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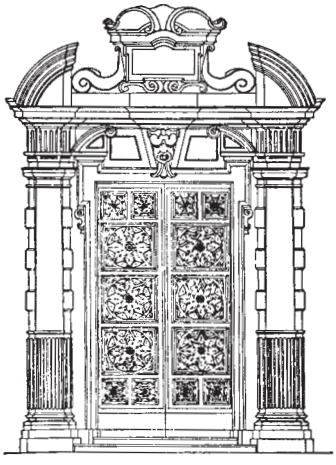
A Conservation Strategy for the Amphibians of Madagascar

Franco Andreone
(Editor)



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ISSCA International Society for the Study and Conservation of the Amphibians
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A Conservation Strategy for the Amphibians of Madagascar

Idea and project by
Franco Andreone

Foreword by
Russell A. Mittermeier and Claude Gascon

Introduction by
Charles P. Blanc and Rose M. A. Blommers-Schlösser

Contributions by
Franco Andreone, Luciano Andriamaro, M. Nandrianina Andrianasolonjatovo, Gennaro Aprea, Olvier Behra, Richard Berridge, Lise Bock, Parfait Bora, Robert Bourou, Angus I. Carpenter, Ylenia Chiari, Jamie Copsey, Angelica Crottini, Kathrin H. Dausmann, Rainer Dolch, Louis Du Preez, Joanna Durbin, Samantha Earle, Rollande Finoana, Karen Freeman, Samuel C. Furrer, Gerardo García, Claudia Gili, Frank Glaw, Julian Glos, Richard K. B. Jenkins, Olga Jovanovic, David H. Knox, Jörn Köhler, K. Eduard Linsenmair, Fabio Mattioli, Joseph R. Mendelson III, Vincenzo Mercurio, Robin D. Moore, Harison Rabarison, Andriamanana Rabearivelo Nirhy Rabibisoa, Falitiana C.E. Rabemananjara, Liliane Raharivololoniaina, Zo Lalaina Rakotobe, Daniel Rakotondravony, Malalan'Ny Aina A. Rakotondrazafy, Noromalala Rasoamampionona Raminosoa, Roseline L. Rampiliamanana, Edouard Randriamitso, Harison H. Randrianasolo, Roma Randrianavelona, Roger-Daniel Randrianiaina, Jasmin E. Randrianirina, Noromalala Rasoamampionona Raminosoa, Olga Ravoahangimalala Ramilijaona, Christopher J. Raxworthy, Tokihery J. Razafindrabe, Onja Robson, Josef Straka, Meike Teschke, Denis Vallan, Miguel Vences, Anselme Toto Volahy, David R. Vieites, Ché Weldon, Katharina, K. Wollenberg, Richard Young

Franco ANDREONE
Sezione di Zoologia
Museo Regionale di Scienze Naturali
Via G. Giolitti, 36
10123 Torino, Italy
franco.andreone@regione.piemonte.it
www.francoandreone.it

Amphibian Specialist Group
Chair for Madagascar
www.sahonagasy.org

SOMMARIO

To Kintana Azzurra,
Serena Crystal Vatosoa,
Marie Olga,
Bruna

A northern tomato frog, *Dyscophus antongilii*, photographed at Maroantsetra. This is maybe one of the best known frogs of Madagascar.

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During the realization of this volume and the preparation of the associated ACSAM Initiative many people contributed with direct assistance and exchange of opinions. My thanks are especially addressed to all the contributors of the present volume: most of them actively participated to the workshop held in Antananarivo 18-21 September 2006, while others joined us later with further data and discussions. Major thank to the several institutions and organizations that supported logistically and economically the workshop and associated events. In particular, Conservation International covered most of the expenses for the invited speakers, while the other NGOs and institutions helped in several ways. Without the illuminated stimulus of Russ Mittermeier and Olivier Langrand it would have been impossible to realize such an important meeting. I am also keen to acknowledge the very useful exchange of opinions and discussions I had with the close circle of colleagues and friends, such as Frank Glaw, Vincenzo Mercurio, Nirhy Rabibisoa, Herilala Randriamahazo, Jasmin E. Randrianirina, Denis Vallan, and Miguel Vences. Many institutions supported logistically and economically my research activities in Madagascar and during the ACSAM. It is a pleasure to thank: Acquario di Genova, Antongil Conservation, BIOPAT, Conservation International, Declining Amphibian Population Task Force and Amphibian Specialist Group, Durrell Wildlife Conservation Trust, EAZA, Gondwana Conservation and Research, International Society for the Study and Conservation of Amphibians, Istituto Oikos, Madagascar Fauna Group, Ministère de l'Environnement et des Eaux et Forets, Museo Regionale di Scienze Naturali and Regione Piemonte, Nando Peretti Foundation, National Amphibian Conservation Center, Parc Botanique et Zoologique de Tsimbazaza, Parco Natura Viva, Società Zoologica La Torbiera, Societas Herpetologica Italica, Université d'Antananarivo (Département de Biologie Animale), Van Thienhoven Foundation, WAZA, Wildlife Conservation Society, WWF, Zoo Project, Zoo Zürich. The Malagasy institutions helped with assistance and delivering the due authorizations in the course of fieldwork and facilitating the administrative needs. Thanks to Blackwell Publishing for having allowed to reprint the Conservation Biology paper. Last but not least, a special "grazie" and "misaotra" to all my family.

Franco ANDREONE

FOREWORD

The decline and extinction of amphibians that is sweeping the globe is unlike anything humans have witnessed since our arrival on earth. With almost a third of approximately 6,000 described species listed as Threatened by the IUCN, we teeter on the brink of a mass extinction spasm affecting an entire class of vertebrates. We are truly entering a new era in conservation, in which novel threats such as climate change and emerging disease combine with traditional factors such as habitat loss, pollution and over-harvesting to produce a lethal cocktail of threats that does not respect political or protected area boundaries. To stem the current amphibian extinction crisis, the global community must respond in a truly innovative and multidisciplinary fashion and at an unprecedented scale.

In a bid to catalyze a unified global strategy for amphibian conservation, the IUCN/SSC Amphibian Specialist Group (ASG) recently published the Amphibian Conservation Action Plan or ACAP (available at www.amphibians.org) the proceedings of an Amphibian Conservation Summit convened by IUCN and Conservation International in Washington, DC in September, 2005. The ACAP presents an ambitious but realistic five-year program to combat amphibian declines and extinctions around the world. It is designed to serve as a template for action that can be adopted by a multitude of stakeholders from all scales from global to local.

The ACSAM represents an effort to implement the ACAP at a regional scale and promises to serve as a model for similar initiatives across the globe. The effort is both timely and critically important, being in a top priority region. Madagascar boasts more than 235 described amphibian species, over 99% of which are endemic, and at least as many more await description. As a country it consistently falls in the top dozen in the world for total number of amphibian species (12^{th}), number of threatened species (11^{th} =) and number of endemics (4^{th}). With the new species currently awaiting description, these figures will likely increase dramatically in the near future.

Fortunately, we now have great opportunities to advance amphibian conservation in this country. President Marc Ravalomanana's commitment to triple protected area coverage – the Durban Vision – opens the door to including many new priority areas, including those for amphibian. An emerging fungal disease that has decimated amphibian populations in other parts of the world appears to be absent on Madagascar according to initial tests on Malagasy frogs – at least for the moment, giving us the opportunity to be proactive and get ahead of the curve. The ACSAM provides the perfect vehicle for seizing these and other opportunities for integrating amphibian conservation into national initiatives.

