A Conservation Strategy for the Amphibians of Madagascar

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Update of the Global Amphibian Assessment for Madagascar in light of species discoveries, nomenclature changes, and new field information

ABSTRACT

We updated the Global Amphibian Assessment for Malagasy amphibians, including considerations on the species described or resurrected between 2005-2007, and newly available information on other taxa. The revised assessment allowed us to include 66 threatened species: 6 Critically Endangered, 31 Endangered, and 29 Vulnerable. Three species formerly assessed as Critically Endangered (*Mantella expectata, M. viridis,* and *Scaphiophryne gottlebei*) are downlisted to Endangered, since they are more widespread than formerly presumed. Other recently described species have been assessed as threatened: seven are categorised as Endangered (*Boophis tampoka, Gephyromantis azzurrae, G. runewsweeki, Mantidactylus noralottae, Tsingymantis antitra, Cophyla berara,* and *Plethodontohyla fonetana*), and a single species (*Boophis sambirano*) categorised as Vulnerable. The little known and enigmatic *Mantella manery,* formerly assessed as Data Deficient, has been recently found on the Tsaratanana Massif. In view of this enlarged distribution and ongoing degradation of the habitats where it lives, it has been re-assessed as Vulnerable.

Key words: Amphibians, Conservation, Global Amphibian Assessment, Madagascar, New assessment.

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INTRODUCTION

The Global Amphibian Assessment (http://www.globalamphibians.org/; Stuart et al., 2004) has proved to be a crucial tool in identifying and defining the conservation priorities for most of the world's amphibians. This global survey, undertaken with a large participation of the worldwide community of herpetologists, led to the compilation of an important fallout, the Amphibian Conservation Action Plan (Gascon et al., 2007), a keystone document towards advancing global and regional efforts for amphibian conservation.

Passing from a global to a more local scale, we here deal with the assessment of the highly diverse amphibians from Madagascar. In this country, an assessment of the global conservation status for the 220 species known from Madagascar in 2004, using the IUCN Red List Categories and Criteria, identified 9 Critically Endangered (CR) species, 21 Endangered (EN) species and 25 Vulnerable (VU) species (Andreone et al., 2005 a).

Furthermore, most of the amphibian conservation projects recently conducted in Madagascar were influenced by the ideas, suggestions and perspectives reported in Andreone et al. (2005 a). These include, for example, the contributions and conservation actions on the threatened *Mantella cowani* (Andreone & Randrianirina, 2003; Chiari et al., 2005; Rabemananjara et al., 2007 a)*, M. milotympanum* (Randrianirina, 2005; Vieites et al., 2005)*, M. aurantiaca* (Bora et al., 2008), *M. bernhardi* (Rabemananjara et al., 2005; Vieites et al., 2006)*, M. viridis, M. expectata,* and *Scaphiophryne gottlebei* (Andreone et al., 2005 b, c; Mercurio & Andreone, 2006). We may also affirm that the ACSAM (A Conservation Strategy for the Amphibians of Madagascar) initiative itself and the present volume took origin from the GAA initiative (Andreone et al., 2004; Moore, 2007).

We here present the facsimile reprint of the GAA paper in its integral form (Andreone et al., 2005 a). In fact, we believe that this important contribution is worth to be available to all those interested in the conservation of Malagasy amphibians. At the same time, we also wish to associate a relevant update on the species discovered and described since 2005, in light of new distribution and field information. In fact, several new species have been described, but the conservation status for only a few of them have so far been assessed. Furthermore, the important taxonomic work carried out by several of the contributors to the present volume led to the revalidation of some taxa that were not yet assessed.

The current paper is intended to provide the new categorisation of the current amphibian fauna. Moreover, for the species included in the Critically Endangered category we provide a summary of the advancement of the knowledge status. It is also worth stating the declaration by the Malagasy President Marc Ravalomanana to triple the existing coverage of the island 's protected network in the application of the so-called "Durban Vision " (Norris, 2006; Andreone & Randriamahazo, 2008). Therefore, we also update the species' occurrence within the new system of protected areas.

