On the systematics of the harlequin frogs (Amphibia: Bufonidae: *Atelopus*) from Amazonia. III: A new, remarkably dimorphic species from the Cordillera Azul, Peru

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Abstract

A new species of harlequin frog (genus *Atelopus*) is described from the Cordillera Azul, an Amazonian pre-cordillera of the Andes in Peru. It is the second member of the genus known from this region, bringing the total number of *Atelopus* species known from Amazonian Peru to nine. The new species is remarkable in that females are not only larger than males, but also differ in skin texture (females have almost smooth skin; males have warts and spiculae). It is similar to *A. erythropus* und *A. nepiozomus* and differs from these mainly in skin texture (the only known specimen of *A. erythropus* has minute spiculae, no warts; in *A. nepiozomus* both sexes have warty skin) and dorsal coloration (uniform olive in the new species versus uniform brown or green with brownish blotches in the two other species).

Key words: Anura: *Atelopus dimorphus* sp. nov.; sexual dimorphism; Peru.

1 Introduction

Harlequin frogs of the genus *Atelopus* are a highly diverse group of Neotropical bufonids with respect to species richness (LÖTTERS 1996). Increased efforts in *Atelopus* alpha-systematics revealed that complexes of species hide behind some of the actually available names. Among them, taxa sometimes are more phenetic than phylogenetic relatives (cf. COLOMA 1997). An example is *A. spumarius* COPE, 1871, which has been suggested to range over almost the entire Amazon basin and adjacent areas in the Guianas in the northeast and the Andean versant in the west. LÖTTERS et al. (2002a, b) figured out that *A. spumarius* comprises a complex of species and that the name *A. spumarius* sensu stricto should probably be applied to populations in the upper Amazon basin only. In the same general area and, several similar taxa have been identified, *A. andinus* RIVERO, 1968, *A. palmatus* ANDERSSON, 1945, *A. planispina* JIMÉNEZ DE LA ESPADA, 1875, *A. pulcher* (BOULENGER, 1882), *A. reticulatus* LÖTTERS, HAAS, SCHICK & BÖHME, 2002, *A. seminiferus* COPE, 1874 and *A. siranus* LÖTTERS & HENZL, 2000. The central Amazon basin is inhabited by *A. spumarius* sensu lato (cf. LÖTTERS et al. 2002 b). From the eastern Andean versant the following species are known: *A. boulengeri* PERRACA, 1904, *A. erythropus* BOULENGER, 1903, *A. halihelos* PETERS, 1973, *A. minutulus* RUÍZ-CARRANZA & HERNÁNDEZ-CAMACHO & ARDILA, 1988, *A. nepiozomus* PETERS, 1973, *A. petriruizi* ARDILA-ROBAYO, "1999" 2000 and *A. tricolor* BOULENGER 1902 (cf. ARDILA-ROBAYO 2000, FROST 2002, LÖTTERS et al. 2002b).

As typical for bufonids, all of the approximately 75 described *Atelopus* species (ARDILA-ROBAYO et al. 2002, FROST 2002, LÖTTERS et al. 2002b) display sexual dimorphism. Females are larger than males and occasionally the sexes differ in proportions, colour pattern and skin texture (e. g. LÖTTERS 1996, PETERS 1973, COLOMA et al. 2000). During revision of the *Atelopus* collection in the Natural History Museum, The University of Kansas, Lawrence (KU), a series of harlequin frogs from the Cordillera Azul, an Amazonian pre-cordillera of the Peruvian Andes, came to my attention. Females in this series are larger than males and almost lack warts, while males have warty skin. Because all other characters of the specimens of this series coincide, I

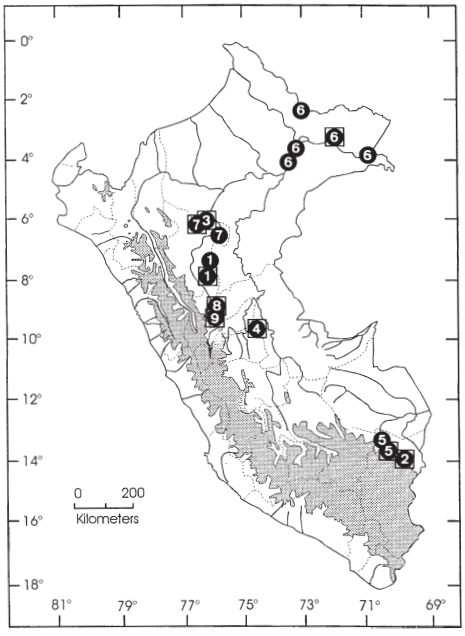

Fig. 1. Map of Peru with major river systems and areas above 3000 m above sea level showing known distributions of species of *Atelopus* from the Amazon basin and the eastern Andean versant. 1 = *Atelopus andinus;* 2 = *A. erythropus;* 3 = *A. seminiferus;* 4 = *A. siranus;* 5 = *A. tricolor;* 6 = *A. spumarius* sensu stricto; 7 = *A. pulcher;* 8 = *A. reticulatus;* 9 = *A. dimorphus.* Localities are as listed in the Appendix and, in addition, correspond to unpublished data in the case of *A. spumarius* sensu stricto. Type localities are surrounded by squares. Map after an original by E. LEHR.