ACSAM is a reflection of what can be achieved by a small number of dedicated and passionate individuals who are committed to making a change, and we are proud to be a part of this globally important effort.

Russell A. MITTERMEIER
President, Conservation International

Claude GASCON
Senior Vice-President, Regional Programs Division,
Conservation International

INTRODUCTION

C'est avec gratitude que nous répondons favorablement à la demande de notre Collègue Franco Andreone de rédiger, de conserve, une brève introduction à son ouvrage sur la conservation des Amphibiens.

L'organisation à Madagascar d'un Workshop dédié à la Conservation des Amphibiens est un évènement scientifique dont nous apprécions toute l'importance. Nous y avons été d'autant plus sensibles que notre position, dans le cours des recherches scientifiques qui se sont déroulées sur ces animaux, nous permet de mesurer l'ampleur du chemin parcouru au cours de ces quarante dernières années. Cette fascinante perspective chronologique montre combien l'inventaire des espèces a progressé. Mais aussi, et peut-être surtout, combien les idées, les concepts, les objectifs de recherche ont changé. Enfin, combien les moyens, humains et matériels, qui leur ont été consacrés se sont accrus.

Dans une première étape, la connaissance des Amphibiens a dépendu essentiellement de l'opportunité de missions de terrain occasionnelles effectuées par des chercheurs, en général européens, et des collectes aléatoires de voyageurs ou de résidents amateurs qui se passionnaient pour telle ou telle composante de la faune malgache lorsqu'ils réussissaient à établir une relation suivie avec un laboratoire susceptible de déterminer et décrire leurs trouvailles.

Dans ces conditions, l'inventaire progressait lentement, irrégulièrement, selon les disponibilités des uns et des autres, au hasard de publications dispersées, parfois difficiles à identifier et à se procurer. Mais les données biologiques ou écologiques restaient fort incomplètes et disparates, limitées assez souvent à des indications aussi vagues que le nom d'un village ou d'une ville voisine du point de collecte, ou même simplement du pays, et parfois entachées d'erreurs quand des collections étaient mélangées par inadvertance.

Dans ce contexte, les problèmes de conservation des espèces n'étaient guère évoqués. Mais ils ne se posaient alors souvent pas avec la même acuité qu'actuellement.

Nous avons eu la chance de résider chacun plusieurs années à Madagascar au cours de la décennie 1962-1973, soit comme chercheur libre à l'ORSTOM (R.B.), soit comme Maître-Assistant dans la toute jeune Université de Madagascar (C.B.).

R.B. a eu l'occasion d'étudier pendant presque trois ans (1970-1973) la biosystématique et l'histoire naturelle des Amphibiens. Tandis que l'analyse des chromosomes et de l'ADN lui a permis de résoudre maints problèmes, accumulés depuis plus de cent années, relatifs à l'identification taxonomique et à l'établissement des affinités phylogénétiques, le succès d'une soixantaine d'élevages, qu'elle a conduits du stade têtard jusqu'au stade adulte, signait le début des connaissances écologiques sur ce groupe riche en espèces endémiques.

Les descriptions des biotopes des deux stades, aquatique et terrestre, des coassements (sonogrammes), des têtards et parfois des subadultes ont été une aide pour les chercheurs lui ont succédé, comme Frank Glaw, Miguel Vences et Franco Andreone. Ce travail a culminé en une thèse.

La création d'enseignements et d'activités pédagogiques adaptés au pays occupèrent la majeure partie du temps et des efforts de C.B. Le reste fut consacré à la réalisation d'une thèse sur les Iguanidés endémiques. Des échantillonnages d'Amphibiens ont pu être réalisés au cours de ses divers séjours sur le terrain, notamment dans le cadre du programme du CNRS sur les écosystèmes montagneux de Madagascar.

L'intérêt scientifique restait alors focalisé sur les progrès nécessaires de la systématique encore imparfaite et très incomplète des Amphibiens, comme en témoigne la synthèse taxonomique, qui intègre l'essentiel des collectes ainsi réalisées, proposée par le Professeur Jean Guibé (1978) dans son ouvrage «Les Batraciens de Madagascar».

La notion de conservation, à cette époque, reposait essentiellement sur la création d'un ensemble d'aires protégées où les activités anthropiques étaient soit proscrites (Réserves naturelles intégrales) soit limitées (Parcs nationaux, Réserves spéciales, Réserves de faune, …), se voulant représentatif des diverses formations végétales originales de la Grande Ile. Les distributions chorologiques et écologiques des espèces étant mal connues, il était implicitement admis que le peuplement animal originel serait lui aussi de ce fait préservé.

Considérant la diversité et l'importance des acquis phylogénétiques et écologiques, il nous apparut nécessaire au cours de la décennie 1980 d'offrir, tant aux chercheurs qu'aux étudiants, une synthèse

actualisée des données systématiques d'une part et biologiques dans son sens le plus large d'autre part, relatives aux Amphibiens malgaches. Nous avons donc entrepris la rédaction des deux tomes qui leur sont respectivement consacrés, publiés dans la Faune de Madagascar éditée par Renaud Paulian.

L'essor de ces jeunes disciplines va jouer un rôle majeur dans l'élaboration des conceptions actuelles sur la conservation des espèces animales en général, et des Amphibiens en particulier, dont cette concertation est l'objet.

C'est pourquoi nous fûmes particulièrement heureux d'apprendre qu'une large réunion internationale était consacrée à cette question cruciale. Son organisation exprime qu'un corpus important de données écologiques, biologiques, biogéographiques a été rassemblé au cours des ces dernières décennies. Il complète les progrès notoires et indispensables de l'inventaire systématique, et couronne les efforts des nombreuses équipes nationales qui ont suivi la voie tracée par Marguerite Razarihelisoa, et internationales engagées dans ce projet.

Charles P. BLANC
Laboratoire de Zoogéographie, Université Montpellier 3
Présent addresse: chemin du¨Pioch de Baillos 34980 Montferrier sur Lez, France

Rose M.A. BLOMMERS-SCHLÖSSER
Zoological Museum Amsterdam
Présent addresse: Willibrordweg 6, 3911 CC Rhenen, The Netherlands

A Conservation Strategy for the Amphibians of Madagascar | Monografie del Museo Regionale di Scienze Naturali di Torino, XLV (2008): pp. 15-20

Robin D. MOORE[1], Joseph R. MENDELSON III[2]

Amphibian conservation at the global, regional and national level

ABSTRACT

Almost a third of amphibians worldwide are threatened with extinction. As a class, amphibians face a variety of threats that are both sadly familiar, such as habitat loss, contamination and overexploitation, as well as threats that are somewhat novel in the history of conservation efforts, such as emerging infectious diseases and climate change. Mitigating these threats at a global scale represents a truly daunting challenge that will require an innovative and multidisciplinary approach. The Amphibian Conservation Action Plan (ACAP) provides a blueprint for actions needed to stem the global extinction crisis. Madagascar lies on the forefront of global priorities for amphibian conservation, ranking consistently in the top 12 countries in the world for numbers of amphibian species, number of threatened species and number of endemics. The ACSAM provides an important opportunity to implement the ACAP at a National scale and serve as a model for expansion to other regions of the world. The Amphibian Specialist Group (ASG) will work with local partners to support efforts to conserve the amphibians of Madagascar. Conservation efforts must include a strategy for habitat protection (incorporating amphibians into plans to increase protected area coverage), targeted research into current and potential threats to amphibians, implementation and enforcement of legislation regulating the movement of amphibians in and out of the country, and building capacity in-country for the establishment and maintenance of captive assurance colonies.

