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froglog

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Conservation news for the herpetological community

Regional Focus

Europe, North Africa and West Asia

Trying to reverse the decline of the Apennine yellow-bellied toad in northern Italy. Page 24
Photo: Emanuele Biggi

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40 Years of Natterjack Toad Conservation in Europe

FrogLog

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Editorial

FrogLog issue 101 is the last in the first series of Regional Focus editions. In May 2011 we relaunched FrogLog in the new regional format. Our goal was to provide regional ASG groups and herpetological community members with an opportunity to showcase their activities. The community has warmly welcomed the new format and we look forward to continuing it into the future. This edition focuses on Europe, North Africa, and West Asia, a diverse region covered by two ASG regional groups.

We had a fantastic response to this edition with articles from Morocco, Tunisia, Turkey, Iran, Italy, and Switzerland to name but a few. We are extremely grateful, as ever, to everyone who submitted articles and hope that your conservation efforts continue to grow. We look forward to receiving an update next year on any progress to these and other projects in the area.

This edition also includes a brief article on the recent SSC Chairs meeting held in Abu Dhabi to mark the beginning of the next IUCN quadrennium. SSC Specialist Group members are enlisted for these four year periods, at the end of which members can decide if they wish to continue with their SG efforts or resign from their commitment. In some cases regional chairs will be stepping down, new members joining, and group structures and priorities will be assessed. Over the coming months we will be working closely with our members to update ASG member guidelines and be seeking your advice on the priorities for the ASG over the coming four years. This is an important time for the Specialist Groups and we look forward to working with you all to ensure that as a network we are as productive as possible to drive amphibian conservation forward.

We are also pleased to welcome two new members to the editorial team of FrogLog. Craig Hassapakis has joined us bringing with him his vast editorial expertise from the open access journal Amphibian and Reptile Conservation (read more about this on page 48) and Regina Fong has joined our team in the role of editorial intern to further develop FrogLog into a useful tool for the herpetological conservation community.

James P. Lewis
ASG Program Coordinator

FrogLog

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Lost Frogs 2012 "Top 10" Announced Along with First Draft of the Complete List of "Lost" Amphibian Species

By Robin Moore & James Lewis

As we launch into this new phase of the Search for Lost Frogs we thought it made sense to replace the three "found" species from the top ten with new ones. Thanks to some very strong nominations from the ASG community, picking just three to feature was a very hard task.

We settled on those species that are iconic, unusual or striking in some way, while maintaining a broad geographic scope. None of the three new species have been seen within the past three decades. The three selected species are:

Chile Darwin's frog, *Rhinoderma rufum*, Chile. Last seen 1980. Chile Darwin's frog is a truly iconic lost species, and one of only two species in the world where the young undergo part of their development in their parent's mouth. Eggs are laid on the ground and when tadpoles start to wriggle, the guarding male swallows them into his vocal sack. The male then transports tadpoles to water where he releases them to complete their development. Another unusual feature of this species is its long, pointed nose. The species lived by slow running streams in wet temperate forests but there have been no recorded sightings since 1980 despite repeated searches.

Dutoit's torrent frog, *Petropedetes dutoiti*, Kenya. Last seen 1962. Dutoit's torrent frog is found in and around fast flowing streams and waterfalls of Mount Elgon in Kenya. The frogs lay their eggs on wet rocks close to torrential streams; upon hatching the tadpoles cling to vertical rock surfaces grazing algae, and here they remain until they develop into froglets. The family to which this frog belongs started to evolve separately from the rest of the amphibians 5 million years before the extinction of the dinosaurs, which according to the EDGE web site, "makes them as different from their closest relatives as pigs are to whales!" The species has not been reported since 1962 despite numerous searches and the habitat being in good shape.

Left. Photo of Chile's Darwin frog by Claudio Soto-Azat. Right. Illustration of the Yunnan lake newt by Arie van der Meijden.

Yunnan lake newt, *Cynops wolterstorffi*, China. Last seen 1979. This is really a striking amphibian; a black background is decorated with orange stripes and blotches. These newts are adapted to an entirely aquatic life and some adults have been observed with the remnants of gills. The male has a deep blue tail in breeding season, and they are the "Peter Pans" of the animal world, demonstrating what is known as "neoteny" and retaining juvenile characteristics into adulthood. The newts would be observed by the thousands swimming among aquatic plants on the shores of the lake during breeding season, but none have been seen since 1979. Local knowledge of the newt is limited to reports by a few older fishermen in the area.

There are a number of searches planned for these species and other lost frogs from around the world and we are eager to hear of any searches that take place. Even if your search is unsuccessful in finding your target species this is important information we are interested in collating in order to eventually feed back into the Red List. We would all encourage search teams to submit blogs for publications on the ASG web site to help publicize your efforts and encourage others to follow in the search. We hope to be able to support more searches in the future, not to mention supporting conservation actions for species that have been found, to ensure they are never lost again.

We thought long and hard about launching phase II of The Search for Lost Frogs under the umbrella of the ASG. We realized that the real value of The Search for Lost Frogs goes beyond just a publicity campaign, although this element is definitely important for garnering support for what we do, we decided to develop a platform

ANURA

ALYTIDAE
Discoglossus nigriventer

ARTHROLEPTIDAE
Cardioglossa cyaneospila
Arthroleptis pyrrhoscelis

BUFONIDAE
Ansonia latidisca
Atelopus balios
Vandijkophrynus amatolicus

HYPEROLIIDAE
Chrysobatrachus cupreonitens
Hyperolius chrysogaster
Hyperolius leucotaenius
Hyperolius nimbae
Hyperolius sankuruensis

MICRIXALIDAE
Micrixalus elegans
Micrixalus thampii

MICROHYLIDAE
Ramanella anamalaiensis

PETROPEDETIDAE
Conraua derooi

PHRYNOBATRACHIDAE
Phrynobatrachus asper

RANIDAE
Amolops chakrataensis

RHACOPHORIDAE
Pseudophilautus semiruber
Raorchestes chalazodes

CAUDATA

PLETHODONTIDAE
Chiropterotriton mosaueri

GYMNOPHIONA

TYPHLONECTIDAE
Atretochoana eiselti

"Lost" amphibian species found to date. This list will be continually updated as species are redicovered.

that will maintain a list of lost species — compiled by amphibian experts, as a means of targeting searches and highlighting searches and rediscoveries. Species in this list will be those considered Possibly Extinct by the IUCN, but also those species that you feel deserve to be included. This updated list can now be found and downloaded from our web site at http://www.amphibians.org/our-work/lostfrogs/lost-frogs-list/ and a summerized version can also been seen at the end of this article. We realize that this list is not comprehensive but rely on the community to provide us with suitable nominees to include, if you therefore feel a species is missing from the list or should not be included then please contact Robin Moore. The long term plan is to publish a full list of "lost" amphibian species every year, updating it to take account of rediscoveries, changes in Red List criteria and adding new species as necessary. We also plan to maintain the "Top Ten" and update it on an annual basis or as needed. Lists such as this are always a tightrope walk between scientific value and public appeal and we fully recognize the subjectivity in this list. However, it is purely intended as a way to bring people in and make the campaign appealing outside of the community who already cares about amphibians. I believe this is very important if we want to garner support for our work. People like digestible lists and we see this as a platform to feature some of the more unusual or iconic species — in addition to species that are in areas that don't typically receive a lot of attention. We will, however, also feature species that are not on this list and searches for any species considered lost.

A Tiny Lost Shrub Frog Species Found After 100 Years!

By Madhava Meegaskumbura, Kelum Manamendra-Arachchi, Gayan Bowatte, & Suyama Meegaskumbura

A group of scientists from the Faculty of Science, University of Peradeniya have rediscovered a tiny frog species that was thought to have been lost, for nearly hundred years.

Pseudophilautus semiruber (Tiny-red shrub-frog) is one of the smallest frog species in the world. So far, out of the total of 5000 plus species of frogs in the world, only 46 species smaller than 15 mm are known, which are referred to as diminutive species. These species are so small that they can rest comfortably on the tip of your small finger. With the new discovery, Sri Lanka has three such extant species (*P. simba* and *P. tanu*, in addition to *P. semiruber*).

Recent rediscovery. A group of scientists from the Faculty of Science, University of Peradeniya have rediscovered *Pseudophilautus semiruber* (Tiny-red shrub-frog), one of the smallest frog species in the world that had not been seen for almost 100 years.

N. Annandale in 1911, found a 12 mm long individual, of a nondescript sex, from Pattipola, at an elevation of 1850 m above sea level. It was formerly described in 1913, using only this single specimen. For the next 95 years nobody ever saw this species again. But in 2005, a single female was discovered by Madhava Meegaskumbura and Mohomed Bahir, from amongst the wet leaf litter, under the cover of a misty montane forest canopy, from a small forest reserve (Agra-Bopath) close to the Horton Plains National Park.

This specimen was subjected to rigorous scrutiny, using both morphology and molecular techniques to determine its systematic relationships. Its morphology was compared to *P. simba*, from Rakwana Hills (Morningside Estate) and the Knuckles Forest Reserve, and to the 1913 description of Annandale. The rediscovery was announced and a new description was presented in the March 2012 issue of the journal ZOOTAXA.

The specimen described by Annandale in 1913 had been deposited in the collection of the Zoological Survey of India in Kolkata under the reference number ZSIC 17401. This specimen however was confirmed lost in 2001 and since 2005, the species has been registered as *Incerte sedis* (uncertain taxonomic position); and classified as Data Deficient on the IUCN Red List. The specimen collected in 2005 by us now remains the only reference material available for this species.

Now that we know that this species, tethering at the edge of extinction, still survives, immediate conservation measures should be taken to save this little red frog species.

The Department of Wildlife Conservation, and Forest Department of Sri Lanka and kindly acknowledged for permission to carryout this work. Christopher J. Schneider (Boston University), James Hanken (Harvard University), Rohan Pethiyagoda (Australian Museum), Don Church (GWC), James Lewis, and Robin Moore (IUCN SSC ASG) are profusely thanked for their support.

For more details, please see: web.mac.com/madhavameegaskumbura

First complete draft list of "lost" amphibian species (n=228)

ANURA

AMPHIGNATHODONTIDAE
Gastrotheca christiani

AROMOBATIDAE
Aromobates nocturnus
Mannophryne neblina
Prostherapis dunni

ARTHROLEPTIDAE
Arthroleptis troglodytes

BUFONIDAE
Adenomus kandianus
Amietophrynus danielae
Amietophrynus perreti
Andinophryne colomai
Ansonia siamensis
Atelopus carauta
Atelopus carbonerensis
Atelopus chiriquiensis
Atelopus chocoensis
Atelopus chrysocorallus
Atelopus dimorphus
Atelopus eusebiodiazi
Atelopus famelicus
Atelopus farci
Atelopus galactogaster
Atelopus guanujo
Atelopus halihelos
Atelopus ignescens
Atelopus longibrachius
Atelopus longirostris
Atelopus lozanoi
Atelopus lynchi
Atelopus mandingues
Atelopus mindoensis
Atelopus minutulus
Atelopus muisca
Atelopus nanay
Atelopus onorei
Atelopus oxyrhynchus
Atelopus pachydermus
Atelopus peruensis
Atelopus petersi
Atelopus pinangoi
Atelopus planispina
Atelopus sernai
Atelopus sonsonensis
Atelopus sorianoi
Atelopus vogli
Duttaphrynus peninsularis
Ghatophryne rubigina
Incilius fastidiosus
Incilius holdridgei
Incilius periglenes
Laurentophryne parkeri
Nectophrynoides asperginis
Peltophryne fluviatica
Rhinella rostrata
Werneria iboundji

CENTROLENIDAE
Centrolene heloderma
Cochranella geijskesi

CERATOPHRYIDAE
Telmatobius brevipes
Telmatobius cirrhacelis
Telmatobius niger
Telmatobius vellardi

CRAUGASTORIDAE
Craugastor anciano
Craugastor angelicus
Craugastor chrysozetetes
Craugastor cruzi
Craugastor emleni
Craugastor escoces
Craugastor fecundus
Craugastor fleischmanni
Craugastor olanchano
Craugastor omoaensis
Craugastor polymniae
Craugastor stadelmani
Craugastor trachydermus

CYCLORAMPHIDAE
Cycloramphus diringshofeni
Cycloramphus valae
Odontophrynus moratoi
Rhinoderma rufum

DENDROBATIDAE
Colostethus jacobuspetersi
Hyloxalus edwardsi
Hyloxalus ruizi
Ranitomeya abdita

DICROGLOSSIDAE
Euphlyctis ghoshi
Fejervarya assimilis
Fejervarya brama
Fejervarya frithi
Fejervarya murthii
Fejervarya parambikulamana
Fejervarya sauriceps
Ingerana charlesdarwini
Limnonectes khasianus
Nannophrys guentheri

ELEUTHERODACTYLIDAE
Eleutherodactylus eneidae
Eleutherodactylus glanduliferoides
Eleutherodactylus jasperi
Eleutherodactylus karlschmidti
Eleutherodactylus orcutti
Eleutherodactylus schmidti
Eleutherodactylus semipalmatus

HEMIPHRACTIDAE
Cryptobatrachus nicefori
Gastrotheca lauzuricae

HYLIDAE
Bokermannohyla izecksohni
Bromeliohyla dendroscarta
Charadrahyla altipotens
Charadrahyla trux
Ecnomiohyla echinata
Hyla heinzsteinitzi
Hyla helenae
Hyloscirtus chlorosteus
Hyloscirtus denticulentus
Hyloscirtus lynchi
Hypsiboas cymbalum
Hypsiboas fuentei
Isthmohyla debilis
Isthmohyla graceae
Isthmohyla tica
Litoria castanea
Litoria piperata
Phrynomedusa fimbriata
Plectrohyla calvicollina
Plectrohyla celata
Plectrohyla cembra
Plectrohyla cyanomma
Plectrohyla ephemera
Plectrohyla hazelae
Plectrohyla mykter
Plectrohyla siopela
Plectrohyla thorectes

HYLODIDAE
Crossodactylus grandis
Hylodes mertensi

HYPEROLIIDAE
Afrixalus schneideri
Callixalus pictus
Cryptothylax minutus

LEPTODACTYLIDAE
Paratelmatobius lutzii

MEGOPHRYIDAE
Scutiger maculatus
Scutiger occidentalis
Xenophrys monticola

MICRIXALIDAE
Micrixalus narainensis
Micrixalus silvaticus
Micrixalus swamianus

MICROHYLIDAE
Dasypops schirchi
Ramanella minor
Ramanella montana

MYOBATRACHIDAE
Rheobatrachus silus
Rheobatrachus vitellinus
Taudactylus acutirostris
Taudactylus diurnus

PETROPEDETIDAE
Petropedetes dutoiti

RANIDAE
Amolops jaunsari
Amolops mengyangensis
Glandirana minima
Hylarana bhagmandlensis
Hylarana intermedius
Hylarana melanomenta
Hylarana montanus
Lithobates fisheri
Lithobates omiltemanus
Lithobates pueblae
Lithobates tlaloci
Meristogenys macrophthalmus

RANIXALIDAE
Indirana longicrus
Indirana tenuilingua

RHACOPHORIDAE
Chiromantis shyamrupus
Philautus jacobsoni
Philautus sanctisilvaticus
Pseudophilautus adspersus
Pseudophilautus dimbullae
Pseudophilautus eximius
Pseudophilautus extirpo
Pseudophilautus halyi
Pseudophilautus hypomelas
Pseudophilautus leucorhinus
Pseudophilautus maia
Pseudophilautus malcolmsmithi
Pseudophilautus nanus
Pseudophilautus nasutus
Pseudophilautus oxyrhynchus
Pseudophilautus pardus
Pseudophilautus rugatus
Pseudophilautus stellatus
Pseudophilautus temporalis
Pseudophilautus variabilis
Pseudophilautus zal
Pseudophilautus zimmeri
Raorchestes dublus
Raorchestes flaviventris
Raorchestes jerdonii
Raorchestes kempii
Raorchestes microdiscus
Raorchestes montanus
Raorchestes sahai
Raorchestes terebrans
Raorchestes travancoricus
Theloderma moloch

STRABOMANTIDAE
Atopophrynus syntomopus
Holoaden bradei
Oreobates zongoensis
Pristimantis bernali

CAECILIIDAE

GYMNOPHIONA
Idiocranium russeli

CAUDATA

HYNOBIIDAE
Hynobius turkestanicus

PLETHODONTIDAE
Bolitoglossa hermosa
Bolitoglossa jacksoni
Bradytriton silus
Chiropterotriton magnipes
Cryptotriton alvarezdeltoroi
Cryptotriton wakei
Eurycea robusta
Oedipina altura
Oedipina paucidentata
Plethodon ainsworthi
Pseudoeurycea ahuitzotl
Pseudoeurycea anitae
Pseudoeurycea aquatica
Pseudoeurycea brunnata
Pseudoeurycea naucampatepetl
Pseudoeurycea praecellens
Pseudoeurycea tlahcuiloh
Pseudoeurycea unguidentis
Thorius infernalis
Thorius minydemus
Thorius munificus
Thorius narismagnus

SALAMANDRIDAE
Cynops wolterstorffi

GYMNOPHIONA

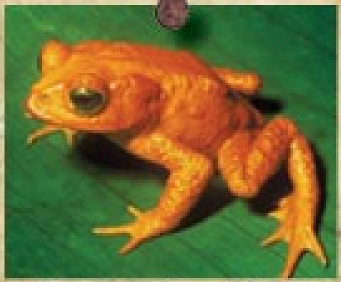
ICHTHYOPHIIDAE
Ichthyophis husaini
Ichthyophis longicephalus
Ichthyophis singaporensis
Uraeotyphlus interruptus
Uraeotyphlus malabaricus
Uraeotyphlus menoni
Uraeotyphlus oommeni

**This is a draft list of "lost" amphibians and is presented in large part to facilitate discussion regarding this list. We intend to publish a complete list on an annual basis but acknowledge this will be a dynamic, ever changing document that is open to some degree of subjectivity in its approach.*

WANTED ALIVE

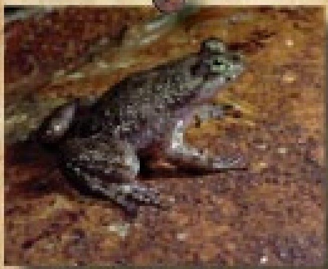
One rainy evening in May 1989, a lone Golden toad appeared at a pool high in a Costa Rican cloud forest. He was the last Golden toad ever seen. Join the Amphibian Specialist Group in the search for this and other lost amphibians. Countries and dates indicate where and when these "top ten" were last seen alive. **Reward:** Pest control, nutrient cycling and other services provided by amphibians for people worldwide.

Golden toad



Coasta Rica 1989

Gastric brooding frog



Australia 1985

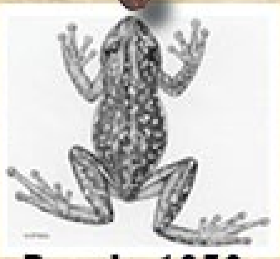
Mesopotamia beaked toad

Colombia 1914

Jackson's climbing salamander

Guatemala 1977

African painted frog



Rwanda 1950

Chile's Darwin Frog

Chile 1980

Turkestanian salamander

Turkmenistan 1909

Scarlet harlequin frog

Venezuela 1990

Dutoit's torrent frog

Kenya 1962

Yunnan Lake Newt

China 1979

The IUCN SSC Chairs' Meeting

23 - 27 February 2012, Abu Dhabi

By Katalin Csatadi & James Lewis

Thanks to generous support from the Environment Agency of Abu Dhabi and the Mohamed bin Zayed Species Conservation Fund, over three hundred scientists, representing IUCN Species Survival Commission Specialist Groups (SSC SGs), Red List Authorities and Task Forces, IUCN Regional Programmes, Zoos, and NGOs gathered together in Abu Dhabi, United Arab Emirates for the 2nd IUCN SSC Chairs' Meeting. This meeting, which takes place every four years in line with the IUCN quadrennium, provides attendees with an important opportunity to network, build partnerships and learn about the vast array of work currently underway across the SSC network.

The Amphibian Specialist Group (ASG) was represented by Co-Chairs James Collins and Claude Gascon along with program coordinator James Lewis and Amphibian Red List Authority Focal Point, Ariadne Angulo. In addition Jaime Garcia Moreno, Executive Director of the Amphibian Survival Alliance, was also in attendance.

Presentations from Simon Stuart, Chair of the Species Survival Commission, Jane Smart, Director of the IUCN Global Species Programme, and Ashok Khosla, President of IUCN opened the ceremony on the 23rd of February. Ashok, who is also the founder of Development Alternatives, an NGO with the aim of eradicating poverty, emphasized how ecology is the basis of society and in turn economies, a rule people often ignore. He spoke of consumption patterns and production systems and the need to change these urgently to create a sustainable future. He argued that 20 years ago we hadn't even considered some of the largest challenges we are now facing, illustrating that the challenges of the future may not have yet been identified. Ashok's talk gave a firm foundation to the conference, challenging SSC members to identify realistic and positive strategies to take into the next quadrennium.

The participants were also privileged to be able to listen to a short talk by Her Excellency Razan Khalifa Al Mubarak, Secretary-General of the Environment Agency of Abu Dhabi. Her Excellency emphasized that they supported this meeting because they think it is important and wished a great meeting to everyone.

The plenary sessions throughout the conference involved talks by Simon Stuart, Jane Smart and others with regards to IUCN policies, strategy, communication, fundraising, in situ – ex situ cooperation and the upcoming World Conservation Congress to be held in September in Jeju, Korea.

The parallel sessions, however, were more specific and prompted the participants for cooperation. Perhaps the two most informative parallel sessions took place in the plenary room: representatives from IUCN Regional offices, SSC Sub-committees, disciplinary Specialist Groups and the other IUCN Commissions gave short presentations on their activities, which were followed by several hours of networking and discussions.

The SSC Chairs' meeting also lays the foundation for the upcoming quadrennium, helping SGs consider their strategy and devise new ways on engaging their membership and the wider community. The new quadrennium also marks the beginning of membership registration, when all ASG members will be asked to re-register with the Commission if they are able to continue their service. During this process members will be given the opportunity to provide details on their areas of expertise and interest, both geographical and thematic. This information will then be used to help direct enquiries that come into the ASG and to build partnerships in a more informed manner.

The Arabian Oryx, a species that was once Extinct in the Wild, now runs free again across the deserts of the UAE. Photo: Topiltzin Contreras MacBeath

The meeting also highlighted the importance of building partnerships across SGs and with this in mind the ASG will be actively pursuing partnerships with other SGs to further our mission and more effectively conserve amphibians. Further details on these partnerships and information on how this will benefit members will follow over the course of the coming months.

The meeting included a day off which provided participants with an opportunity to visit a number of interesting and important sites in the UAE. The sites visited all demonstrated the UAE's incredible dedication to conservation with perhaps the star attraction being the Arabian Oryx, a species that was once Extinct in the Wild but with the incredible support of, among others, the Environment Agency of Abu Dhabi has been successfully down listed to Vulnerable. Others were lucky enough to see wild dugongs, turtles and sharks on the Gulf of the Arabian Sea.

The meeting was an invaluable opportunity to network, meet old friends and make new ones all with a focus on driving forward species conservation in the coming years. A huge thank you goes out to all those who made this opportunity possible and especially the SSC Chair's Office and the IUCN Global Species Programme staff who worked tirelessly to make the meeting such a success.

Eastern Afromontane Amphibian Assessment

Trento Italy, 2nd June – 4th June 2012

Summary

The 2004 Global Amphibian Assessment (GAA) was a landmark initiative that served as the foundation for many conservation actions worldwide. The assessment provided evidence of alarming declines in amphibians, with almost one third of the then >5,700 species assessed to fall into one of IUCN's Threatened categories. However, it is now eight years since this first comprehensive assessment including African amphibians was published. Since 2005, nearly 1,300 amphibian species have been described or revalidated. In addition, a wealth of new field data can potentially inform the conservation status of species. The identification of priority species and areas is achieved in great part due to conservation assessments, and tracking changes in species and areas is thus fundamental for informing conservation action both locally as well as on a regional and global scale. This however is only possible if assessments are maintained to make them current and informative.

Sub-Saharan Africa has a rich and unique amphibian fauna, with mainly endemic families and genera. The region contains 1011 species. Of these, 263 are currently assessed as Threatened, with many having highly restricted distributions. One region of high amphibian species richness is the Eastern Afromontane region, a recognized global biodiversity hotspot with 181 amphibian species, 167 of which have been assessed. Of these, 40% are Threatened — a higher proportion than the global average. A remarkable 39 species of the 799 EDGE (Evolutionary Distinct – Greatly Endangered) amphibian species are also located in this region (5%). Habitat loss, detrimental environmental change and/or spread of emerging infectious diseases are all likely having a big impact on amphibians in this region. However, currently our understanding of the amphibian fauna of this region is patchy in coverage and quality and requires disparate pieces of information to be linked. Focus on this region is urgently required.

In conjunction with the African Amphibian Working Group Meeting in May 2012, we aim to reassess all Eastern Afromontane African amphibians. We expect the assessment to provide a vital update to the status of the highly Threatened amphibian fauna of Africa, and thereby contribute to its long-term conservation and preservation.

Timetable

Following the AAWG 2012 meeting 28th May-31st May (Monday-Thursday), we will conduct a three day workshop from 2nd June-4th June (Saturday-Monday).

Pre-Workshop Objectives

In order to successfully meet the goals of the workshop we need experts interested in the Eastern Afromontane amphibian fauna to update information on taxonomy, spatial distribution of species and their conservation. We have distributed species lists to experts to form a basis for informing us on what species you can update.

We will prioritize the reassessment of Threatened species. First we plan to assess all Threatened amphibians, including EDGE species. In addition, we plan to re-assess Data Deficient species for which there is recent information relevant to their conservation status. Lastly, we will re-assess range-restricted species that are considered as Least Concern following IUCN categories. Overall, we expect to collate new data on taxonomy, distribution, and conservation for ca. 100 Threatened and Data Deficient species.

Workshop Objectives

Preliminary draft assessments of species will be created and new information will be compiled prior to the workshop. Workshop assessments will be completed with IUCN facilitators. During the meeting we therefore aim to: (1) Re-assess all Threatened Eastern Afromontane African amphibians, (2) Discuss action plans for all Critically Endangered Eastern Afromontane amphibian species, (3) Utilize the data to update web-based databases (e.g., IUCN Red List of Threatened Species™), (4) Compile a top 10 list for the most threatened Eastern Afromontane African amphibians and use it to lobby for their conservation.

Contributors

Please can you inform us of your willingness to participate by either i) Filling out the registration form for the AAWG 2012 meeting asap if your attending, or ii) directly email Fabio Pupin (fabiopupin@inventati.org) stating your interest in contributing to the assessment, either remotely or just by attending the workshop (2nd-5th June). We will then contact you directly with an excel database for you to fill out. We need to have an estimation of participants so that we can calculate costs and make bookings for accommodation.

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UNI BASEL

asa amphibian survival alliance
A global partnership for amphibian conservation

IUCN

SSC Species Survival Commission

RED LIST
THE IUCN RED LIST OF THREATENED SPECIES™

ASG IUCN SSC Amphibian Specialist Group

Wildlife Without Borders - Amphibians in Decline

Since 2010, the Wildlife Without Borders - Amphibians in Decline program has funded projects that conserve the world's rapidly declining amphibian species. Species eligible for funding are those frogs, toads, salamanders, and caecilians that face a very high risk of extinction in the immediate future. Species should meet the criteria to be listed as "Critically Endangered" or "Endangered" on the International Union for the Conservation of Nature (IUCN) Red List.

Summary Statistics. From 2010-2011, the Amphibians in Decline Program received 107 applications for financial assistance, or about 53 proposals per year. During that time period, USFWS has awarded approximately $702,033 for the conservation of highly threatened amphibians, while leveraging $1,267,104 in matching funds (a 1.8:1 ratio). The average size of Amphibian grants was $27,000. Based on FY2012 funding levels, proposals requesting less than $25,000 have a higher likelihood of being selected.

The Amphibians in Decline Program is a highly competitive grants program. From 2010-2011, USFWS awarded 26 grants with an annual award rate between 20-32%. Grants have been awarded to conserve highly threatened species in 18 countries, including 4 each in Panama and Mexico. Most proposed projects are based in the Americas (65%), compared to Africa (19%), Asia (12%), and Oceania (3%).

Approximately 30 species have been the focus of conservation activities supported by the Amphibians program. These are among the most highly endangered species that the USFWS Wildlife Without Borders Program works with people to conserve. Approximately 50% of Amphibian grants have been made for the conservation of frogs and toads, 15% for salamanders, and 8% for caecilians (the remainder was for grants conserving multiple species).

Disease and invasive species are the most frequently identified threat to amphibians that USFWS grants address (58%), followed by habitat loss caused by agriculture (31%), pollution (19%), habitat loss caused by residential and commercial development (12%), harvest (8%), and mining (4%).

Similarly, species management is the most frequent conservation action that USFWS supports through its grants program (100% of grants), followed by education and awareness campaigns (81%), land management (23%), and formal protection, policy, and economic incentives (4% each).

Call for Proposals. The U.S. Fish & Wildlife Service has recently announced the call for proposals for the 2012 Amphibians in Decline Fund. Proposals are due MAY 1, 2012.

For 2012 complete 2012 proposal requirements, submission instructions (note that domestic applicants must now apply through Grants.gov), and eligibility criteria for species and projects, please refer to: http://www.fws.gov/international/DIC/howtoapply.html Notices of Funding Availability are available in English, French, and Spanish, but proposals must be submitted in English.

Frequently Asked Questions

- *Which species are eligible for funding?* In general, amphibian species that face a very high risk of extinction in the immediate future are eligible for funding. Species should meet the criteria to be listed as "Critically Endangered" or "Endangered" on the International Union for the Conservation of Nature (IUCN) Red List. Species listed as "Data Deficient" on the IUCN Red List are also eligible if the applicant can provide information that suggests a similar urgency for conservation action.
- *Are subspecies eligible for funding?* Generally, no. The funds provide financial assistance for conservation of *species* that are globally highly threatened. If applicants can provide a compelling case that a taxonomic assessment is outdated and can also provide evidence that the taxon merits a species rank, the proposal will be considered.
- *Are species eligible that are regionally or locally endangered, but not globally endangered?* No. The funds provide financial assistance for conservation of species that are *globally* highly threatened.
- *Are species eligible that meet the criteria to be listed as Endangered or Critically Endangered on the IUCN Red List, but are currently not assessed, or are listed as Data Deficient or under a lower threat category?* Yes. If applicants can provide a compelling case that the species merits a global listing of Endangered or Critically Endangered, the proposal will be considered.
- *Are species eligible that occur in the United States?* No. The funds are global, but species are not eligible for funding if their natural habitat range is located primarily within the United States, territories of the United States, Canada, or the high-income economies of Europe. Projects are also ineligible if they occur in countries that the U.S. Department of State has identified as state sponsors of terrorism (e.g., Cuba, Iran, Sudan, and Syria).
- *What activities are appropriate or are a "good fit" for funding consideration?* Generally, activities that reduce threats to highly threatened wildlife in their natural habitat are appropriate for funding consideration. See the Notice of Funding Availability for details on ineligible activities (e.g., the purchase of firearms or ammunitions). The funds prioritize field conservation activities that directly reduce threats, over data collection, research, and management of captive populations. Proposals that emphasize data collection and status assessment should describe a direct link to management action, and explain how lack of information has been a key limiting factor for management action in the past. Proposals that do not identify how actions will reduce threats, or do not demonstrate a strong link between data collection and management action, have a lower likelihood of being selected. Activities should occur within the species range, or, if work is to be conducted outside of the range, or out of the field, the proposal should demonstrate a clear relevance to the species' conservation.
- *If a project has received USFWS support in the past, may it apply for funding again?* Yes.
- *What if I have a different question?* Please email questions about the fund to fw9_wwb_ad@fws.gov

U.S. Fish & Wildlife Service - International Affairs, Division of International Conservation, 4401 N. Fairfax Drive, Room 100, Arlington, VA 22203. 703/358-1754 / 703/358-2115 fax
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CFDA# 15.650 January 2012

Amphibian Conservation in Britain

By John W. Wilkinson & John Buckley

Just eight species of amphibian are native to the British Isles but the problems of amphibian conservation are no less imperative than elsewhere — we want to hang on to what we do have! Conservationists have been relatively lucky in recent years as pertinent environmental issues have been near the front of people's minds and high on political agendas. Currently, however, conservation is secondary to the economic needs of many nations and the impetus to stimulate economic growth is taking precedence. This article discusses the main conservation issues facing amphibians in Britain and some of the measures taken to address them.

Widespread Species

Five species remain relatively widespread in Great Britain. Of these, the Smooth and Palmate newts (*Lissotriton vularis* and *L. helveticus*) are assigned no special status or protection against killing, development, habitat loss, etc. Both use garden ponds readily and, while *L. vulgaris* might be considered competitively superior to its congener, *L. helveticus* does well in acidic and heathland ponds. An interesting result from the National Amphibian and Reptile Recording Scheme (NARRS) suggests that *L. helveticus* may actually be more common than previously because of the overall decline in pond quality! They are still able to breed successfully in relatively shallow, often humus-filled ponds with a low pH. The common frog (*Rana temporaria*) is also unprotected but carries a requirement to report on its conservation status to the European Union (EU), due mainly to the potential for this species to be exploited as human food (mainly in other EU nations). It has also adapted well to utilizing garden and other anthropogenic ponds as breeding sites in the wider countryside have become less common or less suitable.

The European common toad (*Bufo bufo*) is still widespread too but, unlike many other *Bufo* species, prefers large and permanent water bodies, often with good populations of fish. They tend to remain faithful to their traditional breeding sites, even when other apparently suitable ones are available, and are therefore susceptible to landscape-level development and change. The species has undergone substantial declines in parts of central and lowland England, as well as on the Channel Island of Jersey (Carrier & Beebee, 2004; Wilkinson et al. 2007). The UK government has recognised these declines by designating *B. bufo* as a Biodiversity Action Plan (BAP) priority species. It must now be considered during the process of planning applications, at least, but still has no enforceable legal protection.

The other widespread species is the Great crested newt (*Triturus cristatus*). This enigmatic species enjoys full protection at national and European level. High quality ponds with specific characteristics are preferred and, though some parts of England still support high densities, pond loss and development has meant considerable declines over the last century (Langton et al. 2001). British populations are also important in the European context. The level of protection afforded to this species often brings conservationists and developers into conflict and considerable sums of money are sometimes spent on protecting or relocating newt populations. Though the wisdom and effectiveness of this is questionable, ARC Trust and partners Durrell Institute of Conservation and Ecology (DICE) are currently working on a UK government funded project to assess the effectiveness of *T. cristatus* development mitigation projects that occurred some 5–6 years ago. The results will be used to re-assess the effectiveness of the current mitigation guidelines.

Male *Bufo bufo*. Photo: John W. Wilkinson.

ARC Trust is also currently working in partnership with the UK's statutory conservation bodies (Natural England, Countryside Council for Wales and Scottish Natural Heritage) on a variety of projects to model the habitat characteristics required by *T. cristatus* and set conservation targets for the future to be incorporated into national and local Species Action Plans (see for example the report at http://naturalengland.etraderstores.com/NaturalEnglandShop/NECR080). We anticipate that improved information on habitat and distribution will enable local Strategic Development Plans to take this species into consideration from the outset and remove the need for costly mitigation (that generates bad publicity for the species' conservation) while ensuring that the future conservation status of the species is favourable.

The agile frog

The most naturally-restricted species in the British Isles is the Agile frog (*Rana dalmatina*), native only to Jersey. Until recently the species had declined there to the extent that it bred only in one pond in a protected area in the west of the island. The Jersey Department of the Environment, Jersey Amphibian and Reptile Group and Durrell Wildlife Conservation Trust (Jersey Zoo) have conducted a highly successful head-starting programme in which tadpoles were retained until metamorphosis and released at existing, re-profiled and newly created ponds at the remaining site and one other former site. Both breeding sites now appear to be faring well, the number of spawn clumps being up by about 500% compared to five years ago (JARG 2010), and more breeding ponds on the site are now occupied.

The natterjack toad

The majority of Natterjack (*Bufo* [*Epidalea*] *calamita*) colonies in Britain are well monitored by site managers and volunteers. Annual site reports detail the number of spawn strings found and metamorphic success, and this information is summarized in the Natterjack Toad Site Register for the UK. Data from the decade 2000 to 2009 suggests that, very approximately, the total adult breeding population the UK is 4,000 individuals. Seventy percent are found on the north-west coast of Great Britain bordering the Irish Sea, with slightly more on sites along the Merseyside Coast and in North Wales than in Cumbria and along the Scottish Solway coast. The remaining Natterjacks are on sites in East Anglia and the south of England. The 1999 edition of the Site Register simply considered the 38 known native localities to be separate populations. Now, however, genetic studies have identified six parts of the country where interconnected sites support single populations and assert that just 13 true native populations exist.

Male *Lissotriton helveticus.* Photo: John W. Wilkinson.

While the main thrust of conservation has been to maintain the native colonies, some effort has been put into translocations. With increased understanding of Natterjack ecology, the success rate for post-1980 translocations has improved to an average of 67%, but it remains far easier to re-establish Natterjacks at coastal dune sites than on heathland ones. Although the 16 successful translocation populations outnumber the native ones, they support far fewer Natterjacks. More than 77% of all UK Natterjacks are still in native populations.

Despite all the conservation effort, Natterjack numbers have not risen over the last decade and we are in the position of having to work hard just to stand still. Fortunately, analysis of the data for the 1970 – 2009 edition of the Site Register shows a way forward as, on sites with grazing, Natterjack populations are faring better than those without grazing. Clearly, now that pond creation and management is better understood, conservation action should be directed more equally to both the aquatic and the terrestrial elements of the Natterjacks' habitat.

Chytrid was first identified in Natterjacks at a site in Cumbria and has since been found at many sites on the west coast. At places where Natterjacks have declined, it is hard to decide whether this is due to the effects of chytrid or simply to adverse changes in the habitat. It may yet prove to be the case that, while chytrid is affecting individuals, it is not having an effect at a population level where the habitat remains good. Chytrid is present at the two biggest thriving Natterjack colonies in Cumbria.

An online system designed for Natterjack recording has been developed and will be trialled in Cumbria this season.

The pool frog

The Pool frog (*Pelophylax lessonae*) became extinct here in the mid-1990s at the time as it was being recognised as a native species in England. Research showed that British Pool frogs belonged to the same clade as those found in Norway and Sweden, and plans for a reintroduction were made. In 2005, the first adult frogs, juveniles and tadpoles were collected from Sweden under licence, air freighted to England and released at the recently restored pingo site (pingo ponds are formed by frost action in the historical permafrost landscape). This well-recorded reintroduction process was repeated 3 more times and a small population is now established.

The number of Pool frogs, their health and that of the resident amphibians, Grass snake numbers and the habitat are all meticulously monitored. Individual frogs are identified by the exact nature of their stripes and blotches to allow their growth and survival to be determined and also for capture-mark-recapture studies to estimate the population size.

It is as yet too early to judge the long-term success of the project. The frogs are healthy, grow and survive well but the population has not grown as anticipated. Management at this ARC Trust reserve is funded through the UK's Higher Level Stewardship Scheme and is on-going. Not all the pools are used by the frogs and management is being directed to improving these pingos and the surrounding terrestrial habitat. A small number of other sites have been identified as Pool frog reintroduction sites and the current priority is to prepare these for when the original site has developed a population large enough to provide material for translocation.

Summary

By far the biggest threat to amphibian populations in Britain has been (and remains) habitat loss and fragmentation, mainly through changes in land-use. Emerging threats may also be playing a part in local amphibian declines, however, and the distribution and effects of the chytrid fungus are being assessed and monitored (Institute of Zoology, see http://www.zsl.org/conservation/regions/uk-europe/ukchytridiomycosis,842,AR.html). Invasive alien species can also impact native ones, both as asymptomatic vectors of chytrid (confirmed in the Alpine newt, *Icthyosaura alpestris*) and as competitors (e.g., Marsh frogs, *Pelophylax ridibundus*) and predators such as *Lithobates catesbianus*. Indeed, the latter species has been shown to be both a disease vector and predator of native British species where established populations have been discovered. Considerable efforts have been made to eradicate *L. catesbianus* from the UK (including the prohibition of sale of the species' tadpoles that led to the problem in the first place) and we hope that these have proven successful. Ultimately, however, statutory tools including effective protection legislation and government-level support for ongoing monitoring are both needed in order for NGOs to effectively monitor changes in species' populations and to prioritize conservation action. The present rate of landscape-scale changes and infrastructure projects in a political environment craving growth is currently the conservationists' worst enemy.

Literature Cited

Carrier, J.-A. & Beebee, T.J.C. (2003) Recent, substantial, and unexplained declines of the common toad *Bufo bufo* in lowland England. *Biol. Cons.* **111,** 395-399.

JARG (2010) Agile frog taddy boom! *JARGON: Newsletter of the Jersey Amphibian and Reptile Group* **Autumn 2010:** 1.

Wilkinson, J.W., Beebee, T.J.C. & Griffiths, R.A. (2007) Conservation genetics of an Island toad: *Bufo bufo* in Jersey. *Herpetol. J.* **17**, 192-198.

With Great Crest, Comes Great Responsibility: The Conservation of the Great Crested Newt

By Todd Jenkins

The Great crested newt (*Triturus cristatus*) is widespread from Great Britain and Brittany all the way across north Europe to Russia. Due to a decline in their population across the majority of Europe, they are a protected species. It is also protected in Great Britain via the Wildlife and Countryside Act 1981, this makes it illegal to:

- Intentionally or deliberately capture or kill, or intentionally injure Great crested newts.
- Deliberately disturb Great crested newts or intentionally or recklessly disturb them in a place used for shelter or protection.
- Damage or destroy a breeding site or resting place.
- Intentionally or recklessly damage, destroy or obstruct access to a place used for shelter or protection.
- Posses a Great crested newt, or any part of it, unless acquired lawfully.
- Sell, barter, exchange or transport or offer for sale Great crested newts or parts of them.

Also, the legislation has given additional protection for the Great crested newt under regulation 39 of the Conservation (Natural Habitats, etc) Regulations 1994, as amended by the Conservation (Natural Habitats, &c.) (Amendment) Regulations 2007. It states that it is an offence to tamper with breeding grounds, eggs, or to deliberately disturb the newts, unless licensed to.

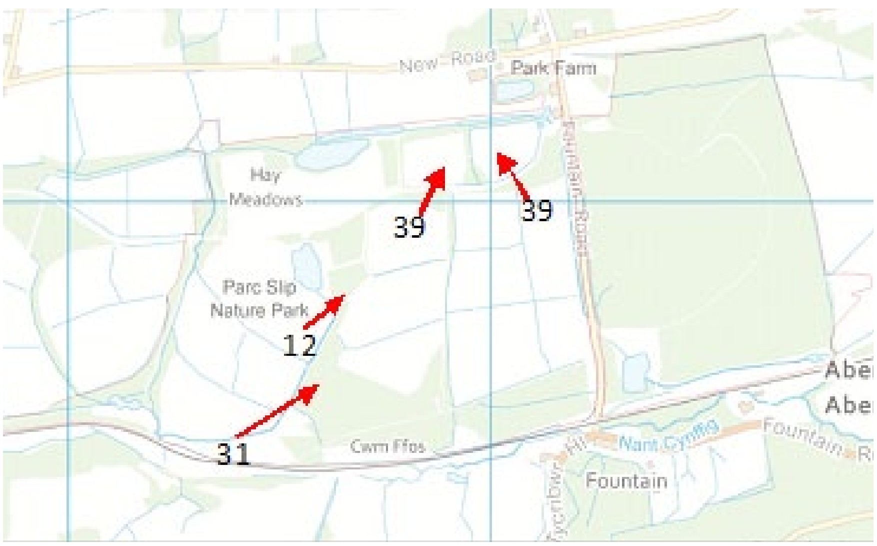

Figure 1. Map of Parc Slip Nature Reserve with the study fields indicated, with the number of sets in them. Field 1 and 2 are the fields with 39 sets, field 3 has 12 sets and field 4, 31 sets.

The decline of the Great crested newt can be linked with land development causing slow population growth. So the need to look for methods to ease this is important to decrease falling numbers before it becomes an issue for the species.

The Trust, Site, and Aims

The project is being run in conjunction with the Wildlife Trust of South and West Wales. The Trust manages and owns around 90 reserves in Wales, and the aim is to keep these sites as areas of conservation for the threatened and declining species of Wales. This project is also being run under license, which has been allocated by the countryside council for Wales.

