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Chapter 3

CONSERVATION OF THE RIVER DOLPHIN (*INIA BOLIVIENSIS*) IN BOLIVIA

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ABSTRACT

The pink river dolphin genus *Inia*, is widely distributed in the Orinoco and Amazon basins. Locally called the bufeo (*Inia boliviensis*) in Bolivia, it is an endemic species to the region, geographically isolated from *Inia* populations within the Amazon's main stem by a series of rapids between Guayaramerin, Bolivia and Porto Velho, Brazil. In Bolivia, they are distributed in three main sub-basins: Abuna, Mamore and Itenes (Guapore). Despite bufeo being a native species and the only cetacean present in a land-locked country, its ecology and conservation status are poorly understood. Unfortunately, no conservation laws explicitly target this cetacean in Bolivia and consequently it only receives relatively minor legal protection when it resides in protected conservation areas. This chapter includes information on the studies that have been conducted in Bolivia; the conservation status; aspects related to the geographic distribution of the species, its behavior, ecology, population size, threats and possible means of protection. This information will lead to recommendations for the implementation of priorities in research programs and conservation for this species in Bolivia.

Key words: Inia boliviensis, bufeo, pink River dolphin, conservation, Bolivia

INTRODUCTION

The only cetacean species of the South American continent that lives exclusively in freshwaters is the pink River Dolphin (genus *Inia*), locally called bufeo in Bolivia. The group is listed as Data Deficient by The International Union for Conservation of Nature and Natural Resources (IUCN) (IUCN, 2009). Although the population is in better condition than other freshwater dolphin taxa, such as the endangered South Asian River dolphins (*Platanista*

gangetica) and the critically endangered baiji (*Lipotes vexillifer*), which it is doubtful will survive as a species (IUCN, 2009; Reeves et al., 2003; Zhanga et al., 2003). Multiple and potentially adverse anthropogenic pressures occur in the major river basins of South America including mining, logging, dam construction, oil and gas exploration, and use of toxic contaminants.

The River Dolphin is distributed widely throughout the Orinoco River basins of Colombia and Venezuela as well as the Amazon basin in Brazil, Colombia, Ecuador, Peru, Guyana and Bolivia (Best & Da Silva, 1993). Little is known about the status of the *Inia* population, and published studies that refer to their ecology, behavior, social structure and biology are scarce. Our knowledge of the basic ecology of the *Inia* comes from research conducted in Brazil (Magnusson *et al*., 1980; Best & da Silva, 1984; 1989; 1993; da Silva, 1994; da Silva & Martin, 2000; Martin & da Silva, 2004), Colombia (Layne, 1958; Trujillo, 1992; Hurtado- Clavijo, 1996; Vidal *et al*., 1997), Ecuador (Utreras, 1995; Herman *et al*., 1996; Deniker, 1999), Peru (Leatherwood, 1996; Reeves *et al*., 1999; Zúñiga, 1999; Leatherwood, *et al*., 2000; McGuire, 2002; McGuire & Henningsen, 2007), Venezuela (Trebbau & Van Bree, 1974; Trebbau, 1978; Meade & Koehnken, 1991; Schnapp & Howroyd, 1992; McGuire, 1995; McGuire & Wienemiller, 1998; McGuire & Aliaga- Rossel, 2007), and Bolivia (Aliaga- Rossel, 2000; 2002; Aliaga- Rossel *et al*., 2006). However, information from Ecuador and Venezuela generally comes from short term studies, using different methods, which makes comparisons among studies difficult. Long term studies in South America are currently being carried out in Brazil by Vera Da Silva and by the Omacha Foundation in Colombia (McGuire, pers. com., 2008; Trujillo, pers. com., 2008) but no long term studies have been initiated for the bufeo in Bolivia. The Faunagua Foundation does have a program that studies aquatic mammals and water quality in Northern Bolivian Amazonian Rivers. Data garnered from this program might prove to be useful and be incorporated into future dolphin studies. This chapter reviews the current information on the taxonomic situation, ecology, distribution, threats and conservation status of the River Dolphin in Bolivia, and identifies research and conservation priorities.