Key words: Amphibian Conservation Action Plan, Amphibian Specialist Group, Global Extinctions.

INTRODUCTION

The phenomenon of global amphibian population declines first received broad scientific and public attention in the late 1980's (Rabb, 1990; Vial, 1990; Wake, 1991). Researchers then spent the 1990's demonstrating that amphibian population declines were real, documenting occurrences, and searching for

[1] IUCN/SSC Amphibian Specialist Group, Arlington.
[2] Zoo Atlanta.

causal agents. After two decades of observing "enigmatic" declines of amphibians and speculating about the causes, a series of recent papers has brought us to the realization that the scale of global amphibian extinctions is massive (Stuart et al., 2004) and that maverick conservation efforts will be required to prevent loss of biodiversity at a level unprecedented in human history (Mendelson et al., 2006).

The Global Amphibian Assessment (GAA) has revealed that almost a third of amphibians are threatened with extinction; this far exceeds the proportion of threatened birds and mammals (12% and 23% respectively). As a class, amphibians face a variety of conservation challenges including threats that are sadly familiar to us (e.g., habitat loss, contamination, overexploitation) as well as threats that are somewhat novel in the history of conservation efforts (e.g., emerging infectious diseases, climate change); complex interactions among these factors are certainly present, but are difficult to assess and mitigate. The program to mitigate global, or local, climate change represents a truly daunting challenge, and there remain far too many unknowns in all of these fields to understand complex synergies that likely underlie the interactions between factors such as environmental contamination, disease spread, and climate change. Tackling these threats will require an innovative and multidisciplinary approach.

A realization of the scale of the global amphibian extinction crisis prompted the establishment in 1991 of the IUCN/SSC Declining Amphibian Populations Task Force (DAPTF). DAPTF succeeded in greatly advancing our knowledge as to the extent and potential causes of amphibian declines worldwide. While we continue to improve our understanding of the problem, however, the crisis has not abated, and amphibian populations continue to decline and disappear at an alarming rate, prompting a response from the global community to tackle the problem at a scale larger than ever before.

Amphibian Conservation Action Plan

In September of 2005, a Summit was convened in Washington, DC by the IUCN-SSC and Conservation International to bring together over 60 world leaders in amphibian research and conservation; the purpose, to develop a global strategy to halt amphibian declines. The Summit produced a Declaration and an ambitious Amphibian Conservation Action Plan (ACAP) with an associated estimated budget of USD 400 million, representing a preliminary road-map of the programs and funds that would be required if we are to have any hope of abating the current amphibian extinction crisis. The summit found consensus amongst stakeholders that the scope of the problem is large and global, and familiar and novel threats are to blame. It was also concluded that science-as-usual and conservation-as-usual are both insufficient. Four main actions were proposed as urgent priorities for global amphibian conservation: (1) expanded understanding of the causes of declines and extinctions; (2) ongoing documentation of amphibian diversity, and how it is changing; (3) development and implementation of novel long-term conservation programs; (4) emergency responses to immediate crises.

The implementation of the ACAP, and securing the funds necessary to do so, is an ambitious task, and one that is beyond the scope of a Task Force. Indeed, DAPTF was never intended to tackle the problem at this level. The decision was therefore made to combine the expertise and experience of DAPTF, the Global Amphibian Specialist Group (GASG) and the GAA into a body devoted to advancing amphibian conservation through the implementation of the ACAP: The IUCN/SSC Amphibian Specialist Group (ASG www.amphibians.org). The ASG works to catalyze a global response through the coordination and support of a global network of expertise. The ASG network is composed of global conservation/research professionals organized around geographic nodes to ensure a "bottom up" body of influence to guide the implementation of the ACAP.

The ASG is coordinated through a Secretariat comprising two Co-Chairs (Claude Gascon and James Collins), who are charged with implementing staff and appointments in the following capacties: an Executive Officer, an Advisory Board, and Directors of four divisions: Conservation, Research and Assessment, Development, and Communications. The ASG will use a constantly updated website and the bimonthly newsletter Froglog to disseminate the latest amphibian news from around the world and facilitate communication among amphibian researchers and conservation practitioners.

Implementing ACAP at local, national, regional and global scales

The ACAP represents a unified global strategy for amphibian conservation. It has been designed with the intention of providing a template that can also be applied at regional, national and local scales. Issues affecting amphibians vary according to region, and some issues-such as trade, invasive species and disease-transcend national boundaries and need to be addressed at local, national and international levels to be effective. The implementation of the ACAP will therefore necessarily be a collaborative effort working synergistically at all levels from local to global; the ASG strives to facilitate the development of such synergistic partnerships. It is hoped that the ACAP will serve as a working template for the development of regional and national Action Plans, such as the ACSAM, that address local issues in the context of the global amphibian crisis. The ACSAM represents an important step in the implementation of the ACAP at a national level and promises to serve as a model for other countries and regions of the world.

Global significance of Madagascar

Madagascar is a country with global significance for amphibian conservation. According to the GAA, it ranks number 12 in the world for number of species (over 220 described); however with so many species remaining to be described in Madagascar this is likely an underestimate. Based on those species that have been described, Madagascar ranks 4th in the world for number of endemics (over 99% of the species found there are endemic) and 11th equal in the world for number of threatened species. Madagascar is a region

that has experienced a particularly steep rise in the numbers of recognized amphibian species, an increase of 42 percent (from 143 to 203) in the period 1992-2003 (Köhler et al., 2005), and many more species are likely to be discovered. At the time of writing, 150 species await description. Madagascar ranks as one of the top biodiversity hotspots (Myers et al., 2000) and with predictions suggesting that by 2025 forests will only exist in the most remote parts of Madagascar (Green & Sussman, 1990), novel conservation strategies are required to save much of its biodiversity.

Threats to amphibians in Madagascar include 'traditional' threats such as habitat loss and collection of animals for the pet trade-however more 'novel' threats such as climate change are likely to become more significant. Introduced species, such as crayfish from the genus *Procambarus* which has recently invaded Madagascar, may also pose a threat through predation and potentially serving as a vector for disease. Disease does not currently appear to be a major threat to the amphibian fauna of Madagascar; initial tests for the amphibian fungus chytridiomycosis, which has been implicated in dramatic declines in Latin America, Australia and Europe, have shown up negative. However, this does not warrant complacency, and patterns observed elsewhere indicate that a disease outbreak could potentially be catastrophic. We must therefore regard this as an opportunity to be proactive in preventing amphibian chytrid fungus from reaching Madagascar, and contingency plans should be developed should an outbreak occur. Suggested measures include stringent control of the movement of animals in and out of Madagascar through the implementation and enforcement of appropriate policies, careful adherence to protocols for minimizing the risk of spread, research into those species which may be particularly susceptible to the disease, and establishing captive assurance colonies for those species deemed to be at risk.

Some amphibian species in Madagascar are heavily collected for the International pet trade. The CITES database first recorded CITES listed amphibian species being traded from Madagascar in 1994, and between 1994 and 2006 a total of nearly 162,000 individuals were traded in 18 species. The CITES data shows that nearly 38% of the trade is accounted for by *Mantella aurantiaca* followed by *M. madagascariensis* (13%) and *Mantella* spp (12%). Similarly, *Mantella aurantiaca* has recorded the highest number of years in the trade (10 years) with four other *Mantella* spp each recording 9 years in the trade. Further research is required to assess the impact that this trade has on wild populations, and appropriate measures must be taken to minimize this impact. This may be achieved at the international level, by ensuring appropriate policies regulate export, as well as at the national and local level, by enforcing legislation and exploring the development of sustainable harvesting protocols and, potentially, captive breeding to supply animals for the pet trade.

