Diversity and Conservation of Amphibians in South and Southeast Asia*

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Abstract

The southern and southeastern parts of Asia host high amphibian biodiversity and comprise four biodiversity hotspots. 285 amphibian species are endemic to South Asia, 342 are distributed in India and 119 in Sri Lanka. Here we document the distribution, threats, and conservation status of amphibians in the major countries of southern and southeastern Asia (India, Bangladesh, Sri Lanka, Pakistan, and China) and list smaller countries with species numbers. Conservation is an umbrella concept that is fundamental yet paradoxical. Training programmes, workshops for students, bio-banking, and the publication of field guides in local languages are urgently needed to conserve amphibian biodiversity in this part of the world.

Key Words: Amphibia: biodiversity; endemism; threats; conservation; Red List status; South Asia, Southeast Asia: country by country.

Introduction

A total of 19,232 species were discovered as new to science in the year 2009. The majority these were plants and insects, but amongst the remaining species, 148 were amphibians (HANCE 2012). Despite a global decline in the number of amphibians over the past 25 years, the number of species has skyrocketed. David WAKE, a biology professor at the University of California, described the 7,000th amphibian taxon in July of 2012 according to the catalogue maintained by FROST (2013), a project which since 2000 has been striving to document every extant amphibian taxon on earth. The 'new' species total of about 3000 means that scientists have defined a previously unknown amphibian every two and a half days since 1987. Nevertheless, about 41 percent of amphibian species are at risk of extinction, according to an assessment by the International Union for the Conservation of Nature and Natural Resources (IUCN) in June of 2012. Some of them are already extinct. Over the past few years, 50 new species of amphibians were discovered in Sri Lanka alone (Pethiyagoda & Manamendra-Arachchi 1998). In recent times, Brazil, Peru, India, and China have taken the lead in claiming the most new species. Three new species were being discovered per week, and a total of about 100 new species were described

in 2012. Most of the new species, however, have yet to be carefully evaluated. They are poorly known, often only from a single population, and many are from areas with limited habitats that are under intense pressure due to land conversion and other factors. 2013 was a dynamic year for amphibians and FROST (2013) added 146 new taxa, 944 new photos, 30 new call recordings, and 62 new species accounts. The current number of amphibian species is 7,215 as of 22 December 2013 (FROST 2013).

In this paper, we discuss the diversity and conservation of amphibians in South and Southeast Asia. We have documented the updated and available information (also included is a checklist with the red list statuses of amphibians in this region) on the diversity of amphibians in South and Southeast Asia and China.

Amphibians in South and Southeast Asian countries

South Asia, as identified by the United Nations, comprises nine countries (Afghanistan, Bangladesh, Bhutan, India, Maldives, Iran, Nepal, Pakistan, and Sri Lanka) and is an area of great importance for conservation both in terms of species diversity and conservation threats. The region continues to gain global economic importance in the world with a human

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population estimated at 1.7 billion-approximately one fifth of the world's population. South Asia hosts three biodiversity hotspots: Eastern Himalayas, Indo-Burma and Western Ghats-Sri Lanka. Recent assessments indicate that 20 of this region's species must be classified as Extinct, 26 Critically Endangered, 66 Endangered, 26 Vulnerable, 11 Near Threatened, 30 Least Concern, and 77 are Data Deficient (MOLUR 2008). As per GAA records (IUCN 2006), 285 amphibian species are endemic to South Asia, with 256 species being endemic to only a single country and 29 having a distribution that extends over more than one country. A total of 348 amphibian taxa are currently described from the region, and India and Sri Lanka feature very prominently with regard to amphibian diversity.

Southeast Asia consists of two geographic regions: Mainland Southeast Asia, also known as Indochina, comprising Cambodia, Laos, Myanmar, Thailand, Vietnam and Peninsular Malaysia, and Maritime Southeast Asia, comprising Brunei, East Malaysia, East Timor, Indonesia, the Philippines, Christmas Island, and Singapore. More than 700 species of amphibians are known to exist in Southeast Asia (IUCN Red List 2009), and the region hosts four major biodiversity hotspots (MYERS et al. 2000): Wallacea, Sundaland, Indo-Burma, and the Philippines.

In general, these animals are at a high risk of extinction before we even know of their existence.

Amphibians Diversity and Conservation in South Asia Afghanistan: Ten amphibian species (5 Bufonidae, 3 Dicroglossidae, 1 Ranidae and 1 Hynobiidae) have been documented (of which 8 species are classified as Least Concern and one Data Deficient). Species like Duttaphrynus olivaceus (BLANFORD, 1874) and Bufotes surdus (BOULENGER, 1891) are possibly present (MOLUR 2008). The entirely aquatic salamander Afghanodon mustersi (SMITH, 1940) (Paghman Mountain salamander) is endemic. Currently Afghanodon mustersi is thought as being critically endangered, but no conservation measures are currently being undertaken for this species, because of the ongoing unrest. It is clear that some habitat protection must be effected for this species to prevent its extinction. The impact of the war is not completely known, but it certainly renders surveys and conservation efforts very difficult.

Bangladesh: Thirty-three amphibian species (2 Bufonidae, 14 Dicroglossidae, 3 Megophryidae, 5 Microhylidae, 3 Ranidae and 6 Rhacophoridae) are known from this country of which 25 species are considered Least Concern according to the IUCN Red List. Habitat destruction, pesticides, climate change, and human population expansion are the main causes of amphibian decline. Amphibian conservation is ignored and little work has been conducted on revealing the local threats to amphibians. Kerry KRIGER, founder of "Save the Frogs" is now collaborating with Shahneaz Ali KHAN to establish a branch of the organization in this country. Species like Duttaphrynus melanostictus (SCHNEIDER, 1799), Euphlyctis cyanophlyctis (SCHNEIDER, 1799), Fejervarya limnocharis (GRAVENHORST, 1829), Hoplobatrachus crassus (JERDON, 1854), Hoplobatrachus tigerinus (DAUDIN, 1803), Kaloula pulchra (GRAY, 1831), Microhyla ornata (DUMÉRIL & BIBRON, 1841), Microhyla rubra (JER-DON, 1854), Uperodon globulosus (GÜNTHER, 1864), Uperodon systoma (SCHNEIDER, 1799), Polypedates leucomystax (GRAVENHORST, 1829), and Polypedates maculates (GRAY, 1830) are widely distributed. Chiromantis doriae (BOULENGER, 1893) is reportedly common in China, but uncommon in Southeast Asia, and even rare in India and Bangladesh. It generally inhabits open grassy areas. Limnonectes laticeps (BOULENGER, 1882), found recently in southeastern Bangladesh, is a medium-sized frog otherwise known from northeastern India, Myanmar and some regions in Thailand. Only two or three species of the genus Micryletta have been reported from Bangladesh, including an adult specimen from the northeastern region that still needs to be identified, and the others representing Micryletta inornata (BOULENGER, 1890), a species known from the Andaman Islands, Mengla in southern Yunnan, China, throughout Thailand, Lao PDR, Cambodia, Vietnam, and Peninsular Malaysia, and Micryletta stejnegeri (BOULENGER, 1909), a species with a fragmented distribution in central and southern Taiwan. Hylarana temporalis (GÜNTHER, 1864) is also found in Bangladesh but its population shows a decreasing trend due to the ongoing conversion of forested land into agricultural fields.