MATERIAL AND METHODS

The analysed species

The species presented and assessed in this contribution are those formally described by 31st December 2007. We explicitly excluded from our analysis other species not yet described at that time, although it is evident that many unknown and informally described species are already known, as shown from the overview of the most recent field guide by Glaw & Vences (2007 b).

In total, we reviewed 238 species (Andreone et al., 2008). The updated list of the threatened species (included in the IUCN categories CR, EN, VU), associated to nomenclatural changes, is provided in Tab. I. Fifteen species (8 mantellids and 7 microhylids) were described from 2005 to the 31st December 2007. They are here listed with considerations on their conservation status and categorization assessment. Then, five mantellid species were resurrected from synonymy, and thus deserve conservation categorisation. Several other species are now better known in terms of distribution, ecology and conservation biology. This leads to some updates and changes in their status as follows. Finally, for some of the Critically Endangered species more data have been accumulated.

Taxonomy and nomenclature

We followed the recent taxonomic contributions by Glaw & Vences (2006) and Frost et al. (2006), integrated within the most recent opinions (e.g., Glaw & Vences, 2007 b). In terms of distribution we took into consideration all the data provided by Andreone et al. (2005 a) and subsequently provided either under the GAA website or on the IUCN red-list website (http://www.iucnredlist.org/). For some of the nine Critically Endangered species defined by Andreone et al. (2005 a) we added information and distribution changes summarised by Glaw & Vences (2007 b), integrated by unpublished data.

Assessment of the conservation status

The analysis of the conservation status was carried out on the basis of a revised distribution and updated knowledge since 2005. After this, we provided further contributions and comments. In general there was full consensus among the authors about the conservation status of most species, but in a few cases the classification represents a majority agreement. This is mainly due to the fact that the distribution knowledge is often fragmentary and the perception of threats affecting the different species is heterogeneous. We provide the rationale for each classification in the following chapters.

Used abbreviations

Abbreviations used in this paper are as follows: GAA, Global Amphibian Assessment; ACSAM, A Conservation Strategy for the Amphibians of Madagascar; CR, Critically Endangered (species); EN, Endangered (species); VU, Vulnerable (species); NT, Near Threatened (species); LC, Least Concern (species); DD, Data Deficient (species); AOO, Area of Occupancy (of a species); EOO, Extent of Occurrence (of a species).

