CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES OF WILD FAUNA AND FLORA

Seventeenth meeting of the Conference of the Parties
Johannesburg (South Africa), 24 September – 5 October 2016

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Inclusion of *Telmatobius culeus* (Garman, 1876) in Appendix I, in accordance with Resolution Conf. 9.24 (Rev. CoP16), Annex 1, criterion C.

B. Proponent

Plurinational State of Bolivia, Republic of Peru*.

C. Supporting statement

1. Taxonomy

1.1	Class:	Amphibia	
1.2	Order:	Anura	
1.3	Family:	Telmatobiidae	
1.4	Species:	*Telmatobius culeus* (Garman, 1876)	
1.5	Scientific synonyms:		
1.6	Common names:	Spanish:	Rana Gigante del Lago Titicaca, Rana del Lago Titicaca
		English:	Titicaca Water Frog
		Local names:	Jamphatu huankele, keles, ispiawatari
1.7	Code numbers:		

2. Overview

The Titaca Water Frog (*Telmatobius culeus*) is endemic to the Lake Titicaca basin, which falls under the jurisdiction of Peru and Bolivia. The species is classified as "Critically Endangered (CR) by the IUCN, and also by the two aforementioned countries.

The proposal to include the species in Appendix I is submitted for the following reasons:

a) Population decline: Icochea *et al*. (2004) estimate a decline, at a species level, of more than 80% over the last three generations.

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b) Habitat degradation. Water is constantly being extracted from the basin. Further, Lake Titicaca is contaminated from mining activities, and from industrial, domestic, and livestock waste (due to the use of organochlorines and organophosphorates) in the area.

c) Illegal and indiscriminate harvesting. According to Rodríguez (2013), in the Bolivian sector, annual harvest would be estimated at 40,248 frogs, which are used for human consumption as meat, traditional medicines, and frog extract. In 2013, the Bolivian newspaper "Opinión" reported that frog extract was being traded in the town of El Alto. Frog extract is also traded in Peru – in Lima, Cusco, Arequipa, and Puno. Although the bulk of the trade in the two countries is for domestic consumption, there is evidence to indicate that international trade is taking place within Latin America (Reading *et al*. 2011), and with Europe.

d) Introduced species. There is evidence of predation of amphibian larvae by species that were introduced into Lake Titicaca, such as trout (*Oncorhynchus mykiss*), and silverside (*Odontesthes bonariensis*), as well as competition from these species for space and food (Aguilar, 2010; Richard, 2010; Martín-Torrijos *et al.* 2016).

e) Presence of emerging infectious diseases. Amphibian pathogens, such as the chytrid fungus (*Batrachochytrium dendrobatidis*) and the ranavirus, have been detected among frogs from the genus *Telmatobius* in Lake Titicaca (Seimon *et al*., 2005; Cossel Jr. *et al*., 2014).

3. Species characteristics

3.1 Distribution

The species is endemic to the highlands of Peru and Bolivia. Its range is restricted to Lake Titicaca and the adjacent lagoons, at elevations of approximately 3,810 m.a.s.l. In Bolivia, it is found only in Lake Titicaca. In Peru, however, the species is also found in Lake Saracocha, Lake Umayo, Lake Chajchora, the Arapa Lagoon, and the River Ilave (Frost, 2014; De la Riva, 2015). Its extent of occurrence is calculated to be 17,440 km^2, based on the polygon mapped by the IUCN Red List using Geographic Information System Tools.

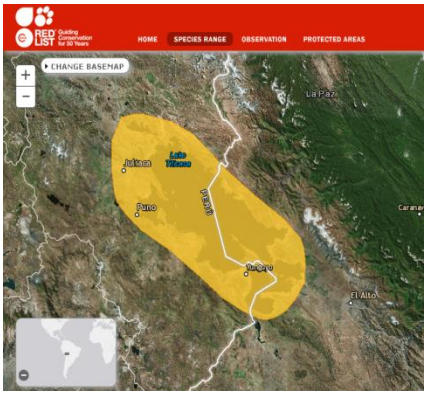

Figure 2.Extent of occurrence of *Telmatobius culeus*

(Source: IUCN, Conservation International and NatureServe. 2004)

3.2 Habitat

T. culeus is a wholly aquatic species. It is the largest (Allen, 1992), and highest-altitude species of water frog. It occurs mainly in Lake Titicaca, which is located at an elevation of 3,810 m.a.s.l. (Roche *et al*., 1991), maximum length 178 km, and maximum width 56 km. Estimated surface area of the lake is 8,562 km^2, with a water volume of approximately 903 km^3 (Wirrmann, 1991; Roche *et al*., 1991).

The species occurs throughout the coastal zone, at depths ranging from 2 to 15 metres (Flores, 2013; Genova, 2011; Ramos, 2000). Nonetheless, local fishermen have reported finding the species in nets at depths down to 30 m. With regard to habitat, individuals occur more abundantly on rocky substrates (Flores, 2013). Genova (2011) reported that adult individuals show a preference for rocky and sandy substrates, whereas juveniles show a strong preference for sandy substrates, and are less abundant in areas of predominantly aquatic vegetation or totora reeds.

In terms of water quality, overall water and carbonate hardness has been found to be related to population density of this species. No influence of water acidity and carbon dioxide concentrations was detected. Sustainable conditions for the species are: pH between 8 and 8.5, overall water hardness between 12 and 13 dH, carbonate hardness 4 and 5 dH, carbon dioxide 0.4 and 0.7 mg/l, nitrate concentration below 0.3 mg/l, and ammonia-free conditions (Genova, 2011).