Bhutan: The herpetofauna of this country is not well known. Bhutan occupies approximately 47,000 km² in the eastern Himalayas. Seven species of amphibians (2 Bufonidae, 2 Dicroglossidae, 1 Megophryidae, 1 Rhacophoridae and 1 Salamandridae) are known from here of which five are Least Concern, one Vulnerable and one Data Deficient according to the 2013 IUCN Red List. At least the Himalayan newt needs urgent conservation measures. Considering the poor state of knowledge of this country's amphibians, some species might become extinct even before they are discovered for science. Amphibians are typically recorded from rice paddies, roadside habitats and the forests in the



areas of Toebisa, Kabjisa, and Kazhi. *Polypedates maculatus* (GRAY, 1830), *Nanorana liebigii* (GÜNTHER, 1860), *Megophrys* cf. *nankiangensis* (LIU & HU, 1966), and *Amolops* cf. *monticola* (ANDERSON, 1871) were recorded only recently. *Scutiger bhutanensis* DELORME & DUBOIS, 2001, the Bhutan cat-eyed toad, is endemic.

India: India's forests represent one of the twelve mega-biodiversity regions of the world, and the Western Ghats and Eastern Himalayas are amongst the 32 biodiversity hotspots on earth. According to one study, this region is also one of top-10 countries with the largest primary forest coverage in the world. India's 0.6 percent average annual rate of deforestation for agricultural land is increasing at an alarming rate, though. The 2009 Indian National Forest Policy emphasizes the need for combining sustainable forest management with India's effort at forest conservation.

The Zoological Survey of India (ZSI), a leading institution under the Ministry, has been undertaking surveys that include the exploration of, and research in, the region, which has been aiming at increasing our knowledge of the remarkably rich faunal diversity of the country since its inception in 1916. With its headquarters in Kolkata and 16 regional centres in different parts of the country, the ZSI has in recent years re-orientated its plan of work by grouping its survey and study projects in the following six major programmes:

- 1. Fauna of states
- 2. Fauna of conservation areas
- 3. Fauna of important ecosystems
- 4. Status survey of endangered species

5. Ecological studies/environmental impact assessment surveys

6. Computerization and dissemination of data

Thus, the ZSI provides: (1) status surveys of endangered species; (2) identification and supporting protection of endangered wildlife to the WCCB, Customs and Forest Department; (3) information on the faunal diversity of protected areas; and (4) is instrumental to the Biological Diversity Act of 2002, which acknowledges the sovereign rights of states to use their own biological resources. This Act aims at conserving biological resources and associated knowledge as well as facilitating access to them in a sustainable manner by means of a just process for justified purposes. In 2010, the ZSI documented a total of 311 amphibian species (DINESH et al. 2010). Out of these, 46 species are found in the state of West Bengal. The Wildlife Protection Act of 1972 provides for the protection of wild animals, birds, and plants. Unfortunately, the central conservation focus is on large charismatic animals. The effects of insecticides and other pesticides on amphibians are not widely acknowledged, because current regulations by the Indian Environmental Protection Agency do not require the testing of agrochemical products on amphibians.

During 2012, 133 new species were discovered and described and 109 new locality records were reported on. The toads Duttaphrynus beddomii (GÜNTHER, 1876), D. brevirostris (RAO, 1937), D. hololius (GÜN-THER, 1876), D. parietalis (BOULENGER, 1882), D. silentvalleyensis (PILLAI, 1981), Xanthophryne koynayensis (SOMAN, 1963), and the caecilian Gegeneophis carnosus (BEDDOME, 1870) are endemic to the Western Ghats (one of the biodiversity hotspots), and Raorchestes terebrans (DAS & CHANDA, 1998) is endemic to the Eastern Ghats. Limnonectes khasianus (ANDERSON, 1871), L. mawlyndipi (CHANDA, 1990) and Fejervarya orissaensis (DUTTA, 1997) are also endemic to India. According to the IUCN Red List of Threatened Species (April 2013), the global status of amphibians is 23.68% Data Deficient, 21.93% Not Evaluated, 30.12% Least concern, 2.63% Near Threatened, 7.02% Vulnerable, 9.36% Endangered, 4.97% Critically Endangered, and 0.29% Extinct. Out of the 342 species of amphibians known from the country, 75 are yet to be evaluated and 81 are still classified in the Data Deficient category. Lost Amphibians of India (LAI) is a nation-wide campaign aiming at rediscovering more than 50 "lost" amphibian species. A primary goal of this project is to generate interest in, and awareness of, conserving vanishing biodiversity in general and specifically to protect the most threatened vertebrates on earth: amphibians. The LAI now has more than 600 team members who conducted about 42 expeditions. This initiative is unique in that it involves civil society in conservation initiatives and has a huge impact on the conservation of amphibians. The open trade in frogs and other wildlife needs strict control measures with awareness about the illegality of the whole business. The cruelty involved in breaking the bones or joints of live frogs to keep them from escaping before they are sold and killed for consumption is shocking, and there appears to be little awareness of the use of wildlife in this barbaric manner.

The northeastern region of the country is an important part of the Indo-Burma biodiversity hotspot. The diversity of habitats along various altitudinal gradients presumably contributes substantially to the biodiversity status of the region. However, the region's biodiversity is still poorly assessed. This is evident from the 25 species of amphibians that were described as new to science during the last 7 years. Taxonomists are today working on many more potentially



Ichthyophiidae



Fig. 1: Ichthyophis longicephalus PILLAI, 1986 from Silent Valley, Western Ghats, Kerala. Records from elsewhere are in Tamil Nadu, Karnataka and Maharashtra, India.

Salamandridae



Fig. 2: Cynops cyanurus (LIU, HU & YANG, 1962) from Saint Louis Zoo, USA (in captivity); this species is endemic to Yunnan, China.

Fig.	Neurergus I	kaiseri Schmidt,	1952 from 2	Zagros M	ountains c	of W Iran	where it	is endemi	с.	
Fig.	4: Pachytrito	n inexpectatus	s Nishikawa,	JIANG, MAT	rsui & Mo, 2	2011 is k	known fro	om E Guizl	hou, SW	/ and

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S Hunan, NW Guangdong, and N and E Guangxi, China. **Fig. 5:** *Paramesotriton caudopunctatus* (Hu, ZHAO & LIU, 1973) is known from SE Chongqing, SW Hunan, E Guizhou, and E Guangxi (Fuchuan) in central China.

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Fig. 6: *Tylototriton shanjing* (NUSSBAUM, BRODIE & YANG, 1995) from Saint Louis Zoo, USA (in captivity); this species is only known from Yunnan, China. © G. M. Rosa

new species from the region. The current number of amphibian species from the northeast (excluding Sikkim-Darjeeling) is 126, including 45 that are endemic to this region. The northeast and the Western Ghats are the best places to go look for amphibians. Northeastern India's forests are now being destroyed primarily for jhoom cultivation (a form of tribal agriculture), amongst other reasons, however.