TAXONOMY AND MORPHOLOGY

The Pink River Dolphin belongs to the Order Cetacea, Suborder Odontoceti; superfamily Platanistoidea; Family Iniidae, with a single Genus *Inia*, located only in South America (Reeves et al., 2003).

The Bolivian River Dolphin is geographically isolated from *Inia* populations in the Amazon's main stem, by a series of waterfalls and rapids between Guayaramerin, Bolivia and Porto Velho, Brazil (ca. 400 km). This isolation formed during the late Pliocene (5- 6 millions ago), which might be the cause of the allopatric separation from the other *Inia* populations in the Amazon basin. Comparative mitochondrial DNA sequence analysis has been used to investigate and clarify the taxonomic relationships within *Inia* (Hamilton et al., 2001; Banguera-Hinestroza et al., 2002). These studies found substantial sequence divergence between Bolivian *Inia* and *Inia geoffrensis* in the Amazon and Orinoco Rivers. Banguera et al., (2002) provided additional and stronger evidence from an *Inia* population in Bolivia that warranted its status as a separate species (*Inia boliviensis).* Their results indicated that two

mitochondrial genes (control region and Cyt-b) in the Bolivian form did not share any haplotype in comparison to the other two populations. Furthermore, Ruiz-Garcia *et al*., (2008b), analyzing autosomal and Y-chromosome intron sequences, presented additional molecular evidence that favored an independent evolutionary history of the Bolivian population. This reinforces the results of Banguera et al., (2002) which subdivided *Inia* into two evolutionary units (Moritz, 1994), although the divergence may not be as temporally distant as was previously claimed.

Similar to molecular genetics studies, morphological studies, have indicated that the Bolivian population is a separate species because of its greater number of teeth, smaller body size but more robust, smaller skull size, larger flipper size and greater tail length (relative to body length) (Pilleri & Gihr, 1977; da Silva, 1994; Ruiz- Garcia *et al*., 2006). These morphologic and molecular data clearly indicate the uniqueness of the Bolivian *Inia*, highlighting the importance of obtaining further knowledge of its biology, distribution, abundance and ecology.

Distribution and Abundance

In Bolivia, the bufeo is located in rivers of the Amazon basin, within the Cochabamba, Santa Cruz, Beni, and Pando areas (Figure 1).

Their population and distribution within these Rivers is determined by the availability of food rather than by the type of water (white waters, black, clear or mixed), pH or physicochemical characteristics (Aliaga-Rossel, 2003; da Silva, 1994; McGuire, 2002). The bufeo has a preference for river confluences, lagoons, river bends/curves. During high water season (November to April), they expand their area of search for food by swimming inside flooded areas (forests) and small or ephemeral tributary rivers (Best & Da Silva, 1993; Aliaga- Rossel, 2002; Aliaga - Rossel and Quevedo, in prep). They can stay in the same area up to a year upon which they move to other habitats. A paucity of seasonal movement information makes it impossible to completely describe their movement patterns. McGuire & Henningsen (2007) indicated that *Inia* frequently move 40 to 60 km within a 24-h period. Although some individuals can remain in the same location for several days, there are anecdotal reports of *Inia* traveling in excess of 1,000 km (McGuire & Henningsen, 2007). In contrast, Aliaga-Rossel (2000) suggested that *Inia boliviensis* had a more conservative maximum range of 60 km which they can potentially travel in less than a week.

The bufeo is located in the sub-basin of the Madeira River (Fig 1), in the department of Pando, in the Negro and Abuná rivers, which flow into the Madeira River. However, there are no published registers of these occurrences (Anderson, 1997).

They also inhabit the Itenez's sub-basin (Guapore in Brazil) in the Iténez, and its respective tributaries including the Baures, Paraguá, Pauserna, Verde, Blanco, San Luis (Yañez, 1999), San Martín (Salinas, 2007, Tapia, 1995), Santa Rosa, Machupo (Anderson, 1997) and Irupururu.