SPECIES	FORMER DENOMINATION	FAMILY
CRITICALLY ENDANGERED		
Boophis williamsi		Mantellidae
Mantella aurantiaca		Mantellidae
Mantella cowani		Mantellidae
Mantella milotympanum		Mantellidae
Mantidactylus pauliani		Mantellidae
Stumpffia helenae		Microhylidae
ENDANGERED		
Aglyptodactylus laticeps		Mantellidae
Boehmantis microtympanum	*Mantidactylus microtympanum*	Mantellidae
Boophis tampoka		Mantellidae
Gephyromantis azzurrae		Mantellidae
Gephyromantis corvus	*Mantidactylus corvus*	Mantellidae
Gephyromantis horridus	*Mantidactylus horridus*	Mantellidae
Gephyromantis runewsweeki		Mantellidae
Gephyromantis silvanus	*Mantidactylus silvanus*	Mantellidae
Gephyromantis webbi	*Mantidactylus webbi*	Mantellidae
Mantella bernhardi		Mantellidae
Mantella crocea		Mantellidae
Mantella expectata * [CR]		Mantellidae
Mantella viridis * [CR]		Mantellidae
Mantidactylus madecassus		Mantellidae
Mantidactylus noralottae		Mantellidae
Spinomantis brunae	*Mantidactylus brunae*	Mantellidae
Spinomantis guibei	*Mantidactylus guibei*	Mantellidae
Spinomantis microtis	*Mantidactylus microtis*	Mantellidae
Tsingymantis antitra		Mantellidae
Anodonthyla rouxae		Microhylidae
Cophyla berara		Microhylidae
Madecassophryne truebae		Microhylidae
Platypelis alticola		Microhylidae
Platypelis mavomavo		Microhylidae
Platypelis milloti		Microhylidae
Platypelis tetra		Microhylidae
Plethodontohyla brevipes		Microhylidae
Plethodontohyla fonetana		Microhylidae
Plethodontohyla guentherpetersi		Microhylidae
Scaphiophryne boribory		Microhylidae
*Scaphiophryne gottlebei** [CR]		Microhylidae
VULNERABLE		
Boophis andreonei		Mantellidae
Boophis blommersae		Mantellidae
Boophis haematopus		Mantellidae
Boophis jaegeri		Mantellidae
Boophis sambirano		Mantellidae
Gephyromantis ambohitra	*Mantidactylus ambohitra*	Mantellidae
Gephyromantis klemmeri	*Mantidactylus klemmeri*	Mantellidae
Gephyromantis rivicola	*Mantidactylus rivicola*	Mantellidae
Gephyromantis salegy	*Mantidactylus salegy*	Mantellidae
Gephyromantis schilfi	*Mantidactylus schilfi*	Mantellidae
Gephyromantis striatus	*Mantidactylus striatus*	Mantellidae
Gephyromantis tandroka	*Mantidactylus tandroka*	Mantellidae
Mantella haraldmeieri		Mantellidae
Mantella madagascariensis		Mantellidae

RED LIST CRITERION	PET TRADE	CITES APPENDIX	PROTECTED AREAS
B1ab(iii)+2ab(iii)			*
B2ab(iii, v)	+	II	*
A2acd + B2ab(iii)	+	II	*
B2ab(iii)	+	II	*
B2ab(iii)			*
B2ab(iii)			+
B1ab(iii)			+
B2ab(iii)			+
B2ab(iii)			+
B2ab(iii)			+
B2ab(iii)			+
B1ab(iii)			+
B2ab(iii)			*
B1ab(iii) + 2ab(iii)			+
B1ab(iii) + 2ab(iii)			+
B2ab(iii, v)	+	II	+
B1ab(iii, v) + 2ab(iii, v)	+	II	+
B2ab(iii, v)	+	II	+
B2ab(iii)	+	II	*
B1ab(iii) + 2ab(iii)			+
B2ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B2ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii, v)	+		
B2ab(iii, v)	+	II	+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)			+
D2			+
B1ab(iii)			+
B1ab(iii)			+
B1ab(iii)	+	II	+
B1ab(iii)	+	II	+

Mantella haraldmeieri		Mantellidae
Mantella madagascariensis		Mantellidae
Mantella manery * [DD]		Mantellidae
Mantella pulchra		Mantellidae
Mantidactylus delormei #		Mantellidae
Spinomantis elegans	*Mantidactylus elegans*	Mantellidae
Spinomantis massorum	*Mantidactylus massorum*	Mantellidae
Anodonthyla montana		Microhylidae
Platypelis tsaratananaensis		Microhylidae
Plethodontohyla tuberata		Microhylidae
Rhombophryne coronata	*Plethodontohyla coronata*	Microhylidae
Rhombophryne coudreaui	*Plethodontohyla coudreaui*	Microhylidae
Rhombophryne serratopalpebrosa	*Plethodontohyla serratopalpebrosa*	Microhylidae
Rhombophryne testudo		Microhylidae
Scaphiophryne menabensis		Microhylidae
Scaphiophryne marmorata		Microhylidae
Stumpffia pygmaea		Microhylidae

Tab. I. Threatened Malagasy amphibians included in IUCN Red List Categories Critically Endangered, Endangered and Vulnerable), with information on Red List Criteria (explained in IUCN (2007), occurrence in the pet trade, listing on the Appendices of CITES, and their occurrence in protected areas (* = in newly created protected areas). New species described since 2005 are