It is worth reiterating that habitat loss remains the most significant threat to amphibians globally, impacting 9 out of 10 threatened species, and efforts to protect critical amphibian habitat are central to any conservation efforts in Madagascar and elsewhere. The ambitious goals set by the Malagasy

government to significantly increase protected areas within the country provide an important opportunity to advance amphibian conservation. It is important that the needs of amphibians are incorporated into plans to establish new protected areas and the Key Biodiversity Areas (KBAs) concept be used to prioritize those areas that are important for conservation.

The ASG will support efforts to devise and implement an Action Plan for the amphibians of Madagascar by working closely with local partners to implement conservation actions, including habitat protection and establishment of captive assurance colonies, in addition to providing financial support for critical research into current and potential threats, continuing the Assessment process through the GAA, and influencing policies relating to the trade of amphibians. We also will work to identify and protect critical habitats for amphibians.

Madagascar represents an important opportunity for amphibian conservation. The country contains a rich diversity of species found nowhere else-a high percentage of which are threatened-and we have the opportunity to address many of these threats before it is too late. The ACSAM is an important milestone in advancing amphibian conservation in Madagascar and globally and may serve as a model to be adopted by other nations around the world.

RESUMÉ

Conservation des amphibiens au Niveau Global, Régional, National.

Presque un tiers des amphibiens sont menacés d'extinctions. Comme catégorie, les amphibiens font face à diverses menaces qui sont à la fois tristement familières, comme la perte de l'habitat, la contamination et la surexploitation, ou des menaces qui ont quelque chose de nouveau dans l'histoire de la conversation, telles les maladies infectieuses ou le changement climatique. Modérer ces menaces à une échelle globale représente un réel et intimidant défit qui demandera une approche innovante et multidisciplinaire. Le Plan d'Action de Conservation des Amphibiens (ACAP) (The Amphibian Conservation Action Plan) fournit des schémas pour des actions qui doivent faire cesser les crises d'extinctions globales. Madagascar se trompe sur le front des priorités globales de la conservation des amphibiens, classée dans le top 12 des pays mondiaux pour le nombre d'espèces d'amphibiens, nombre d'espèces menacées et nombre d'espèces endémiques. L'ASCAM fournit une importante opportunité de se servir de l'ACAP à une échelle nationale et sert de modèle d'expansion à d'autres régions du monde. Le Groupe de Spécialistes des Amphibiens (Amphibian Specialist Group, ASG), travaille avec des partenaires locaux pour soutenir les efforts de conservation des amphibiens de Madagascar. Les efforts de conservation doivent inclure une stratégie de protection de l'habitat (incorporant les amphibiens dans des plans qui accroissent la couverture de zones protégées), des recherches ciblées sur les menaces actuelles et potentielles des amphibiens, une mise en œuvre et un renforcement d'une législation régularisant le mouvement des amphibiens dans et à l'extérieur du pays, et d'exercer son aptitude dans l'établissement et la maintenance de colonies garanties en captivité.

Mots clés: Plan d'Action de Conservation des Amphibiens, Amphibian Conservation Action Plan; Groupe de Spécialistes des Amphibiens; Amphibian Specialist Group; Extinctions Globales.

Robin D. MOORE
IUCN/SSC Amphibian Specialist Group
Conservation International
2011 Crystal Drive, Suite 500, Crystal City
Arlington, Virginia 22202, USA
Email rdmoore@conservation.org

Joseph R. MENDELSON III
Department of Herpetology,
Zoo Atlanta, 800 Cherokee Ave
Atlanta, Georgia, 30315, USA
Email jmendelson@zooatlanta.org

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Franco ANDREONE[1]

Frogging Madagascar: a free chat on frogs and frog conservationists across the Red Island

ABSTRACT

A short history of amphibian conservation of Madagascar is provided, passing through a history of conservation batrachologists.

Key words: Amphibians, Conservation, Madagascar.

The amphibian crisis and Madagascar

Amphibians are indeed at the forefront of the current biodiversity crisis, and the recent analysis through Global Amphibian Assessment (GAA) showed that at least a third of the world's species are in danger of becoming extinct (IUCN et al., 2006; http://www.globalamphibians.org/). Now widely referred to as the "amphibian crisis", there is an overall agreement in the conservation, scientific, and zoo community that conservation actions are urgently needed to prevent the pending extinctions of many species.

In the world there are some true "hot spots" for amphibian diversity, such as Sri Lanka, Brazil, and Madagascar. The amphibian radiation of Madagascar is characterized by a high species diversity: a summary from the GAA shows that when considering the countries with the highest number of amphibian species, Madagascar ranks 12th. Moreover, when looking at endemism patterns, Madagascar ranks 4th with 230 endemic frogs (other 150 wait to be described and – hopefully – protected). The GAA points out that among countries with large numbers of amphibian species, Madagascar (along with Australia) stands out with the highest level of endemicity at 99.6%.

Furthermore, it is obvious that the status of Madagascar's amphibians must be carefully monitored for several compelling reasons:

1) The most relevant threat to amphibians, habitat loss, is a significant and evident problem in Madagascar;

[1] Museo Regionale di Scienze Naturali, Torino.

2) New taxa are continuously discovered in Madagascar, and many new species will likely make the overall species number double (Hance, 2008);
3) Research detailing the distribution and density of frog populations is still in its infancy (apart from taxonomic studies very little is known on behaviour, ecology and life history of most species);
4) Although the amphibian chytrid fungus has not been found in Madagascar, the possibility of this or another emerging disease entering Madagascar could lead to a major wave of extinctions, which would result in a significant loss of the world's amphibian diversity.

The current volume is a "product" of this concern and represents, for the ACSAM organizers and for me in particular, not only a sound "bible" for amphibian conservation, but a real "pole position" from where we all could start to develop together a common strategy. These priorities were all in the mind of a small circle of friends (and herpetologists) who, in the last years, have conducted an intense action of zoological surveys and awareness increase in Madagascar. It has been an honor for me to share experience with some of the most renewed and famous scientists of the moment, persons who will certainly be remembered in the future as the "Malagasy frog scientists". With Frank Glaw, Chris J. Raxworthy, Miguel Vences, Denis Vallan, and all those composing the team who wrote a paper published on *Conservation Biology* (Andreone et al., 2005 a) I had the chance to discuss on several occasions about the need to do something more for the herpetofauna of Madagascar in terms of conservation, and especially for its amphibians.

Of course, this idea was something of unprecedented and – in many ways - absolutely "new", keeping in consideration the overall difficult and "hard" political and economic situation of Madagascar. Being one of the last countries in the world in terms of GDP, and with many structural and socio-economic obstacles, it was a real challenge to speak about the conservation of a "lesser fauna", like the amphibians are. Notwithstanding, the high biodiversity of Madagascar made it already a space where a high number of conservation agencies (just to quote a few: Conservation International, Wildlife Conservation Society, WWF), and Madagascar is a real "melting pot", where researchers meet and compare their ideas, studies and projects on many occasions. For all these reasons, the idea of a workshop to be held in Antananarivo on the Malagasy amphibians, although awkward, soon became a reality, and it would have become the first step of the ACSAM Initiative.