Karte von Peru mit den Haupt-Flusssystemen und Bereichen über 3000 m über dem Meeresspiegel sowie den bekannten Verbreitungen der *Atelopus*-Arten aus Amazonien und vom östlichen Andenabhang. 1 = *Atelopus andinus;* 2 = *A. erythropus;* 3 = *A. seminiferus;* 4 = *A. siranus;* 5 = *A. tricolor;* 6 = *A. spumarius* sensu stricto; 7 = *A. pulcher;* 8 = *A. reticulatus;* 9 = *A. dimorphus.* Fundorte sind im Appendix aufgeführt und, im Falle von *A. spumarius* sensu stricto, teilweise auch unpubliziert. Typuslokalitäten sind mit Quadraten umrandet. Karte nach einem Original von E. LEHR.

consider them as representatives of the same – remarkably dimorphic – species. Since this taxon is not assignable to any of the available names, it is described here, bringing the number of named *Atelopus* species from Amazonian Peru to nine (Fig. 1).

2 Material and Methods

Material examined is listed in the Appendix and is deposited at AMNH (American Museum of Natural History, New York), BM (British Museum, London), CBF (Colección Boliviana de Fauna, La Paz), KU, ICN (Instituto de Ciencias Naturales, Museo de Historia Natural, Universidad Nacional de Colombia, Santafé de Bogotá), MNHNP (Muséum national d'Histoire Naturelle, Paris), NHMW (Naturhistorisches Museum Wien), ZFMK (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn).

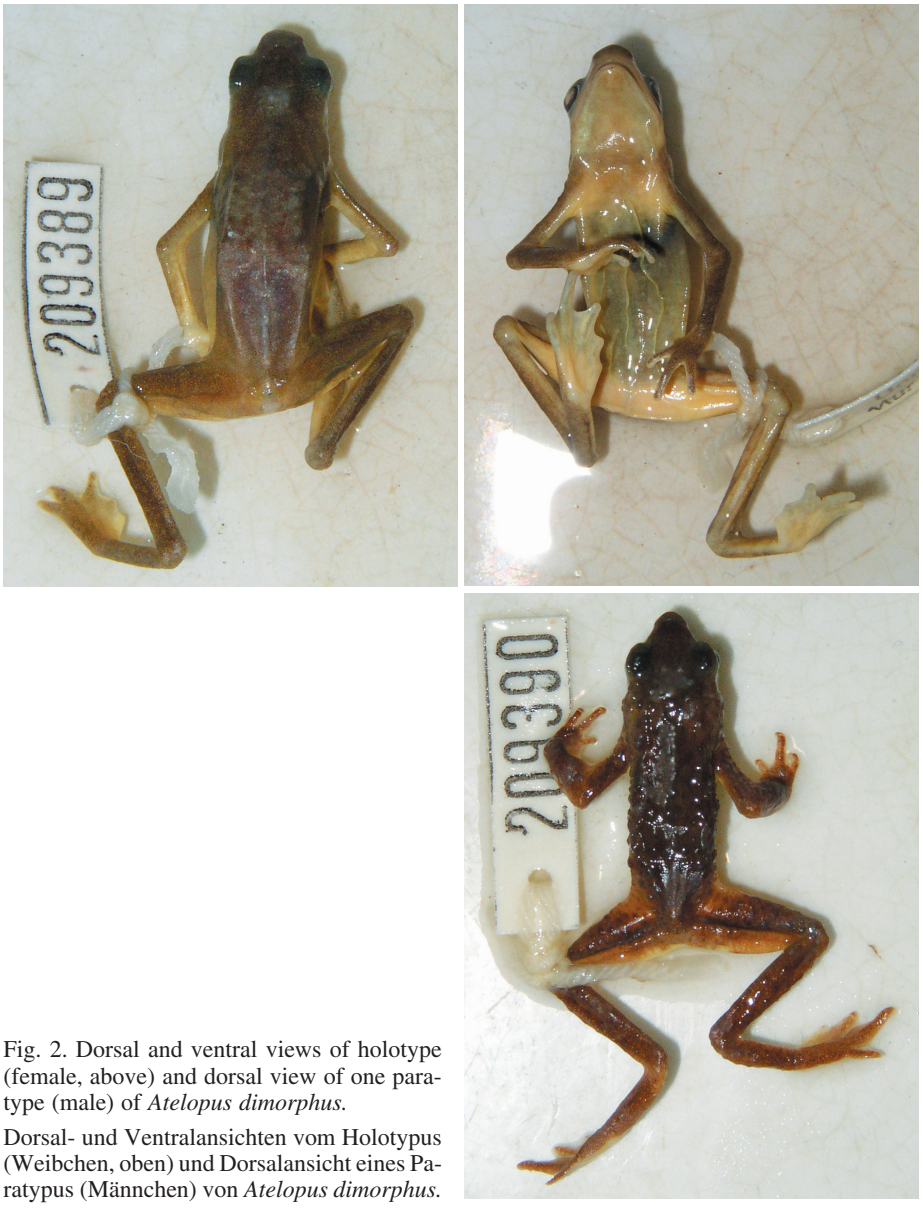

Fig. 2. Dorsal and ventral views of holotype (female, above) and dorsal view of one paratype (male) of *Atelopus dimorphus.*