Iran: The amphibian fauna of Iran consists of about 15 species of frogs and toads, and 7 species of salamanders (POUYANI et al. 2011). No effective conservation system is in place. *Bufotes luristanicus* (SCHMIDT, 1952), *Rana pseudodalmatina* EISELT & SCHMIDT-LER, 1971, *Iranodon gorganensis* (CLERGUE-GAZEAU & THORN, 1979), *Neurergus kaiseri* SCHMIDT, 1952, and *N. derjugini* (NESTEROV, 1916) *are endemic*. There are conservation programs and projects by the Department of the Environment (DOE) that try to expand and increase the knowledge of the country's herpetofauna.

Maldives: Only two amphibians species (*Duttaphry-nus melanostictus* and *Hoplobatrachus tigerinus*) have been documented, with the former having a more widespread presence. The illegal trade in wildlife is one of the challenges of nature conservation. No specific conservation measures exist to protect amphibians.

Nepal: Forty-three species of amphibians (3 Bufonidae, 21 Dicroglossidae, 1 Microhylidae, 5 Megophryidae, 7 Ranidae and 6 Rhacophoridae) have been documented from the country, of which 25 species are classified as Least Concern. *Scutiger nepalensis* DUBOIS, 1974, *Amolops marmoratus* (BLYTH, 1855), *Hylarana chitwanensis* (DAS,1998), *Nanorana rarica* (DUBOIS, MATSUI & OHLER, 2001), and *N. rostandi* (DUBOIS, 1974), are endemic. ARCO-Nepal (Amphibian and Reptile Conservation) has been working since 1997 to promote the knowledge of the local herpetofauna and conservation in general. They use public education campaigns to spread information, and provide training for schools and colleges, institutes and national park staff, as well as initiate conservation projects to help conserve reptiles and amphibians.

Pakistan: Twenty-five species of amphibians (10 Bufonidae, 1 Megophryidae, 2 Microhylidae, 12 Ranidae) have been documented from the country. The frogs of the genera Allopaa and Chrysopaa and several high-altitude toads of the genera Duttaphrynus and Bufotes dominate in the western, central, and eastern Himalayas, whereas 8 wide-ranging plains species are mostly concentrated in the Indus Valley, running along the riverine tracts in Punjab and Sindh, and a few of these extend to higher altitudes of the sub-Himalayas (KHAN 2006). Bufotes pseudoraddei (MERTENS, 1971) and Sphaerotheca strachani (MURRAY, 1884) are endemic. Threats to amphibians are mainly the same as those faced by all amphibians: Environmental changes that incur a rise in temperatures, dryness, increasing human encroachment on natural habitats, pollution, and the destruction of wetlands. The riparian habitats in the Indus Valley, which once teemed with amphibians during monsoons and had their croaking proverbially echoing throughout the valley for days on end, are now nearly devoid of amphibians. Many localities across the valley, which were once important breeding sites, are now silent. They have shrunk or disappeared altogether and been replaced with large industrial complexes or residential areas, or converted for agricultural purposes. Meandering networks of roads have fragmented entire ecosystems and keep on killing toads and frogs (KHAN 1990).

Frogs and toads are distributed from sea level to almost 4,000 m above in Pakistan (Fig. 1). No single species encompasses this entire range, though, and every species faces threats specific to the localities in its distribution range, differing from place to place. *Duttaphrynus olivaceus* (BLANFORD, 1874), *Bufotes surdus* (BOULENGER, 1891) and *Zakerana syhadrensis* (ANNANDALE, 1919) are restricted to relatively low areas, while other species such as *Duttaphrynus himalayanus*, *Scutiger nyingchiensis* FEI, 1977, and *Bufotes pseudoraddei baturae* (STÖCK, SCHMID, STEINLEIN & GROSSE, 1999), are restricted to high altitudes; the remaining species have broad vertical ranges from low to middle altitudes. *Duttaphrynus stomaticus* (LÜTKEN, 1864) is a eurytopic species with the greatest vertical



Bufonidae



Fig. 7: Adenomus kelaartii (GÜNTHER, 1858) is known only from the wet zone of Sri Lankas.	© K. D. B. Ukuwela
Fig. 8: Ansonia kraensis Matsui, Khonsue & Nabhitabhata, 2005 from Khao Lak NP, Phang Nga, S Thailand. Know	wn
only from some places in Peninsular Thailand.	© F. TILLACK
Fig. 9: Ansonia hanitschi INGER, 1960 from Mt. Kinabalu, Sabah; known only from the mountains	
of Borneo.	© U. Manthey
Fig. 10: Ansonia malayana INGER, 1960 from Bukit Larut, Perak; only known from some places	
in West-Malaysia.	© U. Manthey
Fig. 11: Bufoides meghalayana (YAZD & CHANDA, 1971) from Cherrapunjee (Meghalaya); also known fro	m
East Khasi Hills, Meghalaya; Assam and Mizoram, India.	© K. Deuti
Fig. 12: Duttaphrynus himalayanus (GÜNTHER, 1864) from Sebyok (Darjeeling, West Bengal, India);	
widely distributed throughout the Himalayan mountains. It is found from Pakistan through N India and Ne	epal
to Xizang and NW Yunnan, China.	© K. Deuti





Fig. 13: Duttaphrynus melanostictus (SCHNEIDER, 1799); occurs widely from northern Pakistan through Nepal, Bangladesh, India (incl. Andaman and Nicobar Is.), Sri Lanka, S China (incl. Taiwan, Hong Kong and Macau), Myanmar, Laos, Vietnam, Cambodia and Thailand to West-Malaysia, Singapore, and Indonesia (Sumatra, Java, Borneo). © A. RAZZAQUE Fig. 14: Duttaphrynus microtympanum (BOULENGER, 1882) from Munnar, Kerala, India; found only in S India and disjunct in Nepal. © S. Das Fig. 15: Ghatophryne ornata (GÜNTHER, 1876) from Wayanad District, Kerala; endemic to the Western Ghats, India. © S. DAS Fig. 16: Ghatophryne rubigina (PILLAI & PATTABIRAMAN, 1981) from the Nilgiri Hills, endemic to the Western Ghats, India. © S. Das Fig. 17: Ingerophrynus divergens (PETERS, 1871) from Gunung Gading, Sarawak, Borneo; also recorded from Sumatra and S Thailand. © U. MANTHEY Fig. 18: Ingerophrynus kumquat (DAs & LIM, 2001) from Marang, Terengganu, West-Malaysia; © U. MANTHEY endemic to Peninsular Malaysia.





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Fig. 19: Pedostibes tuberculosus GUNTHER, 1876 from Wayanad District, Kerala, endemic to the	
Western Ghats, India.	© S. Das
Fig. 20: Pelophryne signata (BOULENGER, 1895) from Santubong, Sarawak; distributed in Borneo, Sumatra	
and West-Malaysia. 🦚	O U. M anthey
Fig. 21: Phrynoidis asper (GRAVENHORST, 1829) from Pulau Langkawi, Perlis, West-Malaysia; widely distribut	ed
from S Myanmar through Thailand and West-Malaysia to Sumatra, Borneo, and Java; it is also found	
in Vietnam. 🧯	O U. Manthey
Fig. 22: Phrynoidis juxtasper (INGER, 1964) from Ketambe, Aceh, Sumatra; known only from Borneo	
and Sumatra. ©	I. MANTHEY
Fig. 23: Pseudobufo subasper (Duménil & Bibron, 1841) from Sabak Bernam, Selangor, West-Malaysia;	
outside the Peninsular it is known from Sumatra, and Borneo.	© I. Das
Fig. 24: Sabahphrynus maculatus (Mocquard 1890) from Crocker Range, Sabah; endemic	
to Sabah, Borneo.	© M. Matsui





