

Short Communication

Conservation priorities for harlequin frogs (*Atelopus* spp.) of Peru

Stefan Lötters, Rainer Schulte, Jesús H. Córdova and Michael Veith

Abstract Populations of harlequin frogs *Atelopus* are declining throughout their geographical range. In Peru six of the 11 nominally described species are Critically Endangered, and there are at least 17 undescribed additional forms (all representing apparently distinct species), the conservation status of which is unknown. Most *Atelopus* taxa in Peru have relatively small geographical ranges, some known only from single populations, and have only a limited chance of survival. Conservation will require: (1) improvement of the faunistic and taxonomic

knowledge of the genus, (2) field surveys, including in remote areas, (3) assessment of all species and populations for chytridiomycosis and research on the agent's biology, (4) *ex situ* conservation measures to facilitate later reintroduction, and (5) involvement of national and international conservationists and local people.

Keywords Amphibian decline, *Atelopus*, chytridiomycosis, faunistics, Peru, taxonomy.

Over the last decade there have been a number of documented declines of amphibian species worldwide, even in relatively pristine areas (Stuart *et al.*, 2004). In South and Central America species of the bufonid genus *Atelopus* (harlequin frogs) have declined dramatically (IUCN *et al.*, 2004; La Marca *et al.*, 2005). *Atelopus* has >70 described taxa and more await description (La Marca *et al.*, 2005). Most of the species have relatively small geographical ranges, some known only from single populations confined to one stream (Lötters, 1996), and some of those distributed more broadly are allopatric species complexes (Lötters *et al.*, 2002a). One reason why the geographical ranges of most *Atelopus* species are restricted is that c. 85% of *Atelopus* live at 1,500–4,500 m altitude. Such biogeographical and life history traits are factors associated with amphibian decline (Lips *et al.*, 2003).

Comprehensive reports and analyses of the decline of *Atelopus* are available from Costa Rica (Pounds & Crump, 1994), Panama (Lips, 1999), Venezuela (La Marca & Lötters, 1997) and Ecuador (Ron *et al.*, 2003). Little is known, however, about the status of the genus in Bolivia,

Brazil and the Guianas, where there are relatively few species, or in Colombia and Peru, where the genus is relatively species-rich (IUCN *et al.*, 2004; La Marca *et al.*, 2005). With c. 85% of the described species categorized as Critically Endangered and three species extinct (IUCN, 2004; IUCN *et al.*, 2004; Stuart *et al.*, 2004), the conservation status of the genus is of great concern. The causes of these declines are being debated (La Marca *et al.*, 2005), and chytridiomycosis has been identified as a significant cause of sudden mass mortality (Lips, 1999).

Conservation measures proposed for *Atelopus* include *in situ* and *ex situ* breeding programmes and local environmental education (La Marca *et al.*, 2005). In Panama, for example, Proyecto Rana Dorada (Project Golden Frog) is focusing on the population biology, life history and captive breeding of *A. zeteki* (Zippel, 2002). The conservation of *Atelopus* requires appropriate knowledge of faunistics and taxonomy. Eleven nominal species of *Atelopus*, all endemic, have been described from Peru, of which six are categorized as Critically Endangered, one as Endangered, two as Vulnerable, and one as Data Deficient on the IUCN Red List (Table 1). All but the high Andean *A. peruensis* occur in eastern Peru, and amongst these all except the lowland *A. spumarius* occur at altitudes of 600–2,000 m along the eastern Andean slopes or in outlying cordilleras (Fig. 1).

Six of the eleven nominal species have been named since 1968, with the others described in 1921 or earlier. For one of the earlier described species, *A. erythropus*, no material other than the holotype is available. The same was true for *A. seminiferus* until it was rediscovered in 2001 by RS. Both taxa are currently treated provisionally (Gray & Cannatella, 1985; Lötters, 2003). The taxonomy

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Received 11 May 2004. Revision requested 4 November 2004.
Accepted 7 March 2005.

Table 1 List of nominal species of harlequin frogs *Atelopus* from Peru, their Red List category (IUCN, 2004), and recent publications dealing with their taxonomy (original descriptions are indicated by an asterisk). *A. rugulosus* may be a junior synonym of *A. tricolor* (Lötters & De la Riva, 1998), and *A. spumarius* is a complex of species (Lötters *et al.*, 2002a,b).

