Horizontal bar chart show the frequency of which respondents that enter the river for recreational purposes (light grey) or forest (dark grey).

Between the sexes, 52.5% and 42.5% of male respondents reported to enter the forest and river respectively for recreational purposes on a regular basis, whilst this was the opposite for females who utilise the surrounding environment less, with 52.4% and 42.9% stating that they rarely/never enter the forest or river (recreationally) respectively, thus overall male respondents reported to use the forest more than females (Mann-Whitney U test, $p = <0.001$) (figure 23). By age, older respondents (>50 years) reported to be the age group to have used the forest most frequently (this was reported for time during working age), whilst the younger respondents (18-29 years) reported to use the river most frequently, with frequency of entering the forest increasing with age (Kendell's Tau = 0.275, $p = <0.001$) (figure x). People who live within riverine communities use both the forest and river more regularly than respondents from the town of Beruri (figure 24).

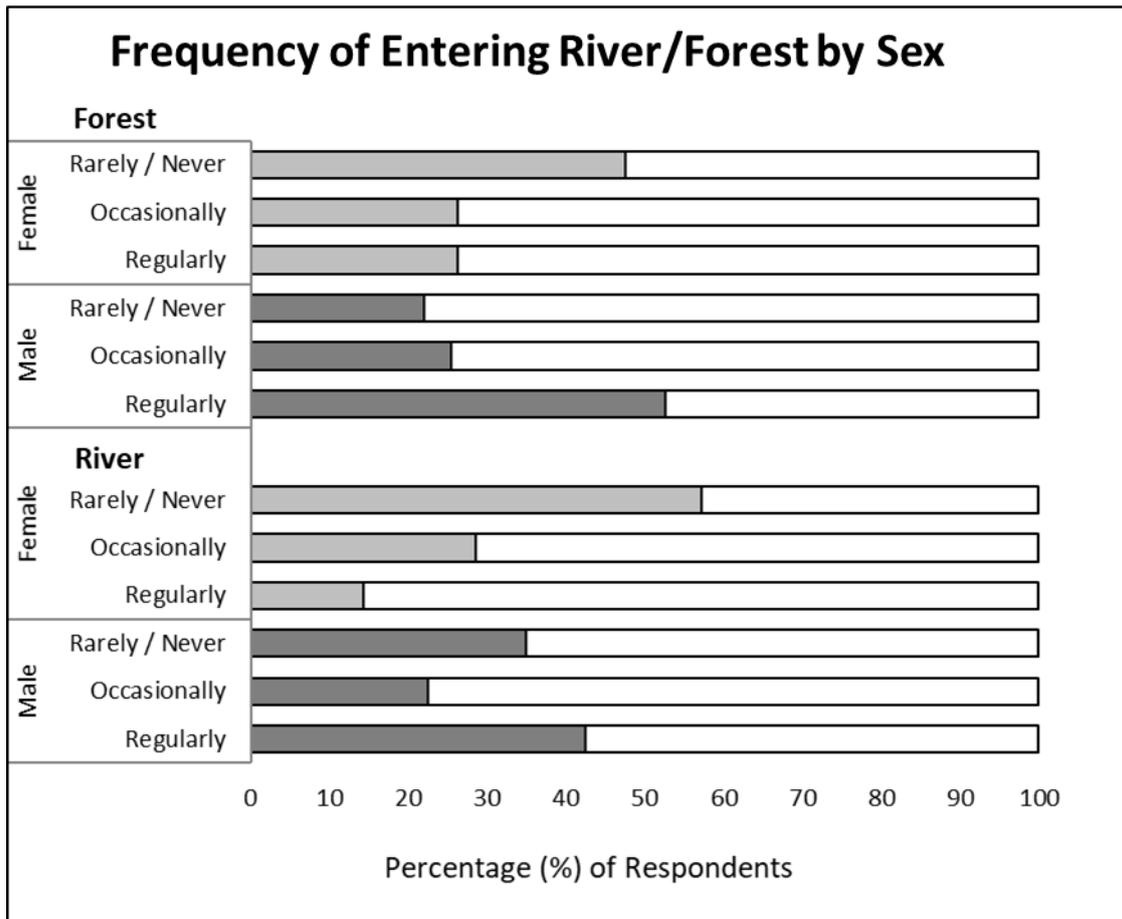


Figure 23. Horizontal bar graph shows the frequency of which respondents that enter the river or forest by sex, males (dark grey), females (light grey).

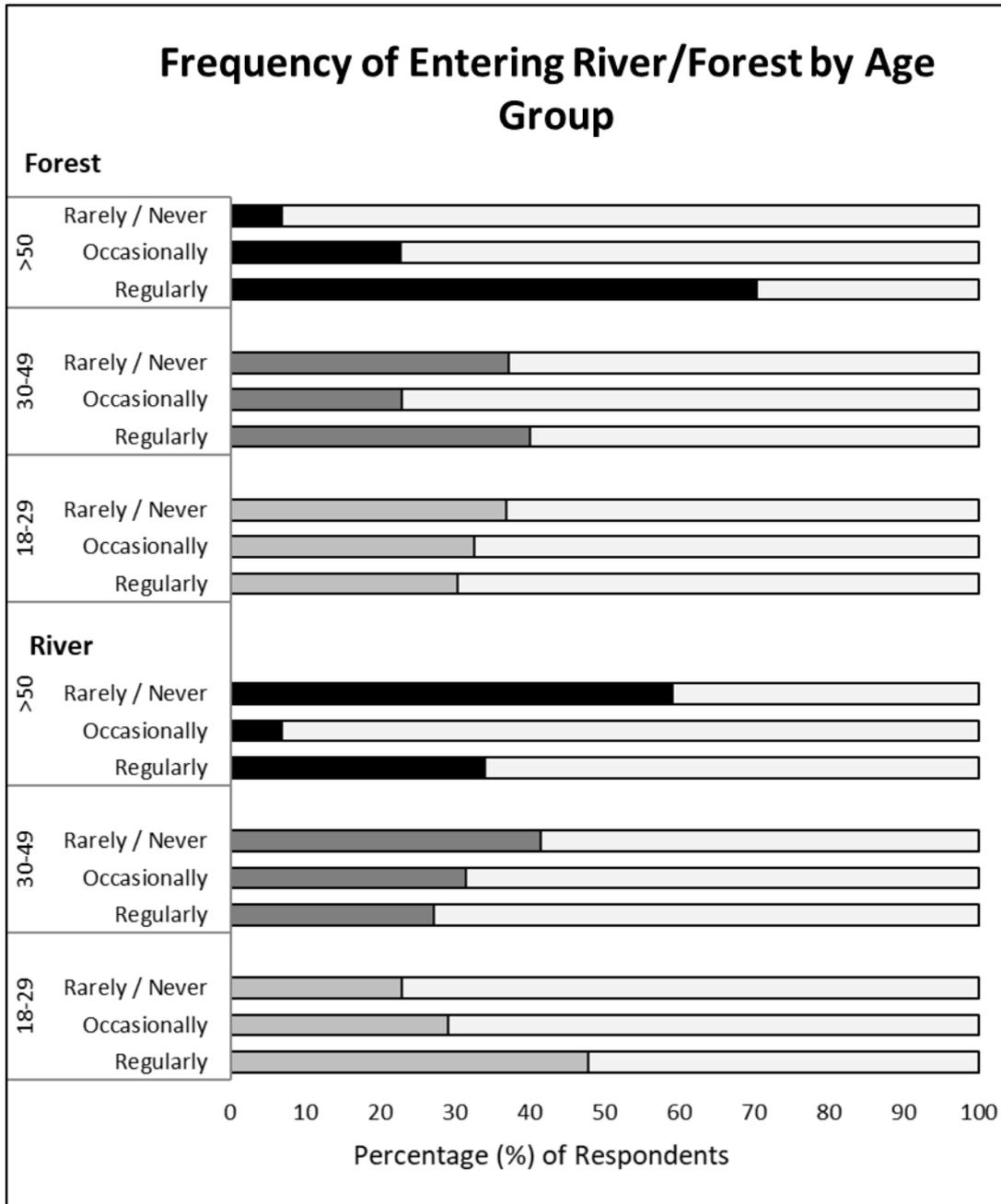


Figure 24. Horizontal bar graph shows the frequency of which respondents that entre the river or forest by age group, >50 (black), 30-49 (dark grey), 18-29 (light grey).

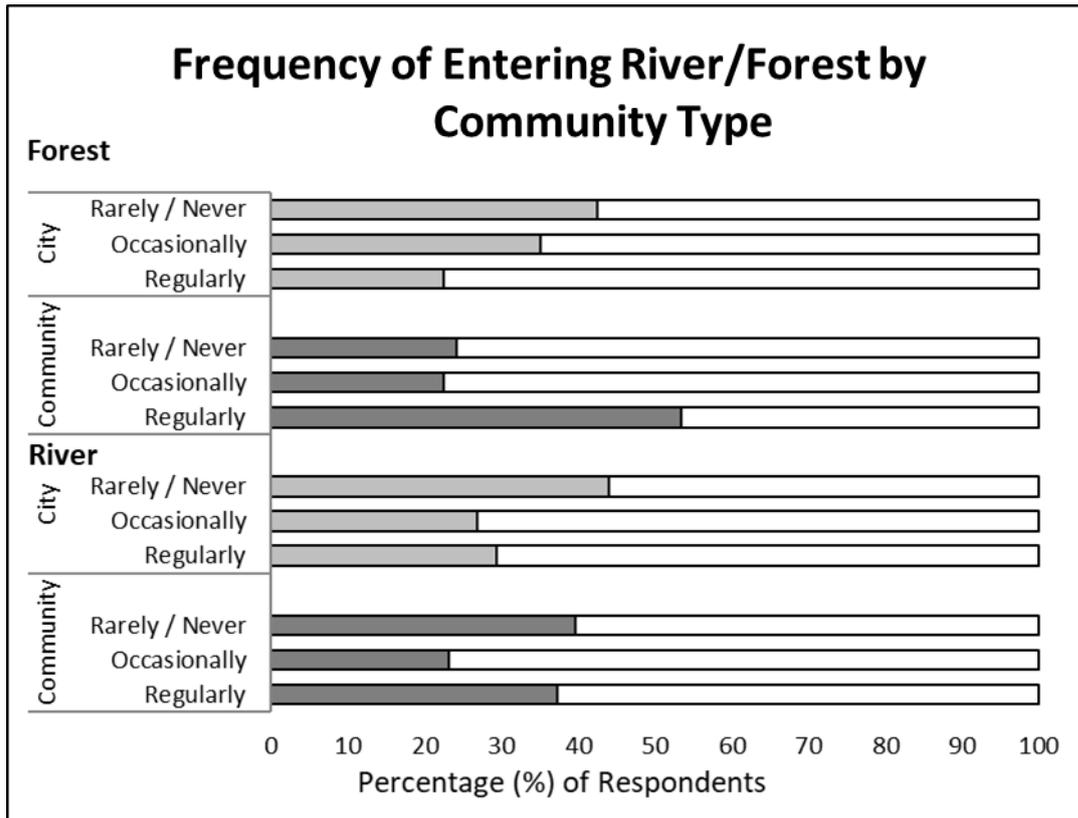


Figure 25. Horizontal bar graph shows the frequency of which respondents that enter the river or forest by community type, community (dark grey), city (light grey).

5.3 Fear of Wildlife

When asked to list animals in the forest that they feared, the most reported animals were snakes (89.8%) and Jaguars (72.2%), with other animals such as spiders, scorpions and frogs only being mentioned by 13% of interviewees combined (Figure 25). In the river, caimans, stingrays, and piranhas were the most feared animals at 83.%, 71.0%, and 69.8% respectively (Figure 26).

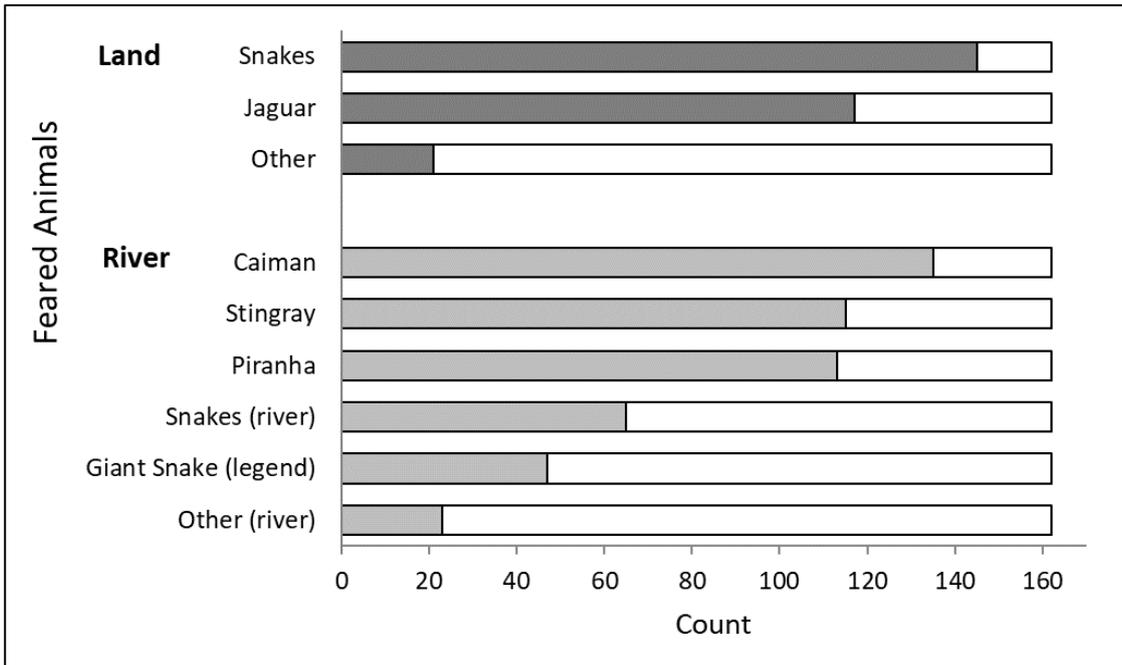


Figure 26. Horizontal bar graph shows the counts of animals that respondents most feared on land (dark grey) and in the rivers (light grey).

5.4 Attitudes towards Jaguars

Of the nine questions used to assess attitude, six items (Table 1) were selected to be used to create an attitude scale based on inter-item correlations (Table 2) and Cronbach's Alpha score of 0.889. As questions ranged from -2 to 2, the attitude towards jaguars was portrayed as the sum of these 6 items giving a range of -12 for most negative, to 12 for most positive.

Table 1. Items and responses

Item	Response and scale options
Jaguars actively hunt people It should be legal to kill jaguars It is OK to kill jaguars in the forest It is OK to kill jaguars close to the community	-2 <i>Strongly Agree</i> ; -1 <i>Agree</i> ; 0 <i>Neither agree nor disagree</i> ; 1 <i>Disagree</i> ; 2 <i>Strongly disagree</i>
If jaguars became extinct, it would be	-2 <i>Very good</i> -1 <i>Good</i> 0 <i>Neither good, nor bad</i> 1 <i>Bad/sad</i> 2 <i>Very bad/sad</i>
Consequences for killing jaguars...	-2 <i>Very positive</i> ; -1 <i>Positive</i> ; 0 <i>Neutral</i> ; 1 <i>Negative</i> ; 2 <i>Very negative</i>

Table 2. Inter-item correlations

	Jaguars actively hunt people	It should be legal to kill jaguars	If jaguars became extinct...	It is OK to kill jaguars in the forest	It is OK to kill jaguar close to the	Consequences for killing jaguars...
Jaguars actively hunt people	1					
It should be legal to kill jaguars	0.486	1				
If jaguars became extinct...	0.437	0.559	1			
It is OK to kill jaguars in the forest	0.425	0.537	0.688	1		
It is OK to kill jaguar close to the community	0.428	0.58	0.649	0.814	1	
Consequences for killing jaguars...	0.399	0.537	0.567	0.731	0.694	1

Across the 162 interviewees, the overall attitude was quite neutral with a slight skew to the negative attitude scale with a mean of 0.52 (Figure 27). No respondents answered all six questions with the most positive responses (+2),

conversely, four people responded to all questions with the most negative response options (-2). Attitude was negatively correlated with age (Spearman's correlation coefficient = -0.163 , $p < 0.05$) (Figure 28). There was no significant difference in attitudes between the sexes, with a male mean of -0.38 (std. = 6.89) and a female mean of -1.81 (std. = 7.67) ($p = 0.37$) (Figure 29); however age was negatively correlated with attitude for males (Spearman's correlation coefficient = -0.187 , $p < 0.05$), but not females (Spearman's correlation coefficient = -0.096 , $p > 0.05$) (Figure 30). Respondents who live within the 4 riverine communities, as a group, had more negative attitudes (mean = -2.14 , std. = 6.96) than respondents from the township of Beruri (mean = 3.34 , std. = 5.91) ($p < 0.001$) (Figure 31). Compared individually, there was also a difference between communities/townships, with respondents from Beruri having the most positive attitudes (mean = 3.34 , std. = 5.91), and the riverine community of Cuiuanã the most negative (mean = -3.65 , std. = 6.31) ($p < 0.001$) (Figure 32). There was a significant correlation between age and attitude for respondents living in Beruri (black line) ($p < 0.05$, Spearman's correlation coefficient = -0.351 , $y = 9.27 - 0.14x$, $R^2 = 0.146$), however age did not correlate with attitude for people living in the riverine communities (grey line) ($p > 0.05$, Spearman's correlation coefficient = -0.126) (Figure 33). There was a significant difference between the attitudes of respondents from the city/town (Beruri) and the riverine communities for both males (mean = 4.534 , Std.Dev. = 5.935 and mean = -0.272 , Std.Dev. = 6.349 respectively $p < 0.0001$) and females (mean = 4.231 , Std.Dev. = 5.183 and mean = -2.517 , St.Dev. = 7.069 respectively, $p < 0.01$), but no difference between the sexes for respondents from the city (Beruri) ($p > 0.1$) or riverine communities ($p = 0.1$). The frequency in which respondents entered the forest did not show to influence attitudes towards jaguars when measured as a whole (Kendall's tau = 0.13 , $p > 0.05$) (Figure 35) although there was a correlation for men (Kendall's tau = -0.153 , $p < 0.05$) but not women (Kendall's tau = 0.02 , $p > 0.05$) (Figure 36).