3.3 Biological characteristics

The species has a large area of vascularized skin and greatly reduced lungs (Amphibia Web, 2016), and is able to effectively remove oxygen from water with its skin (Hutchison *et al*., 1976). Respiration is through its skin, which contains a large number of mucous glands and skin folds that increase its breathing capacity; the species has a dorsal disc that performs a hydrostatic function (Allen, 1922; Garman, 1876; Vellard, 1951). Other adaptations for aquatic life at high altitude include: erythrocyte count, which is the highest reported for any anuran (729,103 erythrocytes/mm^3), and hemoglobin content (0,281 pg/u^3); smallest erythrocyte volume reported for amphibians (394 u^3) (Hutchinson, 1982).

Under hypoxic conditions, these frogs will surface; however, if they are prevented from surfacing, they do not struggle, but will stand on the bottom with legs and toes extended to maximize skin surface exposure to the water, and will bob up and down about once every six seconds (Hutchison *et al*., 1976). This acts to move the large skin flaps, which breaks up the boundary layer between the skin and the water, allowing the skin to more fully absorb the oxygen from the water (Hutchison *et al*., 1976). If the water is well-oxygenated, the frogs will not surface for air. Dissections have shown small amounts of gas in the lungs (Hutchison *et al*. 1976).

Diet. Pérez (1998; 2002) reported dietary variations depending on developmental stage: adults feed mainly on small crustaceans, molluscs, insect larvae, and small fish; diet at the larval stage is phytophagous (See Annex I).

Females are usually larger than males. Amplexus is axillary (A. Muñoz, pers. comm., March 2016) and lasts between 2 to 3 days. Eggs are laid in clutches of 10-20 eggs, usually on plants of *Elodea* sp.; egg size is 2.2 mm (Pérez, 1998); characteristically, males remain close to the eggs (A. Muñoz, pers. comm., March 2016). Clutch size may vary throughout the year: 115 eggs in May, between 777 and 866 eggs in October, and 941 eggs in February (Pérez, 1998). More recent data reports clutch sizes of 200–500 eggs in the wild (A. Muñoz, pers. comm., March 2016).

Clutch sizes of 23, 120, and 450 eggs have been reported for captive-bred individuals in Peru (L. Bermúdez, pers. comm., March 2016), and between 173 and 475 eggs in Bolivia (A. Muñoz, pers. comm., March 2016).

3.4 Morphological characteristics

This frog has a flat head (in lateral profile), and pointed snout; dorsal view shows a round snout; flared lips; post-commissural gland may be present; non-visible tympanum; distinct supratympanic skin fold. Male forelegs have no humeral spines, and have small nuptial pads covering most of the internal surface of the thumb and part of the inner palmar tubercle; webbing varies between 1/2 and 2/3 of toe length, smooth plantar surface; well-marked tarsal fold; dorsal skin mostly smooth; extremely loose skin on thighs and flanks, particularly in larger individuals; dorsal skin colours vary – grey, brown, or greenish-brown, and may present a pattern of yellow, grey, or white spots; white or grey belly, throat, and ventral part of legs, with an irregular pattern of light and dark spots; pale brown iris, with small black reticulations (De la Riva, 2005).

Figure 1. *Telmatobius culeus*, lateral view

3.5 Role of the species in its ecosystem

The species is an important link in the food chain, and, at different stages, it is food for natural predators such as the Andean gull (*Larus serranus*), and the night heron (*Nycticorax nycticorax* (Cortez, 2011). Similarly, the species feeds on numerous invertebrates such as amphipods and gastropods, as well as small fish.

4. Status and trends

4.1 Habitat trends

The causes of contamination in the lake have been identified as follows: wastewater (domestic and industrial), mining waste, solid waste, and livestock waste. Contamination is worse in the area comprising the five municipalities in the Lake Titicaca basin in Bolivia: El Alto, Viacha, Laja, Pucarani, and Puerto Pérez, which discharge their effluents and waste into the Minor Lake through Cohana Bay. All contaminants carried from the River Katari basin end up in Cohana Bay. Contamination levels are a concern, and are higher than the levels of COD, BOD, dissolved oxygen, phosphates, parasites, and heavy metals established for Class D under Bolivian laws (Ministry for the Environment and Water – MMAyA, 2015).

Aquatic plants show high bioaccumulation levels of heavy metals and parasites; fish in the Minor Lake were also found to have high bioaccumulation levels of cadmium. Further, high levels of cadmium and iron were detected in the River Seke, the cadmium from mining waste from Milluni, and the iron from abattoirs in the area of influence. Contamination levels of silt in the Minor Lake are well above the limits for highly-contaminated sludge, containing chromium, copper, iron, lead, zinc, and arsenic. Given the potential negative impact of these components on both the ecosystems and the population, there is cause for great concern about the situation (MMAyA, 2015).

A further important problem is eutrophication, or the accelerated growth of surface algae in the lake, which flourish due to the high level of nutrients (nitrogen and phosphorus), eventually covering the water surface, consuming large amounts of the oxygen needed by other organisms, and leading to the death of other species and deterioration of the ecosystem conditions (MMAyA, 2015).