RESULTS

Recently described species

Boophis axelmeyeri is currently known from the massifs of Tsaratanana, Manongarivo, and Marojejy (Vences et al., 2005 a, b; Glaw & Vences, 2007; Andreone et al., in press). Further observations (F. Andreone, unpublished) suggest its likely presence at Anjanaharibe-Sud, Ambolokopatrika-Betaolana ridge, and Masoala (Andreone et al., 2000). Thus, *Boophis axelmeyeri* is here listed as VU because its EOO is less than 20,000 km^2, it is known from fewer than ten locations, and there is continuing decline in the extent and quality of its habitat in northern Madagascar.

Boophis tampoka. This green *Boophis* was unexpectedly found at Tsingy de Bemaraha, a protected area in western Madagascar (Köhler et al., 2007). We consider it as a Bemaraha endemic and infer that its potential distribution includes only forest habitat along streams of this area. The potential threats are due to ongoing habitat degradation, largely through general deforestation, overgrazing of vegetation by cattle, and water pollution Similarly to other species restricted to arid areas we ascribe it to the EN category because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat.

Gephyromantis azzurrae is known only from the arid Isalo Massif (Mercurio & Andreone, 2007). We infer that its potential distribution includes forest habitats along streams of the Isalo area, within and outside the protected area boundaries (Mercurio et al., 2008). In its original description it was tentatively categorised as

B1ab(iii)	+	II	+
B1ab(iii)	+	II	+
B1ab(iii)			+
B1ab(iii)	+	II	+
B1ab(iii)			+
B1ab(iii) + 2ab(iii)			+
B1ab(iii) + 2ab(iii)			+
D2			+
B1ab(iii)			+
B1ab(iii)			+
B2ab(iii)			
B1ab(iii)			+
B1ab(iii)			+
D2			+
B2ab(iii)			+
B1ab(iii)	+		+
D2			+

reported in bold; # revalidated species; species marked with asterisk (*) are those whose categorization has been changed since the paper by Andreone et al. (2005 a). Their former assessment is reported between square parentheses.

CR, but on further review, we here list it as EN because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitats.

Gephyromantis runewsweeki. It is known only from Ranomafana (Vences & de la Riva, 2007). The authors originally categorized this species as NT. However, despite its characteristic calls it has only been recorded from the type locality and a second site where it is apparently very rare. For this reason, we recategorise it as EN because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations, and there is probably a continuing decline in the extent and quality of much of its habitat.

Guibemantis timidus was not assessed in terms of conservation status by the describers (Vences & Glaw, 2005 b). Its distribution is sufficiently large and the species is apparently able to adapt to rather degraded habitats (F. Andreone, unpublished). It occurs in at least two protected area (Manombo Special Reserve: M. Vences, unpublished; Betampona Strict Nature Reserve: F. Andreone and G. Rosa, unpublished). Therefore, it is listed as LC since it is locally abundant, tolerant of a high degree of habitat disturbance, and not believed to be declining.

Mantidactylus noralottae was described from a single Isalo locality (Mercurio & Andreone, 2007). We infer that its potential distribution includes the whole Isalo area, within and outside the protected area boundaries (Mercurio et al., 2008). Similarly to *Gephyromantis azzurrae* it was originally assessed as CR, but we here list it as EN because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat.

Tsingymantis antitra. This peculiar species was recently found in the Ankarana area (NW Madagascar), and it represents a very ancient relict lineage (Glaw et al., 2006; Kurabayashi et al., 2008). It was categorised as EN. We here confirm this assessment, since its EOO is less than 5,000 km^2, all individuals are in fewer than five locations (currently it is known from two sites), and there is continuing decline in the extent and quality of its habitat".