Map 1: Frogs and toads are common in Pakistan from sea level to almost 4.000 m above.

distribution range from sea level to above 2,400 m, occurring in a number of habitats. In the Indus Valley, it occurs sympatric with Microhyla ornata, Euphlyctis cyanophlyctis, Fejervarya limnocharis, Zakerana syhadrensis, Hoplobatrachus tigerinus, Duttaphrynus olivaceus and Sphaerotheca breviceps (SCHNEIDER, 1799). The Baloochistan olive toad, Bufo olivaceus, ranges from the northern Himalayan foothills to the Indus Valley, where it is rare and spottily distributed. The dicroglossid genera Euphlyctis, Fejervarya, and Hoplobatrachus are typical of riparian Punjab. The burrowing frog (Sphaerotheca breviceps) descends into the plains and while it is spottily distributed in the Punjab, it occurs more commonly along lower river courses and even reaches the coast. The northern cricket frog (Limnonectes *limnocharis*) from the upper Indus Valley is replaced by Z. syhadrensis in the lower Indus Valley. Duttaphrynus olivaceus, like D. stomaticus, is wide-ranging, occurring from the plains to the northern and western foothills. While Duttaphrynus himalayanus and Allopaa hazarensis (DUBOIS & KHAN, 1979) are sub-Himalayan in distribution, *Bufotes pseudoraddei baturae* and *B. latastii* (BOULENGER, 1882) are northeastern Himalayan highland forms, and *B. surdus* and *B. zugmayeri* (EISELT & SCHMIDTLER, 1973) are southwestern Baloochistan species. The Tibetan species *Scutiger nyingchiensis* extends into meadows and wetlands in the northeastern parts of the country. The southern Asian ant-frog, *Microhyla ornata*, ranges from the upper Indus Valley to the sub-Himalayas, but does not extend into Baloochistan and the lower Indus Valley. The secretive south Indian microhylid *Uperodon systoma* is a fossorial species that has been collected at Islamabad in the Potohar Tablelands (KHAN 2011).

Sri Lanka: The tropical island has a total landmass of 65,610 km² with a mostly low flat terrain to rolling plains and mountains in the south-central interior. Together with the Western Ghats, the island is considered a biodiversity hotspot (MYERS et al. 2000).



Hylidae



Fig. 25: *Hyla annectans* (JERDON, 1870) from Kohima (Nagaland), other localities in NE India are in Assam, Meghalaya, Mizoram, and Arunchal Pradesh. More locations are known in SW and central China, N Myanmar, N Thailand, and Vietnam.

Megophryidae



 Fig. 26: Borneophrys edwardinae (INGER, 1989) is a very rare species found only on some places in Borneo.
 © CH'IEN LEE

 Fig. 27: Brachytarsophrys carinensis (Boulenger, 1889) from Guangxi, also known from the Chinese Provinces Yunnan, Sichuan, Hunan, and Jiangxi, furthermore from S Myanmar and Thailand.
 © K. NISHIKAWA

 Fig. 28: Leptobrachella brevicrus DRING, 1983, know only from Mulu NP, Sarawak, East-Malaysia.
 © M. DEHLING

 Fig. 29: Leptobrachium smithi MATSUI, NABHITABHATA & PANHA, 1999 from Barail, Assam, India. Further more records are from Meghalaya, India, SE Bangladesh (Chittagong and Rangamati Hill-district), S Myanmar, Thailand, Laos and West Malaysia (Pulau Langkawi).
 © A. Das





Fig. 30: Laptolalax tamdil Sengupta, Sailo, Lalremsanga, Das & Das, 2010, is only known from the	
type locality Aizawl (Tam Dil lake Mizoram, India).	© A. Das
Fig. 31: Leptolalax gracilis (GÜNTHER, 1872) from Kubah NP (Sarawak); endemic to Borneo (DEHLING 2012).	© A. Das
Fig. 32: Leptolalax heteropus (BOULENGER, 1900) from Kuala Trenggan, Pahang, West-Malaysia,	
known only from the Malayan Peninsular.	© U. MANTHEY
Fig. 33: Megophrys longipes BOULENGER, 1886 from Bukit Larut, Perak, West-Malaysia;	
known only from S Myanmar and the Malayan Peninsular.	© U. MANTHEY
Fig. 34: Megophrys nasuta (SCHLEGEL, 1858), known from the Malayan Peninsular, Sumatra and Borneo,	
specimen from Saint Louis Zoo, USA (captivity).	© G. M. Rosa
Fig. 35: Megophrys parva (BOULENGER, 1893) from W Nepal, known also in E Nepal, Sikkim, Assam and M	anipur
(India), furthermore Bangladesh, W Thailand, N Vietnam, N Laos and Xizang, Yunnan, and Guangxi (Chir	na). © F. Tillack



Fig. 36: Ophryophryne microstoma Boulenger, 1903 from N Vietnam, known also from S Guanxi, S Yunnan and S Guangdong (China), furthermore from NC Thailand, N and E Laos, and NE Cambodia.

Despite its relatively small size, it is home to 119 species of amphibians of which no less than 103 are endemic (86.5% endemism) and as a result considered an amphibian hotspot. During the last two decades, the number of known amphibians has steadily increased (MEEGASKUMBURA et al. 2002, MANAMEND-RA-ARACHCHI & GABADAGE 1996, PETHIYAGODA et al. 1998, MANAMENDRA-ARACHCHI & PETHIYAGOda 1998, 2005, Meegaskumbura & Manamend-RA-ARACHCHI 2005, MEEGASKUMBURA et al. 2011a, WICKRAMASINGHE et al. 2013b). The 119 known taxa represent two orders: Anura and Gymnophiona. The latter is embodied by three species of limbless amphibians belonging to the family Ichthyophiidae and the genus Ichthyophis that are endemic. A cryptic fourth species has been discovered through DNA analysis although it has not been formally described (GOWER et al. 2005). The order Anura is represented by 6 families (Bufonidae, Dicroglossidae, Microhylidae, Ranidae, Rhacophoridae and Nyctibatrachidae). The family Bufonidae is represented by eight species in two genera, Adenomus and Duttaphrynus, with the former comprising endemic tree species (MANAMEND-RA-ARACHCHI & PETHIYAGODA 1998). The Dicroglossidae is represented by 12 species in five genera. The endemic relict genus Nannophrys of this family has terrestrial tadpole stages that live on wet rock surfaces. The family Microhylidae, which includes the narrow-mouthed frogs, is represented by 10 species in 4 genera. The family Nyctibatrachidae is represented by a single monotypic species, Lankanectes corrugatus (DECKERT, 1938). The other members of the family Nyctibatrachidae are found only in India, indicating Sri Lanka's ancient zoogeographic affinities with the Indian amphibian fauna (ROELANTS et al. 2004). The family Ranidae is represented by 3 species in a single genus: *Hylarana*. The family Rhacophoridae is the most diverse family of with 81 known species in three genera: *Polypedates, Pseudophilautus*, and *Taruga*. The most speciose genus in this family, *Pseudophilautus*, has undergone a radiation within the island (Bossuvr et al. 2004, MEEGASKUMBURA et al. 2002), producing 75 endemic species of direct-developing frogs (BAHIR et al. 2005). The unique tree frog genus *Taruga* with three species is also endemic (MEEGASKUMBURA et al. 2011).