Dorsal- und Ventralansichten vom Holotypus (Weibchen, oben) und Dorsalansicht eines Paratypus (Männchen) von *Atelopus dimorphus.*

Description scheme follows LÖTTERS et al. (2002a, b). Webbing formula is described in the manner of SAVAGE & HEYER (1969, 1997) and MYERS & DUELLMAN (1982). Sex determination was by presence and absence of keratinized nuptial pads and relative thickness of forearm (cf. PETERS 1973). Morphometric data to the nearest 0.1 mm were taken with dial callipers. Definitions of measurements are those of GRAY & CANNATELLA (1985) and COLOMA (1997): SVL (snout-vent length), HDWD (head width), HLSQ (head length from the squamosal), EYDM (eye diameter), ITNA (internarial distance), EYNO

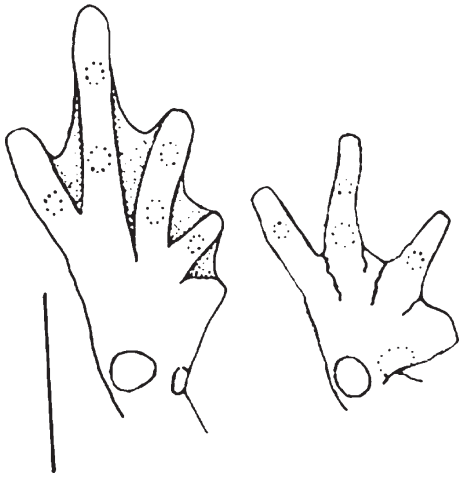

Fig. 3. Sole and palm of holotype of *Atelopus dimorphus* (KU 209389).
Fuß und Hand vom Holotypus von *Atelopus dimorphus* (KU 209389).
Balken/bar 2 mm.

(eye to nostril distance), SW (widest sacrum width), TIBL (tibia length), FOOT (foot length), HAND (hand length), THBL (thumb length).

3 Systematics

Atelopus dimorphus sp. nov. (Figs. 2-3, 6)

Holotype: KU 209389, an adult female from the Cordillera Azul (ca. 9°11'S, 75°50'W), along the Tingo María-Pucallpa road, 1650 m above sea level, Departamento Huánuco, Peru; leg. April 1980 by an unknown collector.

Paratypes: KU 209387, 209390-391, 209393 (four males), KU 209388 (a subadult female), KU 209392 (a cleared and stained specimen), same data as holotype.

Diagnosis: A medium-sized *Atelopus* (SVL of one adult female 31.3 mm and four adult males 21.6-24.2 mm) that can be distinguished from all other known species by the following combination of characters: (1) Body slender (SW/SVL 0.21-0.23; n = 5), snout acuminate with tip gently rounded to slightly pointed; (2) neural spines externally not or weakly visible; (3) hind limbs long, tibiotarsal articulation reaching to posterior corner of eye when leg adpressed forward along body (TIBL/SVL 0.45-0.5; n = 5); (4) foot shorter than tibia (FOOT/TIBL 0.79-0.84; n = 5); (5) tympanic membrane, tympanic annulus and stapes absent; (6) males with dorsal warts and, in part, spiculae; females almost entirely smooth; (7) foot webbing formula I0 – 0^{+}II0^{+} – 1III0 to 1½ – 1 to 2IV1 to 2 – ½ to 1V; (8) thumb short (THBL/HAND 0.36-0.45; n = 5), phalangeal formula of hand 1 – 2 – 3 – 3; (9) plantar and palmar surfaces almost smooth, with ill-defined subarticular tubercles on some phalanges; (10) in preservative, dorsal body uniform reddish olive or olive, ventral sides entirely bright yellowish cream.

Atelopus dimorphus is most similar to *A. erythropus* (Fig. 4) and *A. nepiozomus* (Fig. 5) from the eastern Andean versant (Peru, Ecuador; PETERS, 1973, LÖTTERS 1996). *Atelopus erythropus* has minute spiculae, not warts, on all dorsal surfaces (see Comments) while *A. dimorphus* males have well developed warts and in part spiculae (except on snout), whereas females lack warts except at the arm insertion. In addition,

A. erythropus is in preservative dorsally chocolate brown and was said to have had, freshly after preservation, "thighs and … feet vermilion" (BOULENGER 1903: 555). In preservative, *A. dimorphus* is dorsally reddish olive to olive and ventrally bright yellowish cream (see Comments). *Atelopus nepiozomus* females and males both have well developed warts (*A. dimorphus* females lack warts except at arm insertion) and hind limbs are shorter than in the new species (tibiotarsal articulation reaching to arm insertion when leg adpressed forward along body to posterior corner of eye in the new species). In addition, *A. nepiozomus* has irregular brownish blotches on the dorsum (absent in *A. dimorphus*).