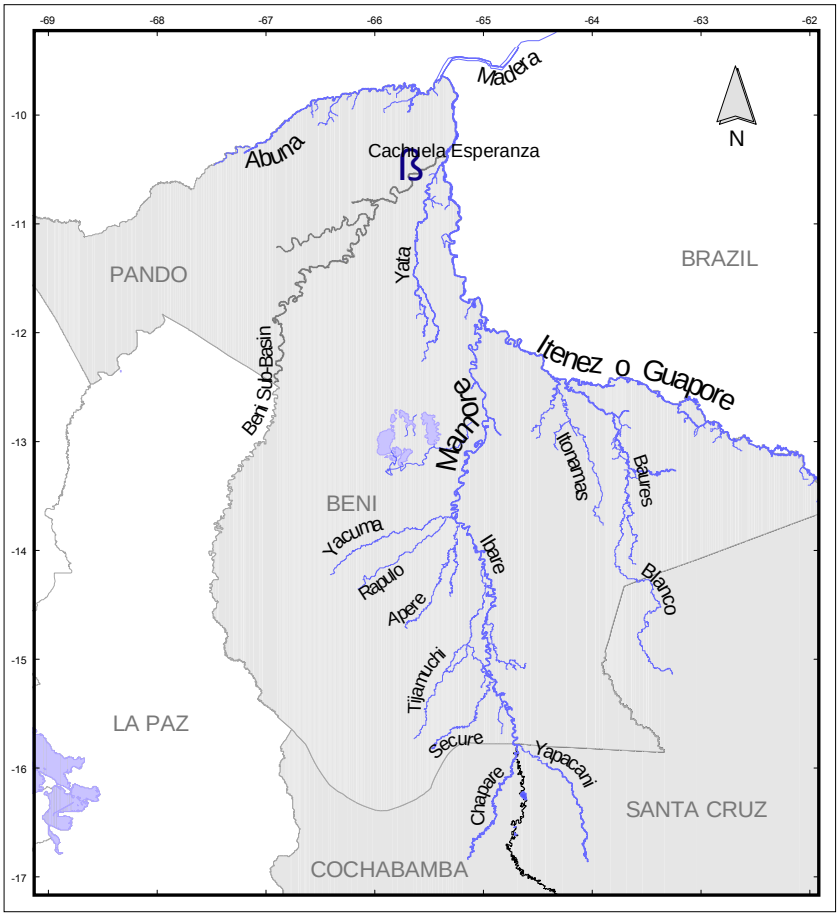

Figure 1. Distribution of the river dolphin, bufeo (*Inia boliviensis*) in the three sub-basins in Bolivia. In the Abuna sub-basin, there is a possible presence of *I. geoffrensis.* "Cachuela Esperanza" is the beginning of the rapids that extends to Brazil and isolates *Inia boliviensis.*

In the Mamore sub-basin, the bufeo is located all along the Mamore River, from the Ichilo River (in Cochabamba) to the Guayanamerin in Beni, including most of their tributaries, such as Sécure, Ibare, Tijamuchi, Apere, Abuná, Rapulo, Itonamas, Yacuma, Yata, Mariquipiri, Baures, and Chapare rivers close to the confluence of the Rio Grande . The indigenous group, the Yuracaré, along the Chapare River have reported the presence of the bufeo close to the community of San Antonio (16º 56'45.4''S- 65º 22'42,9''W, approximately 600 m above sea level) only during the rainy season when the river current is rapid and there is strong turbulence (J. Flores, I. Soria, N. Chavez 2007 com. pers.). This might be the highest elevation for the species, the previous highest elevation being 380m, close to the Puerto Villarroel on the Ichilo River, in the same sub-basin (Pilleri & Ghir, 1977).