Anodonthyla hutchisoni. This species is apparently restricted to the Masoala Peninsula, NE Madagascar (Fenolio et al., 2007). There, it is known from five localities, although it is likely that it is more widespread. The authors categorised the species as DD, due to the fact that it could be potentially present at other sites of Masoala. We confirm this assessment since there is still very little known about its distribution. If it will be confirmed at other Masoala sites it is likely that it should be categorised as LC.

Anodonthyla moramora, known from Ranomafana area (E Madagascar), was declared as potentially NT (Glaw & Vences, 2005). We here categorise the species as DD, since there is still very little known about its status and ecological requirements.

Cophyla berara is known only from the Sahamalaza Peninsula, NW Madagascar (Vences et al., 2005 a). Although surveys at other north-western sites did not yield any further findings (Andreone et al., in press) we here list *C. berara* as EN because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations (actually only a single locality is currently known), and there is continuing decline in the extent and quality of its forest habitat.

Paradoxophyla tiarano. Andreone et al. (2006) found this species at a single site of Masoala, NE Madagascar. For this they categorised it as DD. We confirm this listing since it has only recently been described, and there is still very little known about its distribution, status and ecological requirements.

Plethodontohyla fonetana. Described from the Bendrao Forest in the Tsingy de Bemaraha National Park (W Madagascar), it is currently one of the few cophyline microhylids occurring in the arid west (Glaw et al., 2007; Andreone & Randrianirina, 2008). The authors categorised the conservation status as DD. We here list it as EN because its EOO is less than 5,000 km^2, all individuals are in fewer than five locations (actually only one locality is currently known), and there is continuing decline in the extent and quality of its forest habitat in the Tsingy de Bemaraha, especially by zebu grazing.

Plethodontohyla guentheri. This species is currently known only from Marojejy (NE Madagascar) and has been categorized as DD (Glaw & Vences, 2007 a). Although its presence has been confirmed at Anjanaharibe-Sud (F. Andreone, unpublished), we confirm its listing as DD since there is still very little known about its distribution, status and ecological requirements.

Scaphiophryne menabensis is known mainly from the Menabe area, W Madagascar (Glos et al., 2005), although it was reported from Tsingy de Bemaraha, Isalo and other apparently isolated western areas (Glaw & Vences, 2007 b; Mercurio et al., 2008). We therefore assess it as VU, since its AOO is very small (< 2,000 km^2) and its habitat is in decline.

Revalidated species

Mantella ebenaui. This species was recently differentiated from *M. betsileo,* of which it represents the northern relative (Rabemananjara et al., 2007b; Glaw & Vences, 2007). It is listed as LC in view of its wide distribution, adaptation to a broad range of habitats, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category.

Mantidactylus bellyi. Formerly considered conspecific with *Mantidactylus curtus* (Glaw & Vences, 2006). Listed as LC because it has a likely wide distribution in N Madagascar (e.g., Ankarana, Montagne d'Ambre, and Montagne des Français), it is apparently rather tolerant of habitat degradation, has presumably large populations, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category.

Mantidactylus bourgati. Formerly included within *Mantidactylus curtus* (Glaw & Vences, 2006). Only known from the Andringitra Massif (SE Madagascar). Listed as DD since it has only recently been revalidated, and there is still very little known about its status and ecological requirements.

Mantidactylus cowanii. Until recently included within *Mantidactylus lugubris* (Glaw & Vences, 2006), it is apparently exclusive of the high plateau (e.g., Ambohitantely, Antoetra, and Mantadia). Listed as NT since although it is relatively widely distributed, it lives along fast-flowing stretches of streams and waterfalls only, and its AOO is probably not much larger than 2,000 km^2, and the extent and quality of its habitat is declining, thus making the species close to qualifying for VU.

Mantidactylus delormei. Previously included within *Mantidactylus brevipalmatus* (Glaw & Vences, 2006). Only known from the Andringitra Massif and the Maharira Forest (SE Madagascar). Anyhow, it is probably not so rare in highland forests between Andringitra and Ranomafana. Listed as VU, in view of its EOO of less than 20,000 km^2, with all individuals in fewer than ten locations, and a continuing decline in the extent and quality of its habitat.