The survey will be conducted at the Parc Slip Nature Reserve, owned and managed by the Wildlife Trust of South and West Wales (WTSWW), and located near Bridgend in South Wales. The reserve covers 124.9 hectares in the watershed between the Ogmore and Afon Kenfig catchments. It is a previous open cast coal mining site, restored over a period of 5 years and managed as a nature reserve since the mid 1980s. The reserve contains conifer and broadleaf plantations, species rich grasslands, grazed pastures and wetlands, including a number of ponds, lakes, ditches and scrapes.

The aim of the study is to is to see what, if any, factors affect the distribution (as a species), and the movement (to and from potential breeding grounds) of Great crested newts at the Parc Slip Nature Reserve.

The Project

The main basis of this project surrounds two different sized artificial Refugia (328 0.5m^2 and 82 1.0m^2 sheets around the site), these are corrugated bitumen roofing sheets. The sheets will be placed in fields that are not within public access, as to not cause large disturbances to the sheets, and the potential newt habitats. It is also based around the belly patterns of the Great crested newt; these patterns are unique to the individual, so it makes it easier to identify them.

Fields 1 and 2 (**figure 1**) will be set up as follows: field one 39 sets of one 1.0 m^2 sheet; field two 39 sets of four lots of 0.5 m^2 sheets. This is due to another project running in conjunction with this, and fields 3 and 4 will have sets of one 1.0 m^2 sheet and 4 0.5 m^2 sheet per set.

Three times a week the sheets will be checked and anything found under the sheets will be noted and placed into a database. Any Great crested newts found will be handled (under license) and their belly patterns will be photographed, stored in a database, and matched up where they are the same. This is to check for any movement by the newt in their feeding grounds, and for the second part of the project to determine what body of water the newts are using as breeding grounds. Furthermore, newts will be matched up with the photos taken in a project run last year, so that any movement, in position, can be monitored between breeding seasons.

So far this year, between September 2011 up until now, 39 individual newts have been found at the Parc Slip site. Of these 39, 13 individuals have been re-captured, all of which have been found under the same sheet sets. Other than individual 23, this moved

Figure 2: Individual 32 taken by Rose Revera on 3/11/10 found under sheet 102 (left); Individual 2 taken by Todd Jenkins 4/11/11 found under sheet 102a.

from set 115(c) to set 112 within 2 days. Also, of the 39 captured this year, 6 individuals were also seen last year, all of which have not moved far from the sheet sets they were found under in the previous year. This suggests that these individuals were not in breeding condition last year, and hibernated nearby.

As you can see from the picture above, the identification of the newts can be relatively easy. Here you can see an "L" like shape on the chest, accompanying this with the two smaller spots near the start of the tail. Some patterns are however harder to match due to the sheer volume and number of spots on the underside of the newt.

The first part of this project is merely to see the distribution of the Great crested newt dependant on habitat type, and also to see if there is any correlation between the newt and any of its known predators on site. The main predators of the Great crested newt on the Parc Slip site are the Grass snake. This work will continue up until the breeding season around March 2012.

The next part of the project will involve the ponds, and various other potential breeding sites, across Parc Slip. This will involve float trapping, using bottles and regular checking to insure the newts are not in the traps for too long. Each trap will be checked often, and any newts caught in the traps will be photographed, and then compared to all the photos taken from the feeding grounds. This will then enable us to predict the route taken by the newt to get from its feeding ground to its breeding ground.

This prediction is the most important part of the project, and the most important to assist conservation plans for the newt across Europe. From this data, measures can be developed to assist the newt's route. For example, if a small distance is travelled, the route could be eased via corridors. Or if the route undertaken is arduous and of a great distance, then plans could be implemented to place in artificial ponds near the feeding sites or use existing ditches and create pools within them to ease the pressure on the newts.

For any enquires or further details feel free to e-mail Todd at t.jenkins@welshwildlife.org (weekdays 9-5) and/or todd.jenkins@sky.com (evenings or weekends).

Dynamics in the Trade of Amphibians and Reptiles Within the United Kingdom Over a 10 Year Period

By Benjamin Tapley

Amphibians and reptiles have become increasingly popular as pets, and there is a continued growth in the range of species and taxonomic groups being offered to hobbyists. To investigate the dynamics of the United Kingdom live amphibian and reptile market we compared the trade in amphibians and reptiles in the UK between 1992-3 and 2004-5.

The number of amphibian and reptile species in the trade more than doubled over this period, even relatively unknown and fossorial species such as caecilians were offered to hobbyists in 2004-5, caecilians had not been detected in the 1992-93 data set. This suggests that there is a market for a diverse range of species. Species turnover for amphibians and reptiles between the two time periods was high; with less than a third of traded species common to both trading periods. When amphibians were examined on their own, species turnover was even higher, with less than a fifth of recorded species traded in both time periods. This high level of turnover in traded species could jeopardize sustainable ranching projects undertaken by local communities in range states, as market volatility for all but the most carefully selected species could preclude investment due to a variety of factors including: marketing; market connectivity; supply; captive breeding in 'consumer' countries; changing trade regulations and fashion. More traded species were listed by CITES in 1992-3 than in 2004-5. Taking into account inflation, the study showed that the price of all groups of amphibians and reptiles recorded had increased over the ten year period.

Breeding amphibians on a commercially viable scale, in the UK, for many species, is still in its infancy. The price increases of amphibians seemed to represent their increased popularity coupled with overhead costs of captive breeding on a commercial scale being transferred to the hobbyist. The dynamics of the UK herpetofauna market are similar to those of the avicultural and freshwater ornamental fish markets. Thus, a high price may have various impacts on the captive population of a species whose trade is regulated.

Figure 1. *Megophrys nasuta* was available in both trading periods. Photo: Suzan Girgin.

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Literature Cited

Tapley, B., Griffiths, R.A. and Bride, I. (2011) Dynamics of the trade in reptiles and amphibians within the United Kingdom over a ten-year period. The Herpetological Journal. 21: 27-34

Figure 2. *Agalychnis callidryas* was available in both trading periods. This species is well established in captivity hence the relative price change between 1993 and 2005 decreased by 22%. Photo: Benjamin Tapley.

Monitoring Natterjack Toad Breeding Activity and Success to Better Target Conservation Programs

By Aurélie Aubry

The Natterjack toad (*Epidalea calamita*, formerly *Bufo calamita*) is a protected species listed on Annex IV of the EU Habitats & Species Directive (92/43/EEC). Until recently, very little was known of the conservation status of *E. calamita* in Ireland, where it is found at the edge of its European distribution. In Ireland, Natterjack toads are restricted to 12 distinct native sites. Each site represents a single pond, a small lake or a cluster of ponds. Since 2002, the Irish National Parks and Wildlife Service (NPWS) have commissioned several studies to define and monitor the conservation status of the species in Ireland (Beebee, 2002; Aubry & Emmerson, 2005; Bécart et al. 2007). To further explore the fundamental ecological processes that determine the Natterjack toad population dynamics in Ireland, additional and complementary research and conservation work were carried out at University College Cork (Aubry, 2009; Aubry et al. 2010; 2012).

Figure 1. Adult Natterjack toad in a sand dune habitat, Ireland. Photo: Aurélie Aubry.

Comprehensive data on toad breeding activity (start and length of breeding season, number of egg strings) and reproductive success (egg and tadpole survival, production of metamorphs) were collected over three consecutive years at 40 ponds, representing 11 breeding sites. These data were used to clarify and assess the suitability of a relatively simple method (the Kiritani-Nakasuji-Manly (KNM) method) to estimate the survival rates of stage-structured populations with extended breeding seasons, resulting in overlapping life stages (Aubry et al. 2010). Survival and fecundity rates were then used to carry out population viability analyses. The findings led to the implementation of practical conservation measures at several sites where populations were most vulnerable to extinction. These remedial works were funded by the Irish Heritage Council as part of a dedicated Biodiversity Fund supporting capital conservation works. The measures included the creation of nine additional ponds (thus representing a potential increase in toad breeding habitat by 25%) and the improvement of three existing breeding ponds by clearing encroaching vegetation (Shaw, 2006). A major component of the Biodiversity Fund project also comprised education and outreach collaborating with the local landowners who lived or worked near Natterjack toad breeding sites. In 2008, *E. calamita* was included within a national agri-environmental scheme launched by NPWS to encourage the creation of toad breeding ponds in County Kerry. The scheme is still ongoing and more than 70 ponds have been created. Such conservation measures should increase connectivity among populations, with the aim of increasing breeding success and ensuring viability of the species in this region.

Figure 2. Excavating a new pool at Glenbeigh marsh in 2006 as part of a Biodiversity Fund project. Photo: William Shaw.

The abundance and survival data collected at each pond were also used to assess the spatiotemporal dynamics of toad populations at local (2-5 km) and regional (>10 km) scales (Aubry et al. 2012). There was no synchrony in the toad breeding activity and success at the local level, suggesting that populations function as individual clusters independent of each other, with little or irregular dispersal among populations. Regional synchrony in both rainfall and temperature are likely to explain the observed regional synchrony in both the start and length of the breeding season and in the number of egg strings (used as a surrogate for adult breeding female population size). There was no evidence supporting regional synchrony in toad breeding success, most likely due to spatial variability in the environmental conditions at the breeding ponds and to the observed differences in local population fitness (e.g., fecundity).

The consequences of synchronous dynamics in populations are crucial for their monitoring. In the present study, the small scale asynchronous dynamics and regional synchronous dynamics in the number of breeding females indicate that it is best to monitor several populations within a subset of regions. Considering the high level of vulnerability for this species in Ireland, it is nonetheless also important to monitor each region. Furthermore, the study of synchrony can help to implement successful conservation strategies. Theory predicts that asynchronous dynamics should increase

Figure 3. Water beetle larva predating on Natterjack toad eggs. Photo: Aurélie Aubry.

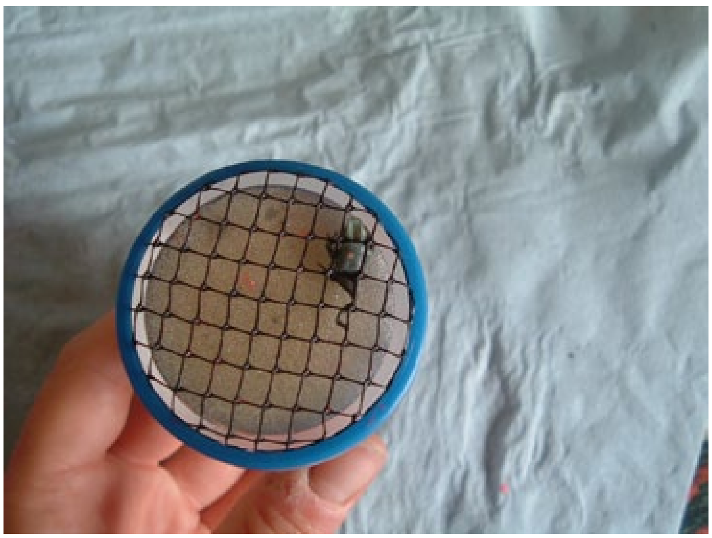

Figure 4. *E. calamita* toadlet (9 mm snout-vent length, 100 mg) on an insect holder just after receiving a red VIE tag under the skin in the abdominal region. Photo: Aurélie Aubry.

the regional persistence of populations (Heino, 1998) when there is moderate dispersal among populations (Palmqvist & Lundberg, 1998). We found that the small scale dynamics of toad populations were largely asynchronous, which indicates that maintaining a network of partially connected populations should increase their long term persistence.

In Ireland, *E. calamita* is found along the entire gradient of pond ephemerality, from highly seasonal to permanent ponds. This situation provided a unique opportunity to explore the local determinants of population size and reproductive success for this species, based on a particularly wide range of environmental values at the breeding ponds. Using a model selection approach, the results indicated that the abundance and diversity of predators of tadpoles were the most influential factors for toad reproductive success (Aubry, 2009). *E. calamita* was surprisingly resilient to many other environmental factors (e.g., pH, aquatic vegetation structure and primary production). Overall, the results indicated that conservation measures should favor ponds with high conductivity, warm conditions and a limited number of predators (Bécart et al. 2007; Aubry, 2009). For example, to maximize mean temperature, while maintaining hydroperiod to enable tadpoles to grow and metamorphose, ponds should have shallow margins, with little or no shade. As for many other amphibians, conservation practitioners thus need to achieve a fine balance between pond depth, temperature and hydroperiod (ephemerality), allowing regular recruitment and also occasional drying out, in order to limit the abundance of tadpole predators.

Understanding the movement of individuals within and between breeding sites is another crucial requirement for the conservation management of pond-breeding amphibians. Visible Implant Elastomer (VIE) tags were successfully used to batch mark 1,242 newly-metamorphosed Natterjack toads and 229 adult toads. The marking technique had no detectable negative effect on the growth or survival of toadlets during the first three weeks following marking. The results provided further evidence that *E. calamita* toadlets could cover distances of up to 100 m from their natal pond in just a few weeks, and that male adult toads were highly philopatric to a breeding area, with occasional exchange of individuals breeding at neighbouring ponds (Aubry, 2009). This marking technique can be used to batch mark even very small individuals (SVL < 1 cm) and it is also straightforward to detect the mark in the field during day or night, since it only requires a LED blue torch and filtering glasses. The use of VIE tags appears therefore to be a satisfactory alternative method to mark amphibians, compared with traditional methods using toe clipping (Hoffmann et al. 2008) or other, more expensive tags such as wire tags (Sinsch, 1997).

Acknowledgments
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Literature Cited

Aubry A (2009) Population dynamics of the Natterjack toad (*Bufo calamita*) in a fragmented pond complex, South West Ireland. PhD thesis, University College Cork.

Aubry A, Bécart E, Davenport J, Lynn D, Marnell F, Emmerson MC (2012) Patterns of synchrony in Natterjack toad breeding activity and reproductive success at local and regional scales. Ecography 35: 1-11.

Aubry A, Bécart E, Davenport J, Lynn D, Marnell F, Emmerson MC (2010) Estimation of survival rate and extinction probability for stage-structured populations with overlapping life stages. Popul Ecol 52: 437-450.

Aubry A, Emmerson MC (2005) Monitoring of Natterjack toad (*Bufo calamita*) in Ireland, Breeding season 2004. Report to the National Parks and Wildlife Service.

Bécart E, Aubry A, Emmerson MC (2007) Monitoring the conservation status of Natterjack toad (*Bufo calamita*) in Ireland, 2004-2006. Irish Wildlife Manuals, National Parks and Wildlife Service.

Beebee TJC (2002) The Natterjack toad (*Bufo calamita*) in Ireland: current status and conservation requirements. Irish Wildlife Manuals, National Parks and Wildlife Service.

Heino M (1998) Noise colour, synchrony and extinctions in spatially structured populations. Oikos 83: 368-375.

Hoffmann K, McGarrity ME, Johnson SA (2008) Technology meets tradition: a combined VIE-C technique for individually marking anurans. Applied Herpetology 5: 265-280.

Palmqvist E, Lundberg P (1998) Population extinction in correlated environments. Oikos 83: 359-367.

Shaw W (2006) Conservation of Natterjack toad (*Bufo calamita*) breeding habitats in County Kerry, Ireland. Report to the Heritage Council.

Sinsch U (1997) Postmetamorphic dispersal and recruitment of first breeders in a *Bufo calamita* metapopulation. Oecologia 112: 42-47.

POPAMPHIBIEN - Estimating Amphibian Population Trends in France

By Jean-Pierre Vacher & Claude Miaud

Amphibian distribution available in national atlases is a very useful knowledge in many aspects. However, it is often based on presence-absence data at a rather large scale (e.g., 50 x 50 km), which prevents estimating abundance variation. In 2009, the French Herpetological Society (SHF) launched a national amphibian monitoring program in order to estimate regional population trends within French mainland territory (overseas territories are currently excluded). This program is undertaken in collaborations with the French Forestry Agency (ONF), the French Nature Reserves (RNF) and the National Museum of National History (MNHN). It involves a large network of herpetologists, both professionals and volunteers. The so-called POPAMPHIBIEN has two declinations: (i) monitoring the occurrence of species (community approach) (ii) monitoring the abundance of focus species (specific approach). Both protocols are based on occupancy models and robust design statistical framework. The first protocol aims to gather data relating to amphibian communities by estimating species richness in wetlands. The second collects count data, taking into account detection probabilities, for a group of target species (4 anurans and 5 newts). Surveys are annual and conducted in a set of aquatic sites (with or without amphibians) corresponding to one area. The number of monitored sites per area is not constrained, usually ranging from one up to ten. As France is a rather large country with a lot of different habitat types, POPAMPHIBIEN has been launched in stages across different regions, with various partners. Every year, the SHF centralizes all the data in a national database and works on their analysis together with the MNHN. Up to 2012, POPAMPHIBIEN have been implemented in 5 regions, involving 11 partners, which represent about 150 participants. These figures are continually growing as new volunteers and environment institutions wish to take part in this program. Still, it is too soon to present results, but the goal of the SHF and the MNHN is to present the first outputs in 2015. A dedicated web page with the whole protocol and its different appendices can be found on the Internet site of the SHF (with a link on the MNHN webpage) at the following address: http://lashf.fr/suivi-amphibiens.php . A dedicated email list has been put together in order to enable everyone who is taking part in the program to ask questions, share experience, and discuss all things related to amphibian monitoring.

This national level approach, taken by the POPAMPHIBIEN amphibian monitoring program, is new in France and will enable scientists to have a better dataset with which to assess the status of species in the scope of the EU article 17 of the Habitats Directive.

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Amphibian Conservation in Switzerland – karch and the Story So Far

By Benedikt R. Schmidt & Silvia Zumbach

Amphibian conservation has a long history in Switzerland. Conservation efforts began in the 1960's when people started to notice that many amphibians were being killed on roads and around the same time herpetologists noted that many amphibian habitats were being destroyed (Heusser 1968; Meisterhans and Heusser 1970). Habitat destruction is the main reason for amphibian declines in Switzerland with 90% of Switzerland's wetlands being drained or otherwise destroyed (Imboden, 1976). The best data are available for the Swiss canton Zurich (Gimmi et al. 2011). In 1850, wetlands covered 8.3% of the canton (n=4300 wetlands), this number decreased to 0.7% in 2000 (n=700 wetlands). The mean size of a wetland patch is now only 1.7 ha. It is therefore no surprise that wetland-inhabiting species are more threatened than species inhabiting terrestrial habitats (Cordillot & Klaus, 2012).

The first Swiss Red List of threatened amphibians was published in 1981 by Hotz and Broggi. Hotz and Broggi (1981) listed 15 out of 19 species as endangered. The most recent Swiss Red List, which is based on the criteria and categories of the IUCN, lists 70% of all species as Endangered (category EN), Vulnerable (category VU) or Regionally Extinct (RE; one species: the Green toad *Bufo viridis*). The proportion of Red Listed species in 2005 was lower than in 1981 but this is mainly due to a change in Red List assessment methodology. At the national level, many species are threatened even though they are not threatened globally. The main reasons for the threat status include small distribution ranges (e.g., *Hyla intermedia* and *Triturus carnifex*) or large population declines. Many species, such as *Hyla arborea*, *Bufo calamita*, *Alytes obstetricans*, *Bombina variegata*, *Lissotriton vulgaris*, and *Triturus cristatus* have suffered population declines of 50% since 1985.

Figure 1. Screenshot of karch web site.

The first systematic survey of amphibian breeding sites was completed in canton Zurich in the late 1960's (Escher, 1972). Later, systematic surveys were conducted in almost all cantons such that a comprehensive atlas of the distributions of the Swiss amphibians could be published in 1988 (Grossenbacher, 1988). Updated distribution maps were published by Meyer et al. (2009). Currently, roughly 12,700 amphibian breeding sites are known in Switzerland.

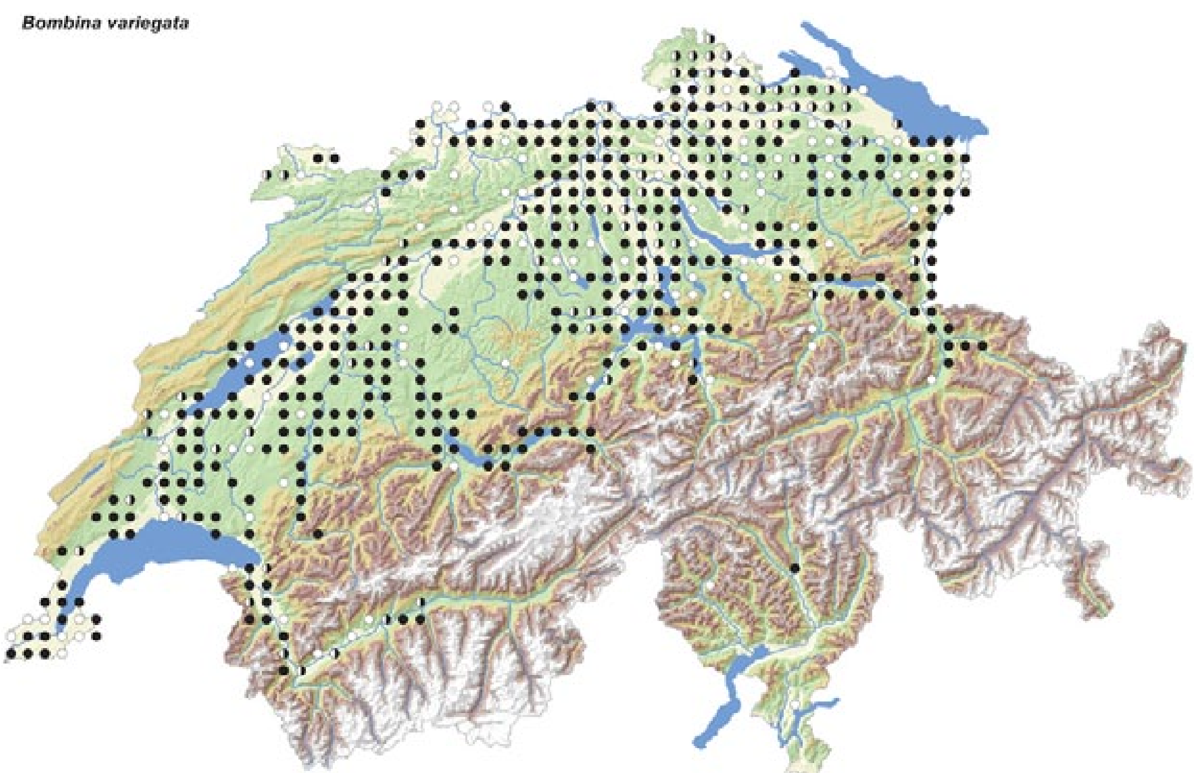

Figure 2. Map showing the distribution of the Yellow-bellied toad *Bombina variegata* in Switzerland. ◌ < 1992 ◑ 1992 - 2001 ● 2002 - 2011. © Swisstopo and karch 2012.

Figure 3. Two Yellow-bellied toads *Bombina variegata* in amplexus. Photo: Andreas Meyer.

Figure 4. A newly created temporary pond in a gravel pit will be habitat for many endangered species. The pond is equipped with a drain. Photo: Mario Lippuner.

Amphibian species and their habitats have been protected by law since 1966. It is forbidden to harm or kill amphibians or to destroy their breeding sites. In 2001, the Swiss government published a list of ca. 800 amphibian breeding sites of federal importance (acronym: IANB; Ryser, 2002). These sites must be protected by the cantonal conservation authorities. A recent report by the Swiss government (Borgula et al. 2010), concluded that while the IANB initiated many amphibian conservation projects, many goals have not yet been met. More effort is necessary to maintain the conservation value of the amphibian breeding sites of federal importance. In 2011, the Swiss federal office of the environment launched a monitoring program for the amphibian breeding sites of federal importance. This will help to better assess the success of amphibian conservation in the amphibian breeding sites of federal importance and amphibians in general.

The major player in amphibian conservation in Switzerland is the "Koordinationsstelle für Amphibien- und Reptilienschutz in der Schweiz" (acronym: karch), the Swiss amphibian and reptile conservation program (www.karch.ch; the web site is available in German, French and Italian). Founded in 1979, karch is an independent foundation supported by the Swiss federal office for the environment. The duties of karch are described in the bylaws: "to support all activities, including research, that improve amphibian and reptile conservation." Currently karch has six part time employees that deal with amphibian and reptile conservation (Jean-Claude Monney, Andreas Meyer, Silvia Zumbach, Benedikt Schmidt, Ursina Tobler, Murielle Mermod), and a data base manager (Thierry Bohnenstengel). In addition, the IANB consultation service is also part of karch (one post). Also maintained by karch, is a network of local representatives in all the cantons who are paid by the cantonal offices for nature conservation. While local representatives deal with local amphibian and reptile conservation issues, karch itself deals with conservation issues at the federal and sometimes cantonal level. We launch amphibian conservation projects and provide expert advice on projects run by other organisations. karch closely collaborates with the Swiss federal office for the environment and provides advice on various issue, such as agricultural policy and the federal biodiversity strategy. Recently, the Swiss federal office for the environment provided funding for an additional employee. The person is responsible for the "1001 ponds project." The goal of this project is to construct 1001 new temporary ponds. karch also collaborates with universities on research topics such as chytridiomycosis, amphibian monitoring and assessment of the success of amphibian conservation projects.

In collaboration with CSCF, the Swiss centre for the cartography of the fauna, karch maintains an amphibian and reptile presence-only distribution data base. Currently (30 January 2012), 12,684 amphibian breeding sites and 160,529 observations of amphibians are registered in the data base. Most of the data were provided by herpetologists and naturalists. Other data are from systematic amphibian surveys, monitoring programs and research projects. While the distribution data are not freely available, the data can be used for research purposes, conservation projects and environmental impact assessments if data users comply with the data privacy policy.

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Literature Cited

Borgula, A., Ryser, J., and Fallot, P. (2010) Zustand und Entwicklung der Amphibienlaichgebiete von nationaler Bedeutung in der Schweiz: Ergebnisse der Erfolgskontrolle zum Schutz der Amphibienlaichgebiete. Bundesamt für Umwelt, Bern.

Cordillot, F., and Klaus, G. (2012) Gefährdete Arten in der Schweiz: Synthese Rote Listen. Stand 2010. Bundesamt für Umwelt, Bern.

Escher, K. (1972) Die Amphibien des Kantons Zürich. Vierteljahresschrift der naturforschenden Gesellschaft Zürich 117: 335-380.

Gimmi, U., Lachat, T., and Bürgi, M. (2011) Reconstructing the collapse of wetland networks in the Swiss lowlands 1850-2000. Landscape Ecology 26: 1071-1083.

Grossenbacher, K. (1988) Verbreitungsatlas der Amphibien der Schweiz. Documenta faunistica helvetiae 7: 1-207.

Heusser, H. (1968) Wie Amphibien schützen? Flugblatt Naturforschende Gesellschaft Schaffhausen 3: 1–14.

Hotz, H., and Broggi, M. F. (1982) "Rote Liste der gefährdeten und seltenen Amphibien und Reptilien der Schweiz." Schweizerischer Bund für Naturschutz, Basel.

Imboden, C. (1976) "Leben am Wasser: Kleine Einführung in die Lebensgemeinschaften der Feuchtgebiete." Schweizerischer Bund für Naturschutz, Basel.

Meisterhans, K., and Heusser, H. (1970) Amphibien und ihre Lebensräume: Gefährdung – Forschung – Schutz. Natur und Mensch 12: 1–20.

Meyer, A., Zumbach, S., Schmidt, B., and Monney, J.-C. (2009) "Auf Schlangenspuren und Krötenpfaden: Amphibien und Reptilien der Schweiz." Haupt Verlag, Bern.

Ryser, J. (2002) "Bundesinventar der Amphibienlaichgebiete von nationaler Bedeutung: Vollzugshilfe." Bundesamt für Umwelt, Wald und Landschaft, Bern.

Schmidt, B. R., and Zumbach, S. (2005) "Rote Liste der gefährdeten Amphibien der Schweiz." Bundesamt für Umwelt, Wald und Landschaft, Bern.

Common Toad in Italy: Evidence for a Strong Decline in the Last 10 Years

By Anna Bonardi & G. Francesco Ficetola

The Common toad (*Bufo bufo*) is a widespread amphibian, inhabiting large areas of Europe and Western Asia. Although classified as "Least Concern" by the IUCN, data suggested that the Common toad may be declining in some European countries (Carrier and Beebee, 2003; Schmidt and Zumbach, 2005). Measuring a species decline is pivotal to evaluate their conservation status, but an accurate assessment of demographic trends requires observations collected across broad spatial and temporal scales. Indeed, populations may undergo natural demographic fluctuations, with strong year-to-year variation, even in absence of a true decline. Unfortunately, gathering of such a mass of data is complex, requiring many resources like time, money, personnel. The use of volunteers can help to overcome the difficulties of a broad scale monitoring.

Vehicular traffic may cause high mortality to amphibians crossing roads during breeding migrations, therefore, in several European countries, mitigation measures are established, frequently managed by groups of volunteers. Volunteer groups sometimes rescue amphibians over many years, with important consequences on mortality, and can also collect a large amount of data on the crossing individuals. Obtaining quantitative estimates of toad decline is difficult, but the availability of a large amount of data collected by volunteers may help to achieve this task. Nevertheless, volunteer data need to be conveniently checked before their use in demographic analyses. If volunteer groups follow different monitoring protocols, their data may be extremely heterogeneous. It might therefore be difficult integrating such volunteer counts to obtain reliable information for the analyses of population trends. In our study we combined volunteer data to assess whether the Common toad is declining over broad temporal and spatial scales, and to obtain quantitative measures of its decline (Bonardi et al. 2011).

We integrated yearly abundance data, collected by different groups of volunteers, on 33 toad populations spread across Central and Northern Italy. For these populations, in night-time during the migration period, volunteers walk along the stretch of roads where the migration occurs, gathering the toads to transfer them to the other side, and recording the number of toads crossing the road toward the breeding site as a measure of toad abundance. Time series obtained covered periods ranging from three to 18 years (average 8.5), corresponding to a total of 1,042,966 toad rescues.

A single time series may have bias or may only represent a local situation. However, observing a coherent trend among multiple series collected over the same period, and representing populations spread through a wide region, may provide useful information on the overall trend of a species. Variation in monitoring effort across years may affect detection probability, therefore we integrated measures of volunteer sampling effort in our analyses (Schmidt, 2004). We then used the meta-analysis approach to combine results from multiple, heterogeneous sources and obtain a reliable

Common toad (*Bufo bufo*). Photo: Matteo Di Nicola.

measure of the overall strength of the demographic trend. Furthermore, we combined data from multiple populations to obtain quantitative estimates of the overall population changes in time using the Δ*N* method, an approach allowing the analysis of average changes in population size (Houlahan et al. 2000).

The majority of the investigated populations declined during the period 2000–2010. After taking into account sampling effort, 21 out of 30 populations showed a significant decline, while only three showed an increase during this period. Integrating sampling effort into analyses strongly reduced the heterogeneity of data from multiple populations, i.e., allowed to better integrate data from disparate sources. Demographic trends were not spatially autocorrelated (Moran's I = -0.16, P = 0.18) indicating that the decline was not idiosyncratic to one particular region.

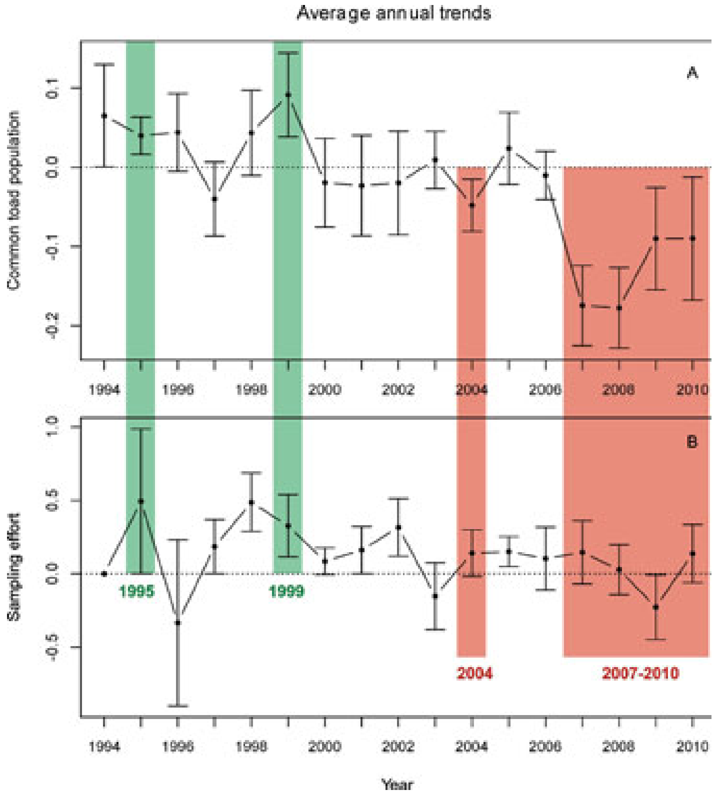

Figure 1. Average annual trends, calculated with Δ*N* method, of all Common toad populations monitored (A). and of the sampling effort (B). Error bars represent SE and values below zero indicate declines, values above zero indicate increases. Years of apparent increase are highlighted in green, years of decline are highlighted in red.

not biased by the effect of one or a few populations, but was consistent across the whole study area. It is difficult to identify the causes of such a widespread decrease; we therefore expect that the decline will continue in the near future. The concern for Common toads is even higher, as analogous trends are ongoing also in other countries (Carrier and Beebee, 2003; Schmidt and Zumbach, 2005). The Common toad occurs in many modified habitats, nevertheless several factors may negatively affect its populations. Road mortality is a primary threat for these populations, but other causes, including habitat loss, fragmentation, chytridiomycosis, pollution and climate change may be involved; joint effects of multiple factors are possible. Future studies are required to identify the drivers of Common toad decline.

By pooling the data from all 33 populations together we quantitatively evaluated the overall trend of populations. Apparent increases occurred several times during the 1990's (Fig. 1A: 1995 and 1999), but corresponded to years in which sampling effort substantially increased (Fig. 1B). Conversely, strong overall decline was evident in 2004 and for the whole period 2007–2010, despite sampling effort remained high during these years (Fig. 1). For the period 2000 – 2010, there was a 76% cumulative average decline of populations, despite an increasing mean sampling effort.

These results show a widespread, dramatic decline of the Common toad in Italy, particularly during recent years. A simultaneous decrease over such a large area is unlikely to be caused just by natural fluctuations. The combination of multiple time series indicates a strong decline during the last decade. This decline was

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Literature Cited

Bonardi, A., Manenti, R., Corbetta, A., Ferri, V., Fiacchini, D., Giovine, G., Macchi, S., Romanazzi, E., Soccini, C., Bottoni, L., Padoa-Schioppa, E., Ficetola, G.F. (2011) Usefulness of volunteer data to measure the large scale decline of "common" toad populations. Biological Conservation 144: 2328-2334.

Carrier, J.-A., Beebee, T.J.C. (2003) Recent, substantial, and unexplained declines of the Common toad *Bufo bufo* in lowland England. Biological Conservation 111: 395-399.

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

Schmidt, B., Zumbach, S. (2005) Liste rouge des amphibiens menacées en Suisse. UFAFP & KARCH, Berne.

Schmidt, B.R. (2004) Declining amphibian populations: The pitfalls of count data in the study of diversity, distributions, dynamics, and demography. Herpetological Journal 14: 167-174.

Robin Moore / iLCP

Trying to Reverse the Decline of the Apennine Yellow-Bellied Toad in Northern Italy

By Stefano Canessa

The Apennine yellow bellied toad *Bombina variegata pachypus* occurs throughout peninsular Italy. Its name comes from its brightly colored underside, which serves to deter predators. It is usually associated with temporary water bodies, where tadpoles enjoy less predation although at the price of a higher desiccation risk. Unfortunately, *B. v. pachypus* has declined dramatically over the last 30 years, particularly in the northern Apennines: more than half its populations have disappeared, prompting a relisting from "Least Concern" to "Endangered" in the IUCN Red List. The exact reasons of the decline are still unclear, but habitat loss is the main suspect. In 2001, mortality by chytridiomycosis was observed at the northeastern limit of the species' range (Stagni et al. 2004), but surprisingly this hasn't been followed by any systematic monitoring.

Figure 1. We are using photographic mark-recapture to monitor wild populations and obtain estimates of survival, movement and recruitment.

In the region of Liguria, at the northern limit of its range, the toad has declined by a frightening 75% since 1998 (Arillo et al. 2009). In 2011, the loss of one more site and the discovery of two new populations raised the number of current breeding sites to eight, but only one of these is estimated to host more than 100 individuals, so they may all be at risk from catastrophic events.

Traditional agriculture and habitat loss

In a recent study (Canessa et al. *in press*), we found that, between 2005 and 2010, populations associated with man-made water bodies (troughs, washtubs) were more likely to have disappeared than those occurring in natural sites (mainly mountain brooks). Artificial sites have been a characteristic feature of the regional landscape over the last few centuries, when extensive agriculture created hectares of terraces: irrigation required the maintenance of purpose-built water bodies, which farmers would drain and clean in spring and autumn. By doing so, they removed substrate and vegetation, which would otherwise favor tadpole predators (dragonflies and newts) and shading, detrimental to tadpole development. These agricultural practices simulated the effect of seasonal floods and droughts observed in natural sites: in addition, artificial sites would never risk desiccation, and so were ideal for tadpole development. Such positive influence of disturbance, including that generated by humans, may appear surprising to conservationists used to regard any human activity as negative: however, previous studies of *B. variegata* have shown similar patterns (Warren & Büttner, 2008).

Figure 2. Artificial sites provide great habitat when properly maintained (left), but when abandoned they become rapidly infested by vegetation and tadpole predators (right).

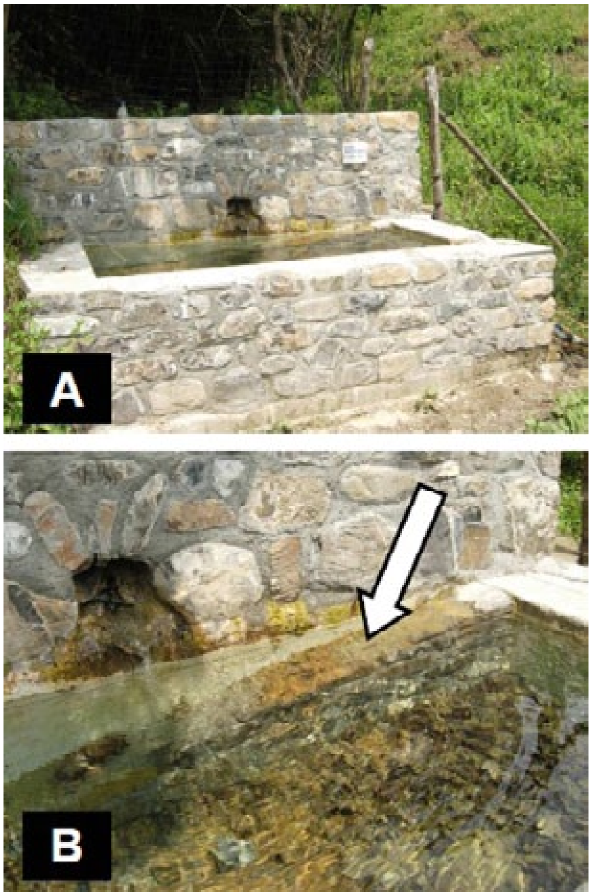

Figure 3. Purpose-built artificial sites for release of captive-bred individuals consist of stone washtubs (top) with a ramp to facilitate exit by metamorphs (bottom).

Then why has the decline been particularly marked at artificial sites, while natural ones appear reasonably stable? Since the 1960s, the depopulation of inland valleys has led to the abandonment of most previously cultivated areas. Those that remain have forgone traditional practices, for example pumping water directly from mains. As a result, many water bodies have disappeared altogether; others have become invaded by vegetation and predators. With the loss of this cultivated landscape matrix, even natural sites may become isolated and at risk from both genetic and environmental factors. That land abandonment can reduce biodiversity is now clear to conservationists across Europe, and the Yellow-bellied toad represents only another example. In the future, we wish to relate genetic distances between populations with current and past land use: we are open to collaboration with anyone interested!

Looking for chytrid

In 2011 we tested all Ligurian toad populations for chytrid. We estimated that between 30% and 40% of all the existing individuals were sampled: luckily, none returned positive, and although a few infected individuals may still have gone undetected, we could rule out large infections. We must test populations of *B. v. pachypus* across Italy for chytrid, possibly with carefully planned programs which reduce the probability of missing actual infections. If chytrid is indeed affecting the species, limiting our approach to countering habitat loss may not be good enough: restoration of breeding sites can provide suitable habitat, but it won't prevent outbreaks of chytridiomycosis. We should also clarify the role of other amphibians (such as newts and *Pelophylax* frogs) as carriers of the disease (Simoncelli et al. 2005).

Captive breeding and reintroduction

In 2008 the Regional Park of Monte Marcello - Magra and the University of Genoa started a cooperative program to breed individuals in captivity and then release them at a number of purpose-built suitable breeding sites. These replicate traditional stone washtubs, since focusing on artificial sites helps cooperation with local people, especially farmers: without their support, any conservation action is unlikely to succeed. However, farmed land only covers a fraction of its previous extension, and conservation plans, no matter how well researched and funded, won't reverse the social processes which have driven land abandonment. Therefore, we are also striving to involve new actors in the program, such as eco-tourism enterprises which are becoming more popular in the area. They represent a new approach to a sustainable use of the landscape, and their integration within conservation plans may reserve benefits for the future.

Currently, the captive breeding program has entered the most productive phase, with several tadpoles reaching metamorphosis in 2011. We hope to start reintroductions in 2012: meanwhile, we are carrying out further research on the existing populations, to obtain estimates of survival, movement and recruitment which will inform the release of captive-bred individuals. However, since 2009 the program has come under severe criticism from local politicians, in a general scenario of decreasing support for environmental conservation in Italy: funding will be discontinued, just as the program enters its most delicate phase. It is important that the program is kept alive, as with the current rate of decline we may soon face the complete extinction of the species from the area. If this program succeeds, useful scientific and technical insights can be gained, which can then be applied elsewhere in Italy, not only on *B. v. pachypus* but on other endangered and declining amphibian species.

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Literature Cited

Arillo, A., Braida, L., Canessa, S., Oneto, F., Ottonello, D. & Raineri, A. (2009) Problematiche di conservazione delle popolazioni di *Bombina pachypus* (Bonaparte, 1838) in Liguria. *Boll. Mus. Ist. Biol. Univ. Genova,* **71:** 89.

Canessa, S., Oneto, F., Ottonello, D., Arillo, A. & Salvidio, S. Land abandonment may reduce disturbance and affect the breeding sites of an endangered amphibian in northern Italy. *Oryx, accepted for publication*.

Simoncelli, F., Fagotti, A., Dall'Olio, R., Vagnetti, D., Pascolini, R. & Di Rosa, I. (2005) Evidence of *Batrachochytrium dendrobatidis* infection in water frogs of the *Rana esculenta* complex in central Italy. *EcoHealth*, **2:** 307-312.

Stagni, G., Dall'Olio, R., Fusini, U., Mazzotti, S., Scoccianti, C. & Serra, A. (2004) Declining populations of Apennine yellow-bellied toad *Bombina pachypus* in the northern Apennines (Italy): is *Batrachochytrium dendrobatidis* the main cause? *Italian Journal of Zoology*, **71:** 151-154.

Warren, S.D. & Büttner, R. (2008) Relationship of endangered amphibians to landscape disturbance. *The Journal of Wildlife Management*, **72:** 738-744.

Amphibians in South-Eastern Spain

By Maribel Benítez, Manuel Chirosa & Juan M. Pleguezuelos

Water is a scarce resource in the Mediterranean Basin, a region that concentrates a high degree of biodiversity within the global context (Myers et al. 2000). In this region, the unstable and unpredictable climate spans a broad range of temperature and rainfall values, with long, dry periods punctuated by intermittent heavy rains. Therefore, the presence and conservation of small water reservoirs proves vital for wildlife (Blondel and Aronson, 1999). In south-eastern Spain, within this environmental context (Fig. 1), we have studied the possibility of reconciling the human use and the conservation of biodiversity of small points of water suitable for amphibian reproduction.

The study area, covering 18,193 km^2, has an abrupt relief, with elevations from sea level, on the Mediterranean coast, to 3,478 m a.s.l., on the Sierra Nevada, the highest mountain in the Iberian Peninsula. The region also has vigorous economic activity (residential construction, tourism, intensive agriculture) as well as being a biodiversity hotspot, the result of high endemism.