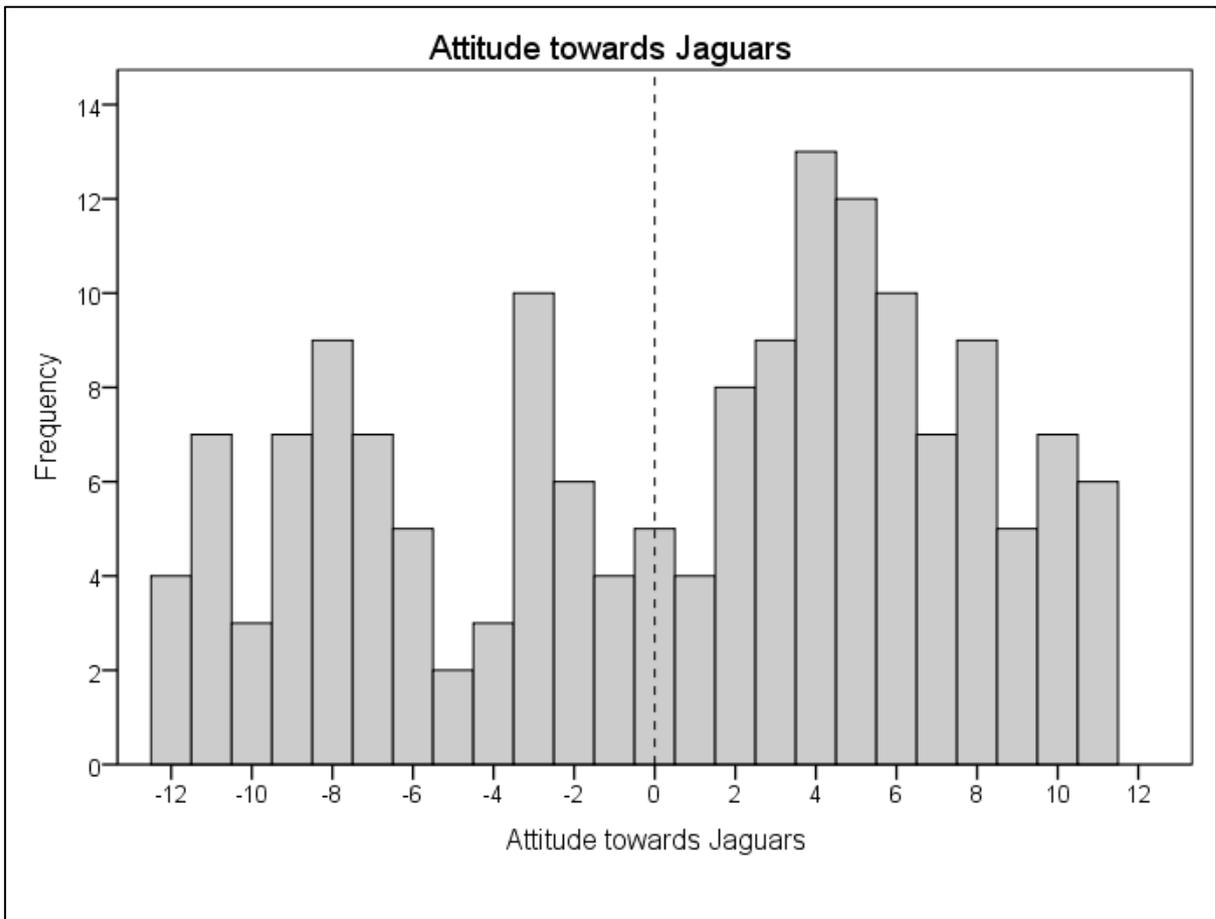


Figure 27. Histogram showing the spread of the respondent's attitudes towards jaguars based on the 6-item Likert scale. Mean attitude= 0.52, Std. Dev = 6.73.

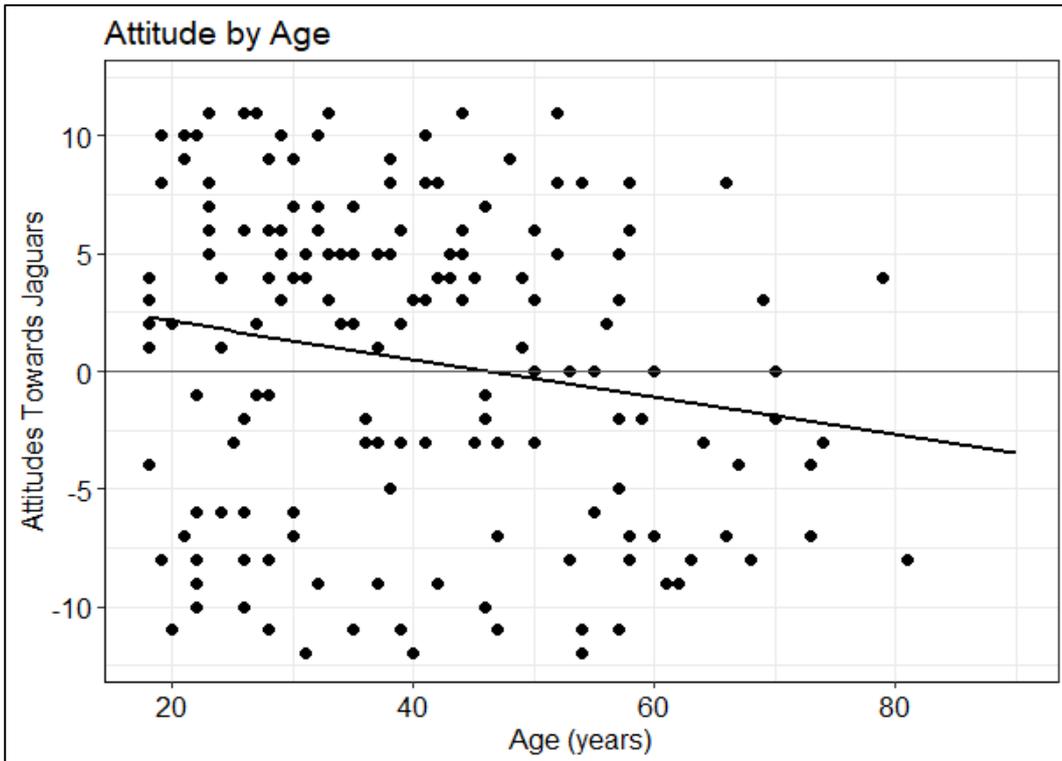


Figure 28. Scatter plot shows the correlation between age and attitude towards jaguars ((black line) $p = < 0.05$, $y = 3.725 - 0.08x$, $R^2 = 0.026$, $n = 162$).

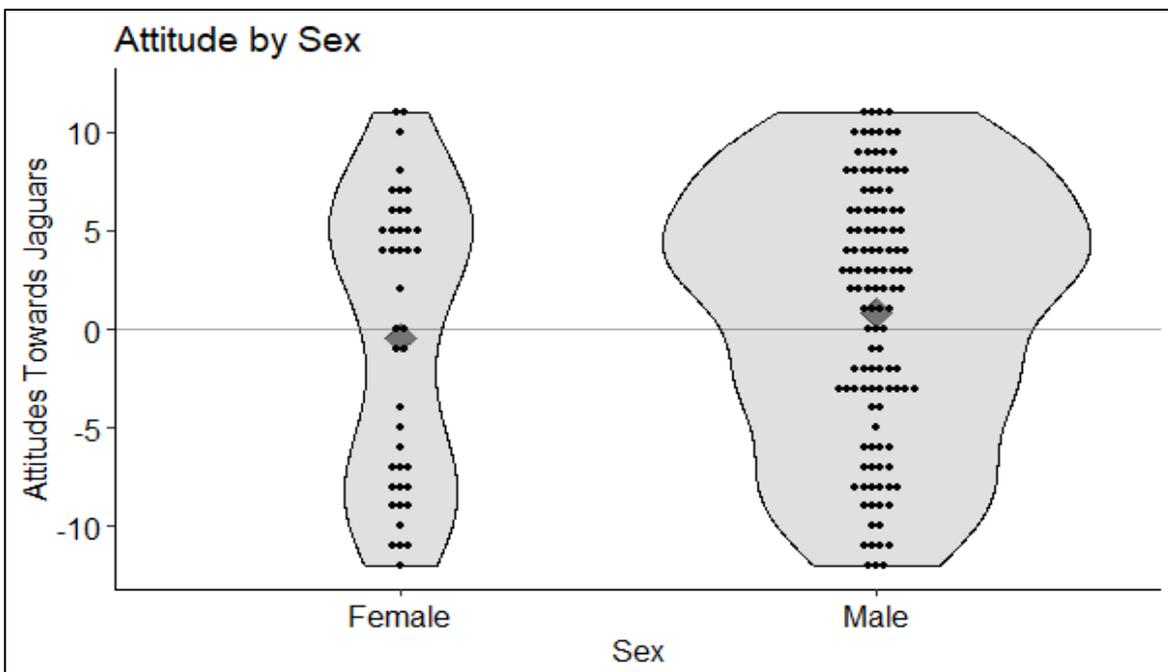


Figure 29. Violin plot shows the distribution of attitudes between sexes with each black dot representing a respondent. Grey diamonds represent mean values, females -0.43 (Std. Dev. = 7.20) and males 0.85 (Std. Dev. = 6.56), $p = > 0.05$.

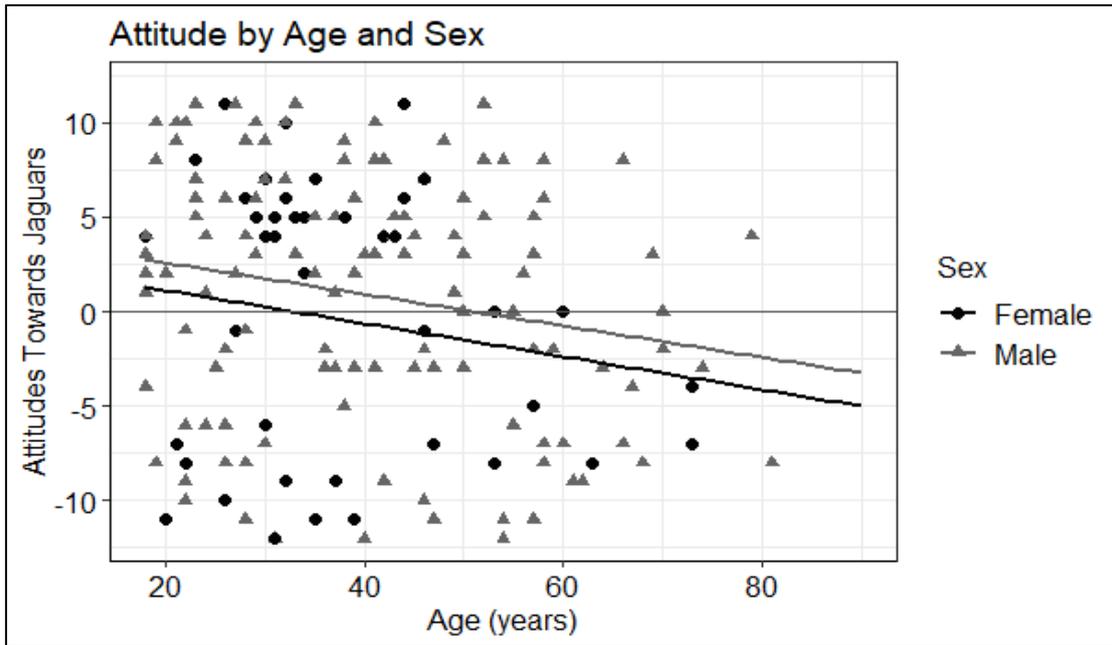


Figure 30. Scatter plot shows the correlation between age and attitude towards jaguars for each sex, males (black line, $p = <0.05$, $y = 4.251 - .083 x$, $R^2 = 0.032$), females ((grey line) $p = > 0.10$, $y = 2.869 - 0.087x$, $R^2 = 0.026$). Black dots represent female respondents ($n=42$), and grey triangles represent male respondents ($n = 120$).

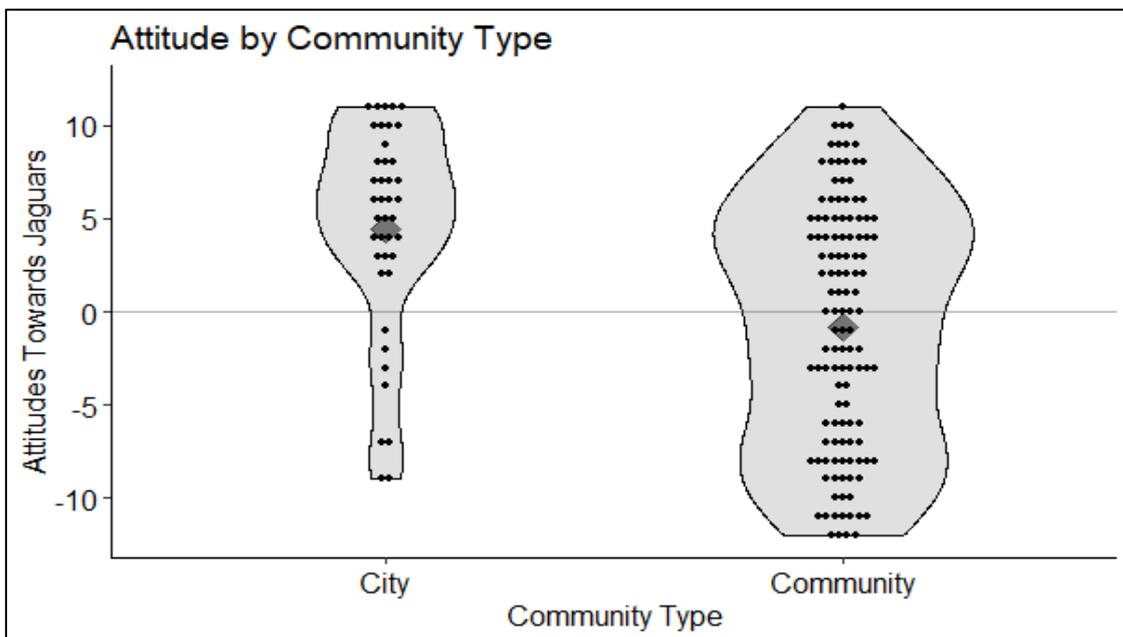


Figure 31. Violin plot shows the distribution of attitudes between community types (riverine community and city/town (Beruri)) with each black dot representing a respondent. Grey diamonds represent mean values, community -0.81 (Std. Dev.= 6.57) and city (Beruri) 4.44 (Std. Dev.= 5.64), $p < 0.0001$.

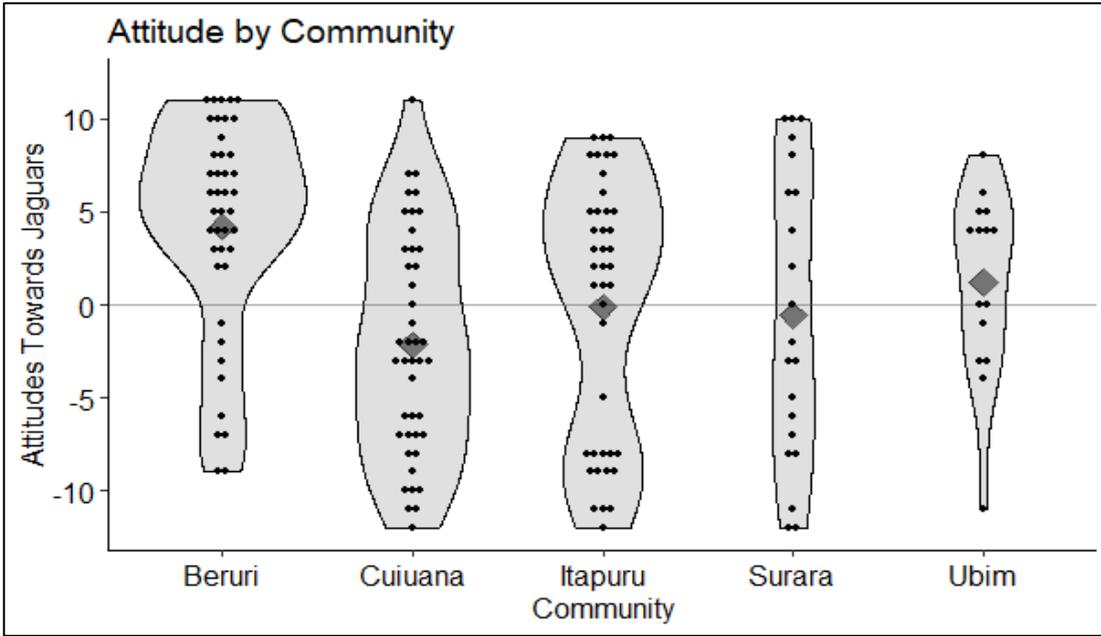


Figure 32. Violin plot shows the distribution of attitudes between communities (riverine community and city/town (Beruri)) with each black dot representing a respondent. Grey diamonds represent mean values for each community, for which there was no significant difference between these values ($p = >0.05$).