There are significant economic activities at the sources of the Rivers Ramis, Coata, and Illpa, in the department of Puno in Peru, e.g., mining at the Kallawaya mountain range. The provinces of Carabaya, Melgar, Azángaro, Putina, and Huancané on the Peruvian side do not have efficient wastewater treatments in place, and wastewater is discharged directly into the rivers. Further, there is a large livestock population throughout the region, including the buffer zone of the Titicaca National Reserve.

In order to assess the quality of water in the river system at Titicaca National Reserve, the main tributaries of which are the Rivers Ramis, Coata, and Illpa, water samples were taken for physicochemical analysis. Results showed the presence of contaminants, e.g., pH level of the River Coata, which is probably due to the discharge of domestic and industrial wastewater from the town of Juliaca. A similar trend was seen in the River Ramis, which showed a high level of contamination from heavy metals (RNT-SERNANP, 2011).

Further, the following environmental problems were detected at the Titicaca National Reserve: a) inadequate disposal of solid waste near the Uros Chulluni sector, Carata, and Kapy-Uros; b) discharge of wastewater at the mouth of the River Coata, in the vicinity of the Uros Chulluni sector, and Kapy-Uros; c) unauthorized livestock presence in the northwest strip (in the dry, shallow-water zone) of Yanico, Moro, Faón, Yasín, Carata, and Capano; and d) informal fishing on the stretch of the River Huile, Landmark 1. (SERNANP, 2012) (see Annexes).

4.2 Population size

The geomorphological variance of the lake, and the heterogeneous distribution of the species, added to which the extreme conditions and low temperatures, make it difficult to obtain an accurate estimate of the population of *T. culeus,* and standardize assessment methodologies. Nonetheless, BTA PERU (2002) estimated a population of between 17 and 51 million individuals in Lake Titicaca, depending on the season (See Annex, Table 4). Also, in the same year, Pérez (2002) estimated a population of 655,112 individuals for the whole of Lake Titicaca, down to a depth of 10 metres; based on the assumption that the frogs might occur down to a depth of 40 metres, the population was estimated as 2,549,856 individuals, which was significantly lower than BTA's estimate.

Sampling efforts at the lake have increased in recent years, corroborating the heterogeneity of Lake Titicaca; accordingly, given the main assumption used in some estimates (i.e., uniform distribution of frogs throughout the lake), it is difficult to extrapolate densities to the whole of the lake with any degree of confidence. However, the data obtained from monitoring over a period of five years in the same locations show that the population in Bolivia is declining (A. Muñoz, pers. comm., March 2016).

Although several estimates suggest a large and potentially healthy population, mortality continues: during monitoring on the Bolivian side of the lake, often approximately 3% of the population was found dead (A. Muñoz, pers. comm., March 2016). Mass mortality events have also occurred, particularly in the Minor Lake area in 2009 and 2011, and more recently in April 2015 (A. Muñoz, pers. comm., March 2016).

4.3 Population structure

There is no detailed information available on population structure. However, an analysis of the data relative to the latest mortality in April/May 2015 (Bolivian sector/the Minor Lake) showed that 70% of the individuals were females (Bolivian Amphibian Initiative/Alcide d'Orbigny Natural History Museum, 2015; unpublished data)

Based on interviews carried out by Cortez *et al*. (2009), 68% of interviewees reported that it was more difficult than in the past to find large individuals, and searches required greater effort. According to this author, the fact that no large frogs are to be found indicates that the proportion of individuals who succeed in reaching adulthood is low, and survival also seems to be lower. Further, Cortez (2011) reports that in the 1990s there were more large-sized frogs.

4.4 Population trends

According to assessments of population status made at the Minor Lake of Titicaca, it is estimated that between 1999 and 2008 there was a 39% loss of population (Pérez, 2009). The extinction risk assessment for this species, using IUCN methodology, shows that the Lake Titicaca population suffered a severe decline – estimated at 80% of the population over three generations (Icochea *et al.* 2004).

In the areas monitored under the Bolivian Amphibian Initiative/Alcide d'Orbigny Natural History Museum project, the population has decreased by 70% in some locations compared to previous years. Further, only juveniles or small individuals were found, and it seems that the highest mortality is found in adults (Muñoz, 2015). Similarly, in the period between April and May 2015, the Project reported a high mortality of frogs, fish, and birds in the Minor Lake in Cohana Bay, between Puerto Pérez and Pata Patani, where there was 100% mortality of the local population of *T. culeus*, and not a single live individual was found by divers. The causes of this mortality event are being investigated at Ghent University, Belgium, within the framework of the Bolivian Amphibian Initiative/Alcide d'Orbigny.

According to reports from the Research for Development Institute, and the Institute of Ecology at the University of San Andrés, this recent mortality would have been caused by the high levels of

dissolved hydrogen sulphide in the water due to an explosion of green algae that reduced the levels of dissolved oxygen in the water (Darío Acha, pers. comm., June 2015).

4.5 Geographic trends

In May 2015, the Project Bolivian Amphibian Initiative/Alcide d'Orbigny Natural History Museum and Ghent University in Belgium quantified the mortality event of the Titicaca water frog in an area of approximately 500 km^2 in the Minor Lake, concluding that the species is no longer present in half of said area, possibly as a result of drastic habitat alterations.