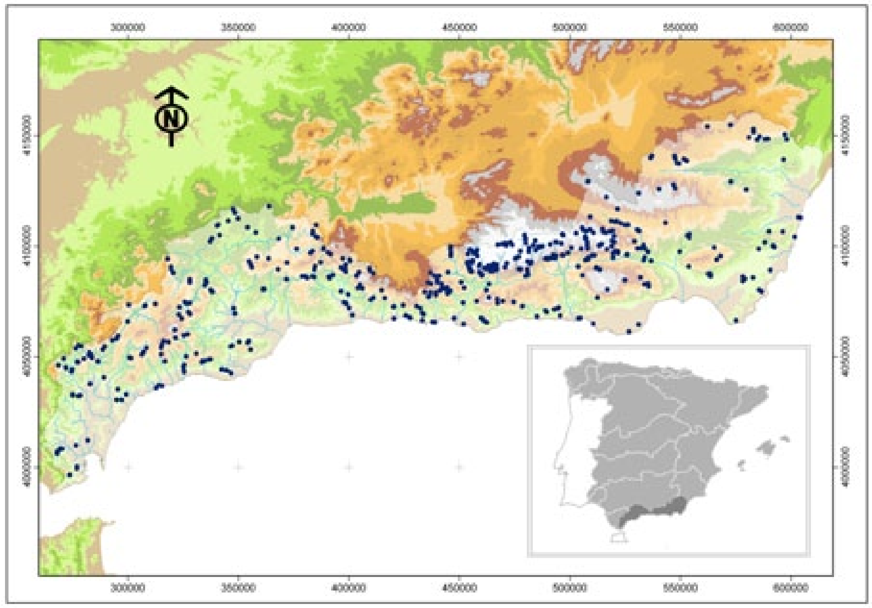

Figure 1. Location of the study area within the Iberian Peninsula and watershed delineation. The dots indicate sampling sites.

The topography and geology of the region give rise to many small ponds and temporary pools, vital for the reproduction of many amphibians. These water resources have historically been exploited by the region's inhabitants over the millennia. However, human impact on these points of water has grown from negligible in the past to very intense at present. The present use of water, mainly for agriculture and livestock, has led to the alteration of these aquatic habitats (casing, sealing traditional springs and ponds, pollution, drying). The overexploitation of aquifers due to changes from traditional rainfed agriculture to irrigated agriculture has also resulted in the disappearance of many of these habitats.

The region has a marked rainfall gradient from west to east. The Strait of Gibraltar in the west averages about 1500 mm/year, while in Cabo de Gata, in the east, precipitation is less than 200 mm/year. The richness of amphibians is associated with this weather pattern, being higher in the western part (10 species) than in the eastern part (3 species) (Real et al. 1992).

During the years 2009 to 2011, we sampled 670 points of water potentially suitable for amphibian reproduction, 58% of artificial origin (fountains, basins and troughs, ditches, irrigation ponds, cisterns, wells, dams; Fig. 3) and 42% natural (springs, temporary puddles, natural ponds, mountain streams). We found 11 species of amphibians (Table 1), four endemic to the Iberian Peninsula, and two threatened with extinction, one in the eastern part of the region (*Alytes dickhilleni*, Fig. 2) and another in the western one (*Salamandra salamandra longirostris*) (Table 1).

Figure 2. *Alytes dickhilleni* male carrying a clutch.

Figure 3. Types of artificial points of water for amphibian reproduction in the south-eastern Iberian Peninsula.

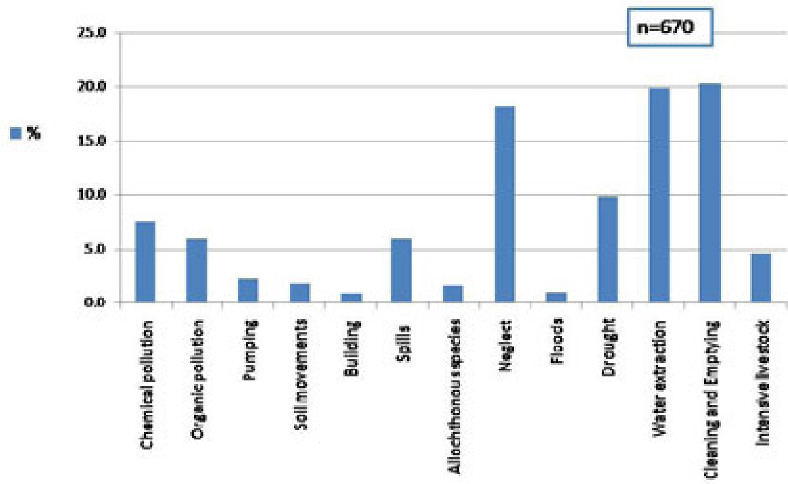

Figure 4. Threats to points of water with reproducing amphibians in the south-eastern Iberian Peninsula.

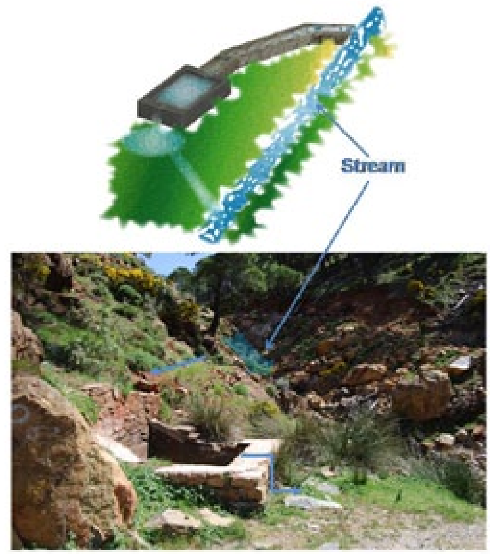

Figure 5. Recovery of old stream-fed reservoirs.

We found that the main risks to the survival of these points of water are extraction, abandonment of old water storage infrastructures, and inadequate management (frequent cleanings and emptying; Fig. 4).

A minimum of recovery intervention in these areas could help decisively to conserve the species present, preventing the reduction of their ranges and even extinction (Welsh and Ollivier, 1998). Therefore, for each point of water of value for the amphibian reproduction, we propose management measures, focusing on their restoration and conservation (Fig. 5). These are meant to build new infrastructure, to reconstruct and adapt existing systems, and to regulate agricultural, livestock or recreational uses where necessary (Fig. 6).

These measures will benefit all amphibian species in the region and especially *Pelobates cultripes*, which in the past 20 years has reduced its range from 25 to 12 squares 10 x 10 km. In places where some of these management actions have already been accomplished, the results have been immediate (Fig. 6), evidenced by the presence of reproducing individuals of the most threatened species in the region (*Alytes dickhilleni, Pelobates cultripes, Pelodytes ibericus*; Gonzalez-Miras, 2010).

Species	Extinction risk (IUCN categories)	Endemic condition	UTM 10x10 km squares (%)
Pleurodeles waltl	NT	-	20
Salamandra salamandra longirostris	EN	Iberian	32
Triturus pygmaeus	NT	Iberian	12
Alytes dickhilleni	VU	Iberian	17
Discoglossus jeanneae	NT	Iberian	40
Pelodytes ibericus	LC	Iberian	24
Pelodytes punctatus	LC	-	1
Pelobates cultripes	NT	-	7
Bufo bufo (spinosus)	LC	-	82
Bufo calamita	LC	-	66
Hyla meridionalis	LC	-	33
Pelophylax perezi	LC	Iberian	97

Table 1. Species in the study area.

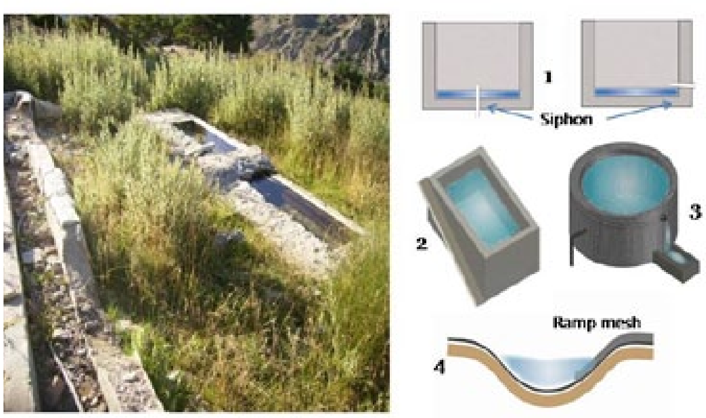

Figure 6. Management of artificial points of water to improve their suitability for amphibians in south-eastern Spain. 1: adequacy of irrigation ponds to prevent complete emptying, 2 and 4: construction of entrance and exit ramps to avoid the death of adult and post-metamorphic amphibians. 3: construction of new infrastructure to facilitate access to water.

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Literature Cited

Blondel, J. and J. Aronson. (1999) Biology and Wildlife of the Mediterranean Region. Oxford University Press, Oxford.

González-Miras, E. (2010) Programa de Actuaciones para la Conservación de Anfibios Amenazados de Andalucía oriental. Unpublished report. Junta de Andalucía.

Myers, N., Mittermeler, R. A., Mittermeler, C. G., da Fonseca, G. A. B. and Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature*, 403: 853-858.

Real, R., Vargas, M. and Antúnez A. (1993) Environmental influences on local amphibian diversity: the role of floods on river basins. *Biodiversity and Conservation* 2: 376-399.

Welsh, H.H.(Jr) y Ollivier, L.M. (1998) Stream amphibians as indicators of ecosystem stress: a case study from California's redwoods. Ecological Applications 8(4): 1118-1132.

Disclosing Northwest African Amphibians: moroccoherps.com

By Octavio Jiménez Robles & Gabriel Martínez del Mármol

Northwest Africa, due to its geological, topographic and climate features, is one of the most biodiverse areas in the Palearctic (Cox et al. 2006). It comprises of many ecosystems whose heterogeneity is enhanced by: a) the climatic and ecological transition from the Mediterranean southwards to the Sahara Desert; b) the influence of the Atlantic and Mediterranean coasts vs. the continentality further inland; and furthermore, c) the presence of several parallel mountain ranges (from north to south: Rif, Low Atlas, Middle Atlas, High Atlas and Antiatlas) reaching up to more than 4,100 m above sea level.

The effects of this ecological and spatial heterogeneity are especially noticeable in the case of the amphibians, represented by different taxa of high interest. In Morocco and Western Sahara there are 14 species with different biogeographic origins: five of them endemic to areas within these countries (*Salamandra algira, Alytes maurus, Pelobates varaldii, Discoglossus scovazzi, Bufo brongersmai*), two restricted to the African west Mediterranean (*Amietophrynus mauritanicus, Discoglossus pictus*), three with broader western Mediterranean distributions including part of Europe (*Pleurodeles waltl, Bufo spinosus, Hyla meridionalis*), two spread throughout North Africa (*Bufo boulengeri, Pelophylax saharicus*) and two paleotropical species with relict populations northwest of the Sahara (*Amietophrynus xeros, Hoplobatrachus occipitalis*).

Amphibians in these developing countries must deal with the loss and alteration of habitat by agriculture, urbanism and natural resources exploitation. Furthermore, this area is suspected to undergo significant climate change which may affect the fitness of regional amphibian populations. Of the 14 amphibian species in the region, one of them is classified as Endangered (*Pelobates varaldii*), three as Vulnerable (*Salamandra algira, Amietophrynus xeros, Hoplobatrachus occipitalis*) and four as Near Threatened (*Pleurodeles waltl, Alytes maurus, Bufo brongersmai, Bufo spinosus*), following the IUCN criteria for conservation status (Pleguezuelos et al. 2010).

Fig 2. *Salamandra algira* another Moroccoan endemic from the wet mountains of the north, considered as Vulnerable (VU) due to its reduced and fragmented range and the degradation of its habitat. Photo: Juan Pablo González de la Vega.

Figure 1. *Hyla meridionalis*, a common species in Morocco. Photo: Javier Gállego.

With this interesting scenario, a group of passionate naturalists had the initiative to create an online reference guide where information on regional herpetofauna could be collated, updated and used to promote conservation. The result of this collaboration is www.moroccoherps.com, a web site dedicated to the dissemination of current knowledge on natural history, ecology, distribution, systematics and conservation of amphibians and reptiles of Morocco and Western Sahara. Since its origin at the beginning of 2011, many naturalists, researchers and nature photographers from different countries have collaborated to help create this project.

The goal of the web site is to serve as a reference guide to the herpetology of these countries, compiling all the information existing on them, including the most current scientific content together with photographs and videos showing the incredible diversity of amphibians and reptiles in the area, their habitats, behaviour, ecology and conservation threats. Unlike books or any other printed publications, the contents can be updated constantly, therefore not becoming obsolete.

Developing species accounts is the current focus with much work still to be completed to cover all the regional herpetofauna. The authors are open to participation by anyone interested in publishing or enhance web content. Every species account is linked to The IUCN Red List of Threatened Species, and includes a gallery of photographs and videos that will be regularly updated and increased as we produce or receive more material. There will also be sections on biogeography, conservation threats, ethnoherpetology and other issues related to northwest Africa herpetofauna.

We are currently handling a large database which will hopefully continue to increase as observations from us and other scientists and naturalists are submitted. This compiled information will be an essential tool for research and conservation enabling us to create comprehensive distribution maps merging data from old records (e.g., Bons & Geniez, 1996; Geniez et al. 2004) with the more recent information we are collecting.

Finally, we would like to acknowledge the help of many collaborators from different countries who contribute with information, text, photographs and also attend to our inquisitive questions. If you want to learn more about our project or get involved please visit www.moroccoherps.com.

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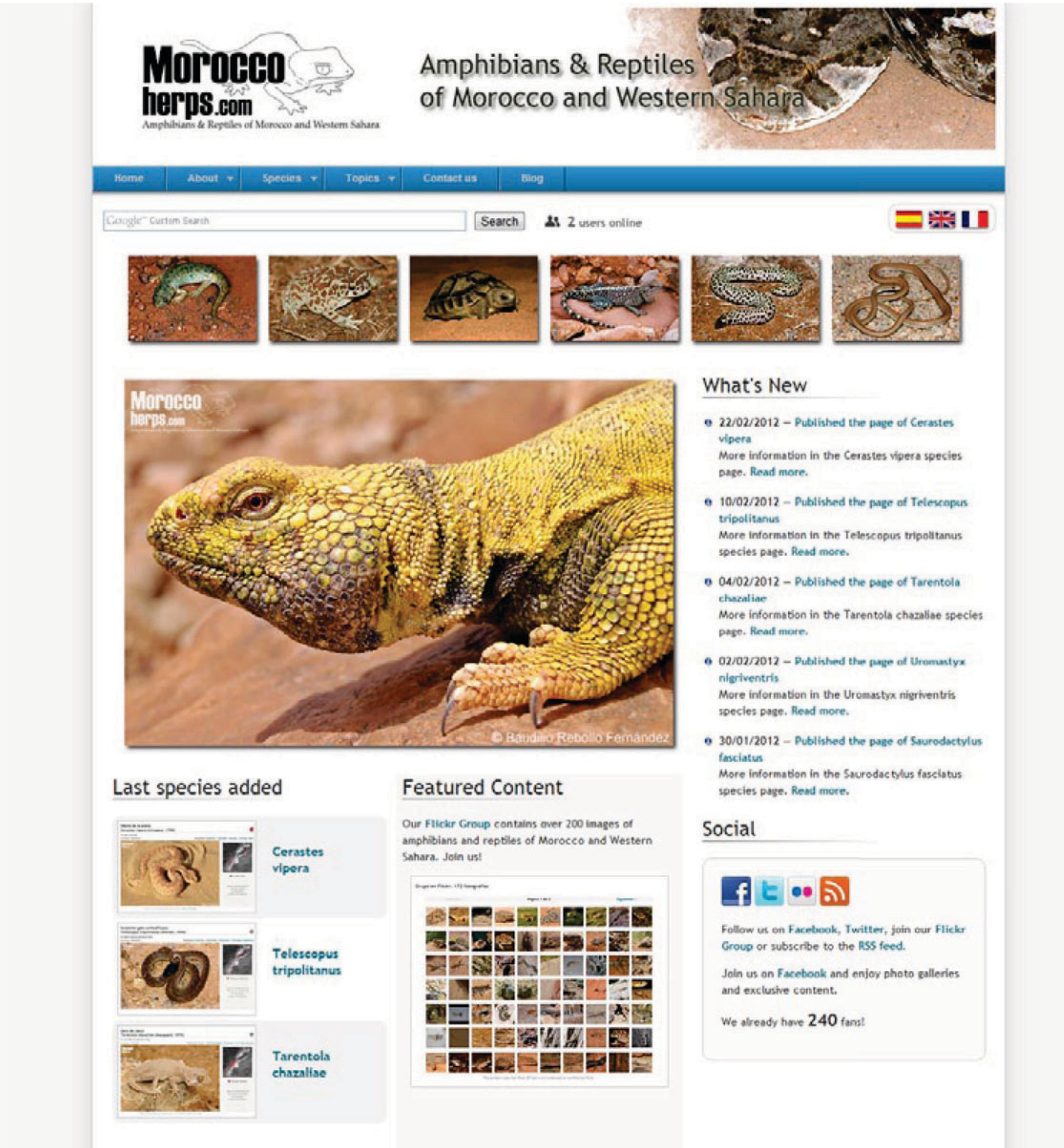
Literature Cited

Bons, J. & Geniez, P. (1996) *Anfibios y Reptiles de Marruecos* (incluyendo Sáhara Occidental). Atlas Biogeográfico. Asociación Herpetológica Española. Barcelona. 319 pp.

Cox, N., Chanson, J. & Stuart, S. (2006) The Status and Distribution of Reptiles and Amphibians of the Mediterranean Basin. IUCN, Gland, Switzerland and Cambridge, UK. 42 pp.

Geniez, P., Mateo, J.A., Geniez, M. and Pether, J. (2004) The amphibians and reptiles of the Western Sahara (former Spanish Sahara) and adjacent regions. Edition Chimaira, Frankfurt, 228 pp.

Pleguezuelos, J.M., Brito, J.C., Fahd, S., Feriche, M., Mateo, J.A., Moreno-Rueda, G., Reques, R. & Santos, X. (2010) Regional Red Listing of the Amphibians and Reptiles of Morocco: Its utility for setting conservation priorities. *Oryx* 44: 501-508.



Overview of Conservation and Red List of Turkey's Threatened Amphibians

By Uğur Kaya, Nazan Üzüm, Yusuf Kumlutaş, Aziz Avci, Yakup Kaska, Mehmet Öz, Rızvan Tunç & Eyup Başkale

In 2008, herpetologists from around the world gathered in Antalya, Turkey to conduct an IUCN workshop to reevaluate the status of some 509 reptile (388) and amphibian (121) species from Europe and the Middle East, including the Caucasus region. This workshop was also the first comprehensive Red List assessment of Turkish amphibians since the 2004 Global Amphibian Assessment. Turkey is home to 29 native species of amphibians, including 14 salamanders and 15 frogs (Baran & Atatür, 1998) of which eight species of salamanders and two species of frogs are endemic. Of the 29 native species of anuran and urodeles in Turkey, 11 were assessed as Threatened (13.3% anuran and 64.2% salamanders) (Tables 1 & 2). Remaining amphibians were assessed as either Near Threatened (NT) or Least Concern (LC) during the workshop.

There were a number of threats to Turkish amphibians identified during the workshop, the most significant are summarized in three main headings as follows:

- Habitat loss, caused by destruction of forest through commercial harvest and forest fires, construction of roads, summer homes and dams, loss of breeding sites through pollution, drought, and drainage.
- Over collection of specimens for scientific purposes, pet trade and for the food trade.
- Introduction of predatory fishes (Tables 1 & 2).

Habitat destruction caused by human activities is a major threat to species survival and significant cause of species extinction throughout the world. This is also the case in developing Turkey; houses, highways, dams, and construction for tourism now dominate landscapes formerly occupied by forests, prairies, scrublands, and wetlands. In addition to addressing the challenges of habitat destruction there is a pressing need to monitor the trade in Turkish amphibians. Although a significant number of traded species are not currently listed as Threatened, it is believed that at cur-

Scientific Name	Red List Status (*)	Population Trend	Justification	Major Threat(s):
Lyciasalamandra antalyana +	EN	decreasing	Listed as Endangered because its Extent of Occurrence is less than 5,000 km2, all individuals are in fewer than five locations, and there is a continuing decline in the extent and quality of its habitat.	Within its naturally restricted range, the major potential threat to this species is habitat loss caused by forest fires and overcollection for scientific purposes. Currently, there is only limited habitat loss taking place, since the human population in its range is generally low, and there is little tourism in the area where it is found, but with ongoing development in the region habitat loss could become more severe. Further development within this species' restricted range would lead to declines because it does not tolerate habitat modification.
Lyciasalamandra atifi +	EN	stable	Listed as Endangered because its Extent of Occurrence is less than 5,000 km2, all individuals are in fewer than five locations, and there is a continuing decline in the extent and quality of its habitat.	Within its naturally restricted range, the major potential threat to this species is habitat loss caused by forest fires, and overcollection for scientific purposes. Currently, there is only limited habitat loss taking place, since the human population in its range is generally low, and there is little tourism in the area where it is found, but with ongoing development in the region habitat loss could become more severe.
Lyciasalamandra billae +	CR	decreasing	Listed as Critically Endangered because its Extent of Occurrence is less than 100km2, all individuals are in only one location, and there is a continuing decline in the extent and quality of its habitat.	There is generally a low human population density and little tourism in the area where it is found, and limited habitat loss is taking place. However, a potential future threat is the loss of habitat due to ongoing development in the region and forest fires, as well as overcollection for scientific purposes.
Lyciasalamandra fazilae +	EN	stable	Listed as Endangered because its Extent of Occurrence is less than 5,000 km2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat from forest fire and coastal development.	Within its naturally restricted range, the major potential threat to this species is habitat loss caused by forest fires, and overcollection for scientific purposes. Currently, there is only limited habitat loss taking place, since the human population in its range is generally low, and there is little tourism in the area where it is found, but with ongoing development in the region habitat loss could become more severe.
Lyciasalamandra flavimembris +	EN	decreasing	Listed as Endangered because its Extent of Occurrence is less than 5,000 km2, all individuals are in fewer than five locations, and there is continuing decline in the extent and quality of its habitat. The low population density of this species also makes it more vulnerable to declines from habitat conversion.	Within its naturally restricted range, the major potential threat to this species is habitat loss caused by forest fires, and overcollection for scientific purposes. Currently, there is only limited habitat loss taking place, since the human population in its range is generally low, and there is little tourism in the area where it is found.
Lyciasalamandra luschani +	VU	stable	This species is listed as Vulnerable because its extent of occurrence is less than 5,000 km^2, all individuals are in fewer than ten locations, and there is continuing decline in the extent and quality of its habitat.	Within its naturally restricted range, the species is potentially threatened by habitat loss caused by forest fires, and overcollection for scientific purposes. Currently, there is only limited habitat loss taking place, since the human population in its range is generally low, and there is little tourism in the area where it is found, but with ongoing development in the region habitat loss could become more severe.
Mertensiella caucasica	VU	decreasing	Listed as Vulnerable because its Area of Occupancy is less than 2,000 km2, its distribution is severely fragmented and confined to small streams free of fish, and there is continuing decline in the extent and quality of its habitat in Turkey and Georgia. The species is undergoing a rapid reduction across its range at it may also qualify for Vulnerable under A3c upon further investigation.	Habitat destruction is a major threat across the species range. In Georgia, the destruction of forests (tree felling), use of brooks as roads for the transportation of cut trees, and destruction of habitats by cattle are known causes of population declines. In Turkey, only around 12% of suitable forest habitat remains within the species range (Özhatay, Byfield and Atay 2003), and suitable subalpine and alpine meadows are being degraded through road construction and "summer house" tourism in the Eastern Black Sea Mountains (Magnin and Yarar 1997). Additionally, several dams are being constructed on streams used by this species. This species is collected for the pet trade.
Neurergus crocatus	VU	decreasing	Listed as Vulnerable because its Area of Occupancy is less than 2,000 km2, its distribution is severely fragmented, and there is continuing decline in the extent and quality of its habitat in Turkey, Iran and Iraq. More research is needed on this species.	Very little is known about this species. It is likely to be relatively susceptible to habitat change including habitat loss, pollution, and drought. In Turkey, the construction of several dams is planned within the species range. The area of distribution in Turkey is expected to undergo significant development over the next 10 years, and presumably the species will be impacted by these changes.
Neurergus strauchii +	VU	decreasing	This species is listed as Vulnerable because its Area of Occupancy is less than 2,000 km2, its distribution is severely fragmented, and there is continuing decline in the extent and quality of its habitat in Turkey. The subspecies Neurergus strauchii barani is particular need of conservation action.	In general, this species lives at high elevations where there is a low human population and few threats. In the eastern part of the species range, close to Bitlis, the species is presumably threatened by pollution of streams and rivers with domestic detergents and sewage. Construction of a dam is planned on the river catchments where the western subspecies in the Kubbe Dağı occurs (G. Eken pers. comm.). This species has been recorded in the pet trade, although it is not known if this is a threat to wild populations (Bogaerts et al., 2006).

Table 1: Threatened urodeles of Turkey. Threatened species and their Red List justification with major threats are summarized here (IUCN, 2011). This represents the first summary of Turkish amphibians on the Red List and is a precursor to a more comprehensive document that will soon be prepared in both English and Turkish
+ Endemic to Turkey * CR: Critically Endangered, EN: Endangered, VU: Vulnerable.

Scientific Name	Red List Status (*)	Population Trend	Justification	Major Threat(s):
Rana holtzi +	CR	decreasing	Listed as Critically Endangered because its Area of Occupancy is less than 10km2 and its Extent of Occurrence is less than 85 km2. All individuals are in a single sub-population, and there is a continuing decline in the number of mature individuals and in the extent and quality of its habitat. Tourism in the area and predation from introduced carp are major sources of decline.	The species is endemic to a popular tourist area. A road has recently been completed at the site potentially increasing the number of visitors. It is reported to be declining through overcollection for scientific and possibly other purposes (Olgun 1998; Eken pers. comm.), and the introduction of predatory fishes (including carp) into the lakes in the 1990s, has led to a significant decline in the population. The impact of local fisheries (including dynamite fishing) and overgrazing of surrounding meadows by goats on the species requires further information, but is presumed to be having a negative impact.
Rana tavasensis +	EN	decreasing	This species is listed as Endangered because the Extent of Occurrence is less than 5,000 km2 and Area of Occupancy is less than 500 km2 with all individuals occurring in two locations, with ongoing habitat loss and fragmentation within the species range. In addition it has an estimated population of less than 2,500 mature individuals.	This species is threatened by the destruction of its forest habitat for small scale commercial harvest within its restricted range. It is also threatened by the general pollution and drainage of breeding sites and wetlands.

Table 2: Threatened anurans of Turkey. Threatened species and their Red List justification and major threats are summarized (IUCN, 2011).
+ Endemic to Turkey * CR: Critically Endangered, EN: Endangered, VU: Vulnerable.

rent rates of exploitation they soon will be. *Pelophylax bedriagae, Pelophylax caralitanus,* and *Pelophylax ridibundus* are all major export species. Most significantly is *Pelophylax ridibundus* which is reported to be declining within its area of distribution in Turkey, although its population is increasing in other parts of world (Başkale, 2009; Kaya unpub. data).

In Turkey, there is an urgent need to raise the level of commitment from official government agencies to amphibian conservation, in addition to improving public awareness of the conservation issues. To the best of our knowledge there is currently only one published action plan for the conservation of the Caucasian Salamander, *Mertensiella caucasica,* in Turkey and Georgia (Tarknishvili & Kaya, 2009). There is therefore a need to prioritize action plans for all Turkish amphibian species that are threatened or have declining populations. There is still significant opportunity and need for further studies relating to amphibian conservation biology and ecology in Turkey. Current data with which population change can be quantified is limited (Kaya et al. 2005; Başkale, 2009), with the first quantified evidence of a sharp decline in Turkish frog populations being provided by Kaya et al. (2010). The habitat requirements of Turkish amphibians is even less well known (Başkale and Kaya, 2009; Sayım et al. 2009). High priority must be given to management actions to address Turkish endemic species population declines. Our conservation efforts to save the amphibians of Turkey and neighboring countries are still in progress and hopefully we will not be too late to take required actions.

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We are most grateful to the IUCN, SSC and Doğa Derneği. Our special thanks are to Neil Cox, Helen Temple, and all colleagues for sharing their scientific knowledge during the IUCN workshop, the Global Reptile and Amphibian Assessment at Antalya/Turkey, in 2008.

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Literature Cited

Baran, I. and Atatür, M.K. (1998) Turkish herpetofauna (amphibians and reptiles). Republic of Turkey Ministry of Environment, Ankara.

Başkale, E. (2009) Monitoring of Amphibian Species, Estimation of Population Sizes and Determination of Habitat Characteristics in Some Lakes in Aegean Region. 168 pages. (Ph.D. Thesis in Biology, Supervisor: Prof. Dr. Uğur KAYA)

IUCN (2011) IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on **19 February 2012**.

Kaya, U., Çevik, I. E. and Erismi, U. (2005) Population status of the Taurus Frog, *Rana holtzi* Werner, 1898, in its terra typica: Is there a decline? Turkish Journal of Zoology 29: 317-319

Kaya, U., Başkale, E., Çevik, İ. E., Kumlutaş, Y. and Olgun, K. (2010) Population sizes of Taurus frog, *Rana holtzi*, in two different localities, Karagöl and Eğrigöl: new estimations, decline, and a warning for their conservation. Russian Journal of Herpetology. Vol. 17(4): 247 – 250.

Sayım, F., Başkale, E., Tarkhnishvili, D., & Kaya, U. (2009) Some water chemistry parameters of breeding habitats of the caucasian salamander, *Mertensiella caucasica* in the western Lesser Caucasus. Comptes Rendus Biologies. 332: 464-469.

Tarkhnishvili, D. and Kaya, U. (2009) Status and Conservation of the Caucasian Salamander (*Mertensiella caucasica*). In "Status and Protection of Globally Threatened Species in the Caucasus" Biodiversity Investments in the Caucasus Hotspot 2004-2009" Edited by Nugzar Zazanashvili and David Mallon. Tbilisi: CEPF, WWF. Contour Ltd., 232 pp.

The Amphibians of Tunisia: Biodiversity, Distribution, Status and Major Threats

By Jihène Ben Hassine & Saïd Nouira

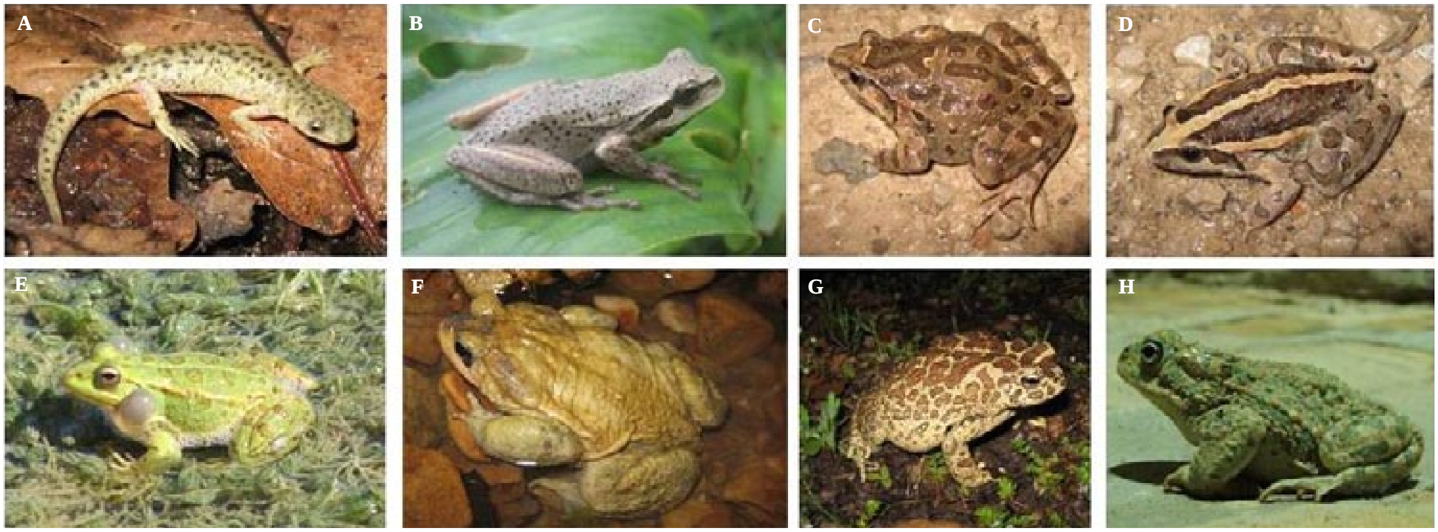

Figure 1. The amphibians of Tunisia. A. *Pleurodeles nebulosus;* B. *Hyla meridionalis;* C and D. *Discoglossus pictus;* E. *Pelophylax saharicus;* F. *Bufo spinosus;* G. *Bufo mauritanicus;* H. *Bufo boulengeri.* © Jihène BEN HASSINE.

Tunisia is located within the Maghreb region of Northern Africa, an area consisting of two climatic zones, a Mediterranean region to the north and arid Sahara region to the south. The Maghreb region contains many unique environmental elements yet also has much in common with Europe (Bons & Geniez, 1996). The herpetofauna of the region reflects the combination of these varied environments.

The amphibians of the Maghreb are relatively few compared to the reptiles of the region however their importance is in the key role they play in maintaining natural biological balance by occupying a key link in food chains (as prey or predators) of different ecosystems, including wetlands.

In the course of 2005-2011, we recorded seven amphibian species in Tunisia: six anuran (*Hyla meridionalis, Bufo spinosus, Bufo mauritanicus, Bufo boulengeri, Discoglossus pictus, and Pelophylax saharicus*) and one caudate (*Pleurodeles nebulosus*) which is endemic to Tunisia and Algeria (Ben Hassine, 2011; Ben Hassine et al. 2011; Ben Hassine & Nouira, 2012 *in press*) (Table 1; Figure 1).

The spatial distributions of the amphibian species occurring in Tunisia are closely related to their biogeographical affinities. There is a clear difference in the distribution pattern between palaearctic species whose distribution is restricted to northern part of Tunisia and the other species of North African or Mediterranean affinities having a larger distribution (Table 1) (Ben Hassine & Nouira, 2012 *in press*).

Family	Species name	Common name	IUCN status	Distribution and status in Tunisia*
Salamandridae	*Pleurodeles nebulosus*	Algerian Ribbed Newt	VU	Small, severely fragmented and disconnected populations in Kroumiria and Cap Bon. Rare and declining species.
Hylidae	*Hyla meridionalis*	Mediterranean Tree Frog	LC	Declining species. Fragmented populations in Kroumiria and Cap Bon.
	Bufo spinosus	Common Toad	LC	Very rare species restricted to the extreme northwest of the country.
Bufonidae	*Bufo mauritanicus*	Mauritanian Toad	LC	Disjointed geographical distribution from the north to the south. Common and abundant in Kroumiria and oases.
	Bufo boulengeri	Green Toad	LC	Common and particularly abundant in north, on the coastal regions and in Chott Djerid oases (Kebilli).
Ranidae	*Pelophylax saharicus*	North African Green Frog	LC	Frequent, abundant and ubiquitous frog, colonizing varied biotopes from the north to the south.
Alytidae	*Discoglossus pictus*	Painted Frog	LC	Frequent and abundant in northern Tunisia and in the oasis (Gabes, Gafsa and Tozeur).

Table 1: List, IUCN status and distribution of amphibian species recorded from Tunisia. (* for further details, see Ben Hassine & Nouira, 2012 *in press*).

B. spinosus, *P. nebulosus* and *H. meridionalis* are the rarest amphibians and most threatened species in Tunisia. They are mainly confined in Kroumiria, Mogods forests with the last two species also being found in Cap-Bon (North East). *P. nebulosus* and *H. meridionalis* reach the sub-humid bioclimatic zone, they are locally present and confined in very humid and cool micro-habitats.

P. nebulosus, an endemic species to northern Algeria and Tunisia (Carranza & Wade, 2004; Veith et al. 2004) is restricted to a limited number of suitable breeding sites within its range and is subject to a continuous decline in the extent and quality of its habitats in northern Tunisia (Schleich et al. 1996; Ben Hassine, 2011). Pollution of breeding ponds are a major threat to the long term survival of this species with agriculture activities in Kroumiria identified as one of the major concerns.

Algerian ribbed newt is suffering from rapid loss and fragmentation of its habitat and as a result it threat status is likely to increase. Some populations hitherto recorded in Tabarka, have not been observed since 1998 due to hotel construction (Joger, 2003; Ben Hassine, 2011) and to urbanization (authors observations) in the region. This is also the case with populations in Oued Tinja, Mjez El Bab, Oued Miliane, Tunis and Grombalia which have disappeared completely due to drainage and the destruction of the breeding sites described by Chaignon (1904), Gauthier (1928) and Blanc (1935) (Ben Hassine & Nouira, 2012 *in press*).

Figure 2. Habitat and reproduction sites in Tunisia of *Bufo spinosus* in Beni Mtir (left) and *Pleurodeles nebulosus* and *Hyla meridionalis* in Fernana (right). © Jihène BEN HASSINE.

The populations of *H. meridionalis* occur mainly in the extreme northwest in an area stretching from the Algerian border (El Feija National Park) to Bizerte, south and north of Medjerda (Ben Hassine & Nouira, 2012 *in press*). The Mediterranean tree frog shows similar distribution limits though it is more abundant and more anthropophilic. It even occurs in the same bioclimatic zones and in some biotopes frequented by the Algerian ribbed newt (Figure 2). Populations of Mediterranean tree frog, reported around Tunis and Bardo's gardens (Boulenger, 1882; Doumergue, 1901; Mayet, 1903; Blanc, 1935), have disappeared completely following the urbanization and the anthropization of these areas. In Tunisia, *H. meridionalis* is declining mostly through the loss of breeding and terrestrial habitat (deforestation, intensification of agriculture, infrastructure development) and aquatic pollution (agriculture and mosquito control). The presence of *Gambusia* observed in numerous breeding sites could represent a serious threat to this species.

The Common toad, found only at seven stations in Tunisia, is restricted to the extreme northwest of the country and confined to high altitude (Beni Mtir, Ghardimou, and El Feija) (Ben Hassine & Nouira, 2012 *in press*). Its regional status differs markedly from the global one and there is a need to closely monitor its populations.

B. spinosus is very hygrophilous palaearctic species occurring only in very particular bioclimatic zone and environments, with Oak forests character (Figure 2). This species is very rare in Tunisia, increasingly suffering from habitat fragmentation and the multiple pressures on the breeding sites (urbanization, deforestation, pollution, etc.).

B. mauritanicus is a Mediterranean species, endemic in North Africa (Joger, 2003), widely distributed in all the countries of the Maghreb (Bons & Geniez, 1996; Schleich et al. 1996). The Mauritanian toad has a disjoint geographical distribution in Tunisia although it is present from the north to the south and reaches the coastal zone. Its populations are very abundant especially in Kroumiria, and the south-western oases (Tozeur and Gafsa). The species is common and its populations are locally more abundant than Green toad, *B. boulengeri*, who is one of the most widely distributed and ubiquitous amphibian (Joger, 2003; Ben Hassine & Nouira, 2012 *in press*).

The Green toad is common and particularly abundant in northern Tunisia especially on the coastal regions and in the south-easterly sector of Chott Djerid (Kebilli oases) and occupies all available habitats (Ben Hassine & Nouira, 2012 *in press*). It is, on the other hand, very dispersed at the Center. Its reproductive strategies (Le Berre, 1989; Guillon et al. 2004) would certainly provide an adaptive advantage in arid environments and could partly explain its presence in the different oases of Kebili and in the islands of Djerba and Kerkennah (Mertens, 1929; Blanc & Nouira, 1988; Nouira, 2001; Stoecks et al. 2006; Ben Hassine & Nouira, 2012 *in press*). The three bufonidae species are sensitive to the intensification of agricultural and urbanization activity but are also subject to a high mortality on roads (Figure 3).

D. pictus, considered for a long time as rare and vulnerable species in Kroumiria with often low densities (Boulenger, 1891; Mayet, 1903; Gadeau de Kerville, 1908; Domergue, 1959; Nouira, 2001; Joger, 2003; Azouzi & Tekaya, 2007), is the second most frequent species even though its populations in some areas are much more abundant than *P. saharicus*, with which it is often in symaptry. Its populations range from the humid superior to the superior Saharan bioclimatic zones. It's the only frog reported from La Galite Island. The Painted frogs populations densities are often locally high, particularly in the oases (Ben Hassine, 2007; Ben Hassine & Nouira, 2009). Populations are however disconnected although the presence of Painted frog confirmed at Tozeur oases and extended to Gabes oases (Ben Hassine, 2007; Ben Hassine et al. 2011; Ben Hassine & Nouira, 2012 i*n press*). Therefore, the species must be considered frequent and abundant in northern Tunisia and in the oases (Gabes and Tozeur).

P. saharicus is abundant where suitable habitat exists, and it is the most common amphibian of the Maghreb region (Schleich et al. 1996). In Tunisia, it is very often linked to the Painted frog but relatively less exigent, North African Green frog occurs from the lower humid bioclimatic zone in high altitude of the northwest and the Algerian border to the Saharan superior bioclimatic zone in Kebilli and Tozeur oases even though the populations are dispersed at low steppes of central Tunisia (Ben Hassine & Nouira, 2012 i*n press*). The species is largely aquatic, being found in and around streams, oasis pools, irrigation canals, water bodies and in other modified habitats. It is widespread in the whole country and has colonized varied biotopes. The North African green frog is indeed the most frequent, abundant, and ubiquitous species thus the less threatened of all amphibians in the region.

Although the two last species (*D. pictus* and *P. saharicus*) are very common in Tunisia, they are threatened by pollution of natural breeding ponds, agricultural intensification which might cause some malformations. In this respect, several cases of morphologi-

Figure 3: Road mortality of Tunisian Bufonidae near a breeding site (left to right) *B. boulengeri*, *B. mauritanicus* and *B. spinosus*). © Jihène BEN HASSINE.

cal abnormalities were recently reported in species dwelling in agricultural habitat (Ben Hassine et al. 2011).

The highest values in terms of species richness are recorded at the humid bioclimatic zone with a maximum of seven species in the humid superior. This specific richness decreases gradually from the cool and humid climate in the north to a hot and dry climate in the south. The high species richness observed from humid to subhumid is certainly related to the spatial heterogeneity provided by these sectors permitting coexistence and cohabitation of several species of amphibians in sympatry or even in syntopy (Ben Hassine & Nouira, 2012 *in press*). Thus, the presence of rare species, in Kroumiria and Medjerda plain, seems to depend strongly on the surrounding sites where the environments are varied and human action relatively moderate. Amphibians absence in some coastal and central areas of the country, particularly in western Tunisia, can be explain by abiotics but also, anthropics loss and fragmentation of habitat due to forestry activities (sector under severe threat by human activities) associated to a reducing of their food supply (due to the use of pesticides), mortalities caused by road traffic and particularly a rarefaction of suitable sites assuring the breeding and especially reproductive success.

All amphibian species are protected by Tunisian law (since july 2006) and they are preserved locally in many protected areas covering all bioclimatic zone (national park, wildlife refuge and nature reserve). To effectively conserve this fauna, we need to preserve streams, swamps, forests, wetlands, grasslands, among other threatened habitats, and even mitigation measures to reduce road kill needs to be established, both inside and outside existing protected areas. Despite some local critical situation of the batrachofauna in Tunisia, limited information is available on its population fluctuations. Given the scale of threats to the herpetological biodiversity, there is an absolute and immediate need of an assessment of the extent of the decline and the conservation management of the Tunisian herpetofauna.

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Literature Cited

Azouzi K. and Tekaya, S. (2007) Adaptation aux facteurs climatiques de l'ovogenèse chez le Discoglosse en Tunisie (Amphibien, Anoure). Bulletin Société Zoologique de France, 132: 57-66.

Ben Hassine, J. (2007). Contribution à la connaissance de l'écologie de Discoglossus pictus (Amphibien, Anoure) : Cas de trois populations des Oasis de Gabès. Mémoire de Mastère, Faculté des Sciences de Tunis, Tunisia, 109p.