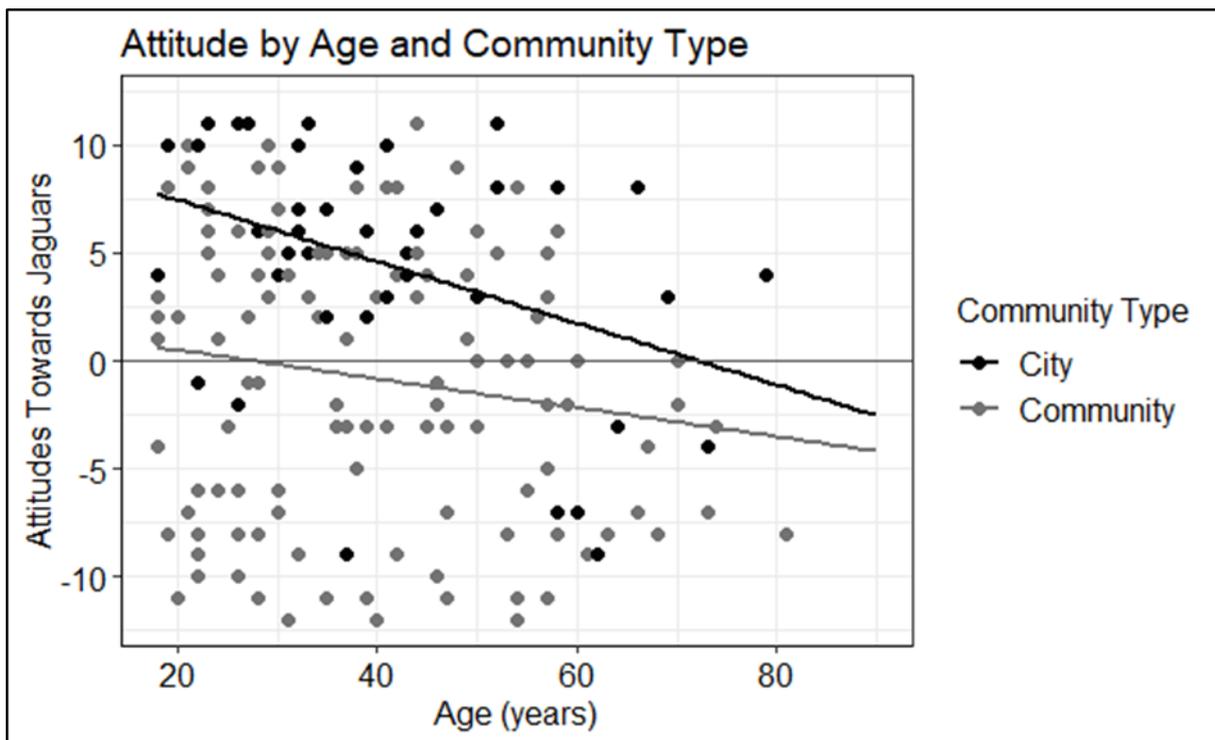


Figure 33. Scatter plot showing the correlation between age and attitude towards jaguars for the two community types, town/city (Beruri) ($p = >0.05$, $y = 10.317 - 0.143x$, $R^2 = 0.157$, $n=41$ (black dots)), and riverine communities ($p = <0.05$, $y = 1.830 - 0.067x$, $R^2 = 0.023$, $n=121$ (grey dots)). Black dots represent female respondents ($n=41$) and grey triangles represent male respondents ($n= 120$) a respondent and the black line represents regression.

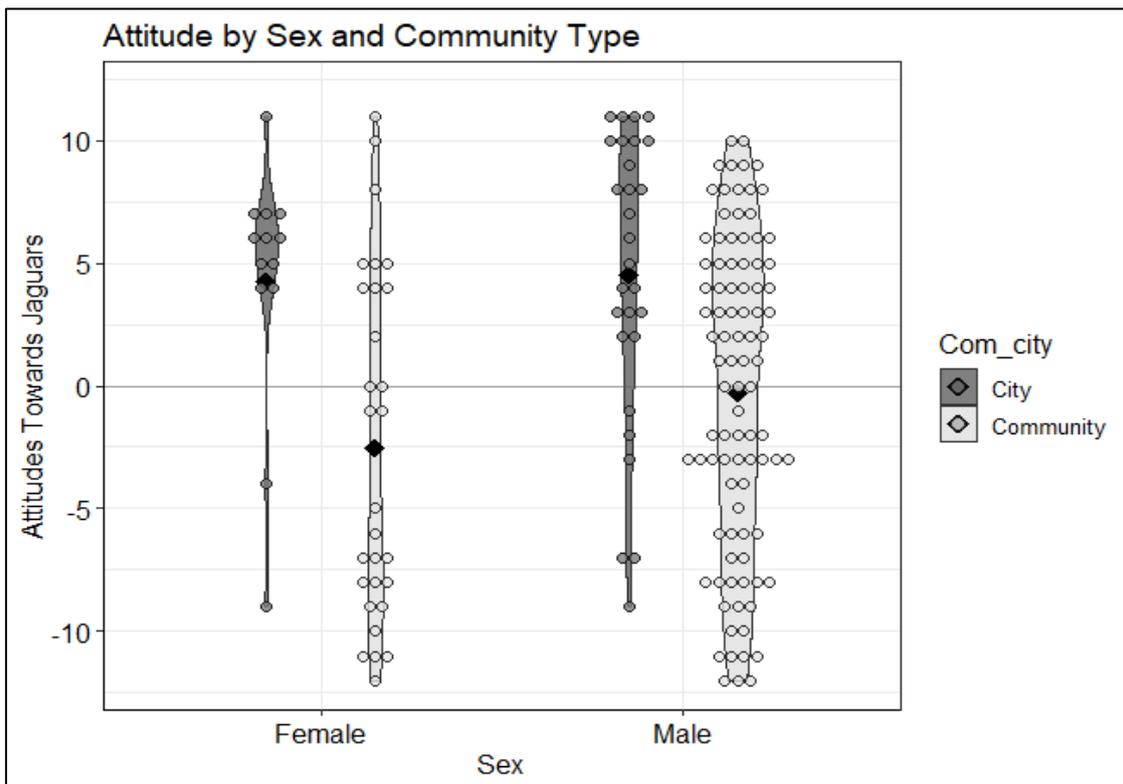


Figure 34. Violin plot shows the distribution of attitudes for respondents by sex and between community types. Dots represent individual respondents, and black diamonds showing mean attitudes for each group. There was a significant difference between the attitudes of respondents from the city/town (Beruri) and the riverine communities for both males (mean= 4.534, Std.Dev.= 5.935 and mean= -0.272, Std.Dev.= 6.349 respectively $p = <0.0001$) and females (mean= 4.231, Std.Dev.= 5.183 and mean= -2.517, St.Dev. = 7.069 respectively, $p = <0.01$), but no difference between the sexes for respondents from the city (Beruri) ($p = >0.1$) or riverine communities ($p = 0.1$).

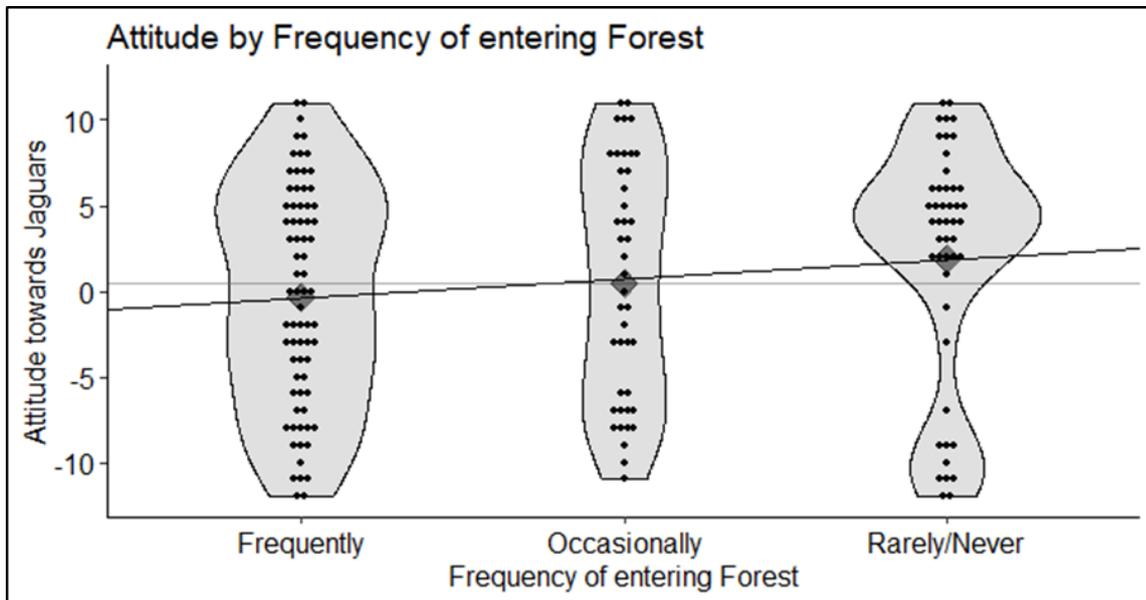


Figure 35. Violin plot shows the distribution of attitudes across the frequency of entering the forest with each black dot representing a respondent. Grey diamonds represent mean values. There was no correlation between use of forest and attitude towards jaguars (Kendall's tau correlation coefficient= 0.103, $p = >0.05$).

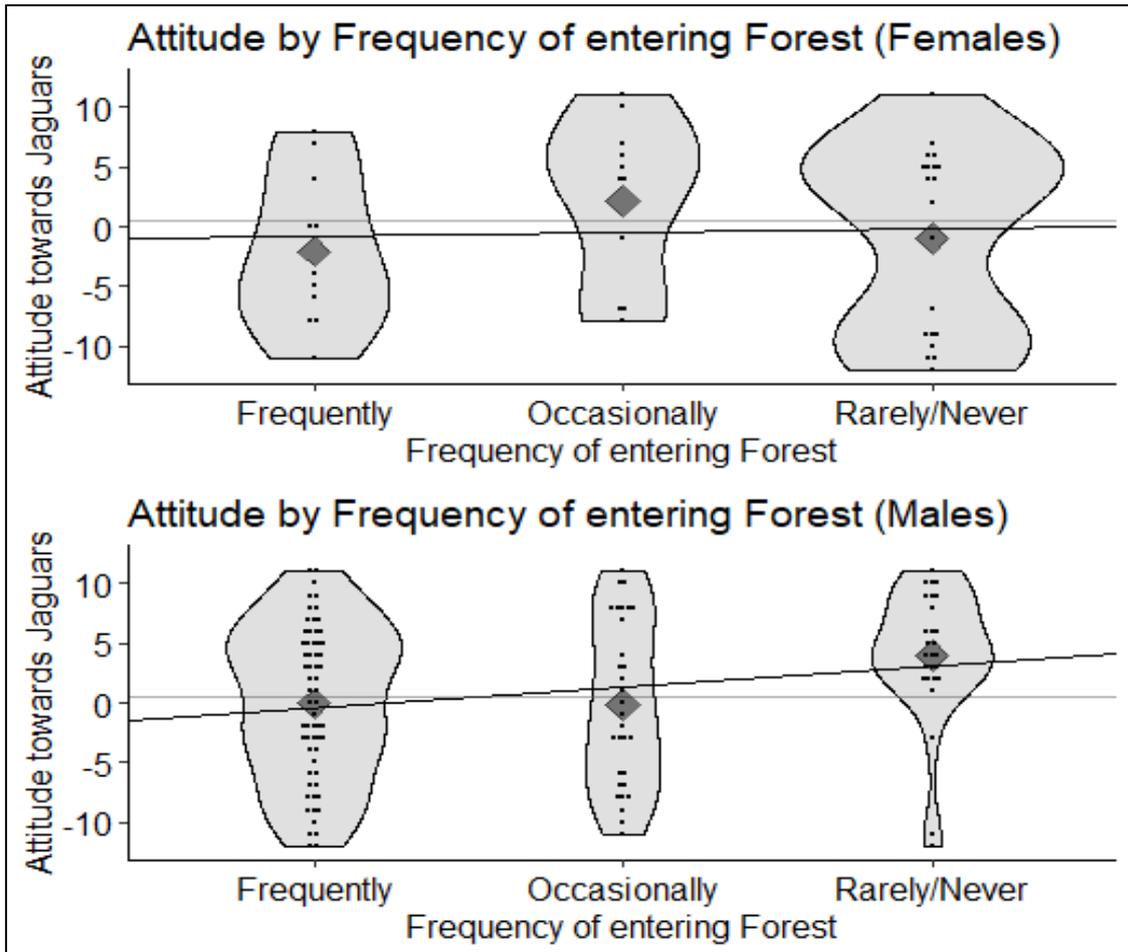


Figure 36. Violin plots show the distributions of attitudes towards jaguars for male and female respondents based on how often they used (entered) the surrounding forest. For males attitudes were negatively correlated (Kendall's tau correlation coefficient= -0.153, $p = <0.05$) with how often they used the forest, whilst for females, there was no change (Kendall's tau correlation coefficient= 0.02, $p = >0.05$).

Table 3. Accounts of Jaguar Attacks

Heard stories of Jaguar attacks	Yes	No
No. of respondents	134	28
Percentage	82.7%	17.3%

There was no difference in attitudes towards jaguars between those who had heard stories of attacks involving wild jaguars (mean attitude of 0.33 (Std. Dev.= 6.59)) and the minority who had not (mean attitude of 0.92(Std. Dev.=7.08)($p = >0.05$).

5.5 Belief in Local Folklore

Legends were shown to be widely established in the study area, with eight of the ten legends used in the questionnaires being familiar to at least 90% of respondents, with all interviewees reporting to have heard of the story of the Cobra Grande (Figure 37 A). Belief in the legends was also shown to be common, with at least 50% of the respondents stating that they believe in the least eight of the legends mentioned in the surveys. The Cobra Grande, Fogo Fatuo and Matim were the most accepted legends with 87.7%, 85.8% and 77.2% of people reporting to believe in these legends respectively (Figure 37 B). At least 50% of the respondents admitted to fearing seven or more of the legends mentioned in the survey, with the Cobra Grande, Fogo Fatuo and the Water Jaguar were the most feared (Figure 37 C). Over 50% of people claimed to have perceived the presence or evidence (sightings of legend or its tracks, heard calls, etc.) of the Matim and Fogo Fatuo, although claimed sightings of most legends were not common (Figure 37 D).

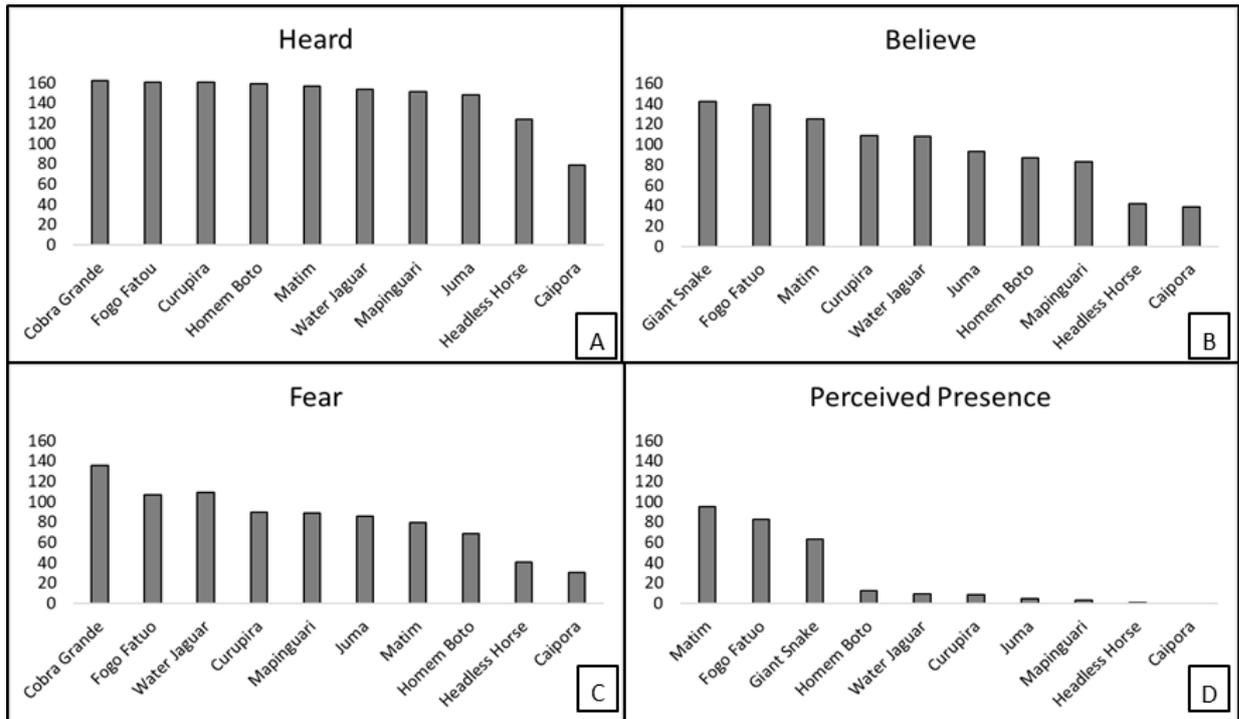


Figure 37. Bar graphs show counts respondents who have heard (A), believe (B), fear (D) or have perceived the presence (C) of local folklore in the lower Purus River region.

The belief scale (BS) was based on the percentage of legends that the respondent both believed and feared, taken from those legends of which they were previously familiar. Across all respondents, the average belief scale for all legends was .63 with 25 of the 162 interviewees believing and fearing 100% of the legends of which they had previously heard (Figure 38). Between the sexes, there was no difference between the level of belief in legends with females having a mean of 0.709 (Std.Dev.= 0.328) and males a mean of 0.602 (Std.Dev.= 0.308, $p = >0.1$) (Figure 39). The level of belief was shown to increase with age (Spearman's correlation coefficient = 2.11, $p = 0 < .05$), There was a lot of variation in the younger respondents (ages 18- 40) with beliefs being spread across the belief scale quite with little obvious pattern, however, older respondents consistently had high belief in legends (Figure 40).