5. Threats

As previously indicated, the following main threats have been reported by various sources:

a) Sales as pets (Bolivia and Europe): In March 2016, six specimens were seized in Ecuador en route to Europe (A. Muñoz, pers. comm., March 2016)

b) Presumed predation: Presumed predation of frog larvae by introduced species such as trout (*Oncorhynchus* sp.), and silverside (*Odontesthes bonariensis*) (Pérez, 2009; Icochea *et al*., 2014).

c) Habitat disturbance and loss due to:

- Water extraction from the Lake Titicaca basin (MMAyA 2015).

- Water pollution from mine tailings, industry, domestic waste, livestock waste Icochea *et al*. 2004; Pérez, 2009, Beltrán-Farfán *et al*., 2015; MMAyA, 2015), and use of organochlorine and organophosphate compounds in agriculture (Pérez 2009).

d) Presence of pathogens and infectious agents such as *Batrachochytrium dendrobatidis,* "chytrid fungus" (Cortez *et al*., 2011; Cossel *et al.,* 2014; Berenguel *et al*., 2015), and ranavirus (A. Muñoz, pers. comm., March 2015) in wild populations in the two countries, and detected at Titicaca National Reserve (Berenguel *et al*., 2015). Further, it is possible that the fungus is being spread through illegal trade (Catenazzi *et al*., 2010). Potential threats are the presence of the fungus *Saprolegnia*, and co-infection by ranavirus, and also, leech and nematode parasitism (Martín-Torrijos *et al*., 2016; Warne *et al*., 2016)

e) Contamination from motorboat fuel: (bad practice) (SERNANP, 2015).

f) Climate change: higher temperatures, more ultraviolet rays on the lake, etc. (Hoffann & Requena, 2012).

g) Bycatch. The species is often caught in fishing nets.

h) Over-exploitation of adults: Over-exploitation is a serious problem for species of the genus *Telmatobius* in general, including *T. culeus*. It is understood from interviews that some 500–1,000 individuals are collected each month for sale at markets in Peru (Icochea *et al.,* 2004; Angulo, 2008; Pérez, 2009; Aguilar *et al*., 2010; Catenazzi *et al*., 2010; Reading *et al*., 2011; Berenguel *et al*., 2015).

6. Utilization and trade

Vellard (1981) reports that the Titicaca water frog has been used in the region for traditional and cultural practices. Currently, it is consumed in soups and juice, and is attributed with curative (Herzog, 2009) and aphrodisiac properties.

6.1 National utilization

The species is taken from the wild to be used for medicinal, ritual, aphrodisiac, and folkloric purposes, and as an alternative food. Many families eat frog meat for a varied diet, or as an occasional dish (Montaño, 2004). In a study of 28 communities in the surrounding area of Lake Titicaca, Álvarez (2006) determined that the level of utilization meant that a total of 27,548 frogs were consumed per year.

Further, the frogs are used for gourmet dishes for tourists (the frogs' hind legs are used, which means that some 8 frogs per dish are required in Bolivia). In some cases, frogs caught as bycatch are used to feed other animals (pigs).

6.2 Legal trade

In Peru, any trade of endangered species is prohibited by national law (Supreme Decree 004-2014-MINAGRI); accordingly, any trade in this species is illegal in Peru.

In Bolivia, Supreme Decree 22641, which was enacted on 8th November 1990, declared an indefinite, overall ban on the hunting, capture, collection, and processing of wildlife, and the products or derivatives thereof; accordingly, any trade is considered illegal.

6.3 Parts and derivatives in trade

There is no legal trade in parts and derivatives of this specie.

6.4 Illegal trade

Plurinational State of Bolivia: In a study of 28 communities in the area surrounding Lake Titicaca, Álvarez (2006) reported that fishermen accept the use of frogs for consumption. The actual volume of the species that is used is around 26,500 and 1,248 units in the rural and urban areas, respectively, making a total of 27,548 frogs per year. However, Rodríguez (2013) suggests that the frog meat market in Bolivia has diminished, and frogs' legs are no longer a common dish on the menu. Between 1,065 and 1,800 frogs/month (12,780 and 21,600 frogs/year) are used for frog juice and medicinal products, respectively. According to Rodríguez (2013), the number of frogs harvested in Bolivia is estimated at 40,248 frogs/year, which are used for meat, traditional medicine, and frog juice.

Leather is a subproduct of this species that is traded in Bolivia, and untreated skins are sold for 1 – 1.5 US$ (Richard, 2010; Rodríguez, 2013). In 2011 and 2012, there were reports of Asians searching for live frogs in Lake Titicaca (A. Muñoz, pers. comm., March 2016). There are also reports of seizures of specimens being traded as charms and amulets in markets, although the taxonomy of the seized specimens is uncertain.

Republic of Peru: There are reports of the species being traded in markets in Cusco (Angulo, 2008). According to data from the National Forestry and Wildlife Service (SERFOR), during the period 2012–2015, more than 9,500 specimens were seized in the regions of Puno, Arequipa, and Lima (SERFOR, unpublished data).

Pérez (2009) reports that the subproducts of the species that are most frequently found in illegal trade include frog legs, which have been traded for decades, mainly for human consumption (Berenguel *et al*., 2015). According to Rodríguez (2013), the following parts and derivatives of *T. culeus* are used:

- Whole fresh specimens or dried specimens
- Derivative products such as flour or creams (interview with trader, Reading *et al*., 2011).
- Export of leather to the USA (Richard, 2010).

At international level

A large export, intended for exotic dishes, to the United States and France was reported (Catari, 1994, in Pérez, 2002).