The bufeo is not registered in the Madre de Dios and Beni sub-basins, probably because these rivers are isolated by rapids, principally in the area called "Cachuela Esperanza" that form a natural barrier to the Mamore River (Figure 1). Pilleri & Ghir, (1977) and Tello, (1986) indicated the occurrence of the bufeo in the Beni River, but these reports may be inaccurate reports because small tributaries of the Mamore sub-Basin are only a few

kilometers from the reported area (Anderson, 1997). For example, in a town close to the Beni River (Beni Sub-Basin), tourist companies offer swimming experiences with River dolphins, taking tourists to the Yacuma River (Mamore Sub-Basin). Informal interviews with fisherman and local people by the author indicate that there are no bufeos in the Rivers of these Sub-Basins.

There are studies determining the abundance of the bufeo in Bolivia (Table 1). In 2007 the Omacha Foundation (Colombia) and Faunagua (Bolivia) started a program to determine the abundance of bufeo in South America, which is the largest survey carried out in Bolivia. However to date, these data are not yet published.

Table 1. Population Density (PD) of *Inia* as individuals per square kilometer within rivers, sub-basins and departments of Bolivia.

Rivers	Sub-Basin	Department	PD (ind/km²)	Study
Ibaré	Mamoré	Beni	1.0	Pilleri 1969; Pilleri & Gihr 1977
			0.2	Aliaga-Rossel & Quevedo (in prep)
Ichilo	Mamoré	Cochabamba	0.25	Pilleri & Gihr 1977
Ichilo-Mamore	Mamoré	Cochabamba-Beni	0.88	Omacha-Faunagua unpublished data 2008
Mamoré	Mamoré	Beni	1.6 (dry season)	Aliaga-Rossel et al. 2006
Tijamuchi	Mamoré	Beni	1.12 (all seasons); 5.8 (dry Season)	Aliaga-Rossel 2000, 2002; Aliaga-Rossel et al. 2006
Apere	Mamoré	Beni	2.9 (dry season)	Aliaga-Rossel et al. 2006
Rapulo	Mamoré	Beni	2.6 (dry season)	Aliaga-Rossel et al. 2006
Yacuma	Mamoré	Beni	2.4 (dry season)	Aliaga-Rossel et al. 2006
Iténez	Iténez	Santa Cruz	1.57	Omacha–Faunagua unpublished data 2008
Irupurupuru	Iténez	Beni	1.17	Pilleri & Gihr 1977
Blanco	Iténez	Beni	1.62	Salinas 2007
San Martin	Iténez	Beni	0.74	Salinas 2007

Research on *Inia* in Bolivia

Only a handful of Bolivian bufeo studies have been conducted and published. The first study was conducted by Pilleri, (1969) in the Mamore River, and described the morphology of collected individuals, estimated abundance and compared the behavior of individuals collected in Bolivia with those in Venezuela. Van Bree & Robineau, (1973) compared the morphology of the River dolphins *I.g. geoffrensis* and *I.g. boliviensis*. They suggested the presence of *I.g. geoffrensis* in the Abuná sub-basin, and the other subspecies (now *Inia boliviensis*) in the Mamore and Itenez sub-basins. However, this proposal was not accepted due its lack of comprehensive morphometric and genetic data (Anderson, 1997). Pilleri & Gihr, (1977) surveyed the Ichilo River from Puerto Villarroel to Mamore and morphologically compared Venezuelan and Bolivian individuals and suggested that the Bolivian bufeo was a new species (*Inia boliviensis*). Also, Anderson's book of Bolivian mammals (1997) provides a limited description of the river dolphin distributions based on collections.

Yáñez, (1999) worked in Noel Kempf Mercado National Park, on the Itenez and Paragua Rivers, in the Santa Cruz area. His descriptive study included distribution patterns, dolphin sounds, and possible interactions with the giant otter (*Pteronura brasiliensis*) as well as incorporated legends and myths related to bufeos in the area.

The studies conducted by Aliaga-Rossel, (2000, 2002) evaluated the distribution and abundance of river dolphins during four heavy precipitation seasons across three different water types (white, black and mixed waters) in the Tijamuchi River. Aliaga-Rossel documented one of the highest population densities relative to other areas surveyed. This work constituted the first study in Bolivia using standardized methodology.