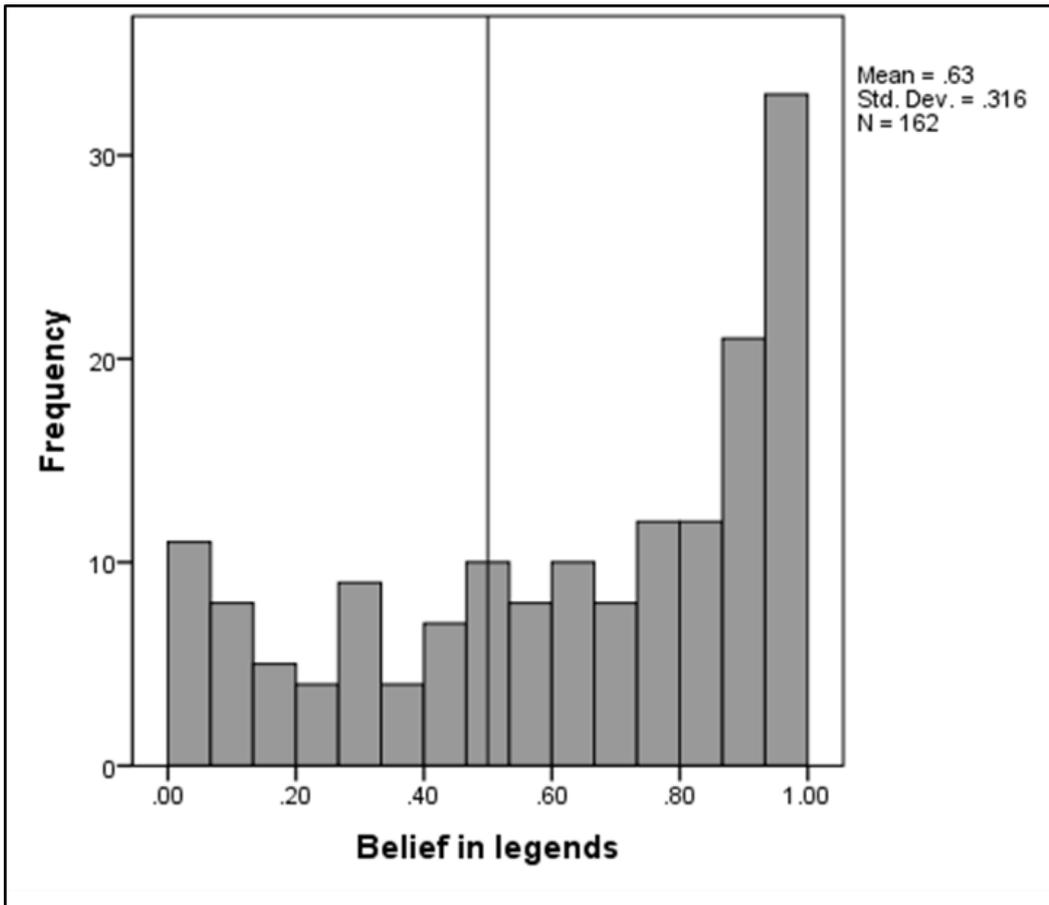


Figure 38. Histogram show the distribution of the proportion of legends in which the respondents believe.

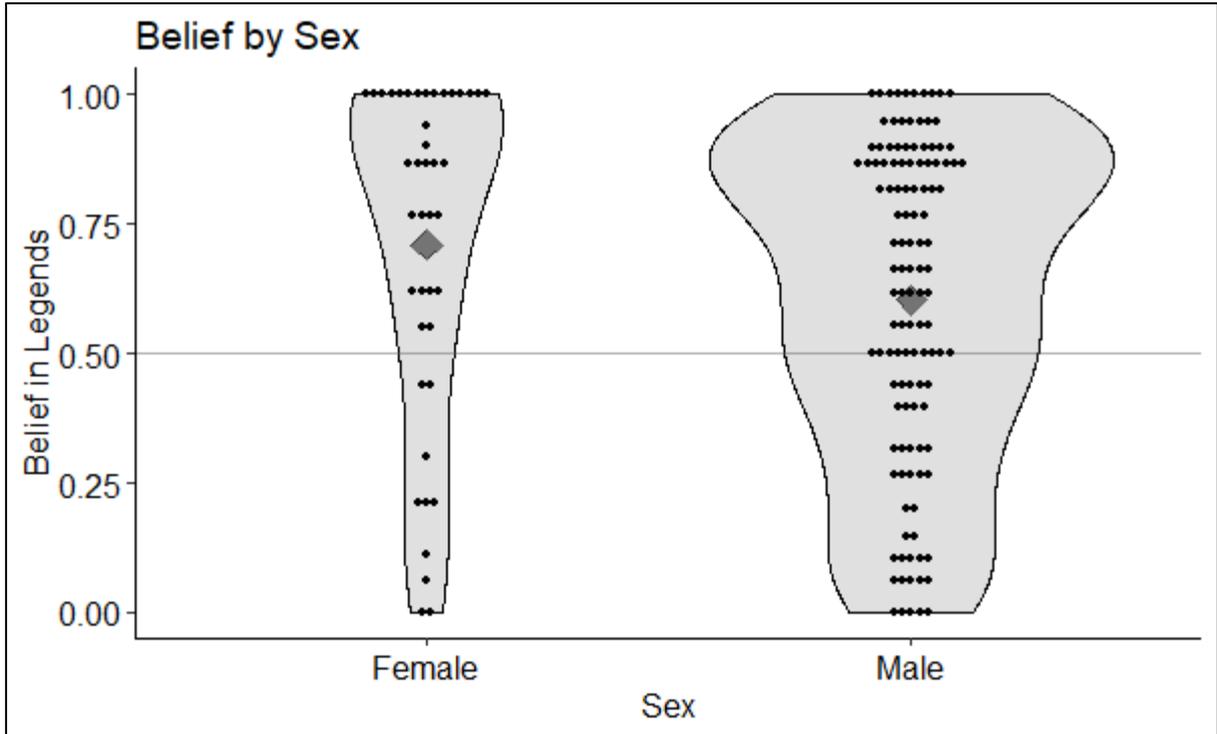


Figure 39. Violin plot shows the distribution of the proportion of legends which male and female respondents believe, with females having a mean of 0.709 (Std.Dev.= 0.328) and males a mean of 0.602 (Std.Dev.= 0.308) ($p = >0.1$).

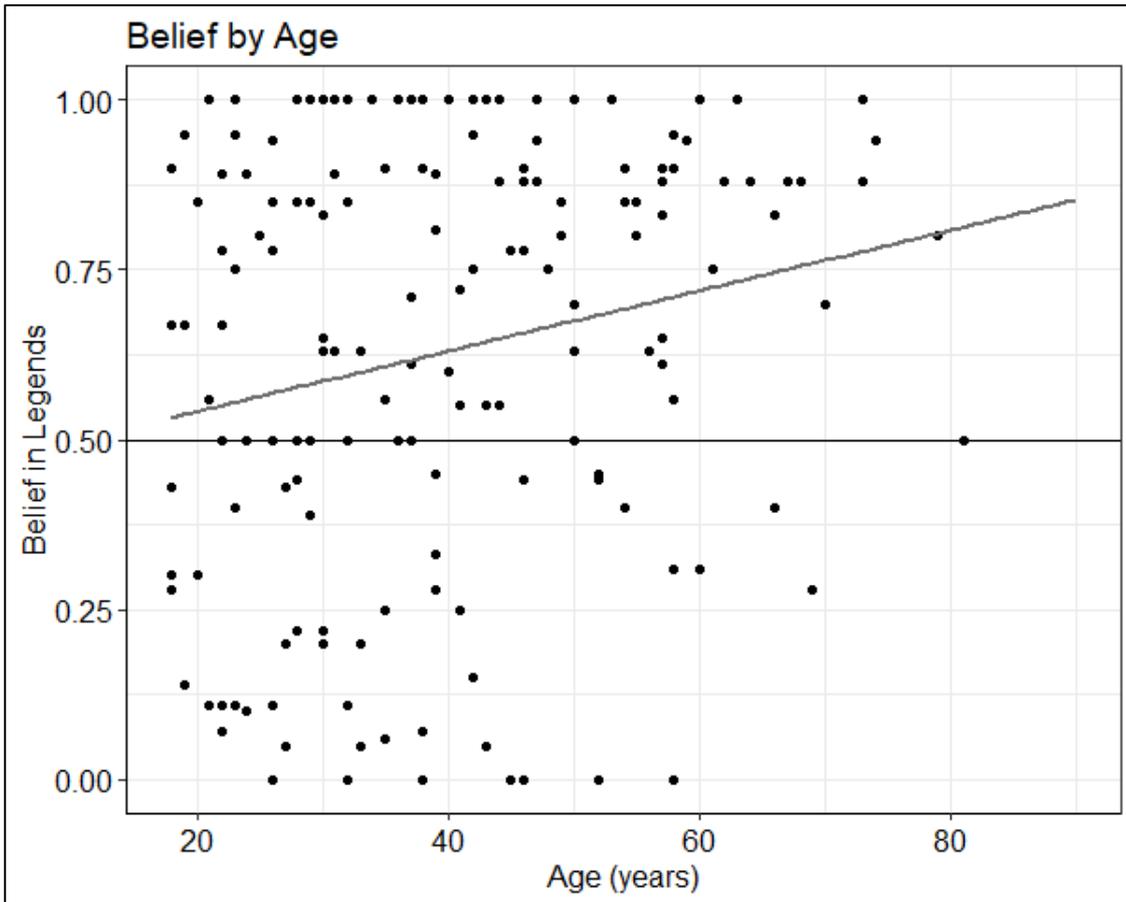


Figure 40. Scatter plot shows the distribution of proportions of belief in legends for respondents in relation to age. The level of belief in legends increases with age ($p = <0.005$, $R^2 = 0.045$, $y = 0.453 + 0.004x$).

Respondents from Beruri with BS of 0.357 (std.= 0.296) had the lowest when measured both against the communities as a group ($p = <0.001$) (Figure 41) and individually ($p = <0.001$) (Figure 42). The riverine communities as a group had a BS of 0.723 (Std.Dev.. =0.296) (Figure 41), whilst individually, Itapuru had the lowest BS (0.627, std.= 0.298) between the riverine communities and Ubim had the highest (0.803, Std.Dev..= 0.214) (Figure 42) and this difference between the riverine communities (i.e. not including Beruri) was also shown to be statistically significant ($p = >0.05$).

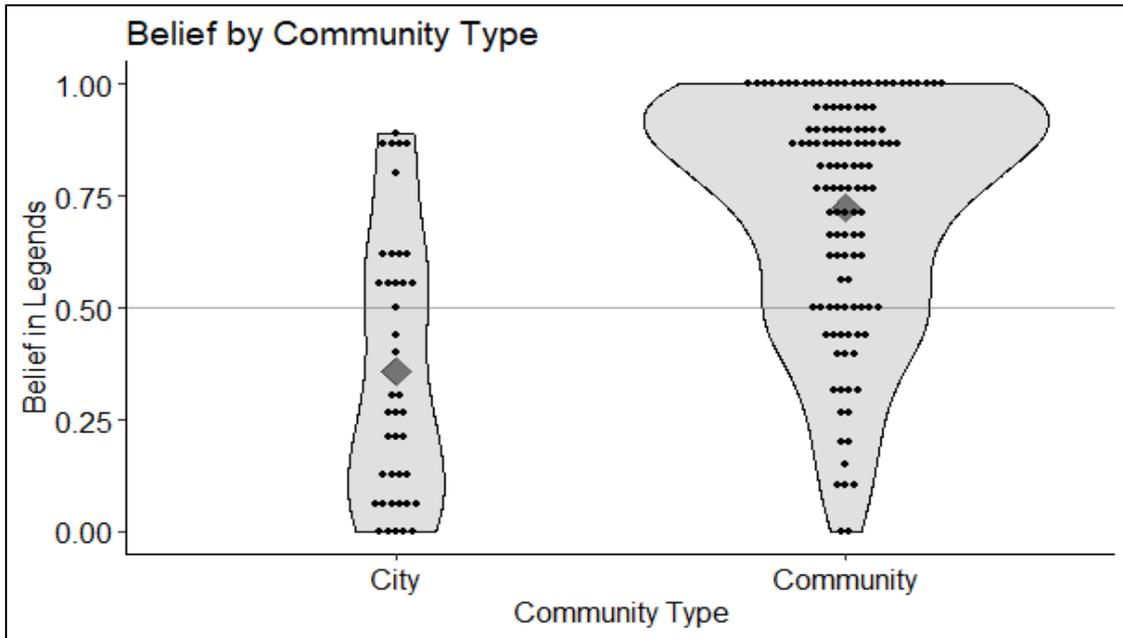


Figure 41. Violin plot shows the distribution of the proportion of legends which respondents from each community type believes (riverine community and city/town (Beruri)) with each black dot representing a respondent. Grey diamonds represent mean values, community 0.723 (Std.Dev.. =0.296) and city (Beruri) 0.370 (Std.Dev..= 0.304), $p < 0.001$.

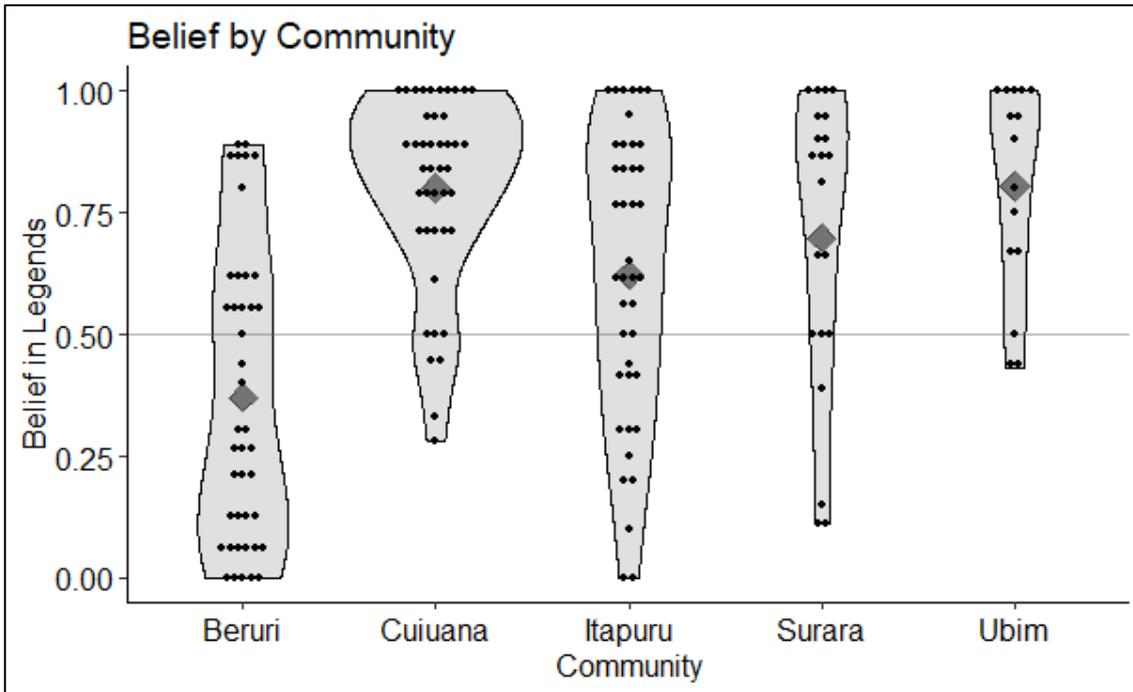


Figure 42. Violin plot shows the distribution of the proportion of legends which respondents from each individual community believes with each black dot representing a respondent. Grey diamonds represent mean values, Beruri 0.370 (std.= 0.304), Itapuru 0.620 (Std.Dev.= 0.299), Cuiuana 0.800 (Std.Dev.= 0.197), Ubim 0.803 (Std.Dev= 0.214) and Surará 0.698 (Std.Dev= 0.299).

Belief scale scores increased with the frequency in which the respondents used/entered the surrounding forest (Kendall's tau coefficient = 0.142, $p= 0.024$), with respondents who entered the forest on a regular basis having a meas BS of 0.715 (Std.Dev.= 0.27) and those who entered occasionally or rarely/never had BS of 0.534 (Std.Dev.= 0.30) and 0.588 (std.= 0.35) (Figure 43) and males belief was positively correlated (Kendall's tau correlation coefficient= 0.212, $p= <0.005$) with how often they used the forest, whilst for females, there was no change (Kendall's tau correlation coefficient= 0.114, $p= >0.01$) (Figure 44).

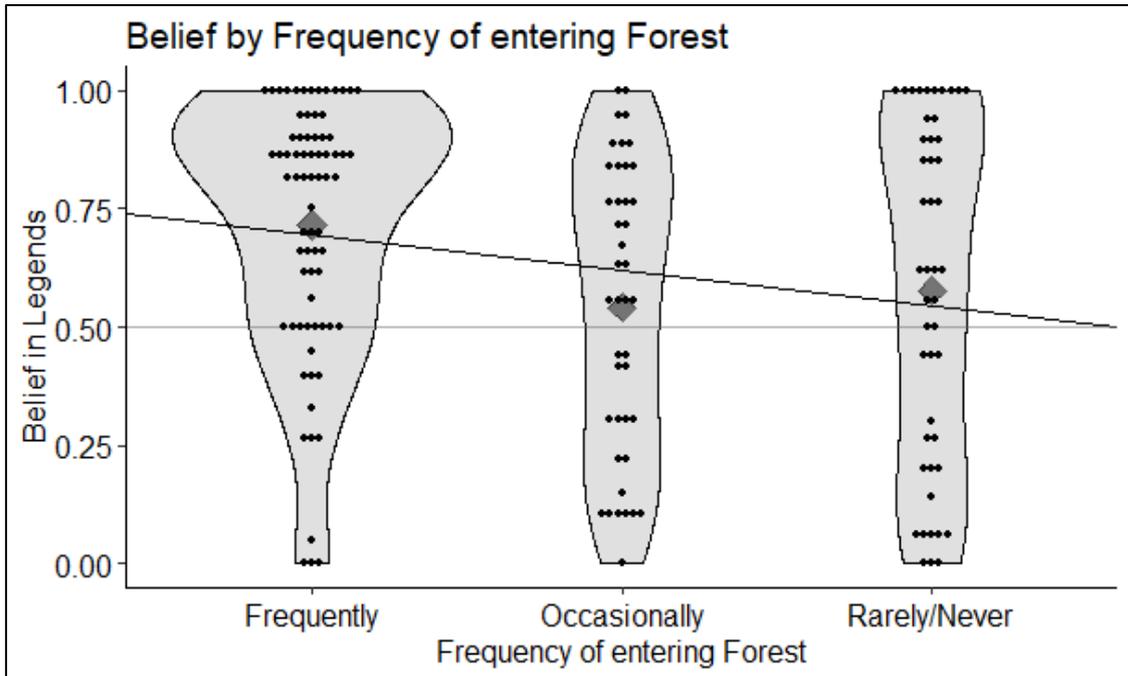


Figure 43. Violin plot shows the distribution of proportion of belief in legends in relation to how often the respondents use (enter) the surrounding forest, with each black dot representing a respondent. Grey diamonds represent mean values, frequent 0.715 (Std. Dev.= 0.273), occasionally 0.534 (Std. Dev.= 0.305), rarely/never 0.589 (Std. Dev.= 0.356), showing that belief increases with frequency of entering forest (Kendall's tau= 0.142, $p < 0.05$).