Species with revised conservation status

Mantella expectata. Until recently, this mantella was known from only a few localities of the Isalo Massif (S Madagascar), and considered to be subject to heavy collection for pet-trade. Then its EOO was estimated to be less than 100 km^2, with all individuals considered to be in a single location, and with a continuing decline in the extent and quality of its habitat. For these reasons it was classified as CR (Andreone et al., 2005 a). Subsequently, through recent survey work (Mercurio et al., 2008; Crottini et al., submitted), *M. expectata* has been found in many other Isalo sites, from the southernmost border to the north of the massif. The final distribution area is now recognised as being much wider than 100 km^2. Recent genetic work undertaken by Rabemananjara et al. (2007b) also indicates that populations from Tsingy de Bemaraha and from other western sites should possibly be considered to be a distinct species. In view of these findings, we follow Mercurio et al. (2008) and consider as *M. expectata* s.str.

only the Isalo populations, in large part characterised by males with blue legs. For all these reasons we here reclassify *M. expectata* in the EN category, as it has an EOO of >5,000 km^2 and populations are likely fragmented.

Mantella manery. This species was known from only a few individuals found at a low altitude forest of the Marojejy Massif, NE Madagascar (Glaw & Vences, 2007 b). For this reason it was classified as DD. More recently the species was also located at Tsaratanana (NW Madagascar) (N.H.C. Rabibisoa and C.J. Raxworthy, unpublished). In view of this new information, we recategorise it as VU because its EOO is less than 20,000 km^2, only two populations are known and there is continuing decline in the extent and quality of its assumed habitat in northern Madagascar.

Mantella viridis. This mantella from N Madagascar was formerly classified as CR due to its restricted distribution and intense collecting activity (Andreone et al., 2005 a). Surveys undertaken by V. Mercurio in 2004-2005 (Mercurio & Andreone, 2008), F. Glaw and J. Köhler (2007, unpublished) and others (Metcalf et al., 2007) have shown that the species has an EOO that is much larger than 100 km^2. In addition, genetic work done by Rabemananjara et al. (2007b) showed that populations from Ankarana are also rather close to those from Montagne des Français and Antongombato, thus indicating a much wider distribution of this species. *Mantella viridis* is here recategorised as EN because its EOO is less than 5,000 km^2, it is severely fragmented, and there is continuing decline in the extent and quality of its habitat.

Scaphiophryne gottlebei. This endemic frog of the Isalo Massif (S Madagascar) was also formerly categorised as CR (Mercurio et al., 2008; Crottini et al., submitted), due to narrow distribution and threats due to collecting activity. Similarly to *M. expectata,* the number of locations for *S. gottlebei* is now recognised to be higher than believed. It is here classified as EN, since its EOO is less than 5,000 km^2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat around Isalo. It is possibly subject to over-collecting for the pet trade leading to a decline in the number of mature individuals. Further investigations of this possible threat are necessary.

New data on the critically endangered species

Mantella aurantiaca. Recent reports of this frog in E Madagascar clearly indicate that the golden mantella is more widespread than formerly believed. New population discoveries of *M. aurantiaca* are being compiled to provide a more complete assessment of the AOO of these species (Bora et al., 2008). A conservation survey of *M. aurantiaca* in 2008 by the NGO Madagasikara Voakajy allowed to confirm over 20 populations of this species and identified a cluster of sites in the forests south of Moramanga (R. K. B. Jenkins, pers. comm.). These forests are currently unprotected and are under severe pressure but should be considered priority sites for the conservation of *M. aurantiaca.*

Mantella cowani. The harlequin mantella is known from only a few sites from the high plateau, central Madagascar (Andreone & Randrianirina, 2003;

Chiari et al., 2005). Listed by Andreone et al. (2005 a) as CR because its AOO was considered less than 10 km^2, its distribution was severely fragmented, the extent of its habitat was declining; and also because of a drastic population decline, estimated to be more than 80% over the last three generations, inferred from observed shrinkage in distribution and declines in the number of mature individuals, anecdotal information on habitat destruction and/or degradation, and from levels of exploitation inferred from the numbers of animals in international trade. Although some data on the species' occurrence were provided by Andreone et al. (2007), and new sites have been recently found at Itremo (C. J. Randrianantoandro, unpublished), this results in no change to its threat categorisation.