Aliaga-Rossel et al., (2006) reported distribution and abundance survey results collected during the dry season in the central Mamore River and four of its tributaries: the Tijamuchi, Apere, Yacuma and its tributary, the Rapulo (Table 1). More recently, Aliaga-Rossel & Quevedo, (in prep) surveyed the Tijamuchi and Ibare Rivers and compared their findings with earlier surveys of the same areas (Aliaga-Rossel, 2002; Pilleri, 1977); they concluded that the abundance of river dolphins varied temporally with the lowest values for both rivers in the most recent surveys. Although both rivers possessed similar water characteristics, the authors noted a decreased abundance of river dolphins in the Ibare River compared to Pilleri & Gihr, (1977) and the Tijamuchi River. The authors also suggested that this spatial variation may reflect increased human activities in the Ibare River. This work was conducted during the rainy season of a Niña year, when garbage accumulates along the shores and sewage overflows into the river. Salinas, (2007) worked in the Blanco and San Martin Rivers of the Itenez sub-basin, covering an area of 56 km with a single observer in a boat (non standardized method). This constituted the first study of relative abundance in this area.

In 2007, Omacha-Faunagua (unpublished data), initiated a long survey project titled "First evaluation of the abundance of the three River dolphin species (*Inia geoffrensis, I. boliviensis*, and *Sotalia fluviatilis*) in the Orinoco and Amazon River Basins, South America". This extensive survey was carried out during the dry season in Bolivia, travelling more than 500 km along the Mamore River, and 598 km along the Itenez River.

Several expeditions were carried out to capture samples for different genetic studies (Banguera *et al.*, 2002; Hamilton *et al*., 2001; Ruiz-García *et al*., 2006, 2007, 2008a, b; Ruiz-García, 2009), all of them supporting the status of the Bolivian bufeo as a separate species. In

the genetic expedition carried out by Ruiz-García and collaborators in 2003, more than 1.300 km of the Mamoré, Yacumo, Iruyañez, Yata, Itenez and Beni rivers were traveled.

Many other completed studies simply provide lists or distribution data, but these reports are not directly related to bufeos. Other less reliable or non standardized reports such as grey literature, casual observation and posters in scientific conferences also exist (Aramayo, 2008; Tapia, 1995; Tello, 1986). They are considered questionable sources because the methods and/or results were poorly presented and unclear. A common problem that easily leads to the collection of inaccurate data is the use of non-standard methods.

CONSERVATION STATUS AND THREATS

The conservation status of the bufeo in Bolivia is incompletely known and laws that explicitly protect the bufeo do not currently exist in Bolivia. Some protection is afforded by the Veda General Indefinida (D.S. 25458), enacted in July of 1999, which is a general decree that prohibits the harassment, capture, harvest, and training of wild animals and their derivatives. Debate exits over the effectiveness of this law, but it continues to be in effect in the absence of more stringent or specific laws (Aliaga-Rossel, 2002).

The IUCN has categorized the bufeo (*Inia geoffrensis*) as a *Data Deficient* (IUCN, 2009) and is listed under CITES Appendix II. In the 2008 workshop for the "Red List of Vertebrates of Bolivia", *Inia boliviensis* was categorized as *Vulnerable*, but there are no direct actions or conservation plans from the government. It is important to highlight that the Beni Department declared the bufeo as a "Natural Heritage" of the Beni area (Law evicted on March 2008) (Aliaga-Rossel, 2009).

Although much of the area of distribution of *Inia* is unprotected, River Dolphins do occur in fiveprotected areas: Noel Kempff Mercado National Park, Indigenous territory and National Park Isiboro-Securé, Beni Biological Biosphere Reserve, Itenez Protected Area and the Elsner Espiritu Private Wildlife Refuge. However even in these areas water quality can be reduced because of contamination or other factors, from outside the area.

Genetic studies by Ruiz-García *et al*., (2008a), indicated that the bufeo population (*Inia boliviensis*) has the lowest genetic richness compared to the other populations, indicating that in some lagoons there are no genetic flows and that there is a very limited inter-connection among populations. Consequently the species seems to be vulnerable to any threat that may affect it.