The decision point was on the occasion of the meeting of the ACAP (the *Amphibian Conservation Action Plan;* see Gascon et al., 2007), held in Washington in 2005. Two important "CI people", Russ Mittermeier and Olivier Langrand, expressed there the desire of Conservation International to support and encourage a similar project. Of course, I considered and still believe that a meeting and scientific symposium should never be a mere finality. For this, the ACSAM Initiative had to give the possibility to meet and discuss, and, moreover, to propose a strategy of conservation.

Around one year after this crucial meeting, the ACSAM Initiative was ready to be held in Antananarivo, 18-21 September 2006. Indeed now I see it as a great event and a success. More than 100 persons/scientists met and many others discussed about the peculiar frogs of Madagascar (Fig. 1). The action plan produced after this meeting will indeed an important document that will be hopefully integrated in the MAP (Madagascar Action Plan; http://www.madagascar.gov.mg/MAP/), and represents an important offshoot. Finally, the papers published in this book are in many points the most updated information regarding the conservation of the amphibians of Madagascar, and, especially, they present original ideas on how to deal with the future of these animals.

In this paper, that is also a sort of "expanded" introduction for the book, comment, and summary of all the history and actions, I would also like to enlighten the main conservation events that accompanied the formation of a true interest in the safeguard of amphibians in Madagascar. This is also the occasion of making a long story short and describe the profile of the major actors in this process.

Fig. 1. The inauguration of the ACSAM meeting held at Antananarivo, 18-21 September 2006. from left to right: Russell A. Mittermeier (President of Conservation International), Ferdinand Andriamihaja (Director of the "Cabinet" of Ministry of Environment, of Waters and Forests), Harison Edmond Randriarimanana (Former Minister of Agriculture, of Breeding and Fishing (currently Minister of Waters and Forest, Environment and Tourism), Joelisoa Ratsirarson (General Secretary of Ministry of Environment, of Waters and Forests), Herilala Randriamahazo (Marine and Coastal Program Director in Madagascar for the Wildlife Conservation Society and Chair, Amphibian Specialist Group).

A short conservation story

When I first arrived in Madagascar, in 1988, on the occasion of a sort of naturalistic holiday, rather little was already known on the life history traits and the conservation status of its frogs. At that time I was pushed to go to Madagascar after having read the papers by Peracca (1892, 1893) and having admired, in the important herpetological collection of the University of Turin, some of Peracca's types (e.g., those of *Guibemantis liber*, *Mantidactylus opiparis,* and *M. alutus*) (Gavetti & Andreone, 1993). Further energy to my Madagascar travel came from the occasional reading, when revising the herpetological collection, of Blommers-Schlösser's (1979a, b) important work on the biosystematics of mantelline frogs: the color plates really hit me and stimulated my imagination of a naturalist explorer. A lot of studies had already been carried out, but they were mainly focused on taxonomic aspects, as the most important priority was to know what is present there. Anyhow, despite the great efforts of "mytical" herpetologists like Boulenger, Peracca, Angel, Guibé, Mocquard, and Boettger, we are still far from a final taxonomic and nomenclatorial stability, considering that beyond the currently known 238 species, about an equal number still waits to be discovered, described and named.

By the way, the priority of taxonomic discoveries and revisions, that featured and still characterizes most of the zoological studies in Madagascar, has anyhow prevented and somehow "obscured" the need to go "beyond", and analyse more in depth the species and community ecology and threats. A lot of work still remains to be done, especially if we consider that many of the species are still known for a limited series number (some are known only for the type specimens), and that despite the gigantic efforts of Vences' team (e.g., Raharivololoniaina et al., 2006; Randrianiaina et al., 2007), many tadpoles still remain to be described.

The trend of the herpetological conservation studies and published papers is represented in Fig. 2. Amphibians and reptiles are calculated together for commodity, and also because many contributions dealt with both the vertebrate classes together.

The first indications for a major interest in the overall aspect of amphibian biology and conservation were already visible in the pioneer studies by Rose M. Blommers-Schlösser (Fig. 3). It was evident that, oppositely to the mostly morphological and taxonomic work carried out by J. Guibé (1978), Rose's work was also often addressed to unveil the biology of the species. She was also one of the first herpetologists to live in that country, and thus to meet and describe the species and their behaviour and ecology basing upon direct observations. For the first time colour photographs often accompanied her work. Rose also published the first popular papers on the amphibians (e.g., Blommers-Schlösser & Blommers, 1984). In collaboration with Charles P. Blanc (Fig. 4) she also realized the first real monographs destined to enlighten and widen the knowledge of Malagasy amphibians. When the first volume of the Faune of Madagascar devoted to amphibians saw the light

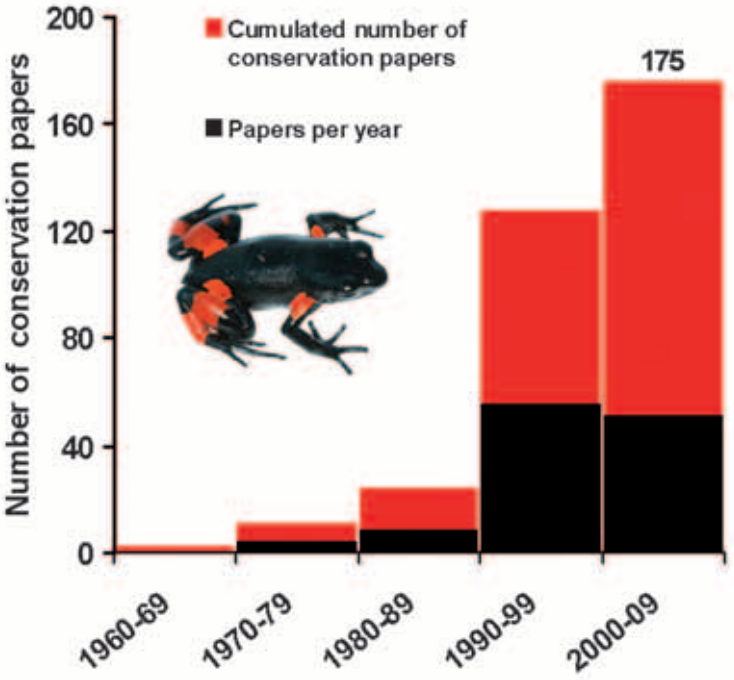

Fig. 2. Trend in the publication of conservation papers (scientific and popular contributions pooled together) for amphibians and reptiles.

(Blommers- Schlösser & Blanc, 1991) it soon became a stepstone in bibliography. I still remember one of my first visits to the rainy forest of Nosy Mangabe Island, accompanied by this "grey book". Most of the frogs that before were very mysterious for me, and very difficult to recognize, became something real. Before, I was obliged to send my photographs either to Rose Blommers Schlösser, or to Christopher J. Raxworthy. Chris in those years was already a "personality", (see for this purpose a portrait made by Holmes, 1997) (Fig. 5). Although Chris' main interest is oriented to reptiles, he also wrote, together with the French herpetologist Olivier Behra, one of the first papers devoted to amphibian conservation and pet-trade (Behra & Raxworthy, 1991).

Later on, Blommers-Schlösser and Blanc published the second volume of the "Faune" (Blommers- Schlösser & Blanc, 1993). While the first one was mainly based on Blommers-Schlösser's published and unpublished papers (mainly on species description and taxonomic revisions), the second volume was focused on biogeography. This volume, amazingly not yet sufficiently

Fig. 3. Rose M. A. Blommers-Schlösser, the first European researcher having conducted field surveys in Madagascar, at the quest of amphibians.

known and often missing in several libraries and university departments of Madagascar, contained most of Blanc's still unpublished observations, and surely it represented an unprecedented attempt to provide ecological notes that would have been extremely useful in terms of conservation biology.