Species, with author & year	Red List category ¹	Taxonomic publications within the last 50 years
<i>A. andinus</i> Rivero, 1968	CR	Rivero, 1968*; Lötters & De la Riva, 1998
<i>A. dimorphus</i> Lötters, 2003	EN	Lötters, 2003*
<i>A. erythropus</i> Boulenger, 1903	CR	Lötters & De la Riva, 1998; Lötters, 2003
<i>A. peruensis</i> Gray & Cannatella, 1985	CR	Gray & Cannatella, 1985*
<i>A. pulcher</i> Boulenger, 1882	CR	Lötters <i>et al.</i> , 2002a
<i>A. reticulatus</i> Lötters, Haas, Schick & Böhme, 2002	CR	Lötters <i>et al.</i> , 2002b*
<i>A. rugulosus</i> Noble, 1921		Lötters & De la Riva, 1998
<i>A. seminiferus</i> Cope, 1874	CR	Gray & Cannatella, 1985
<i>A. spumarius</i> Cope, 1871	VU	Lescure, 1981; Cocroft <i>et al.</i> , 1990; Lötters <i>et al.</i> , 2002a,b
<i>A. siranus</i> Lötters & Henzl, 2000	DD	Lötters & Henzl, 2000*
<i>A. tricolor</i> Boulenger, 1902	VU	Lötters & De la Riva, 1998

¹VU, Vulnerable; EN, Endangered; CR, Critically Endangered; DD, Data Deficient.

of three of the earlier described species (*A. pulcher*, *A. tricolor* and its suggested junior synonym *A. rugulosus*) has been comprehensively discussed (Lötters & De la Riva, 1998; Lötters *et al.*, 2002a). The sixth earlier described species, *A. spumarius*, appears to be a complex of species awaiting revision (Cocroft *et al.*, 1990; Lötters *et al.*, 2002a). Three of the taxa described since 1968 are also known only from their original descriptions, but their taxonomy is well studied (*A. dimorphus*, Lötters, 2003; *A. reticulatus*, Lötters *et al.*, 2002b; *A. siranus*, Lötters & Henzl, 2000). From scientific collections and field surveys we are aware of at least 17 additional undescribed forms of *Atelopus* in Peru (Fig. 1), all apparently representing distinct species.

A. dimorphus, *A. erythropus*, *A. reticulatus*, *A. seminiferus* and *A. siranus* all occur within relatively small areas (Fig. 1), suggesting that each consists of only one or a few populations. *A. siranus* occurs in the remote Cordillera del Sira and has only been found once. Because of the limited accessibility of its type locality, there have been no recent efforts to relocate it. *A. dimorphus* and *A. reticulatus* are from the Cordillera Azul and *A. seminiferus* is from the Cordillera Oriental, both accessible by road. Occasional visits by RS since the mid 1980s have not confirmed the presence of harlequin frogs in the Cordillera Azul, but both adults and juveniles of *A. seminiferus* were observed in the Cordillera Oriental in February 2004 by RS.

A. andinus, *A. peruensis*, *A. pulcher*, *A. spumarius* and *A. tricolor* have wider distributions (Fig. 1). Apparently healthy populations of *A. andinus* and *A. spumarius* (i.e. specimens were not rare and relatively easy to find) were found in 2000 in the Río Biabo region (L.O. Rodríguez, pers. comm.) and in February 2004 near Iquitos (D. Bernauer, pers. comm.). *A. peruensis*, *A. pulcher* and *A. tricolor* appear to have become relatively rare for unknown reasons (J.C. Chaparro, pers. comm.; RS,

unpubl. data), including the sudden disappearance of *A. peruensis* in 1999/2000 in the Cajamarca-Celendín range, Departamento Cajamarca. Over-collecting of this species for pets in the mid 1990s may have been responsible for this (RS, unpubl. data), but no monitoring has been undertaken. Ten populations of *A. pulcher* were known in the early 1980s from near the town of Tarapoto, Departamento San Martín (RS, pers. obs.) but only one of these populations now survives, with adults last seen in July 2004. A single specimen found dead at this site in 2003 tested positively for chytridiomycosis (F. Mutschmann, unpubl. data). Pollution, increased algae growth and deforestation, implicated in *Atelopus* declines (La Marca *et al.*, 2005), have occurred in the habitats of these populations within the last few years (RS, pers. obs.).

We conclude that most Peruvian *Atelopus* have only a limited chance of survival. However, the recent finding of subadult specimens in a population of *A. pulcher* (RS, pers. obs.), otherwise affected by chytridiomycosis, suggests that it is not too late to commence appropriate conservation. This will require: (1) improvement of the faunistic and taxonomic knowledge of the genus, (2) field surveys, including in remote areas, (3) assessment of all species and populations for chytridiomycosis and research on the agent's biology, (4) *ex situ* conservation measures to facilitate later reintroduction, and (5) involvement of national and international conservationists and local people.