All other *Atelopus* species known from the same general area (cf. PETERS 1973, LÖTTERS 1996, ARDILA-ROBAYO 2000, LÖTTERS et al. 2002b) in which *A. dimorphus* occurs, possess dorsal and in part ventral pattern and both sexes have smooth skin (*A. pulcher*) or have warts [*A. andinus, A. halihelos, A. minutulus, A. palmatus, A. petriruizi, A. reticulatus, A. siranus, A. spumarius* sensu stricto, *A. planispina, A. tricolor* (including its junior synonyms *A. rugulosus* NOBLE, 1921 and *A. willimani* DONOSO-BARROS, 1969)]. *Atelopus boulengeri* (including its junior synonym *A. bicolor* NOBLE, 1921) and *A. seminiferus* almost lack pattern. The former also lacks but the subsequent possesses warts. Both species can be distinguished from *A. dimorphus* by their larger size with adult SVL ≥ 40 mm (versus < 32 mm in the new species).

All other more or less uniform greenish species of *Atelopus* so far known develop warts in both sexes [i.e. *A. angelito* ARDILA-ROBAYO & RUIZ-CARRANZA, 1998, *A. bomolochos* PETERS, 1973 (at least some populations), *A. exiguus* (BOETTGER, 1892), *A. muisca* RUEDA-ALMONACID & HOYOS, 1991, *A. tamaense* LA MARCA, GARCÍA-PÉREZ & RENJIFO, 1990 "1989", *A. vogli* MÜLLER, 1934] or have smooth skin (*A. franciscus* LESCURE, 1973 "1972", *A. limosus* IBÁÑEZ, JARAMILLO & SOLÍS, 1995) (cf. LÖTTERS 1996, ARDILA-ROBAYO & RUIZ-CARRANZA 1998).

Description of type series (if variation occurs, holotype condition is given in parentheses): Body slender; neural spines externally not or weakly visible (weakly); head longer than broad; head length less than one third of SVL; snout acuminate, tip from above gently rounded to slightly pointed (gently rounded), dorsally slightly depressed; in lateral aspect, upper jaw extending beyond lower; nostril lateral, not visible from above; tongue about three times as long as wide, broadest anteriorly, free for half of its length; canthus rostralis straight or slightly convex (straight) from nostril to tip of snout, concave and longer from nostril to anterior corner of eye – most concave immediately anterior to eye; eye width longer than distance from nostril to anterior corner of eye; loreal area barely concave; upper lip fleshy below the eye; immediate lateral postorbital area straight or slightly convex (straight); tympanic membrane absent; dorsal postorbital crest poorly developed, shorter than eye. Tibia long, less than half SVL, tibiotarsal articulation extending to approximately posterior corner of eye when hind limb adpressed forward along body; foot shorter than tibia; relative length of toes: I < II < III < or = V < IV (I < II < III = V < IV); metatarsal tubercles ill-defined, outer rounded, inner about half size of the outer tubercle and more elongate; rest of sole smooth with ill-defined subarticular tubercles present at joints of phalanges of Toes II-V; foot webbing formula is I0 – 0⁺II0⁺ – 1III0 to 1½ – 1 to 2IV1 to 2 – ½ to 1V (I0 – 0⁺II0⁺ – 1III1½ – 1IV1 – 1V). Forearm short, less than one third of SVL, proximally considerably wider than distally in males; relative length of fingers: I < II < IV < III; palmar tubercle indistinct, rounded, thenar tubercle smaller, less distinct and more ovoid; rest of palm smooth with ill-defined subarticular tubercles at joints of phalanges of Fingers II to IV; thumb relatively short, distance from tip to outer edge

Fig. 4. Dorsal and ventral views of holotype of *Atelopus erythropus* (BM 1947.2.14.65).
Dorsal- und Ventralansicht vom Holotypus von *Atelopus erythropus* (BM 1947.2.14.65).

Fig. 5. Paratype of *Atelopus nepiozomus* (BM 1972.735).
Paratypus von *Atelopus nepiozomus* (BM 1972.735).

of palmar tubercle less than half hand length; keratinized nuptial pads present on thumbs in males. In males, skin of dorsal surfaces of body, except snout, including extremities scattered with well developed warts, partly spiculae, ventral surfaces wrinkled or smooth; in females (as the holotype), all surfaces entirely smooth, below wrinkled in part, except for some few warts at arm insertion and on upper forearm.