It was for a fortunate combination that some of the most passionate young herpetologists met in Madagascar, and formed one of the most active working groups. The nineties and early years of the 21st century were particularly important for the study and conservation of Malagasy frogs. I was especially interested and oriented to amphibians (more than to reptiles), and with a sufficiently strong interest in life history, distribution, and conservation of these vertebrates. It was the encounter with the two "German guys", Frank Glaw and

Miguel Vences to boost my interests and studies (Figs. 6-7). Glaw and Vences, soon after the publication of Blommers-Schlösser & Blanc's book, published the first fieldguide on the amphibians (Glaw & Vences, 1992). While this first edition was still rough and with part of the observations not yet corroborated by first-hand field notes, and also included reptiles, it was the first and real field guide on the herpetofauna of Madagascar, later much improved with the second edition (Glaw & Vences, 1994), and now with the ultimate field guide, the third edition that will be difficultly overpassed in the future (Glaw & Vences, 2007). Frank and Miguel also shared a marked love for amphibians: with a titanic action they gathered an impressive information bulk on the amphibians, their recognition in the field, and their conservation. They also included a set of beautiful colour photographs that turned out to be among the most important factors in allowing the determination of the Malagasy frogs. While they continue to describe new frogs they also give a special emphasis to conservation too, by providing indications on their status. Although criticized (Nussbaum & Raxworthy, 1995), "the" fieldguide allowed a whole generation of herpetologists to discover the wonderful cold-blooded creatures of Madagascar!

As already stated, new data were also provided by the team of Chris J. Raxworthy and Ronald A. Nussbaum, with the collaboration of several Malagasy students, in particular Achille P. Raselimanana, Jean-Baptiste Ramanamanjato, and Nirhy Rabibisoa. The activity of this Anglo-American-Malagasy team was particularly intense in conducting extended field-surveys in

Fig. 4. Rose M. A. Blommers-Schlösser and he French zoogeographer and herpetologist Charles P. Blanc, during a working meeting, while preparing the "Faune de Madagascar".

Fig. 5. The British Herpetologist Chris Raxworthy with Prof. Daniel Rakotondravony and University of Antananarivo herpetology students (front to back) Paule Razafimahatratra, Nirhy Rabibisoa, and Andrianja Fiadanantsoa Ranjanaharisoa. planning a survey at Tsaramandrosa in 2006.

all the corners of Madagascar, in rain and dry forests, in open habitats and in deep canyons, by providing for the first time almost exhaustive species lists, especially for key protected areas of Madagascar. Most of these papers were accompanied by important conservation considerations. Especially Raxworthy's sensibility in terms of conservation and safeguard was evident in the publication of some papers, such as a pioneer work on reptiles and rainforests (Raxworthy, 1988), and a remarkable analysis of the montane amphibian and reptile communities and an overall excursus on the conservation problems (Raxworthy & Nussbaum, 1996, 2000).

Another key frog-person is Denis Vallan (Fig. 8), who started his studies on the amphibian communities by accompanying me during survey work to Andohahela (Andreone & Randriamahazo, 1997), and then by developing a conservation-oriented PhD research theme. Denis was particularly keen to know the effect of forest fragmentation on frog communities - an argument formerly touched by me at Ranomafana (Andreone, 1994) - and by looking at the effect of forest fragmentation. His studies soon became true classics in terms of amphibian conservation (Vallan, 2000, 2002, 2003; Vallan et al., 2004).

Finally, it is important to quote the activity of the American John E. Cadle. Especially oriented on snake studies, John provided some incisive amphibian studies (Cadle, 1995) or in collaboration with others (Vallan et al., 1998). John's style of describing new species and their behaviour still remains difficult to be reached: full of details and very precise, it provides important issues helpful to conservation.

Further conservation works were also carried out more recently by Ramanamanjato et al. (2002) and Lehtinen & Ramanamanjato (2006), who conducted research especially on the herpetological communities of southern Madagascar, and studied the effect of forest fragmentation and reduction on the herpetological communities.

It has always been my deep conviction that only through a collaborative effort we could do something for the conservation of Malagasy frogs. The contacts I kept on one side with the team of Frank and Miguel, and on the other with Chris and Ron convinced me that only with a multidisciplinary approach it would have been possible to boost frog conservation. Thus, I carried out field works following the methods recommended by Raxworthy and Nussbaum, but always giving a special attention to the taxonomic aspects of amphibians, as suggested by Glaw and Vences. My work was carried out with the assistance of the Parc Botanique et Zoologique de Tsimbazaza (PBZT). At the beginning of my visits in Madagascar I collaborated with Felix Rakotondraparany and Herilala Randriamahazo, now at the University

Fig. 6. The German herpetologist Frank Glaw at Andohahela.

Fig. 7. Miguel Vences, while frogging and fishing tadpoles.

Fig. 8. Denis Vallan while photographing.

of Antananarivo and at the Wildlife Conservation Society, respectively, the latter being eventually my co-chair for DAPTF and ASG (Fig. 9). It was also in this framework that Jasmin E. Randrianirina (now curator in PBZT) has been formed. By the way, it was just this collaborative effort that represented the starting point to organize the ACSAM Initiative, and making Madagascar a crucial point for frog conservation.

The Malagasy initiatives

A part from the foreign teams conducting frog research and promoting conservation, an important role in the research is plaid by the scientific Malagasy community. University professors and researchers, zoo curators, and many other professionals are continuously involved in many biodiversity projects. It would be very difficult to remind all the key-persons involved in this. First and still important researches were conducted by Marguerite Razarihelisoa, who published a series of contributions on the life history traits of many frog species (e.g., Razarihelisoa, 1977, 1988). Other remarkable studies are those on the alkaloid skin contents in Mantella species made by Marta Andriatsiferana in collaboration with the American researcher J.W.

Daly (Andriamaharavo et al., 2005). Several other professors the University of Antananarivo (Department of Animal Biology), among which Daniel Rakotondravony, Olga Ramilijaona Ravohangimalala and Noromalala Raminosoa (to report only a few ones), have been indeed the most important supervisors for the active student community and are closely collaboratoring with many foreign teams. At the Parc Botanique at Zoologique de Tsimbazaza Felix Rakotondraparany (now at the University), Herilala Randriamahazo (now at WCS) and Jasmin E. Randrianirina collaborated with some research teams and also carried out studies on some threatened species (e.g., Randrianirina, 2005). The University students are being formed by the two major foreign teams. Achille P. Raselimanana (now at University of Antananarivo and Vahatra), and Jean-Baptiste Ramanamanjato (now at QITFER Madagascar) worked with Raxworthy, and then carried out many autonomous field researches (Fig. 10). Nirhy Rabibisoa and Malalan'Ny Aina Rakotondrazafy recently collaborated with Raxworthy in studies in N. Madagascar, and published several papers, some of which given in the current volume: Rabibisoa et al. (2008) on the Mantidactylus sugenus Ochthomantis; and Rakotondrazafy & Raxworthy (2008) on Guibemantis (Pandanusicola) biogeography. In the last years Vences and Glaw assisted the thesis and PhD preparation of many students. Among these we remind Falitiana Rabemanananjara, Parfait Bora and Tokihery J. Razafindrabe (working on Mantella species), and Roger Daniel Randrianiaina and Liliane Raharivololoniaina (working on tadpoles) (Fig. 11). Other researches on

Fig. 9. Herilala Randriamahazo and Jasmin E. Randrianirina at Anjanaharibe-Sud (1996).

