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

Eighteenth meeting of the Conference of the Parties
Colombo (Sri Lanka), 23 May – 3 June 2019

CONSIDERATION OF PROPOSALS FOR AMENDMENT OF APPENDICES I AND II

A. Proposal

Include glass frogs of the genera *Hyalinobatrachium, Centrolene, Cochranella,* and *Sachatamia* in Appendix II in accordance with Article II 2a and II 2b of the Convention.

Wild populations of some species of glass frogs have very restricted ranges or are affected by severe habitat loss. This has led to a marked population decline in the wild. Accordingly, they would be elegible for inclusion in Appendix I, in accordance with Article II, paragraph 2a, of the Convention, and pursuant to Annex 2a, paragraph A, of Resolution Conf. 9.24 (Rev. CoP 17). These species meet the criteria due to an observed and/or projected decline in the area and quality of the habitat (A. i.), and because the wild populations are vulnerable to other intrinsic or extrinsic factors (A. v.). (See Annex 1 for a list of species that meet these criteria, and Annex 1.1 for information on the extent of occurrence and area of occupancy of these species.)

According to recent reports, over the past ten years, several species of glass frogs have been regularly traded in the United States of America and Europe. Accordingly, the proposal is to include these species in Appendix II, in accordance with Article II, paragraph 2a of the Convention, and pursuant to Annex 2a, paragraph B of Resolution Conf. 9.24 (Rev. CoP17). (See Annex 2 for a list of species subject to regular trade.)

Further, several species meet the criteria for listing in Appendix II under Article II, paragraph 2b, of the Convention, and pursuant to Annex 2b of Resolution Conf. 9.24 (Rev. CoP 17). (See Annex 3 for the list of species that meet these criteria).

B. Proponents

Costa Rica, El Salvador and Honduras*:

C. Supporting statement

1. Taxonomy

1.1 Class: Amphibia

1.2 Order: Anura

1.3 Familly: Centrolenidae

1.4 Genus, species or subspecies, including author and year:

Centronele spp., *Cochranella* spp., *Hyalinobatrachium* spp., *Sachatamia* spp.

* *The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.*

Annex A of the information document (Inf. Doc.) on the proposal for inclusion of glass frogs lists all species of glass frogs included in this proposal, along with their respective scientific synonyms and common names.

1.5 Scientific synonyms:

1.6 Common names: English:
French:
Spanish:

1.7 Code numbers:

2. Overview

Species of the family Centrolenidae, also known as glass frogs, are nocturnal arboreal species endemic to the American continent. Distribution of this family ranges from the south of Mexico to the north of Argentina, and across the Andes from Venezuela to Bolivia. These frogs rely exclusively on permanent bodies of running water such as streams and waterfalls. Glass frogs occur in lower and montane, wet tropical forests; most species tolerate very low levels of habitat disturbance, and some are able to survive in secondary forests.

The wild populations of several species have naturally restricted ranges. Further, most of the species included in this proposal are currently threatened by habitat fragmentation. Reduced habitat availability has had a severe impact on the stability of wild populations of many species (average extent of occurrence or area of occupancy: 2280 km^2; min 10 km^2; max = 5000 km^2). Like other frog species throughout the world, many species of the family Centrolenidae are also threatened by chytridiomycosis and climate change. However, trade is a further threat to these species.

The 104 species listed in this proposal include four critically endangered species, twelve endangered species, and sixteen vulnerable species, based on their classification in the IUCN Red List (2018) (Inf. Doc. Annex B).

Due to their unique appearance (transparent abdominal skin through which their internal organs are visible) and other biological characteristics (e.g., parental care behaviour), over the past few years, glass frogs have become popular in the international pet trade. Several cases of trade have been documented in the United States of America and Europe involving the four genera covered by the proposal. Between 2004 and 2016, the United States of America imported 1857 glass frogs, half of which were only recorded at the genus level, the main exporting countries being Panama and Costa Rica (US LEMIS Database 2017).

In 2014, Costa Rican officers caught a German smuggler carrying specimens of several species of reptiles and amphibians. The seizure included a number of specimens of *Hyalinobatrachium valerioi* and *Sachatamia ilex* (Altherr, 2014). Traders in various countries such as Germany, Holland, and Spain are advertising these frogs for sale on the Internet.

While a large variety of glass frog species meet the criteria for inclusion in the Appendices, their rarity and the potential impact of international trade would advise including the remaining species of the four genera in CITES Appendix II for look-alike reasons, considering the difficulties in identifying many of the species due to their very similar colour and size morphology (Cisneros-Heredia y McDiarmid, 2007).

3. Species characteristics

3.1 Distribution

Hyalinobatrachium is the most widely distributed genus of glass frog, and its range includes the tropical forests in Central America, the tropical Andes, the Venezuelan coastal range, Tobago, the upper Amazon basin, and the Guiana Shield, at altitudes ranging between sea level and 2500 metres. Twenty of the thirty-six species of Hyalinobatrachium are endemic species: Venezuela has ten endemic species; Colombia, Costa Rica, and French Guiana each have two endemic species; and Brazil, Ecuador, Guyana, and Peru each have one endemic species.