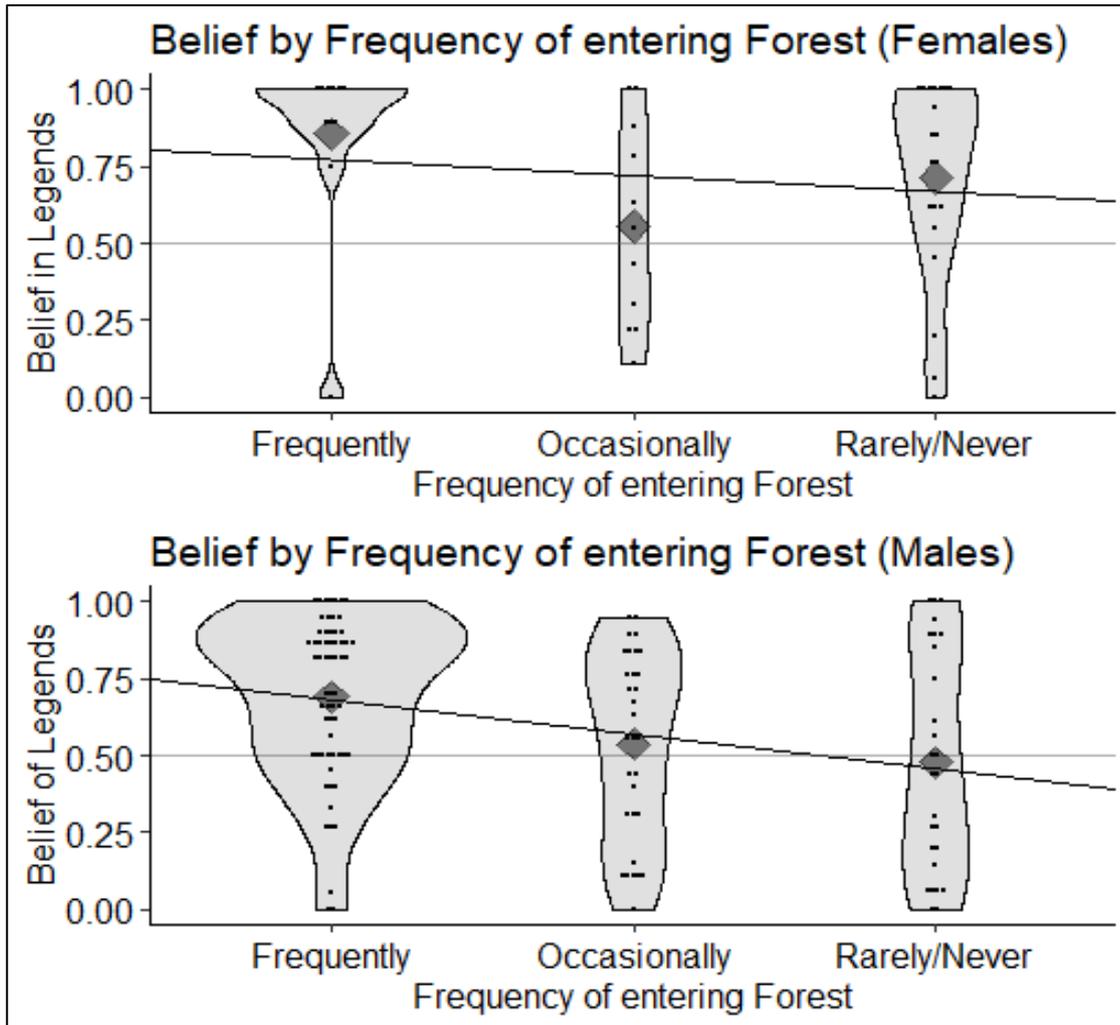


Figure 44. Violin plots show the proportion of belief in legends for male and female respondents based on how often they used (entered) the surrounding forest. For males belief was positively correlated (Kendall's tau correlation coefficient= 0.212, $p = <0.005$) with how often they used the forest, whilst for females, there was no change (Kendall's tau correlation coefficient= 0.114, $p = >0.01$).

5.6 Perceived Attitudes and Beliefs of Peers

Of the six questions used to assess attitudes of peers, four items (Table 4) were selected to create an attitude scale based on inter-item correlations and Cronbach's Alpha score of 0.716. These questions were then compared to the same questions in which the respondents were asked to answer about themselves. As

questions ranged for -2 to 2, the attitude towards jaguars was portrayed as the sum of these 4 items giving a range of -8 for most negative, to 8 for most positive.

When asked to indicate how other members of the community felt about jaguars, respondents were more likely to assert that their peers had more negative attitudes ((Figure 45 A) mean= -1.679, St.Dev.= 3.433) than themselves ((Figure 45 B) mean= 1.481, Std.Dev.= 2.951) ($p = <0.0001$).

For BS, on average respondents asserted that their peers believed in 0.345 (34.5%) more legends than themselves, with the peers 0.967 (96.7%, Std.Dev.= 0.075) (Figure 47 A), and respondents 0.630 (63.0%, Std.Dev.= .317) ($p = <0.0001$) (Figure 47 B). Thus the respondents believed that their peers had a higher propensity than themselves to accept legends as true.

Table 4. Inter-item correlation matrix (peers)

	Peers' general opinion of Jaguars	(peers) If Jaguar became extinct	If a hunter killed a jaguar, peers would think...	Peers who think that it should be legal to kill Jaguars
Peers' general opinion of Jaguars	1.000			
(peers) If Jaguar became extinct	.361	1.000		
If a hunter killed a jaguar, peers would think...	.355	.681	1.000	
Peers who think that it should be legal to kill Jaguars	.179	.310	.403	1.000

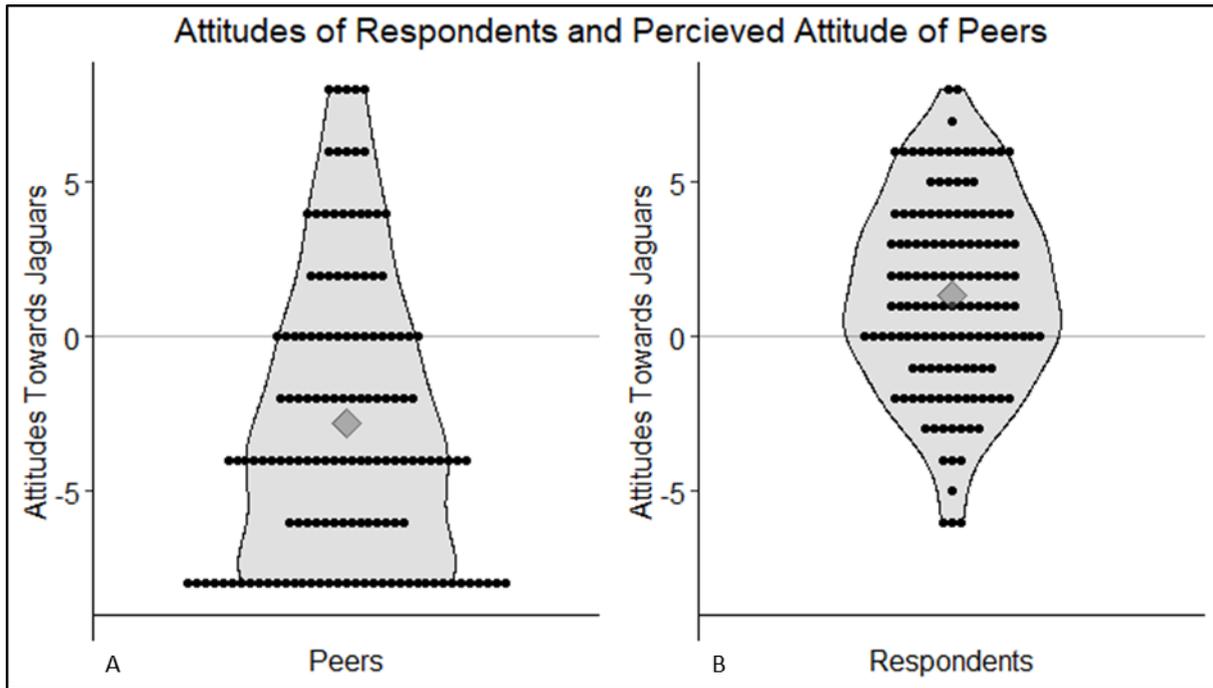


Figure 45. Violin plots show the distribution attitudes towards jaguars for respondents ((plot B) mean= 1.481, Std.Dev.= 2.951) and the proportion which they assumed that their peers believed ((plot A) mean= -1.679, Std.Dev.= 3.433). This differences was statistically significant ($p = <0.0001$).

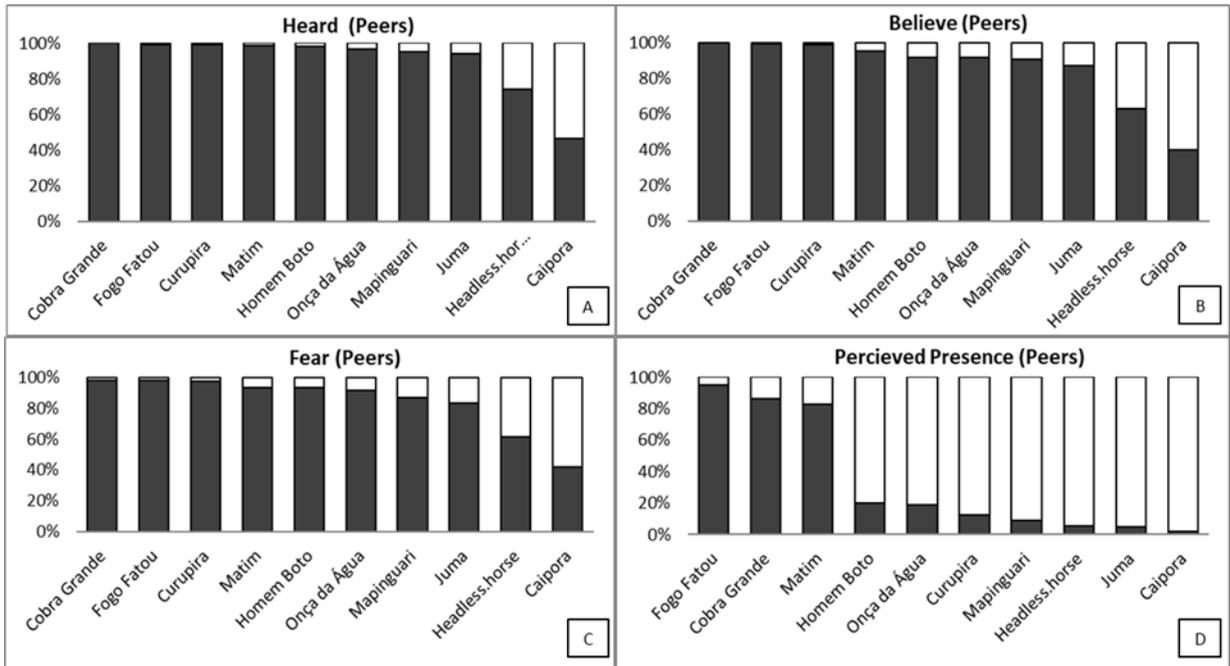


Figure 46. Bar graphs show percentages of respondents who believe tha their peer have heard (A), believe (B), fear (D) or have perceived the presence (C) of local legends in the lower Purus River region.

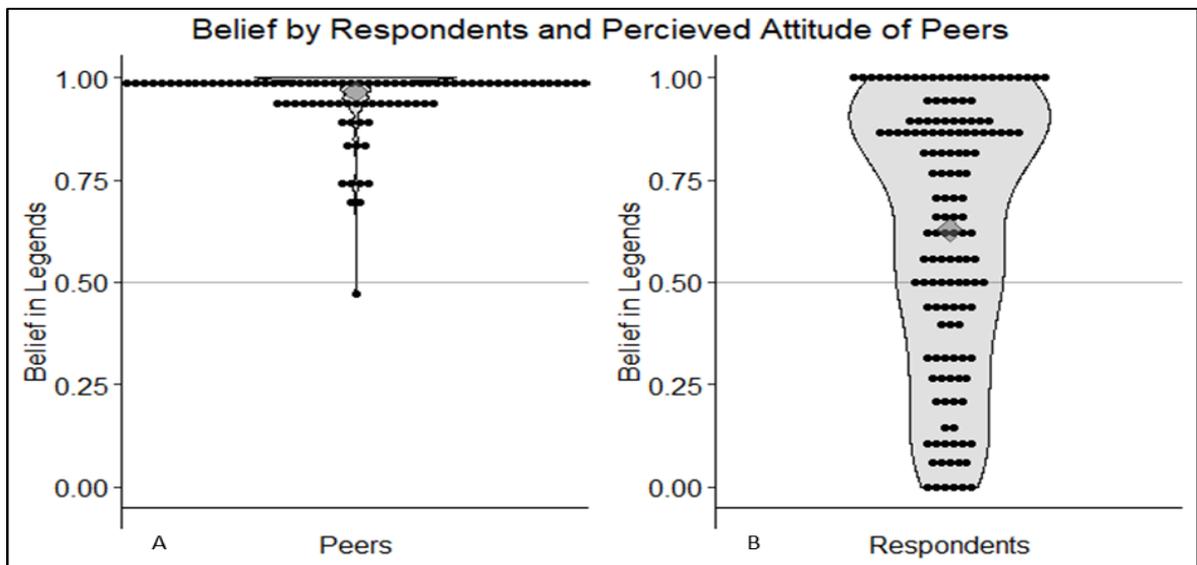


Figure 47. Violin plots show the distribution of the proportion of legends which respondents belived ((plot B) mean= 0.630 std.= .317) and the proportion which they assumed that their peers believed ((plot A) mean= 0.967, std.= 0.075). This differences was statistically significant ($p= <0.0001$).

5.7 Multivariate Analyses

There was a negative correlation between the attitude and propensity to believe in legends, and was the best predictor of the models tested (Spearman's correlation coefficient -0.497 , $p = <0.0001$), particularly for those respondents with lower scores for belief in legends who tended to have the highest positive scores for attitude towards jaguars. Respondents with higher belief scores tended to have more negative attitudes towards jaguars, though these scores were shown to be more spread across the attitude scale (Figure 48).

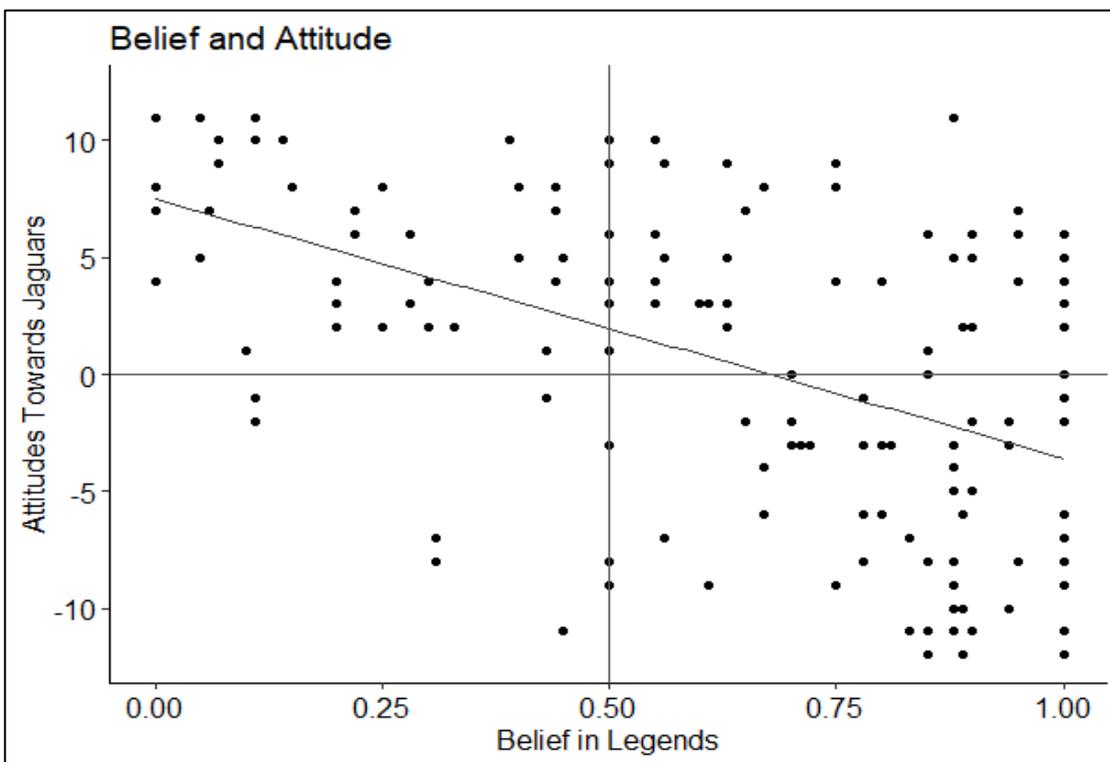


Figure 48. Scatter plot shows the relationship between the propensity to believe in local legends and attitudes towards jaguars. Each point represents an individual respondent, and the grey line shows the regression relationship ($p = <0.0001$, $R^2 = 0.273$, $y = 7.515 - 11.106x$).

This negative correlation between the attitude and propensity to believe in legends, was consistent for sex, age and community type, except for females in the

age groups of >50 and 30-49 (50B) years and females from from riverine communities (Figure 49 B), for which this trend was not significant. Also, age groups 18-29 and 30-49 years in Beruri and, >50 in riverine communities did not show this trend (Figure 51).