The direct threats to the bufeo population are identified as habitat degradation, contaminate loads, hunting, over-fishing, navigation by aquatic vessels, and dams. Each of these factors is discussed next.

Habitat Degradation, Decreased Water Quality and Contaminants

The main threat is the deterioration and degradation of the aquatic habitat due to high phosphorus loads and influxes of toxins such as heavy metals, DDT, and chlorine compounds (Maurice-Bourgoin, 1999; Reeves & Kasuya, 2000; Reeves *et al.*, 2003). That comes from pesticides, and agricultural activities. Heavy metals (mercury, arsenic, and lead) originate

from gold mine areas, and are used to separate gold from other elements. Later these contaminate bi-products are dumped into rivers where they can magnify in the food chain (Best & Da Silva, 1993; Maurice-Bourgoin *et al*., 1999).

There is uncontrolled gold exploitation along the Beni River, where there are no controls or specific laws regarding the contaminants that are dumped into the water. Studies carried on the Beni River and among human populations along the upper Madeira River in Brazil have shown that the mercury level is above regulatory limits (Barbosa *et al*., 1998; Dorea *et al*., 1998; Maurice-Bourgoin *et al*., 1999, 2000; Hacon *et al*., 2000; Dolbec *et al*., 2001). These authors indicate that these elevated contamination concentrations are affecting not only the people directly engaged in or near mining activities, but also affecting populations located 150 km downriver, where mercury has been found in the hair of people that have a high consumption of fish. Mercury is associated with lesions in the neurological system, motor dysfunction and ocular problems. Studies show the direct effects of the bio-accumulation of contaminants in fish and humans (Hacon *et al*., 2000; Senthilkumar *et al*., 1999). This clearly indicates how mining contaminant bi-products might be affecting the bufeo population, constituting a serious threat for the species located at the top of the food chain.

Hunting and Fishing

There is no strong evidence in Bolivia that people in the area kill bufeos as a source of protein in their diet. However, in Brazil, Colombia, and Peru a main human cause of mortality comes from the death of individuals trapped in fishing nets. Although some of these trapped bufeos are released, in many cases the fishermen let them die or kill them with machetes to avoid damages to their catch and nets. In such cases it is common for the fishermen to use the remains as bait (Best & Da Silva, 1989; Reeves *et al*., 1999; Aliaga-Rossel, 2002). However, interviews with fishermen in the central and downriver portions of the Mamore River indicate that the fishermen do not consider the bufeo to be a competitor for their fish (Aliaga- Rossel, 2002), as is the case in the Pacaya-Samiria National Reserve in Peru. Here, commercial fishing is a problem, and there have been reports that the dolphins have been intentionally poisoned using methyl-parathion (Reeves *et al.*, 1999). Also a report from near of Tefé, in the Brazilian Amazon, indicates the intentional kills to use as bait, where 1650 bufeos were estimated to be killed per year (V. da Silva 2008 com.pers.).

There are only a few studies that have focused on the effects of commercial fishing and the possible impact on aquatic populations. Commercial fisheries in Bolivia are not as extensive compared to neighboring counties. There are reports that some members of the indigenous group, the Yucararés, occasionally hunt bufeos to sell the fat in towns around the area of Trinity City. This seems to be an income-generating practice. Bufeos are also shot for amusement or by sport hunters practicing their aim (R. Cuellar 2008 com. pers.; Aliaga-Rossel, 2003).

Navigation

The increase in boat traffic on the rivers has had a negative effect on the bufeos and other aquatic fauna (Constantine *et al*., 2004; King & Heinen, 2004; Lusseau, 2003). A similar observation was made in the study of Pilleri & Gihr, (1977), indicating that the increase in boat traffic and the construction of new roads are harmful for the species, were the construction of new roads lead to river bank erosion problems. The increase in traffic is a real threat for the bufeos causing acoustic contamination which can affect communication, orientation and stress for the bufeos, but also the effects of the leakage of oil from boats.