Mantella milotympanum. Individuals with the typical red colouration come from Fierenana (E Madagascar), while populations intermediate with *M. crocea* are known from several other sites, e.g., Andriabe and Sakavoakina, thus showing that there is not a reliable method to distinguish these colour morphs as separate species. Seen these difficulties in terms of identification, and substantial genetical identity with *M. crocea*¸ it is likely that in the future the conservation status of *M. milotympanum* will be reconsidered. Some studies have been conducted on the species abundance and distribution at Fierenana (Randrianirina, 2005; Vieites et al., 2005; Bora et al., 2008).

Boophis williamsi. So far, very little is known about the distribution and ecological requirements of this species. It is apparently restricted to a few altitude streams of the Ankaratra Massif (central-eastern Madagascar). Urgent actions are therefore needed to protect the species' stream habitats and to unveil its habitat requirements.

Mantidactylus pauliani. This montane frog is also known only from the Ankaratra Massif. Conservation activities, in particular the protection of important stream habitats, are urgently needed.

Stumpffia helenae. This small terrestrial frog species remains known only from Ambohitantely Special Reserve (central Madagascar). Surveys at other potential localities on the high plateau have yet to reveal any additional populations.

DISCUSSION

A new assessment for the amphibians of Madagascar

Taking into account the current total of 238 species (at May 2008), the number of threatened species (CR + EN + VU) sums up to 66, thus representing the 27.7% of the whole Malagasy amphibian fauna. This is only slightly different from the 25% given by Andreone et al. (2005 a) for a total number of 220 species.

Since the publication of the GAA paper in 2005, specifically addressed studies have been carried out on some threatened species, such as *Mantella cowani, M. expectata, M. viridis, M. aurantiaca, M. milotympanum* and

Scaphiophryne gottlebei (Andreone & Randrianirina, 2003; Chiari et al., 2005; Bora et al., 2008; Mercurio et al., 2008).

One important fallout of these studies is that three of the formerly CR species have been downgraded to EN, *Mantella expectata, M. viridis* and *Scaphiophryne gottlebei.* As stressed the rationale for these changes is mainly based on the fact that they have a distribution larger than formerly believed. This means that, although threats were not removed, a better comprehension of their distribution was necessary to realistically assess their conservation category. Moreover, they also have a rapid generation period and comparatively short life span (F.M. Guarino and F. Andreone, unpublished). For this reason both *M. expectata* and *M. viridis* are likely species that could better support the take off for the pet-trade under carefully managed and monitored programs to be defined according to the Action Plan addressed to the amphibians of Madagascar (see also Rabemananjara et al., 2008).

Scaphiophryne gottlebei appears more ecologically specialised than *M. expectata* and *M. viridis,* since it lives within the more stable canyon habitats, and tadpoles develop in deep pools within canyons (Mercurio & Andreone, 2006; Mercurio et al., 2008). Due to its chromatic attractiveness it is currently exported for the pet-trade. Surprisingly enough, up to now no data is published on the captive breeding. A reproduction event in captivity occurred in London Zoo, but tadpoles did not complete their development (R. D. Gibson, unpublished). Due to this difficulty in obtaining captive breeding success, we recommend that it is maintained with a rather low number of allowed export animals per year (1000).

The downlisting of these three species is based on new data on distribution and life-history and a different interpretation of the impact of pet-trade. The effect of pet-trade on the conservation status of many species currently considered as threatened is indeed still controversial, and up to now little data are available for Madagascar (Andreone et al., 2005 b). We recommend investigating this aspect in the future.