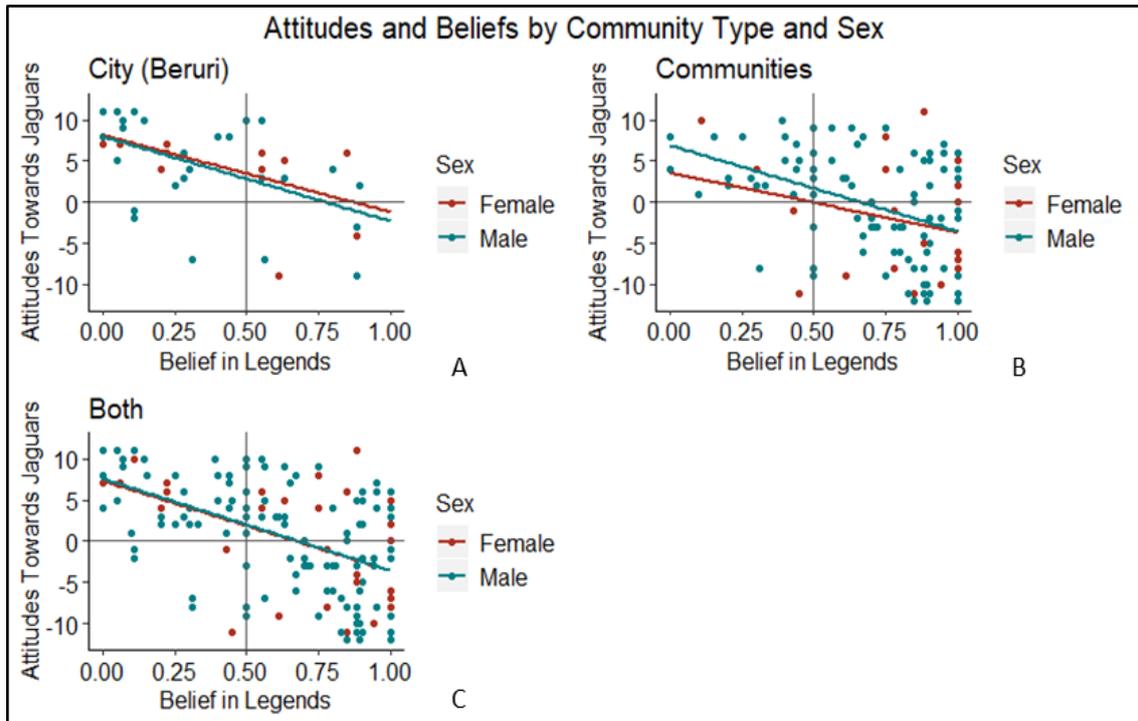


Figure 49. Scatter plots show the relationships between the propensity to believe in local legends and attitudes towards jaguars between sexes and community types. Each point represents an individual respondent, and the blue (male) and red (female) lines show regression relationships. The relationship between belief in legends and attitude towards jaguars was similar across all crossed variables (with p values <0.05) except for females from the riverine communities, where the relationship is not significant (red line plot B) ($p = >0.05$).

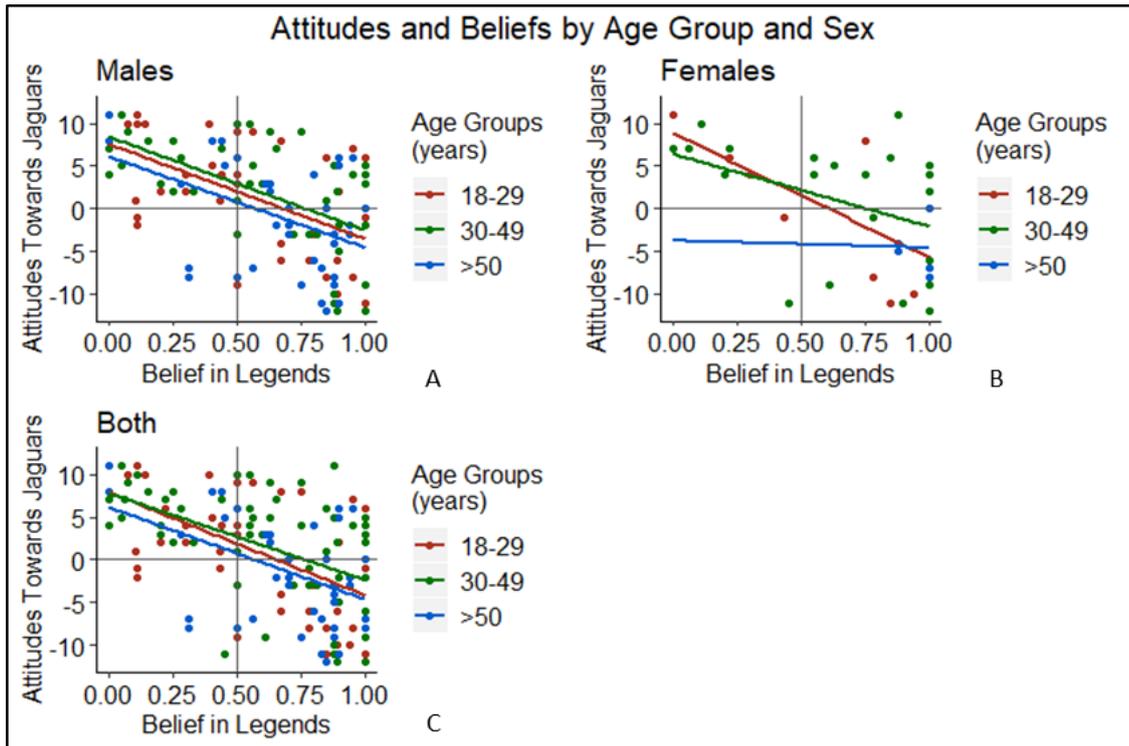


Figure 50. Scatter plots show the relationships between the propensity to believe in local legends and attitudes towards jaguars between sexes and age groups. Each dot represents an individual respondent, and the blue (> 50 years), green (30-49 years) and red (18-29 years) lines show regression relationships. The relationship between belief in legends and attitude towards jaguars was similar across all crossed variables (with p values <0.05) except for females in the age groups of >50 and 30-49 years, where the relationships is not significant (green and blue lines plot B) ($p = >0.05$).

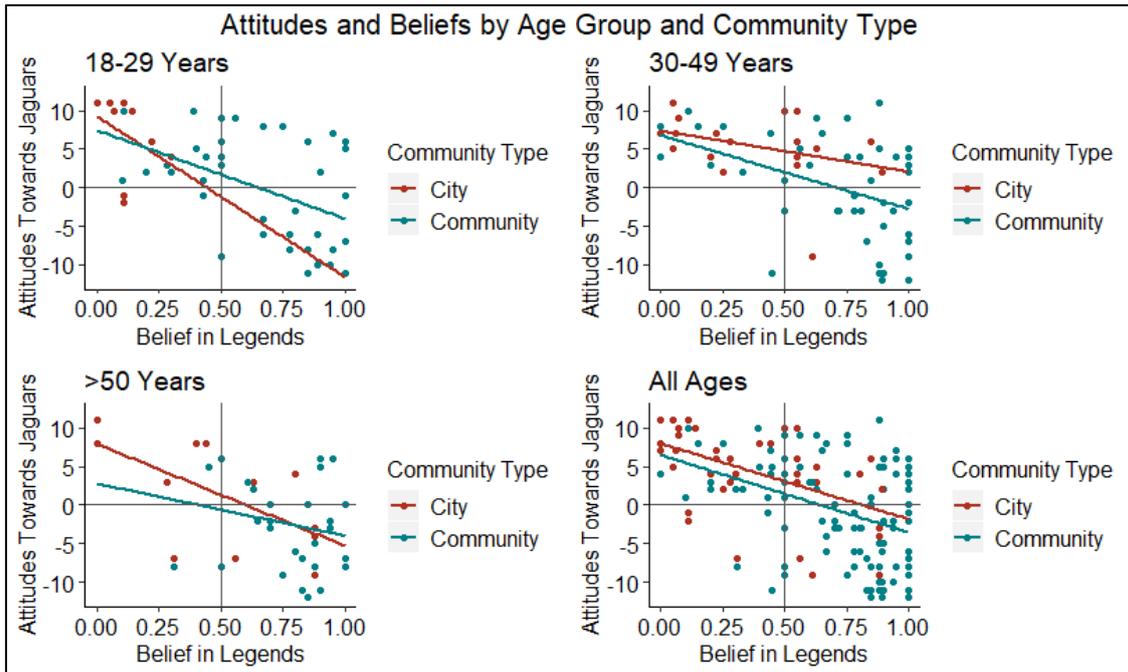


Figure 51. Scatter plots show the relationships between the propensity to believe in local legends and attitudes towards jaguars between community types and age groups. Each dot represents an individual respondent, and the blue (riverine communities) and red (city of Beruri) lines show regression relationships. The relationship between belief in legends and attitude towards jaguars was similar for the two younger age groups (18-29 and 30-49 years (plots A and B) living in the communities (blue lines) (with p values <0.05), but there was no relationship for respondents from these age groups who live in Beruri ($p = >0.05$). The opposite was true for respondents aged over 50 years (plot C), with the relationship between belief and attitude only being present in those from Beruri (red line) ($p = <0.05$).

6. DISCUSSION

The results from this study show that a respondent's propensity to believe in local folklore was the strongest predictor for attitudes towards jaguars. This trend was similar across age, sex, community, and relationship to the surrounding habitat (measured by frequency of entering forest), with attitude being negatively correlated with belief in folklore. Given that this study failed to identify a correlation between fear of other potentially dangerous wildlife such as snakes, caiman or piranhas, this trend does not appear to be linked to one's inherent fear of the wildlife. These results also illustrate the importance of oral communication and storytelling as a means of passing information between community members in these areas. Given that most local legends have origins in indigenous lore that promote a spiritual connection to the forest or warn against the consequences of overexploitation of important resources (da Câmara Cascudo, 2015), these findings may be counter-intuitive to conservationists or anthropologists, particularly those who work within indigenous communities. However, what these results essentially show is that for many ribeirinhos, there is no difference between the stories of the existence of Cobra Grande or Curupira (for example) and the tales of charging jaguars (whether they have been embellished or not), or recounts of unseen jaguars following hunters for days. They are regarded as fact by many. Understanding the importance of storytelling and the verbal transmission of ideas between peers in non-indigenous traditional communities is essential for changing attitudes and/or behaviour towards wildlife for conservation purposes.

6.1 Respondents

The discrepancy between the numbers of male to female respondents was a result of many of the women being timid, unwilling to participate in the survey, or believing that they had nothing to contribute as they rarely entered the forest. The comparatively low number of female respondents may have had an influence on the failure to identify differences between the sexes. Other studies conducted within isolated communities have also produced similar proportions of male-to-female

respondents (Conforti and de Azevedo, 2003; Marchini and Macdonald, 2012; Mir et al., 2015) and future researchers should think of strategies to reduce this bias, possibly by including female members in the interview team.

In contrast to female residents, most males that were invited to participate in the survey were willing and eager to speak about their experiences, beliefs, and opinions. Sharing my personal experiences of hunting in my home country of Australia was usually met with enthusiasm and interest and generally proved as a means of initiating conversation and creating an atmosphere of trust. An ice-breaker.

Despite the foreign accent, after training on presenting the questionnaire during its development, and being careful to maintain the selected vocabulary, the local assistants that had been contracted to participate in the interviews were rarely needed to clarify any questions. On the occasions they were required, the questions were answered without problems after a brief clarification and we moved onto the next questions. Although interviewer biases will always exist in these types of studies, I do not believe language barriers to having had a major influence in this study.

6.2 Relationship with Environment

As residents of upper Rio Purus, like many regions within the Amazon Basin, rely highly on an extraction based economy, the results of this study showing that many respondents confessed to rarely, or never entering the forest were surprising. Many of the respondents, explained that they did not like to spend time in the forest due to a fear of snakes, jaguars or other wildlife.

Many residents also admitted to rarely, or never entering the river to swim (for recreation) or cool down, even on hot days. This would be a surprise to anybody who has felt the extreme tropical, almost year-round heat of the Amazon, and given the close proximity that these communities have with the river, one could assume that the river may be a central focus for recreation and swimming during hot periods. For many respondents, particularly women, residents of Beruri, and those over 50 years of age, this was not the case. In fact, a number of respondents, including fishermen and

people who lived in floating houses, admitted to not knowing how to swim, and many more explained that they do not enter the water due to their fear of piranhas, caiman and in a few cases, river dolphins. This is despite there being no reports of unprovoked caiman attacks in the region by locals and indeed, caiman attacks, in general, are extremely rare and even less for adults (Haddad Junior, 2008; Haddad Jr and Fonseca, 2011). For the case of piranhas, whilst many interviewees told stories of receiving one or two isolated bites to feet, or legs whilst swimming, or to hands whilst removing the fish from fishing nets. Single bites to swimmers have been shown to be associated with territorial behaviour of fish whilst defending spawning areas (Haddad Junior and Sazima, 2010). Of the 162 people interviewed, there were only 2 stories that allegedly involved more than two bites were reported.

One case, told by a single interviewee in Beruri, was of a teenage boy (15-16 years) who had received around a dozen bites to his back and legs whilst swimming in the river near the community of Jacaré, around 10 years prior. The boy was able to exit the water and receive treatment for superficial wounds. The other case, which had occurred around 6 years ago (as of the time of the interview) in the community of Cuiuanã, was a young boy "Ronaldinho" (4-5 years) who fell into the river and the body was found several hours later partially eaten by piranhas. This story was told by many respondents of Cuiuanã and mentioned by a number of respondents from the neighbouring communities of Itapuru, Ubim and Surará. Although the young boy almost certainly drowned before the piranhas began to scavenge his body, there were mixed reports of the event, with some supporting the assumption that the boy drowned first, saying that the young boy could not swim and simply disappeared under the dark tannin filled waters of the Acauá River, with no signs of piranhas attacking; whilst others reported that the water began to bubble with frenzied piranhas attacking the boy soon after falling into the water. Most of these stories were recounts of versions they had heard. One young male respondent even described the attack as being akin to a scene of one of the various horror movies featuring terrorising schools of piranhas

which are occasionally broadcasted on Brazilian television (see: "Piranha", Corman, Davison and Dante, 1978).

Like with many dramatic stories, particularly after a number of years of being told and retold, details from this event changed with each person who told it. As with the Bartlett (1932) experiments and the study on family memory of events (Welzer, 2010), pre-existing biases and personal experiences are likely to have influenced each individual's versions of the story, whether they had seen it first hand, or it was a re-narration of a version that they had heard. This explains the modified details of each version of the event of the young boy drowning or being attacked by piranhas, which may have been influenced by pre-established attitudes towards piranhas. This is supported by the frequency in which piranhas are mentioned as animals that are feared in the rivers.

Whilst there are no registered deaths of humans caused by piranha attacks (Haddad Junior, 2008), incidents involving singular or a few isolated single bites do occur and are usually associated with parental care and defence of spawning territory. There have in fact been a number of incidences in which cadavers have been found partially eaten by piranhas after prolonged periods of time in the water (Sazima and de Andrade Guimaraes, 1987). It is understandable that community members tasked with retrieving a cadaver partially consumed by piranhas could jump to the conclusion that the cause of death was due to piranha attacks, and that such stories could spread rapidly through and between communities. It is also understandable that such stories, prominent within the community could lead to high proportions of people being reluctant to dive into the dark waters of the surrounding rivers, despite the appeal of the cooling relief from the tropical Amazonian heat. This has many parallels with stories of killer jaguars, the associated fear, and reluctance of many residents to enter the surrounding forests.

6.3 Fear of Wildlife

Of all the wildlife that can be encountered in the Brazilian Amazon Rainforest, the animal group that presents the highest risk of death or serious injury, are the venomous snakes, particularly the family Viperidae (Borges, Sadahiro, and Santos, 1999; de Fraga, 2013; Oliveira et al., 2013). This was reflected in the responses during the interviews with snakes being the most common response when interviewees were asked to list the animals they fear most. A study by Sliva Souza et al. (2018) found that there were 127 snake bite deaths officially reported in the state of Amazonas between 2007 and 2015, although given the size of the state and the level of isolation of many communities, this is likely to be an underrepresentation. The researchers found that *Bothrops* sp. and *Lachesis muta* (Bushmaster) were responsible for the majority of deaths (68.5% and 29.5% respectively), with *Micrurus* sp. causing just one death. Deaths were associated with age, sex and level of isolation, with males aged 46 - 60 years living more than 300km from the state capital of Manaus being the highest risk group. It is noteworthy that in the current study, males from the older age groups (>50 and 29-49 years) reported having the highest frequency of entering the forest, thus having the highest chance of snake encounters. As part of this study, interviewees were asked to identify poisonous snakes and the names of each species from a chart of photos featuring snake species from the region. Knowledge of snakes was very low (unpublished data), with no respondents being able to identify all of the poisonous snakes, and many confusing harmless snake species such as the Amazon tree boa (*Corallus hortulanus*), the green tree boa (*Corallus caninus*) and the lora (cobra cipó) snake (*Leptophis ahaetulla*, Family, *Colubridae*) as being venomous (unpublished data). The green tree boa, regionally known as "cobra papagaio", which translates to parrot snake, was believed by many respondents to be highly venomous, and as the story goes according to a young male interviewee from Itapuru, "if the snake sings (like a parrot) when it bites you, you will surely be dead by the end of the night". Similar versions were repeated many times throughout the interviews. The story of a species of "singing snake" seems to be widespread across the Amazon, with reports of

indigenous and riverine settlers believing that the Bushmaster (*Lachesis muta*) in the Peruvian and Ecuadorian Amazon can sing. It has recently been revealed that the acoustic song that is often believed to belong to the Bushmaster in these regions, is actually made by two frog species (Ron et al., 2016). In regards to many residents believing that the green tree boa is venomous may be a case of misidentification, confusing this snake with the green Amazonian palm viper (*Bothrops bilineatus*), which is highly venomous, and indeed, no respondents correctly identified this viper species during this study.

Fear and widespread dislike for snakes in the region is likely to result in the killing of many snakes, both venomous and non-venomous, that are encountered by residents, with many respondents believing that killing snakes is justified (unpublished data). This shows that education focusing on wildlife and wildlife safety is lacking in this region of Amazonas. Snake identification training and precautionary strategies, such as the use of snake chaps (perneiras) fitted to the lower legs whilst in high-risk areas, such as forests or farm plots, snake bite first aid, and even safe snake handling techniques have been shown to drastically reduce the risk of snake bites and increase tolerance towards snakes (Cooper, Furst, and Bridger, 1969; Makashvili, Kaishauri, and Azmaiparashvili, 2014). Future conservation and social health plans should look to invest in such programs which would result in fewer deaths and injuries for both local residents and snakes.