Currently, 35 species are considered to be Critically Endangered and 26 Endangered. The majority of the amphibians are restricted to the southwestern wet zone lowlands and the central hills (DUTTA & MANAMENDRA-ARACHCHI 1996). These two regions used to be dominated by tropical lowland rainforests and montane rainforest habitats, nearly 95% of these have by now disappeared as a direct result of anthropogenic activities such as agriculture and clearing. Only fragments of the former rainforest cover remain in the wet zone, with the largest being the Singharaja MAB Reserve, Kanneliya-Dediyagala-Nakiyadeniya Complex, Knuckles Forest Reserve, and the Peak Wilderness Sanctuary. As a consequence, nearly 65% of the amphibians are regarded as being threatened with extinction (MANAMENDRA-ARACHCHI & MEEGASKUMBURA 2012), and 19 species are already considered extinct (MANAMENDRA-ARACHCHI & MEEGASKUMBURA 2012). However, recent studies have rediscovered three of these (WICKRAMASINGHE et al. 2012, WICKRAMASINGHE et al. 2013a). Based on current trends, habitat loss is the major threat to amphibians. The effects of pollution, pesticide use and diseases on amphibians have not been properly assessed yet. However, there are reports of malformations in frogs possibly due to detrimental chemicals (DE SILVA et al. 2009, RAJAKARUNA et al. 2007). Forest dieback, possibly caused by air pollution and acid rain (GUNAWARDENA et al. 1998), has been reported from montane rainforests in places such as Hortain Plains National Park, Knuckles Forest Reserve and Peak Wilderness Sanctuary (WERNER 1988). The loss of such pristine and important habitats would be devastating to many species of amphibians that are restricted to the montane regions.

Amphibians in Himalayas

There are 88 species of amphibians belonging to 29 genera in the Himalayas. Of these 88, about 51 species are found in Nepal, about 34 in Bhutan, and about 50 in the Tibetan Highlands of China. Twenty species are common to both Nepal and China, 6 of which are high-altitude species found at 3000-5000 m above sea level.



Micrixalidae



Microhylidae



Fig. 37: Micrixalus fuscus (BOULENGER, 1882) from Thiruvananthapuram, Kerala, endemic to the Western	
Ghats, India.	© S. Das
Fig. 38: Micrixalus gadgili Pillai & Pattabiraman, 1990 from Periyar, Kerala, endemic to the	
Western Ghats, India.	© S. Das
Fig. 39: Micrixalus phyllophilus (JERDON, 1853) from the Nilgiri Hills, endemic to the Western	
Ghats, India.	© S. Das
Fig. 40: Micrixalus saxicola (JERDON, 1854) from Wayanad District, Kerala, endemic to the Western	
Ghats, India.	© S. Das
Fig. 41: Calluella guttulata (Вцутн, 1856) from near Pak Chong, Nakhon Ratchasima, Thailand; widely	
distributed from S Myanmar through Thailand to West-Malaysia and C Vietnam.	© F. Tillack
Fig. 42: Chaperina fusca Mocquard, 1892 from Pulau Tioman, West-Malaysia; isolated populations in the	,
Malayan Peninsular, Borneo and some Islands of the Philippines (Palawan, Mindanao, and Jolo).	© U. MANTHEY



Fig. 43: Gastrophrynoides immaculatus CHAN, GRISMER, AHMAD & BELABUT, 2009 is only known from Gunung	g
Besar Hantu, Negeri Sembilan, West-Malaysia. ©	CHAN KIN ONN
Fig. 44: Glyphoglossus molossus GÜNTHER, 1869 from near Pakchong, Nakhon Ratchasima, Thailand;	
distributed from N Myanmar through Thailand and Laos to S Vietnam.	© U. Manthey
Fig. 45: Kalophrynus pleurostigma TSCHUDI, 1838 from Songhla, S Thailand, isolated Populations from	
S Thailand and adjacent Myanmar through West-Malaysia to Borneo, Philippines,	
Sumatra and Java.	© U. MANTHEY
Fig. 46: Kaloula assamensis Das, SENGUPTA, AHMED & DUTTA, 2005 from Orang, Assam; known records outsic	de
from Assam in Arunachal Pradesh and in West Bengal, India.	© K. Deuti
Fig. 47: Kaloula taprobanica (PARKER, 1934) from Orissa, India; found throughout much of E India,	
Bangladesh and Sri Lanka.	© S. K. Dutta
Fig. 48: Metaphynella pollicaris (BOULENGER, 1890) from Bukit Fraser, Pahang; endemic to West-Malaysia.	© U. Manthey





Fig. 49: Metaphynella sundana (PETERS, 1867) from Poring Hot Springs, Sabah, East-Malaysia; endemic to Borneo. © M. MARONDE Fig. 50: Mircohyla ornata (DUMÉRIL & BIBRON, 1841) from C Nepal; outside Nepal populations are known from Pakistan and India (incl. Andaman and Nicobar Is.) as well as Sri Lanka and Bagladesh. © F. TILLACK Fig. 51: Microhyla fissipes Boulenger, 1884 from Phou Khao Khouay NP, Laos; widely distributed from S and C China through Indochina, and Thailand to West-Malaysia and Singapore. © U. MANTHEY Fig. 52: Micryletta inornata (TAYLOR, 1962) near Pakchong, Nakhon Ratchasima, Thailand; distributed from Manipur, India, through Myanmar and Thailand to S Yunnan (China) to Malaysia and Sumatra, also reported from the Nicobar and Andaman Is. (India). © W. GROSSMANN Fig. 53: Phrynella pulchra BOULENGER, 1887 from Templer Park, Selangor, West-Malaysia; distributed in the Malayan Peninsular, Sumatra and the Mentawei Is. (Indonesia). © W. GROSSMANN Fig. 54: Ramanella anamalaiensis RAO, 1937 from Parambikulam WLS, Palakkad District, Kerala; endemic to the Western Ghats, India. © S. Das



 Fig. 55: Ramanella montana (JERDON, 1854) from Wayanad District, Kerala, known only from the
 © S. Das

 Western Ghats and Gujarat, India.
 © S. Das

 Fig. 56: Ramanella variegata (STOLICZKA, 1872) from Orissa, India; widely distributed in India and Sri Lanka.
 © S. K. Dutta

 Fig. 57: Uperodon systoma (SCHNEIDER, 1799) from Kapilas, Orissa, India; widely distributed in India, reported from Pakistan and Nepal.
 © K. Deuti