Several other species from relatively arid environments are now included within the EN category: *Gephyromantis corvus, Mantidactylus noralottae, Tsingymantis antitra, Plethodontohyla fonetana* and *Boophis tampoka.* All these species share a similar situation in terms of distribution and threats. A special attention should be paid in the future on the species from the western and arid sites, since they are in general less known than species from rainforests and since threats are more difficult to assess.

The need for further studies on threatened species

Seen the current knowledge further field studies should be carried out on the CR species. We recommend studying the distribution of *Mantella cowani* and to develop management plans for its main habitats. The realisation of a protected area destined to *M. cowani* and/or to other amphibians is crucial, especially when not yet included in the protected area network (Rabemananjara et al., 2008 b).

A special attention is to be paid to three species that actually are poorly known: *Boophis williamsi, Mantidactylus pauliani* and *Stumpffia helenae.* These CR species are indeed to be studied, since almost nothing is known for their distribution and life history traits. The former two species are among the few Malagasy amphibians which do not occur in any existing protected area (although the sites where they live are scheduled to become future protected areas). Again, very few data are available on distribution and ecological requirements of *Stumpffia helenae*. For this, we strongly advocate collecting basic data on their distribution and biology (e. g. activity, sex ratio, egg number and longevity) that will become useful to establish conservation priorities and to estimate extinction probabilities.

Mantella aurantiaca and *M. milotympanum* should also better studied in terms of recovering capacity after collecting for the pet-trade. The effect of pet-trade on the conservation status of these frogs is currently little known: this aspect is worth to be urgently analysed to warrant the definition of quotas of exportable individuals based on scientific data collected in the wild (Carpenter et al., 2008).

Because new CR and EN species have been added to the GAA list, it is evident that studies and surveys should be promoted on them. Anyhow, a further important issue regards the need to carry out research on the DD species. For most of these species the information is really limited and this obscures their real conservation status. We advocate that, in parallel to research conducted on threatened species a special attention is paid to little-known species and funds should be made available to collect new field data so that their conservation status might be better understood..

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RÉSUMÉ

Mise-au-jour du Global Amphibian Assessment pour Madagascar sur la base des récentes découvertes d'espèces, des changements nomenclaturels et sur les informations d'histoire naturelle.

Nous avons mis au jour le Global Amphibian Assessment, en tenant conte des découvertes de nouvelles espèces à partir du 2005, avec informations sur la distribution et sur leur abondance. La nouvelle catégorisation comprends 6 espèces Menacées critiquement (CR), 31 espèces Menacées (EN), et 29 espèces Vulnérables (VU). Trois espèces considérées en précédence comme Menaces critiquement (*Mantella expectata, M. viridis, Scaphiophryne gottlebei*) sont maintenant re-catégorisées comme Menacées. Cette variation est due au fait que elles vivent dans une aire plus vaste que celle auparavant reconnue. Des autres espèces décrites recemment ont eté classées comme Menacées (*Boophis tampoka, Gephyromantis azzurrae, G. runewsweeki, Mantidactylus noralottae, Tsingymantis antitra, Cophyla berara* et *Plethodontohyla fonetana*), et une comme Vulnerable (*Boophis sambirano*). Un'espèce très enigmatique, *Mantella manery, en* precedence classes comme Données insuffisantes, a eté recemment trouvée sur le Massif du Tsaratanana Massif. Sur la base de cette distribution enlargie, il a eté classée comme Vulnerable.

Mots clés: Amphibiens, Conservation, Global Amphibian Assessment, Madagascar, Nouvelle catégorisation.

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ADDENDUM

Together with the current contribution we here report the facsimile reprint of the original Global Amphibian Assessment for Madagascar, published in 2005. This must be intended as a "special service" for the readers of the ACSAM book, due to the fact that this paper is an important step in the knowledge of the amphibians of Madagascar and their conservation.