Bufeos can also be injured or killed by boat propellers. A necropsy was performed on a bufeo from the Tijamuchi River (Aliaga-Rossel, 2000) and it was found that the animal had probably been struck by an outboard motor propeller. The left side of its beak was heavily cut and the lower left jaw was broken. Although this was an isolated registered event, deaths by boats have been documented in the Colombian Amazon (Trujillo, 1992). This danger increases during the low water season when more neonates are observed (McGuire and Aliaga-Rossel, 2007) and dolphins use shallow river channels that are also used by fishing boats and other vessels. In some areas (i.e. the Yacuma River), an increase in unorganized tourism and the offer of swimming with dolphins increases boat traffic and results in pollution and increased stress and other possible negative effects on dolphin and other wildlife populations.

Dams

The construction of dams is a direct threat to the bufeo populations due to habitat fragmentation (IUCN, 2009) which influences movement and migration, resulting in isolated populations, as has happened in Asian Rivers and the Brazilian Amazon (Reeves *et al*., 2000; Reeves *et al*., 2003), and having a major impact on fish movement and migration, affecting the food chain (Best & da Silva, 1989). Currently, there is no official information in Bolivia to build dams on the main basins where bufeos are present. However, there are plans to build two dams (Jirau and Santo Antonio) on the Madeira River in Brazil near the border with Bolivia. While there is concern about the project by the Bolivian scientific community, it will proceed. The argument against the project is that this dam might affect water levels, eventually flooding Bolivian territory and therefore affecting the entire ecosystem,fish populations, migration, and several ecologic factors. Brazil anticipates that the construction of channels will facilitate navigation between Porto Velho and Guayaramerín which will allow boat traffic all year around. Furthermore, the construction of a fish bypass will also allow dolphins to pass the rapids with unknown consequences for the isolated *I. boliviensis* and therefore, the construction of this dam might constitute a direct threat for this population. To date, there is no further information about this construction, and the studies and controversy continue.

Traditions, Myths and Local Use

Traditional myths and legends in Bolivia related to bufeo are rare and relatively unknown, as is the case in Colombia and Peru. For example, some indigenous communities in Bolivia, such as the Itonamas or Baurenses believe that the bufeos were people that were punished by gods by converting them into animals (Ribera, 2000). Other groups believe that bufeos transform themselves into humans and seduce young woman in the surrounding villages (Yañez, 1999). However, most of the beliefs are simply erroneous perceptions, such as dolphins come out of the water to reproduce; they can have up to 5 neonates at the same time or that they have similar mammary glands (breasts) and reproductive organs as humans. These particular beliefs do not result in respect for or fear of dolphins, as do beliefs common in neighboring countries.

The indigenous group "the Yuracaré", located on the central Mamore, occasionally hunt for subsistence commerce and consume dolphin meat. There are no registers of the number of dolphins killed by the Yuracaré. However, in general, the dolphin meat is considered too greasy and smelly for regular consumption (I. Soria; N. Chavez, com. pers. 2006). In the north of the country (Costa Marquez) people believe that the meat is unhealthy and even poisonous (Anderson, 1997). People in several villages along the rivers and also in the main towns agree that the fat can be used as a very effective traditional medicine to cure respiratory problems (tuberculosis) and some lung infections. In the local market of Riberalta, they sell bufeo teeth valued as good luck charms or as sexual attractors. There are some indigenous witches who use dolphin genitals, eyes or other body parts for various purposes. This however is not very common.

Natural Mortality

There are no registers on the natural predation of the bufeo. Best & Da Silva, (1993) indicated that the black caiman (*Melanusuchus niger*) and the jaguar (*Panthera onca*) are potential predators. There is an anecdotic report in Bolivia that a crocodile (*Caiman yacare*) was on the shore of a river with a bufeo calf in its jaws, but there is no certainty that the crocodile killed the bufeo or if it was already dead (Leonardo Cuellar pers. com. 2009). The author of the chapter observed a dead bufeo possibly caused by intra-species sexual aggression in the Mamore River; the day before encountering the corpse, there was a lot of behavior activity, plays, splashes and contact between them. These behaviors were observed and heard the whole night. The next morning the dead individual was found, with bites marks on the fins, cuts and lesions in the blow hole and internal bleeding. Similar sexual aggression has also been observed in the Colombian Orinoquia (Fuentes *et al.*, 2000).