The genus *Centrolene* ranges from the Cordillera de Mérida in Venezuela, across the Andes in Colombia and Ecuador, to the Huancabamba mountains in the north of Peru. It occurs at elevations between 1100 and 3500 metres above sea level. Twenty-nine of the forty-one species of *Centrolene* are endemic: 14 to Colombia; six to Peru, five to Ecuador, three to Venezuela and one to Guyana.

The genus *Cochranella* inhabits lowlands or mountain elevations below 1750 metres above sea level in Central America, the Pacific lowlands, cloud forests in Colombia and Ecuador, the Amazonian slopes in the Bolivian Andes, and the Amazonian lowlands of Ecuador, Peru, and Bolivia. Fifteen of the twenty-four species of the genus *Cochranella* spp. are endemic: Peru and Colombia each have four endemic species; Venezuela, two; and Ecuador and Suriname, one endemic species each.

The genus *Sachatamia* is found in the tropical forest at elevations below 1500 metres above sea level in Central America (Costa Rica, Honduras, Nicaragua, and Panama), and South America (Colombia and Ecuador). One of the three species of *Sachatamia* is endemic to Colombia.

The highest level of endemism is in Colombia (21 species; 32.8 %), followed by Venezuela (16 species; 23.4 %) and Peru (11 species; 17.2 %). See Annex C (Inf. Doc.) for a list of endemic species.

3.2 Habitat

Glass frogs of the genera *Hyalinobatrachium*, *Centrolene*, *Cochranella*, and *Sachatamia* inhabit forests and vegetation along the banks of rivers, streams, waterfalls and/or streams in lowland or montane tropical forests, cloud forests, or moorlands. Most species are found in primary forests, and only 15 species have been reported as being able to cope with the conditions in disturbed habitats or secondary forests, i.e., *Hyalinobatrachium esmeralda, Hyalinobatrachium fleischmanni, H. aureoguttatum, H. pellucidum, H. bergeri, Centrolene bacatum, C. buckleyi, C. condor, C. daidaleum, C. savage, C. robledoi, C. quindianum, Cochranella mache, Cochranella resplendens, and Cochranella guayasamini.* None of the remaining 88 species have been reported in disturbed or secondary forests; some species are reported to inhabit exclusively primary forests (Cisneros-Heredia & McDiarmid, 2007).

3.3 Biological characteristics

All glass frog species are nocturnal and arboreal; they lay their eggs on leaves, moss or branches overhanging streams, or nearby rocks. When the eggs hatch, the tadpoles fall into the water where they complete their development (Ruiz-Carranza & Lynch, 1991). Glass frogs are reported to actively defend their eggs against predators (e.g., Vockenhuber et al., 2008), and significantly higher spawn mortality rates have been documented when guardian males were removed (Delia et al., 2017, and bibliography). The most significant biological characteristics of each genus are described below, as summarized by Cisneros-Heredia & McDiarmid (2007), Guayasamin et al. (2009), and Delia et al. (2017).

Hyalinobatrachium: males usually call from the underside of leaves; and females deposit a layer of eggs on the underside of leaves. Paternal care has been reported in most species, including *Hyalinobatrachium oriental* (Lehtinen & Georgiadis, 2012), *H. fleischmanni, H. chirripoi, H. colymbiphyllum, H. talamancae, H. valerioi,* and *H. vireovittatum*; however, female parental care has been reported for the species *H. Tayrona.*

Centrolene: males usually call from the upper side of leaves; females deposit egg masses on the upper sides of leaves overhanging streams; *C. geckoideum* males call from the walls of waterfalls or near spray zones, and females lay their clutches on rocks; *C. peristictum* males call from the underside of leaves, and females also deposit their eggs on the underside of leaves; *C. antioquiense* males call from the upper side of leaves or twigs, and females lay their eggs on the underpart of leaves. Male parental care has been observed in *C. geckoideum, C. savagei, C. peristictum, C. antioquiense,* and *C. daidaleum.*

Cochranella: males call from the surface of leaves, and females lay their eggs on the upper sides of leaves overhanging streams. Female parental care may occur in *Cochranella resplendens, C. granulosa, C. pulverata, C. spinosa,* and *C. euknemos.*

Sachatamia: males call from the upper surface of leaves or rocks; females deposit pigmented eggs on the upper sides of leaves or rocks. Parental care may be performed by females of *Sachatamia albomaculata*.

3.4 Morphological characteristics

Body size is highly variable in glass frog species: small (<22 mm; e.g., *H. ruedai*); medium-sized (22–35 mm; e.g., *Centrolene acanthidiocephalum, C. grandisonae*); large (35–55 mm; e.g., *C. paezorum)*; giant (> 55 mm; e.g., *C. geckoideum*). Sexual dimorphism is evident in most centrolenids, and females have a longer snout-vent length (SVL) than males, the only known exception being *C. geckoideum*, where males are larger than females (Guayasamin et al., 2009).

Species of the family Centrolenidae have been reclassified several times due to the fact that some groups are polyphyletic, making the taxonomic classification of this family very difficult. In this proposal, the authors used the morphological descriptions established by Cisneros & McDiarmid (2007), and Guayasamin et al. (2009) for each of the genera proposed for inclusion.

Hyalinobatrachium: humeral spine absent, digestive tract and bulbous liver covered by white peritoneum, completely transparent ventral parietal peritoneum, white bones, green in *H. mesai* and *H. taylori*, white or cream dorsal colouring, males lack conspicuous dorsal spinules during the mating season, small nuptial pad on inner margin of thumb, and absent dentigerous process of vomer.