Conservation status of amphibians in South Asia Conservation is an umbrella concept. Several important terms are associated with this key word, such as sustainable development, allocation, and protection. We are protecting our natural wealth through conservation. Conservation is very fundamental and yet paradoxical. What are we conserving? Where are we conserving? These are two fundamental questions. Are there still species that are not yet known to science? Are all extinct species really extinct? Conservation polices are more theoretical than applied. Amphibians are fascinating creatures that have evolved within a variety of habitats, ranging from the hot lowlands to cold mountain summits, and from scorching deserts to cool wet forests. All of these habitats are under serious threat, and adequate conservation strategies are needed to protect these unique species. Overpopulation, illiteracy, overexploitation, and unemployment are the major problems in this part of the world. "Western" countries generally have a higher standard of living than so-called Third World countries. Western people normally have access to employment, clean water, electricity, food, clothing, housing, schools and medical care, but they also consume more resources per capita than people living in the so-called developing countries. In the third world countries, most people are forced to live without access to these things. Therefore, while living in poor conditions, how can anybody think about sustainability or conservation? India, encompassing a total of 329 million ha, is rich in biodiversity, including amphibians, because of its location, varied features, and climate. Biodiversity and its conservation are the foundation of ecosystem services to which human wellbeing is intimately linked. The conservation of biodiversity (especially amphibians) is of critical importance not only because the very diversity is under threat of extinction, but also because it is of direct and indirect benefit to humankind. Biodiversity is a universal wealth. No human or country can own it. Hence nature, if not protected and conserved, should be given freedom to respond to human indiscretions. In some cultures especially Asian, Greek, and Roman - frog meat has been considered a delicacy for centuries. The export of frog legs from India began in the early 1960s and it was evident that this would be harmful to frog populations. In 1985, the Indian bullfrog (Rana, today Hoplobatrachus, tigerinus) was listed in Appendix II of CITES. Consequently, fresh water frogs (Rana spp.) were listed in Schedule IV of India's Wild Life (Protection) Act of 1972. Local illegal collection, trade, and utilization takes place unabated in some Indian states such as Assam and Nagaland in northeastern

India, though. In many parts of India, frogs, especially the Indian bullfrog, are exploited for vivisection in the education sector (VASUDEVAN & SUPRIYA 2011). Over the past 30 years, scientists have suggested that extinctions through tropical forest loss are occurring at a rate of up to 100 species a day and yet less than 1,200 extinctions have been recorded in the last 400 years. Impacts of climate change are local to global, and climate change is acting synergistically with a range of other threats to biodiversity including deforestation.

Currently, people are talking more about sustainable development. What is sustainable development? According to the United Nation's World Commission on Environment and Development (the Brundtland Commission), "sustainable development" is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs". How can we do justice to these noble words against such a backdrop? Conserving animals with proper awareness and education is problematic in India.

Amphibians reach their greatest diversity in the tropics, mainly in the moist and hot environment of tropical rainforests and freshwater swamp forests. Southeast Asia (more than 700 species occur in the region) is one of the world's major biodiversity hotspots for amphibians. The number of known species of Southeast Asian amphibians has dived under the global conservation community's collective radar (Rowley et al. 2010). Of 732 scientific papers with the key words 'amphibian' and 'conservation', only 8 referred to Southeast Asian countries, compared to 16 for Central American countries, 25 for South American countries, and 37 for tropical African countries (ISI Web of Science, 1 May 2009). Information on the diversity, distribution and biology of Southeast Asian amphibians is scarce. Although scientists suppose that the amphibians of Singapore, Thailand and the Philippines are reasonably well studied, even basic information on the amphibian diversity, distribution and conservation status is limited for most areas, particularly for Myanmar, Laos, Cambodia and Indonesia (Rowley et al. 2009).

Amphibians in Southeast Asian countries

East Timor: 100 species of amphibians are known (KAISER et al. 2011); *Duttaphrynus melanostictus* is the most common species. *Limnonectes timorensis* (SMITH, 1927) is endemic. The island has lost 50-70% of its original forest cover to cultivation and industrialization. The greatest challenge is to develop management plans for protected areas that balance biodiversity conservation with the needs of local people.



Nasikabatrachidae



Ceratobatrachidae (vormals Ranidae)



 Fig. 58: Nasikabatrachus sahyadrensis BIJU & BOSSUYT, 2003 from Nelliyampathy Hill Kerala; endemic to the
 © S. Das

 Western Ghats, India.
 © S. Das

 Fig. 59: "Ingerana" baluensis (BOULENGER, 1896) from Sarawak, East-Malaysia; endemic to Borneo.
 © K. NISHIKAWA

Brunei: There are 12 amphibians species (2 Bufonidae, 4 Dicroglossidae, 1 Megophryidae, 3 Ranidae and 2 Rhacophoridae) of which 9 are Least Concern according to the IUCN Red List of 2013. *Meristogenys kinabaluensis* INGER, 1966, *Pedostibes rugosus* INGER, 1958, *Ansonia platysoma* INGER, 1960, *Limnonectes paramacrodon* INGER, 1966, and *Rhacophorus dulitensis* BOULENGER, 1892 are found in Brunei, but *Rhacophorus belalongensis* DEHLING & GRAFE, 2008 is the only endemic species. Brunei is losing its rainforests faster than any other region in the Tropics.

Indonesia: The volatile chain of 17,500 islands that straddle the equator between the Pacific and Indian Oceans is an amphibian hotspot, hosting 392 species (IUCN 2013) and the largest amphibian populations in Asia. The country also has the second highest number of endemic species in Asia, with 175 amphibian species being endemic to its rainforest habitats. Unfortunately it has also lost ~80% of its natural forests to rubber, oil palm, pulp and other plantations.

Philippines: With more than 20,000 endemic species of plants and animals, the Philippines are identified as one of the world's 17 "mega-diverse" countries. They support 112 amphibian species, with 79% of these being endemic (IUCN 2013). According to the Global Amphibian Assessment (GAA), one of the amphibian species is Critically Endangered, 15 species are Endangered, and 32 Vulnerable.

Singapore: There are 28 species (3 Bufonidae, 6 Dicroglossidae, 2 Megophryidae, 6 Microhylidae, 5 Ranidae, 4 Rhacophoridae and 2 Ichthyophiidae) of amphibians, of which 21 are considered Least Concern according to 2013 IUCN Red List. The most common amphibians are the Asian toad (*Duttaphrynus melanostictus*) and the banded bullfrog (*Kaloula pulchra*). *Ichthyophis singaporensis* TAYLOR, 1960 is endemic. Researchers detected the chytrid fungus on two wild and eleven captive frogs. There is a link between traded exotic frogs and diseases in wild frogs in Southeast Asia (HANCE 2013). Frogs imported as pets, food, or traditional medicines are very likely spreading diseases to wild populations.

West Malaysia: The country is the twelfth richest mega-centre for biodiversity in the world and has more than 185,000 animal species. 103 species of amphibians are found in Peninsular Malaysia (NORHAYATI 2014) of which 17 species in 8 genera represent the family Bufonidae, 17 species in 4 genera the Dicroglossidae, species in 4 genera the Megophryidae, 21

species in 8 genera the Microhylidae, 18 species in 6 genera the Ranidae, and 21 species in 8 genera the family Rhacophoridae.

United Nations' reports indicate that the rate of deforestation is accelerating.

East Malaysia: After an increase of almost 50% over the number listed in the monograph on Bornean Amphibia by INGER (1966), the known anuran fauna of Borneo now includes 138 species (INGER & LIU 1996). The distribution of amphibians on Borneo is far from uniform. After HAAS et al. (2013), the East-Malaysian frog fauna counts 31 toad species in 8 genera, 3 species of the genus Ingerana (Ceratobatrachidae), 17 dicroglossid species in 4 genera, 28 ranid species in 5 genera, and the family Megophryidae contains 22 species in 6 genera. The latter constitutes approximately 15% of all megophryid species known. The family Microhylidae currently comprises 25 species in 7 genera on Malaysian Borneo, and the Rhacophoridae 40 species in 6 genera. Some species have very restricted ranges, such as Philautus saueri MALKMUS & RIEDE, 1996, which is only found at 5 locations in Sabah. One of the world's top-10 most wanted "lost" anurans, Ansonia latidisca INGER, 1966 was rediscovered on Gunung Penrissen, Western Sarawak (ANONYMOUS 2011).