According to Rodríguez (2013), several cases of illegal offtake for export have been reported, mainly to the USA, Canada, and Western Europe. The exported product consists of vacuum-packed meat (frog legs). Further, large numbers of specimens are known to be exported illegally, mainly to Brazil and Japan (De Morales and Ergueta, 1996; Ergueta and Harvey, 1996).

In 2008, the species was being advertised on the Internet for the European pet market (A. Muñoz, pers. comm., March 2016). Early in 2009, it was reported that a batch of 13 Titicaca water frogs was offered to a pet shop in Quito (Ecuador). The batch was purchased by the pet shop owner, and the

specimens subsequently donated to the Pontifical Catholic University of Ecuador (PUCE) (A. Merino Viteri, pers. comm., March 2016).

Perez (2009) stated that in 2006, over 15,000 specimens/year were used for frog legs, and also that complaints were filed in the Bolivian sector about the high number (thousands) of specimens of this species being sold for consumption (juice) in the city of Lima (Peru).

According to the information obtained directly from Bolivian frog-collectors who sell the untreated leather, the species is also used at an international level for its leather, which is used to make wallets that are sold on the international market (USA) at 70–120 US$ (Richard, 2010).

6.5 Actual or potential trade impacts

The species is affected by domestic trade in both Bolivia and Peru, and although the true scope of international trade is unknown, there is evidence that it exists. Even though the overall impacts of trade have not been quantified for this species, they may represent significant pressure on its populations, considering that the species is widely consumed at a local level, and the synergic effects of other threats may be intensifying such pressure.

7. Legal instruments

7.1 National

See **Annex 3** for further details of Bolivian and Peruvian laws.

In Bolivia, the species is classified as Critically Endangered (CR) in the Red Book of Vertebrate Wildlife of Bolivia (2009). At the *First Workshop on Evaluation of Conservation Needs of Amphibian Species in Bolivia (2014)*, it was decided that the species should remain in said category (CR). It is also important to highlight the "Action Plan for Conservation of Endangered Amphibians of Bolivia (2013-2017)", which includes *T. culeus*, and establishes specific actions to support its conservation (MMAyA, 2013).

In Peru, the species *T. culeus* is classified as Critically Endangered (CR) under current laws; accordingly, there are certain applicable provisions relative to the management and conservation of endangered species, and to the penalties for activities that involve their illegal use.

7.2 International

Despite the species being classified as Critically Endangered (CR) on the IUCN Red List of Endangered Species, the species is not currently specifically included in any instrument for international protection.

It should be noted that since June 2015, Bolivia and Peru have been developing bilateral measures aimed at joining efforts toward the conservation of biodiversity, and have signed the "Declaration of Esteves Island" (See Annex 4 for agreements on species and ecosystems).

8. Species management

8.1 Management measures

Bolivia's Action Plan for Conservation of endangered Amphibians (2013-2017) includes actions for protection, research, monitoring, and economic options such as tourism, to ensure protection of the species.

Currently, the Plurinational State of Bolivia, through its Ministry of the Environment, is in the process of entering into an interinstitutional agreement with the Alcide d'Orbigny Natural History Museum in order to foster ex situ and in situ conservation initiatives of the species at Lake Titicaca.

Further, there is a national Natural Protected Area (NPA) in Peru that comprises part of the species' range: Titicaca National Reserve.

Since 2007, Denver Zoo, in coordination with the Peruvian Cayetano Heredia University (UPCH), has been working to support conservation of the species. In 2010, the first workshop was held to develop the "National Plan for Conservation of the Titicaca Water Frog in Peru". The outcome of the workshop led to three components being developed under the project: captive breeding, research, and education (social marketing).

Captive breeding began in 2008 at the Wildlife Laboratory of the UPCH, using seized specimens. The species was first bred two years later, with the assistance of Huachipa Zoological Park (PZH) in Lima.

Following the initial workshop, Denver Zoo formed an alliance with the Titicaca National Reserve, by means of a letter of understanding, to monitor the species in the lake, and provide up-to-date technical data. Further, emphasis was placed on developing the project's social component through education, awareness-raising, and the promotion of artisanal alternatives using the species' image. Last year, thanks to these efforts, and to the support of local media and participating institutions, the Regional Government of Puno declared the Titicaca water frog a species of regional interest.

Peru is also currently in the process of adopting a "National Strategy to combat the illegal trade of wildlife in Peru", which includes measures relative to the trade of the Titicaca water frog.

8.2 Population monitoring

The Bolivian Amphibian Initiative/Alcide d'Orbigny Natural History Museum has been monitoring the populations of *T. culeus* since 2009, based on diving (scuba diving and snorkelling) transects in Sicuani, Moon Island, Chachapolla, and Chicharro. Monitoring for chytrid fungus is also being implemented in various locations at Lake Titicaca (Muñoz, 2015).

In 2012, Denver Zoological Foundation and the Titicaca National Reserve signed a letter of understanding in respect of their mutual interest in developing research, monitoring, and environmental education projects. In 2015, Denver Zoo and the Regional Government of Puno in Peru also signed a memorandum of understanding to cooperate in monitoring the population of *T. culeu*s in the region.

8.3 Control measures

8.3.1 International

There is no international regulation of trade in this species. The number of prohibitions in respect of amphibians is limited; accordingly, regulation is necessary.