Centrolene: large humeral spines present on males of all species except *C. daidaleum* and *C. salvage* in which humeral spine is absent. Tri-, tetra-, or pentalobed liver, covered by a transparent hepatic peritoneum; white, anteriorly transparent ventral parietal peritoneum. Bone colour varies from pale to bright green. Dorsum of males generally covered by spinules during the mating season (spinules not visible on *C. antioquiense, C. hybrida*). Vomerine teeth absent in most species of *Centrolene* (teeth present in *C. condor, C. daidaleum, C. geckoideum, C. savagei,* and *C. solitaria).*

Cochranella: Absence of humeral spine (small spine present in *C. litoralis*), white digestive tract (translucent in *C. nola*), lobed liver covered by a transparent hepatic peritoneum, anteriorly transparent ventral parietal peritoneum, moderate to extensive hand webbing between fingers III and IV, green bones, lavender dorsum, with or without spots, dentigerous process of vomer and vomerine teeth present (absent in *C. litoralis*).

Sachatamia: humeral spine present (*S. ilex*) or absent (*S. albomaculata, S. Punctulata)*, lobed liver covered by a transparent hepatic peritoneum; translucent digestive tract; white, transparent anterior ventral parietal peritoneum; green bones; lavender dorsum, with or without spots; presence of dentigerous process of vomer and teeth.

3.5 Role of the species in its ecosystem

Glass frogs are an important element in stream food webs, and have an impact on food chain dynamics. Although glass frog tadpoles are microbiotic feeders, adult specimens shift to a terrestrial diet based on insects (Verburg et al., 2007) and, accordingly, form part of the functional ecological groups that keep insect populations under control. Glass frogs are known to have a wide variety of predators, including birds such as quetzals (Quiroga-Carmona & Naveda-Rodríguez, 2014), snakes, bats, and spiders (Delia et al., 2010 and publications). Glass frog eggs are eaten by crabs or predatory insects such as crickets and wasps (Delia et al., 2010; Vockenhuber et al., 2008).

4. <u>Status and trends</u>

4.1 Habitat trends

Over the past few decades, forest loss in Central and South America has reached over nine per cent, which is significantly higher than the world average of 5.2 % (Manners & Varela-Ortega, 2017). The main cause of forest loss in these regions is the expansion of commercial agriculture, which accounts for 70 % of the total (FAO, 2016). This has a very heavy impact on the populations of glass frogs, considering that most species rely on undisturbed forests and very few are able to cope with the conditions in disturbed and secondary forests. As a result, the habitat of most species of the genera *Hyalinobatrachium, Centrolene, Cochranella*, and *Sachatamia* has declined significantly throughout the species' ranges (e.g., Coloma et al. 2010; Solis et al. 2010a, b).

Recent research indicates that the habitats of only four species are stable: *Hyalinobatrachium crucifasciatum, H. eccentricum, H. nouraguense,* and *Cochranella riveroi*. The habitat of *Centrolene charapita, C. híbrido,* and *C. notostictum* is known to be an almost intact forest.

The habitat of *Cochranella euknemos* is in decline in Costa Rica, and in the case of *Sachatamia albomaculata* and *S. ilex,* habitat loss is either highly localized or is not extended throughout the range.

The habitat of *Centrolene robledoi* is fragmented throughout its range; forest patches are unconnected, which means that this species is wholly restricted to a microterritory.

4.2 Population size

Data on the population size of the various species of glass frogs is very limited. However, some species are reported as abundant: *Hyalinobatrachium talamancae, H. taylori, Sachatamia albomaculata, and Centrolene notostictum.* In fact, the population of *Centrolene notostictum* is reported as presumably large (Rueda & Ramírez-Pinilla, 2004), while the population of *Centrolene sabini* is described as extremely small (IUCN SSC Amphbian Specialist Group, 2017).

4.3 Population structure

There is very little information available on the population structure of glass frogs. However, the trait most commonly described in studies on the species' ecology and life history traits is clutch size. This trait is reported as a range of clutch sizes, average clutch size with or without standard deviation, or merely as an observed value.

Average clutch sizes recorded for species of *Hyalinobatrachium*: *H. valerioi*, 29 eggs; *H. orientale*, 28.0 ± 5.3 eggs; and *H. fleischmanni*, 23 eggs (range 14–30) (Mangold et al., 2015; Nokhbatolfoghahai, 2015; Salazar-Nicholls & Del Pino, 2015).

Average clutch size of species of the genus *Centrolene*: *Centrolene daidaleum*, 21.8 ± 6.7 eggs (Cardozo-Urdaneta & Searis, 2012); *Centrolene prosoblepon*, 35.4 ± 4.79 eggs (Basto-Riascos et al., 2017); and *Centrolene salvage*, ranges from 15 to 27 eggs (Vargas-Salinas et al., 2014).

Average clutch size of species of the genus *Cochranella*: *C. granulosa* and *C. pulverata,* 81.48 ± 13.59 and 59.18 ± 7.5 eggs, respectively (Delia et al., 2017); *C. mache*, average clutch size of an observed female is reported as 30 eggs (Ortega-Andrade et al., 2013).