We are aware of the following research and conservation measures currently underway for Peruvian *Atelopus*. (1) Three new species are currently being described by ourselves and others. (2) Studies on the biology of a population of *A. pulcher* apparently infected by chytridiomycosis started in 2004 (Instituto de Investigación Biológica de las Cordilleras Orientales, data not yet published). (3) Under the auspices of the Conservation

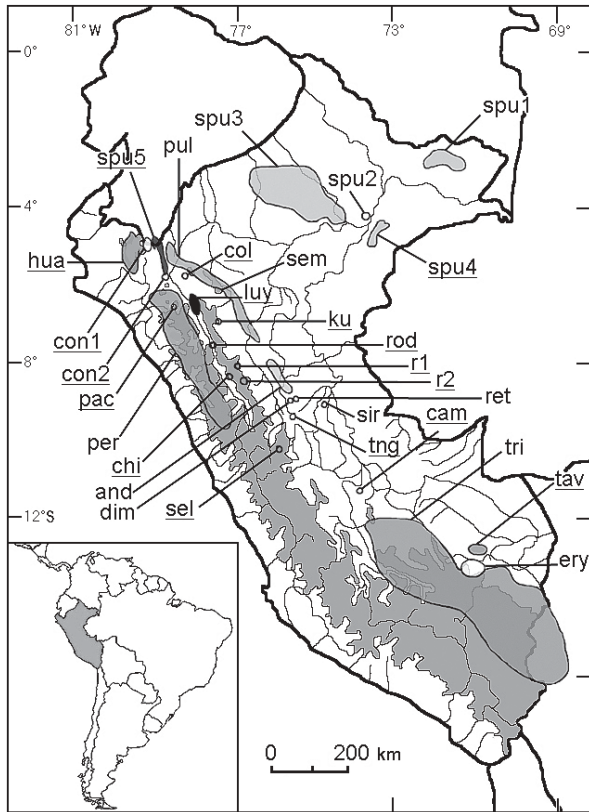


Fig. 1 Peru, with major river systems, areas >1,000 m altitude (shaded), and known locations of the 11 named species of *Atelopus* (Table 1) and of 17 undescribed forms (underlined). Acronyms are those used by taxonomists dealing with this genus: and, *A. andinus*, Alto Río Biabo valley; dim, *A. dimorphus*, Cordillera Azul; ery, *A. erythropus*, Cordillera Carabaya; per, *A. peruensis*, northern Andes; pul, *A. pulcher*, Cordillera Oriental; ret, *A. reticulatus*, Cordillera Azul; sem, *A. seminiferus*, Cordillera Oriental, Alto Mayo valley; sir, *A. siranus*, Cordillera del Sira; spu1, *A. spumarius* sensu stricto, Río Ampiyacu region, left bank Río Amazonas; spu2, *A. spumarius* sensu stricto (?), Iquitos-Río Itaya drainage region; spu3, *A. spumarius* sensu stricto (?), Pastaza Fan and lower Río Marañon, left bank; tri, *A. tricolor*, southern eastern Andes; cam, *Atelopus* sp., Camisea region; chi, *Atelopus* sp., East Andes in Departamento San Martín; col, *Atelopus* sp., Cordillera de Colán; con1, *Atelopus* sp., northern Cordillera del Condor; con2, *Atelopus* sp., southern Cordillera del Condor; hua, *Atelopus* sp., Cordillera Occidental de Ayabaca-Huancabamba; ku, *Atelopus* sp., Cordillera Central; luy, *Atelopus* sp., northern Cordillera de Luya; pac, *Atelopus* sp. (cf. *pachydermus*), Cutervo region; rod, *Atelopus* sp., Cordillera Central; r1, *Atelopus* sp., East Andes in Departamento San Martín; r2, *Atelopus* sp., East Andes in Departamento San Martín; sel, *Atelopus* sp., Selva Central; spu4, *Atelopus* sp. (cf. *spumarius*), Río Tahuayo river drainage; spu5, *Atelopus* sp. (cf. *spumarius*), lower Río Santiago valley; tav, *Atelopus* sp., Río Távara; tng, *Atelopus* sp. (cf. *andinus*), Tingo María region. All taxa are known only from the indicated localities, except for *A. spumarius* which is believed to occur elsewhere in the western Amazon basin and *A. tricolor* which ranges into Bolivia (Lötters, 1996).

International Species Conservation Unit, a mini guide to *Atelopus* is being prepared for free distribution to scientists and local people. (4) In January 2005 a workshop on the *ex situ* conservation of *Atelopus* was held at Atlanta Botanical Garden, USA, in which guidelines for the captive breeding of *Atelopus* were discussed.

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Biographical sketches

Stefan Lötters studies amphibian systematics, biogeography and conservation. He is involved in the monitoring of anuran diversity in South America and Africa, and has interests in the evolution of colour and pattern polymorphism in frogs.

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