Fig. 10. Field herpetologists with Christmas dinner at Ampamakiesiny Pass, Andohahela, in 1990. Far left Jean-Baptiste Ramanamanjato, Achille Raselimana, far right Chris Raxworthy.

Mantella species were carried out largely independently and autonomously within the framework of the FADES (Fonds d'Appui au Développement de l'Enseignement Supérieur) program (Rabemananjara et al., 2007). Most recently, Nirhy Rabibisoa was named "Amphibian Executive Secretary", and is currently working together the Amphibian Specialist Group's chairs to make amphibian conservation a reality (see later). Finally, many of these students (or former students) are present in this book in quality of authors or coauthors: it has been (and will also be in the future) with their help that the frog conservation will be developed in Madagascar.

The CAMP, the DAPTF, and the GAA initiative

An important and crucial momentum for the conservation status of the amphibians of Madagascar occurred in 2001 at Mantasoa, during the CAMP (Conservation Assessment and Managing Planning). The workshop, sponsored by the Madagascar Fauna Group and by the Captive Breeding Specialist Group of IUCN, allowed an evaluation of the status of the vertebrate species, including the amphibians. This also made it possible to identify some endangered species, and to draw the attention on these species (Andreone et al., 2001). The list included five species, which were *Mantella aurantiaca*, *M. cowani*, *M. bernhardi*, *M. expectata*, and *Scaphiophryne gottlebei*. Although

the selection modalities were not yet fully standardized, and the results had to be considered preliminary, it is worth stating that all these species were subsequently (during the GAA) classified as Critically Endangered, and only one (*M. bernhardi*) was classified as Vulnerable, but only after the discovery of further populations not yet known at that time.

A further and important step for amphibian conservation was the appointment of a chair for the *Declining Amphibian Populations Task Force* (DAPTF/IUCN). This task force of the IUCN – recently metamorphosed into *Amphibian Specialist Group* – helped in identifying the conservation key factors for the amphibians of Madagascar, and promoted important actions.

Then, the Global Amphibian Assessment (GAA) allowed prioritizing all the amphibians of the world. In terms of Malagasy species, an overview was done on the occasion of a meeting held in Gland in 2003 (Andreone et al., 2004). This meeting between F. Andreone, J.E. Cadle, D. Vallan, F. Glaw, C.J. Raxworthy, S. Stuart, N. Cox, and M. Vences allowed to comment a first draft written by R. A. Nussbaum and thus drawing the distribution of all the 220 species known at that time (Andreone & Luiselli, 2003). The results were that an overall number of 55 species was considered as "threatened", including 9 critically endangered, 21 endangered, and 25 vulnerable species (Andreone et al., 2005 a, b). We may in fact consider the GAA project as the most important recent keystone for

Fig. 11. A group of herpetologists on the Ankaratra summit (2006) The photo shows (from the left) Parfait Bora, Tokihery J. Razafindrabe, a local assistant, Roger Daniel Randrianiaina, and David Vieites.

amphibian conservation. Together with the *Amphibian Conservation Action Planning* (ACAP) it allowed to identify the most important action axes and boosted the conservation actions (Gascon et al., 2007). The results of GAA also allowed to show that none of the over 220 species of frogs known in Madagascar went extinct. This is a very important information and a very powerful indication, taken into account that the considerable deforestation rate for Madagascar, and the fact of having only 10% of the original rain and dry forests, could have, as a logical consequence, the result that at least some species would have already gone extinct.

While it cannot be excluded that some frog species went extinct much before the starting of a specific study activity on amphibians (early nineteenth century), and thus that the current frog fauna is only a part of the original one, it is clear that, at least during the the last decades no species became extinct. Anyhow, considering the above mentioned deforestation, general habitat degradation and climate change, we can assume that the original distribution areas have shrunk and/or become isolated. This could produce many major problems in the future, also in front of the announced climatic changes and subsequent species distribution effects. In spite of this, we are not aware of any extinction, and this contrasts with data obtained from other continents, where species extinctions have been documented. Likely, this could be the effect of the non-presence (or non-virulence) of the amphibian chytrid fungus in Madagascar.

Conservation-oriented projects for the amphibians

While the attention for amphibians has always been present mostly since Boulenger's works, it is only recently that a series of projects started and aimed to save and study some particular species. Following the GAA, a special attention was recently drawn on species considered as "threatened", thus including those assessed as "vulnerable", "endangered", or "critically endangered".

For this purpose it is not possible to ignore the importance given to the golden frog, *Mantella aurantiaca*, as an iconic species. Together with the tomato frog (*Dyscophus antongilii*) it is likely the most known Malagasy frog: almost all the terrarium journals and books, when speaking of the peculiar amphibians of Madagascar, know and show the golden mantella. For this reason, it is clear that this species has always been among the "most wanted" Malagasy frogs for pet-trade. According to a recent evaluation of the *Mantella* trade (Rabemananjara et al., 2007), the number of exported individuals has reached a peak in 2001 (Carpenter & Robson, 2008). The high commercial interest is also witnessed by the fact that this has been the first *Mantella* species to be included in the CITES listing. *Mantella aurantiaca* was included in CITES II in 1995, while the remnant species (and the genus as a whole) in 2000 (see http://www.cites.org/eng/cop/11/prop/46.pdf). *Mantella aurantiaca* is also one of the easiest captive bred species, with several reproductive nuclei held by public aquariums and private people (Mattioli et al., 2005; Garcia et al., this book).

The great interest is also mirrored by the fact that *M. aurantiaca* was indeed one of the first species to be studied in terms of conservation. For this purpose, it is worth reminding the several actions of the The Foundation for Tropical Nature and Species Conservation (NAT) with a series of actions and proposals aimed at the conservation of the species' most typical habitats and the inclusion in 2005 of the Torotorofotsy marsh within the Ramsar convention. (http://digitalmedia.iespana.es/diariodelastablas/ramsar.pdf) (Zimmermann, 1992, 1996).

The relevant study project on the harlequin mantella, *Mantella cowani*, was started in 2003, although some data were already collected in the past (Fig. 12). The study aimed to define more precisely the species' distribution, until then quite uncertain, and allowed to gather some natural history data. Thus, it turned out that *M. cowani* is present in some high altitude sites around the Antoetra village and at least in a site not far from Ankaratra (Andreone & Randrianirina, 2003; Andreone et al., 2007). Tissue and bone samples obtained by toe-clipping allowed to carry out a phylogeographic analysis (Chiari et al., 2005), and to obtain data on the age structure (Tessa, 2006; Guarino et al., 2008). Interestingly, the trade of *M. cowani*, indeed one of the major concerns together with habitat alteration, was stopped by Malagasy authorities in 2004. This study will be re-launched in 2007, with the crucial support of the Van Thienhoven Foundation (http://www.vantienhovenfoundation.com).

Fig. 12. *Mantella cowani.* The harlequin mantella is the top priority for frog conservation. Still present at a few altitude sites, it suffered for the pet-trade (currently stopped) and for habitat alteration.

Studies of distribution and mitochondrial variation in *Mantella bernhardi* also revealed that the populations of this species are arranged into two conservation units that need particular attention (Rabemananjara et al., 2005) (Fig. 13).