In the case of the genus *Sachatamia*, the only information available refers to a study on captive-bred *S. Albomaculata,* according to which average clutch size ranges from 28 to 60 eggs (Hill et al., 2012).

With regard to other population structure parameters, a male-biased sex ratio was found (Mangold et al., 2015).

4.4 Population trends

According to the status shown in the IUCN Red List for species of *Hyalinobatrachium, Centrolene, Cochranella,* and *Sachatamia*, population trends are mostly unknown, 30 species are in decline, and only 17 are stable. Specific estimated historic and/or projected declines are reported for only a few species.

The following species are in decline: *Hyalinobatrachium esmeralda, H. aureoguttatum, H. fragile, H. ibama, H. orientale, H. valerioi, H. fleischmanni, H. guairarepanense* (even in pristine habitats), *H. pallidum* (almost extinct Andean population), *Centrolene daidaleum, C. gemmatum, C. hesperium, C. lynchi, C. peristictum, C. pipilatum, C. savagei, C. balionota, C. quindianum, C. petrophilum, C. azulae, C. ballux* (drastic population decline, estimated at more than 80 % over the past three generations), *C. buckleyi* (projected decline of more than 30 % over the next 10 years, mainly in the Ecuatorian range), *C. geckoideum* (estimated decline of more than 30 % over the next 10 years), *C. heloderma* (estimated decline of more than 80 % over the past three generations), *Cochranella euknemos, Cochranella nola, Cochranella megista, Cochranella xanthocheridia, Sachatamia ilex,* and *S. punctulata.*

The population status of the following species is stable: *Hyalinobatrachium bergeri, H. colymbiphyllum, H. ruedai, H. talamancae, H. taylori, H. chirripoi, H. mondolfii, H. crurifasciatum, H. nouraguense, Centrolene hybrida, C. notostictum, C. venezuelense, C. prosoblepon* (stable in Panama; McCaffery & Lips, 2013), *Cochranella granulosa, Cochranella riveroi, Sachatamia spinose,* and *S. albomaculata*.

Those species for which population trends are unknown include some known or suspected rare species that would be more vulnerable to decline, namely: *Hyalinobatrachium munozorum, Centrolene solitaria, C. puyoense, C. sabini, C. sanchezi, C. altitudinale, Cochranella phryxa, Cochranella resplendens, Cochranella mache* and *Sachatamia orejuela.*

4.5 Geographic trends

The main factor influencing the geographic trends of glass frog species is climate change, which is affecting the humid zones of mountaintops. Also, climate change is reducing humidity in the range of altitudes at which the species occurs and could cause a shift in population distribution. The effects of climate change are usually more acute in high altitude forests. Based on reported trends in the IUCN Red List of Threatened Species, the following species are particularly sensitive to this process, and it is expected that their ranges will change: *Centrolene lynchi, C. peristictum, C. ballux, C. heloderma, C. balionota , C. scirtetes,* and *C. geckoideum*.

5. <u>Threats</u>

The main threat to grass frog populations is habitat loss and fragmentation due to the expansion of the agricultural frontier to accommodate smallholdings, agro-industrial farming, livestock farming, and illegal plantings. Habitat loss has also increased as a result of logging and timber extraction, mining, human settlements, and hydroelectric schemes (Furlani et al., 2009; La Marca & Señaris, 2004a; Ortega-Andrade et al., 2013). Water pollution from herbicides, pesticides, oil spills, and illegal crop fumigation is also a significant threat to glass frogs (Castro et al., 2010; IUCN SSC Amphibian Specialist Group, 2017a), as is Chytridiomycosis (Voyles et al., 2018). Climate change is a further threat to the population stability of glass frogs, just as it is to all amphibians. Climate change affects the cloud layer at mountain peaks, reducing humidity in the species' altitudinal range. These effects generally lead to fragmentation of the species' habitat (Ortega-Andrade et al., 2013).

Other threats are landslides, which might be considered a secondary effect of habitat loss and climate change. The result is a loss of soil structure, and increased rainfall (La Marca y Señaris, 2004a; IUCN SSC Amphibian Specialist Group, 2017b). Finally, the report states that the introduction of alien predator fish species has become a significant threat to certain species such as *Centrolene lynchi, C. peristictum* (Coloma et al., 2004 a, b), and *C. ballux* (Bolivar et al., 2004). The recent surge in the demand for these attractive, see-through frogs in the international pet trade, as described in section 6 below, is now a further threat to these species.

6. <u>Utilization and trade</u>

6.1 National utilization

There is no available information on the utilization of glass frogs in the countries where these taxa occur.

6.2 Legal trade

Given that glass frogs are protected at a national level in many range States, it is difficult to determine the legal source of specimens found in international trade. Many specimens in trade are obtained from illegal sources (AFP, 2017; Fendt, 2014) – see point 6.4.