RESEARCH PRIORITIES

It is a priority to conduct long term studies on the abundance, distribution, social organization, migration patterns, behavior and mortality of bufeos in different areas where they are present. Standardized techniques should be used in these studies so that the results can be replicated and easily compared, to identify threats to bufeo populations in the different areas of their distribution.

It is important to conduct in-depth studies on the distribution and morphometrics and genetics of bufeos in the Abuna Sub-basin, to evaluate Van Bree & Robineau's (1973) proposition of the possible presence of *Inia g. geoffrensis.* If this is confirmed, Bolivia would have two different river dolphin species. It would also be interesting to monitor the northern area around the rapids or cachuelas, to verify the number of bufeos present and the possible barriers that the rapids represent, because it is probable that during high water season they can overcome the rapids.

Studies need to be carried out on the impacts of deforestation, as well as human settlements along the rivers and the pollution caused by gold mines and the effects of the industries and pesticides on water quality and fish populations. More comprehensive studies on the effect of fishing and the impact on fish communities need to be undertaken.

A monitoring system that records natural and human caused mortalities among the bufeos should also be initiated.

CONCLUSION AND CONSERVATION PRIORITIES

It is necessary to improve the administration and the effectiveness of protected areas where bufeos are located. It is also important to create laws that regulate water use in the head basins, since pollution and contaminates travel well-beyond their sources. It is a priority to not only stop habitat degradation but to also remediate those habitat areas already negatively impacted.

Increased educational awareness of the importance of the Bufeo is critical to a successful long-term conservation plan. Bufeos are clean-water species and consequently their presence and health indicate the general health of the river ecosystem. Therefore the conservation of the bufeo is correlated to the conservation of all aquatic species which in turn is related to water quality. Human pressures on this resource are increasing, therefore activities such as environmental education campaigns can be started, to teach people and make them aware of the importance of conserving and protecting biological diversity and natural resources, as well as recovering local traditions.

It would be important to monitor bufeo populations, to detect natural fluctuations, which could be a basis to understand genetic exchanges.

An environmental education campaign should be started that highlights the indiscriminate use of mercury and its effects on water quality. Mercury regulated levels need to be created and enforced.

Its recommended to stipulate clear regulatory guidelines regarding the use of nylon fishing nets (monofilaments) and to reduce the use of nets that do not discriminate fish size.

The Mamore River should be a priority area to implement the proposed environmental education plans because it is heavily used by boats and fishermen, and the high biodiversity along this river.

There is also a need to regulate tourism activities and tour guides. The activity of swimming with dolphins should be discouraged because this activity causes stress in the animals and changes their behaviors, as has also been determined for other aquatic mammals (Constantine *et al*., 2004; King & Heinen, 2004). As indicated by Wilson *et al*., (1999) in a species like the dolphin, that is long-lived and slow-breeding, the long-term effects of reduced

rest on fitness, individual reproductive success and population size could take decades to detect, which reinforces the need for long term studies.

It is essential to increase public awareness of the River Dolphin across Bolivia. The charismatic or emblematic species can stimulate people to be engaged in conservation issues and to understand conservation problems. In this way, by using this species, it will be possible to start long term educational campaigns similar to the Omacha Foundation's in Colombia or in Brazil. An efficient conservation plan that incorporates a strong educational component can even transform factors that negatively affect river dolphins into positive ones. For example, a well-organized and regulated tourism based on cetacean observation can be a good incentive for protection of these areas, as occurs in Brazil. This activity can contribute to sustainable use and provide another employment option that helps the economies of the communities along these rivers.

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