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A NEW DIMENSION OF CURRENT BIODIVERSITY LOSS?

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Abstract: Current loss of global biodiversity is dramatic. At present, species extinctions are scattered across the evolutionary tree of life, thus affecting numerous species. However, extinctions of entire species-rich evolutionary lineages have not been documented among the current biodiversity loss. Allocation of IUCN Red List categories to all 74 described species of the Neotropical frog genus *Atelopus* (harlequin frogs) revealed that nowadays two and 61 species are in the categories Extinct and Critically Endangered (which means nearly extinct), respectively. This is the first evidence that presently an entire species-rich evolutionary lineage of animals is next to extinction and may shift current biodiversity loss into a new dimension.

Key words: Amphibia, Bufonidae, *Atelopus*, Neotropics, IUCN Red List categories, extinction.

Resumen: "Una nueva dimensión de pérdida de biodiversidad actual?". La pérdida actual de biodiversidad es dramática. Actualmente, las extinciones de especies están dispersas por todo el árbol evolutivo de la vida, afectando por consiguiente a numerosas especies. Sin embargo, en la pérdida de biodiversidad actual no han sido documentadas extinciones para linajes evolutivos completos. La asignación de categorías en la Lista Roja de la UICN para todas las 74 especies descritas del género de ranas neotropicales *Atelopus* (ranas arlequín) reveló que hoy en día hay dos y 61 especies en las categorías de Extincto y Criticamente Amenazado (que significa casi extincto), respectivamente. Esta es la primera evidencia que actualmente un completo linaje evolutivo rico en especies animales está cercano a la extinción y puede desplazar la pérdida de biodiversidad actual hacia una nueva dimensión.

Palabras clave: Amphibia, Bufonidae, *Atelopus*, Neotrópico, categorías de la Lista Roja de la UICN, extinción.

Current worldwide biodiversity loss is dramatic due to increasing species extinction rates. Prognoses are alarming. Human impact, in particular habitat destruction and climate change, is being held responsible for the drastic loss of life forms today and in the future (e.g. Thomas *et al.* 2004a, b). It has been suggested that this loss of biodiversity is comparable in quantity to earlier mass extinctions through geological times (e.g. Wilson 1992).

Present extinctions are widely scattered across the evolutionary tree of life. However, it has not been documented yet that an entire large group of species belonging to the same evolutionary lineage (e.g., in biological systematic terminology, a genus) is close to extinction. Such a dimension of biodiversity loss occurred in earlier mass extinctions, as for example at the end of Cretaceous, when several lineages, including the dinosaurs, went extinct (e.g. Wilson 1992).

Amphibians are a group of vertebrates in which many species nowadays have become rare or even extinct. This is best documented in anurans from the Australis, Neotropics, and Nearctics (e.g. Houlahan *et al.* 2000). However, until now there is not known a single species-rich genus of Amphibia that is entirely under threat of extinction.

We here report that presently the entire species-rich anuran genus *Atelopus* Duméril and Bibron (Fig. 1), from the Neotropics, commonly known as harlequin frogs, is next to extinction. This may represent the first evidence of current biodiversity loss among animals at a dimension not known before.

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The status of harlequin frogs (*Atelopus*): This genus includes more than 75 diurnal and mostly conspicuously colored species (Fig. 1) from Central and South America, comprising a monophyletic lineage within the Bufonidae (Lötters 1996). In historical times, these amphibians were in part extremely abundant, as for example the Ecuadorian "jambato", *Atelopus ignescens* Cornalia, 1849, with up to 0.75 individuals per square meter (cf. Ron *et al.* 2003). However, for more than 15 years now, drastic population declines have been documented in several *Atelopus* species from Costa Rica, Panama, Venezuela, Ecuador, and Peru (e.g. Vial and Saylor 1993; La Marca and Lötters 1997; Pounds *et al.* 1999; Lips 1999; Ron *et al.* 2003). Few harlequin frogs, such as the once abundant "jambato" - which has, despite intensive searches, not been seen since 1989 -, are already considered extinct (Ron *et al.* 2003).

Most *Atelopus* species display similar life style, including adaptation to riparian habitats, and usually their geographical ranges are relatively restricted (e.g. to a single drainage system) at higher altitudes (Lötters, 1996). These traits make these animals likely candidates for population declines (cf. Lips *et al.* 2003). Moreover, independently, many scientists and conservationists agree in that *Atelopus* species in different regions are no longer or difficult to find. These observations led us to assume that, presently, this entire large amphibian genus may be next to extinction.

However, contrary to the "jambato", no status data were available until recently for the majority of harlequin frogs. Recently, the on-going IUCN/CI/NatureServe Global Amphibian Assessment (GAA; http://www.iucn.org/themes/ssc/news/gaa.htm) has evaluated their current status by allocating all described *Atelopus* species to IUCN Red List categories (see IUCN 2001). The detailed results will be published elsewhere (Stuart *et al.* in press). With respect to our assumption, we here focus on the quantitative allocation of species to IUCN Red List categories only, using the GAA database of March 2004.

Discussion and conclusions: How to explain this short-term change of status? There is no evidence that null models of normal population dynamics explain the absence of harlequin frogs (Pounds *et al.* 1997). Similarly, "traditional" threats, such as habitat destruction or over-collecting, display a minor role because they are generally not operational (cf. La Marca and Lötters 1997). Instead, in different regions, an epizootic fungus (*Batrachochytrium dendrobatidis*) was identified to be responsible for mass mortality in harlequin frogs (e.g., Lips 1999; Puschendorf 2003). It is still not known whether this chytridiomycosis represents a new pathogen to the Neotropics, or whether it has been there for a long time and only recently has become pathogenic. A favored hypothesis is that there is an interaction between incidences of chytridiomycosis with anthropogenic climate change, bringing into the discussion the "climate-envelope concept" (Thomas *et al.* 2004a).