Ben Hassine, J. (2011). Biodiversity and wetlands in Tunisia: distribution of the Algerian Ribbed Newt (*Pleurodeles nebulosus*) (Guichenot, 1850) (Amphibia, Caudata) the challenge to protect it and ensure its survival. Mediterranean Weltlands Observatory Newsletter, 19, 4p. http://www.medwetlands-obs.org/en/content/distribution-algerian-ribbed-newt-tunisia.

Ben Hassine, J. and Nouira, S. (2009). Diet of *Discoglossus pictus* Otth 1837 (Anura, Alytidae) and *Pelophylax saharicus* (Boulenger *in* Hartert, 1913) in the oases of Kettana (Gabes, Tunisia). Bulletin Société Zoologique de France, 134: 321-332.

Ben Hassine, J. and Nouira, S. 2012 (in press). Répartition géographique et affinités écologiques des Amphibiens de Tunisie. Revue d'Écologie (Terre Vie), vol. 67.

Ben Hassine, J., de Buffrénil, V., and Nouira S. 2011. First Record of Morphological Abnormalities in Natural Populations of two Amphibians species in Tunisia. Journal of Herpetology, 45 (4): 465-471.

Blanc, Ch. P. and Nouira, S. (1988). Faune herpétologique des îles Kerkennah. Inventaire et distribution. Bulletin Ecologie, 19 (2-3): 259-263.

Blanc, M. (1935). Reptiles et Batraciens. Faune Tunisienne. Tunis, 3: 267-277.

Bons, J. and Geniez, P. (1996). Amphibiens et reptiles du Maroc (Sahara Occidental compris) Atlas Biogéographique. Asociación Herpetológica Española, Barcelona.

Boulenger, G.A. (1882). Catalogue of the Batrachia Gradientia S. Caudata and Batrachia Apoda, Second edition. Collection of the British Museum.

Boulenger, G.A. (1891). Catalogue of Reptiles and Batrachians of Barbary (Morocco, Algeria and Tunisia) based chiefly upon the notes and collections made in 1880-1884 by M. Fernand Lataste. The Transactions of the *Zoological Society* of *London*, *13*: 93-164.

Carranza, S. and Wade, E. (2004). Taxinomic revision of Algero-Tunisian *Pleurodeles* (Caudata : Salamandridae) using molecular and morphological data. Revalidation of the taxon *Pleurodeles nebulosus* (Guichenot, 1850). Zootaxa, 488: 1-24.

Chaignon, de H. (1904). Contribution à l'histoire naturelle de la Tunisie. Bulletin de la Société d'Histoire Naturelle d'Autun, 17: 1-280.

Domergue, C.A. (1956-57). Liste des batraciens, chéloniens et sauriens de Tunisie et d'Afrique du Nord. Bulletin de la Société des Sciences Naturelle de Tunisie, 9-10: 75-79.

Doumergue F., (1901). Essai sur la faune Erpétologique de l'Oranie avec des tableaux analytiques et des notions pour la détermination de tous les reptiles et Batraciens du Maroc, de l'Algérie et de la Tunisie. Bulletin de la Société Géographie Archéologie d'Oran, 19-21: 324-397.

Gadeau de Kerville, H. (1908). Voyage zoologique en Khroumirie (Tunisie) mai-juin 1906. (ed. by Baillière et fils), pp. 1-316, Paris.

Gauthier, H. (1928). Recherches sur la faune des eaux continentales de l'Algérie et de la Tunisie. Thèse de Doctorat, Université d'Alger, Algérie.

Guillon, M., Le Lierre, G. and Slimani, T. (2004). Nouvelles données sur la répartition et l'écologie de reproduction de *Bufo brongersmai*, *Bufo viridis* et *Bufo mauritanicus* (Anura, Bufonidés) dans les Jbilets centrales (Maroc). Bulletin Société Herpétologique de France, (111-112): 37-48.

IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 18 February 2012.

Joger, U. (2003). Reptiles and Amphibians of the Southern Tunisia. Kupia : Darmstadter Beitrage zur Naturgeochichtt Heft, 12: 71-88.

Le Berre, M. (1989). Faune du Sahara1. Poissons - Amphibiens - Reptiles. Lechevalier- R. Chabaud, Paris.

Mayet, V. (1903). Catalogue raisonné des Reptiles et Batraciens de *la Tunisie. Exploration Scientifique de la* Tunisie : Zoologie Reptiles et Batraciens, pp. 1-32, Paris.

Mertens, R. (1929). Beiträge zur herpetologie Tunisiens. Senckenbergiana, 11 (5-6): 291-310.

Nouira, S. (2001). Conservation des zones humides littorales et des écosystèmes côtiers : Cap Bon, pp. 1-34. Projet de conservation des zones humides littorales et des écosystèmes côtiers. MedWestCost Publication.

Schleich, H.H., Kastle, W. and Kabisch, K. (1996). Amphibians and reptiles of North Africa. Koeltz Scientific Books, Koenigstein.

Stöck, M., Moritz, C., Hickerson, M., Frynta, D., Dujsebayeva, T., Eremchenko, V., Macey, R., Papenfuss, T.J., Wake, D. (2006). Evolution of mitochondrial relationships and biogeography of Paleartic green toads (*Bufo viridis* subgroup) with insights in their genomic plasticity. Molecular Phylogenetics and Evolution, 41: 663-689.

Veith, M., Mayer, C., Samraoui, B., Donaire-Barroso, D. and Bogaerts, S. (2004). From Europe to Africa and vice versa: evidence for multiple intercontinental dispersal in ribbed salamanders (Genus *Pleurodeles*). Journal of Biogeography, 31: 159–171.

Range-Wide Monitoring of Betic Midwife Toad Populations

By Emilio González Miras & Jaime Bosch

Midwife toads (genus *Alytes*) comprise an ancient frog lineage with a very particular reproductive biology. After mating, which takes place on land, the female transfers the fertilized eggs to the male, which takes care of them until hatching. This is a unique form of parental care in amphibians and its evolutionary origin remains a mystery. The genus *Alytes* includes five extant species in Western Europe and North Africa, some of them with very restricted ranges. This is the case of the Betic midwife toad (*Alytes dickhilleni*), which is endemic to a few mountain systems in southeastern Spain. The species was described recently, in 1995, after genetic studies (Arntzen & García-París, 1995) revealed its distinctiveness from the morphologically similar Common midwife toad (*Alytes obstetricans*). However, little is known about its biology, distribution and conservation status.

With the goal of filling this gap, the Spanish Herpetological Society (Asociación Herpetológica Española, AHE) recently undertook a range-wide monitoring program of Betic midwife toad populations (Bosch & González-Miras, 2012), as part of the more general SARE program (Seguimiento de Anfibios y Reptiles de España, or Monitoring of Amphibian and Reptile populations in Spain). This program, active since 2008, is carried out by volunteers and is funded by the Spanish Ministerio de Medio Ambiente y Medio Rural y Marino. The SARE program seeks to involve everyone interested in the long-term monitoring of populations of amphibians and reptiles in compiling long series of data so as to determine population trends. It currently counts with 157 volunteers across the country, reflecting the high degree of involvement of professional and amateur herpetologists if compared with the 518 members of the AHE. Details of participation in the SARE program and access to its results is available at the web site http://siare.herpetologica.es/, in addition to other applications related to the monitoring and inventory of Spanish herpetofauna.

As a result of the study on the Betic midwife toad, we have documented that the species breeds at present in a minimum of 330 sites distributed in 99 10 x 10 km UTM grids. Even though we found some new records for the species, we have also documented local extinctions in at least 20 10 x 10 km UTM grids with respect to the latest available census (MAMRM, 2008). The species has been found in a wide variety of habitats, in altitudes ranging from sea level to over 2500 m. However, a detailed analysis of the distribution shows that the Betic midwife toad is preferentially found in high altitudes, generally in very steep areas. This seems to be related to the heavy alterations suffered by habitats at low altitudes and valleys.

The larval period in Betic midwife toads is quite long, generally comprising more than one year, and as a consequence they need high quality, stable water points for breeding. In arid regions, like in southern Spain, these are more and more scarce and many of them have been altered for uses related to agricultural or livestock activities. These alterations have forced the species to breed in heavily modified habitats, with almost 80% of the populations breeding in water tanks and cattle troughs. These sites generally present little water (less than 100 m^3) and thus cannot sustain large populations. In fact, in nearly 50% of the breeding sites we did not find more than 50 tadpoles during the surveys, and most of the sites presented one or several threats for the species.

On the other hand, most populations are isolated from each other. The studies carried out have shown a strong genetic structure. Considering that this species could be one of the most sensitive to climate change and that in the course of the study we found several populations infected with the chytrid fungus (*Batrachochytrium dendrobatidis*), to which they seem to be particularly sensitive, the future seems grim for the Betic midwife toad. Even so, in our study we also review the conservation measures recently undertaken, especially by the regional "Consejería de Medio Ambiente de la Junta de Andalucía." We have documented how simple, economic measures like creating, managing and protecting breeding sites have resulted in population recoveries in some areas, for example in Sierra de los Filabres, in Almería.

We conclude that the conservation status of the species should be re-evaluated under the IUCN criteria, and recommend the urgent elaboration of a Recovery Plan and a long-term monitoring program for the species.

The AHE aims to favor collaborations among herpetologists and to promote and coordinate the study and conservation of amphibians and reptiles, as well as of their habitats. Since its foundation in 1984 numerous projects have been carried out along these lines. The AHE publishes yearly two scientific periodicals, Basic and Applied Herpetology and Boletín de la AHE, as well as other books and monographs without established periodicity. Every two years the AHE co-organizes with its Portuguese correspondent the Iberian Meeting of Herpetology, which usually attracts around 300 experts from around the world. More information about the AHE can be found at http://www.herpetologica.es.

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Literature Cited

Arntzen JW, García-París M (1995) Morphological and allozyme studies of midwife toads (genus *Alytes*), including the description of two new taxa from Spain. Bijdragen tot de Dierkunde 65: 5-34.

Bosch J, González-Miras E (2012) Seguimiento de *Alytes dickhilleni*. Informe final. Monografías SARE. Asociación Herpetológica Española - Ministerio de Medio Ambiente y Medio Rural y Marino, Madrid. (in press).

MAMRM (2008) Inventario Nacional de Biodiversidad. Vertebrados. Ministerio de Medio Ambiente y Medio Rural y Marino, Madrid.

Distribution of the Critically Endangered Yellow Spotted Newt, *Neurergus microspilotus* (Nesterov, 1916); (Salamandridae: Caudata) in Northwest Iran: New Localities and New Hope for its Conservation

By Elnaz Najafımajd & Uğur Kaya

The Middle Eastern newt genus *Neurergus* (Cope, 1862) comprises of four species: *N. crocatus*, *N. strauchii*, *N. microspilotus*, and *N. kaiseri* that occur in north and southwestern Iran, Anatolian Turkey, and northern Iraq. All species are narrowly distributed and their distribution areas do not appear to overlap (Leviton et al. 1992). *N. microspilotus* was originally described by Nesterov (1916) from the Avroman Mountains (Balch, Iraq and Tawale, Kordestan Province, Iran) on the border between Iran and Iraq.

Neurergus microspilotus is large-bodied but slender salamander with flattened head (longer than wide) and rounded snout. Paratoids are not prominent. Dorsal color is dark brown to black with many small yellow-orange, rounded, irregular spots; similar spots on the sides of the tail. Ventral surface (belly) is red carmine contrasting with lateral black coloration. Throat and ventral surface of limbs orange, often speckled with back spots (Schmidtler & Schmidtler, 1975). This species is sexual dimorphic and males are generally smaller than females. Cloaca half rounded in males, swollen in the breeding season, with a longitudinal slit. Female cloaca slightly elongated during the breeding season with a rounded opening, protruding three mm. The larvae have clearly long bright stains toward two lines along center in the dorsal view. Belly is bright with two imperfect dark spotted lines along its edges. Tail fin with blackish brown "clouded" coloration protrudes from the back center (Schmidtler & Schmidtler, 1975) (Fig. 1).

Figure 1. The adult and larva (inset) of *N. microspilotus*.

Neurergus microspilotus is distributed in southern Kordestan Province and northern Kermanshah Province (Leviton et al. 1992; IUCN, 2011) where it is known from five streams. It may now be restricted to only four localities in the mid-Zagros region, as it is probably extirpated at the type locality of Ghorighaleh (Sharifi & Assadian, 2004). A new and significant extension to the known range of *N. microspilotus* in northwest Iran was described by Najafi Majd & Kaya (2010).

Figure 2. Breeding habitat of *N. microspilotus* in Mahabad town.

Our field surveys began in May 2009 and a new locality for *N. microspilotus* was found on July 16, 2009. The new locality is situated in the southwest of Mahabad town (36°33'N, 45°31'E) in the northwest of Iran (north Zagros Mountains). Finding larvae shows this spring is also used as breeding habitat by the newts (water temperature 10.5 °C). Our specimens (Najafi Majd & Kaya, 2010) displayed the typical characteristics of *N. microspilotus* given in the literature (Nesterov, 1916; Schmidtler & Schmidtler, 1975) (Fig. 2).

Analysis of some water chemistry parameters of breeding habitat (spring) using a DR 2800 VIS Spectrophotometer in the laboratory revealed that chemicals such as ammonia, sulfide, and calcium (Hardness Ca) were not detected in the breeding water. The values of iron (0.02 mg/L < 2008 WHO = 1–3 mg/L), chloride (1.6 mg/L < 2008 WHO = 250 mg/L) and nitrate (2.2 mg/L < WHO = 50 mg/L) of the new locality, were lower than the 2008 WHO International Standards for drinking water. However the value of manganese (0.9 mg/L > 2008 WHO = 0.4 mg/L) of the new locality was higher than the 2008 WHO International Standards for drinking water. There was no health-based guideline value for water hardness which is not caused by a single substance but by a variety of dissolved polyvalent metallic ions, predominantly calcium and magnesium cations, although other cations can be present, e.g., barium, iron, manganese, strontium. We were therefore not able to compare the manganese hardness of the new locality with

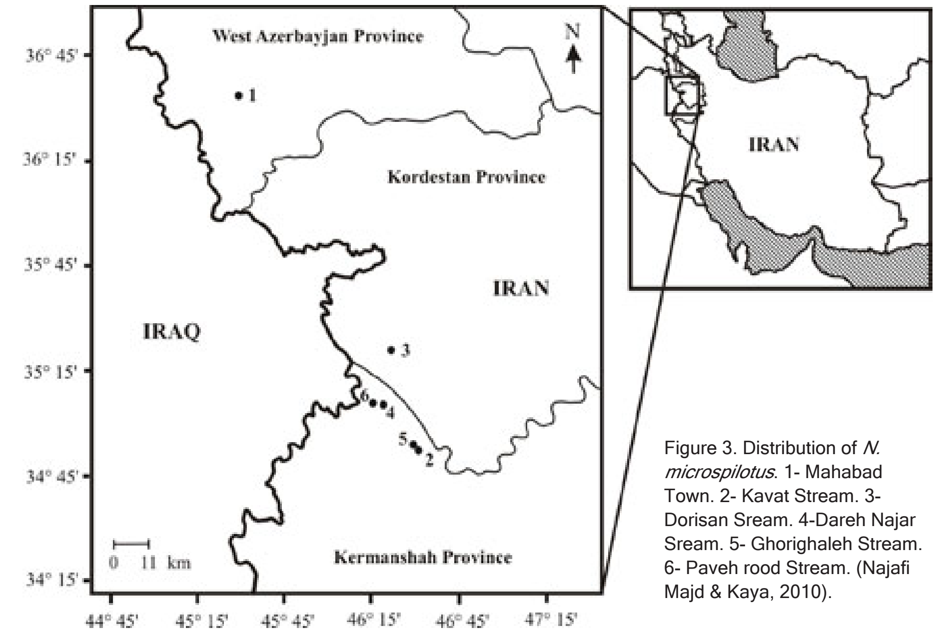

Figure 3. Distribution of *N. microspilotus*. 1- Mahabad Town. 2- Kavat Stream. 3- Dorisan Sream. 4-Dareh Najar Sream. 5- Ghorighaleh Stream. 6- Paveh rood Stream. (Najafi Majd & Kaya, 2010).

the 2008 WHO International Standards for drinking-water. Our initial analysis of the water quality based on 2008 WHO International Standards for Drinking-water indicated that the water does not represent any significant risk to human health over a lifetime of consumption.

The Yellow spotted newt, *Neurergus microspilotus* was previously known only from five localities in the mid-Zagros region (Nesterov, 1916; Schmidtler & Schmidtler, 1975; Sharifi & Assadian, 2004): Kavat Stream (34°53'N, 46°31'E), Dorisan Stream (35°21'N, 46°24'E), Dareh Najar Stream (35°06'N, 46°19'E), Ghorighaleh Stream (34°54'N, 46°30'E), Paveh rood Stream (35°06'N, 46°17'E). It has not been recorded from neighbouring countries to date. Our new record (Mahabad Town) extends the distribution range (about 160 km) further northward and adds a new upper limit in elevation (Fig. 3)(Najafi Majd & Kaya, 2010). Our findings indicate that *N. microspilotus* is more widely distributed than previously thought.

Neurergus microspilotus has been classified as "Critically Endangered" by the IUCN 2011. Its Red List status stresses the importance of studying the ecological characteristics of this species in order to formulate appropriate management and conservation strategies (Najafi Majd & Kaya, 2010). This species is protected by national legislation in Iran, but it will require better enforcement to assure its conservation.

The major threats of *N. microspilotus* in the Zagros Mountains are stated by Rastegar-Pouyani (2006) as; 1) severe droughts in recent years; 2) man-made habitat destruction; and 3) pollutants (e.g., chemicals such as herbicides, fertilizers, and pesticides). Most of the known localities are easily accessible and an illegal pet trade, both nationally and internationally is considered to be an increasing threat to the species (Sharifi et al. 2008). The new Mahabad population appears to be afforded some protection being located within water sources used for consumption and therefore protected by locals. In addition, the local people have a positive attitude towards these newts, and have expressed willingness to protect them. No use of pollutants such as herbicides, fertilizers, and pesticides or man-made habitat destruction have been observed around the Mahabad population, and therefore this new population is now offering hope for the future conservation of this species (Najafi Majd & Kaya, 2010).

This preliminary data (Najafi Majd & Kaya, 2010) is only the beginning of our investigations and much research still needs to be conducted. Our field studies are continuing in the area with efforts to find additional new localities. Local people are being interviewed to obtain information about the species and detailed monitoring studies will be conducted in the area as soon as suitable habitat is found. It is hoped that with increased data on the distribution and ecological requirements of this species that protection can be enhanced and new hope offered for the continued existence of this unique species.

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Literature Cited

Baloutch, M. & H. G. Kami (1995) Amphibians of Iran. Tehran University Publications, p. 91-98.

IUCN (2011) IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 19 February 2012.

Leviton, A. E., S. C. Anderson, K. Adler & S. A. Minton (1992) Handbook to Middle East Amphibians and Reptiles. – Society for the Study of Amphibians and Reptiles, p. 138-139.

Najafi majd, E. & U. Kaya, (2010) A newly found locality for the critically endangered yellow spotted Newt, Neurergus micriospilotus (nesterove, 1917) nourishes hope for its conservation. – Zoology in the Middle East 51: 51-56.

Sharifi, M., S. Shafiei Bafti, T. Papenfuss, S. Anderson, S. Kuzmin & N. Rastegar-Pouyani (2008) *Neurergus microspilotus*. In: IUCN 2010. IUCN Red List of Threatened Species. Version 2011.2. <www.iucnredlist.org>. Downloaded on 2011.

Nesterov, P. V. (1916) Tri novych chvostatych amfibii is kurdistana. Annuaire du Musée Zoologique de L'Académie des Sciences, Petrograd 21: 1-30.

Schmidtler, J. J. & J F. Schmidtler (1975) Untersuchungen an westpersischen Bergbachmolchen der Gattung *Neurergus* (Caudata: Salamandridae). Salamandra 11: 84-98.

Sharifi, M. & S. Assadian (2004) Distribution and conservation status of *Neurergus microspilotus* (Caudata: Salamandridae) in western Iran. Asiatic Herpetological Research 10: 224-229.

Rastegar-Pouyani, N. (2006) Conservation and disturbution of *Neurergus microspilotus* (Caudata: Salamandridae) in Zagros Mountains, Kermanshah Province, Western Iran. 13th Congress of the Societas Europaea Herpetologica, p. 115–116.

WHO (2008) Guidelines for Drinking-water Quality: Third Edition Incorporating The First And Second Addenda, Vol. 1, Recommendations. Geneva: World Health Organization. Available: http://www.who.int/water_sanitation_health/dwq/fulltext.pdf [accessed 14 February 2010].

Assessing the Potential Impact of an Invasive Species on a Mediterranean Amphibian Assemblage: A Morphological and Ecological Approach

By Daniel Escoriza & Dani Boix

The introduction of exotic species is a major cause of biodiversity loss and alteration of ecosystems (Gurevitch and Padilla, 2004), and eradication of exotics is often complex, especially if it involves large geographic areas (Hulme, 2006). Many species of amphibians have been introduced outside their natural range, some of them with proven negative effects on native frogs (Picker and De Villiers, 1989; Crossland et al. 2008). In Europe the introduction of several amphibian species has been described throughout the twentieth century (Kark et al. 2009) including *Discoglossus pictus*, whose potential impact on native amphibian communities is currently unknown. The presence in mainland Europe of this species, native to central and north-eastern Maghreb (eastern Morocco, Tunisia, and Algeria), was first observed at the southern tip of France a century ago (Wintrebert, 1908) and since then it has been progressively colonizing the contiguous Mediterranean regions (Montori et al. 2007). Nowadays this species is occupying an area of about 11,400 km² in mainland Europe (Amphiaweb 2012).

In the studied region (north-eastern Spain) local climatic conditions, relatively warm and humid, enable the existence of high amphibian diversity, being a contact region among temperate species with wide European range (e.g., *Rana temporaria*) and Mediterranean species (e.g., *Pelobates cultripes*). These anuran species are widely diversified, occupying the different types of aquatic habitats although *D. pictus* has established itself with great success. We focused on the larval stage interactions with native species, as interspecific competition is of great importance in the survival of tadpoles (Kupferberg, 1997). It has been shown that tadpoles of invasive frog species have very negative impacts on the fitness of the native tadpoles (Smith, 2005). The impact of *D. pictus* has to be more significant on those native species that breed in similar habitats and occur in the same climatic region. For this reason we had studied 1) native morfospace and the position of *D. pictus* within it, 2) patterns of species aggregations, 3) physical characteristics that determine pond selection 4) the bioclimatic degree of divergence based on presence localities and GIS-supported data.

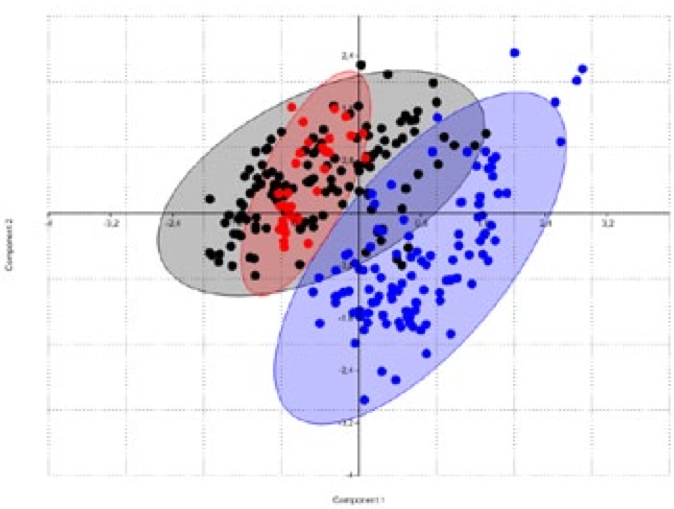

Figure 1. Principal Component Analysis scatter plot showing the relative position of *D. pictus* in the morfospace respect to benthic (black) and nektonic (blue) ecomorphs. Explained variance Component 1:46%, component 2:25%.

Methods

The definition of morphospace was based on the assignment of different species to the benthic and nektonic ecomorphs, following the classification proposed by Altig and Johnston 1989 and Altig 2007. The ecomorph concept implied the existence of morphological analogies among unrelated species that have evolved under similar environmental constraints, thus the comparison of some morphological characters proved to be useful to determine the existence of niche overlap. In the regional pool of anuran species the results obtained from non-parametric regression of distance matrices suggested a significant covariation between physical habitat characteristics and larval morphology, after controlling for phylogenetic history.

Morphological analyses revealed that *D. pictus* was clustered with the benthic ecomorph, along with *Alytes obstetricans*, *Bufo bufo*, *Bufo calamita*, and *Pelodytes punctatus*, while *Hyla meridionalis* and *Pelobates cultripes* were clustered in the nektonic ecomorph. *Pelophylax perezi* shown intermediate characters and was studied separately.

ANOVA results indicated that these groups also differed significantly in the selection of ponds based on surface area and mean depth. The existence of structured aggregation among species was tested performing null model analysis, contrasting the observed presence-absence matrix (containing 135 observations) with 1,000 randomly assembled matrices maintaining the observed sums of the columns and rows (Gotelli, 2000).

Pairwise significant co-occurrences were also estimated performing empirical bayesian analysis. Based on the same presence-absence matrix we calculated the resource overlap Pianka's index (Pianka, 1974), a measure of pairwise niche overlap.

During the sampling we measured average depth and surface area of 94 aquatic habitats (permanent and temporary ponds and streams) from 16 different localities spread in an area of 5900 km². The potential effect of climate on local assemblages had been controlled using GIS-supported climate data obtained on regional presence localities at a resolution of 1 km², especially taking into

Figure 2. *D. pictus* tadpole, a benthic species. Photo: Daniel Escoriza.

Figure 3. An example of tadpole belonging to the nektonic guild, *P. cultripes*. Photo Daniel Escoriza.

account the local existence of species that also occur in temperate conditions, where *Discoglossus pictus* is very scarce (Escoriza et al. 2007).

Results

All these analyses indicated a higher overlap in habitat selection among *D. pictus* and native species Natterjack toad *B. calamita* and Parsley frog *P. punctatus*. These species also belong to the benthic guild, reproduced in small temporary ponds, had higher Pianka's resource overlap and showed low climatic divergence. However, although both species may occur in the same aquatic habitat, our results revealed that *B. calamita* and *D. pictus* co-occur less than expected by chance. This pattern could be an effect of competitive exclusion, a key factor limiting the composition of anuran assemblages on ephemeral ponds (Wilbur, 1987), as suggested by the fact that in our sample, in a total of 45 observations, 60% of the time *D. pictus* occurred as unique species

Conservation Summary

The studied region is densely populated and many threats exist on native frog species, as the desiccation of wetlands, water chemical pollution and the spread of other invasive species such as *Gambusia affinis* and *Procambarus clarkii*. *D. pictus* has successfully occupied a wide range of aquatic habitats and even it has spread to protected areas. Our results suggested that *D. pictus* could limit the presence, in some breeding ponds, of *B. calamita* and *P. punctatus* and affect diffusely to other species of benthic group. This can be a major conservation problem since *D. pictus* occurs in wide range of temporary ponds and streams, coexisting with all native species. So far there has not been evidence that there is a rarefaction of other species of anurans, perhaps in part because competition relaxes in the adult stage. The adults of *D. pictus* are dependent of humid environments (Capula, 2007) while *B. calamita* and *P. punctatus*, are well adapted to drier habitats (García-París, 2004).

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Literature Cited

Altig R, Johnston GF (1989) Guilds of anuran larvaes: relationships among developmental modes, morphologies, and habitats. Herpetological Monographs 3: 81–109.

Altig R (2007) A primer for the morphology of anuran tadpoles. Herpetological Conservation and Biology 2(1): 71-74.

AmphibiaWeb (2012) *Discoglossus pictus*. Retrieved January, 2012, from http://amphibiaweb.org/.

Capula M (2007) *Discoglossus pictus*. In Lanza B, Andreone F, Bologna MA, Corti C & Razzetti E (eds) Fauna d'Italia Amphibia. Ed. Calderini, Bologna. 537 pp.

Crossland MR, Brown GP, Anstis M, Shilton CM, Shine R (2008) Mass mortality of native anuran tadpoles in tropical Australia due to the invasive cane toad (*Bufo marinus*) Biological Conservation 141(9): 2387-2394.

Escoriza D, Espejo D, Comas MM (2007) Nuevo límite altitudinal para *Discoglossus pictus* Otth, 1837 (Anura: Discoglossidae) en el nordeste de Cataluña Boletín de la Asociación Herpetológica Española 18: 24-25.

García-París M, Montori A & Herrero P (2004) Amphibia, Lissamphibia. In Ramos, MA et al. (eds) Fauna Iberica,Vol 24. Museo Nacional de Ciencias Naturales, CSIC,Madrid. 639 pp.

Gotelli NJ (2000) Null model analysis of species co-occurrence patterns. Ecology 81: 2606–2621.

Gurevitch J, Padilla DK (2004) Are invasive species a major cause of extinctions?. Trends in Ecology & Evolution 19 (9): 470-474.

Hulme PE (2006) Beyond control: wider implications for the management of biological invasions. Journal of Applied Ecology 43: 835–847.

Kark S, Solarz W, Chiron F, Clergeau P, Shirley S (2009) Alien Birds, Amphibians and Reptiles of Europe. In Handbook of Alien Species in Europe. Springer. Netherlands: 105-118

Kupferberg SJ (1997) Bullfrog (*Rana catesbeiana*) invasion of a California river: the role of larval competition. Ecology 78: 1736–1751.

Montori A, Llorente G, Richter-Boix A,Villero D, Franch M, Garriga N (2007) Colonización y efectos potenciales de la especie invasora *Discoglossus pictus* sobre las especies nativas. Munibe 25: 14–27.

Pianka, ER (1974) Niche overlap and diffuse competition. Proceedings of the National Academy of Sciences 71: 2141–2145.

Picker MD, De Villiers AL (1989) The distribution and conservation status of *Xenopus gilli (Anura: Pipidae)*. Biological Conservation 49: 169-183.

Smith KG (2005) Effects of nonindigenous tadpoles on native tadpoles in Florida: evidence of competition Biological Conservation 123: 433–441.

Wilbur HM (1987) Regulation of structure in complex systems: experimental temporary pond communities. Ecology 68: 1437–1452.

Wintrebert P (1908) Présence à Banyuls-sur-Mer (Pyrénées-Orientales) du *Discoglossus pictus* Otth. Bulletin de la Société zoologique de France 33: 54.

40 Years of Natterjack Toad Conservation in Europe

By Trevor Beebee, Carlos Cabido, Christophe Eggert, Ivan Gomez Mestre, Ainhoa Iraola, Ion Garin-Barrio, Richard A. Griffiths, Claude Miaud, Neus Oromi, Delfi Sanuy, Ulrich Sinsch & Miguel Tejedo

The need for knowledge

Work on *Bufo calamita* in the UK began in the 1970s when it was realised that more than 75% of previously existing populations had become extinct since the start of the 20th century (Beebee, 1976).

Female photographed in a gravel pit of the Basque coast. Photo. Ion Garin-Barrio.

Natterjacks are entirely confined to Europe and range from Iberia, where they are abundant and widespread, east and northwards as far as Belarus and Estonia. They are absent from Italy and the Balkans, the other major southern refugia where many animals and plants survived the Pleistocene glaciations. In Iberia Natterjacks occupy a wide range of habitats and can be found at altitudes as high as 2,500 meters in southern Spain. Elsewhere they are mainly a lowland species and are closely associated with open, unforested habitats including river valleys, gravel pits, coastal marshes, sand dunes and lowland heaths. These restrictions result in increasingly fragmented populations towards the northern range edges. Genetic studies confirmed that Iberia, but also south-west France, were successful refugia for Natterjacks during the last glacial maximum around 20,000 years before present (BP). Genetic diversity declines progressively from that area towards the northerly and easterly range limits. It is also clear that some Natterjacks must have survived the more recent but less severe and shorter Younger Dryas cooling about 11,000 years BP in localities further north than the south of France, and that separate populations from that time colonized the west and east of the British Isles (Rowe et al. 2006).

As in many anuran species Natterjack toad age- and size-related life-history traits vary along latitudinal and altitudinal gradients, i.e., latitudinal variation of size follows roughly a converse Bergmann cline, but some populations do not fit to this pattern. Demographic life-history traits were studied in twelve populations (eleven in Spain and one in Germany) representing a variation of adult size from 39 mm to 95 mm snout-vent length, a latitudinal gradient from 37° to 50°, and an altitudinal gradient from sea level to 2,270 m. Skeletochronology was used to estimate age as number of lines of arrested growth and lifetime pattern of growth in breeding adults. At southern latitudes toads matured and reproduced earlier than those at northern latitudes, but had a reduced potential reproductive lifespan (PRLS) due to lower longevity. Similarly, age at maturity and longevity increased at elevation exceeding 2,000 m, but female PRLS did not increase with altitude, as it did in northern latitudes. Spring and summer breeding Natterjacks at the German locality differed with respect to longevity and PRLS by one year in favor of the early breeders, increasing the fitness of this cohort under current climate conditions. Integrating available evidence, lifetime fecundity of Natterjacks decreases at the upper altitudinal range because PRLS is about the same as in lowland populations but females are smaller. In contrast, small size of northern females was compensated for by increased PRLS which minimized latitudinal variation of lifetime fecundity. However, altitudinal effects on life-history traits do not mimic latitudinal effects. Life history trait variation along the altitudinal gradient seems to respond directly to the contraction of the annual activity. As there is no evidence for increasing mortality in highland populations, reduced lifetime fecundity may be the ultimate reason for the inability to colonize elevation exceeding 2,500 m (Oromi et al. 2012).

Age-adjusted adult size depended mainly on the size achieved between metamorphosis and first hibernation or aestivation which in turn was influenced by local factors. The first-year size corresponds to the duration of the above ground activity period, temperature during the activity period, and the type of shelter sites and hibernacula available in the habitat. After attaining sexual maturity, growth rates did not differ among populations. Interactions of multiple environmental factors during the first year of life determine age at maturity, adult size and size variation among populations. Local body size and potential reproductive lifespan co-vary to optimize lifetime fecundity throughout the geographical range. The presence of a small-sized population in southern Spain does not fit to the pattern predicted by a converse Bergmann cline, but is compatible with the hypothesis that body size variation among Natterjack populations may be the evolutionary byproduct of optimized lifetime fecundity (Lescovar et al. 2006; Sinsch et al. 2010).

Natterjacks have a considerable potential for adapting to local conditions. Thus, Natterjacks are among the few amphibian species that have been capable of adapting locally to survive moderately saline water, which is otherwise known to cause severe physiological stress in amphibians. Nevertheless, Natterjack populations naturally breeding in brackish ponds in south-western Spain have evolved an increased tolerance to salinity compared to populations breeding in freshwater ponds (Gomez-Mestre & Tejedo, 2003). Moreover, Natterjacks also seem to have been able to adapt to geographic differences in the presence of other amphibian competitors, since individuals from populations with a long history of competition with *Bufo bufo* tadpoles had also evolved greater competitive ability than individuals from areas where *B. bufo* was absent from (Gomez-Mestre & Tejedo, 2002).

The delimitation of the spatial equivalent of isolated populations or interacting sets of local populations is crucial for conservation management of Natterjacks. The individual variation of annual migratory capacity within local populations allows delimiting core habitats of and connectivity among local populations. The migratory behaviour of adult Natterjack toad was monitored using radio telemetry at eight localities in Spain, France, Germany and the UK covering a latitudinal range from 41° to 54°N. Radio telemetry data were used to model the adults' capacity for dispersal assuming exclusively unidirectional movements. Migratory range was not sex-biased, but was three times lower in population inhabiting sandy areas than in those on clay soils, probably due to the scarcity of moist shelters causing more frequent and more distant movements. For conservation management of local Natterjack populations, we use the migratory capacity of the 50% most sedentary individuals to delimit the core area around a given breeding site. To estimate the potential genetic connectivity between neighbouring local populations, we use the minimum migratory capacity of the 5% of individuals which moved most. Estimates obtained for populations in central Europe and the UK indicate a core area of 600 m around the breeding site and a maximum distance of 2,250 m between the breeding ponds to maintain connectivity. Thus, the principal conservation problem in the UK is that most populations are isolated by distance and prone to local extinction. In contrast, core areas of populations in Spain extend to distances of about 5 km and connectivity is maintained up to 12 km distance between neighbouring breeding ponds (Sinsch et al. 2012).

Behavioural regulation of body temperature (t_b) was monitored in 38 free-ranging adults in two populations (Spain, Germany) using temperature-sensitive transmitters implanted to the abdominal cavity. In field t_b varied between +0.3 °C and 32.2 °C in Spain and between +0.5 °C and 37.4 °C in Germany. Maximum t_b measured during an experimental trial was 38.8 °C. Thermoregulatory behavior differed considerably between populations. In Germany, toads avoided environmental temperature extremes by burrowing actively into moist sandy soil (2-90 cm deep), whereas in Spain, toads hid exclusively in mammal burrows or pre-existing subterranean cavities providing moist and temperature-buffered microhabitats. Frost avoidance in Spain included frequent changes of shelter sites by above ground dispersal, distinguishing this population from conspecifics in Germany evading frost by burrowing. The control of water balance superposed behavioral efforts to optimize t_b identifying Natterjacks as thermal conformers (Sinsch & Lescovar, 2011). Upper thermal tolerances of tadpoles do not differ geographically between Spanish and Swedish populations (39.7 °C and 39.8 °C, respectively). This high thermal tolerance appears to be adaptive to the shallow sunny ponds where Natterjacks breed (Duarte et al. 2012; H. Duarte, B. Rogell, and M. Tejedo, unpublished data). However, the temperatures reached at the breeding ponds may be only slightly lower than upper thermal tolerances, especially at southern populations, that may be exposed to physiological thermal stress in the coming years due to the predicted increase in the frequency of heat waves by global warming. Other consequences of global warming include the increasing drying conditions expected during the early terrestrial life, particularly at its southernmost range. Experimental results indicate similar drought tolerances in juveniles of Natterjack populations across their geographical distribution (M. Tejedo and C. Iriarte, unpublished data).


Transmitter implantation in *B calamita*. Photo: Ulrich Sinsch.

Conservation in action

In Britain conservation action has mostly entailed the maintenance of ephemeral ponds and removal of invasive scrub, eventually reintroducing a grazing regime using domestic livestock to maintain early successional habitat conditions.

The first attempts to reintroduce Natterjacks to sites in Britain where they had recently gone extinct started in the 1970s. These early efforts failed but since 1980 there have been increasing successes (Denton et al. 1997; Griffiths et al. 2010), such that by 2009, 19 out of 27 translocations where the level of success could be judged were successful (i.e., a minimum of adults returning to breed successfully), a success rate of about 70%. Translocations have been carried out by transfer of spawn, the equivalent of eight strings but made up of small sections from multiple strings to maximize genetic diversity, for two consecutive years. It has remained easier to re-establish Natterjacks at coastal dune sites (85% success) than on heathland sites (57% success). Successful translocations now out number native populations in the UK, of which there are 13 as defined by genetic studies. However, native populations are, on average, four times larger than successfully translocated ones. More than 77 % of all UK Natterjacks are still in native populations. In northern France, the expansion of the port of Le Havre in the Seine estuary has resulted in the irreversible destruction of terrestrial habitats and amphibian breeding sites. A decision was taken to translocate resident Natterjacks and the capture of migrating or erratic toads was conducted in 2001 thanks to about 5 km of drift fence and pitfall trap system and 160 plywood or carpet boards used by toads as artificial shelters widespread in the 400 hectares of the area. More than 5000 toads (adults and juveniles) were translocated in 3 areas where Natterjacks were still or historically present. The operation success was estimated in this latter area only by yearly survey of potential breeding sites and adult radio tracking. Annual survival was 25% in these adults, i.e., half the value estimated in native populations, but repeated breeding over several years indicates a successful translocation (Eggert & Miaud, unpublished).

The existence of a 37-year data set on a population in southern England provided an opportunity to model the impact of long-term habitat management on Natterjacks (Di Minin & Griffiths, 2011). The management interventions were consistent with an increase in carrying capacity over this period. As with many amphibian populations, habitat management aimed at improving juvenile survival

Couple of Natterjack toads in oviposition. Photo. Ion Garin-Barrio.

is likely to have the most positive effects on population viability. However, even with ongoing management, fluctuating Natterjack populations may remain vulnerable to extinction for several decades unless efforts can be made to offset reductions in recruitment caused by pond desiccation.

In Iberian Peninsula, gene flow, genetic diversity and genetic structure have been investigated in 13 populations, including the isolated ones in the Basque coast, in order to determine the best *conservation* management strategy. Significant differentiation between isolated and the rest of the analysed populations was shown, with various genetic diversity and isolation (Iraola et al., unpublished). Since both populations have to be considered as independent units for conservation purposes, it was examined whether genetic depression may increase population vulnerability to anthropogenic disturbance. Lethal concentrations of a common herbicide (glyphosate) were determined for the two genetically depressed populations, two "healthy" ones and crosses between both types of populations. Tadpoles from low genetic diversity populations tolerated lower doses of herbicide, whereas intermediate values were obtained with crossbreed tadpoles which suggest a genetic effect (Cabido et al. 2010, 2011). In addition, immune response (phytohemagglutinin test) of adults from one of the genetically depressed populations was found to be lower than those from a 'healthy' one (Cabido & Garin-Barrio, unpublished). In conclusion, genetic diversity could determine the capacity to tolerate anthropogenic environmental stress or health status of different populations and it should be taken into account in conservation plans.

Conclusion

The Natterjack toad remains one of the best-studied amphibians within Europe and much of the research conducted has had a direct conservation focus. Long-term collaboration between researchers and conservation practitioners in different countries has been a hallmark of the programme, and the exchange of data and experiences has been of mutual benefit.

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Literature Cited

Beebee, T.J.C. (1976) The Natterjack toad (*Bufo calamita*) in the British Isles: a study of past and present status. *British Journal of Herpetology* **5**: 515-521.

Cabido C, Garin-Barrio I, García-Azurmendi X, Rubio X, Gosá A. (2010) Population differences in vulnerability to glyphosate of Natterjack toad tadpoles. 2nd International Symposium on the conservation of amphibians: *Bufo calamita*. Donostia/San Sebastian (Spain).

Cabido C, Garin-Barrio I, Rubio X, Gosá A. (2011) Pesticide vulnerability and genetic diversity: a cross-breeding experiment with two populations of Natterjack toad. 3er Congress of the Spanish Society of Evolutionary Biology. Madrid (Spain).

Denton, J.S., Hitchings, S.P., Beebee, T.J.C. & Gent, A. (1997) A recovery program for the Natterjack toad (*Bufo calamita*) in Britain. *Conservation Biology* **11**: 1329-1338.

Di Minin, E., Griffiths R.A. (2011) Viability analysis of a threatened amphibian population: modelling the past, present and future. Ecography 34: 162-169.

Duarte, H., Tejedo, M., Katzenberger, M., Marangoni, F., Baldo, D., Beltrán, J.F., Martí, D.A., Richter-Boix, A., Gonzalez-Voyer, A. (2012) Can amphibians take the heat? Vulnerability to climate warming in subtropical and temperate larval amphibian communities. Global Change Biology 18: 412-421.

Gomez-Mestre & Tejedo (2003) Local adaptation of an anuran amphibian to osmotically stressful environments. Evolution 57: 1889-1899).

Griffiths, R.A., McGrath, A., & Buckley (2010) Re-introduction of the Natterjack toad in the UK. In Global re-introduction perspectives: additional case studies from around the globe (Ed: P. Soorae). IUCN/SSC Re-introduction Specialist Group, Abu Dhabi, pp. 62-65.

Gomez-Mestre, I. & Tejedo, M. (2002) Geographic variation in asymmetric competition: A case study with two larval anuran species. Ecology 83: 2102-2111.

Leskovar, C., Sinsch, U. (2005) Harmonic direction finding: a novel tool to monitor the dispersal of small-sized anurans. Herpetological Journal 15: 173-180.

Leskovar, C., Oromi, N., Sanuy, D., Sinsch, U. (2006) Demographic life history traits of reproductive Natterjack toads (*Bufo calamita*) vary between northern and southern latitudes. Amphibia-Reptilia 27: 365-375.

Miaud, C., Sanuy, D., Avrillier, J.N. (2000) Terrestrial movements of the Natterjack toad *Bufo calamita* (Amphibia, Anura) in a semi-arid, agricultural landscape. Amphibia-Reptilia 21, 357-369.