In preservative (Fig. 2), dorsal surfaces are completely reddish olive or olive (olive) including extremities; light olive below eye. All ventral surfaces including sole and

palm are bright yellowish cream. Some individuals show poor reticulation in olive on the ventral sides of arms and legs (absent). Colour in life is unknown.

Measurements and proportions of female holotype are (mm) SVL 31.3, SW 6.9, HDWD 7.1, HLSQ 9.0, EYDM 3.3, ITNA 3.1, EYNO 2.6, TIBL 13.9, FOOT 11.1, HAND 7.3, THBL 3.3, SW/SVL 0.22, HDWD/SVL 0.23, HDWD/HLSQ 0.79, HLSQ/SVL 0.29, FOOT/TIBL 0.8, TIBL/SVL 0.45, THBL/HAND 0.45; of four adult male paratypes are (mean ± standard deviation, range in parentheses) (mm) SVL 22.9 ± 0.95 (21.6-24.2), SW 5.2 ± 0.28 (4.9-5.6), HDWD 6.1 ± 0.3 (5.8-6.6), HLSQ 7.5 ± 0.37 (7.1-7.8), EYDM 2.5 ± 0.1 (2.3-2.6), ITNA 2.2 ± 0.26 (2.0-2.6), EYNO 1.9 ± 0.21 (1.7-2.1), TIBL 11.0 ± 0.39 (10.6-11.4), FOOT 8.9 ± 0.35 (8.3-9.2), HAND 6.2 ± 0.14 (6.1-6.4), THBL 2.5 ± 0.23 (2.2-2.8), SW/SVL 0.23 ± 0.1 (0.21-0.23), HDWD/SVL 0.27 ± 0.02 (0.25-0.29), HDWD/HLSQ 0.81 ± 0.07 (0.74-0.92), HLSQ/SVL 0.33 ± 0.03 (0.29-0.36), TIBL/SVL 0.48 ± 0.02 (0.46-0.5), FOOT/TIBL 0.81 ± 0.02 (0.79-0.84), THBL/HAND 0.41 ± 0.03 (0.36-0.44).

Osteology: One of the paratypes was cleared and stained for bones (not cartilage) by a previous worker. COLOMA (1997) reviewed the osteology of the genus and provided a detailed general description of the *Atelopus* skeleton. The available skeleton of *A. dimorphus* is in relatively poor condition, it has fallen into several pieces. As far as recognisable, in aspects of the skull, axial and appendicular system, *A. dimorphus* largely agrees with the general description given by COLOMA (1997). Some specific characters I can report here, include: absence of a tympanic annulus and stapes; no calcified septum or tectum nasi; the lateral ramus of the septomaxilla is cylindrical; frontoparietals separated anteriorly; the semi-rounded cultriform process of the parasphenoid underlies the posterior spenethmoid. The hyobranchium displays a lot of species-specific information in *Atelopus* with respect to length and shape of its cartilagous processes (COLOMA 1997). Because only ossified structures are visible in cleared and stained specimen of *A. dimorphus,* I can just state here that two well separated calcified posteromedial processes, each almost straight, are present. The structure of the vertebral column and pelvic girdle is shown in Figure 6. The phalangeal formula of the foot is 2 – 2 – 3 – 4 – 3 with a bony prehallux of about half the length of the most proximal phalange of Toe I; that of the hand is 1 – 2 – 3 – 3 with a bony prepollex of more than two thirds the length of the thumb.

Distribution: The new species is known only from the Cordillera Azul, Amazonian Peru (Fig. 1). Notes by the collector indicate that it was observed between 1650 and 1800 m above sea level in an area of the mountain chain situated in the Departamento Huánuco, which shall refer to the western versant of the Cordillera Azul. The general geo-ecological zone of this region is humid mountain forest. *Atelopus reticulatus* is the only other species of the genus known from the Cordillera Azul. However, it is said to originate from an area of this mountain chain that is situated in the Departamento Ucayali, i. e. on the eastern versant of the Cordillera Azul (LÖTTERS et al. 2002a).

Etymology: The specific name refers to the remarkable sexual dimorphism in this species.

Comments: Sexual dimorphism in *A. dimorphus* is indicated by larger female size and different skin texture among the sexes. Females are almost entirely smooth while males are dorsally warty. In addition, the forearm is proximally considerably wider than distally in males, and males have keratinized nuptial pads on the thumbs.

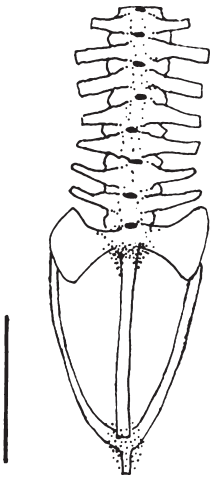

Fig. 6. Dorsal view of vertebral column and pelvic girdle of *Atelopus dimorphus* (KU 209392).

Dorsalansicht der Wirbelsäule und des Hüftgürtels von *Atelopus dimorphus* (KU 209392).

Balken/bar 2 mm.