The United States database, LEMIS, reported imports of a total of 2138 specimens between 2004 and 2016, comprising 891 specimens of *Centrolene ilex* (referred to herein as *Sachatamia ilex*), 178 specimens of *Cochranella granulosa*, 288 specimens of *Centrolene prosoblepon*, 194 specimens of *Hyalinobatrachium fleischmanni*, 41 specimens of *Cochranella spinosa*, 16 specimens of *Hyalinobatrachium colymbiphyllum,* and eight specimens of *H. vireovittatum*. The database also reported other specimens that were not identified at the species level, namely: 355 *Centrolene spp*., 222 *Hyalinobatrachium spp*., and 155 *Cochranella spp*. This database reports peak imports in 2011, when 374 specimens were imported. The main exporter is Panama with 1023 specimens, followed by Costa Rica with 518 specimens, and Suriname with 167 specimens during the period of reference. Further, the United States database, LEMIS, had records of captive-bred specimens sourced from outside the species' range (91 from Canada, 68 from the United States, and 4 from Germany, and also from Costa Rica, Ecuador, and Panama (one specimen from each country). Specimens of *H. valerioi* sell for around 150 in the United States (see Annex D (Inf. Doc.) for original data).

In Europe, glass frogs are regularly sold on the Internet, and also at European reptile and amphibian fairs, particularly Terraristika, which is held in Hamm (Germany) several times a year. Traders involved are from Austria, the Czech Republic, Germany, the Netherlands, Spain, and the United Kingdom. Prices of glass frogs vary, ranging from 45 to 175 euros. For example, *Hyalinobatrachium valerioi* and *Teratohyla pulverata* (referred to herein as *Cochranella pulverata*) were on sale in November and December 2017, and again in May and June 2018 (see Annex 8). In October 2017, the online platform www.terraristik.com was also offering glass frogs of the species *Hyalinobatrachium valerioi*. As in the case of Germany and the Netherlands, this website is also used to offer samples for future events. Specimens of *Hyalinobatrachium fleischmanni* were on offer at 45 euros each, for sale at the Terraria Fair in Houten, the Netherlands (http://vhm-events.nl/index.php/nl/terraria-2018/terraria-houten-september-2018).

In Spain, *Hyalinobatrachium valerioi* is advertised on the Internet at 89 euros per specimen (www.harkitoreptile.com/en/en), and *H. fleischmanni* at 110 euros per male/female pair. Following the example of Germany and the Netherlands, Spanish traders are also using www.terraristik.com to announce that *H. valerioi* will be on sale at Expoterraria in Madrid.

6.3 Parts and derivatives in trade

Only live animals are known to be traded internationally.

6.4 Illegal trade

The majority of countries in which glass frogs occur prohibit the trade of specimens of all species, regardless of whether the species is included in the IUCN Red List or not. In some countries (e.g., Colombia, Costa Rica, and Panama), trade is permitted provided the appropriate permits are obtained. In the light of a number of smuggling incidents, and the dubious information shown in online advertising, as described in point 6.2, it is evident that an unknown number of specimens were obtained illegally, thus infringing domestic laws in the range States.

In 2017, a Dutch trader was advertising a large quantity of specimens of *Teratohyla spinosa* (referred to herein as *Cochranella spinosa*) on the website www.terraristik.com, specifying that they were "ranched" specimens from Costa Rica (see Annex 8). However, the Costa Rican authorities confirmed that there were no breeding establishments registered for that species, and that any export of specimens taken from the wild was illegal (pers. M; CITES Management Authority of Costa Rica, 2017).

In 2014, a German national was caught in Costa Rica trying to smuggle 438 specimens of frogs, lizards, and snakes to Germany, including 18 *Hyalinobatrachium valerioi* and 20 *Sachatamia ilex*. The authorities described the case as "the largest wildlife seizure in 20 years" (Fendt, 2014). Only a few days before the seizure was made, the smuggler's business partner had advertised several species of glass frogs on the website www.terraristik.com for sale at the Terraristika Fair in Hamm, Germany. The following species were advertised on the Internet: *Sachatamia ilex, Hyalinobatrachium valerioi, Sachatamia albomaculata, Cochranella granulosa, Cochranella euknemos, Teratohyla spinosa (*referred to herein as *Cochranella spinosa),* and *Teratohyla pulveratum* (referred to herein as *Cochranella pulverata*) (Altherr, 2014; see also Annex E, Inf. Doc.).

6.5 Actual or potential trade impacts

As previously indicated, the habitat of only seven species (*Hyalinobatrachium crurifasciatum, Hyalinobatrachium eccentricum, Hyalinobatrachium nouraguense, Cochranella riveroi, Centrolene charapita, Centrolene hybrida,* and *Centrolene notostictum*) is known to be stable or undisturbed. In the case of *Cochranella riveroi*, this is a rare species, and is therefore still classified as Vulnerable in the IUCN Red List of threatened species (La Marca & Señaris, 2004b). Habitats of the remaining species of the genera *Hyalinobatrachium, Centrolene, Cochranella,* and *Sachatamia* are affected by deterioriation and degradation.

While habitat degradation, climate change, and the chytrid fungus are the main threats to glass frogs (von May et al., 2008; Mendoza & Arita, 2014), all other secondary threats further increase the negative pressure on wild populations of glass frog species. In recent years, a number of articles in the media comparing glass frogs to the popular "Kermit the Frog" (Martins, 2015) have aroused the interest of society and traders in these species. The IUCN assessed the status of most glass frogs almost ten years ago; at that time, trade was not mentioned as a threat (Coloma et al., 2010; Guayasamin, 2010;

Solis et al., 2010 a, b). However, the data for imports to the United States, as well as online advertising in Europe, indicate that glass frogs have become a target for the international exotic pet trade.