Oromi, N., Sanuy, D., Sinsch, U. (2010) Thermal ecology of Natterjack toads (*Bufo calamita*) in a semiarid landscape. Journal of Thermal Biology 35: 3440. DOI: 10.1016/j.jtherbio.2009.10.005

Oromi, N., Sanuy, D., Sinsch, U. (2012) Altitudinal variation of demographic life-history traits does not mimic latitudinal variation in Natterjack toads (*Bufo calamita*). Zoology 115: 30-37. Doi: 10.1016/j.zool.2011.08.003.

Rowe, G., Harris, J.D. & Beebee, T.J.C. (2006) Lusitania revisited: a phylogeographic analysis of the Natterjack toad *Bufo calamita* across its entire biogeographical range. *Molecular Phylogenetics and Evolution* 39: 335-346.

Sinsch, U., Marangoni, F., Oromi, N., Leskovar, C., Sanuy, D., Tejedo, M. (2010) Proximate mechanisms determining size variability in Natterjack toads. Journal of Zoology 281: 272-281.

Sinsch, U., Leskovar, C. (2011) Does thermoregulatory behaviour of green toads (*Bufo viridis*) constrain geographical range in the west? A comparison with the performance of syntopic Natterjacks (*Bufo calamita*). Journal of Thermal Biology 36: 346-354.

Sinsch, U., Oromi, N., Miaud, C. Denton, J., Sanuy, D. (2012) Connectivity of local amphibian populations: modelling the migratory capacity of radio-tracked Natterjack toads. Animal Conservation (in press).

Taking the pulse of the planet's biodiversity: a new tool for tracking changes in amphibian abundance

The Living Planet Index : A call for support

The Living Planet Index (LPI) is a measure of the state of the world's biological diversity based on population trends of vertebrate species from around the world. The Amphibian Survival Alliance (ASA), in collaboration with the Zoological Society of London and WWF, aims to develop a new index of amphibian population change. To find out more about the LPI download the fact sheet here static.zsl.org/files/1-2-1-living-planet-index-1062.pdf or contact Jaime Garcia Moreno (jaime.garciamoreno@iucn.org) or Phil Bishop (phil.bishop@iucn.org) to find out how you can get involved in this innovative initiative.

The 2nd International Symposium on the Conservation of Amphibians: *Bufo calamita*

By Ion Garin-Barrio

The 2nd International Symposium on the Conservation of Amphibians: *Bufo calamita*, took place on 17 and 18 December 2010 in the Aquarium of Donostia-San Sebastián, Spain. The symposium was organized by the research group at the Aranzadi Society of Sciences, Department of Herpetology. This team currently drives the monitoring work on the surviving populations of *Bufo calamita* on the Cantabrian coast. At the meeting the research group worked closely with a large number of specialists in the conservation of threatened Natterjack toad populations, including the Irish, British, Swedish and Estonian.

About 100 people participate in the meeting from a range of countries including but not limited Estonia, Sweden, Belgium, Germany, France, Ireland, United Kingdom, and Spain. Twenty eight studies (15 oral presentations and 13 posters) were presented at the symposium, which also provided an opportunity for attendees to exchange information and create working groups. Finally, a series of general species management measures were agreed upon and are outlined below. Any comments and questions should be sent to Ion Garin-Barrio (igarin@aranzadi-zientziak.org) Herpetology-Department, Aranzadi Society of Science.

Guidelines for recovery of threatened populations of the Natterjack toad (*Bufo calamita*)

- Natterjacks require open (non-forested) areas in sandy soils, and shallow ponds to breed.
- Natterjacks do well in areas in early ecological successional stages. That implies that conservation of the species needs not be restricted to protected areas, but can also be extended to apparently disturbed areas such as sand and gravel pits or farmlands. Such environments usually lack competitors and predators of *B. calamita*.
- Therefore, it is important to build public awareness about the species conservation, locally modify agricultural uses to fit in the existence of suitable habitats and possibly contemplate compensatory measures.
- Reduced effective population sizes result in low genetic diversity and low heterozygosity. Steep reduction in heterozygosity becomes an issue right after a severe bottleneck. However, low heterozygosity may not be a problem *per se* for populations that have been small for a long time, because selection is likely to have purged deleterious alleles.
- Hence, we should not give up on small populations. Large, healthy populations can be restored from them.
- Recovery of relic populations or reintroductions of *B. calamita* should aim for establishing local metapopulations. This could be achieved by establishing a minimum pond network of 4-5 suitable ponds 200-500 m (max. 1 km) away from one another. Ideally this pond system would result in a stable population in the vicinity of a few hundreds of toads. Pond connectivity is important, but population nuclei should retain certain degree of independence (i.e., migration should not be too high), or otherwise the system would behave as a single population rather than a metapopulation.
- There is no fool-proof recipe for restoring *B. calamita* populations, but recommendations based on several decades of research across several countries can be made.
- Density-independent factors are important in regulating population size, and hence carrying capacity may not be critical.
- Juvenile survival is key in population viability, and measures should be taken to maximize it.
- Refuge availability is also important: sandy areas should contain patches of small to medium sized rocks for juveniles and adults to hide and hibernate/aestivate safely.
- Translocations may be needed from neighboring populations to recover populations in the brink of extinction. Adult translocations over short distances should be avoided because they are likely to attempt to return to their site of origin. Instead, translocations should be attempted using both eggs and tadpoles, and even metamorphic individuals. In any case, translocations should not be attempted unless there is good evidence that it is possible to establish a self-sustaining, stable population in the long-term. Translocations should follow current IUCN guidelines.
- Monitoring of recovering or newly established populations is essential. "Success" can be measured at three stages: (1) released individuals survive in the new site; (2) released individuals breed successfully; and (3) a viable population is established. Ideally, (3) should be the long-term goal. Demographic stochasticity is inherent to *B. calamita* population dynamics, in part because of the ephemerality of their preferred ponds. Therefore, it should be assumed that monitoring of threatened populations is a long term task. Life span is variable among populations, but Natterjacks can easily live up to 7-10 years. Generation time is typically 3 years, so no conclusions can be seriously drawn before 3 years of monitoring, but 5-10 years is more realistic in terms of assessing whether a population is likely to become established. Longer-term monitoring may be needed to determine whether the population is viable and sustainable.
- In any case, it is the number of generations, and not the actual time passed that will determine the extent of monitoring required, until it can be verified whether breeding occurs consistently.
- It would be desirable to adopt the collective aim of recovering the original range of the species, taking into account the models of suitable habitat predictions when planning translocations.
- We request that the Gobierno del Pais Vasco takes action to conserve Natterjack toad populations, and more specifically, that the Diputacion Foral de Gipuzkoa takes swift and decisive conservation measures to protect the severely threatened population of *Bufo calamita* in Gipuzkoa.

RACE: Risk Assessment of Chytridiomycosis to European Amphibian Biodiversity

By Matthew C. Fisher, Benedikt R. Schmidt, Klaus Henle, Dirk S. Schmeller, Jaime Bosch, David M Aanensen, Claude Miaud & Trenton W. J. Garner

Batrachochytrium dendrobatidis (*Bd*) is now known to be a proximate cause of amphibian declines on five continents. *Bd* infects more than 500 species of amphibians and infections in wild amphibians are reported for 54/81 countries for which data are available (http://www.bd-maps.net/surveillance/). At its worst, emergence of *Bd* leads to a 70% loss of local amphibian biodiversity in a matter of months (reviewed by Fisher et al. 2009). Lethal chytridiomycosis affecting midwives (*Alytes obstetricans*) was discovered at what is now considered the European Index site for *Bd*, the Peñalara Natural Park (Spain) in 2001 (Bosch et al. 2001). Further research showed that the infection in European amphibians was widespread (Garner et al. 2005). In response to what could be a significant threat to Europe's amphibians we established a collaborative project among seven institutions based in five countries. The project *RACE* is funded by the FP7 ERA-NET project BiodiverERsA (http://www.biodiversa.org/) and is designed to develop a European-wide scientific program in response to the detection of lethal chytridiomycosis in Europe. The specific goals of *RACE* are:

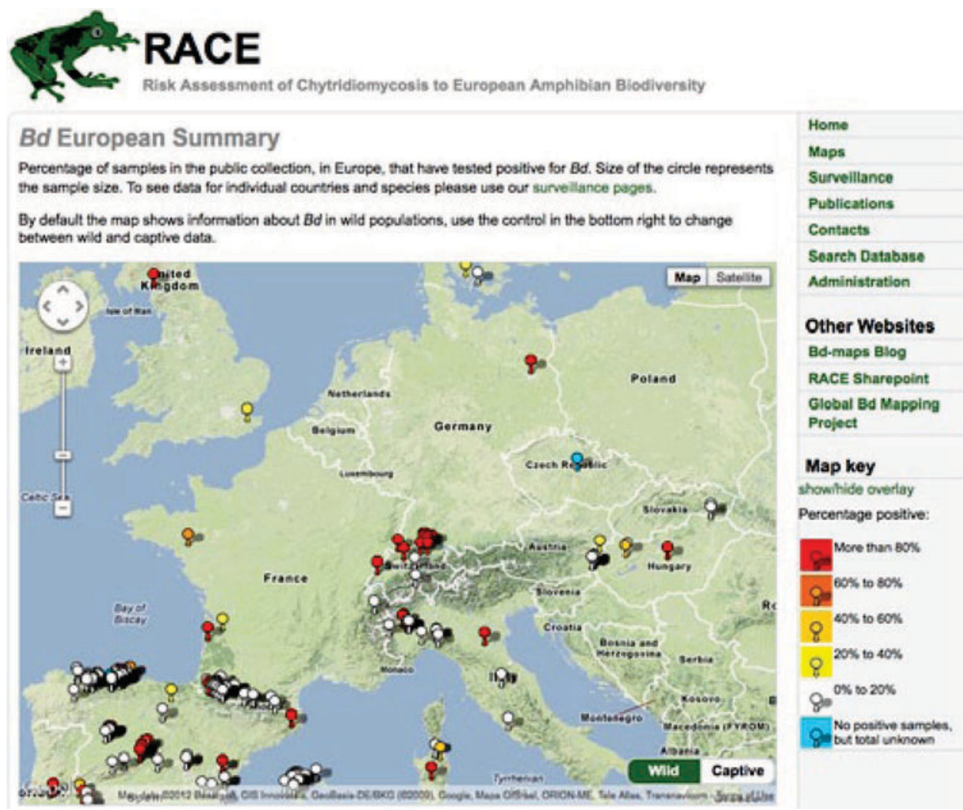

Figure 1. The EU RACE infection summary page at www.bd-maps.eu.

- *Identification of natural and anthropogenic drivers of chytridiomycosis.*
- *Development of an informatics solution to acquire field data.*
- *Analysis of species' susceptibility and environmental drivers across scales.*
- *Assess the effectiveness and efficiency of policy instruments to respond to emerging infectious diseases and disease-related biodiversity loss.*
- *Disseminating results to a range of relevant policy makers, public sector representatives, land users, NGOs, scientists, and the general public.*

At its heart, *RACE* is a risk assessment, the first of its kind in Europe, designed to assess if and how *Bd* may threaten our amphibian fauna. If a threat is detected, the project is designed to produce and disseminate a European Threat Abatement Plan (ETAP) in 2013, to aid the European Parliament in developing an appropriate response to the threat. Since its initiation in 2009, *RACE* has achieved significant milestones. Foremost has been the development of an extensive network outside the seven core *RACE* groups. The combined effort of the associated groups (extra*RACE*rs) and the original seven has resulted in a significantly increased understanding of the distribution of *Bd* and chytridiomycosis across Europe. Extensive surveillance is completed, or underway, in the UK, France, Spain, Switzerland, Austria, the Czech Republic, the Netherlands, Belgium, Italy and Hungary, with other countries gearing up to assess the scale of infection. An informatics database has been established that allows the prevalence of infection to be assessed across various geographic scales. This web application can be accessed at the *RACE* project web site (www.bd-maps.eu/) with surveillance data summarised (www.bd-maps.eu/stats.php).

Figure 2. *RACE* inaugural meeting, 2009 (Dirk Schmeller).

Figure 3. *RACErs* disinfecting after fieldwork in the Pyrenees, Lac Arlet 2009 (Mat Fisher).

The European patterns of infection, originally described in a study by three of the seven founding members of *RACE* (Garner et al. 2005), holds up to some degree: *Bd* is widespread across Europe. Eleven out of 15 countries providing data to *RACE* have infected amphibians in the wild. However, previous estimates of prevalence sorely underestimated how heavily *Bd* had penetrated Europe. Prevalence in Switzerland, Austria, France and the UK were all seriously underestimated in the earlier study [respectively, Switzerland current estimate, 54% (unpublished), previous estimate 25%; Austria current 20% (Sztatecsny and Glaser, 2011), previously 0%; France current 34% (unpublished), previously 0%; UK current 26% (unpublished) previously <1%]. Other national estimates currently available include Spain (~25%; Walker et al. 2008) and the Netherlands/Belgium (~30%). The overall prevalence for Europe stands at 27% (1351 positives/4999 samples).

Several European species other than *A. obstetricans* are experiencing substantial mortality in the wild due to chytridiomycosis (e.g., (Bielby et al. 2009; Garner et al. 2009a) and *A. obstetricans* is dying from chytridiomycosis outside of Iberia (Tobler and Schmidt, 2010; Walker et al. 2010; Pasmans et al. 2010). Amphibian species currently described in the literature that are experiencing lethal chytridiomycosis are undoubtedly an underestimate of the full range of susceptible European hosts. Mass-mortalities are generally detected at locally high-altitude montane regions but temperatures associated with mortality in *A. obstetricans* are not the same at different locations. At the index site, death followed the globally 'typical' pattern based on lab-based estimates of *Bd* temperature requirements (Bosch et al. 2007), while in the Pyrenees, atypically colder temperatures were associated with mass mortality (Walker et al. 2010). In addition, a correlation with UV-B has been observed at both sites and in both natural and experimental settings, suggesting a role for levels of radiation in governing the intensity of infection (Walker et al. 2010; Ortiz-Santaliestra et al. 2011). However, several species may be tolerant or even resistant to infection (e.g., Luquet et al. 2012). *RACE* team members have identified numerous populations, communities and areas across Europe where *Bd* is not associated with detectable mortality, even at high prevalence. In Switzerland, despite significant reduction in the numbers of *A. obstetricans* populations, *Bd* has not been confirmed as a cause of these declines.

The inconsistent pattern of chytridiomycosis in Europe may in part be explained by a recent significant *RACE* finding. *Bd* is composed of at least three divergent lineages (*Bd*GPL, *Bd*CH and *Bd*CAPE) of variable virulence (Farrer et al. 2011). The most virulent lineage, *Bd*GPL, is the only widespread lineage and is the one associated with mortality and the increasing spread of disease evident in Iberia, as well as on other continents. This study and a previous study by Walker et al. (2008) also provide the first well-supported evidence that *Bd* was introduced to Europe. *Bd*CAPE infecting *Alytes muletensis* on Mallorca is only found outside of Europe in South Africa. This unusual pattern is best explained by the introduction of *Bd*CAPE into Europe by an infected South African endemic, *Xenopus gilli*. The third lineage remains enigmatic: *Bd*CH infecting *Alytes obstetricans* in Switzerland has only been isolated once. Additional *Bd* isolation and sequencing is underway.

Substantial effort is now being undertaken to identify the vectors of infection, as well as develop means to control spread of *Bd*. *RACErs* have also expended considerable effort in attempting to mitigate infection by removing animals and clearing infection *ex situ* by the use of the antifungal drug itraconazole (Garner et al. 2009b; Schmeller et al. 2011) and elevated temperature (Geiger et al. 2011). Currently, this has been ineffective in clearing infection for study sites on Mallorca however antifungal treatment has reduced the intensity of infection. This suggests that mitigation may alter the host/pathogen dynamics in ways that may protect amphibians from the lethal effects of infection (Woodhams et al. 2011). Future control protocols will likely not involve clearing the pathogen, but will instead focus on *in situ* methods for reducing the intensity of infection.

Figure 4. (a) The Sardinian brook newt, *Euproctus platycephalus*, and (b) Tyrrhenian painted frog *Discoglossus sardus*. Both species have been identified by *RACE* as infected by BdGPL (Trent Garner).

Figure 5. *Alytes obstetricans* chytridiomycosis mass mortalities in the Pyrenees. Photo Mat Fisher.

News, updates and reports from *RACE* are regularly recorded at our project blog and can be viewed at http://bd-maps.blogspot.com/

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Literature Cited

Bielby, J., S. Bovero, G. Sotgiu, G. Tessa, M. Favelli, C. Angelini, S. Doglio, F. C. Clare, E. Gazzaniga, F. Lapietra and T. W. J. Garner (2009) Fatal Chytridiomycosis in the Tyrrhenian Painted Frog. Ecohealth 6(1): 27-32.

Bosch, J., L. M. Carrascal, L. Duran, S. Walker and M. C. Fisher (2007) Climate change and outbreaks of amphibian chytridiomycosis in a montane area of Central Spain; is there a link? Proceedings of the Royal Society B-Biological Sciences 274(1607): 253-260.

Bosch, J., I. Martínez-Solano and M. García-París (2001) Evidence of a chytrid fungus infection involved in the decline of the common midwife toad (*Alytes obstetricans*) in protected areas of central Spain. Biological Conservation 97: 331-337.

Farrer, R. A., L. A. Weinert, J. Bielby, T. W. J. Garner, F. Balloux, F. Clare, J. Bosch, A. A. Cunningham, C. Weldon, L. H. du Preez, L. Anderson, S. L. K. Pond, R. Shahar-Golan, D. A. Henk and M. C. Fisher (2011) Multiple emergences of genetically diverse amphibian-infecting chytrids include a globalized hypervirulent recombinant lineage. Proceedings of the National Academy of Sciences of the United States of America 108(46): 18732-18736.

Fisher, M. C., T. W. J. Garner and S. F. Walker (2009) Global Emergence of Batrachochytrium dendrobatidis and Amphibian Chytridiomycosis in Space, Time, and Host. Annual Review of Microbiology 63: 291-310.

Garner, T. W. J., S. Walker, J. Bosch, S. Leech, J. M. Rowcliffe, A. A. Cunningham, and M. C. Fisher (2009a) Life history trade-offs influence mortality associated with the amphibian pathogen *Batrachochytrium dendrobatidis*. Oikos 118: 783-791.

Garner, T. W. J., G. Garcia, B. Carroll and M. C. Fisher (2009b) Using itraconazole to clear Batrachochytrium dendrobatidis infection, and subsequent depigmentation of Alytes muletensis tadpoles. Diseases of Aquatic Organisms 83(3): 257-260.

Garner, T. W. J., S. Walker, J. Bosch, A. D. Hyatt, A. A. Cunningham and M. C. Fisher (2005) Chytrid fungus in Europe. Emerging Infectious Diseases 11(10): 1639-1641.

Geiger, C. C., E. Küpfer, S. Schär, S. Wolf and B. R. Schmidt (2011) Elevated temperature clears chytrid fungus infections from tadpoles of the Midwife toad, *Alytes obstetricans*. Amphibia-Reptilia 32(2): 276-280.

Luquet, E., T. W. J. Garner, J.-P. Léna, C. Bruel, P. Joly, T. Lengagne, O. Grolet and S. Plénet (2012) Does genetic erosion influence the impact of exposure to infectious disease? *Evolution* doi:10.1111/j.1558-5646.2011.01570.x

S. Plénet (in press) Does genetic erosion influence the impact of exposure to infectious disease? *Evolution*

Ortiz-Santaliestra, M. E., M. C. Fisher, S. Fernandez-Beaskoetxea, M. J. Fernandez-Beneitez and J. Bosch (2011) Ambient Ultraviolet B Radiation and Prevalence of Infection by *Batrachochytrium dendrobatidis* in Two Amphibian Species. Conservation Biology 25(5): 975-982.

Pasmans, F., M. Muijsers, S. Maes, P. Van Rooij, M. Brutyn, R. Ducatelle, F. Haesebrouck and A. Martel. (2010) Chytridiomycosis related mortality in a Midwife toad (*Alytes obstetricans*) in Belgium. Vlaams Diergeneeskundig Tijdschrift 79: 461-463.

Sztatecsny, M. and F. Glaser (2011) From the eastern lowlands to the western mountains: first records of the chytrid fungus *Batrachochytrium dendrobatidis* in wild amphibian populations from Austria. Herpetological Journal 21(1): 87-90.

Schmeller D.S. , Loyau A., Dejean T., Miaud C. (2011) Using amphibians in lab studies – precautions against the emerging infectious disease Chytridiomycosis. Laboratory Animals 45: 25-30.

Tobler, U. and B. R. Schmidt (2010) Within- and Among-Population Variation in Chytridiomycosis-Induced Mortality in the Toad *Alytes obstetricans*. PLoS ONE 5(6): e10927.

Walker, S. F., J. Bosch, V. Gomez, T. W. J. Garner, A. A. Cunningham, D. S. Schmeller, M. Ninyerola, D. A. Henk, C. Ginestet, C. P. Arthur and M. C. Fisher (2010) Factors driving pathogenicity vs. prevalence of amphibian panzootic chytridiomycosis in Iberia. Ecology Letters 13(3): 372-382.

Walker, S. F., J. Bosch, T. Y. James, A. P. Litvintseva, J. A. O. Valls, S. Pina, G. Garcia, G. A. Rosa, A. A. Cunningham, S. Hole, R. Griffiths and M. C. Fisher (2008) Invasive pathogens threaten species recovery programs. Current Biology 18(18): R853-R854.

Woodhams, D. C., J. Bosch, C. J. Briggs, S. Cashins, L. R. Dacvis, A. Lauer, E. Muths, R. Piuschendorf, B. R. Schmidt, B. Shaeafor and J. Voyles (2011) Mitigating amphibian disease: strategies to maintain wild populations and control chytridiomycosis. Frontiers in Zoology 8(8). doi:10.1186/1742-9994-8-8.

Amphibian and Reptile Conservation

By Craig Hassapakis & Robert K. Browne

Amphibian and Reptile Conservation: Supporting the Sustainable Management of Amphibian and Reptile Biodiversity is an international open-access journal of growing importance—with an established history of innovation and publication.

The founding of *Amphibian and Reptile Conservation* began in 1996 with the publication of the premiere issue establishing the first herpetological conservation journal, and later becoming the first herpetology journal published as Open Access (2004).

Since 1996 the conservation needs for amphibians and reptiles have increased exponentially, as the pressures on their populations spread through a combination of habitat clearance, climate change, invasive species, disease, and many other factors, and deficiencies in taxonomic, ecological, and distribution information have become increasingly apparent (AmphibiaWeb, 2010; IUCN, 2010).

Of the ~6,500 amphibian species listed by the IUCN 30% are Threatened; including ~500 Critically Endangered, and ~750 Endangered species, with more than 200 species already extinct. More than 300 species of reptiles are also threatened with imminent extinction, with many more threatened (AmphibiaWeb, 2010; IUCN, 2010).

In 2010 to address the conservation crisis in amphibians and reptiles *Amphibian and Reptile Conservation* has been revamped significantly to embrace conservation, publicity, and the project support potentials of the Internet. Furthermore, we have adopted a new policy to modernize and encompass amphibian and reptile conservation as "*Supporting the Sustainable Management of Amphibian and Reptile Biodiversity*." Most importantly, *Amphibian and Reptile Conservation* will not only provide information services through our large and growing Internet community, but through our developing "hands on" conservation projects in our targeted biogeographical region(s) the Caribbean and Central America.

Cochranella spp., Glass frog (unidentified; possibly *Rulyrana ermine* or undescribed species). Departmento Amazonas, Peru. (Photographer: Brad Wilson, DVM).

We have established a progressive and flourishing Internet presence through our web site www.redlist-arc.org and multiple affiliated Facebook sites. Facebook affiliates and web site presence offer news feeds, special products, publication updates, and project potentials. Become involved today and help protect and manage amphibian and reptile species for future generations!

- *Amphibian & Reptile Conservation* http://www.facebook.com/AmphibianAndReptileConservation
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- *Amphibian Conservation and Cloning Lab (ACCL)* http://www.facebook.com/groups/clones/
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- *Reptile Conservation Breeding (RCB)* http://www.facebook.com/groups/ReptConBreeding/

Amphibian and Reptile Conservation has continued to expand its coverage and now includes the following topics: new species descriptions (two new species described in 2011; a new *Ophiomorus* and *Carinatogecko*), taxonomy and phylogeny, species inventories, distribution, conservation, species profiles, ecology, natural history, sustainable management, conservation breeding, citizen science, social networking, and more.

Amphibian and Reptile Conservation continues to be the best of graphic design (larger journal format: 8.0 x 10.75 inches; and the use of copious full color photographs and illustrations), complete open-access, and developing social networks and web site capacities to maximize individual participation and conservation efforts.

Our statistics demonstrate web site visits at www.redlist-ARC.org are increasing 25% per month. Extra publicity ensures published papers reach targeted audiences through dedicated email notices and our social networking capacities.

Amphibian and Reptile Conservation is currently published free-of-charge through volunteer contributors. We welcome assistance in the production of *Amphibian and Reptile Conservation* through article submissions, copy editors and editors, reviewers, and other skilled and enthusiastic individuals.

To submit a paper, to become a part of our team, and/or for more information please contact "*Amphibian and Reptile Conservation*" <redlist-arc@gmail.com>, **or** co-editors "Craig Hassapakis" **<**arc.coeditor1@gmail.com**>** **or** "Robert Browne" <robert.browne@gmail.com>.

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- Range extension for *Duttaphrynus kotagamai* (Amphibia: Bufonidae) and a preliminary checklist of herpetofauna from the Uda Mäliboda Trail in Samanala Nature Reserve, Sri Lanka. 5(2):52-64(e38).
- Herpetofaunal diversity and distribution in Kalugala proposed forest reserve, Western province of Sri Lanka. 5(2):65-80(e39).

Literature Cited

AmphibiaWeb (2010) Worldwide amphibian declines: How big is the problem, what are the causes and what can be done? [Online]. Available: http://amphibiaweb.org/declines/declines.html [Accessed: 24 August 2010].

IUCN (2010) IUCN Red List of Threatened Species. Version 2010.2. [Online]. Available: http://www.iucnredlist.org [Accessed: 24 August 2010].

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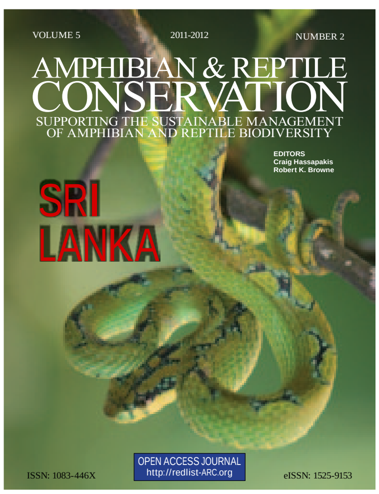

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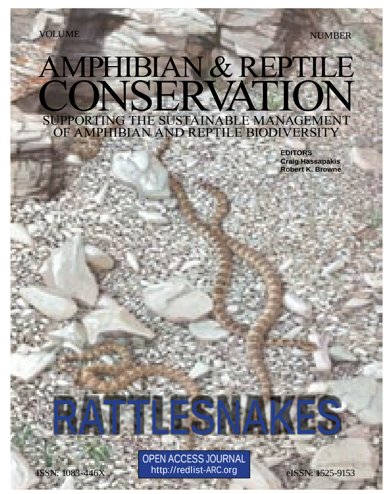

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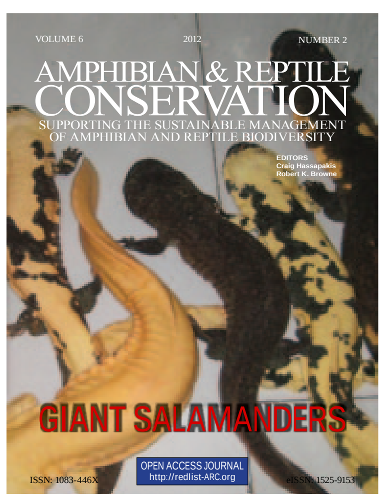

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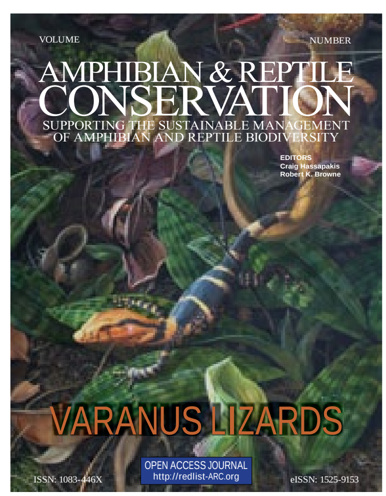

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Amphibian Composition of the Uda Mäliboda Trail in the Samanala Nature Reserve (SNR), Sri Lanka: A Cautionary Note

By Dinal Samarasinghe, Suranjan Karunarathna, Indika Peabotuwage, Majintha Madawala, Nirmala Perera,Dushantha Kandambi, Nuwan Bandara & Chamara Amarasinghe

The Samanala Nature Reserve (SNR), also known as the Peak Wilderness Sanctuary is the third largest nature reserve in Sri Lanka (Fig. 1). Peak Wilderness was declared a sanctuary on 25th October 1940, encompassing an area of about 55,300 acres (22,379 ha). During the British colonial rule (1815 – 1948) large areas of forest were cut down and converted to tea plantations mainly in the Nuwara Eliya district, while other areas were cleared for different agricultural purposes. According to the current management plan, the geographical area of the sanctuary is about 24,000 ha, of which 21,175 ha comprises natural or semi natural vegetation, while the remaining includes tea estate and village settlements (DWC, 2007; Karunarathna et al. 2011).

This forest is regarded as one of the most important forested areas for endemic biodiversity in Sri Lanka and is owned by the Central Highlands World Heritage Centre (UNESCO, 2011). This tropical rainforest spreads over 224 km^2 around Adam's Peak (2,245 m asl) which is the most prominent peak in the area and a mountain with great religious significance. There are four main trails used by pilgrims to reach Adams Peak (Peabotuwage et al. 2012). The Uda Mäliboda trail starts from the 'Uda Mäliboda village' and continues via Madáhinna (Kuruwita trail) to Adams Peak. This is the longest trail and is seldom used by pilgrims since it consists of rough terrain and narrow foot paths (Karunarathna et al. 2011).

The Study area (Uda Mäliboda) lies between 6°53' 01.58'' N and 80°26' 31.18'' E with elevations ranging from 300 – 700 m. This forested area is part of the Kegalle district in Sabaragamuwa Province (Fig. 2). Average annual rainfall ranges from 3,000 – 4,500 mm and the average annual temperature is 27.9 °C. The vegetation of Uda Mäliboda Trail is categorized as lowland wet evergreen forest (Gunatilleke and Gunatilleke, 1990) and is comprised of the following *dominant* genera: *Doona*, *Stemonoporus*, *Calophyllum*, *Syzygium*, *Shorea*, *Dipterocarpus*, *Cullenia*, *and Mesua* (Fig. 3). This part of SNR is hitherto an unstudied area. Hence, a preliminary study on the amphibian composition was conducted (Peabotuwage et al. 2012). Visual encounter survey methods were used to conduct herpetofaunal surveys for a total of 17 days and nights between 2006 and 2011. Night searches were performed using headlamps and torches. Specific microhabitats including underneath stones, decaying logs, inside tree holes, and other potential herpetofaunal retreats were thoroughly examined (Fig. 4). Road kills and data from animals dispatched by villagers were also used as sources of information.

Figure 1. Samanala Nature Reserve and Adams peak (Peak Wilderness). Photo: Dinal Samarasinghe.

During the study we encountered 34 amphibian species representing 15 genera and seven families (Table 1). Among those genera *Adenomus*, *Lankanectes*, *Nannophrys*, and *Taruga* are considered endemic to Sri Lanka. Our results show that at least 31% of Sri Lanka's extant amphibians occur in the Uda Mäliboda area. Twenty-six of the 34 species encountered (76%) are endemic, five (14%) are considered Near Threatened, four (11%) are Vulnerable, and ten (29%) are classified as Endangered (IUCN-SL and MENR-SL, 2007). Families with the greatest number of endemic species include Rhacophoridae (16 species) and Dicroglossidae (6 species) while the families Ichthyophiidae, Ranidae (2 species each) and Nyctibatrachidae (1 species) showed the lowest rates of endemism (Peabotuwage et al. 2012).

The range extensions of two endangered anurans: *Duttaphrynus kotagamai* (Fig. 5) and *Pseudophilautus sarasinorum* (Fig. 6) were also recorded in this study area. The Uda Mäliboda locality for *D. kotagamai* is ~ 6 km (direct distance through the forest) away from published nearest location "Eratne" (kuru river basin). The direct distance between the type locality and the new location is about 80 km (Peabotuwage et al. 2012). All of these areas have closed canopies with wet and cool habitats. The toads were only found in primary forest and were absent from human-disturbed areas. Also *P. sarasinorum* direct distance was known from published nearest location "Bogawantalawa" ~ 30 km and direct distance between the type locality is ~ 50 km away. *P. sarasinorum* was previously known only

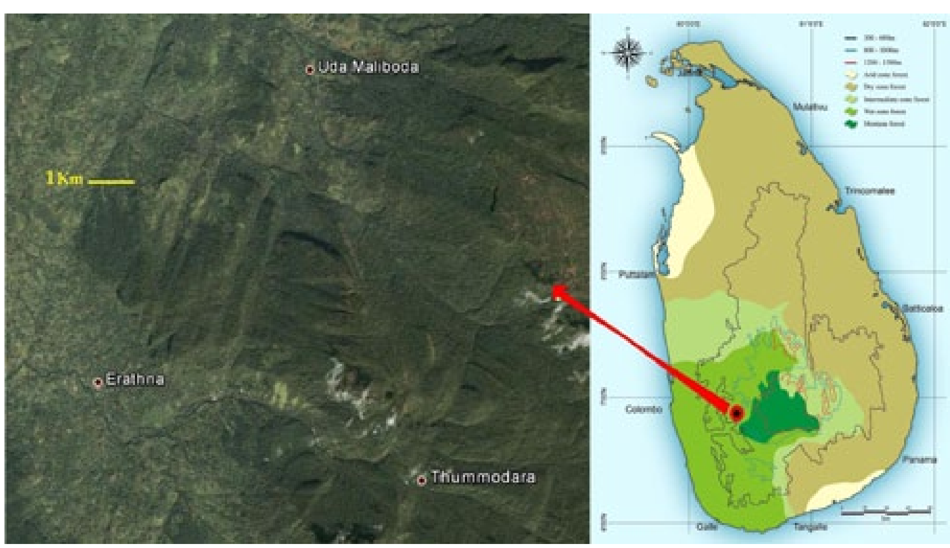

Figure 2. Map of study area (sky view; source: Google map).

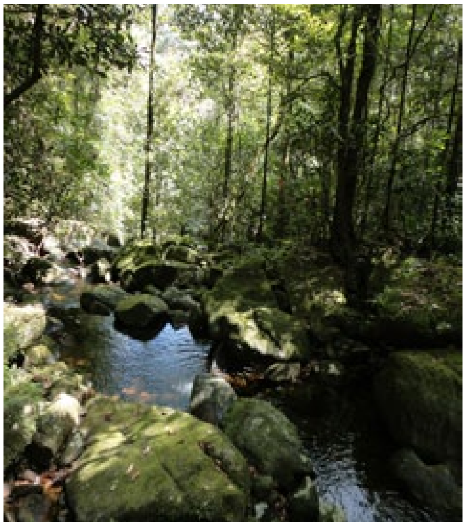

Figure 3: (left) Cascade habitat: shrub mixed with riverine forest patch. Figure 4: (right) Inside forest: tall trees, mixed vegetation with good leaf litter. Photo: Suranjan Karunarathna.

from the following localities: Peradeniya (07°16' N 80°37' E) (type locality); Bogawantalawa–Balangoda road (near 25th km post), elev. 1,300 m, (06°45' N 80°42' E); Corbett's Gap, elev. 1,000 m (07°22' N 80°50' E); Hunnasgiriya, elev. 367 m (07°23'N, 80°41'E); Agra Arboretum, elev. 1,555 m (06°50' N, 80°40' E) (Manamendra-Arachchi and Pethiyagoda, 2005).

We also recorded the lowest elevation (ca. 700 m asl) for the following four endemic and endangered highland species: *Pseudophilautus alto* (1,890 – 2,135 m elevation) (Fig. 7), *P. asankai* (810 – 1,830 m) (Fig. 8), *P. femoralis* (1,600 – 2,135 m) (Fig. 9) and *Taruga eques* (1,750 – 2,300 m) (Fig. 10) (Manamendra-Arachchi and Pethiyagoda, 2006). These results were recorded from an area of ca. 20 ha within one km of direct distance between the start and end points. A large number of people including tourists, devotees, and laborers annually visit Adams Peak via Uda Mäliboda Trail located within the SNR (Peabotuwage et al. 2012). As a result endemic and threatened species, like many other fauna, are seriously affected by increasing pressure caused by habitat loss and degradation in the montane forests, lower montane forests, and marshes.

The Uda Mäliboda area has a remarkable amphibian diversity and endemism compared with other wet zone forests in Sri Lanka. It is intriguing that this trail compose of such a great diversity not recorded anywhere in the island hitherto. We believe the presence of many more species including novel species may inhabit the unstudied areas of this forest in our survey. However, the forest is also threatened due to a number of anthropogenic activities (Fig. 11). The major threats identified include illegal timber harvesting, illegal human encroachment, slash and burn forest clearing for human settlement and monoculture plantations (especially for tea cultivation), and gem mining. Additionally there is an ongoing hydro electric power plant project (Fig. 12), which is occupying a large area of the forest (Peabotuwage et al. 2012).

Some of the frog species encountered in our survey show extreme habitat specialization. For example *Ramanella nagaoi* and *R. obscura* use specific micro habitats which contain small bodies of water as breeding sites, especially tree holes. Four endangered frog species *Adenomus kelaarti, Duttaphrynus kotagamai, Taruga eques, and T. longinasus* select small bodies of water with clean water sources found inside forests as breeding sites (Peabotuwage et al. 2012). Such extreme habitat specialization can make these species vulnerable to environmental changes that can lead to the

Figure 5. *Duttaphrynus kotagamai*. Photo: Suranjan karunarathna.

Figure 6. *Pseudophilautus sarasinorum*. Photo: Dinal Samarasinghe.

Figure 7. *Pseudophilautus alto*. Photo: Dinal Samarasinghe.

Figure 8. *Pseudophilautus asankai*. Photo: Dinal Samarasinghe.

Figure 9. *Pseudophilautus femoralis*. Photo: Dinal Samarasinghe.

Figure 10. *Taruga eques*. Photo: Dinal Samarasinghe.

Figure 11. Plastic and polythene mixed garbage dumping in SNR. Photo: Suranjan Karunarathna.

decline or extinction of local populations. Current studies have shown that tree-hole breeders, direct developers, and those that depend on clear forest streams are the most susceptible to forest deterioration and fragmentation (Gascon et al. 1999; Funk and Mills, 2003; Lemckert, 1999). Human activities that occur within this forest can aggravate and accelerate the rate of decline of the local populations.

It is recommended that long-term data on environmental variables such as forest cover, temperature, precipitation, rain and stream chemistry, and atmospheric dust transport, relative humidity and light intensity are gathered and constantly monitor the forest, additionally systematic studies on micro habitat associations of amphibians, especially of the recently described frogs during the past decade should also be carried out for us to have a better understanding on what ecological parameters are necessary to maintain healthy populations in forests such as Uda Mäliboda. This, however would be the first step, a great responsibility lies on the shoulders of policy makers and scientists presently active today to save the remaining forest area and its inhabitants of the sanctuary. However, work should not be only limited to constant monitoring; short term and long term conservation strategies should be developed and implemented. Although there is an ongoing hydro electric power plant project, it is strongly recommended that further development activities in this area must not continue. Additionally, the villagers must be educated about the importance of the forest around them to minimize further encroachment, slash and burn forest clearing for settlement and plantation.

Figure 12. Hydroelectric power plant (note: concrete wall built across the steam and concrete particles dump in to the steam). Photo: Suranjan Karunarathna.

Acknowledgements

We would like to thank Devaka Weerakoon, Channa Bambaradeniya, Thasun Amarasinghe, Mendis Wickramasinghe, Kelum Manamendar-Arachchi, Aruna Karunathilake, Nadeesh Gamage, Mahesh De Silva, Deepthi Yakandawala, Suranjan Fernando, Villagers, John Rudge, Daniel Fogell, Kanishka Ukuwela, and Craig Hassapakis for various help and assistance in publishing this paper.

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Family and species name	Common name
Bufonidae	
Adenomus kelaartii	Kelaart's dwarf toad [E]
Duttaphrynus kotagamai	Kotagama's dwarf toad [E, EN]
Duttaphrynus melanostictus	Common house toad
Microhylidae	
Kaloula taprobanica	Common bull frog
Microhyla rubra	Red narrow mouth frog
Ramanella nagaoi	Nagao's pugsnout frog [E, VU]
Ramanella obscura	Green-brown pugsnout frog [E, NT]
Nyctibatrachidae	
Lankanectes corrugatus	Corrugated water frog [E]
Dicroglossidae	
Euphlyctis cyanophlyctis	Skipper frog
Euphlyctis hexadactylus	Sixtoe green frog
Fejervarya kirtisinghei	Montain paddy field frog [E]
Fejervarya cf. syhadrensis	Common paddy field frog
Hoplobatrachus crassus	Jerdon's bull frog
Nannophrys ceylonensis	Sri Lanka rock frog [E, VU]
Rhacophoridae	
Pseudophilautus abundus	Labugagama shrub frog [E]
Pseudophilautus alto	Horton plains shrub frog [E, EN]
Pseudophilautus asankai	Asanka's shrub frog [E, EN]
Pseudophilautus cavirostris	Hollow snouted shrub frog [E, EN]
Pseudophilautus femoralis	Leafnesting shrub frog [E, EN]
Pseudophilautus folicola	Leaf dwelling shrub frog [E, EN]
Pseudophilautus hoipolloi	Anthropogenic shrub frog [E]
Pseudophilautus popularis	Common shrub frog [E]
Pseudophilautus reticulatus	Reticulated-thigh shrub frog [E, EN]
Pseudophilautus rus	Kandiyan shrub frog [E, NT]
Pseudophilautus sarasinorum	Muller's shrub frog [E, EN]
Pseudophilautus sordidus	Grubby shrub frog [E, NT]
Pseudophilautus stictomerus	Orange-canthal shrub frog [E, NT]
Polypedates cruciger	Common hour-glass tree frog [E]
Taruga eques	Mountain tree frog [E, EN]
Taruga longinasus	Long-snout tree frog [E, EN]
Ranidae	
Hylarana aurantiaca	Small wood frog [VU]
Hylarana temporalis	Common wood frog [E, NT]
Ichthyophiidae	
Ichthyophis glutinosus	Common yellow-band caecilian [E]
Ichthyophis pseudangularis	Lesser yellow-band caecilian [E, VU]

Table - 1: Checklist of amphibian species in the Uda Mäliboda area (Abbreviations: E - endemic; EN - endangered; VU - vulnerable; NT - near threatened).

Literature Cited

DWC (2007) Biodiversity Baseline Survey: Peak Wilderness Sanctuary. Consultancy Services Report prepared by Green, M.J.B. (ed.), De Alwis, S.M.D.A.U., Dayawansa, P.N., How, R., Singhakumara, B.M.P.,Weerakoon, D. and Wijesinghe, M.R. ARD Inc in association with Infotech IDEAS and GREENTECH Consultants. Sri Lanka Protected Areas Management and Wildlife Conservation Project (PAM&WCP/CONSULT/02/BDBS), Department of Wildlife Conservation, Ministry of Environment and Natural Resources, Colombo. 44 pp.

Funk, W. C., and L. S. Mills (2003) Potential causes of population declines in forest fragments in an Amazonian frog. Biological Conservation. 111(2): 05–14.

Gascon, C., T. E. Lovejoy, R. O. Bierregaard, J. R. Malcolm, P. Stouffer, H. L. Vasconcelos, W. F. Laurance, B. Zimmerman, M. Tocher, and S. Borges (1999) Matrix habitat and species richness in tropical forest remnants. Biological Conservation. 91(2): 23–29.

Gunatilleke, I.A.U.N. and Gunatilleke, C.V.S. (1990) Distribution of floristic richness and its conservation in Sri Lanka. Conservation Biology. 4(1): 21-31.

IUCN-SL, MENR-SL (2007) The 2007 Red List of Threatened Fauna and Flora of Sri Lanka. IUCN Sri Lanka, Colombo, Sri Lanka. 148 p.