Jaguars were the second most common response in regard to the fear of wildlife in the forest. There is no doubt an adult jaguar would be a formidable and intimidating sight for anybody coming face-to-face with the predator in the middle of the dark forest. However, incidents of jaguars attacking humans are very rare, with many of the registered cases involving hunters pursuing the Jaguars, particularly with dogs (Neto, Neto and Haddad, 2011). One such event was recounted by a 38-year-old male resident of Itapuru. Whilst two men from a nearby community were hunting, the accompanying group of hunting dogs came upon and began to corner a jaguar. The jaguar attacked one of the dogs, and then briefly attacked one of the hunters as it was

escaping the pursuing dogs. He defended himself with his machete and received cut to his arm. The other hunters shot and killed the jaguar as it climbed a nearby tree.

Caimans were the animals that were most feared in the rivers. Although there are two species that are physically capable of killing small people, serious attacks are extremely rare (Haddad Jr and Fonseca, 2011), with most accidents occurring when caiman are trapped in fishing nets. A local fisherman/caiman hunter of the community of Cuiuanã was involved in an incident around 10-15 years ago with a large (3-4 meter) black caiman (*Melanosuchus niger*) whilst hunting caiman in the RDS-PP. He was paddling alone in his wooden canoe preparing to harpoon the large caiman. As the canoe got close to the caiman, the caiman attacked the small boat, knocking the man into the water. The caiman then grabbed the man's thigh and dragged him underwater. The man was able to fight off the caiman and rose to the surface, where nearby fishermen were able to get him out of the water. The man suffered deep lacerations to his thigh and still has severe scarring to this day.

Stingrays and piranhas were the next most common responses when asked to list animals most feared in the river. As with the piranha bites mentioned in the section above, many respondents had personally (or knew of somebody who had) received envenomation by stingrays, whilst wading through water, swimming or removing fish from nets. The barbs of the stingray can cause significant lacerations and are coated with a cocktail of neurotoxins and proteins that cause convulsions and severe pain that can last for up to 48 hours and lead to severe infections (Lameiras et al., 2014; Monteiro et al., 2016). Given the isolation, and little access to quality medical facilities, means that accidents with stingrays could be very problematic for residents, particularly fishermen, and it is understandable that residents are wary of them.

Another animal that came up in several conversations, was a giant catfish (most likely the Paraiba (*Brachyplathystoma filamentosum*)) but was known locally as the pacamão and is said to be able to swallow people whole. There are no registered reports of fish swallowing people in the Amazon, although the subject was covered on the Animal Planet's docudrama series River Monsters (Dijkstra et al., 2009).

The Amazonian pink river dolphin (*Inia geoffrensis*) was also mentioned during a number of interviews with females and this fear is likely associated with the legend of the Homen Boto and will be talked about in more detail in the section regarding folklore.

6.4 Attitudes towards Jaguars

Attitudes assigned to respondents were calculated using the sum of six of the nine Likert-scale (1-5) questionnaire items. Three items within the questionnaire were not included in the attitude scale as they were shown to not sufficiently represent the attitudes of the respondents in relation to jaguars. The first item to be excluded asked the interviewees to rate the appearance of the Jaguars, from 'very ugly' to 'very beautiful'. Most respondents responded positively (very beautiful (+2) or beautiful (+1)), regardless of attitude, and comments generally referred to characteristic patterns of the jaguar's coat, such as "they are beautiful, I would like one as a pet if they were not so dangerous" (female respondent from Itapuru), and "their coats are beautiful, I would like one (pelt/skin) in my house" (male respondent from Surará). Another male respondent from Cuiuanã commented "Beautiful they are, but they are angry". Thus showing that both people with positive and negative attitudes agreed on the beauty of the Jaguars, and that this was not a good measure of attitude.

The second item to be excluded referred to the interviewee's impression of changes in the population of jaguars in the region. The inclusion of this item in the questionnaire was based on the premise that those interviewees who perceived or believed that the population of Jaguars was increasing or overly abundant, may infer an increase in the risk of jaguar-human encounters, and thus more negative attitudes. However, like most wild felids, jaguars are secretive and stealthy. As top-tier predators, they also have low population densities and large home ranges, making them hard to see, particularly in the dense Amazon Rainforest. Indeed, many respondents declared to have never seen a jaguar, or only experienced brief glimpses on rare occasions. This meant that perceived changes in population may have been based on rationale that

did not reflect the respondent's attitude. For example, a number of interviewees explained that the jaguar population must be increasing because people are not hunting them for their pelts anymore (like they had done up until the 1970s), whilst others used similar explanation, but with a different conclusion, saying that the population must be declining because "...it is very rare that hunters bring a Jaguar back to the village to eat, so it seems that there are fewer these days. It is difficult to see them" (paraphrased from female respondent from Ubim). Thus this item was also deemed as poor representation of attitude, an assumption that was confirmed by statistical analyses.

The final item to be excluded from the analysis asked if they considered jaguars to be dangerous. Again, many respondents that were later found to have both positive and negative attitudes answered positively (that, yes, they consider the jaguar to be dangerous). This question may have been interpreted as being "potentially dangerous", which they surely can be under certain circumstances. Thus this question was deemed to not be a good representation of overall attitude.

The residents of the lower region of Rio Purus are diverse. Those who participated in the current study varied in measurable demographics such as age, sex, occupation, frequency of interaction with the environment; and unmeasured attributes, such as level of education, ethnicity, cultural background, and prior encounters with wildlife (either positive or negative). Thus, it is not surprising that the current results showed that attitudes towards jaguars were quite spread across the spectrum, from extremely negative (-12) to highly positive (+11).

There was no difference between the attitudes between male and female respondents when measured by sex alone. The communities in the study area, in particular, the riverine communities, are very isolated, with little outside influence. Ubim and Surará were only connected to an outside source of electricity one year and Itapuru and Cuiuanã 8 and 5 years prior to the surveys being conducted respectively and had all previously relied on small scale diesel generators that produced energy for a few hours per day at best. Also, there is was no internet in any of the communities except

for restricted use in the schools of Itapuru and Cuiuanã. This lack of outside influence may explain why there is no difference in attitude between male and female respondents, as experiences, ideas, and stories passed verbally between couples and family become the most important source of information to base one's ideals and attitudes.

There was no difference in attitude between the four riverine communities, however, respondents from these communities held more negative attitudes towards jaguars than those from the town of Beruri. This is consistent with other studies that have found a correlation with attitude and distance from large carnivore habitats (Karlsson and Sjöström, 2007; Hemson et al., 2009; Carter et al., 2014) with city residents having more positive attitudes compared to those who live in the country (Heberlein and Ericsson, 2005). There may be a number of factors that have influenced this trend. Firstly, Beruri is more developed in comparison to the riverine communities, and the residents are likely to have higher levels of formal education as well as access to "the outside world" in the form of internet and broadcast television. Residents of Beruri also generally spend less time in the forest than members of the riverine communities, thus, may feel that they have less to fear from jaguars than, for instance: fishermen, hunters, or ribeirinhos who collect açai or brazil nuts, and may spend multiple days and nights at a time camping in the forest. The residents of the four neighbouring riverine communities often travel between villages, selling fish, playing football, for social and festive occasions or to in the case of residents of the smallest community Ubim, to attend school. This may explain why there was no significant difference in attitude between these communities as stories and ideas flow freely between them. Indeed, many of the same stories of animal encounters (and versions of folklore) were recounted across the four communities during the interviews.

The factors mentioned above also explain why, for males, age showed a negative correlation with attitude, as older men are likely to have received little formal education, have less access to outside information and as shown by this study, spend more time in the forest and thus higher exposure to perceived risks. Indeed, the current

study also showed that for men (though not women) there is a negative correlation for both age and the frequency of entering the forest and attitude towards jaguars. As the age and frequency of entering the forest are correlated, it is difficult to separate the causal relationship between these factors.

There was a negative correlation between attitude and age for all respondents measured as a whole. This was also true for males but not females when measured by sex, and for the town of Beruri, but not the riverine communities when measured by area of residency. This latter trend was mostly driven by the younger respondents in Beruri, which generally had more positive attitudes towards jaguars than their counterparts that live within the riverine communities. This difference in attitude may likely be due to contrasts in lifestyles between the township and the riverine communities such as differences in exposure to forest, and the passing of negative stories of jaguar encounters. Also, Beruri has higher indices of education and more outside influences such as access to the internet and a more transient population. This also explains why there was no difference in attitudes for people over 50 years of age and living in Beruri or the riverine communities, as the increased development in Beruri, is quite recent, and the difference in living conditions between residents of Beruri and riverine communities would have been less drastic 40 years ago. The negative correlation with age and attitude in males is likely linked to the fact that older males tend to spend more time in the forest, thus have a greater exposure to the perceived risk of jaguars as mentioned above.

There were four stories of jaguar attacks that were mentioned by various respondents in the region.

Story 1.

*One story that was common in Itapuru and Cuiuanã involved a man and his brother who were collecting rubber from the rubber tree (*Hevea brasiliensis*) when a jaguar reportedly jumped on the back of one of the men. The brother quickly grabbed his*

hunting rifle and shot at the Jaguar, however, the sprayed of bullets impacted the man's shoulder and the Jaguar fled, reportedly unharmed.

Story 2.

Another story involved a man who was alone fishing in his canoe in a shallow tributary when a jaguar came running through the water from the bank. The man grabbed his harpoon, which is used to hunt pirarucu, and threw it at the jaguar hitting it under the eye. The jaguar grabbed the man by the arm, but the man was able to fight the injured jaguar off. The man's arm was severely injured and was said to be in bad condition when he was found paddling back to the community with his good arm.

Story 3.

A small group of people was returning from a day of collecting Brazilian nuts, with baskets made of woven palm leaves on their backs full of the nuts. A jaguar jumped onto the back of one of the men but landed on the basket. The basket and the jaguar landed on the ground and the group chased the jaguar away. Nobody was harmed.

Story 4

Another alleged incident that happened when a man, Dinho, was in the shallow water in a small river in the flooded forest planes when a jaguar jumped from a tree above him. The man was able to fight the jaguar off with his machete but received significant injuries to his arm and chest. This incident reportedly occurred 15-20 years ago and now Dinho lives in the town of Beruri.

Variations of these stories were told many times during the interviews and whilst talking with people during my stay. In all cases, the Jaguars were said to have been unprovoked and with little to no warning. This is not an exhaustive list of incidences, and the stories that had sufficient detail to report and many versions

seemed to get the situations of the above stories mixed up. For example, some versions of 'story 2' insist that the man was on the land when the jaguar attacked him and the man threw the harpoon into the animal's eye. There were a number of reported incidences in which jaguars displayed signs of aggression and made threatening advances at people but did not actually attack, or were quickly shot and killed or injured and escaped. There were also a number of cases that involved hunting with dogs in which dogs were killed or hunters attacked. The prevalence of these stories and others like them would surely be a major factor for individuals to form opinions about jaguars, especially considering that many people in these communities have never seen a jaguar, and thus their opinions are likely formed influenced by social attitudes.

Notably, the events from all of these stories occurred in other municipals, although Dinho (the man attacked in story 4) does now live in Beruri. Given the population of the municipal of Beruri is currently estimated to be around 19,000 and that the majority of these people have a close relationship with the forest (with around 35% of respondents in the current study confirming to enter the forest on a regular basis), the fact that there have been no attacks in the region further highlights the extremely low risk to personal safety that jaguars represent in the Amazon; and even this is with the assumption that these stories are true and separate events.

In reality, most encounters with jaguars were benign and simply involved the jaguar sleeping or walking away as it sensed the presence of the people. Such stories are not attention grabbing, memorable, or dramatic. Negative encounters are much more vivid and more likely to be spread through the community compared with more benign encounters (Campion-Vincent, 1992; Welzer, 2010; Strange and Takarangi, 2015). Also, as mentioned previously, dramatic stories are likely to be exaggerated and embellished, especially when told within a group scenario. These stories also become modified over time as it passes from person to person, and as with the example of the young boy and the piranhas, pre-existing perceptions towards jaguars are likely to influence how these stories were told. Indeed, many variations of

the these stories being told during this study, and on a few occasions, the details of multiple stories being joined into one.

6.5 Cases of Hunting Jaguars

As within other communities mentioned in the introduction, there were a number of historical incidences of interviewees and community members killing jaguars (as well as pumas and ocelots) within the study area.

Case 1.

During a house visit whilst conducting interviews in Itapuru, one of the interviewees showed me a cranium (Appendix B (A)) of a young jaguar that he had shot around 10 years prior. The man had told me that he had shot it whilst hunting as it was walking past him in front of him. He said that the jaguar had shown no aggression and had barely acknowledged him and that he had shot it more out of curiosity than fear, stating that he had never seen a jaguar up close. The man added that he had done it when he was younger and that today if he sees a jaguar he does not kill them.

Case 2.

One of the interviewees (hunter A) who is a renowned hunter, commented that he had killed one jaguar and two pumas, whilst his friend (hunter B) had killed two pumas. Hunter A then went on to say that he now felt bad about killing them and would not shoot anymore "onças" (jaguars and pumas) in the future. Hunter B said that he had no remorse, confirming "Para mim, as onças são como as cobras, se eu vejo eu não as deixo" (for me, jaguars are like snakes, if I see them, I kill them).

Case 3

One of the oldest interviewees in the study was an 83-year-old man from Surará. He had lived his whole life in the region, and during his working years, spent his time traveling following the work seasons of the time, collecting rubber, hunting for pelts and bushmeat during the times it was legal, fishing, collecting açai and Brazilian nuts, etc.. The respondent said that he had killed many Jaguars over the years, “probably around 15-20” individuals. He had a very negative attitude towards jaguars and said that still today he would kill any jaguar that he saw (if able). He told of one occasion that he and a friend saw a sub-adult jaguar whilst collecting rubber. They did not have their guns with them but had their harpoons in the canoe. They got their harpoons, armed with metal barbs attached to a thin, strong cord and threw the harpoons at the Jaguar. With the barbs firmly sunk into the Jaguar, they pulled it from the tree where it had taken refuge and tightly tied the cords to some trees. After the jaguar was secured, they killed the young animal with large sticks and rocks.

Case 4.

Whilst conducting an interview in the town of Beruri, one of the houses had a pelt/skin of a large jaguar hanging on the wall (Appendix B (B)). The interviewee informed that his brother had killed it around 10-15 years earlier whilst hunting in the region.

Case 5.

A case that was mentioned by a number of interviewees and during open discussions in Cuiuanã, was one of the “vigilantes” (guards) who had shot a jaguar from the floating guards’ base as the jaguar passed along the bank of the river. This had happened 3 years prior to the interviews and was confirmed by a number of guards. When asked why they shot the jaguar, the group replied: “because they are dangerous”.

6.6 Belief in Folklore

Folklore is engrained in the lives of community members throughout the Amazon Basin, and this was shown to be true in the lower Purus River. At least 76% of the residents had heard of nine of the folklore, with the story of the Caipora (48.8%) being the least well known. The Caipora seems to be a variation of the Curupira and is more common in the north-east of Brazil. The Cobra Grande and Fogo Fátuo are the most widely accepted folklores (87.6% and 85.8% respectively). In regards to the Cobra Grande, which is the most widespread of all the folklore, this is likely to do with the presence of the anaconda. A common explanation for the existence of the Cobra Grande, given by the interviewees, was "Where there is small, there is big". The Amazon is an immense area, full of dark black water lagoons and endless rivers. It is not hard to imagine dinosaur sized snakes lurking in these areas. Also, large anacondas can ingest large prey such as caiman, peccary, or deer, making them appear much bigger than they really are. This, together with the fact that during moments of anxiety, people have been shown to vastly magnify recounts of the experience (in this case, the size of the snake) (Anaconda.org, 2019), it is understandable that a person who has grown up hearing these local legends could assume that this was the Cobra grande.

Many people (38.8%) also claimed that they have perceived the presence of the Cobra Grande. Very few respondents claimed to have seen the actual snake, with most attributing the presence to tracks or sounds of the Cobra Grande slithering through the undergrowth as it noisily knocked over small trees and flattened large areas of grass as it slid into the water. Others told of large burrowing holes that appeared in the dry muddy river banks during the dry season as the rivers retreated. There was only one case in which a man from one of the neighbouring villages of Sumara, re-narrated a story of somebody seeing the Cobra Grande close hand. The wife of his cousin was alone in their small house along an isolated tributary looking after their two young children as the husband was away for a number of days fishing. The wife had been washing her clothes in the river when the 30 meter long Cobra Grande appeared, so she grabbed the children and ran down the along the bank of the

river and climbed a tree. There they stayed for the rest of the day and night until the husband and his brother arrived home the next day. The family reportedly left the house and did not return.

An interesting phenomenon that may be related to both the widespread belief of both the Cobra Grande and the Fogo Fátuo is the combustion of methane and propane gasses that appear above the water or forest floor due to decomposing biomatter (Newell, 1904). Depending on the individual, a shining light of fire above the water in the distance could be interpreted as the glowing red eyes of the Cobra Grande or a floating fire spirit to those who have grown up hearing these stories. With the amount of biomatter that would be deposited along the bottom of slow-moving rivers, lagoons, and forest floor, one would expect such releases of gasses to be relatively common. A young female respondent from the town of Beruri recalled that she had seen a Fogo Fátuo in the local cemetery, which is consistent with the theory that this myth is related to the release of methane and propane gasses, in this case from a rotting body. It is reasonable to expect that a person who has grown up hearing such stories would conclude that light spontaneously appearing in the middle of a cemetery (or in other cases, rivers, lagoons or marshy forests) would be that of a Fogo Fátuo.

Another well-accepted story is of the Matim, which was incidentally, also the being that was seen or heard (perceived presence) most. As mentioned in the description of the legend of the Matim above, there was a lot of variation in the recounts among respondents. For most interviewees, the Matim is a small bird, sometimes with spiritual connotations, that is relatively harmless and playful, singing the characteristic "tin-tin-ting" sound outside of people's wooden houses. This is reflected in the low proportion of respondents who feared the Matim, despite being the most accepted folklores of those mentioned in this study. Stories of an old woman asking cigarettes and returning as a bird to the houses of people who refused also appeared in the interviews, although most accounts were quite vague.

Understandably from the basis of the legend, most of the respondents that feared the Homem Boto, and the river dolphins in general, were women. One

female interviewee from Cuiuanã described her fear in a story of a dolphin who followed her in her canoe while she was fishing in a lagoon with her husband, explaining that the dolphins like to push women from their canoes into the water in order to have sex with them.