FIG. 1. Representatives of harlequin frogs (from upper left to lower right)/Representantes de ranas arlequín (desde izquierda superior hasta derecha inferior): Atelopus subornatus Werner, 1899 - Colombia (photo/foto: A. Widmer); A. varius (Lichtenstein and Martens, 1856) - Costa Rica, Panama/Panamá (photo/foto: J. Regös); A. peruensis Gray and Cannatella, 1985 - Peru/Perú (photo/foto: J. Köhler); A. tricolor Boulenger, 1902 - Bolivia, Peru/Perú (photo/foto: J. Köhler).

Extreme dryness may cause stress to frogs, which in turn weakens them, as it is supposed to be the case for the extinct "jambato" from Ecuador (Ron *et al.* 2003). Alternatively, unusual weather conditions, such as increased cloud cover or dryness, might hamper the defense of frogs against chytridiomycosis through basking (i.e., the absence of sunny places or the climate being too dry for frogs to leave their places of shelter), as suggested to be the case in *Atelopus sp.* (*aff. varius*) from Monteverde, Costa Rica (Pounds and Puschendorf 2004).

Relating the "climate-envelope concept" to all *Atelopus* which have recently moved to Critically Endangered (Table 1), leave us with a strong evidence to support our assumption that this entire amphibian genus is close to extinction. This could be an example that expected climate-related extinctions are already underway (cf. Thomas *et al.* 2004a).

Whatever the reasons, harlequin frogs seem to represent the first documented case of extinctions currently taking place among a larger group of species belonging to a single evolutionary lineage. This may shift current biodiversity loss into a dimension resembling the extinctions documented for previous geological eras.

Table 1. Current IUCN Red List categories of the 74 described species of harlequin frogs, genus *Atelopus*, and their likely categories in 1980 (data taken from GAA database of March 2004).
Categorías actuales de las 74 especies descritas de *Atelopus* en la Lista Roja de la UICN, y sus categorías probables en 1980 (datos tomados de la base de datos del GAA de marzo 2004).

Category/categoría	2004	1980
Extinct/Extinto	2	0
Critically Endangered/En Peligro Crítico	61	0
Endangered/En Peligro	3	33
Vulnerable/Vulnerable	5	29
Near Threatened/Casi Amenazado	0	4
Least Concern/Preocupación Menor	0	5
Data Deficient/Datos Insuficientes	3	3

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LITERATURE CITED

Houlahan, J.E., C.S. Findlay, B.R. Schmidt, A.H. Meyer and S.L. Kuzmin. 2000. Quantitative evidence for global amphibian population declines. Nature 404:752-755.

IUCN. 2001. IUCN Red List categories, Version 3.1. IUCN. Gland/Switzerland. [http://www.redlist.org/info/categories_criteria2001.html]

La Marca, E. and S. Lötters. 1997. Population declines in Venezuelan *Atelopus* (Amphibia: Anura: Bufonidae). Pp. 207-213 *In* W. Böhme, W. Bischoff and T. Ziegler (eds.). Herpetologia Bonnensis. Societas Europeae Herpetologica. Bonn.

Lips, K., J.D. Reeve and L.R. Witters. 2003. Ecological traits predicting amphibian population declines in Central America. Conservation Biology 17:1078-1088.

Lötters, S. 1996. The Neotropical Toad Genus *Atelopus*. Vences & Glaw. Cologne.

Pounds, J.A., M.P.L. Fogden, J.M. Savage and J.C. Gorman. 1997. Tests of null models for amphibian declines on a tropical mountain. Conservation Biology 11:1307-1322.

Pounds, J.A., M.P.L. Fogden and J.H. Campbell. 1999. Biological response to climate change in a tropical mountain. Nature 398:611-615.

Pounds, J.A. and R. Puschendorf. 2004. Clouded futures. Nature 427:107-109.

Puschendorf, R. 2003. *Atelopus varius* (harlequin frog) - fungal infection. Herpetological Review 34:355.

Ron, S.R., W.E. Duellman, L.A. Coloma and M.R. Bustamante. 2003. Population decline of the jambato toad *Atelopus ignescens* (Anura: Bufonidae) in the Andes of Ecuador. Journal of Herpetology 37:116-126.

Stuart, S.N., J. Chanson, N. Cox and B. Young. In press. The IUCN Global Amphibian Assessment. IUCN - The World Conservation Union, Center for Applied Biodiversity Science at Conservation International, NatureServe. Washington.

Thomas, C.D, A. Cameron, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F.N. Erasmus, M. Ferreira de Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A.S. van Jaarsveld, G.F. Midgley, L. Miles, Mi.A. Ortega-Huerta, A.T Peterson, O.L. Phillips and S.E. Williams. 2004a. Extinction risk from climate change. Nature 427:145-148.

Thomas, J.A., M.G. Telfer , D.B. Roy, C.D. Preston, J.J. Greenwood, J. Asher, R. Fox, R.T. Clarke and J.H. Lawton. 2004b. Comparative losses of British butterflies, birds, and plants and the global extinction crisis. Science 303:1879-1881.

Vial, J.L. and L. Saylor. 1993. The status of amphibian populations. Declining Amphibian Populations Task Force, IUCN/SSC. Gland/Switzerland.

Wilson, E.O. 1992. The Diversity of Life. Harvard Univ Press. Cambridge/MA.