Karunarathna, D.M.S.S., Amarasinghe, A.A.T. and Bandara, I.N. (2011) A survey of the avifaunal diversity of Samanala Nature Reserve, Sri Lanka, by the Young Zoologists' Association of Sri Lanka. Birding Asia 15: 84-91.

Lemckert, F. (1999) Impacts of selective logging on frogs in a forested area of northern New South Wales. Biological Conservation. 89(3): 21–28.

Manamendra-Arachchi, K. and Pethiyagoda, R. (2005) The Sri Lankan shrub-frogs of the genus *Philautus* Gistel, 1848 (Ranidae: Rhacophorinae), with description of 27 new species. The Raffles Bulletin of Zoology, Supplement No. 12: 163–303.

Manamendra-Arachchi, K. and Pethiyagoda, R. (2006) Sri Lankawe Ubhayajeeween [Amphibians of Sri Lanka] (Text in Sinhala). Wildlife Heritage Trust of Sri Lanka, Colombo, Sri Lanka. 440 pp.

Peabotuwage I, Bandara, I.N., Samarasinghe, D., Perera, N., Madawala, M., Amarasinghe, C., Kandambi, H.K.D. and Karunarathna, D.M.S.S. (2012) Range extension for *Duttaphrynus kotagamai* (Amphibia: Bufonidae) and a preliminary checklist of herpetofauna from the Uda Mäliboda Trail in Samanala Nature Reserve, Sri Lanka. Amphibian and Reptile Conservation 5(2): 52-64.

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2011) UNESCO Headquarters, 7, Place de Fontenoy, 75352, Paris, 07 SP, France. [Online]. Available: http://whc.unesco.org/en/list/1203/documents/ [Accessed: 25 November 2011].

Discovery of the Largest Lungless Tetrapod, *Atretochoana eiselti* (Taylor, 1968) (Amphibia: Gymnophiona: Typhlonectidae), in its Natural Habitat in Brazilian Amazonia

By Marinus S. Hoogmoed, Adriano O. Maciel & Juliano T. Coragem

The largest limbless and lungless tetrapod, the wormsalamander *Atretochoana eiselti*, was described in 1968 by Taylor based on one old specimen in the Vienna museum, with locality "South America." When it was described as *Typhlonectes eiselti* it was not known to be lungless. Only in 1995 Nussbaum & Wilkinson discovered this and placed the species in its own genus *Atretochoana*, based on its lunglessness, closed choanae and on other anatomical characters of the skull. In 1997 these same two authors published an extensive anatomical and morphological description of the type specimen and speculated that it would be aquatic and inhabit upland environments in cold, fast moving waters, where it could cover its oxygen needs through skin respiration. In 1998 a second specimen without locality was discovered in the collection of the University of Brasilia. *A. eiselti* shows a number of peculiar characters, like having external nostrils but with the choanae closed by valves, lacking lungs and having a flattened skull with a bulbous snout and expanded articulation between lower jaw and skull that is displaced to far beyond the end of the braincase. It is a large species with a length of up to 105 cm, a body diameter of about 4 cm, a weight of up to 840 g and loose baggy skin in which the annuli characteristic for Gymnophiona are hard to distinguish. These morphological details present us with a number of questions concerning respiration, physiology and functional morphology that can not be solved on the basis of preserved material.

At the end of June 2011 we received eight pictures of a large caecilian that had been captured in a shrimp trap in Mosqueiro Island, just north of Belém, Pará, Brazil. The specimen was photographed and, unfortunately, released again. Based on the photos we reached the conclusion that this was a specimen of *A. eiselti* and we alerted fishermen in Mosqueiro Island to try and collect more specimens. Early August 2011 another specimen of *A. eiselti* was collected at Cachoeira Santo Antônio in the Madeira river near Porto Velho, Rondônia, Brazil, about 2,000 km W. of Mosqueiro Island. This specimen was collected (three others were released) and preserved and sent to us after we had identified it on the basis of pictures. When the specimen reached the Museu Paraense Emilio Goeldi in Belém, we could verify our original identification as being correct. In November and December 2011 we received three more specimens (two females, one male) from Mosqueiro Island, the December specimen still alive when it reached us. [In the meantime two more specimens have been collected at Santo Antônio and will be deposited in MPEG]. Our data show that this species is not an inhabitant of cool, oxygen rich and fast running water in elevated localities as supposed until now, but on the contrary occurs in warm (24-30 °C), turbid, fast running water (cataracts and areas with strong tidal currents) in the lowland Brazilian Amazon basin (altitude < 60 m), but with high oxygen content. The three freshly preserved specimens (one male, two females) were compared with the only two female specimens known, a more extensive description could be made and variation indicated. We describe the probable habitat and provide some data about the biology of this species, that seems to have a wide distribution in Brazilian Amazonia and possibly also occurs in other countries, like Bolivia. However, its distribution in the Amazon and its affluents is not clear at all. Whether the distribution is continuous or restricted to isolated areas with specific conditions still remains enigmatic. We do not know whether the species only occurs in the deep main channel of the Amazonas, Solimões and Madeira rivers, or whether it also enters other (e.g., northern) affluents of the Amazon. Much work is still needed to get a better idea about its distribution. Now that we know more or less where to look for this enigmatic species, we can try to find out more about its biology, physiology (especially respiration), genetics, behavior and ecology. DNA studies already are underway. The fact that several specimens have been released again in both the Madeira river and at Mosqueiro Island shows that there are apparently populations around and that worry expressed about the species being extinct are unfounded. It appears that this large species has long gone unnoticed (even near a large city like Belém with an active group of herpetologsts) because of possible confusion with a synbranchid fish and because of its specialized habitat. The species could be added with certainty to the already extensive list of Brazilian amphibians, on which it already figured, but not based on any firm evidence.

Atretochoana eiselti lateral view of head, Mosqueiro Island, Belém, Pará, Brazil. Photo: M. S. Hoogmoed.

This study was first published in Hoogmoed, M.S. Maciel, A.O. & Coragem, J. T., 2012 [2011]. Discovery of the largest lungless tetrapod, *Atretochoana eiselti* (Taylor, 1968) (Amphibia: Gymnophiona: Typhlonectidae), in its natural habitat in Brazilian Amazonia. Boletim do Museu Paraense Emílio Goeldi. Ciências Naturais 6(3): 241-262. Available on line at http://www.museu-goeldi.br/editora/naturais

Frogs of Shoolpaneswr Wildlife Sanctuary, Gujarat, India

By Raju Vyas

The Shoolpaneshwar Wildlife Sanctuary (SWS) is one of the most biologically and economically important protected areas in Gujarat state, India. Several papers have been published on the biodiversity of the area including general biodiversity papers such as Sabnis and Amin (1992), and papers more specific to amphibians such as Naik and Vinod (1992) and Naik et al. (1992). Sabnis and Amin's paper is particularly significant as it was written prior to the completion of the the Narmada Dam, when a number of large forest areas were intact within the States of Gujarat, Madhya Pradesh and Maharashtra. The flooding of the dam led to most of the biologically important forests being submerged, along with the inter-state forest corridors, creating a mosaic of forest patches that have not since been surveyed for remaining amphibian populations.

The current literature reveals that few herpetologists have attempted to study the amphibians and reptiles at the Shoolpaneshwar Wildlife Sanctuary (Naik & Vinod, 1992; Naik et al. 1992; Naik et al. 1995; Sabnis and Amin, 1992). The limited literature is supported to some extent by a few published miscellaneous notes indicating records of some amphibian species from the area such as Vinod (1994).

To help provide a more complete picture as to the amphibian communities of the region we undertook a literature review and field surveys which included visual encounter surveys, plot and transact surveys, and recording any indirect evidence of amphibian species.

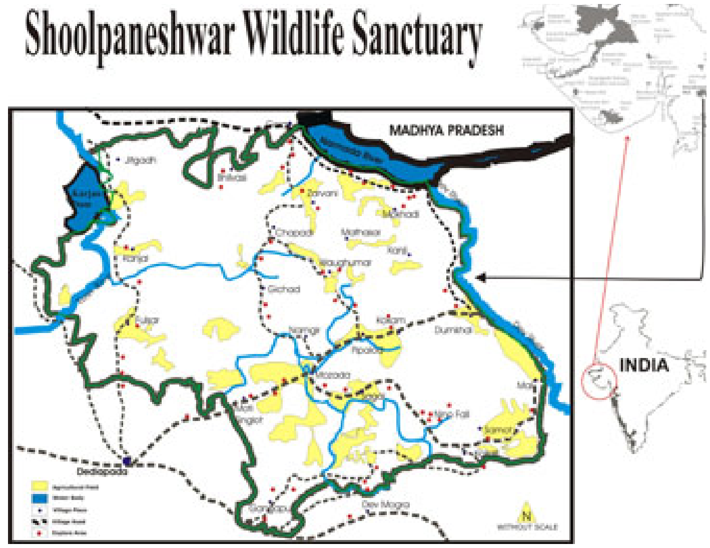

Figure 1. The detail map of Shoolpaneshwar Wildlife Sanctuary and red color spots showing the area explored during the study. Inset map showing location of the Sanctuary in the Gujarat State.

The study area lies on the southern side of the Narmada River on the western end of the Satpura mountain ranges (Figure 1). The sanctuary, located between 21° 39' – 21° 51' N and 73° 34' – 73° 54' E, shares a common boundary on its eastern side with two Indian States of Madhya Pradesh and Maharasthra and encompasses 607.71 km^2 of deciduous forest.

According to Champion & Sheth (1968) these forests are classified as biogeographic Zone 4, Semi-Arid and considered as 4B Gujarat-Rajwada Biotic Province. This ecosystem represents remnants of semi-evergreen to moist deciduous forest, which consists of moist teak forest, moist mixed deciduous forest, dry deciduous scrub, dry bamboo brakes and dry tropical riverine forest.

A total 50 field days were spent from November 2006 to December 2007, with four main objectives: (1) Collect and compare baseline information on past and current amphibian diversity (2) Create a new inventory of amphibian fauna and their associated habitats (3) Update basic information on relative abundance of amphibian species (4) Indentify threats facing amphibian fauna in SWS, if any.

A rapid habitat survey of the entire study site was undertaken and habitats categorized according to commonly used classification. The main habitats recorded were as follows:

Wetlands: Within the sanctuary area there is no stagnant water wetland, except a few river pools found on the river streams of Narmada and its other tributaries namely: Karjan, Terav, Dev and its small rivulets. There are two manmade water reservoirs Narmada Dam and Karjan Dam situated/found on the edges of the sanctuary.

Riverine forest: A good number of river forests are found on both the sides of the river Terav and rivulets of Narmada (left bank) and Dev Rivers (left bank only), in the sanctuary.

Moist Teak forest: Very few pockets of moist teak forests are found on Gichad, Waghumar and Chopadi area. These are surrounding the high hills of Dhaman Mal, Mat Baman and Dev Aanbalh Dungar.

Moist mixed deciduous forest: Very small pockets of the habitat are found within the sanctuary, including Gichad, Waghumar, Chopadi, Mal, Samot and Ninoy.

Figure 2. Common Asian toad *Duttaphrynus melanostictus.*

Figure 3. The unidentified Ramanella frog (*Ramanella* sp.) Shoolpaneshwar Wildlife Sanctuary, Gujarat State.

Figure 4. Unidentified frog *Fejervarya* sp.

Dry deciduous forest: There are large areas of dry deciduous forests found within the sanctuary.

Dry Bamboo brakes: Very small forest areas of Dry Bamboo brakes are in the sanctuary and found in the forest blocks of 233, 237 & 238.

Agricultural fields: There are large areas of agricultural fields found within the sanctuary. Most of the agricultural fields are situated surrounded by the villages but some of agricultural fields are found in the interior parts of the forest and in experimental silvicultural & research plots, too. Also, noticed that there are large areas of the forest illegally encroached by the inhabitants, especially in monsoon seasons. Local inhabitants clear the healthy forest by fire in the end of summer and prepare a large area for the agricultural practice.

Degraded disturbed scrub forest: Large sized degraded and disturbed scrub forest areas are situated on the margins of the sanctuary and are surrounded by agricultural fields within the sanctuary.

The habitat map was then used to select potentially suitable locations for amphibian and reptiles which were subsequently intensively explored (especially microhabitats) through repeated visits in various seasons.

All of the important species were documented through color photographs and when close examination was required, the animals were caught and then released in the same location. All collected specimens were examined and carefully identified using the diagnostic keys, Daniel (1963a, 1963b, and 1975) and Daniels (1997) and the nomenclatures adopted here are those of Datta (1997) and Frost et al. (2006) for amphibians.

The status of each species of amphibians was observed in four categories on the basis of total number of species encountered or sighted during the survey. The category values are: rare (1-5); less common (6-25); common (26-75) and abundance (above 76).

A total of 11 species of anuran amphibians belonging to four families are recorded from the sanctuary and details are as follows.

Figure 5. Author in search of amphibians at night.

1. Common asian toad *Duttaphrynus melanostictus* (Figure 2): A very common toads in the sanctuary, usually found in and around the human settlements.

2. Marbled toad *Duttaphrynus stomaticus*: This species is found in Fulsar forest compartments of the sanctuary. This frog species is less common and found on the floor of the forest at night. During day time it hides under crevices, dead wooden logs, stones, and leaf's litter but as soon as the sun sets, they come out from to foraging. An adult voucher was deposited at museum of BNHS (5366).

3. Ornate narrow-mouthed frog *Microhyla ornate*: This small microhyla is found on forest floors during the rainy season. During the survey this species was commonly found in many areas of the sanctuary. This species is found in and around all man made road side ditches, including Mal, Samot, Sagai and Dumkhal. An adult voucher deposited at museum of BNHS (5363).

4. Ramanella frog *Ramanella* sp. (Figure 3): This is an arboreal frog species. Few adult and sub-adult frogs are found on the trunks of Mango tree at Samot village. As per the color and morphology, the frogs belong to the genus *Ramanella*. For further detailed study, two vouchers were collected (BNHS 5364 & 5365) for further confirmation of the identification.

5. Indian skipping frog *Euphlyctis cynophlyctis*: This aquatic frog is one of the most common species in the entire sanctuary. It is found in all types of habitats, usually around small to large water bodies.

6. Green frog *Euphlyctis hexadactyla*: The distribution of the species is limited in the sanctuary. Few specimens of the species are found in small road side ditches at Waghumar and Kokam area, during the rainy season only.

7. Indian bull frog *Hoplobatrachus tigerinus*: This is one of the large sized anuran species and quite common in many parts of the sanctuary. A good number of Indian bull frogs are found on the road after first heavy rains and at night and most of them become a victim of running vehicles.

8. Cricket frog *Fejervarya limnocharis*: This medium sized semi-aquatic frog is one of the most abundant frog species in many areas of the sanctuary, usually found in moist & wet area under the rocks and leaf litter. Its relative abundance is low during rainy season but as soon as the rain is over, it congregates in large numbers in pockets of river streams and water reservoirs.

9. Unidentified frog *Fejervarya* sp. (Figure 5): Few specimens were found at Sagai and Waghumar. Which is very similar with previous species but it differs from having more number of dorsal body warts and less webbed hind limb toes. These specimens are identified up to genus levels only because there are many un-described species in *Fejervarya* complex. Few specimens collected for vouchers are deposited BNHS (5357 to 5360) for further detailed study and species confirmation.

10. Short-headed burrowing frog *Sphaerotheca breviceps*: This medium sized frog is one of the common species in the area after *Fejervarya* species, a voucher deposited in BNHS (5362). It is found in all parts of the sanctuary. After the monsoons, it is usually found on forest floors.

11. Indian brown tree frog *Polypedates maculates*: This is an arboreal frog species found in many parts of sanctuary. During the monsoon its presence is noticed by calls of male from beneath the tree canopy, otherwise it is difficult to locate. A good population was recorded at Mal, Samot, Waghumar and Kokam village area. It is found in bathrooms and toilet blocks of forest guest house of Dediyapada, also.

According to evolutionary adaptation of each species of amphibians, they inhabit in different habitats. During the study we observed three species of aquatic and two of each species of semi-aquatic, terrestrial, fossorial and arboreal amphibians. The status of amphibian fauna of the area is intermediate (in comparison to other PAs of Gujarat) and individual status of the each species is mentioned in Table 1.

In this study, a species of Rammanella frog (*Ramanella* sp.) amphibian is the first record from the sanctuary, Rammanella frog (*Ramanella* sp.) is believed to be one of the endemic genus from the Western Ghats and all members are distributed from Kanyakumari to Dangs, except a species: *R. variegate* reported from outside the Western Ghats, from Madhya Pradesh. Present report of the Rammanella frog is worth recording from the area. These records of amphibian and reptile species from the Shoolpaneshwar Sanctuary area show the biological importance of the area.

COMMOM NAME	SPECIES	HABITS	STATUS
ORDER: Anura			
FAMILY-I: Bufonidae			
Co. Asian toad	*Duttaphrynus melanostictus*	Terrestrial	Abundant
Marbled toad	*Duttaphrynus stomaticus*	Terrestrial	Uncommon
FAMILY -II: Microhylidae			
Ornate narrow-mouthed frog	*Microhyla ornate*	Fossorial	Common
Ramanella frog	***Ramanella sp.***	Arboreal	Rare
FAMILY-III: Dicroglossidae			
Indian skipping frog	*Euphlyctis cyanophlyctis*	Aquatic	Abundant
Indian green frog	*Euphlyctis hexadactylus*	Aquatic	Rare
Indian bull frog	*Hoplobatrachus tigerinus*	Aquatic	Common
Cricket frog	***Fejervarya limnocharis***	Semi Aquatic	Abundant
Unidentified frog	***Ferjervarya sp.***	Semi- Aquatic	Un Common
Short-headed burrowing frog	***Sphaerotheca breviceps***	Fossorial	Common
FAMILY-IV: Rhacophoridae			
Indian tree frog	*Polypedates maculatus*	Arboreal	Uncommon

Table 1: List of amphibians and its status recorded in and around Shoolpaneshwar Wildlife Sanctuary, Gujarat, India.

The result of this systematic study of amphibians diversity of Sholpaneshwar Wildlife Sanctuary indicates that there are over eleven species of amphibians, belonging to four families and ten genera inhabiting the area. This shows the diversity and richness of the sanctuary.

During the study a number of species previously recorded from the sanctuary were not found (Table 2), these were: 1) *Microhyla rubra*, 2) *Rana brevipalmata* (now *Fejervarya brevipalmata*), 3) *Rana temporalis* (now *Hylarana temporalis*) 4) *Rana phrynoderma* (now *Indirana phrynoderma*), 5) *Bufo microtympanum* (now *Duttaphrynus microtympanum*) and 6) *Bufo fergusonii* (now *Duttaphrynus scaber*). The presence of these frogs in the sanctuary is doubtful.

These six species are listed by Sabnis and Amin (1992) in “An environment impact assessment report of Shoolpaneshwar Wildlife Sanctuary,” but records of them are uncertain. Of these six species only *Microhyla rubra* was observed by Naik and Vinod (1992, 1993a & b) and Naik et al. (1995).

The records of two unidentified frog species from the study area not only illustrates the urgent need for further, more extensive, survey work but also emphasizes the importance of specimen collection for further detailed study on molecular systematics, including tissues and DNA fingerprints.

The results of this study show that there is clearly the availability of various complex habitat structures in the sanctuary to support further amphibian species and once again illustrate the need for further work in the area.

No.	Name of Species
	Family: Dicroglossidae
1	*Hoplobatrachus tigerina*
2	*Euphlyctis cyanophlyctis*
3	***Fejervarya limnocharis***
4	***Fejervarya keralensis***
5	*Euphlyctis hexadactyla*
6	***Fejervarya brevipalmata***
7	***Sphaerotheca breviceps***
	Family: Ranidae
8	*Hylarana temporalis*
9	*Indirana phrynoderma*
10	***Kurixalus verruculosa***
	Family: Rhacophoridae
11	*Polypedates maculates*
	Family : Microhylidae
12	*Microhyla ornate*
13	*Microhyla rubra*
14	*Kalaula pulchra*
15	*Uperodon globulosum*
	Family: Bufonidae
16	*Duttaphrynus melanostictus*
17	*Duttaphrynus stomaticus*
18	*Duttaphrynus microtympanum*
19	*Duttaphrynus scaber (fergusonii)*

Table 2: List of earlier records of amphibians from the Shoolpaneshwar Wildlife Sanctuary, Gujarat, India (Source: Sabnis & Amin 1992).

Acknowledgements

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Literatures Cited

Champion, H G. & Seth, S. K. (1968) A revised survey of the forest types of India, Manager of Publication, Government of India, New Delhi. 404 pp.

Daniel, J. C. (1963a) Field guide to amphibian of western India. Part-I. *J. Bombay Natural History Society* 60: 415-438.

Daniel, J. C. (1963b) Field guide to amphibian of western India. Part-II. *J. Bombay Natural History Society* 60: 690-702.

Daniel, J. C. (1975) Field guide to amphibian of western India. Part-III. *J. Bombay Natural History Society* 72: 506-522.

Daniels, R. J. (1997) A field guide to the frog and toads of the Western Ghats, India. Part I, II and III , *Cobra*. (27 to 29): 1-25, 1-24, and 1-13.

Datta, S. K. (1997) Amphibians of India and Sri Lanka (Checklist and bibliography). Odyssey Publication House, Bhubaneswar, Orissa, India. 342 pp.

Frost, D. R., T. Grant, J. Faivovich, R. H. Bain, A. Haas, C. F. B. Haddad, R. O. Desa, A. Channing, M. Wilkinson, S. C. Donnellan, C. J. Raxworthy, J. A. Campbell, B. L. Blotto, P. Moler, R. C. Drewes, R. A. Nussbaum, J. D. Lynch, D. M. Greeen & W. C. Wheeler. (2006) The amphibian tree of life. *Bulletin of the American Museum of Natural History* (297): 1-370.

Naik, Y. M. and Vinod, K.R. (1992) Amphibians of Shoolpaneshwar Sanctuary, *Cobra* (8): 7-10.

Naik, Y. M. and Vinod, K.R. (1993a) Record of the verrucose frog *Rana keralensis* (Dubois) in Shoolpaneshwar Wildlife Sanctuary (Bharuch Dist., Gujarat). *J. Bombay Nat. Hist. Soc.* 90: 521-522.

Naik, Y. M. and Vinod, K.R. (1993b) The distribution of amphibians in Gujarat State, India, *Hamadryad* 18: 28–34.

Naik, Y.M., K. R. Vinod and Patel, C. (1992) Record of the frog *Kaloula pulchra* Gray, 1831 at Mal-Samot, Bharuch Dist., Gujarat State. *J. Bombay Nat. Hist. Soc. 90*: 299.

Naik, Y. M., K. R. Vinod and Pilo, B. (1995) The importance of preservation of biodiversity of amphibians in Shoolpaneshwar Sanctuary, *In*: Proc. Nat. Symp. Recent Trends Indian Wild. Res. Pp. 38–40. A. V. C. College, Mayiladuthurai.

Sabnis, S. D. & Amin, J. V. (1992) Eco-environmental studies of Sardar Sarovar Environs M. S. University, Baroda. 388 pp.

Recent Publications

Conservation and Ecology

Biology and conservation of a Critically Endangered stream-breeding frog in a Costa Rican tropical dry forest

By Héctor Zumbado-Ulate, Federico Bolaños, Beatriz Willink & Fernando Soley-Guardia

The stream-breeding frog *Craugastor ranoides* is a Critically Endangered species that was very common throughout Costa Rica, however most populations declined and now occurs only in the tropical dry forest of Costa Rica, specifically in the arid Peninsula de Santa Elena. In this region, we conducted a study of density, habitat use, and morphometry of *C. ranoides* in three streams during two consecutive dry seasons. We found that the density of adult frogs and the probabilities of detection were similar during both dry seasons but we found differences in both parameters between streams. Counts of juveniles and subadults differed between seasons and between streams. Stream occupancy was approximately 80% during both dry seasons. Most frogs were observed motionless on boulders, but juveniles also frequented leaf litter. Sexual dimorphism was found in SVL, mass, and tympanum diameter. This study establishes a baseline for further monitoring of wild populations. Additional research and monitoring are necessary to detect possible changes in abundance and potential decline of these populations, which might be the only ones remaining in Costa Rica.

Adult male *Craugastor ranoides* on a fallen leaf. Photo: Héctor Zumbado Ulate. Escuela de Biología, Universidad de Costa Rica.

Full article: Zumbado-Ulate, H., Bolaños, F., Willink, B. & Soley-Guardia, F. (2011) Population status and natural history notes on the Critically Endangered stream-dwelling frog *Craugastor ranoides* (Craugastoridae) in a Costa Rican tropical dry forest. *Herpetological Conservation and Biology* 6(3): 455–464.

Evaluation of the effectiveness of three survey methods for sampling terrestrial herpetofauna in south China

By Yik-Hei Sung, Nancy E. Karraker & Billy C.H. Hau

Southeast Asia exhibits high herpetofaunal biodiversity, yet many areas and taxa in the region remain understudied. Extensive surveys are needed to fill information gaps, yet at present we have little knowledge about the effectiveness of different herpetofaunal survey methods in the region. We conducted field studies to examine the effectiveness of three survey methods for sampling terrestrial amphibians and reptiles in Hong Kong. Transect surveys were the most effective at sampling species richness and drift fences with pitfall traps and funnel traps were the most efficient in capturing high numbers of reptiles. We recommend the use of transect surveys for rapid biodiversity assessment and the combination of transect surveys and pitfall traps for comprehensive species inventories. Pitfall traps represent an excellent tool for surveys or population monitoring of leaf litter species. The results of this study will aid researchers in assessing the feasibility of and in choosing herpetofaunal survey methods in Southeast Asia.

Full article: *Herpetological Conservation and Biology* 6(3): 479–489.

The energetic cost of exposure to UV radiation for tadpoles is greater when they live with predators

By Lesley A. Alton, Craig R. White, Robbie S. Wilson & Craig E. Franklin

Global increases in ultraviolet-B radiation (UVBR) associated with stratospheric ozone depletion are thought to be contributing to the rapid disappearance of amphibian populations from pristine habitats around the world. While several studies have examined the lethal and sublethal effects of UVBR, alone and in combination with other environmental stressors, on amphibians, few have considered how UVBR affects amphibian metabolism, or how amphibian metabolism may change in response to exposure to other stressors in addition to UVBR. Using a controlled laboratory experiment, the independent and interactive effects of UVBR and predatory chemical cues (PCC; cues that signal risk of predation) on the tissue and whole-animal metabolic rate (MR), and activity of *Limnodynastes peronii* tadpoles were examined. Exposure to UVBR caused tissue MR to increase by 36%, but whole-animal MR to decrease by 14%, which is most likely due to tadpoles reducing their activity levels by 56%. Exposure to PCC had no significant effect on tissue or whole-animal MR, but caused tadpoles to reduce their activity levels by 36%, indicating that the whole-animal MR of tadpoles exposed to PCC is elevated relative to their activity levels. Compared to tadpoles exposed to neither stressor, tadpoles exposed simultaneously to UVBR and PCC showed no change in whole-animal MR despite reducing their activity levels by 62%. These findings show that, for tadpoles, there is an energetic cost associated with being exposed to UVBR and PCC independently, and that this cost is greater when they are exposed to both stressors simultaneously. Our previous research (Alton et al. 2010. Global Change Biology 16: 538–545) has shown that exposure of tadpoles to PCC enhances the lethal effects of UVBR, and the present study suggests that this synergistic interaction may arise as a consequence of the effect of these combined stressors on MR. Global increases in UVBR may therefore be contributing to amphibian population declines by compromising energy allocation towards growth and development as well as energy allocation towards coping with additional environmental stressors.

Full article: Alton, L. A., White, C. R., Wilson, R. S., and Franklin, C. E. (2012) The energetic cost of exposure to UV radiation for tadpoles is greater when they live with predators. *Functional Ecology* 26: 94-103.

Patterns of synchrony in Natterjack toad breeding activity and reproductive success at local and regional scales

By Aurélie Aubry, Emeline Bécart, John Davenport, Deirdre Lynn, Ferdia Marnell & Mark C. Emmerson.

Empirical studies of the spatiotemporal dynamics of populations are required to better understand natural fluctuations in abundance and reproductive success, and to better target conservation and monitoring programmes. In particular, spatial synchrony in amphibian populations remains little studied. We used data from a comprehensive three year study of Natterjack toad (*Bufo calamita*) populations breeding at 36 ponds to assess whether there was spatial synchrony in the toad breeding activity (start and length of breeding season, total number of egg strings) and reproductive success (premetamorphic survival and production of metamorphs). We defined a novel approach to assess the importance of short-term synchrony at both local and regional scales. The approach employs similarity indices and quantifies the interaction between the temporal and spatial components of populations using mixed effects models. There was no synchrony in the toad breeding activity and reproductive success at the local scale, suggesting that populations function as individual clusters independent of each other. Regional synchrony was apparent in the commencement and duration of the breeding season and in the number of egg strings laid (indicative of female population size). Regional synchrony in both rainfall and temperature are likely to explain the patterns observed (e.g., Moran effect). There was no evidence supporting regional synchrony in reproductive success, most likely due to spatial variability in the environmental conditions at the breeding

Adult Natterjack toads in amplexus in Ireland. Photo: Aurélie Aubry.

ponds, and to differences in local population fitness (e.g., fecundity). The small scale asynchronous dynamics and regional synchronous dynamics in the number of breeding females indicate that it is best to monitor several populations within a subset of regions. Importantly, variations in the toad breeding activity and reproductive success are not synchronous, and it is thus important to consider them both when assessing the conservation status of pond-breeding amphibians.

Full article: Aubry, A. et al. (2012) Patterns of synchrony in Natterjack toad breeding activity and reproductive success at local and regional scales. *Ecography* 35: 1-11 (a.e.aubry@gmail.com)

Integrating variability in detection probabilities when designing wildlife surveys: A case study of amphibians from south-eastern Australia

By Stefano Canessa, Geoffrey W. Heard, Kirsten M. Parris & Michael A. McCarthy

Frog species will not always be detected by field surveys, even when present at a site: such "false absence" records can bias data and inferences. The probability of detecting a species if present can be estimated based on survey methods and conditions (weather, date and time, observer). When models provide adequate predictions of survey performance, protocols can be adjusted accordingly. In this study, we repeatedly surveyed 128 sites around the city of Melbourne, Australia between 2006 and 2009. We found the detection probability for the common froglet *Crinia signifera* could be predicted reliably simply based on date, time of day and survey duration; for the Pobblebonk *Limnodynastes dumerilii*, adding weather information improved predictions by 10%. We then used the output from the models to design survey protocols. For *C. signifera*, 5-minute surveys were as effective as 1-hour surveys in spring, but became markedly less effective in summer. For *L. dumerilii*, less surveys would be needed to achieve a detection probability of 95% if they were restricted to nights only 15% less humid than average, also allowing a longer seasonal window for monitoring. These methods should be adopted when planning monitoring programs to improve cost-efficiency and data quality, reducing the risk of misdirected conservation actions resulting from false absences.

Full article: Canessa, S., Heard, G. W., Parris, K. M. and McCarthy, M. A. (2012) Integrating variability in detection probabilities when designing wildlife surveys: a case study of amphibians from south-eastern Australia. *Biodiversity and Conservation* 21(3): 729-744. DOI 10.1007/s10531-011-0211-0

Rural road networks as barriers to gene flow for amphibians: Species-dependent mitigation by traffic calming.

By Claudia Garcia-Gonzalez, Daniel Campo, Iván G. Pola & Eva Garcia-Vazquez

Road networks represent the first cause of habitat fragmentation for many species, particularly for those with low dispersal capacity as most of amphibian species. Population structuring based on mitochondrial DNA variation along the rural landscape of the Trubia valley in North Iberia revealed significant association between road density and genetic distance between populations of two amphibian species, the midwife toad *Alytes obstetricans* and the palmate newt *Lissotriton helveticus*. Traffic calming (concentration of flows on minor rural roads at a few highways to decrease volumes and speeds) near urban settlements seems to benefit differentially the two species considered. We found a positive correlation between weighted traffic calming road density and the intensity of barriers for *L. helveticus* but not that of *A. obstetricans*. Narrow secondary roads act as a barrier to gene flow, even with traffic calming solutions, for species highly sensitive to habitat fragmentation as *A. obstetricans*. Therefore, traffic calming could be taken into account as a possible measure to alleviate fragmentation of *L. helveticus* but not that of *A. obstetricans*, indicating that even small roads with low-intensity traffic act as barriers for the latter species. We suggest combining traffic calming solutions with the construction of passages for amphibians across rural roads to mitigate population fragmentation of the highest possible range of species.

Full article: Garcia-Gonzalez C, Campo D, Pola IG, Garcia-Vazquez E. (2012) Rural Road Networks as Barriers to Gene Flow for Amphibians: Species-Dependent Mitigation by Traffic Calming. *Landscape and Urban Planning* 104: 171-180.

Survey techniques for giant salamanders and other aquatic Caudata

By Robert K. Browne, Hong Li, Dale McGinnity, Sumio Okada, Wang Zhenghuan, Catherine M. Bodinof, Kelly J. Irwin, Amy McMillan & Jeffrey T. Briggler

The order Caudata (salamanders and newts) comprise ~13% of the ~6,800 described amphibian species. Amphibians are the most threatened (~30% of species) of all vertebrates, and the Caudata are the most threatened (~45% of species) amphibian order. The fully aquatic Caudata family, the Cryptobranchidae (suborder Cryptobranchoidea), includes the world's largest amphibians, the threatened giant salamanders. Cryptobranchids present particular survey challenges because of their large demographic variation in body size (from three cm larvae to 1.5 m adults) and the wide variation in their habitats and microhabitats. Consequently, a number of survey techniques (in combination)

Turning heavy rocks, combined with snorkeling with face masks and nets is an effective means to survey juvenile and adult *C. alleganiensis*. Photo: Robert Browne.

may be required to reveal their population and demography, habitat requirements, reproduction, environmental threats, and genetic subpopulations. Survey techniques are constrained by logistical considerations including habitat accessibility, seasonal influences, available funds, personnel, and equipment. Particularly with threatened species, survey techniques must minimize environmental disturbance and possible negative effects on the health of targeted populations and individuals. We review and compare the types and application of survey techniques for Cryptobranchids and other aquatic Caudata from a conservation and animal welfare perspective.

Full article: Browne RK, Hong L, McGinnity D, Okada S, Zhenghuan W, Bodinof CM, Irwin KJ, McMillan A, Briggler JT. (2011) Survey techniques for giant salamanders and other aquatic Caudata. *Amphibian and Reptile Conservation* 5(4): 1-16(e34).

Zoo based amphibian research and Conservation Breeding Programs

By Robert K. Browne, Katja Wolfram, Gerardo García, Mikhail F. Bagaturov & Zjef J. J. M. Pereboom

The rapid loss of amphibian species has encouraged zoos to support amphibian research in concert with conservation breeding programs (CBPs). We explore "Zoo-based amphibian research and conservation breeding programs" through conducting a literature review and a survey of research publication with public and subscription search engines. Amphibians are ideal candidates for zoo-based amphibian research and CBPs because of their generally small size, high fecundity, ease of husbandry, and amenability to the use of reproduction technologies. Zoo-based amphibian research and CBPs can include both in situ and ex situ components that offer excellent opportunities for display and education, in range capacity building and community development, and the support of biodiversity conservation in general. Zoo-based amphibian research and CBPs

Neurergus kaiseri. In a pioneering program, Sedgwick County Zoo, Kansas, USA, is breeding for sale the Critically Endangered Loristan newt (*Neurergus kaiseri*) to support conservation and to increase stocks with private breeders. Photo: Nate Nelson.

can also benefit zoos through developing networks and collaborations with other research institutions, and with government, business, and private sectors. Internet searches showed that zoo based research of nutrition, husbandry, reproduction, gene banking, and visitor impact offer special opportunities to contribute to amphibian conservation. Many zoos have already implemented amphibian research and CBPs that address key issues in both ex situ and in situ conservation; however, to reach its greatest potential these programs must be managed by scientific professionals within a supportive administrative framework. We exemplify zoo-based amphibian research and CBPs through the experiences of zoos of the European Association of Zoos and Aquariums (EAZA), the Russian Federation, and the United States.

Full article: Zoo based amphibian research and Conservation Breeding Programs (CBPs). Robert K Browne, Katja Wolfram, Gerardo Garcia, Mikhail F Bagaturov, Zjef JJM Pereboom. *Amphibian and Reptile Conservation* 5(3): 1-14(e28).

A runaway train in the the making: The exotic amphibian, reptile, turtles, and crocodilians of Florida

By Walter E. Meshaka, Jr.

Fifty exotic species of amphibians, reptiles, turtles, and crocodilians are established in Florida. Temporal and spatial colonization patterns revealed in this study indicated rapid changes in some aspects and corroborated relative stability in others. The number of species that have successfully colonized Florida beginning in the 1800s has continued to increase since the last two comprehensive examinations of this topic in 1983 and 2004, and, like the earlier findings, the trend showed no sign

A dominant male Green iguana in Broward County, Florida. Photo: Gary Busch.

of an asymptote. Likewise, the taxonomic distribution in this study mirrored that of earlier treatments, whereby lizards, especially anole and gecko species, predominated the colonizing landscape. Disturbed habitat has not changed in being important for most of the established species. Regional hotspots having been southern Florida and primary sources of introduction having been the pet trade remained unchanged. Exceptions to some of the trends, such as the establishment of large-bodied vertebrate predators like the Nile monitor, the Boa constrictor, Northern African python, and Burmese python, and the ability of the latter species to thrive in many of the natural habitats of the southern Everglades underscored the importance of taking responsibility for, and correcting as much as possible, a human-mediated ecological tragedy — a runaway train symptomatic of Florida's exotic species problem generally. The proposed framework to control Florida's exotic herpetofaunal problem was based on known and unknown colonization patterns in Florida. A ban on importation of species known to pose a threat to health and human safety and those taxonomic groups demonstrably capable of colonizing Florida was proffered to minimize the pool of potential introduced taxa. Alternatively, a registry could be instituted for the former category. Also suggested were restriction on the harvesting of native species for the pet trade and greater funding to protect natural areas as functionally intact communities. A statewide grade school curriculum on Florida ecology and a partnering with of schools with interpretation and research at public trust lands was suggested as an important step to instill and strengthen a collective ethic among students with respect to environmental stewardship and would also provide students interested in biology with the much needed tools necessary to make advances in this field. Lastly, an increase in the sorts of life history studies necessary to understand colonization dynamics regarding likelihood of success, impacts, and the extent to which and how best to approach eradication.

Meshaka, W. E. (2011) A runaway train in the making: The exotic amphibians, reptiles, turtles and crocodilians of Florida. Monograph 1. *Herpetol. Conservation & Biology*: 6: 1-101.

On the presence of *Scinax pedromedinae* (Henle, 1991) (Amphibia: Anura: Hylidae) in Amazonian Brazil and northern Peru

By Marinus S. Hoogmoed & Teresa C.S. Avila-Pires

The South and Central American hylid genus *Scinax* contains many species which are often confused and apparently many species are still undescribed. In short it needs further attention from taxonomists in order to get a better understanding of its content and the distribution of the species within it. Especially in the Amazon basin many new species await description and several names (especially *S. ruber* and *S. x-signatus*) have been misused for unrelated species. Distributions of many species remain unclear. During fieldwork in the three country frontier area (Brazil, Peru and Colombia) near Benjamin Constant (1989) and in the Sustainable Development Reserve Mamirauá in central Amazonia (1994) a number of small hylid frogs that were reminiscent of *S. nebulosus*, were collected. They differed from *S. nebulosus* in having the front and the back of the thighs uniformly colored, without any pattern, having less tubercles on the lower jaw and having a large light area on the posterior part of the flanks or in the inguinal area. Comparison of the specimens collected in northern Peru and in Mamirauá with the holotype and one of the paratypes of *S. pedromedinae*, described from southern Peru, showed that the new material was identical with the types. Thus, the area of distribution of *S. pedromedinae* in Peru was extended northward to W of Porto Alegria, Loreto (near Benjamin Constant, Brazil), about 900 km N of Puerto Maldonado, and 660 km NE of Pucallpa. The occurrence of *S. pedromedinae* in Mamiraua (1,100 km NNE of Puerto Maldonado, 1,200 km NE of Pucallpa and 600 km E of Porto Alegria) represents a new distribution record for Brazil from where the species had not yet been reported. These new localities suggest that *S. pedromedinae* has a continuous distribution in the western Amazon basin, in eastern Peru, western Brazil and northern Bolivia. The species no longer can be considered endemic to Peru. The fact that *S. pedromedinae* has been collected near the type locality of *S. nebulosus* (Tefe) might give rise to the idea that *S. nebulosus* might be identical with *S. pedromedinae*. However, Spix who described *S. nebulosus* mentioned and illustrated quite clearly the blue and black checkered aspect of the thighs in *S. nebulosus*. Thus, there is a chance that *S. nebulosus* still might be found in Tefe (from where it has not been reported recently), or the type locality given by Spix was wrong (most likely).

Full article: Hoogmoed, M.S. & Avila-Pires, T.C.S., 2012 [2011]. On the presence of *Scinax pedromedinae* (Henle, 1991) (Amphibia: Anura: Hylidae) in Amazonian Brazil and northern Peru. *Boletim do Museu Paraense Emílio Goeldi*. Ciências Naturais 6(3): 263-271. Available on line at http://www.museu-goeldi.br/editora/naturais, click on the image of the cover and a page from which the article can be downloaded appears.

A comparison of short-term marking methods for small frogs using a model species, the Striped marsh frog (*Limnodynastes peronii*)

By Leigh J. Martin & Brad R. Murray

We compared three methods of marking individual small frogs for identification in short-term (several days) research using a model species, *Limnodynastes peronii* (the striped marsh frog). We performed a manipulative experiment under laboratory conditions to compare retention times of gentian violet, mercurochrome and powdered fluorescent pigment. Gentian violet produced the most durable marks with retention times between two and four days. Mercurochrome was retained for at least one day by all treated frogs. Fluorescent pigment was either not retained at all or for one day at most which suggests that this marking method may not be reliable for short-term studies where identification is required. No adverse reactions to any of the marking methods were detected in our study. Our findings indicate that gentian violet represents a promising alternative as a minimally-invasive marking technique for studies of small frogs requiring only short-term retention of identification marks.

Full article: Martin & Murray (2011) A comparison of short-term marking methods for small frogs using a model species, the striped marsh frog (*Limnodynastes peronii*). *Herpetological Journal* 21: 271-273.

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If you would like to include an abstract from a recent publication in this section of FrogLog please email froglog@amphibians.org. We also encourage all authors of recent publications to inform Professor Tim Halliday (formerly DAPTF International Director) (tim.r.halliday@gmail.com) of their publication in order for it to be referenced on the AmpibiaWeb latest papers page. The full list of latest papers from AmphibiaWeb is also included in every edition of FrogLog following the recent publications abstract section.

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Robin Moore / iLCP

Pesticide distributions and population declines of California, USA Alpine frogs, *Rana muscosa* and *Rana sierrae*

By David F. Bradford, Roland A. Knapp, Donald W. Sparling, Maliha S. Nash, Kerri A. Stanley, Nita G. Tallent-Halsell, Laura L. McConnell & Staci M. Simonich

Atmospherically deposited pesticides from the intensively cultivated Central Valley of California, USA, have been implicated as a cause for population declines of several amphibian species, with the strongest evidence for the frogs *Rana muscosa* and *Rana sierrae* at high elevation in the Sierra Nevada mountains. Previous studies on these species have relied on correlations between frog population status and either a metric for amount of upwind pesticide use or limited measurements of pesticide concentrations in the field. The present study tested the hypothesis that pesticide concentrations are negatively correlated with frog population status (i.e., fraction of suitable water bodies occupied within 2 km of a site) by measuring pesticide concentrations in multiple media twice at 28 sites at high elevation in the southern Sierra Nevada. Media represented were air, sediment, and *Pseudacris sierra* tadpoles. Total cholinesterase (ChE), which has been used as an indicator for organophosphorus and carbamate pesticide exposure, was also measured in *P. sierra* tadpoles. Results do not support the pesticide-site occupancy hypothesis. Of 46 pesticide compounds analyzed, nine were detected with ≥ 30% frequency, representing both historically- and currently-used pesticides. In stepwise regressions with a chemical metric and linear distance from the Central Valley as predictor variables, no negative association was found between frog population status and the concentration of any pesticide or tadpole ChE activity level. By contrast, frog population status showed a strong positive relationship with linear distance from the Valley, a pattern that is consistent with a general west-to-east spread across central California of the amphibian disease, chytridiomycosis, observed by other researchers.