According to one interviewee from the town of Lábrea, the upper Purus River, the Mapiquari was deemed responsible for the death of a hunter who was gruesomely killed whilst illegally hunting within one of the national parks that surround the town of Tápua around 10 years prior. Friends and park guards who went looking for the missing hunter allegedly came upon the creature as it was devouring the man and chased it into a cave. The men repeatedly shot into the cave but dared not enter. Whether they had managed to kill the Mapiquari or not, the interviewee was not sure, but the body of the creature nor the man were recovered.

In regards to the legend of the Onça da água, although it was vaguely familiar to many of the respondents, few could supply any detailed descriptions of its appearance or its behaviour, and those details that were given, often changed greatly between person, and was not consistent with the story mentioned in the introduction of this paper. For instance, a number of respondents said that the Onça da água is black and much like a normal black jaguar, just bigger, more aggressive and with webbed feet that it could use to dive and swim under the water for distances.

Along the lower Purus River, stories of large glowing red eyes over one meter apart that appear on the surface of the water along the deepest rivers or isolated lagoons were common. Testimonies of large holes at the bottom of dry river beds or large areas of flattened grass and small trees were attributed to being made by Cobra Grandes, although none of the interviewees had reported seeing the snake close up or first hand.

That many of the respondents recognised the name Juma when asked about legends is not surprising, as the story of the cannibalistic tribe in the upper parts of the river may have been familiar. Few people could describe the Juma in any great detail, and those that did, mentioned a small ape-like man similar to that mentioned in

the news reports of the float (alegoria) in Parantins for the famous Boi Garantido festival, but little more.

A story that was mentioned a number of times in the region involved a hunter who had just killed a number of white-lipped peccaries, presumably more than he actually needed when the small Indian with long and scruffy red hair appeared from behind. The man knowing that it was the potentially dangerous Curupira, pressed his gun against his mouth and ordered him to open his mouth. The hunter, not wanting to deal with the consequences of killing too many peccaries, fired into his mouth. The gun went off with a bang, however, the small red-haired Curupira simply smiled and blew out a large puff of smoke.

Unlike with attitudes towards jaguars, where there was no significant difference between the sexes, female respondents showed greater belief/fear of the beings from the folklores than the men. Studies have shown that women are more fearful or anxious in general than men and may be due to biological, genetic, physiological and hormonal differences (McLean and Anderson, 2009). In particular, Tucker and Bond (1997) showed that women tend to be more fearful than men of 'potentially dangerous' or 'repulsive' creatures (considered as snakes or toads). In the current study, attitudes towards jaguars takes into account different emotional and cognitive sentiments (empathy, favor, etc.), as opposed to fear specifically, which could explain why there was no difference between the sexes. However, fear of beings featured in folklore was measured in parallel with belief, and thus these findings are in accordance with Tucker and Bond (1997) as for a believer, these beings would be akin to a 'potentially dangerous' animal; that is, for some people, the Cobra Grande (for example) is equally as real as the jaguar, and indeed, some respondents included the Cobra Grande when asked to list the 'animals in the river they most feared'.

That belief in folklore increases with age is likely due to a number of factors such as education, time spent in the forest, and exposure to outside influences, such as television and the internet. Older respondents who have grown up in the region before the installation of electricity had little formal education, spent more time in the

forest (which is correlated with age, suggesting that the same factors apply) and little contact with the outside world, were no doubt exposed to more stories of local legends than their younger counterparts of today. The majority of respondents over 40 believed in at least 50% of the local legends.

Curiously, the oldest respondent, a man of 82 year from the community of Surará (mentioned previously in Case 3 of killing jaguars), had stated that he did not believe any of the folklores, adding: "I have walked these forests for 70 years harvesting rubber, hunting (for the fur and meat trade), collecting Brazil nuts, harvesting wood, and travelled throughout this region, and I have never seen any of these creatures. If I have not seen them, then they do not exist". Continuing the survey, and after being asked if he feared any of the beings of these folklore stories, he admitted that he was still afraid of many of them, adding: "I may not believe in them, but you can never be too careful". Thus it seemed that although he was quite confident that these folklores were fictitious, a lifetime of hearing accounts of encounters with these beings had still left him with some doubts.

As with the attitudes towards jaguars, belief in folklore was greater within the communities, measured both individually and grouped, and is likely to do with factors mentioned relating to differences in community development, social factors and education as mentioned with attitudes. It was also correlated with age and relationship with the forest (inter-correlated variables) which is also like due to factors stated above.

6.7 Peers

When asked how they believed their fellow residents felt about jaguars, respondents consistently assumed that the opinions of others were more negative than their own and that others believed in and feared more of the legends than themselves. This is consistent with both the "false consensus effect", which is a type of cognitive bias in which people tend to overestimate the degree to which their opinions, beliefs, preferences, values, and habits are normal and represented by others (Ross, Greene

and House, 1977), and the “self enhancement bias” whereby most people consider themselves more moral than others (Tappin and McKay, 2016; Dong, van Prooijen and van Lange, 2019).

For respondents who had negative attitudes towards jaguars or believed in much of the folklore, it is likely that they assumed that this was the social norm and that the majority of the people within the community have a similar feelings or beliefs. Indeed, as most residents in the region have had very little direct or no exposure jaguars, most attitudes are likely formed from indirect experiences, such as television or through discussions with peers. Hook and Robinson (1982) showed that, particularly for young males, friends were one of the most influencing factors in forming negative attitudes towards carnivores. Given the prevalence of stories of jaguars and mythical beings that were mentioned during this study, it would be easy to assume that negative attitudes and belief in folklore are the norm within the region.

In accordance with the theory of self-enhancement bias, respondents with more positive attitudes may see themselves as morally superior, or more educated, and thus regard other residents as having more negative attitudes towards jaguars. A 36 year old female respondent from Cuiuanã who was later shown to have a positive attitude towards jaguars complained about the apparent lack of empathy that many other residents had for the wildlife, and that she refused to eat meat from wild game, although she did raise a number of pigs and chickens on a small patch of cleared land along the bank of the river above her flutuante, and ate fish that her husband caught. Tappin and McKay (2016) found that the vast majority of those asked to assess their morality against the average persons' morality, judged themselves as having higher moral compass than average. This was shown to not be connected to self-esteem or ego. In regards to folklore, respondents may see other people as more gullible or naïve than themselves, and thus believe in more of the folklore stories.

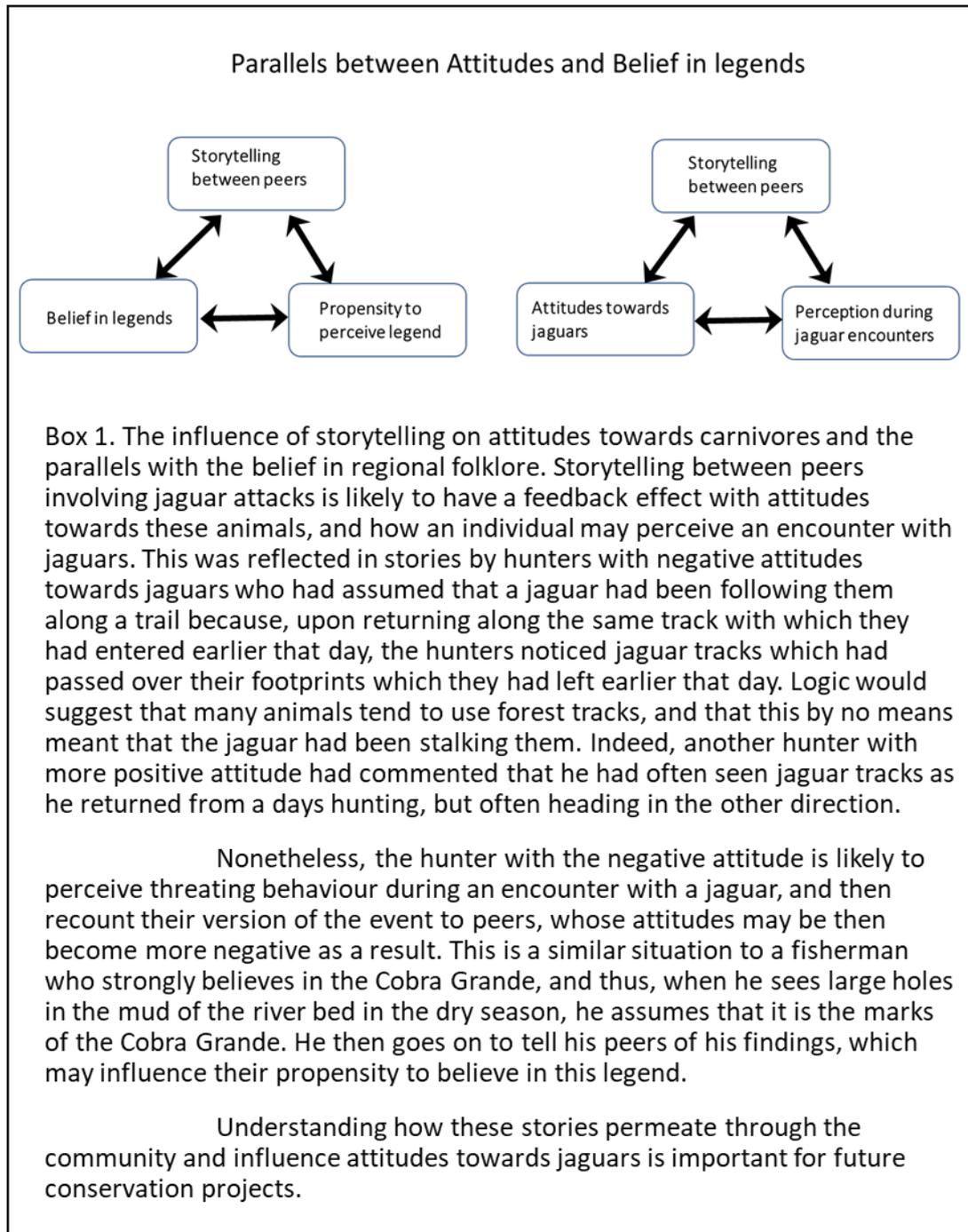
6.8 Belief and Attitude

That there was a correlation between attitudes towards jaguars and the belief in folklore shows the importance of storytelling and verbal communication in such traditional communities (Box 1). The belief in folklore was the strongest predictor for attitude towards jaguars. This trend was fairly consistent across variables: sex, age group, community-type and individual communities. In the absence of high degrees of outside influences, these attitudes and beliefs are likely heavily influenced by peer-to-peer interactions, in the form of verbal communication and storytelling. Stories and opinions shared amongst friends and family members from a young age and continue on throughout one's life have a strong influence on the development of attitudes and beliefs (Kaye and Jacobson, 1999; Lekoko, 2017). Such stories may become deeply rooted in the beliefs of a person and once established, these beliefs and attitudes can become very difficult to change.

This study does not wish to imply that there is any causal relationship between believing in folklore and forming attitudes towards jaguars. Nor does it wish to deter the belief of folklore, or replace it with "western-style" education. In fact, some legends such as the Curupira, the guardian of the forest, no doubt has some conservation value by encouraging sustainable hunting practices. Also, these myths and legends represent an important cultural value and identity, as being a connection to the past and current relationships with the forest, rivers and indigenous culture. What these results show is how accounts of wildlife interactions disperse through a population, and influence attitudes towards wildlife, and that, for many people, these attitudes, acquired over many years will unlikely be changed by using education and rationality.

Of course, not all people are so defiant about changing ideas over time or establish firm beliefs or attitudes. Critical thinkers may grow to question some of these stories such as the Cobra Grande and Curupira, or recounts of man-eating jaguars due to a lack of confirmable evidence or as other points of view arise. Whilst at least over 90% of respondents had heard of at least eight of the ten folklores and 82.7% of

respondents had heard of negative stories involving jaguar attacks, there was a high degree of variation in how much people believed in folklore, and how much these stories influenced respondents attitudes towards jaguars. What is evident, however, is that these tendencies are connected and influenced by other factors, in particular, age, and area of residency.



6.9 Changing Attitudes

This study has shown that attitudes, like belief in folklore, are highly influenced by social norms and peer-to-peer interactions, in this case, in the form of storytelling. This supports Schultz (2011) idea that “humans tend to look to the behaviour of others as a guide for interpreting event... as a consequence, we are generally reluctant to deviate from the norm”.

Although many conservationists may be tempted to rely heavily on education-based conservation programs to mitigate negative attitudes and the persecution towards carnivores, this study gives further evidence that the knowledge deficit model is likely inadequate (at least in isolation) for changing attitudes of Amazonian ribeirinhos: attitudes and beliefs are robust.

Older, male residents of Amazonian riverine communities, in particular, are likely to hold the most negative attitudes towards jaguars as well as the highest propensity to believing in local folklore. For a conservationist to arrive from the ‘outside world’ and try to convince an elderly hunter that jaguars very rarely attack people and are of little concern, would likely be as futile as trying to convince him that the Cobra Grande does not exist. Biologists or conservationists aiming to promote community-based conservation and human-carnivore coexistence in traditional communities such as this, should take into account how deeply rooted negative attitudes may be and acknowledge that for many residents, facts and reason are likely not enough to elicit attitude change. Given that age was shown to be a major predictor, attitude intervention programs should concentrate efforts on younger, and more socially important community members (30 years and below), with the aim of changing social norms and the community acceptance of killing carnivores. Projects such as “Amigos do Peixe Boi” in the community of Cuiuanã (INPA, 2019), that involve community members in monitoring programs and promote a sense of ownership, in conjunction with educational programs, have shown to be successful with other species. In the case of the project “Amigos do Peixe Boi”, the increased presence of researchers and reserve officials, had the additional benefit of a perceived increased

presence of enforcement. Indeed, during this study period, conversations with respondents and other residents of the region in regards to the hunting of river manatee, it seemed that the threat of large fines and jail time, rather than attitude change, may play a major role as to why people no longer hunt manatees, which are a popular game meat species.

However, similar projects involving Jaguars may be complicated. Firstly, although manatee is a popular game meat species, attitudes towards them are likely mostly positive as they are charismatic, and, unlike Jaguars, pose no threat to safety or livelihood. Secondly, they are a large animal, and any resident bringing back manatee carcass, would risk being noticed by officials or concerned community members, risking fines and jail time. Conversely, most Jaguars are shot in isolated areas of the forest, and their bodies are often left to rot. Even if body parts are taken for meat or souvenirs (pelt, skull, teeth, claw, etc.), the smaller size allows it to be easily concealed. This reduces the perceived risk of being caught, and thus the likelihood of changed behaviour (John, Mai, and Pei, 2015). Conservation projects should incorporate a combination of mitigation strategies, education, collaboration, exposure (possibly in the form of zoo visits or documentaries), and financial incentives/deterrents.

7. CONCLUSIONS

The aim of this study was to highlight the importance of storytelling and verbal communication in relation to shaping attitudes towards jaguars and other wildlife using folklore as a parallel to demonstrate how these stories can permeate and spread through a community and may be influenced by pre-existing individual experiences and preconception as well as the collective memory as a whole.

The issue of conservation of carnivores is contentious and complicated as these animals are often considered as of high value globally, and of little or negative value locally. Conservation projects should attempt to understand the origins of negative attitudes and consider local culture, history, and relationships with wildlife, and even accept the fact that, for many members of such communities, changing attitudes may not be viable. It is by doing this, that different mitigation efforts can focus on specific social groups, whether it be by using education and participation strategies to change attitude, or financial incentives or deterrents to change behaviour.

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APPENDICES

APENDIX A

Table. Folklore distributions by references.

Folklore	Variations	Region	References
Cobra Grande	Minhacão	<ul style="list-style-type: none"> • Uruguay and Paraguay River Basins 	Souza, Santos and Fontes (2007)
	Yacumama	<ul style="list-style-type: none"> • Pantanal, Goiás, Mato Grosso do Sul 	Martins (2007) Gow (1994) Whitten Jr (2016)
	Cobra Grande/Boiuna	<ul style="list-style-type: none"> • Amazon Basin within Peru, Bolivia, Colombia and Ecuador • Brazilian Amazon Basin • Guianese, French Guianese and Surinamese Amazon 	Santos, (2009) Tol, (2014) Aculdade, Epartamento and Rograma (2007)
Fogo Fátuo/Boitatá	Fogo Fátuo/Boitatá	<ul style="list-style-type: none"> • Brazilian Amazon Basin • Espírito Santo, Minas Gerais 	Pereira (2015), Machado et al.(2019). Cascudo (2012)
Curupira	Curupira	<ul style="list-style-type: none"> • Espírito Santo • Brazilian Amazon 	Cascudo (2012) Cascudo (2012)

Homem Boto	Homem Boto El buefo colorado	<ul style="list-style-type: none"> • Brazilian Amazon • Peruvian Amazon • Bolivia Amazon • Colombian Amazon 	Santos (2009), Cardoso (2018) Cruz and Simões, (2014) Yañez, (1999) Pedrosa (2013)
Caipora	Caipora	<ul style="list-style-type: none"> • North-east Brazil • Brazilian Amazon 	Cascudo (2012), (Hoefle 2015) Machado (1987), Cascudo (2012)
Onça da Água	Onça da Água	<ul style="list-style-type: none"> • Venezuelan Amazon • Amazonas, Pará 	Smith (1996) Smith (1996)
Martim	Matim	<ul style="list-style-type: none"> • Pará, Amazonas, Acre 	Cascudo (2012)
Mula sem Cabeça	Mula sem Cabeça	<ul style="list-style-type: none"> • North-eastern Brazil • South-western Amazon (AC, RO, MT) • Central and Southern Brazil (SP, MT, MG, ES, GO, PR,RS, RJ, SC) 	Cascudo (2012) Cascudo (2012) Cascudo (2012)
Mapinguari	Mapinguari	<ul style="list-style-type: none"> • Brazilian Amazon • North-East Brazil 	Machado (1987), Cascudo (2012) Cascudo (2101)

Juma	Juma	<ul style="list-style-type: none">• City of Parantins• Madeira River, Purus River, Tapajós River Catchments	Gonzaga (2013)
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APPENDIX B



Photo A shows a pelt of a jaguar shot around 10-15 years prior, by the brother of a man in Beruri. Photo B shows the skull of a young jaguar shot by an interviewee from Itapuru around 10 years prior. The interviewer had said that the jaguar did not show any aggression and that he shot it mainly out of curiosity, then saying that he would not shoot a jaguar again.