Differences in size and arm proportions among the sexes as well as the presence of nuptial pads in males are present all *Atelopus* species in which both sexes are known (cf. LÖTTERS 1996). Inter-sexual variation in skin texture has been found in some *Atelopus* species (e. g. COLOMA et al. 2000), but variation is always less than between the sexes of *A. dimorphus.* Nevertheless, there is almost no doubt that the specimens here assigned to this species are conspecific, because all other characters including aspects of the snout, leg length, sole and palm structure, webbing and colour coincide.

Atelopus dimorphus is very similar to *A. erythropus,* which is only known from the holotype of uncertain sex (Fig. 4). Its body cavity has been opened by previous workers and parts have been destroyed and removed. Based on what remains I suggest that it is probably a male. It shares almost all characters with *A. dimorphus* – the two can only be distinguished on the basis of differences in skin texture and colour. Like in *A. dimorphus* males, the entire dorsal surface of *A. erythropus* is not smooth. However it has very tiny spiculae only (not well developed warts as present in *A. dimorphus* males) and therefore appears to be "smooth" (Fig. 4; cf. LÖTTERS & DE LA RIVA 1998; LÖTTERS & HENZL 2000). In contrast, *A. dimorphus* males have a "warty" appearance (Fig. 2), because both warts and spiculae in the latter species are larger and broader than the spiculae in *A. erythropus.* This species, shortly after preservation, was said to have had vermilion ventral surfaces (BOULENGER 1903: 555). All individuals of *A. dimorphus,* preserved approximately 20 years ago, lack vermilion colour. However, I will not rule out, that they originally had vermilion ventral surfaces, because, based on personal observations, vermilion may disappear after some time in preservation. Additional studies on *A. erythropus* are necessary. Unfortunately, material other than the holotype has not become available so far. In such "rare" species, one may ask if probably the type locality is incorrect. I suggest there is little doubt in the correctness. According to the original BM catalogue, the holotype was collected by G. OCKENDEN at "Santo Domingo, Carabaya" (which is in southern Peru, Departamento Puno), along with a series of anurans only known from that area and in part further south, e. g. *Bufo fissipes* BOULENGER, 1903, *Eleutherodactylus platydactylus* (BOULENGER, 1903), *Hyla callipleura* BOULENGER, 1902.

Both *Atelopus dimorphus* and *A. reticulatus* are known from the Cordillera Azul (sympatric occurence is not documented, however). Therefore, it may be asked if both

are probably conspecific. *Atelopus dimorphus* lacks reticulation (and probably reddish ventral surfaces) and has a different skin texture. At our current state of knowledge (apart from inter-sexual variation within one species, e. g. as in *A. dimorphus*), skin texture is a constant, taxon-specific character in *Atelopus* (cf. LÖTTERS 1996, COLOMA et al. 2000).

4 Discussion

Nine species of *Atelopus* are currently known from the upper Amazon basin of Peru (Fig. 1). Most of them are suggested to have very restricted distributions, in part limited to Andean pre-cordilleras. Taking the large amount of unexplored pre-cordilleras in the general region, additional *Atelopus* species can be expected. Sympatry is rather rare in the genus (LÖTTERS 1996). Since both *A. dimorphus* and *A. reticulatus* are described from the Cordillera Azul, their sympatric occurrence is possible.

According to MCDIARMID (1971) and COLOMA (1997), some Amazonian *Atelopus* possess a tympanic annulus and a stapes (i.e. a middle ear). *Atelopus dimorphus* belongs to the species which lack these characters (as the majority of the members of the genus does). However, this probably does not exclude a close phylogenetic relationship of Amazonian taxa with a middle ear and *A. dimorphus* (cf. COLOMA 1997). LYNCH (1993) proposed that phalangeal reduction in the thumb (as in *A. dimorphus*) may be interpreted as a synapomorphy. This character occurs in several of the species compared with *A. dimorphus* (e. g. *A. tricolor* and probably *A. siranus*, both from the same general area; LÖTTERS & DE LA RIVA 1998, LÖTTERS & HENZL 2000). However, COLOMA (1997) found intraspecific and even intra-individual phalangeal variation and rejected the hypothesis of synapomorphy. The existence of *A. dimorphus* (with females and males displaying different skin texture) shows that even the presence/absence of an "evident" morphological character does not allow for any phylogenetic conclusion. As a consequence, any phylogeographic relationships concerning the *Atelopus* from the upper Amazon basin of Peru remain unclear at the current state.

Acknowledgements

I am grateful to W.E. DUELLMAN and L. TRUEB for inviting me to study material at KU and for their kind "hospedaje". Material examined at BM was kindly made available through the SYS-RESOURCE Major Research Infrastructure of the Natural History Museum (BM, London) with financial support by the IHP Programme of the European Community; I am especially thankful to B.T. CLARKE (BM) for being my mentor. L.A. COLOMA has shared ideas with me concerning *Atelopus* systematics and especially the status of the material of the species described in this paper. The map used here was redone after an original by E. LEHR.