Full article: Bradford, D.F. et al. (2011) Pesticide distributions and population declines of California, USA, Alpine frogs, *Rana muscosa* and *Rana sierrae*. *Environmental Toxicology and Chemistry*, 30: 682-691. DOI: 10.1002/etc.425

Mercury in tadpoles collected from remote alpine sites in the southern Sierra Nevada mountains, California, USA

By David F. Bradford, Joanna L. Kramer, Shawn L. Gerstenberger, Nita G. Tallent-Halsell & Maliha S. Nash

Amphibians in alpine wetlands of the Sierra Nevada mountains comprise key components of an aquatic-terrestrial food chain, and mercury contamination is a concern because concentrations in fish from this region exceed thresholds of risk to piscivorous wildlife. Total mercury concentrations were measured in whole tadpoles of the Sierra chorus frog, *Pseudacris sierra*, two times at 27 sites from high elevations (2,786-3,375 m) in the southern Sierra Nevada. Median mercury concentrations were 14 ng/g wet weight (154 ng/g dry weight), which were generally low in comparison to tadpoles of 15 other species/location combinations from studies that represented both highly contaminated and minimally contaminated sites. Mercury concentrations in *P. sierra* were below concentrations known to be harmful in premetamorphic tadpoles of another species and below threshold concentrations for risk to predaceous wildlife. Concentrations in tadpoles were also lower than those observed in predaceous fish in the study region presumably because tadpoles in the present study were much younger (1-2 months) than fish in the other study (3-10 years), and tadpoles represent a lower trophic level than these fish. Mercury concentrations at these high-elevation sites were not related to distance from the adjacent San Joaquin Valley, a source of agricultural and industrial pollutants. It remains unknown whether mercury concentrations in adults of long-lived frog species in the Sierra Nevada (e.g., *Rana muscosa* and *R. sierrae*) pose a risk to predaceous wildlife.

Full article: Bradford, D.F. et al. (2012) Mercury in tadpoles collected from remote alpine sites in the southern Sierra Nevada Mountains, California, USA. Archives of *Environmental Contamination and Toxicology* 62: 135-140. DOI 10.1007/s00244-011-9674-y

Blood collection from the facial (maxillary)/musculo-cutaneous vein in True frogs (Family Ranidae)

By María J. Forzán, Raphaël V. Vanderstichel, Christopher T. Ogbuah, John R. Barta & Todd G. Smith

Collection of blood from amphibians, as in other classes of vertebrate animals, is essential to evaluate parameters of health, diagnose hemoparasitism, identify viral and bacterial pathogens, and measure antibodies. Various methods of blood collection have been described for amphibians. Most can be cumbersome (venipucture of femoral vein, ventral abdominal vein or lingual venus plexus) or result in pain or deleterious health consequences (cardiac puncture and toe-clipping). We describe an easy and practical technique to collect blood from frogs and toads that can be used in multiple species and is minimally invasive. The technique consists of puncturing either the facial or, less commonly, the musculo-cutaneous vein and collecting the blood with a capillary tube. These veins run dorsal and parallel to the maxillary bone and can be accessed by quick insertion and withdrawal of a needle through the skin between the upper jaw line and the rostral or caudal side of the tympanum. The needle should be of 27 or 30 gauge for anurans weighing more or less than 25 g, respectively. Although the technique has been used by some amphibian researchers for years, it is little known by others and has never been fully described in a peer-reviewed publication.

Green frog, *Rana (Lithobates) clamitans*, adult male, caught and sampled as part of amphibian health surveillance in Prince Edward Island, Canada. Photo: Darlene Weeks.

Full article: Forzán, M.J. et al. (2012) Blood collection from the facial (maxillary)/musculo-cutaneous vein in True frogs (Family Ranidae). *Journal of Wildlife Diseases* 48(1): 176-180 (mforzan@ccwhc.ca)

Context-dependent symbioses and their potential roles in wildlife diseases

By Joshua H. Daskin & Ross A. Alford

Amphibians, like nearly all living things, form symbioses, direct relationships between different species. Given symbioses can vary, e.g., from disease-causing to protective, depending on environmental (e.g., temperature) or ecological (e.g., habitat) context. We review how variable symbioses are important to ecology, medicine, and evolution, and how understanding them better could help manage diseases threatening endangered wildlife. For example, managing the amphibian skin disease chytridiomycosis may include augmenting protective bacterial communities on frogs' skin. This requires understanding how interactions among amphibians, the beneficial bacteria, and the fungal pathogen depend on the environment. Increased focus on context-dependent symbioses should improve investigation and management of chytridiomycosis and wildlife disease outbreaks, in general.

Full article: Joshua H. Daskin, JH, Alford RA (2012) Context-dependent symbioses and their potential roles in wildlife diseases. Proceedings of the Royal Society B: *Biological Sciences* 279(1733): 1457-1465.

Phylogeny meets ecotoxicology: Evolutionary patterns of sensitivity to a common insecticide

By John I. Hammond, Devin K. Jones, Patrick R. Stephens & Rick A. Relyea

Pesticides commonly occur in aquatic systems and can have many negative effects on amphibians. Traditionally, ecotoxicology has focused on single species, short-term experiments and has selected the most sensitive species for risk assessment. Rarely has an evolutionary perspective been used with sensitivity data even though insights into these patterns would be critical for conservation. We combine previous results and add new species to examine the sensitivity to a common insecticide endosulfan across 15 species of North American anurans. Sensitivities vary greatly between species with traditional 4 day tests producing estimates from 1.3 parts per billion for the most sensitive species to 112 parts per billion for the least sensitive species. Some species also show delayed increases in mortality that occurred when exposed for longer than the traditional test period. We found sensitivities and time lags in mortality are phylogenetically related with more closely related species having similar estimates. In general, toads were less sensitive than tree frogs, which were less sensitive than true frogs. Time lags in mortality appear common in the true frogs, occasional in the tree frogs, and rare in the toads. These results highlight the needed connections between evolutionary perspectives and conservation.

Spring peepers show a substantial increase in mortality post traditional ecotoxicology testing methods. Photo: John Hammond.

Full article: Hammond, J. I. et al. (2012) Phylogeny meets ecotoxicology: Evolutionary patterns of sensitivity to a common insecticide. *Evolutionary Applications*: Early View, Article first published online: 23 JAN 2012 DOI:10.1111/j.1752-4571.2011.00237.x

The impact of pesticides on the pathogen *Batrachochytrium dendrobatidis* independent of potential hosts

By Shane M. Hanlon & Matthew J. Parris

Amphibians around the world are experiencing the greatest organismal decline in recent history. Xenobiotics, such as pesticides, and pathogenic biotic perturbations, including the fungus *Batrachochytrium dendrobatidis* (*Bd*), have played major roles in amphibian reductions. We conducted laboratory culture studies to determine the effects of the three pesticides carbaryl, glyphosate, and thiophanate-methyl (TM) on *Bd* zoospore production and zoosporangia growth. We applied *Bd* to pesticides mixed in an agar culture to simulate pathogen introduction to a system with pre-existing pesticides (*Bd* addition). Alternatively, pesticides were applied to pre-established *Bd* to simulate pesticide introduction following *Bd* establishment (pesticide addition). We then measured *Bd* zoosporangia and zoospore production. All pesticides significantly inhibited zoospore production; however, glyphosate and TM were more effective than carbaryl. In addition, only carbaryl and glyphosate inhibited zoosporangia production. Our data suggest that carbaryl and glyphosate are equally effective at inhibiting both zoosporangia and zoospore production; however, TM is selectively toxic to zoospores but not zoosporangia. One possible explanation for this observation could be that the zoosporangia act as a protective structure that TM cannot penetrate. In the case of pesticides applied to established *Bd* cultures, all pesticides caused significant mortality in both zoosporangia and zoospores, and no differences were found among pesticides. We conclude that examining pesticide and pathogen interactions independent of hosts provides mechanistic understanding of such interactions before and after host infection or contamination.

Full article: Hanlon SM and Parris MJ. (2012) The impact of pesticides on the pathogen *Batrachochytrium dendrobatidis* independent of potential hosts. *Archives of Environmental Contamination and Toxicology*. DOI 10.1007/s00244-011-9744-1

Evaluation of a filtration-based method for detecting *Batrachochytrium dendrobatidis* in natural bodies of water

By Oliver J. Hyman & James P. Collins

Infectious diseases are emerging as a significant threat to wildlife. The resulting increased effort to monitor wildlife diseases is driving the development of innovative pathogen monitoring techniques, including many polymerase chain reaction (PCR)-based diagnostics. Despite the utility of these PCR-based techniques, there is still much to be learned about their ability to accurately detect target pathogens in nature. We assessed the diagnostic sensitivity of a PCR-based water filtration technique to detect the directly transmitted aquatic fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*) by comparing the results of 4 repeated filter sampling events from 20 ponds to those of skin swabs from ca. 60 Boreal chorus frogs *Pseudacris maculata* from each pond. Filters failed to

Breeding Boreal chorus frogs *Pseudacris maculata* on Arizona's Mogollon Rim. Photo: Oliver Hyman.

detect *Bd* in 31 to 77% of the swab-positive ponds, depending on the time of sampling. However, after 3 repeated sampling events, filtration of small volumes of water (ca. 600 ml) correctly identified 94% of the ponds that tested *Bd* positive with swabbing, with the highest rates of detection occurring after breeding but before larvae reached metamorphosis. Our results are a case study demonstrating the importance of timing and resampling for the detection of an aquatic microbial pathogen, *Bd*, from water. This will be a useful technique for monitoring *Bd*, but additional data are needed to test the degree to which our findings are species or population specific. Future studies need to examine the sensitivity of this technique in other habitats and species that host *Bd*. These studies will aid in the development of cost-effective monitoring regimes for *Bd* and potentially other aquatic pathogens.

Full article: Hyman, OJ and Collins, JP. (2012) Evaluation of a filtration-based method for detecting *Batrachochytrium dendrobatidis* in natural bodies of water. *Dis aquat org* 97: 185-195.

Nothing a hot bath won't cure: Infection rates of amphibian chytrid fungus correlate negatively with water temperature under natural field settings

By Matthew J. Forrest & M A. Schlaepfer

Dramatic declines and extinctions of amphibian populations throughout the world have been associated with chytridiomycosis, an infectious disease caused by the pathogenic chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*). Previous studies indicated that *Bd* prevalence correlates with cooler temperatures in the field, and laboratory experiments have demonstrated that *Bd* ceases growth at temperatures above 28 °C. Here we investigate how small-scale variations in water temperature correlate with *Bd* prevalence in the wild. We sampled 221 amphibians, including 201 Lowland leopard frogs (*Rana* [*Lithobates*] *yavapaiensis*), from 12 sites in Arizona, USA, and tested them for *Bd*. Amphibians were encountered in microhabitats that exhibited a wide range of water temperatures (10–50 °C), including several geothermal water sources. There was a strong inverse correlation between the water temperature in which lowland leopard frogs were captured and *Bd* prevalence, even after taking into account the influence of year, season, and host size. In locations where *Bd* was known to be present, the prevalence of *Bd* infections dropped from 75–100% in water <15 °C, to less than 10% in water >30 °C. A strong inverse correlation between *Bd* infection status and water temperature was also observed within sites. Our findings suggest that microhabitats where water temperatures exceed 30 °C provide Lowland leopard frogs with significant protection from *Bd*, which could have important implications for disease dynamics, as well as management applications.

There must be quite a few things a hot bath won't cure, but I don't know many of them - Sylvia Plath, "The Bell Jar" (1963).

Full article: Forrest MJ, Schlaepfer MA (2011) Nothing a hot bath won't cure: Infection rates of amphibian chytrid fungus correlate negatively with water temperature under natural field settings. *PLoS ONE* 6(12): e28444. doi:10.1371/journal.pone.0028444

http://www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0028444

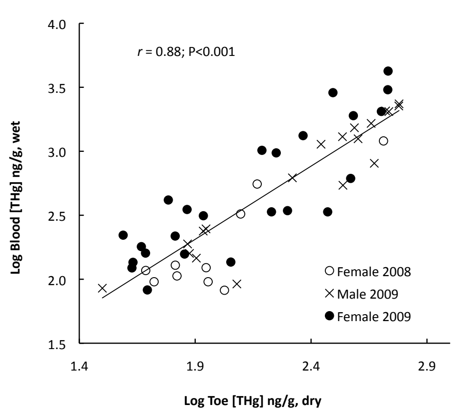
http://www.conservationmagazine.org/2012/01/a-nice-hot-bath/

http://explorations.ucsd.edu/research-highlights/2011/research-highlight-curing-disease-with-a-nice-hot-bath/

Use of toe clips as a nonlethal index of mercury accumulation and maternal transfer in amphibians

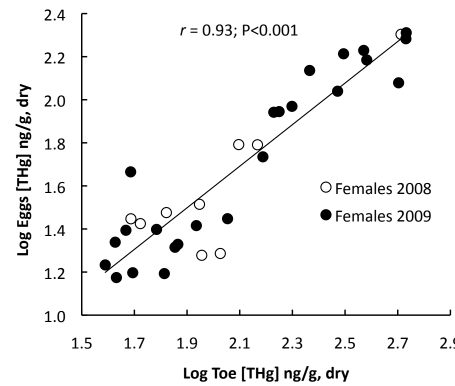
By Brian D. Todd, Christine M. Bergeron & William A. Hopkins

Many amphibians live or breed in riparian and wetland habitats where environmental contaminants and metals often accumulate. As a result, these species can accumulate high levels of these potentially toxic substances



Relationship between blood total mercury (THg) concentrations and toe THg concentrations in American toads collected along the Hg-contaminated South River near Waynesboro, VA, USA.

in their tissues. The ability to use non-lethal methods to quantify contaminant accumulation can greatly aide efforts to understand the ecological and physiological



Relationship between maternal toe total mercury (THg) concentrations and egg THg concentrations in female American toads collected along the Hg-contaminated South River near Waynesboro, VA, USA.

consequences of these substances. Often, one or more toes may be amputated from amphibians to individually mark animals for later identification. These toe clips are often discarded unless they are saved for later genetic analyses. Here, we examined the use of these discarded toe clips as a means of determining total mercury concentrations in the animals from which the toes were removed. We found significant positive correlations between the concentrations of total mercury in toes and blood of American toads sampled across a gradient of contaminated habitats. In female toads, we also found that total mercury concentrations in toes were significantly correlated with concentrations in the eggs, providing evidence that toe clips can be used to demonstrate maternal transfer of mercury to offspring. Our results indicate that amputated toes are effective for identifying mercury concentrations in amphibians. This method may prove useful for determining concentrations of other metals or compounds in amphibians but remains to be tested.

Full article: Todd BD, Bergeron CM, Hopkins WA. in press. Use of toe clips as a nonlethal index of mercury accumulation and maternal transfer in amphibians. *Ecotoxicology*, forthcoming.

Morphological abnormalities in amphibian populations from the mid-eastern region of Argentina

By Paola M. Peltzer, Rafael C. Lajmanovich, Andrés M. Attademo & Celina M. Junges

Over the last decades, scientists have become increasingly concerned about the ongoing numbers of amphibians with abnormalities in several parts of the world. The widespread and current nature of the abnormalities has centered the studies on the indirect and direct impacts of anthropogenic activities. In Argentina, reports on abnormal anurans have been episodic and were recorded affecting a single species or an individual in restricted location or type of site (native forests, wetlands, or agroecosystems). No inventories or analyses of abnormal amphibians have been made in the last ten years. We present the first compilation and analysis of cases of morphological abnormalities anurans from Argentina, comprising specifically Córdoba, Santa Fe, and Entre Ríos Provinces. We sampled for abnormal individuals at 51 sites in agricultural, suburban, and forest sites settings between January 2000 and December 2009. These samplings were carried out during continuous research efforts to study biology and ecotoxicology of anurans in different habitats in this region of Argentina. We recorded 71 abnormal individuals, including 16 types of abnormalities (absence of horny covering in eyes, alterations in the back skin, amelia, brachygnathia, brachydactyly, ectromelia, forelimb remaining under skin, forked tail, hemimelia, missing tympanum, mixed abnormalities, phocomelia, polydactyly, polymelia, syndactyly, ulcerated skin) in 15 anuran species. There was a significant difference in the presence of abnormalities among the different types of sites. In agricultural sites, we found 12 types of abnormalities affecting 12 species, with ectromelia being the most abundant. In suburban sites, we recorded seven types of abnormalities comprising five species, with brachygnathia and ectromelia being the most common. In forest sites, we found three types of abnormalities involving four species, with ectromelia again being the most abundant. Although our study has limitations in interpretation because we only recorded abnormal individuals and did not sample the same number of sites among the three types of sites, this is the first catalog of anurans with morphological abnormalities for Argentina. In addition, this study expands the geographic range of observed morphological abnormalities in amphibians and illustrates the ubiquity of this phenomenon. While our comparisons between sites are preliminary for the reasons pointed out above, we noted that the number of abnormal individuals in agricultural sites was four times higher than in forest sites. These field data highlight that the potential connection with different abnormalities hypothesis is need in our country where pesticide contaminations, alteration and fragmentation of natural habitats are increasing as threats to our amphibians, and it is a pending matter for future integrations of ecological, epidemiological, and developmental tools in puzzle out such environmental mystery.

Abnormalities: A. Brachygnathia in *Hypsiboas pulchellus* juvenile; B. Ectromelia in *R. schneideri*, C-D. Polymelia in *Rhinella arenarum* and E. Polymelia in *R. fernandezae*. Illustrations: Juan Fioramonti.

Full article: Paola M. Peltzer, Rafael C. Lajmanovich, Laura C. Sanchez, Andrés M. Attademo, Celina M. Junges, Clarisa L. Bionda, Adolfo L. Martino, and Agustín Bassó (2011) Morphological abnormalities in amphibian populations from the mid-eastern region of Argentina. *Herpetological Conservation and Biology* 6(3): 432–442. http://anfibios-ecotox-conser.blogspot.es/

Global and endemic Asian lineages of the emerging pathogenic fungus *Batrachochytrium dendrobatidis* widely infect amphibians in China

By Changming Bai, Xuan Liu, Matthew C. Fisher, Trenton W. J. Garner & Yiming Li

Panzootic chytridiomycosis caused by the chytrid fungus *Batrachochytrium dendrobatidis* (*Bd*) is the proximate cause of rapid amphibian declines across diverse biomes. While the origin of *Bd* remains unclear, increasingly the global trade in amphibians is associated with the spread of the infection. Global samples of *Bd* genotypes from previously unsampled regions are essential to test this hypothesis. In this paper, we present a study of the prevalence and phylogeny of *Bd* in both invasive and native amphibian species in markets and in the wild in ten provinces of China. We used a nested PCR assay to amplify the ribosomal internal transcribed spacer region of *Bd* followed by sequencing. Our results showed 246 of 2,734 amphibians testing positive for *Bd*, with 157 positive samples in the wild (7.6%) and 89 in markets (13.5%). 30 haplotypes of *Bd* were identified, including 20 first detections. Introduced *Lithobates catesbeianus* had the highest prevalence of infection and the largest number of *Bd* haplotypes in both the wild and markets. Phylogenetic analysis based on 73 haplotypes (57 from Asia and 16 from other continents) showed that a unique, well-supported, basal haplotype is present in Asia. Phylogeographical analyses revealed that some geographical structure exists amongst a subset of global haplotypes. Strains of the basal haplotype infected *Babina pleuraden*, an amphibian that is endemic to China, and *Andrias japonicus*, endemic to Japan, showing that Southeast Asia harbours a novel endemic lineage of amphibian-associated *Bd*. Our data suggest that *Bd* in Asia pre-dates the expansion of a globalized lineage of *Bd*, a finding that is indicative of a broader association of amphibians and chytrids than has previously been recognized. More genetic data from *Bd* isolates are needed to reveal the phylogenetic relationship of *Bd* in China compared to that found elsewhere.

Full article: Bai et al. (2012) Global and endemic Asian lineages of the emerging pathogenic fungus *Batrachochytrium dendrobatidis* widely infect amphibians in China. *Diversity and Distributions* DOI: 10.1111/j.1472-4642.2011.00878.x

Interaction between breeding habitat and elevation affects prevalence but not infection intensity of *Batrachochytrium dendrobatidis* in Brazilian anuran assemblages

By Michael C. Gründler, Luís Felipe Toledo, Gabriela Parra-Olea, Célio F. B. Haddad, Luis O. M. Giasson, Ricardo J. Sawaya, Cynthia P. A. Prado, Olívia G. S. Araujo, Fernando J. Zara, Fernanda C. Centeno & Kelly R. Zamudio

A large number of frog species are endemic to Brazil's Atlantic Coastal Forest (ACF), and almost all of the reproductive modes known from frogs can be seen there. Twenty-five frog species from the ACF have tested positive for infection with the amphibian fungal pathogen *Batrachochytrium dendrobatidis* (*Bd*). We sampled three frog communities at different elevations to investigate how topography and breeding habitat influence the prevalence of *Bd* in the ACF. The probability that an individual frog was infected with *Bd* increased with elevation. Additionally, the number of *Bd* zoospores on an individual frog's skin was larger at higher elevation. At elevations between 1,000 and 2,000 meters the probability of infection was independent of breeding habitat. At low elevations, frogs that breed in streams had a higher probability of infection than frogs that breed on land or in ponds. Our results indicate that *Bd* is common in many amphibian habitats in the ACF, and that amphibian habitat preference influences the probability of infection only in lowland forests. The humid and topographically complex environments that spurred the evolution of such remarkable amphibian diversity in the ACF are also responsible for the widespread persistence of the fungal pathogen that poses such a threat to biodiversity.

Full article: Michael C. Gründler et al. 2012. Interaction between breeding habitat and elevation affects prevalence but not infection intensity of *Batrachochytrium dendrobatidis* in Brazilian anuran assemblages. *Diseases of Aquatic Organisms* 97(3): 173-184.

Treatment of amphibians infected with chytrid fungus: Learning from failed trials with itraconazole, antimicrobial peptides, bacteria, and heat therapy

By Douglas C. Woodhams, Corina C. Geiger, Laura K. Reinert, Louise A. Rollins-Smith, Brianna Lam, Reid N. Harris, Cheryl J. Briggs, Vance T. Vredenburg & Jamie Voyles

Amphibian conservation goals depend on effective disease-treatment protocols. Desirable protocols are species-, life stage-, and context-specific, but currently few treatment options exist for amphibians infected with the chytrid fungus, *Batrachochytrium dendrobatidis* (*Bd*). Treatment options, at present, include antifungal drugs and heat therapy, but risks of toxicity and side-effects make these options untenable in some cases. Here, we report on the comparison of several novel treatments with a more generally accepted antifungal treatment in experimental scientific trials to treat *Bd*-infected frogs including *Alytes obstetricans* tadpoles and metamorphs, *Bufo bufo* and *Limnodynastes peronii* metamorphs, and *Lithobates pipiens* and *Rana muscosa* adults. The experimental treatments included commercial antifungal products: itraconazole, mandipropamid, steriplantN, PIP Pond Plus; antimicrobial skin peptides from the *Bd*-resistant *Pelophylax esculentus*; microbial treatments (*Pedobacter cryoconitis*); and heat therapy (35 °C for 24 hrs). None of the new experimental treatments were considered successful in terms of improving survival; however, these results may advance future research by indicating the limits and potential of the various protocols. Caution in the use of itraconazole is warranted because of observed toxicity in metamorphic and adult frogs, even at low concentrations. Results suggest that rather than focusing on a single cure-all, diverse lines of research may provide multiple options for treating *Bd* infection in amphibians. Learning from "failed treatments" is essential for the timely achievement of conservation goals and one of the primary aims for a publicly accessible treatment database under development.

A newly metamorphosed Striped marsh frog, *Limnodynastes peronii* with clinical signs of chytridiomycosis. Photo: Jamie Voyles.

Full article: Woodhams DC, Geiger CC, Reinert LK, Rollins-Smith LA, Lam B, Harris RN, Briggs CJ, Vredenburg VT, Voyles J. (2012) Treatment of amphibians infected with chytrid fungus: learning from failed trials with itraconazole, antimicrobial peptides, bacteria, and heat therapy. *Diseases of Aquatic Organisms* 98: 11-25.

The genome sequence of the emerging Common midwife toad virus identifies an evolutionary intermediate within ranaviruses

By Carla Mavian, Alberto López-Bueno, Ana Balseiro, Rosa Casais, Antonio Alcami & Alí Alejo

Ranavirus infections are thought to be one of the drivers of worldwide amphibian population declines. The recent emergence of these viruses as pathogens of amphibians is probably linked to their host range plasticity as well as to environmental and ecological factors. Although ranavirus outbreaks affecting numerous species have been described from different locations worldwide, complete genome sequences had only been published for Asian, American and Australian isolates.

Common midwife toad tadpole infected with CMTV. Photo: Isabel Márquez.

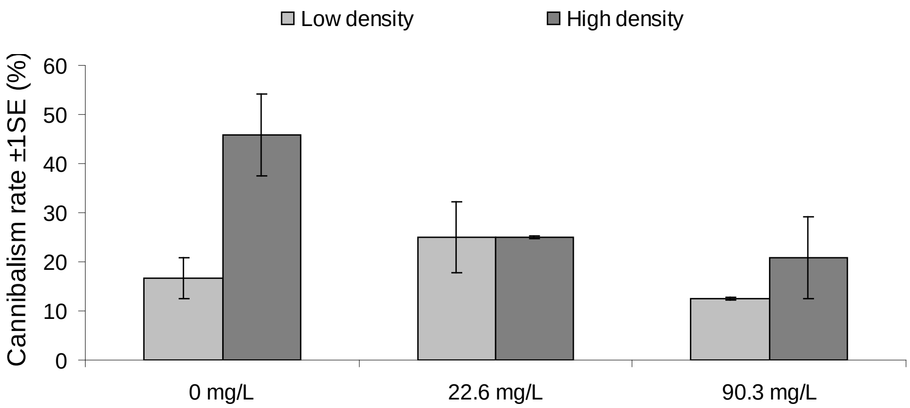
We have obtained the complete genome sequence of the Common midwife toad virus (CMTV), which was first isolated on the European continental mainland in 2007 from diseased tadpoles of the Common midwife toad (*Alytes obstetricans*) in a high altitude permanent water trough in the "Picos de Europa" National Park in Spain. The virus, causing a high mortality rate in this species as well as in juvenile Alpine newts in the 2008 outbreak (*Mesotriton alpestris cyreni*), was shown to be responsible for a systemic hemorragic disease. In 2010, a CMTV outbreak in a pond in the Netherlands was described as the cause of a mass mortality event affecting water frogs and common newts, showing that both the host range and geographic distribution of CMTV is much wider than previously suspected. Analyses of the genome sequence presented in this article show that CMTV is a distinct amphibian-like ranavirus that occupies an intermediate evolutionary position between previously recognized groups of ranaviruses and that it is closely related to a set of ranaviruses isolated from both amphibians and fish in Europe and China.

Full article: Mavian C. et al. The genome sequence of the emerging Common midwife toad virus identifies an evolutionary intermediate within Ranaviruses. *Journal of Virology* 86(7): 3617-3625.

Density effects on ammonium nitrate toxicity on amphibians. Survival, growth and cannibalism

By Manuel E. Ortiz-Santaliestra, María J. Fernández-Benéitez & Adolfo Marco

Temporary ponds where many amphibians breed experience a gradual desiccation that leads to growing larval densities, which can reduce tadpole survival rates by increasing the intensity of intraspecific competition. Under high density conditions, the occurrence of cannibalism among larvae of some species, particularly salamanders, becomes more frequent. Furthermore, pond desiccation



Cannibalism rate (±SE) per treatment among larvae of *Salamandra salamandra* exposed to ammonium nitrate (0-90.3 mg N/L) at two different densities.

is also associated with increasing concentrations of many agrochemicals, including nitrogenous fertilizers. We investigated the combined effects of a commonly used fertilizer, ammonium nitrate, on larval amphibians at different densities. In a first experiment, we assessed the two factors in combination on *Rana dalmatina* tadpoles. Both stressors significantly reduced survival probabilities, acting synergistically at specific times of exposure (e.g., at day 13, the mortality rate of individuals exposed to environmentally relevant fertilizer levels was 5.3 times higher among those that grew at high density than in those growing at low density). In a second experiment, we studied how the exposure to the fertilizer affected the incidence of cannibalistic interactions among *Salamandra salamandra* larvae raised at different densities. As expected, larval crowding stimulated the occurrence of cannibalism (Mean cannibalism rates ±1SE: High density: 30.6±5.2 %; Low density: 18.1±3.0 %). However, cannibalism was density-dependent only among larvae that were free from the impact of ammonium nitrate; when we exposed animals to the fertilizer, density did not influence the number of cannibalized larvae. The presence of ammonium nitrate in the water inhibited the natural, density-dependent incidence of cannibalism, thereby compromising the potential benefits associated with this phenomenon such as increased growth rate or stimulation of defensive behaviours. The paper provides novel information on the study of the ecological effects of environmental pollution in amphibians by testing, for the first time, the effects of nitrogenous fertilizers at different larval densities, and by introducing the cannibalistic interactions as a response in ecotoxicological studies with amphibians.

Full article: Ortiz-Santaliestra et al. (2012) Density effects on ammonium nitrate toxicity on amphibians. Survival, growth and cannibalism. *Aquatic Toxicology* 110-111: 170-176.

Occurrence of *Batrachochytrium dendrobatidis* in amphibians of Wise County, Virginia, USA

By Sarah R.A. Davidson & David L. Chambers

Batrachochytrium dendrobatidis (*Bd*) has been implicated as a deadly pathogen at least partially responsible for global amphibian declines. Despite this fungal pathogen being considered as an invasive species, we lack knowledge regarding its geographic distribution in many regions (e.g., www.Bd-maps.net). In addition, there is a significant knowledge gap concerning which amphibian species are infected by *Bd*. We address these knowledge gaps by assessing the occurrence of *Bd* in amphibians of Wise County, Virginia, U.S.A. Wise County is located in southwest Virginia, in the heart of the Appalachian Mountains. Amphibian biodiversity, particularly urodele species richness, is incredibly high in this region. It is of particular importance to assess the occurrence of *Bd* in the areas of high amphibian biodiversity and endemism because these areas could be more vulnerable to cross-contamination and potential losses. Samples for DNA analysis (qPCR) for *Bd* were taken via toe clip of individual amphibians. We collected 119 samples from 18 amphibian species. Overall, 21 of 119 (17.6%) amphibians tested positive for *Bd*. Specifically, 15 of 21 (71.4%) *Bd*-positive samples were urodeles and 6 of 21 (28.6%) were anurans. We are the first to report *Bd* in several urodele species, including *Eurycea longicauda*, *E. lucifuga*, and *Plethodon cinereus* (although, *Bd* has been documented to infect *P. cinereus* under laboratory settings.

Full article: Davidson, S.R.A & Chambers, D.L. (2011) Occurrence of *Batrachochytrium dendrobatidis* in amphibians of Wise County, Virginia, USA. *Herpetological Review* 42(2): 214-215.

Ranavirus prevalence in amphibian populations of Wise County, Virginia, USA

By Sarah R.A. Davidson & David L. Chambers

Several factors have been linked to catastrophic amphibian declines, including habitat alteration and pathogens. Ranaviruses (Family: Iridoviridae; Genus: *Ranavirus*) are one particular group of pathogens linked to massive amphibian die-offs. Despite the evidence of ranaviruses becoming an emerging disease, we still know relatively little concerning its geographic distribution among amphibian species. Rather, most recent amphibian pathogen studies center on *Batrachochytrium dendrobatidis*. However, *B. dendrobatidis* should not be the only pathogen that warrants investigative attention, as others are quite capable of exerting deleterious effects upon amphibian populations. We examined the occurrence of ranavirus infections in amphibians (including urodeles and anurans) present in the southern Appalachian Mountain areas, specifically Wise County, Virginia, U.S.A. Ranaviruses have been associated with some mortality events in this region, yet much of this area (and, much of North America in general) remains unsurveyed despite it being a hotspot for urodele diversity and endemism. Samples for DNA analysis (qPCR) for ranavirus were taken via toe clip of individual amphibians. We collected 119 samples from 18 amphibian species. Overall, 39 of 119 (33%) amphibians tested positive for ranavirus. Specifically, 36 of 39 (92%) ranavirus-positive samples were urodeles and 3 of 39 (8%) were anurans. We are the first to report ranavirus infection in five new plethodontid species: *Desmognathus fuscus*, *Eurycea cirrigera*, *E. longicauda*, *E. lucifuga*, and *P. glutinosus* complex).

Full article: Davidson, S.R.A & Chambers, D.L. (2011) Ranavirus prevalence in amphibian populations of Wise County, Virginia, USA. *Herpetological Review* 42(4): 540-542.

Infectious disease screening of Western Ghats amphibians

By Abhilash Nair, Olivia Daniel, Sujith V. Gopalan, Sanil George, K. Santhosh Kumar, Juha Merilä & Amber G. F. Teacher

Batrachochytrium dendrobatidis (*Bd*) and *Ranavirus* are emerging pathogenic infections that have both been implicated in amphibian declines. *Bd* infections have caused large scale population declines and extinctions in amphibians. *Ranavirus* is also known to cause large scale mortalities in amphibians in many parts of the world. To date, there have been no reports of disease screening from the Western Ghats in India, which is a biodiversity hotspot that is well known for its high endemic amphibian diversity. We screened for the presence of both *Bd* and *Ranavirus* in species within endemic genus *Indirana*: *I. beddomii* (from Agumbe, Kudremukh, Aralam, Kanamvayal, Athirapalli), *I. brachytarsus* (Ponmudi, Periyar, Malkappara), *I. semipalmata* (Periyar), *I. diplosticta* (Periyar), *I. leptodactyla* (Munnar) and *Indirana* sp. (Vellarimala). Additionally chytrid screening was also done for *Hylarana temporalis*, *Fejervarya keralensis* and *Micrixalus fuscus* from Peppara Wildlife Sanctuary in Western Ghats. *Ranavirus* was not detected in any of the tested samples, whereas *Bd* was detected from one specimen of *I. brachytarsus* (mean Bd zoospore Genomic Equivalent = 2.92) from Ponmudi in Kerala. This specimen was re-tested in another laboratory and was again found to be positive in both replicates (mean Bd zoospore Genomic Equivalent = 0.30). Considering that many of the endemic amphibians from the Western Ghats are already at high risk of extinction, we suggest that more organized and extended efforts need to be put into screening of emerging infectious diseases from the entire range of Western Ghats biodiversity hotspot.

Full article: Nair A., O. Daniel, S.V. Gopalan, S. George, K.S. Kumar, J. Merilä & A.G.F. Teacher (2011). Infectious disease screening of *Indirana* frogs from the Western Ghats biodiversity hotspot. *Herpetological Review* 42: 554-557.

Salt toxicity to tree frogs (*Hyla chrysoscelis*) depends on depth

By Emily K. Dobbs, Maria G. Brown, Joel W. Snodgrass & David R. Ownby

Road salts are used to lower freezing points and reduce the formation of ice on roads in many regions where freezing precipitation is common. Following application to roads and parking lots, salt is carried in runoff to streams and wetlands where it can have toxic effects on aquatic and semiaquatic organisms. In stagnant water situations salt concentration may become stratified with concentrations near the bottom of ponds and wetlands being several times higher than those of surface waters. To investigate the interaction between salt stratification and toxic effects of salt on tadpoles, we created salt stratification in laboratory microcosms and placed Cope's grey tree frog (*Hyla chrysoscelis*) eggs at varying depths in the microcosms. During the experiment salt concentrations were four to seven times higher on the bottom of the microcosms when compared to the water column. Moreover, embryos on the bottom of the microcosm did not survive while those in the water column had greater than 60% survival. After hatching tadpoles in the salt contaminated microcosms avoided the bottom and clustered on the sides. In contrast, tadpoles in the uncontaminated microcosms were associated with the bottom. Our results suggest that pond-breeding amphibians that place their eggs on or near the bottom will be particularly susceptible to road salt contamination of wetland and pond habitats.

Salt dome covered in snow in Baltimore County, Maryland. Photo: Joel W. Snodgrass.

Full article: Dobbs, EK, MG Brown, JW Snodgrass, DR Ownby (2012) Salt toxicity to tree frogs (*Hyla chrysoscelis*) depends on depth. *Herpetologica* 68: 22-30.

Lead and cadmium accumulation in anuran amphibians of a permanent water body in arid midwestern Argentina

By Mariana B. Jofré, Rosa I. Antón & Enrique J. Caviedes-Vidal

The metals Lead (Pb) and Cadmium (Cd) are stable and persistent contaminants released into the environment. Amphibians accumulate Pb and Cd from their surrounding environment, and may be adversely affected by these heavy metals. The Embalse La Florida, an artificial lake situated in the dry midwest of Argentina, is one of the few sources of permanent water available in the region allowing reproduction and early development of amphibians. The importance of this water body is underscored by the diversity of anuran populations (8 species) previously reported. Cadmium (Cd) and lead (Pb) have been detected in water, sediments and fauna from this reservoir. The south shore of Embalse La Florida exhibits high metal contamination and poor water quality and conversely, the north shore, is less contaminated. Adult anuran amphibians of six species, *Rhinella arenarun*, *Leptodactylus mystacinus*, *Hypsiboas cordobae*, *Odontophrynus occidentalis*, *Melanophryniscus stelzneri* and *Pleurodema tucumanum*, were collected on the north and south shores of the Embalse La Florida and samples of whole body homogenates were dried and digested in nitric and perchloric acid. Determination of Cd and Pb in samples was performed by stabilized temperature graphite furnace atomic absorption spectrometry. Whole body concentrations of Pb ranging from 1.19 to 5.57 μg/g dry mass and and Cd between 1.09 and 6.86 μg/g dry mass were detected in the six species of anurans assayed. Between and within species differences were detected in Cd and Pb concentrations. Although anuran amphibians from the south shore accumulated 21% more Cd and 40% more Pb than individuals from the less contaminated north shore, the amount of Cd and Pb accumulated was not significantly correlated with the water concentration of metals at the site of collection. Anuran amphibians that inhabit shallow waters near or at the shores of the Embalse La Florida accumulated Cd and Pb present in water and sediments. In addition to Cd and Pb burden, we have previously reported organochlorine contamination in the anuran fauna. Therefore, we stress the need of adequate management policies that may ameliorate contamination in this ecosystem and its impact on fauna in general and amphibians in particular, given the fact that this area holds the highest richness of anuran amphibians reported up to date in the semiarid region of San Luis.

Full article: Jofré, M. B. Antón, R. I. and Caviedes-Vidal E. J. (2012) Lead and cadmium accumulation in anuran amphibians of a permanent water body in arid midwestern Argentina. *Environmental Science and Pollution Research* DOI: 10.1007/s11356-012-0795-2.

Effects of two stressors on amphibian larval development

By Karolina Stark, David E. Scott, Olga Tsyusko, Daniel P. Coughlin & Thomas G. Hinton

In parallel with a renewed interest in nuclear power and its possible environmental impacts, a new environmental radiation protection system calls for environmental indicators of radiological stress. Amphibians have been identified as a class of organisms for which data are particularly sparse. However, because environmental stressors seldom occur alone, this study investigated the combined effects of an ecological stressor (larval density) and an anthropogenic stressor (ionizing radiation) on amphibians. An outdoor low dose irradiation facility (LoDIF) with 40 fiberglass tanks arranged in eight replicated blocks at the University of Georgia's Savannah River

Low dose irradiation facility (LoDIF) with outdoor tanks at the University of Georgia's Savannah River Ecology Laboratory (SREL) used to exposed *Scaphiopus holbrookii* tadpoles. Photo: Thomas G. Hinton.

Ecology Laboratory (SREL) was used in the experiment. *Scaphiopus holbrookii* tadpoles reared at different larval densities were exposed to four low irradiation dose rates (0.13, 2.4, 21, and 222 mGy d^{-1}) from ^{137}Cs during the sensitive period prior to and throughout metamorphosis. Body size at metamorphosis (measured as body index: mass/snout-to-vent length) and development rate (measured as age at metamorphosis) served as fitness correlates related to population dynamics. Results showed that increased larval density decreased body size but did not affect development rate. Low dose rate radiation had no impact on either endpoint. Under our experimental protocols, the combination of radiation exposure and different larval density did not result in any additional stress on body size and development rate. No interactions among the two stressors were detected.

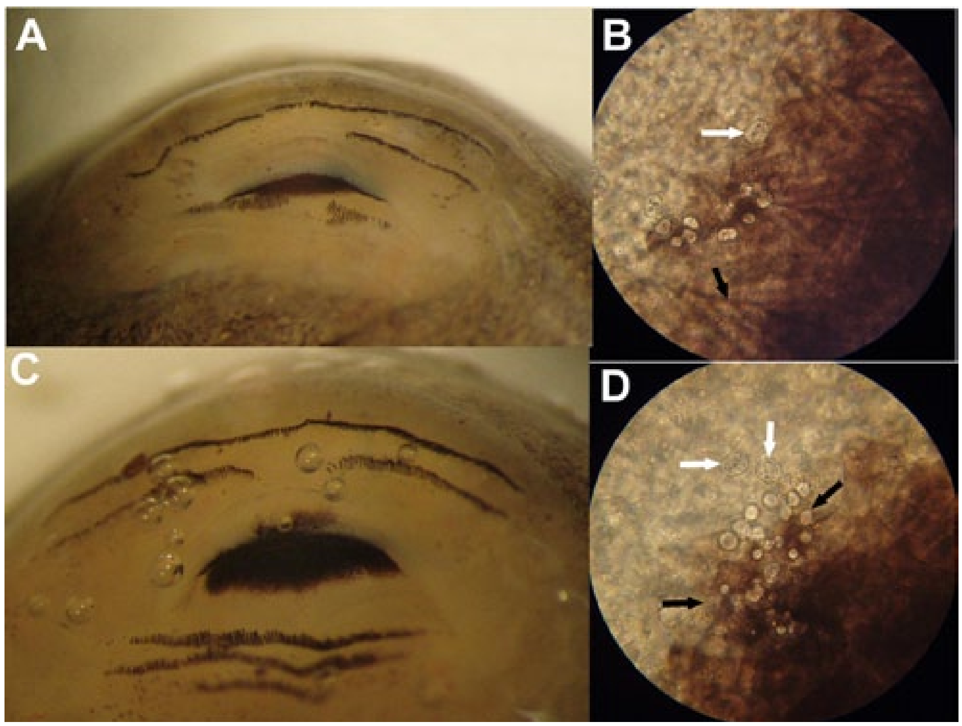
Full article: Stark, K. et al., (2012) Effects of two stressors on amphibian larval development. *Ecotoxicology and Environmental Safety* 79: 283-287. doi:10.1016/j.ecoenv.2012.01.014

Batrachochytrium dendrobatidis in *Plectrohyla arborescandens* (Anura: Hylidae) larvae at a montane site in the Sierra Negra, Puebla, México

By Ricardo Luría-Manzano, Luis Canseco-Márquez and Patricia Frías-Alvarez

The fungus *Batrachochytrium dendrobatidis* causes a widespread cutaneous infection in young postmetamorphic and adult individuals of many anuran species, which may result in death. Although tadpoles don't seem to die from the infection, they develop remarkable damage to their keratinized mouthparts, and swelling and redness of the labial papillae and oral disc. In June 2008, we collected four tadpoles of *Plectrohyla arborescandens* in Tilancingo stream, Sierra Negra, Puebla, México (18.3027°N, 97.0644°W; 2,607 m elev.), where the vegetation (oak-pine forest) is relatively undisturbed. The tadpoles were carried to the laboratory to test for the presence of *B. dendrobatidis*, using the wet-preparation technique. All of them were infected with the fungus, which was determined by the presence of empty sporangia, sporangia with zoospores and septed sporangia. Furthermore, all had conspicuous oral disc abnormalities, like loss of the jaw sheaths and tooth rows. This is the second report of *B. dendrobatidis* in Puebla State, and the first case associated with an anuran species, since the fungus had been detected only in the salamander *Ambystoma velasci*. It is of particular concern, because *P. arborescandens* is an endemic frog of the Atlantic slopes of México, in the states of Tlaxcala, Puebla, and Veracruz, and is considered Endangered and with a decreasing population trend, according to the Red List of the IUCN.

Full Article: Luría-Manzano, R. et al. (2011) *Batrachochytrium dendrobatidis* in *Plectrohyla arborescandens* (Anura: Hylidae) Larvae at a Montane Site in the Sierra Negra, Puebla, México. Herpetological Review 42: 552-554.



Oral disc of two *Plectrohyla arborescandens* tadpoles with conspicuous abnormalities (A and C), collected in Tilancingo stream, Puebla, México, and their respective wet-preparation (B and D). White arrows indicate sporangia with zoospores and the black ones empty sporangia of *Batrachochytrium dendrobatidis*. Photo: Luis Canseco-Márquez.