7. Legal instruments

7.1 National

Annex 9 shows a summary of the national legislation that regulates the breeding, transportation, trade, and export of wildlife specimens in most of the countries in Central and South America in which glass frogs occur.

Brazil: Under Art. 29 of Brazil's Environmental Crimes Act (Law 9,605 of 12th February 1998), "the killing, persecution, hunting, capture, or utilization of specimens of wild fauna is a crime".

Colombia: Article 56 of Decree 1608 pertaining to Law 23 of 1973 prohibits the hunting of wild fauna for commercial purposes without an appropriate permit. Article 60 provides the requirements for obtaining a permit to hunt and trade wild specimens.

Costa Rica: Wild species are protected by Wildlife Conservation Law No. 7317 of 1992 and implementing Regulations 40548, which prohibit the offtake of wild animals from their natural habitat. Article 18 prohibits the export of any endangered species, and Article 51 establishes the permit requirements to trade in wild animals.

Ecuador: Articles 80 and 82 of the Law on Conservation of Forests and Areas provide the requirements for authorization to market wild fauna, including a penalty of five times the minimum wage for trading without the required permit.

El Salvador: Article 8 of Decree 844 pertaining to the Wildlife Conservation Law establishes the regulations for marketing and exporting wild fauna, and also includes permit requirements.

Guatemala: Articles 26 and 27 of the Environment Law affords protection to endangered species; under Article 82, any form of trade in wild fauna is illegal. Only specimens obtained from authorized captive-breeding operations and which meet the requirements established by law, may be exported. Amphibians are protected under Articles 64 and 97 of the Constitution of the Republic of Guatemala and the Law on Protected Areas (Decree 4-89), according to which exporters should be registered and obtain permits.

Honduras: Wildlife Law, Decree 98/07, Article 98/07, prohibits the capture of endangered species. Hunting of specimens for commercial purposes is subject to authorization by local authorities and compliance with the permit requirements applied by the National Institute for Forest Conservation and Development, Protected Areas and Wildlife (ICF).

Mexico: Article 54 (General Law of Ecological Balance and Environmental Protection) provides the requirements for transportation of live specimens; Articles 53 and 54 establish trade permit requirements. Under Article 55, exports are permitted for scientific purposes.

Nicaragua: Decree 8-98 establishes the requirements to obtain a licence for captive-breeding. Trade in species is only allowed for specimens of *Oophaga pumilio* acquired from one of the four operations that are licensed to export wild fauna.

Panama: Resolution 17.7 establishes the guidelines for trade in captive-bred specimens. Article 15 of the Wildlife Law prohibits the transportation of wildlife, unless authorized and in compliance with the requirements of the National Directorate for Protected Areas and Wildlife. Export permit requirements are provided under Article 37.

Peru: Law 29763 prohibits the acquisition, marketing, and export of wild fauna resources, unless duly authorized.

Further, Ecuador and Colombia have a Binational Strategy in place to pursue joint efforts with the supervisory body for the purpose of monitoring and controlling illegal trade, and to improve the management of seized specimens (Ministry for the Environment, Ecuador, 2015).

7.2 International

These species are not protected under any international law.

8. Species management

8.1 Management measures

There are no management measures in place for any of these species.

8.2 Population monitoring

No known monitoring systems.

8.3 Control measures

8.3.1 International

The species, and their classification in the IUCN Red List of threatened species, are listed in Annex 1.1 of this proposal and Annex B of the Information Document.

8.3.2 Domestic

Removal of species classified in the IUCN Red List as "endangered" is prohibited in all countries, and a permit is required by each country for species that are not endangered.

8.4 Captive breeding and artificial propagation

Almost 7.1 % of specimens imported to the United States of America between 2004 and 2016 were declared as captive-bred. The main exporters of captive-bred specimens were Canada (91 specimens) and the United States of America (68 specimens). Germany (4), Costa Rica (1), Ecuador (1), and Panama (1) were also reported to export specimens declared as captive-bred (US LEMIS Database 2017). According to press reports, farms in Ecuador are breeding *Hyalinobatrachium aureoguttatum* in captivity for export (AFP 2017). A further example is the CRARC Lab (Costa Rica Amphibian Research Centre), which is located in a private reserve with captive-breeding facilities. The frogs are sold through Understory Enterprise (www.understoryenterprises.com) and can be shipped to any country.

8.5 Habitat conservation

The habitat of most glass frog species is not protected by any type of conservation area. Only the habitat of 17 of the 36 species of *Hyalinobatrachium* is protected; the range of 25 of the 41 species of *Centrolene* is wholly or partially within the confines of a protected area; the habitat of 10 of the 24 species of *Cochranella* is protected; and three of the four species of *Sachatamia* are located within protected areas.

The range of the following species is not limited to protected areas: *Hyalinobatrachium esmeralda, H. pallidum, Centrolene petrophilum, C. hesperium, C. gemmatum, Cochranella balionota, Cochranella balionota, Cochranella armata, Cochranella saxiscandens, Cochranella megacheira,* and *Sachatamia punctulata*. All these species, except *Cochranella balionota* and *Cochranella megacheira*, are endemic species.