Zur Systematik der Harlekinfrösche (Amphibia: Bufonidae: *Atelopus*) aus Amazonien. III: Eine neue, bemerkenswert dimorphe Art aus der Cordillera Azul, Peru

Einleitung

Harlekinfrösche, Gattung *Atelopus,* sind eine sehr artenreiche Gruppe neotropischer Bufoniden. Aus dem oberen Amazonas-Becken, speziell den östlichen Andenabhängen beziehungsweise den vorgelagerten Gebirgszügen, sind eine ganze Reihe von Arten beschrieben worden (ARDILA-ROBAYO 2000, FROST 2002, LÖTTERS et al. 2002b: vgl. Auflistung im englischen Text).

Wie für Bufoniden typisch, zeigt sich bei allen der zirka 75 beschriebenen *Atelopus*-Arten ein Geschlechtsdimorphismus, der sich vor allem darin ausdrückt, dass Weibchen größer sind als Männchen (z. B. PETERS 1973, LÖTTERS 1996, COLOMA et al. 2000). Bei einer Serie von Harlekin-Fröschen aus der Cordillera Azul im amazonischen Peru unterscheiden sich die Geschlechter nicht nur in der Größe, sondern auch darin, dass Weibchen fast glatt und Männchen stark warzig sind. Da sich die Tiere in sämtlichen anderen Merkmalen gleichen, betrachte ich sie als Angehörige einer einzigen, bemerkenswert dimorphen Art. Da kein Name verfügbar ist, wird diese Art hier neu beschrieben. Es ist das zweite Taxon der Gattung aus der Cordillera Azul und erhöht die Anzahl der aus dem amazonischen Teil Perus bekannten *Atelopus*-Arten auf neun (vgl. Abb. 1).

Material und Methode

Material aus folgenden Sammlungen wurde untersucht (für die Bedeutung der Akronyme siehe englischer Text): AMNH, BM, CBF, KU, ICN, MNHNP, NHMW, ZFMK. Es ist im Anhang aufgelistet. Das Schema der Beschreibung sowie die verwendeten Merkmale folgen LÖTTERS et al. (2002a, b); vermessen wurden: SVL (Kopf-Rumpf-Länge) HDWD (Kopfbreite), HLSQ (Kopflänge), EYDM (Augendurchmesser), ITNA (Abstand zwischen den Nasenlöchern), EYNO (Abstand Auge-Nasenloch), SW (Sacrum-Breite), TIBL (Tibialänge), FOOT (Fußlänge), HAND (Handlänge), THBL (Daumenlänge).

Ergebnisse und Diskussion

Für Angaben zu den Typusexemplaren (Abb. 2-3) sowie der Typuslokalität siehe englischer Text.

Diagnose: Mittelgroße *Atelopus*-Art (SVL von einem adulten Weibchen 31,3 mm und von vier adulten Männchen 21,6-24,2 mm), die sich durch die folgende Merkmalskombination von allen anderen Arten unterscheidet: (1) Körper schlank (SW/SVL 0,21-0,23; n = 5), Schnauze zugespitzt, mit leicht abgerundeter oder spitzer Schnauze; (2) Fortsätze der Wirbel von außen nicht oder schwach erkennbar; (3) Hinterbeine lang, Tibiotarsalgelenk reicht bis zum hinteren Augenrand, wenn Bein nach vorne gezogen wird (TIBL/SVL 0,45-0,5; n = 5); (4) Fuß kürzer als Tibia (FOOT/TIBL 0,79-0,84; n = 5); (5) Tympanalmembran und -ring sowie Stapes fehlen; (6) Männchen mit dorsalen Warzen und teilweise Spiculae; Weibchen fast glatt; (7) Schwimmhautformel des Fußes I0 – 0^{+}II0^{+} – 1III0 bis 1½ – 1 bis 2IV1 bis 2 – ½ bis 1V; (8) Daumen kurz (THBL/HAND 0,36-0,45; n = 5), Phalangenformel der Hand 1 – 2 – 3 – 3; (9) Plantar- und Palmaroberflächen fast glatt, mit wenig definierten Subarticulartuberkeln an einigen Phalangen; (10) im Konservierungsmedium dorsaler Körper einfarbig rötlich oliv bis oliv, Ventralseiten uniform hellgelblich creme.

Die neue Art ist *A. erythropus* (Abb. 4) und *A. nepiozomus* (Abb. 5) ähnlich. Sie unterscheidet sich von diesen hauptsächlich in der Hautbeschaffenheit. Das einzig bekannte Exemplar von *A. erythropus* hat winzige Spiculae, keine Warzen. Bei *A. nepiozomus* haben beide Geschlechter warzige Haut. Zudem ist *A. erythropus* in Alkohol dorsal braun und *A. nepiozomus* in Alkohol braun bis grün mit dunklen Flecken.