Call for recent publication abstracts

If you would like to include an abstract from a recent publication in this section of FrogLog please email froglog@amphibians.org. We also encourage all authors of recent publications to inform Professor Tim Halliday (formerly DAPTF International Director) (tim.r.halliday@gmail.com) of their publication in order for it to be referenced on the AmpibiaWeb latest papers page. The full list of latest papers from AmphibiaWeb is also included in every edition of FrogLog following the recent publications abstract section.

AmphibiaWeb Recent Publication List

This reference list is compiled by Professor Tim Halliday (formerly DAPTF International Director; tim.r.halliday@gmail.com). It lists papers on amphibian declines and their causes and amphibian conservation, with an emphasis on those that describe methods for monitoring and conserving amphibian populations. Tim is always delighted to receive details of forthcoming papers from their authors.

AmphibiaWeb: Information on amphibian biology and conservation. [web application]. 2011. Berkeley, California: AmphibiaWeb. Available: http://amphibiaweb.org/ (Accessed: September 11, 2011).

January 2012

Alton, L. A. et al. (2012) The energetic cost of exposure to UV radiation for tadpoles is greater when they live with predators. *Functional Ecology:* 26: 94-103. (l.alton@uq.edu.au)

Aubry, A. et al. (in press) Patterns of synchrony in natterjack toad breeding activity and reproductive success at local and regional scales. *Ecography:* (m.emmerson@qub.ac.uk)

Bai, C. et al. (in press) Global and endemic Asian lineages of the emerging pathogenic fungus *Batrachochytrium dendrobatidis* widely infect amphibians in China. *Diversity & Distributions:* (liym@ioz.ac.cn)

Bradford, D. F. et al. (2012) Mercury in tadpoles collected from remote alpine sites in the southern Sierra Nevada Mountains, California, USA. *Arch. Environ. Contam. Toxicol:* 62**:** 135-140. (bradford.david@epa.gov)

Brown, M. G. et al. (in press) Ameliorative effects of sodium chloride on acute copper toxicity among Cope's gray tree frog (*Hyla chrysoscelis*) and green frog (*Rana clamitans*) embryos. *Envtl. Toxicol. & Chem:* (downby@towson.edu)

Browne, R. K. et al. (2011) Zoo-based amphibian research and conservation breeding programs. *Amphibian & Reptile Conservation:* 5 (3): 1-14 (e28). (robert.browne@gmail.com)

Browne, R. K. et al. (2011) Survey techniques for giant salamanders and other aquatic Caudata. *Amphibian & Reptile Conservation:* 5 (4): 1-16 (e34). (robert.browne@gmail.com)

Canessa, S. et al. (in press) Integrating variability in detection probabilities when designing wildlife surveys: a case study of amphibians from south-eastern Australia. *Biodiversity & Conservation:* (canessas@unimelb.edu.au)

Chai, N. (2012) Mycobacteriosis in amphibians. In: R. E. Miller & M. Fowler (Eds.), *Fowler's Zoo and Wild Animal Medicine. Vol. 7. Current Therapy*. Elsevier. Chap. 29. pp. 224-230.

Connette, G. M. & Semlitsch, R. D. (in press) Successful use of a passive integrated transponder (PIT) system for below-ground detection of plethodontid salamanders. *Wildlife Research:* (gmcco@gmail.com)

Crawshaw, G. (2012) Amphibian viral disease. In: R. E. Miller & M. Fowler (Eds.), *Fowler's Zoo and Wild Animal Medicine. Vol. 7. Current Therapy*. Elsevier. Chap. 30. pp. 231-238.

Daskin, J. H. & Alford, R. A. (in press) Context-dependent symbioses and their potential roles in wildlife diseases. *Proc. R. Soc. B:* (jhdaskin@gmail.com)

Davidson, M. A. et al. (2011) Fate and developmental effects of dietary uptake of methylmercury in *Silurana tropicalis* tadpoles. *J. Toxicol. & Envtl. Health A:* 74: 364-379.

Duarte, H. et al. (2012) Can amphibians take the heat? Vulnerability to climate warming in subtropical and temperate larval amphibian communities. *Global Change Biology:* 18: 412-421. (tejedo@ebd.csic.es)

Fellers, G. M. et al. (2011) Amphibian chytrid fungus (*Batrachochytrium dendrobatidis*) in coastal and montane California, USA anurans. *Herpetol. Conservation & Biology:* 6: 383-394. (gary_fellers@usgs.gov)

Ficetola, D. F. et al. (2011)*Batrachochytrium dendrobatidis* in amphibians from the Po River Delta, northern Italy. *Acta Herpetologica:* 6: 297-302.

Forrest, M. J. & Schlaepfer, M. A. (2011) Nothing a hot bath won't cure: infection rates of amphibian chytrid fungus correlate negatively with water temperature under natural field settings. *PLoS One:* 6: e28444. (mjforrest@ucsd.edu)

Forzán, M. J. et al. (2012) Blood collection from the facial (maxillary)/musculo-cutaneous vein in true frogs (family Ranidae). *J. Wildlife Diseases:* 48: 176-180. (mforzan@ccwhc.ca)

Friesen, L. R. & Kuhn, R. E. (in press) Fluorescent microscopy of viable *Batrachochytrium dendrobatidis*. *J. Parasitology:*

Gammill, W. M. et al. (in press) Norepinephrine depletion of antimicrobial peptides from the skin glands of *Xenopus laevis*. *Developmental & Comparative Immunology:* (louise.rollins-smith@vanderbilt.edu)

Garcia-Gonzalez, C. et al. (2012) Rural road networks as barriers to gene flow for amphibians: species-dependent mitigation by traffic calming. *Landscape & Urban Planning:* 104: 171-180. (claudiacgg@yahoo.es)

García-Rodríguez, A. et al. (2012) Where are survivors? Tracking relictual populations of endangered frogs in Costa Rica. *Diversity & Distributions:* 18: 204-212. (garclar.adrian@gmail.com)

Gründler, M. C. et al. (2012) Interaction between breeding habitat and elevation affects prevalence but not infection intensity of *Batrachochytrium dendrobatidis* in Brazilian anuran assemblages. *Diseases of Aquatic Organisms:* 97: 173-184. (kelly.zamudio@cornell.edu)

Hammond, J. I. et al. (in press) Phylogeny meets ecotoxicology: evolutionary patterns of sensitivity to a common insecticide. *Evolutionary Applications:* (jih36@pitt.edu)

Hanlon, S. M. & Parris, M. J. (in press) The impact of pesticides on the pathogen *Batrachochytrium dendrobatidis* independent of potential hosts. *Archives Envtl. Contamination & Toxicology:* (shanlon1@memphis.edu)

Hoogmoed, M. S. & Avila-Pires, T. C. S. (2012 [2011]) On the presence of *Scinax pedromedinae* (Henle, 1991) (Amphibia: Anura: Hylidae) in Amazonian Brazil and northern Peru. *Boletim do Museu Paraense Emílio Goeldi. Ciencias Naturais:* 6(3): 263-271. (marinus@museu-goeldi.br)

Hyman, O. J. & Collins, J. P. (2012) Evaluation of a filtration-based method for detecting *Batrachochytrium dendrobatidis* in natural bodies of water. *Diseases of Aquatic Organisms:* 97: 185-195. (ohyman@asu.edu)

Johnson, P. T. J. et al. (in press) Living fast and dying of infection: host life history drives interspecific variation in infection and disease risk. *Ecology Letters:* (pieter.johnson@colorado.edu)

Lowe, W. H. (2012) Climate change is linked to long-term decline in a stream salamander. *Biol. Conservation:* 145: 48-53. (winsor.lowe@umontana.edu)

Luquet, E. et al. (in press) Genetic erosion in wild populations makes resistance to a pathogen more costly. *Evolution:*

Melvin, S. D. & Trudeau, V. L. (2012) Toxicity of napthenic acids to wood frog tadpoles (*Lithobates sylvaticus*). *J. Toxicol. Environ. Health A:* 75: 170-173.

Meshaka, W. E. (2011) A runaway train in the making: the exotic amphibians, reptiles, turtles and crocodilians of Florida. Monograph 1. *Herpetol. Conservation & Biology:* 6: 1-101. (wmeshaka@state.pa.us)

Muchai, V. et al. (2011) Kitobo Forest of Kenya, unique hotspot of herpetological diversity. *Acta Herpetologica:* 6: 149-160.

Narajan, E. & Hero, J.-M. (2011) Absence of invasive chytrid fungus (*Batrachochytrium dendrobatidis*) in native Fijian ground frog (*Platymantis vitiana*) populations on Viwa-Tailevu, Fiji Islands. *Acta Herpetologica:* 6: 261-266.

Pask, J. D. et al. (in press) The ebb and flow of antimicrobial skin peptides defends northern leopard frogs (*Rana pipiens*) against chytridiomycosis. *Global Change Biology:* (louise.rollins-smith@vanderbilt.edu)

Pauly, G. B. et al. (2012) Conservation and genetics of the frosted flatwoods salamander (*Ambystoma cingulatum*) on the Atlantic coastal plain. *Conservation Genetics:* 13: 1-7. (gbpauly@ucdavis.edu)

Peltzer, P. M. et al. (2011) Morphological abnormalities in amphibian populations from the mid-eastern region of Argentina. *Herpetol. Conservation & Biology:* 6: 432-442. (paolapeltzer@hotmail.com)

Pessier, A. P. (2012) Diagnosis and control of amphibian chytridiomycosis. In: R. E. Miller & M. Fowler (Eds.), *Fowler's Zoo and Wild Animal Medicine. Vol. 7. Current Therapy*. Elsevier. Chap. 28. pp. 217-223.

Prestridge. H. L. et al. (2011) Trade in non-native amphibians and reptiles in Texas: lessons for better monitoring and implications for species introduction. *Herpetol. Conservation & Biology:* 6: 324-339. (hlprestridge@tamu.edu

Ruthig, G, R. & DeRidder, B. P. (2012) Fast quantitative PCR, locked nucleic acid probes and reduced volume reactions are effective tools for detecting *Batrachochytrium dendrobatidis* DNA. *Diseases of Aquatic Organisms:* 97: 249-253. (grruthig@noctri.edu)

Sarasola-Puente, V. et al. (2012) Population structure and genetic diversity of *Rana dalmatina* in the Iberian Peninsula. *Conservation Genetics:* 13: 197-209. (mariajose.madeira@ehu.es)

Snow, N. P. & Witmer, G. W. (2011) A field evaluation of a trap for invasive American bullfrogs. *Pacific Conservation Biology:* 17: 285.

Sung, Y.-H. et al. (2011) Evaluation of the effectiveness of three survey methods for sampling terrestrial herpetofauna in south China. *Herpetol. Conservation & Biology:* 6: 479-489. (heisyh@gmail.com)

Todd, B. D. et al. (2012) Do effects of mercury in larval amphibians persist after metamorphosis? *Ecotoxicology:* 21: 87-95. (btodd@ucdavis.edu)

Todd, B. D. et al. (in press) Use of toe clips as a nonlethal index of mercury accumulation and maternal transfer in amphibians. *Ecotoxicology:* (btodd@ucdavis.edu)

Van Schmidt, N. D. et al. (2012) Effects of chronic polybrominated diphenyl ether exposure on gonadal development in the northern leopard frog, *Rana pipiens*. *Envtl. Toxicol. & Chem:* 31: 347-354. (vanschmidt@berkeley.edu)

Van Wilgen, N. J. & Richardson, D. M. (in press) The roles of climate, phylogenetic relatedness, introduction effort, and reproductive traits in the establishment of non-native reptiles and amphibians. *Conservation Biology:* (nvanwilgen@gmail.com)

Whitton, F. J. S. et al. (2012) Understanding global patterns in amphibian geographic range size: does Rapoport rule? *Global Ecology & Biogeography:* 21: 179-190. (felix@synchronicityearth.org)

Winkler, J. D. & Forte, G. (2011) The effects of road salt on larval life history traits and behavior in *Rana temporaria*. *Amphibia-Reptilia:* 32: 527-532. (jasmin.winkler@ieu.uzh.ch)

Zhang, J. et al. (2012) Effect of titanium dioxide nanomaterials and ultraviolet light coexposure on African clawed frogs (*Xenopus laevis*). *Envtl. Toxicol. & Chem:* 31: 176-183. (george_cobb@baylor.edu)

Zippel, K. et al. (2011) The Amphibian Ark: a global community for ex situ conservation of amphibians. *Herpetol. Conservation & Biology:* 6: 340-352. (kevinz@amphibianark.org)

Zumbado-Ulate, H. et al. (2011) Population status and natural history notes on the critically endangered stream-dwelling frog *Craugastor ranoides* (Craugastoridae) in a Costa Rican tropical dry forest. *Herpetol. Conservation & Biology:* 6: 455-464. (hugozu1@yahoo.com)

February

Bai, C. et al. (2012) Global and endemic Asian lineages of the emerging pathogenic fungus *Batrachochytrium dendrobatidis* widely infect amphibians in China. *Diversity & Distributions*: 18: 307-318. (liym@ioz.ac.yk)

Becker, M. H. et al. (in press) Towards a better understanding of the use of probiotics for preventing chytridiomycosis in Panamanian golden frogs. *EcoHealth*: (beckermh@vt.edu)

Brinkman, S. F. & Johnston, W. D. (2012) Acute toxicity of zinc to several aquatic species native to the Rocky Mountains. *Arch. Environ. Contam. Toxicol*: 62: 272-281. (steve.brinkman@state.co.us)

Camardelli, M. & Napoli, M. F. (2012) Amphibian conservation in the Caatinga biome and semiarid region of Brazil. *Herpetologica*: 68: 31-47. (milenacamardelli@yahoo.com.br)

Canessa, S. et al. (2012) Integrating variability in detection probabilities when designing wildlife surveys: a case study of amphibians from south-eastern Australia. *Biodiversity & Conservation*: 21: 729-744. (canessas@unimelb.edu.au)

Castañeda, F. E. & McCranie, J. R. (2011) Natural history notes on the ecology and conservation status of the Honduran endemic frog *Isthmohyla insolita* (Anura: Hylidae). *Herpetol. Review:* 42: 502-504. (franklin.castaneda@gmail.com)

Cohen, J. S. et al. (2012) Traits, not origin, explain impacts of plants on larval amphibians. *Ecol. Applications:* 22: 218-228. (isc74@cornell.edu)

Connette, G. M. & Semlitsch, R. D. (2012) Successful use of a passive integrated transponder (PIT) system for below-ground detection of plethodontid salamanders. *Wildlife Research*: 39: 1-6. (grmcco@gmail.com)

Davidson, S. R. A. & Chambers, D. L. (2011) Ranavirus prevalence in amphibian populations of Wise County, Virginia, USA. *Herpetol. Review*: 42: 540-542. (chambers@uvawise.edu)

Decout, S. et al. (2012) Integrative approach for landscape-based graph connectivity analysis: a case study with the common frog (*Rana temporaria*) in human-dominated landscapes. Landscape Ecology: 27: 267-279. (sandra.luque@cemagref.fr)

Del Lama, F. et al. (2011) The use of photography to identify individual tree frogs by their natural marks. S. *American J. Herpetol*: 6: 198-204.

Dobbs, E. K. et al. (2012) Salt toxicity to treefrogs (*Hyla chrysoscelis*) depends on depth. *Herpetologica*: 68: 22-30. (jsnodgrass@towson.edu)

Fenolio, D. B. et al. (2011) A review of the Chile Mountains false toad, *Telmatobufo venustus* (Amphibia: Anura: Calyptocephalellidae), with comments on its conservation status. *Herpetol. Review:* 42:

514-519. (dfenolio@atlantabotanicalgarden.org)

Gaertner, J. P. et al. (2011) Detection of *Batrachochytrium dendrobatidis* in frogs from different locations in Cambodia. *Herpetol. Review:* 42: 546-549. (dh49@txstate.edu)

Gómez-Rodríguez, C. et al. (2012) Integrating detection probabilities in species distribution models of amphibians breeding in Mediterranean temporary ponds. *Diversity & Distributions*: 18: 260-272. (carola@ebd.csic.es)

Gratwicke, B. et al. (2012) Will amphibians croak under the Endangered Species Act? *BioScience*: 62: 197-202.

Harner, M. J. et al. (2011) Chytrid fungus in American bullfrogs (*Lithobates catesbeianus*) along the Platte River, Nebraska, USA. *Herpetol. Review*: 42: 549-551. (mharner@cranetrust.org)

Jarvis, L. E. (2011) *Triturus cristatus* (great crested newt) malformation. *Herpetol. Bulletin*: 117: 40-41. (laurencejarvis@field-studies-council.org)

Jofré, M. B. et al. (in press) Lead and cadmium accumulation in anuran amphibians of a permanent water body in arid midwestern Argentina. *Environmental Science & Pollution Research*: (marianajofre@gmail.com)

Jonas, M. et al. (2011) Using spot pattern to identify individual Long-tailed salamanders. *Herpetol. Review*: 42: 520-522. (jlbowman@udel.deu)

Jourdan-Pineau, H. et al. (2012) Phenotypic plasticity allows the Mediterranean parsley frog *Pelodytes punctatus* to exploit two temporal niches under continuous gene flow. *Molecular Ecology*: 21: 876-886. (helene.jourdan@unil.ch)

Lehtinen, R. M. & MacDonald, M. C. (2011) Live fast, die young? A six-year field study of longevity and surviviorship in Blanchard's cricket frog (*Acris crepitans blanchardi*). *Herpetol. Review*: 42: 504-507. (rlehtinen@wooster.edu)

Lesbarrères, D. & Fahrig, L. (in press) Measures to reduce population fragmentation by roads: what has worked and how do we know? *Trends in Ecology & Evolution*:

Luquet, E. et al. (in press) Genetic erosion in wild populations makes resistance to a pathogen more costly. *Evolution*: (emilien.luquet@gmail.com)

Luría-Manzano, L. et al. (2011) *Batrachochytrium dendrobatidis* in *Plectrohyla arborescandens* (Anura: Hylidae) larvae at a montane site in the Sierra Negra, Puebla, México. *Herpetol.* Review: 42: 552-554. (doumbek@hotmail.com)

Martin, L. J. & Murray, B. R. (2011) A comparison of short-term marking methods for small frogs using a model species, the Striped marsh frog (*Limnodynastes peronii*). *Herpetol. J*: 21: 271-273. (leigh.martin@uts.edu.au)

Mavian, C. et al. (in press) The genome sequence of the emerging Common midwife toad virus identifies an evolutionary intermediate within ranaviruses. *J. Virology*: (alejo@inia.es)

Mendoza, J. A. et al. (2011) Detection of *Batrachochytrium dendrobatidis* on amphibians in Pursat Province, Cambodia. *Herpetol. Review*: 42: 542-545. (dh49@txstate.edu)

Nair, A. et al. (2011) Infectious disease screening of Indirana frogs from the Western Ghats biodiversity hotspot. *Herpetol. Review*: 42: 554-557. (abhilash.nair@helsinki.fi)

Nowacki, A. M. et al. (2011) Lake proximity as a determinant of anuran abundance at Lago Sachavacayoc, Amazonian Peru. *S. American J. Herpetol*: 6: 234-238.

Ortiz-Santaliestra, M. E. et al. (2012) Density effects on ammonium nitrate toxicity on amphibians. Survival, growth and cannibalism. *Aquatic Toxicology*: 110-111: 170-176. (manuele.ortiz@uclm.es)

Padhye, A. et al. (2012) Population variations in the fungoid frog *Hylarana malabarica* (Anura: Ranidae) from northern Western Ghats of India. *J. Threatened Taxa*: 4: 2343-2352.

Pramuk, J. et al. (2011) An effective method for transporting hellbenders (*Cryptobranchus alleganiensis*). *Herpetol.* Review: 42: 532-534. (jennifer.pramuk@zoo.org)

Reynaud, S. et al. (2012) Toxicokinetic of benzo[a]pyrene and fipronil in female Green frogs (*Pelophylax* kl. *esculentus*). *Environmental Pollution*: 161: 206-214. (stephane.reynaud@ujf-grenoble.fr)

Rosenblum, E. B. et al. (in press) Only skin deep: shared genetic response to the deadly chytrid fungus in susceptible frog species. *Molecular Ecology*: (rosenblum@berkeley.edu)

Stark, K. et al. (in press) Effects of two stressors on amphibian larval development. *Ecotoxicology & Envtl. Safety*: (karolina.stark@ecology.su.se)

Urbina, J. C. & Galeano, S. P. (2011) *Batrachochytrium derndrobatidis* detected in amphibians of the central Andean Cordillera of Colombia. *Herpetol. Review*: 42: 558-560. (jennyurbina@gmail.com)

Van Rooij, P. et al. (2012) Detection of *Batrachochytrium dendrobatidis* in Mexican *bolitoglossine* salamanders using an optimal sampling protocol. *EcoHealth*: 8: 237-243. (pascale.vanrooij@ugent.be)

Woodhams, D. C. et al. (2012) Treatment of amphibians infected with chytrid fungus: learning from failed trials with itraconazole, antimicrobial peptides, bacteria, and heat therapy. *Diseases of Aquatic Organisms*: 98: 11-25. (dwoodhams@gmail.com)

Young, S. et al. (2012) Using community surveillance data to differentiate between emerging and endemic amphibian diseases. *Diseases of Aquatic Organisms*: 98: 1-10. (sam.young@my.jcu.edu.au)

General Announcements

Upcoming Meetings & Workshops

March

North Carolina PARC Annual Meeting. Mar 20, 2012. Weymouth Woods Sandhills Nature Preserve, Southern Pines, NC.

AZA Mid-Year Meeting. Mar 24 – 30, 2012. Palm Springs, CA. Detials: http://www.aza.org/midyearmeeting/

Smithsonian Amphibian Monitoring and Conservation Workshop. Mar 26 – Apr 6, 2012. Front Royal, VA. Visit link for more information - http://nationalzoo.si.edu/SCBI/MAB/GMU/

April

Amphibian Taxon Advisory Group's Annual Meeting. Apr 13, 2012. Miami, Florida.

Southwestern Association of Naturalists Annual Meeting. Apr 19 – 22, 2012. Valle de Bravo, Mexico. See link for more details: http://www.biosurvey.ou.edu/swan/

4th Annual Save The Frogs Day, 2012. Apr 28, 2012. Worldwide. Please visit http://www.savethefrogs.com/day

The following information can be found

Internships & Employment

at http://www.parcplace.org/resources/job-listings.html. Herp jobs are posted as a service to the herpetological community. If you would like to list a job opening for your organization, please send the announcement to herpjob@parcplace.org

MS/PhD Assistantship - Lizard Research - Texas A&M University. College Station, TX (3/9/12)

Reptile Biologist - Nevada Department of Wildlife. Nevada (3/9/12)

Lead Field Biologist - Herpetological Research and Management LLC. Lower Michigan (3/9/12)

Spiny Softshell Turtle Field Technician - Montana State University. Bozeman, MT (3/7/12)

Desert Tortoise Translocation Research Assistant. Las Vegas, NV (3/6/12)

Visiting Assistant Professor (one year) - Animal Behavior/Herpetology - Washington & Lee University. Lexington, VA (2/29/12)

Box Turtle Surveyor - Massachusetts Natural Heritage & Endangered Species Program. Westborough, MA (2/27/12)

Blandings Turtle Surveyor - Massachusetts Natural Heritage & Endangered Species Program. Westborough, MA (2/27/12)

Tenure-Track Faculty Position in Aquatic Sciences - Texas Tech University. Lubbock, TX (2/15/12)

Coastal Wildlife Diversity Biologist (Sea Turtle Stranding and Salvage) - NC Wildlife Resources Commission. New Hanover Co., NC (2/7/12)

Herp Conservation Research Assistantship - Indiana-Purdue University. Fort Wayne, IN (2/3/12)

Volunteer Field Technicians - Ornate Box Turtle Research. Nachusa Grasslands, Franklin Grove, IL (1/30/12)

Crew Leaders - Amphibian Research in the Sierra Nevada. Sonora, CA (1/19/12)

Field Technicians - Desert Tortoise Research. Reno, NV (1/24/12)

Research Intern - Restoration Ecology/Herpetology - Archbold Biological Station. South-central Florida (1/23/12)

Assistant Professor - Wildlife Ecology and Management - Purdue University. West Lafayette, IN (1/20/12)

Field Technicians - Amphibian Research in the Sierra Nevada. Sonora, CA (1/19/12)

Field Technician - Gopher Tortoise and Black Pine Snake Research. Camp Shelby Training Site, MS (1/19/12)

Field Technicians - Anuran and Turtle Surveys. Western Iowa (1/11/12)

Graduate Student Opportunity - Salamander Research - University of Alberta. Edmonton, Alberta (1/11/12)

Herpetofaunal and Small Mammal Internship. Grundy County TN (work), Huntsville, AL (housing) (1/10/12)

Reptile Keeper - Ellen Trout Zoo. Lufkin, TX (1/8/12)

Assistant Collections Manager - Reptiles - Ellen Trout Zoo. Lufkin, TX (1/8/12)

Research Assistants - Reptile and Amphibian Research in Mexico. Mexico (1/7/12)

Volunteer Assistant - Iguana Research. Dominican Republic (1/6/12)

Michigan Hereptological Intern. Lower Michigan (12/21/11)

Herpetological Research Interns - Texas A&M University. Maljamar, NM (12/21/11)

Ornate Box Turtle Summer Internship Program - Colorado Humane Society. Longmont, CO (12/21/11)

Biological Technician - Brown Treesnake Research. Guam (12/20/11)

Fish and Wildlife Biologist - Amphibian Research - Florida Fish and Wildlife Conservation Commission. Gainesville, FL (12/20/11)

Curatorial Assistant - Cheadle Center for Biodiversity and Ecological Restoration at University of California, Santa Barbara. Santa Barbara, CA (12/20/11)

Postdoctoral Research Associate - University of Maine. Orono, ME (12/19/11)

Amphibian Research Technicians - USGS Patuxent Wildlife Research Center. Laurel, MD (12/19/11)

Field Technicians - Aquatic Turtle Research - Virginia Tech. Kingston, TN (12/15/11)

Field Technicians - Amphibian Surveys. Yosemite National Park, CA (12/15/11)

Field Herpetology Interns - Archbold Biological Station. Lake Placid, FL (12/14/11)

Biological Technician (Crew Members) - Bureau of Land Management. Corvallis, OR (12/13/11)

Postdoctoral Position - Snake Systematics - University of Sao Paulo. Sao Paulo, Brazil (12/5/11)

Postdoctoral Position - Lizard Systematics - University of Sao Paulo. Sao Paulo, Brazil (12/5/11)

Institute for Applied Systems Analysis Summer Program. Vienna, Austria (12/2/11)

Herpetological Researcher/Educator Intern. Midewin Prairie, Wilmington, IL (12/1/11)

Assistant Professor - University of Wisconsin, Stevens Point. Stevens Point, WI (11/26/11)

Volunteer Research Assistant to Conduct Conservation Ecology and Tropical Herpetology Research in Mexico - Reptile and Amphibian Ecology International. Mexico (11/17/11)

Volunteer Research Assistant to Conduct Conservation Ecology and Tropical Herpetology Research in Ecuador - Reptile and Amphibian Ecology International. Ecuador (11/17/11)

Amphibian and Reptile Monitoring Technicians - Cape Cod National Seashore. Welfleet, MA (11/16/11)

MS Assistantship - Salamander Ecology - Murray State University. Murray, KY (11/10/11)

Herpetologist - North Carolina Aquarium. Pine Knoll Shores, NC (11/10/11)

Coastal Biologist - North Carolina Natural Resource Program. Raliegh, NC (11/10/11)

Genetic Resources Collection Technician – North Carolina Museum of Natural Sciences. Raleigh, NC (11/4/11)

Postdoctoral Fellowship in Salamander Conservation and Reproductive Physiology - Memphis Zoo. Memphis, TN (11/4/11)

Amphibian Conservation Assistant. Madagascar (11/2/11)

Seasonal Herpetological Research Intern - Alabama A&M University. Bankhead National Forest, Northern Alabama (10/31/11)

Director of Conservation - The Nature Conservancy in Kansas. Central Kansas (10/25/11)

Seasonal Herpetology Research Intern - Alabama A&M University. Bankhead National Forest, Northern Alabama (10/25/11)

Threatened & Endangered Species Field Biologist - Florida Fish and Wildlife Commission. Holt, Florida (10/25/11)

Lead Desert Tortoise Monitor - Natural Resources Group, LLC. Southern Nevada (10/17/11)

MS Assistantship - Desert Tortoise Research - University of California, Davis. Davis, CA (10/13/11)

Postdoctoral Scientist – Landscape Ecology and Amphibian Malformations - University of Colorado. Denver, CO (10/6/11)

PhD Assistantship - Population Dynamics of Amphibians and Reptiles - Montana State University. Bozeman, MT (9/25/11)

M.S. Assistantship - Wetland Amphibian Conservation. Ames, IA (9/23/11)

Gopher Tortoise Biologist - the Nature Conservancy. Camp Shelby, MS (9/19/11)

Assistant Professor - Vertebrate Ecology - Purdue University West Lafayette, IN (9/16/11)

Postdoctoral Fellowship - Turtle Research - Department of Fish and Wildlife Conservation, Virginia Tech Blacksburg, VA (9/14/11)

Postdoctoral Consultant - Amphibian Conservation/Reintroduction Tanzania (9/13/11)

Biological Aid - Bog Turtle and Bat Research - Delaware Natural Heritage and Endangered Species Program Smyrna, DE (9/9/11)

Threatened and Endangered Species Habitat Specialist - National Park Service Fort Collins, CO (9/1/11)

Keep In Touch

If you would like to be added to the ASG mailing list, please send an email to froglog@amphibians.org with the subject heading "add me to mailing list."
Also, follow us on Facebook for regular updates on the herpetological conservation community and the latest news from the ASG.
http://www.facebook.com/AmphibiansDotOrg

Funding Opportunities

The following information is kindly provided by the Terra Viva Grants Directory, for more information please visit: http://www.terravivagrants.org/

March 2012

African Network of Scientific and Technological Institutions (ANTSI) -- L'Oréal-UNESCO Regional Fellowships for Women. ANSTI administers the L'Oréal-UNESCO Regional Fellowships "For Women in Science" in Sub-Sahara Africa. Fellowships will be awarded for PhD research by women up to age 40 in any country of Sub-Saharan Africa. All fields of science, engineering, and technology are eligible. The awards are up to US$20 thousand. Applications should be submitted by 30 March 2012.

Australian Government -- Australia Leadership Awards 2012. The Australian government makes a significant contribution to the education of talented individuals in the developing countries through its Leadership Awards. The subject areas for study correspond to priorities of Australia's aid programs by regions and countries— and include agriculture, energy, natural resources, and environment. The deadlines for Development Scholarships and Leadership Award Scholarships are in February, March, April, and May — varying by country.

European Union Central European Initiative -- CEI University Network 2012. The CEI University Network (CEI UniNet) promotes joint university programs in the 18 CEI countries. Thematic areas of cooperation include "Environment and Sustainable Development." Priority is for participation of universities from non-EU Member States (Albania, Belarus, Bosnia and Herzegovina, Croatia, Macedonia, Moldova, Montenegro, Serbia, and Ukraine). The application deadline is 26 March 2012.

Global Biodiversity Information Facility -- Young Researchers Award 2012. The GBIF invites proposals from graduate students for the 2012 Young Researchers Award. The prize aims to foster innovative research and discovery in biodiversity informatics. GBIF will make two awards of €4 thousand each. Nominations are submitted through GBIF's representatives in its voting and associate countries. The deadline for nominations is 15 March 2012.

Nando Peretti Foundation -- Environmental Conservation 2012. Among a broad range of interests, the Nando Peretti Foundation makes grants to nonprofit organizations for environmental conservation. Most past grants have supported projects in Italy and developing countries. There is no pre-defined budget limit. Applications will be accepted 20 February 2012 through 10 March 2012.

Schwab Foundation for Social Entrepreneurship -- Global Competition 2012. The Schwab Foundation for Social Entrepreneurship fosters social entrepreneurs as a catalyst for innovation and progress. Categories include agriculture, animals, biodiversity, energy, environment, waste management, and water (among others). The Social Entrepreneur of the Year Competitions take place in different world regions. Winners are invited to the regional meetings of the World Economic Forum, and are offered other networking opportunities. The Global Competition has a deadline of 15 March 2012.

UK Science and Technology Facilities Council (STFC) -- Global Challenge Networks 2012. The STFC will provide funding for new multi-disciplinary research networks in energy, health care, and environment. Themes in energy include solar devices. Themes in environment include tropical forests, pollution, and others. Each network should be a new collaboration based in the UK, but open to collaboration with other countries. The amount of funding that can be applied for will be limited to £100 thousand per year for up to three years. The closing date is 29 March 2012.

United Nations University - Institute of Natural Resources in Africa -- Research Support 2012. UNU-INRA offers funding for research related to the development and management of natural resources in Africa. The Visiting Scholars Program is for researchers in Africa and worldwide who have their research data, but who need work stations and funding to be able to prepare publications. Applications are invited from PhDs in agricultural sciences, environmental sciences, economics, social sciences, international relations, law, and related disciplines. UNU particularly invites female Africans to apply. UNU will provide US$1,500 per month for researchers who spend at least three months with UNU-INRA in Accra. The deadline for applications is 15 March 2012.

April 2012

African Union -- Research Grants 2012. With funding from the European Commission, the African Union Commission invites proposals for research in post-harvest and agriculture; renewable and sustainable energy; and water and sanitation in Africa. Eligibility extends to most European, African, and other developing (ACP) countries — and OECD/DAC countries for actions in the least-developed African countries. The AU favors proposals from consortia of scientists in at least three ACP countries, including two or more countries in Africa. Grants range from €500 thousand to €750 thousand, subject to co-financing requirements. The deadline for applications (English or French) is 20 April 2012.

Australian Government -- Australia Leadership Awards 2012. The Australian government makes a significant contribution to the education of talented individuals in the developing countries through its Leadership Awards. The subject areas for study correspond to priorities of Australia's aid programs by regions and countries — and include agriculture, energy, natural resources, and environment. The deadlines for Development Scholarships and Leadership Award Scholarships are in February, March, April, and May — varying by country.

British Ecological Society -- Small Ecological Project Grants. The SEPG supports individuals to undertake small pilot projects in any aspect of ecological research or survey. There are no restrictions on nationality or residence, or where the research work is carried out. The grant covers up to £1,000 for travel costs, and up to £1,500 for other expenses. Applicants must be members of BES, except for applicants in low and middle-income countries. The closing dates for applications are 01 April and 01 November.

Cleveland Metroparks Zoo -- Scott Neotropical Fund 2012. The Scott Neotropical Fund makes grants for conservation of wildlife in the neotropics (Mexico, Caribbean, Central America, and South America). Grants support research, training, and technical assistance with the aim of benefiting local communities along with providing wildlife protection. The primary investigator must be resident in the neotropical region. Grants are US$3 thousand to US$5 thousand. The application deadline is 06 April 2012.

European Commission (EC) -- Kolarctic, 4th Call for Proposals. Kolarctic supports cross-border strategies between Russia, Finland, Sweden, and Norway in the Barents region of the Arctic. Projects may include issues related to environment and natural resources (e.g., fisheries, plant resources, etc.). Each proposal must have at least one actor from the EU (Sweden, Finland) and at least one from Russia. Eligibility requirements, and the rules on Lead Partners and partners, are explained in the call for proposals. The deadline for applications is 16 April 2012.

May 2012

Australian Government -- Australia Leadership Awards 2012. The Australian government makes a significant contribution to the education of talented individuals in the developing countries through its Leadership Awards. The subject areas for study correspond to priorities of Australia's aid programs by regions and countries — and include agriculture, energy, natural resources, and environment. The deadlines for Development Scholarships and Leadership Award Scholarships are in February, March, April, and May — varying by country.

Otto Kinne Foundation -- Awards in Ecology 2012. Each year, the Otto Kinne Foundation invites nominations from research ecologists worldwide for the Ecology Institute Prize (€6 thousand) and the IRPE Prize (€3 thousand). In 2012, the Foundation calls for nominations of ecologists distinguished for outstanding achievements in limnetic ecology. The deadline for nominations is 31 May 2012.

U.S. Agency for International Development -- Forests and Land Use in Colombia, Ecuador, and Peru. USAID -- in collaboration with other U.S. government agencies and the Moore Foundation -- funds sustainable forest management and land use in Ecuador, Colombia, and Peru through the program "AmaZONAS Andinas." The objective is to reduce greenhouse gas emissions through forest monitoring, demonstration projects, and capacity strengthening. Grants are up to US$5 million. Applications are invited from U.S. institutions of higher education, nonprofit organizations, and regional NGOs in Latin America and the Caribbean. Funding Opportunity USAID-W-OAA-GRO-11-00603. The due date for the next round of applications is 31 May 2012.

June 2012

Council for the Development of Social Science Research in Africa (CODESRIA) -- Comparative Research Networks 2012. CODESRIA supports researchers in African universities and research centers through funding for Comparative Research Networks. The networks address priority research themes within CODESRIA's strategic plan, including (among others): (i) Water and Water Resources in the Political Economy of Development and Citizenship; (ii) Ecology, Climate, and Environmental Sustainability in Africa; (iii) the Changing Political Economy of African Natural Resources; and (iv) Agrarian Transformation. Most grants range from US$10 thousand to US$30 thousand. The application deadline is 15 June 2012.

Pro Natura Fund -- Grants 2012. The Fund makes grants in biodiversity conservation in Japan and developing countries. Most grants are about US$10 thousand, or the equivalent in yen. The application for international grants, i.e., from the developing countries, is 01 - 07 June. The Fund reminds applicants to check the guidelines each year to confirm the latest details (Note: using internet translation, if required).

World Food Prize Foundation -- Norman Borlaug Award for Field Research and Application. The World Food Prize Foundation, with support from the Rockefeller Foundation, invites nominations for the first annual "Norman Borlaug Award for Field Research and Application." The award will go to an individual under age 40 who works directly in the field -- or at the production or processing level -- with farmers, animal herders, fishers, or others in rural communities. The award can be made to individuals in any discipline or enterprise across the chain of food production, processing, and distribution. The amount of the award is US$10 thousand. Nominations should be submitted before 30 June 2012.

Zoo Boise Conservation Fund -- Wildlife Grants 2012. Zoo Boise makes grants up to US$30 thousand for wildlife conservation in Idaho (USA) and internationally. Grants support habitat restoration, wildlife conservation and management, community-based conservation, and other goals consistent with Zoo Boise's master plan. Project proposals are accepted from conservation organizations around the world. The application period is 01 April 2012 through 30 June 2012.

FrogLog Schedule

January - South America
March - Europe, North Africa and West Asia
May - North and Central America and the Caribbean
July - Sub Saharan Africa
September - Mainland Asia
November - Maritime Southeast Asia and Oceania

Robin Moore / iLCP

2012 Amphibian Ark calendars are now available!

The twelve spectacular winning photos from Amphibian Ark's international amphibian photography competition have been included in Amphibian Ark's beautiful 2012 wall calendar. The calendars are now available for sale, and proceeds from sales will go towards saving threatened amphibian species.

SALE

Now only $5

Pricing for calendars varies depending on the number of calendars ordered – the more you order, the more you save! Orders of 1-10 calendars are priced at **US$15 each**, orders of between 11-25 calendars drop the price to US$12 each, and orders of 26-99 are priced at just US$10 each. (These prices do not include shipping)

As well as ordering calendars for yourself, friends and family, why not purchase some calendars for re-sale through your retail outlets, or for gifts for staff, sponsors, or for fund-raising events?

Order your calendars from our web site:
www.amphibianark.org/calendar-order-form/

Remember – as well as having a spectacular calendar to keep track of all your important dates, you'll also be directly helping to save amphibians, as all profits will be used to support amphibian conservation projects.

www.amphibianark.org

Instructions to Authors

Background

FrogLog has been one of the leading amphibian conservation community newsletters since the early 1990's. Over the years it has been affiliated with different groups but has always strived to help inform the community. In 2005 FrogLog became the official newsletter of the IUCN SSC Amphibian Specialist Group and is produced on a bimonthly basis.

As the ASG's newsletter members are encouraged to contribute to FrogLog's content and direction. To aid in this process each edition of FrogLog focuses on one of the six broad geographical zones identified by the ASG. The publication schedule is as follows:

- January - South America
- March - Europe, North Africa and West Asia
- May - North and Central America and the Caribbean
- July - Sub Saharan Africa
- September - Mainland Asia
- November - Maritime Southeast Asia and Oceania

FrogLog invites contributions of research, reviews on current management and conservation issues, methods or techniques papers and, editorials. We also actively encourage submissions describing the current activities relating to projects and academic institutions in order to help inform the community as to the general state of current research and conservation activities.

Publication

FrogLog is published online at www.amphibians.org and is open access.

Review

All contributions should ideally be channeled through Regional ASG Chairs, the details for which can be found at http://www.amphibians.org/resources/asg-members/. If for some reason this cannot be done, contributions will be reviewed by at least one individual within the ASG. FrogLog is not a peer reviewed publication and the onus for submitting accurate information remains with the authors.

Production Editor

James P. Lewis (jplewis@amphibians.org)

Editorial Committee

- James P. Collins (ASG Co-Chair)
- Claude Gascon (ASG Co-Chair)
- Phillip J. Bishop (ASG Deputy Chair)
- Robin D. Moore (ASG Program Officer)
- Craig Hassapakis (Co-editor, Amphibian and Reptile Conservation)
- (Note: Additional reviewers will be requested as required)

Submission of Manuscripts

Manuscripts can only be received as electronic files. Text should be submitted in MS Word format and may contain tables, but figures should be sent as a separate attachment where possible. All documents should be sent to James Lewis at jplewis@amphibians.org. Each file should be labeled in a style that illustrates clear association, i.e., authors_name_text and authors_name _figure1.

Guidelines for Authors

All manuscripts must be written in English.

Title

Titles should ideally be no more than 15 words.

Authors

Authors names should be written in full as follows: By James P. Lewis & Robin D. Moore

Main body of text

Use Georgia 11-point font. Genus and species names should be in italics as should the abbreviation for *Batrachochytrium dendrobatidis*, *Bd*. Suggested headings include Acknowledgements, Author Details, and Literature Cited.

Author details

Author details should be provided at the end of the article after any acknowledgements. They can include as much or little information as the authors wish to provide.

Figures

Figures should be numbered and include brief, concise legends. Where photographs or illustrations are used please state whom the image should be credited to, e.g., Photo: James P. Lewis. Graphics should preferably be submitted in tiff or jpeg format in the highest possible quality. Resolution should be at least 300 dpi at the final size.

Tables

Tables may be included within the text file and should be numbered and include brief, precise legends.

Citation of literature

List all literature cited in text in alphabetical (author names) and chronological (year) order. Please adhere closely to suggested format.

Journals/Periodicals

Hamer AJ, Mahony MJ (2007) Life-history of an endangered amphibian challenges the declining species paradigm. Australian Journal of Zoology 55(2): 79-88.

Books

Mallari, N. A. D., B. R. Tabaranza, Jr., and M. J. Crosby. (2001) Key conservation sites in the Philippines: A Haribon Foundation and BirdLife International directory of Important Bird Areas. Bookmark, Inc., Makati City. 485 pp.

Papers from books

Alford, R. A. (2010) Declines and the global status of amphibians. Pp. 13-46 In Sparling, D.W., Lindner, G., Bishop, C.A., and S. K. Krest, eds. Ecotoxicology of Amphibians and Reptiles, 2nd edition. SETAC press, USA, pp. 916.

Papers in Conference Proceedings

Berger, L., Speare, R., Daszak, P., Green, D. E., Cunningham, A. A., Goggin, C. L., Slocombe, R., Ragan, M. A., Hyatt, A. D., McDonald, K. R., Hines, H. B., Lips, K. R., Marantelli, G. and H. Parkes. (1998) Chytridiomycosis causes amphibian mortality associated with population declines in the rainforests of Australia and Central America. Proceedings of the National Academy of Science USA 95: 9031-9036.

Web sites/Electronic Resources

EDGE. (2009) "The Zoological Society of London 2008: Top 100 Evolutionarily Distinct and Globally Endangered amphibians." Retrieved April, 2009, from http://www.edgeofexistence.org/amphibians.

Disclaimer

Coming up in FrogLog Vol. 102

North and Central America and the Caribbean

Updates from North and Central America and the Caribbean

Recent Publications

Grants

and much more...

May 2012

Photo: James Lewis