Rainforest Trust, a non-profit conservation organization focused on protecting threatened tropical lands and saving endangered species, is now working on Borneo.

Myanmar: A total of 388 amphibian and reptile species have been documented, but the expected total number of species to be found in Myanmar is estimated to be closer to 500 (California Academy of Sciences, 2010). 15 amphibian species are endemic. The numbers of amphibian studies in Myanmar are inadequate, and the publications confirmed some species in common with the western part of Thailand. Close coordination and cooperation with neighbouring countries is urgently needed to control the illegal trade of wildlife.

Thailand: The 2004 Global Amphibian Assessment lists 129 species for Thailand. In another study, 141 species in 8 families and 3 orders (anuran, caecilian and urodelan) were documented for this country (CHAN-ARD 2003). In the south of Thailand, the Isthmus of Kra is the limit of the distribution of some species (KHONSUE & THIRAKHUPT 2001).

Laos: Ninety species have been recorded, of which 53 are classified as "Least Concern". Nine new am-

SAURIA

Dicroglossidae (vormals Ranidae)



Fig. 60: Euphlyctis cyanophlyctis (SCHNEIDER, 1799) is widely distributed from SE Iran, S Afghanistan, Pak	istan,
Nepal, S Bhutan, India, Bangladesh, Myanmar, Sri Lanka, Malaysia, and Minh Hai Province, Vietnam.	© S. Das
Fig. 61: Euphlyctis hexadactylus (LESSON, 1834) from Wilpattu NP, Sri Lanka. Outside from Sri Lanka, the	
range extends from S India to Pakistan and Bangladesh.	R. Somaweera
Fig. 62: Fejervarya orissaensis (DUTTA, 1997) is only known from Orissa, India.	© S. K. Dutta
Fig. 63: Fejervarya moodiei (TAYLOR, 1920) from Orissa, India. More Populations are known from E India	
through Myanmar and Thailand south to the Isthmus of Kra, S China, Indochina and the Philippines.	© S. K. Dutta
Fig. 64: Hoplobatrachus crassus (JERDON, 1854) from Orissa, India; widely distributed from Sri Lanka	
through India to Nepal and Bangladesh.	© S. K. Dutta
Fig. 65: Hoplobatrachus tigerinus (DAUDIN, 1802) from Orissa, India; found throughout most wetland	
areas of India, Bangladesh and much of N Pakistan, and is recorded from S Nepal, and N Myanmar	
(Sмітн 1940; Zug et al. 1998).	© S. K. Dutta





Fig. 66: Ingerana tasanae (SMITH, 1921) from Khao Lak NP, Phang Nga, S Thailand. Populations of this species are known only from Thailand. © F. TILLACK Fig. 67: Limnonectes ingeri (KIEW, 1978) from Kubah NP, Sarawak. The occurrence is restricted to Borneo. © A. Das Fig. 68: Minervarya sahyadris Dubois, Ohler & Biuu, 2001 from Kannur, Kerala; endemic to the Western Ghats, India. © A. Das Fig. 69: Nannophrys marmorata KIRTISINGHE, 1946 is only known from the Knuckles, Sri Lanka. © K. D. B. UKUWELA Fig. 70: Nanorana liebigii (GÜNTHER, 1860) from Latpancher, Darjeeling District, West Bengal, India. This species is widely distributed in the Himalaya region, from Jammu and Kashmir through N India and Nepal to Xizang, China and Bhutan. © K. DEUTI Fig. 71: Nanorana minica (DUBOIS, 1975) from Benog WLS, Uttarakhand, India. This species is limited to NW India and W Nepal. © A. Das



Fig. 72: Nanorana vicina (Stoliczka, 1872) from Uttarakhand; known also from Himanchal Pradesh,	
Uttar Pradesh, Punjap (India), Kashmir and NC Pakistan.	© K. NISHIKAWA
Fig. 73: Nyctibatrachus deveni Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri & Bossuyt, 2	2011
from Nelliyampathy Hill, Kerala; endemic to the Western Ghats, India.	© S. Das
Fig. 74: Nyctibatrachus kempholeyensis (RAO, 1937) from Wayanad District, Kerala; endemic to the	
Western Ghats, India.	© S. Das
Fig. 75: Nyctibatrachus sanctipalustris RAO, 1920 from Coorg District, Karnataka; endemic to the	
Western Ghats, India.	© S. Das
Fig. 76: Nyctibatrachus vrijeuni Biju, Van Bocxlaer, Mahony, Dinesh, Radhakrishnan, Zachariah, Giri & Bossuyt,	2011
from Wayanad District, Kerala; endemic to the Western Ghats, India.	© S. Das
Fig. 77: Occidozyga martensi (PETERS, 1867) from Nam Tha, N Laos; widely distributed from N West-Mala	aysia
through Thailand, Laos and Vietnam to S China.	© U. MANTHEY





Fig. 78: Occidozyga sumatrana (PETERS, 1877) from Kuala Tahan, Pahang, West-Malaysia; furthermore population are known from Sumatra, Java and Bali (long time confused with O. <i>laevis</i> [GÜNTHER, 1858]). Fig. 79: Ombrana sikimensis (JERDON, 1870) from W Nepal; distributed also in West Bengal, Meghalaya,	© U. Manthey
and Sikkim (India).	© F. TILLACK
Fig. 80: Quasipaa fasciculispina (INGER, 1970) from Khoa Soi Dao WLS, Thailand; known only from	
SE Thailand and SW Cambodia.	© H. Bringsøe
Fig. 81: Quasipaa shini (AHL, 1930) from Guanxi, more records are from S Hunan, and S Chongong,	
all China.	© K. Nishikawa
Fig. 82: Sphaerotheca breviceps (SCHNEIDER, 1799) from Yala NP, Sri Lanka. Outside from Sri Lanka the	
range extends from S India to Pakistan, Nepal, Myanmar and may be Bangladesh.	© R. Somaweera
Fig. 83: Zakerana teraiensis (DUBOIS, 1984) from Bangladesh. Furthermore this species occurs in S Nep	al
below 300 m; and in adjacent Sikkim and NE India (Arunachal Pradesh, Assam, Manipur, Meghalaya,	
Mizoram, Nagaland, and Tripura).	© A. Razzaque

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Nyctibatrachidae (vormals Ranidae)



 Fig. 84: Zakerana rufescens (JERDON, 1854) from Kannur, Kerala; endemic to the Western Ghats, India.
 © S. Das

 Fig. 85: Zakerana asmati (HowLADER, 2011) known from the type locality (Hathazari, Chittagong) and Dhaka,
 © A. Razzaque

 © A. Razzaque
 © A. Data

Fig. 86: Lankanectes corrugatus (PETERS, 1863) from the wet zone of Sri Lanka where it is endemic. © K. D. B. UKUWELA



phibians have been discovered since 2002, and these are already threatened by human interference, habitat destruction, and wildlife trade.