Important projects are currently carried out by the team of Vences and Glaw. In particular, it should be mentioned: (1) the development of effective tools for rapid assessments of Malagasy amphibians: use of mtDNA sequences, bioacoustics, and tadpole morphology in conservation-oriented species inventories. (funded by the Volkswagen Foundation); (2) the biodiversity inventory and conservation priorities of the limestone formation of the Montagne des Francais region in northern Madagascar (funded by EAZA); (3) the realisation of the Malagasy Field Guide to Amphibians and Reptiles - an efficient monitoring tool in a biodiversity hotspot (funded by World Bank/Netherlands partnership Program; (4) the conservation and sustainable use of amphibians in Madagascar: integrating species and area priority assessments with a standardization of monitoring techniques (funded by the Volkswagen Foundation).

A conservation study was recently conducted in the arid Isalo Massif, south-central Madagascar (Fig. 14). This study, funded by the Nando Peretti Foundation, DAPTF, WAZA, and Zurich Zoo, had the finality to collect data on two poorly known CR species, *Mantella expectata* and *Scaphiophryne gottlebei*. Both species are indeed actively searched and collected for pet-trade

Fig. 13. *Mantella bernhardi*, one of the species frogs object of conservation studies.

Fig. 14. Franco Andreone while checking the drift-fence and pitfall trapping at Betampona (2007).

(Andreone et al., 2006). Beside this, life history data were gathered and new species were described (Mercurio & Andreone, 2007), together with data on the amphibian community and their conservation (Mercurio et al., 2007). Part of the same project was also destined to analyze more in detail the distribution of *Mantella viridis*, providing at the same time information on the population and age structure (Tessa, 2006; F. Andreone & V. Mercurio, in prep.).

A relevant survey work that had important conservation fallouts has been the analysis of Ankarana, Tsingy de Bemaraha and other arid western areas. Similarly to what happened for Isalo, the inventories conducted there revealed several still undescribed and endemic frog species (Mercurio & Andreone, 2007). In particular, the discovery of *Plethodontohyla fonetana* and *Tsingymantis antitra* (Fig. 15) gave new impulse to the conservation of frogs from western Madagascar.

While this paper is in press other research is in act, and is mainly reflected by the papers presented in this book. Notably, study work by Raxworthy and colleagues will allow to identify the risk connected to climate change in Madagascar, while Glaw's team is trying to valorize the rich and little known herpetofauna of the Montagne des Français area in N. Madagascar. The latter initiative was financed by the EAZA campaign on Madagascar (http://www.eaza.net/). EAZA also supported the study work on *Dyscophus*

Fig. 15. A female of *Tsingymantis antitra.* This recently discovered and enigmatic frog found at Ankarana is indeed one of the most relevant conservation priorities of Madagascar, since it shows a peculiar basal phylogenetic position (Glaw et al., 2006).

antongilii, led by F. Andreone in collaboration with BIOPAT and the local NGO Antongil Conservation (Tessa et al., 2007). For the first time a land was purchased just to assure the conservation of a frog species (Fig. 16).

The creation of the "Village Saogongogno" within the town of Maroantsetra, and the support to the environmental actions and environmental song and singer activity of A. Sarovy, the local NGO "Antongil Conservation" and the folk group "Antongil Vert" will likely become important conservation tools for this iconic frog (http://www.maroantsetra.com/pages/antongil_conservation.html).

Awareness initiatives

Other important conservation studies and initiatives currently carried out concern the increase of public awareness. The pioneer works in this sense are again due to the activity of Blommers-Schlösser and Blanc, who published important notes on books destined to the scientific community (Blommers-Schlösser & Blommers, 1984; Blanc & Blommers-Schlösser, 1987). Other remarkable initiative focussed on amphibians and reptiles have been the realisation of photographic posters (Andreone, 1997, 2006), and the publication of nature parts in a guide destined to tourists (Andreone & Randrianirina, 2001).

The activity of Vences, Glaw, and coworkers led to the realization of three editions of the well-known fieldguide. The first two were printed in 1992 and

1994, respectively, while the third edition was published in October 2007. Most remarkably, the third edition was printed in Malagasy too, and this project was supported by the World Bank.

Together with the publication of a series of three CDs with the calls of most frogs of Madagascar (Vences et al., 2005), the field-guide initiative represents indeed one of the most important actions supporting the valorization of Malagasy frogs. On the same wavelength it is worth quoting the publication of a popular booklet entitled "Threatened amphibians of Madagascar" (Andreone et al., 2007 a). This booklet, written in English, French, Italian and Malagasy was also aimed to reach a wide public and provide basic information on the importance of the amphibians for the biodiversity valorization in Madagascar. More recently, through the initatives of *Conservation International,* a leaflet on the identification of *Mantella* frogs was published by Jovanovic et al. (2006). Together with

Fig. 16. The Malagasy conservationist, guide and environmental singer Augustin Sarovy, while releasing a pit of *Dyscophus antongilii.*

popular papers published on Orchid, the journal of the Madagascar flight company, Air Madagascar (Andreone, 2006), and in other journals, as well as in a touristic guide (Andreone & Randrianirina, 2001) the activity of awareness valorization represents indeed one of the most important education tool.

Last but not least I wish to remind the initiatives led by two of the major European zoos and aquariums. The Acquario di Genova conducted a series of surveys in collaboration with Andreone and Vences (Mattioli et al., 2005), and realized an important portion of its exhibit dedicated to Madagascar (Gili, 2008). The Zürich Zoo realized the impressive "Small Masoala", a very big exhibit where the Masoala Rainforest has been recreated (Andreone, 2005; Graf, 2005; Rübel & Furrer, 2006.).

Which future for amphibian conservation?

The importance of the conservation actions for the frogs of Madagascar has been stressed by the recent establishement of an Amphibian Executive Secretary of the Amphibian Specialist Group in Antananarivo. The two co-chairs, F. Andreone and H. Randriamahazo still continue their coordination activity. But the recruitment of N. Rabibisoa as Amphibian Executive Secretary, with the financial support of Conservation International represents indeed a novelty in the panorama of amphibian conservation.

Madagascar is an optimal place where to carry out "experiments" in terms of amphibian management and amphibian conservation. In fact: (1) it is an island (and thus is separated from any other land mass, a condition that limits the possibility of contamination and penetration of emerging pathogens), (2) it has a very rich and almost totally endemic batrachofauna, (3) the amphibian chytrid fungus has not yet been detected (and, hopefully, is really absent), (4) a diversified system of protected areas is currently under expansion, (5) there is a clear and evident interest of the Malagasy Government and the herpetological scientific community to act for species and habitat conservation. Seen this, the results obtained during the ACSAM, most of which have been presented and commented in the present book, could represent a solid base for a real conservation action.

The "Sahona Gasy Action Plan (Andreone & Randriamahazo, 2008) is an indispensable tool for obtaining an official recognition of the importance plaid by amphibians in terms of biodiversity assessment. The coming few years offer an unprecedented opportunity for working with the Malagasy Government to establish conservation priorities, and may possibly represent the last chance to make large-scale progress in the designation of protected areas. There is a keen interest among Malagasy officials to prioritize regions of the country in need of protection, and these priorities will be largely based upon basic biological knowledge relating to species diversity and distribution.

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RÉSUMÉ

Grenouillant à Madagascar: histoire de la conservation des amphibiens et des conservationists de l'Ile rouge.

Nous reportons une courte histoire de la conservation des amphibiens à Madagascar, en passant à travers une histoire parallèle de scientifiques de la conservation.

Mots clés: Amphibiens, Conservation, Madagascar.

Franco ANDREONE
Museo Regionale di Scienze Naturali
Via G. Giolitti, 36, I-10123 Torino, Italy
Email franco.andreone@regione.piemonte.it

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