8.3.2 Domestic

In Bolivia, the inspection authorities at a national level are the General Directorate for Biodiversity and Protected Areas (DGBAP), in coordination with certain decentralized, wildlife inspection agencies such as the National Animal and Plant Health, and Food Safety Service (SENASAG), the Directorates for Natural Resources in various Departments of Bolivia, Customs, and the Forest and Environmental Police (POFOMA). In this framework, for example, the DGBAP, the Autonomous Government of La Paz Department ("Mother Earth Secretariat), and POFOMA carry out inspections to detect illegal trade at open markets, where they have seized live and taxidermied specimens of *T. culeus*.

SERFOR, the National Forest and Wildlife Authority in Peru, and the Regional Forest and Wildlife Authorities, are responsible for controlling wildlife outside the Natural Protected Areas (NPAs); SERNANP (National Agency for State-protected Natural Areas) is the wildlife authority inside the NPAs. The aforementioned authorities coordinate their actions with Public Prosecutors specializing in environmental issues (FEMA), the National Tax Administration Authority (SUNAT), the Armed Forces and the Peruvian National Police, the General Directorate of Maritime and Coastguard Authorities (DICAPI), and others. There are administrative and criminal penalties for illegally harvesting and trading wildlife; penalties may be more severe if there are aggravating circumstances, i.e., if the relevant species is classified as endangered, or has been taken from an NPA.

Further, SERFOR, as the national focal point for receiving reports on illegal activities, including wildlife trade, has set up a virtual and telephony platform intended to facilitate the reporting and handling of complaints, and maintain a database.

8.4 Captive breeding and artificial propagation

Although early attempts at captive breeding of the species were unsuccessful (Pérez, 2005), more recent efforts, led by Denver Zoo, the Peruvian Cayetano Heredia University, and Huachipa Zoo in Peru, and the Bolivian Amphibian/Alcide D'Orbigny Museum Initiative in Bolivia, have successfully produced captive-bred specimens.

In February 2016, the pilot project in Bolivia for ex situ conservation of the species transferred 70 specimens from Guaqui and Moon Island to the facilities at the Alcide d'Orbigny Natural History Museum. These specimens will be kept as breeding stock and subsequently returned to the wild.

In Peru, Huachipa Zoo is currently the only institution authorized to breed this species in captivity. Denver Zoo has twenty (20) F2 individuals that were obtained from F1 specimens at Huachipa.

8.5 Habitat conservation

There is no habitat conservation zone in Bolivia. However, under the agreement between MMAyA and Alcide d'Orbigny Natural History Museum, there are plans to take action to define an area for conservation, protection, and repopulation of the species, in conjunction with local stakeholders.

The Republic of Peru has the Titicaca National Reserve, which was established in 1978, encompassing an area of 36.180 hectares (5% of the total lake surface), the purpose of which is to conserve wildlife at the lake, foster socioeconomic development in the region, and maintain the cultural traditions of the population in the Reserve.

9. Information on similar species

Juvenile stages of the species *T. culeus* can be confused with *T. marmoratus*, given that juveniles of *T. culeus* have no skin folds.

10. Consultations

On 11th March 2015, the two Parties met in Lima (Republic of Peru) in order to prepare and review this proposal.

11. Additional remarks

None

12. References

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Las larvas de Telmatobius culeus tienen un régimen alimentario fitófago (consumidor primario), pues consumen organismos fitoplanctónicos: Spyrogira, Zygnema, Microspora, Closterium, Ulothrix, Oedogonium, Chaetophora, Basicladia, Gonatozygon, Fragilaria, Diatoma, Oscillatoriay Lyngbia. Y tiene preferencia por algas filamentosas como Spyrogira, Zygnema y Oscillatoria (con el 42%, 19% y 7% del porcentaje volumétrico total respectivamente). Los adultos presentan un régimen alimentario periódico omnívoro y carnívoro (consumidor terciario y secundario), relacionado con la abundancia de presas en su medio (oportunismo). Siendo los componentes principales: Hyalella, Littoridina, Nostoc e Ispi (IRI > 1000), los secundarios: Taphius, Sphaerium (IRI < 1000) y los casuales o accidentales: Elodea y Miriophyllum (Apaza, 2001). Según Pérez (2002) las algas unicelulares Bacilarioficeas, Cloroficeas y Cianofíceas, constituyéndose el 48%, 32% y 20 % de la dieta, respectivamente.

En edad adulta el Índice de Importancia Relativa de los ítems alimenticios indica lo siguiente: Hyalella (Crustacea), Littoridina (Gastropoda) y los restos vegetales forman los componentes de la categoría alimenticia principal; los componentes adicionales o secundarios constituyen: Taphius (Gastropoda), Telmatobius (Anfibios; quizás sugerente de hábitos canibalísticos), Orestias (Peces) y otros de menor importancia, como: Sphaerium (Lamelibranquia), Elmidae (Insecta), Anysancylus (Gastropoda), y los componentes casuales conformados por los insectos del orden Odonata y algunos Heminópteros, e hidroacáridos (Arácnida), la presencia de hidroacáridos presencia se explica porque realiza su ciclo reproductivo en los macrófitos, en muchos casos fueron los únicos en encontrarse dentro de los estómagos (Pérez, 1998).