Das hier neu beschriebene Taxon ist nur von der Typuslokalität in der Cordillera Azul bekannt, in der auch *A. reticulatus* vorkommt. Die meisten im oberen Amazonas-Becken vorkommenden *Atelopus*-Arten besitzen relativ kleine Areale, oft restringiert auf Täler oder einzelne Bergkämme (vgl. LÖTTERS 1996, LÖTTERS et al. 2002b). Die phylogenetischen Beziehungen sämtlicher *Atelopus*-Taxa aus Amazonien lassen sich zum derzeitigen Zeitpunkt nicht klären, denn die vorgeschlagenen Synapomorphien, wie Fehlen eines Mittelohrs (MCDIRAMID 1971) oder Phalangenreduktion des Daumens (LYNCH 1993), werden sehr kontrovers diskutiert (vgl. COLOMA 1997).

Schlagwörter: Anura: *Atelopus dimorphus* sp. nov.; Geschlechtsdimorphismus; Peru.

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Appendix: Material Examined

Atelopus andinus: PERU: San Martín: upper Río Biabo valley, AMNH A 42657 (paratype), A 43200 (holotype); Loreto: Río Pisqui, AMNH A 43545 (paratype); border area of San Martín-Loreto: Río Cachiyacu (Tocachi), AMNH A 42914, A 43296-927 (paratypes). *Atelopus dimorphus:* PERU: Huánuco: Cordillera Azul, KU 209389 (holotype), 209387-388, 209390-393

(paratypes). *Atelopus erythropus:* PERU: Puno: Santo Domingo, Cordillera Carabaya, BM 1947.2.14.65 (holotype). *Atelopus minutulus:* COLOMBIA: Meta: km 13-15, Guayabetal-Manzanares road, ICN 13709 (holotype), 4851-853, 5028, 7085-891, 12898 (paratypes). *Atelopus nepiozomus:* ECUADOR: Morona-Santiago: Posada San Juan Bosco, BM 1972.735 (paratype, formerly United States National Museum, Washington, J.A. PETERS field number 7203). *Atelopus pulcher:* PERU: San Martín: vicinity of Tarapoto, KU 211676-683, 212530, ZFMK 48573, 50680-685, 76243-244; Chyavetas (= Loreto: Chayahuitas?), BM 1947.2.14.80 (lectotype), 1947.2.14.82-83 (paralectotypes). *Atelopus reticulatus:* PERU: Ucayali: Cordillera Azul, circa 3 km by road after Divisoria on the Tingo María-Pucallpa road, ZFMK 76246-247 (para- and holotype). *Atelopus* cf. *seminiferus:* PERU: Piura: Cerro Chinguela region, KU 196633-42. *Atelopus* sp. (aff. *A. pulcher*): ECUADOR: Morona-Santiago: Chancha, Normandía, AMNH A 16695-712; Cordillera de Cutucú, AMNH 33913-915; Pastaza: Río Villano, BM 1970.68-69, 1970.117-118. *Atelopus spumarius* complex except *A. spumarius* sensu stricto: BRAZIL: Amapá: Serra do Navio, ZFMK 54384-385; Pará: Sudam Floral Reserve, 74 km south-east of Santarém, KU 129954-960; no exact locality, BM 1874.7.16.1-4; COLOMBIA: Amazonas: Igara Parana, BM 1905.1.31.10-11; FRENCH GUIANA: Haut Maroni, Monts Atachi-Bacca, MNHNP A 522 (holotype of *A. pulcher hoogmoedi*), A515, A518, A519-521 (paratypes of *A. pulcher hoogmoedi*); GUIANA: Karisparu, BM 1970.602-613; Potaro District, Echerak, BM 1976.1999-2001; Upper Patavo River, BM 1905.11.1.16; no exact locality, BM 1.3.46-49; SURINAME: Brownsberg, AMNH 7749, KU 206405-406. *Atelopus spumarius* sensu stricto: PERU: Loreto: Colonia, Río Ampiyacu, MNHNP 1979/8382 (neotype); 3 km north-east of Pebas, AMNH A 103-31-35. *Atelopus siranus:* PERU: Huánuco: Serranía de Sira, NHMW 33906: 1 (paratype), NHMW 33906:2 (holotype). *Atelopus tricolor:* BOLIVIA: La Paz: 17 km from Carrasco, Serranía de Bellavista, CBF 285-288; Río Ñeques, km 10, Charazani-Apolo road, Yungas de La Paz, CBF 2502; Pilon-Lajas, CBF 2487; Cochabamba: Río Ronco, Chapare, CBF 892; "old" road from Villa Tunari to Cochabamba, Chapare, ZFMK 69919-920; PERU: Cuzco: Marcapata valley, BM 1947.2.14.57-59 (paralectotypes), ZFMK 28103 (lectotype); 4 km south-west of Santa Isabel, Río Cosñipata, KU 162988; Puno: vicinity of Juliaca, AMNH 6097 (holotype of *A. rugulosus*).

Manuscript received: 18 February 2003

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