9. Information on similar species

The taxonomic classification of glass frogs is the result of a very complex combination of 18 morphological characteristics and 7 ecological characteristics (Cisneros-Heredia & McDiarmid, 2007). Several species from different genera may share the same attributes in the case of more obvious characteristics such as size, dorsal colouring, completely or partially transparent peritoneum, and humeral spine, which makes it extremely difficult for non-experts to identify and distinguish species of *Hyalinobatrachium, Centrolene, Cochranella,* and *Sachatamia*.

10. Consultations

Twelve range States were consulted: Belize, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, and Venezuela. Confirmation was received from El Salvador, Honduras, and Peru, as co-authors of the proposal to include glass frogs of the genera Hyalinobatrachium, Centrolene, Cochranella, and Sachatamia in Appendix II, in accordance with Articles II 2a and II 2b of the Convention (consultations are listed in Annex 4).

Also, at an international level, a number of NGOs were consulted by the Costa Rican CITES Management Authority: Prowildlife, Defenders of Wildlife, Wildlife Conservation Society, Human Society International, Costa Rica por Siempre, and Conservation International. At a national level, a workshop was organized for key actors in wildlife (in this case, amphibians) management, conservation, and traceability processes, including Academia, NGOs, the Ministry of Public Security, amphibian experts and researchers, Prosecutors for the Environment, Interpol, Customs, the Ministry for the Environment and Energy, National Conservation Areas System, and National Animal Health Service, among others.

11. Additional remarks

The difficulty in identifying and distinguishing species of *Hyalinobatrachium, Centrolene, Cochranella,* and *Sachatamia* represents a high risk for species as yet untraded. Further, considering conservation of these species from a global perspective, CITES-listing of the four genera will significantly reduce pressure on wild populations of glass frogs that are already threatened by habitat fragmentation, climate change, and chytridiomycosis.

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ANNEXES

Annex 1: List of species proposed for inclusion in Appendix II in accordance with Article II, paragraph 2a, of the Convention, and pursuant to Annex 2a, paragraph A, of Resolution Conf. 9.24 (Rev. CoP 17)

Centrolene audax	Lynch & Duellman, 1973
Centrolene azulae	Flores & McDiarmid, 1989
Centrolene ballux	Duellman & Burrowes, 1989
Centrolene lynchi	Duellman, 1980
Centrolene peristictum	Lynch & Duellman, 1973
Centrolene pipilatum	Lynch & Duellman, 1973
Centrolene sabini	Catenazzi et al., 2012
Cochranella armata	Lynch & Ruíz-Carranza, 1996
Cochranella balionota	Duellman, 1981
Cochranella mache	Guayasamin & Bonaccorso, 2004
Cochranella megacheira	Lynch & Duellman, 1973
Cochranella megistra	Rivero, 1985
Cochranella saxiscandens	Duellman & Schulte, 1993
Hyalinobatrachium esmeralda	Ruíz-Carranza & Lynch, 1998
Hyalinobatrachium guairarepanense	Señaris, 2001
Hyalinobatrachium pallidum	Rivero, 1985
Hyalinobatrachium pellucidum	Lynch & Duellman, 1973

Annex 1.1: Extent of Occurrence (EOO) and area of occupancy (AOO) of species proposed for inclusion in Appendix II in accordance with Article II, paragraph 2a of the Convention, and pursuant to Annex 2a, paragraph A, of Resolution Conf. 9.24 (Rev. CoP 17):

Species	EOO (Km^2)	AOO (Km^2)	IUCN status
Centrolene audax		500	Endangered
Centrolene azulae	5000	500	Endangered
Centrolene ballux		10	Critically endangered
Centrolene lynchi		500	Endangered
Centrolene peristictum		2000	Vulnerable

Centrolene pipilatum	5000	500	Endangered
Centrolene sabini	10		Vulnerable
Cochranella armata	51		Critically endangered
Cochranella balionota		2000	Vulnerable
Cochranella mache	5000		Endangered
Cochranella megacheira		500	Endangered
Cochranella megistra	4391		Endangered
Cochranella saxiscandens	1588		Endangered
Hyalinobatrachium esmeralda	4622		Endangered
Hyalinobatrachium guairarepanense	5000		Endangered
Hyalinobatrachium pallidum	5000		Endangered
Hyalinobatrachium pellucidum	1148		Near threatened

Annex 2: List of species proposed for inclusion in Appendix II in accordance with Article II, paragraph 2a, and Annex 2a, paragraph B, of Resolution Conf. 9.24 (Rev. CoP17):

Centrolene prosoblepon	Boettger, 1892
Cochranella euknemos	Savage & Starrett, 1967
Cochranella granulosa	Taylor, 1949
Cochranella pulverata	Peters, 1873
Cochranella spinosa	Taylor, 1949
Hyalinobatrachium colymbiphyllum	Taylor, 1949
Hyalinobatrachium fleischmanni	Boettger, 1893
Hyalinobatrachium valerioi	Dunn, 1931
Hyalinobatrachium vireovittatum	Starret & Savage, 1973
Sachatamia albomaculata	Taylor, 1949
Sachatamia ilex	Savage, 1967

Annex 3: List of species proposed for inclusion in Appendix II, in accordance with Article II, paragraph 2b, and Annex 2b of Resolution Conf. 9.24 (Rev. CoP 17):

Centrolene acanthidiocephalum	Ruíz-Carranza and & Lynch, 1989
Centrolene altitudinale	Rivero, 1968