Tabla 1. Dieta de Telmatobius culeus según localidad

Dieta	Localidad
Crustáceos y moluscos	Huatajata
Anfípodos (Orchestidae), moluscos (Hidrobiidae, en mayor proporción que Planorbidae), larvas de Dípteros (Chironomidae) y restos de materia vegetales	Isla del Sol
Peces (Orestiassp.), nayadas o larvas de Odonatos e incluso restos de miembros posteriores de otros anuros	Isla Suriqui

Densidad Poblacional

Hay una alta variación en las estimaciones poblacionales de *Telmatobius culeus*, las cuales son:

Tabla 2. Estimaciones de densidad de *Telmatobius culeus* según diferentes reportes.

Densidad reportada	Densidad km2 (*)	Cantidad total	Ámbito	Método de muestreo	Método	Fuente
0,6 ind/300 m2	2.000 ind/km2		Lago Titicaca (En base a mediciones del lado Peruano)	Transectos mediante Buceo	Área	BTA PERÚ (2002)
80 ind/km2			Lago Menor	Recorridos en embarcación y recolección de individuos mediante redes con la ayuda de personal de buceo	Área	Pérez (2002)
0.575ind/m2	575.000 ind/ km2		6 localidad en la península de Copacabana e Isla del Sol (Lago Mayor)	Transectos mediante Buceo	Distancia	Genova (2011)
16.500 ind/km2 11.400 ind/Km2			Lago Mayor Lago Menor	Transectos mediante Buceo	Área	Flores (2013)
		12.000	Zona boliviana del lago (población visible, año 1955)			Terrazas (1980)
		75 millones (13 millones cerca de las playas)				Morawetz (1994)
		1,000´000,000	Muestreó en el lado boliviano y extrapoló a todo el lago[1].	Arturo confirmará el método de cuadrantes.	Colecta total	J. Cousteau (documental, 1973)

Nota: Donde (*) datos calculados en base a la densidad reportada

1 *Ramos et al. Muestreo en 1,000 m2*

Tabla. 3 Estimaciones de densidad y abundancia por localidad (Genova 2011)

Localidad	Área de relevamiento m2	Densidad Estimada ind/m2	Abundancia Estimada de individuos
Isla Sol	87.576	0,027	2358
Yampupata	40.640	0,135	5470
Siquani	67.367	0,057	3854
Chani	40.714	0,013	548
Weko	51.341	0,030	1555
Copacabana	68.778	0,057	3935
Global	356.416	0,575	23351

Tabla 4 Comparación de la estimación poblacional de *Telmatobiusculeus* para el Lago Titicaca BTA PERÚ (2001).

Época	Media	Intervalo de confianza
Época lluviosa	51.000.000	±34.620.000
Época seca	17.000.000	±14.394.000

Sin embargo diferentes estudios demuestran la preferencia de hábitat de *Telmatobius culeus*, en base a la profundidad se sabe que la especie se distribuye entre 2 a 15 metros (Ramos 2000, Genova 2011, Flores 2013), en base a esto BTA PERÚ (2002) estima hasta los 4 metros de profundidad una población de 2.022.261 de individuos, sin tomar en cuenta otras variables importantes para la sustentabilidad de la especie (sustrato, calidad del agua, entre otras.)

Tabla 5. Estimación poblacional de *Telmatobius culeus* en función a profundidad BTA PERÚ (2002).

Profundidad (m)	Densidad Promedio (300 m2)	Población Estimada (individuos)
2	0.238	187.861
3	0.5	420.000
4	2.6	1.414.400
Total		2.022.261

LEGISLACIÓN BOLIVIA - PERÚ

Bolivia:

Entre las principales disposiciones legales que rigen la conservación de la vida silvestre en Bolivia citamos:

- Ley Nº1333, promulgada en 1992. La Ley del Medio Ambiente establece la obligatoriedad de realizar el uso sostenible de las especies autorizadas, en base a información técnica, científica y económica. Asimismo establece las normas para control y fiscalización de las autoridades pertinentes.

- Ley Nº 300 de 15 de octubre de 2012. Ley Marco de la Madre Tierra y Desarrollo Integral Para Vivir Bien, la cual tiene entre sus bases y orientaciones el de desarrollar políticas, estrategias, planes, programas y proyectos de uso, aprovechamiento, protección y conservación de la biodiversidad de forma participativa, de acuerdo a las características de cada sistema de vida.

- Ley N° 755 de 28 de octubre de 2015. Ley de Gestión Integral de Residuos, donde uno de sus principios indica la Gestión Integral de Residuos debe orientarse a la protección de la Madre Tierra, previniendo riesgos para la salud y de contaminación del agua, aire, suelo, flora y fauna, en concordancia con las estrategias de lucha contra el cambio climático, para el vivir bien de las actuales y futuras generaciones.

- Decreto Supremo de Veda General e Indefinida Nº 22641 promulgado en 8 de noviembre de 1990, que declara Veda General e Indefinida para el acoso, captura, acopio y acondicionamiento de fauna o flora silvestre, sus productos o derivados.

- Decreto Supremo que ratifica la Veda General e Indefinida Nº 25458 permitiendo el uso sostenible de algunas especies de vida silvestre en base a planes de uso sostenible, estudios o inventarios por grupos taxonómicos que determinen la factibilidad de su aprovechamiento y los cupos permisibles por periodos de dos años previa reglamentación llevada a cabo por la Autoridad Ambiental Competente Nacional.

- La Resolución emitida por la Autoridad Ambiental Competente Nacional Nº 309 de diciembre de 2006, que presenta la norma técnica con lineamientos para la preparación y presentación de Planes de Manejo de Fauna Silvestre.

- La Resolución emitida por la Autoridad Ambiental Competente Nacional Nº 024 de 2009, que reglamenta la investigación científica en materia de diversidad biológica en Bolivia.

Convenciones relevantes

- Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres (CITES). Ratificado por Ley Nº 1255 de 1991.

- Convenio sobre la Diversidad Biológica. Ratificado por Ley Nº 1580 de 1994.

- Convención Relativa a los Humedales de Importancia Internacional (RAMSAR). Ratificado por Ley Nº 2357 de 2002.

- La Convención Marco de las Naciones Unidas sobre el Cambio Climático (CMCC) fue firmada en 1992 y ratificada en 1994.

- Convención de Naciones Unidas de Lucha Contra la Desertificación y la Sequía (UNCCD), ratificada mediante Ley Nº 1688 de 1996.

Perú:

En el Perú la especie T. culeus se encuentra categorizada como En Peligro Crítico (CR) según Decreto Supremo N° 004-2014-MINAGRI, resultando aplicables por este motivo una serie de medidas relacionadas a la gestión y conservación de especies amenazadas así como a la sanción de conductas que involucren su aprovechamiento ilícito. En este sentido, podemos citar las siguientes normas legales:

- Ley N° 29763. Ley que aprueba la Ley Forestal y de Fauna Silvestre.

- Decreto Supremo N° 009-2013-MINAGRI, que aprueba la Política Nacional Forestal y de Fauna Silvestre.

- Decreto Supremo N° 004-2014-MINAGRI, que aprueba la actualización de la lista de clasificación y categorización de las especies amenazadas de fauna silvestre legalmente protegidas.

- Decreto Supremo N° 009-2014-MINAM, que aprueba la Estrategia Nacional de Diversidad Biológica al 2021 y su Plan de Acción 2014-2018.

- Decreto Supremo N° 019-2015-MINAGRI, que aprueba el Reglamento para la Gestión de Fauna Silvestre.

- Código Penal modificado por el Decreto Legislativo N° 1237.

ACUERDOS BINACIONALES

Autoridad Binacional Autónoma del Sistema Hídrico del Lago Titicaca, Río Desaguadero, Lago Poopó, Salar de Coipasa (ALT)

En 1996 se crea la Autoridad Binacional Autónoma del Sistema Hídrico del Lago Titicaca, Río Desaguadero, Lago Poopó, Salar de Coipasa (ALT) con la misión de la misión de promover, gestionar e implementar programas y proyectos relacionados con el ordenamiento, manejo, control y protección de los recursos hídricos, hidrobiológicos y ambientales, armonizando las acciones con las organizaciones públicas y privadas para lograr el desarrollo sostenible del sistema TDPS.

Entre las funciones del ALT relativas a la biodiversidad y ecosistemas se tienen:

- Ejercer la autoridad sobre los recursos hídricos e hidrobiológicos de connotación binacional del Sistema Hídrico TDPS, estableciendo las normas y reglas de operación y recomendando las medidas a adoptar en épocas de eventos extremos (sequías, inundaciones).

- Apoyar y promover la preservación, recuperación, protección y conservación de los ecosistemas naturales, de acuerdo al Plan Director, tendiendo a mantener y mejorar la sustentabilidad ambiental del Sistema Hídrico TDPS. Establecer normas de calidad de las aguas. Promover tecnologías de uso racional de los Recursos Naturales.

Declaración de Isla Esteves 2015

El 23 de junio de 2015 se realizó acciones bilaterales entre Bolivia y Perú para aunar esfuerzos en la conservación de la biodiversidad mediante la firma de “Declaración de Isla Esteves”. Puntos relacionados con especies y ecosistemas:

- Reconocer la importancia del Lago Titicaca en la historia y en la integración de ambos países, su relevancia ancestral, cultural, ambiental y económica para los pueblos que lo habitan y la vulnerabilidad de sus ecosistemas, expresando su firme compromiso para poner en práctica todas las medidas que estén a su alcance a fin de restablecer las capacidades ambientales de este ecosistema, de forma que permita su recuperación en beneficio de los pueblos y en equilibrio con sus actividades económicas.

- Al reconocer la importancia del Lago Titicaca en la historia y en la integración de ambos países, su relevancia ancestral, cultural, ambiental y económica para los pueblos que lo habitan y la vulnerabilidad de sus ecosistemas, expresaron su firme compromiso de poner en práctica todas las medidas que estén a su alcance, con el fin de restablecer sus capacidades ambientales, de forma tal que permitan su recuperación en beneficio de los pueblos que habitan la zona circunlacustre, y en equilibrio con sus actividades económicas.

- Como muestra de ese compromiso, dispusieron la creación de una Comisión Binacional de alto nivel, que en un plazo de 90 días, deberá definir los lineamientos y acciones para la recuperación ambiental del Lago Titicaca y de su diversidad biológica, con énfasis inicial en el sector del Lago Menor.

- Acordaron encomendar a los Ministerios de Relaciones Exteriores que propongan medidas para fortalecer la institucionalidad y las funciones de la Autoridad Binacional Autónoma del Lago Titicaca, Río Desaguadero, Lago Poopó y Salar de Coipasa (ALT), incluyendo su normatividad interna, de manera que promueva de manera más eficiente la conservación y el uso sostenible de los recursos hídricos e hidrobiológicos de dicho sistema transfronterizo.