Centrolene antioquiense	Noble, 1920
Centrolene bacatum	Wild, 1994
Centrolene buckleyi	Boulenger, 1882
Centrolene charapita	Twomey et al., 2014
Centrolene condor	Cisneros-Heredia & Morales-Mite, 2008
Centrolene daidaleum	Ruíz-Carranza & Lynch, 1991
Centrolene durrellorum	Cisneros-Heredia, 2007
Centrolene geckoideum	Jiménez de la Espada, 1872
Centrolene gemmatum	Flores, 1985
Centrolene guanacarum	Ruíz-Carranza & Lynch, 1995
Centrolene heloderma	Duellman, 1981
Centrolene hesperium	Cadle & McDiarmid, 1990
Centrolene huilense	Ruíz-Carranza & Lynch, 1995
Centrolene hybrida	Ruíz-Carranza & Lynch, 1991
Centrolene lema	Duellman & Señaris, 2003
Centrolene lemniscatum	Duellman & Schulte, 1993
Centrolene medemi	Cochran & Goin, 1970
Centrolene muelleri	Duellman & Schulte, 1993
Centrolene notostictum	Ruíz-Carranza & Lynch, 1991
Centrolene paezorum	Ruíz-Carranza, et al., 1986
Centrolene petrophilum	Ruíz-Carranza & Lynch, 1991
Centrolene quindianum	Ruíz-Carranza & Lynch, 1995
Centrolene robledoi	Ruíz-Carranza & Lynch, 1995
Centrolene sanchezi	Ruíz-Carranza &Lynch, 1991
Centrolene savagei	Ruíz-Carranza & Lynch, 1991
Centrolene scirtetes	Duellman & Burrowes, 1989
Centrolene solitaria	Ruíz-Carranza & Lynch, 1991
Centrolene tayrona	Ruíz-Carranza & Lynch, 1991

Centrolene venezuelense	Rivero, 1968
Cochranella adenocheira	Harvey & Noonan, 2005
Cochranella duidaeana	Ayarzaguena, 1992
Cochranella erminea	Torres-Gastello et al. 2007
Cochranella euhystrix	Cadle & McDiarmid, 1990
Cochranella geijskesi	Goin, 1966
Cochranella guayasamini	Twomey et al., 2014
Cochranella litoralis	Ruíz-Carranza & Lynch, 1996
Cochranella nola	Harvey, 1996
Cochranella phryxa	Aguayo & Harvey, 2006
Cochranella ramirezi	Ruíz-Carranza & Lynch, 1991
Cochranella resplendens	Lynch & Duellman, 1973
Cochranella ritae	Lutz, 1952
Cochranella riveroi	Ayarzaguena, 1992
Cochranella xanthocheridia	Ruíz-Carranza & Lynch, 1995
Hyalinobatrachium anachoretus	Twomey et al., 2014
Hyalinobatrachium aureoguttatum	Barrera-Rodriguez & Ruíz-Carranza, 1989
Hyalinobatrachium bergeri	Cannatella, 1980
Hyalinobatrachium cappellei	Van Lidth de Jeude, 1904
Hyalinobatrachium carlesvilai	Castroviejo-Fischer et al., 2009
Hyalinobatrachium chirripoi	Taylor, 1958
Hyalinobatrachium crurifasciatum	Myers & Donnelly, 1997
Hyalinobatrachium dianae	Kubicki et al., 2015
Hyalinobatrachium duranti	Rivero, 1985
Hyalinobatrachium eccentricum	Myers & Donelly, 2001
Hyalinobatrachium fragile	Rivero, 1985
Hyalinobatrachium iaspidiense	Ayarzagüena, 1992
Hyalinobatrachium ibama	Ruíz-Carranza & Lynch, 1998

Hyalinobatrachium ignioculus	Noonan & Bonett, 2003
Hyalinobatrachium kawense	Castroviejo-Fischer et al., 2011
Hyalinobatrachium mesai	Barrio-Amorós & Brewer-Carias, 2008
Hyalinobatrachium mondolfii	Señaris & Ayarzagüena, 2001
Hyalinobatrachium muiraquitan	Oliveira & Hernández-Ruz, 2017
Hyalinobatrachium munozorum	Lynch & Duellman, 1973
Hyalinobatrachium nouraguense	Lescure & Marty, 2000
Hyalinobatrachium orientale	Rivero, 1968
Hyalinobatrachium orocostale	Rivero, 1968
Hyalinobatrachium ruedai	Ruíz-Carranza & Lynch, 1998
Hyalinobatrachium talamancae	Taylor, 1952
Hyalinobatrachium tatayoi	Castroviejo-Fisher et al., 2007
Hyalinobatrachium taylori	Goin, 1968
Hyalinobatrachium tricolor	Catroviejo-Fischer et al., 2011
Hyalinobatrachium yaku	Guayasamin et al., 2017
Sachatamia electrops	Rada et al., 2017
Sachatamia orejuela	Duellman & Burrowes, 1989
Sachatamia punctulata	Ruíz-Carranza & Lynch, 1995

Annex 4: Consultations with range St

Brazil

Colombia

Ecuador

El Salvador

Guatemala

Honduras

Mexico

Nicaragua

Panama

Peru

Venezuela.

Co-authors

Honduras

Peru

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