Cambodia: The country hosts 47 amphibian species, 5 of which (*Megophrys auralensis* (OHLER, SWAN & DALTRY, 2002), *Hylarana faber* (OHLER, SWAN & DALTRY, 2002), *Chiromantis samkosensis* GRISMER THY, CHAV & HOLDEN, 2007, and *Philautus cardamonus* OHLER, SWAN & DALTRY, 2002) are endemic.

Vietnam: The 2004 Global Amphibian Assessment lists 135 species for Vietnam, but 162 species of amphibians were documented by NGUYEN et al. (2005). After the publication of the "Herpetofauna of Vietnam" by NGUYEN et al. in 2009, no less than 21 new amphibian and reptilian taxa were described from this country by June of 2010, and FROST (2013) catalogued 189 amphibian species.

Conservation status of amphibians in Southeast Asia

A large portion of the amphibian species of Southeast Asia remain undiscovered. In the climatic history of the planet Earth, there have been significant periods of global warming and cooling, with average global temperatures from some past eras being higher than today (ZACHOS et al. 2001). Many species have adapted and survived through these periods (HUBER 2009), but the contemporary rate of temperature increase is unparalleled and faster than earlier climate changes (HOUGHTON 1997). It will almost certainly be beyond the ability of many species to adapt to or evolve with this rate of change in environmental conditions (MARKHAM 1996, KINGSOLVER 2009). Southeast Asia will be significantly affected by these extensive climatic changes, with possible results ranging from individuals changing in size, declining populations, and distorted community structures to widespread trophic cascades, extinctions, and loss of ecosystem services. Particular attention must be given to biogeographic areas and biodiversity hotspots where groups of organisms are at the highest risk. In this conjunction, the pathogen Batrachochytrium dendrobatidis needs to be monitored very closely in Southeast Asia.

Much of the fauna of the region is threatened with habitat loss from deforestation, and climate change could aggravate the destructive synergistic effects associated with it. Studies have shown that increased temperatures can hasten the development of embryos and larvae by directly increasing development rates or increasing the desiccation of larval environments, leading to accelerated development (ALVAREZ & NICIEZA 2002, LOMAN 2002, SANUY et al. 2008). Conservation measures are necessary to preserve Southeast Asian amphibian biodiversity. Owing to the overriding threat of habitat loss, the most critical conservation action is the identification, establishment and strict protection of Important Amphibian Areas (IAAs). Captive breeding is not generally a good idea to conserve amphibians in Southeast Asia. A case-by-case basis should be considered when major habitat loss is likely to occur along with lethal infectious diseases. Only by changing human attitudes and behaviour towards the environment as well as increasing our understanding of biodiversity will we rationally meet the needs of the future (BICKFORD et al. 2010). Many species are known only from a single location in Southeast Asia, which demonstrates that geographic distributions are also poorly known. Lack of knowledge of this highly threatened group hampers amphibian conservation in this region. Digital images, call recordings, and DNA samples are collected for formal identification and new species description in South East Asia, but not yet at a rate that would support conservation efforts.

Amphibian diversity and conservation in China

Covering approximately 9.6 million km², China is the world's second-largest country by land mass. China's landscape is vast and diverse, with forest steppes and the Gobi and Taklamakan Deserts occupying the arid north and northwest near Mongolia and Central Asia, and subtropical forests prevalent in the wetter south. China is one of the top 12 mega-biodiversity hotspots in the world, and the mountains of southwestern China, Tibet and south China (including Hainan Island) are three of the 32 biodiversity hotspots on Earth. China is also one of the five most forested countries in the world. In order to conduct sustainable forestry management and conservation, a Forest Law was introduced in 1984 and revised in 1998.

China is furthermore one of the world's richest countries in amphibian diversity. More and more new species have been described in last decade. There are more than 410 species in China and half of them are endemic. LIANG et al. (2012) recorded 395 species (or 406 taxa incl. subspecies), of which 281 species were endemic to China. Several research groups in China focus their efforts on surveying and investigating the taxonomy of amphibians. According to an assessment in 2002, nearly one-third of the native frogs and toads were threatened. Habitat destruction, pesticides, climate change, and overexploitation are the main causes of amphibian decline. The Chinese giant salamander (Andrias davidianus [BLANCHARD, 1871]) and salamanders of the genus *Tylototriton* are nationally protected. In addition, the Chinese government has declared a further 17 areas regional biodiversity hotspots with a



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Ranidae



Fig. 87: Amolops assamensis Sengupta, Hussain, Choudhury, Gogoi, Ahmed & Choudhury, 2008; only known from Kamrup District, Assam, India.

 Fig. 88: Amolops formosus (GÜNTHER, 1876) from Benog WLS (Uttarakhand), other localities in India are in

 Himanchal Pradesh, Uttaranchal, Nagaland, Meghalaya, Arunachal Pradesh and Assam. It's also known

 from N Bangladesh and Nepal.

 © A. Das

Fig. 89: Babina chapaensis (BOURRET, 1937) from Yen Tu nature reserve, Bac Giang, N Vietnam. More localities are in the provinces Lao Cai and Ha Tinh (Vietnam), and Xieng Khouang and Salavan (Laos). © T. ZIEGLER **Fig. 90:** Clinotarsus alticola (BOULENGER, 1882) from Khao Lak NP, Phang Nga, S Thailand. Other records are from S. Myanmar; NE India, and N Bangladesh. © F. TILLACK

Fig. 91: *Hylarana macrodactyla* GÜNTHER, 1858 from Lao Pako, Vientiane Province, Laos. Isolated populations are known from Guangdong, Guangxi, and Hainan (China), Indochina, Myanmar and Thailand south to West-Malaysia.

Fig. 92: *Hylarana malabarica* (TSCHUDI, 1838) from Orissa. More known localities are in the Western Ghats, in Madhya Pradesh, Assam, Mizoram, Maharashtra, and Meghalaya, India. © S. K. DUTTA





Fig. 93: Huia sumatrana YANG, 1991 from Ketambe, Aceh, Sumatra, Indonesia; known only from some	
localities in Sumatra.	© U. MANTHEY
Fig. 94: Humerana miopus (Boulenger, 1918) from Khao Lak, Pang Nga, S Thailand;	
endemic to the Malayan Peninsular.	© F. Tillack
Fig. 95: Meristogenys jerboa (GUNTHER, 1872) from Gunung Gading NP, Sarawak,	
East-Malaysia; endemic to Borneo.	© M. Dehling
Fig. 96: Meristogenys kinabaluensis (INGER, 1969) from Mt. Kinabalu, Sabah, East Malaysia;	
endemic to Borneo.	© M. Dehling
Fig. 97: Odorrana chloronota (Boulenger, 1882) from Laitkynsew, Meghalaya, India; distributed from	
Sikkim and Darjeeling over NE India through Myanmar to S China and S Vietnam.	© K. Deuti
Fig. 98: Odorrana mawphlangensis (PILLAI & CHANDA, 1977) from Kohima (Nagaland, India);	
endemic to NE India.	© A. Das





Ranixalidae (vormals Ranidae)



Fig. 99: Sanguirana aurantipunctata FUITEN, WELTON, DIESMOS, BARLEY, OBERHEIDE, DUYA, RICO & BROWN, 2011
from the type locality: mountains of Central Luzon, Philippines (female paratype).
Fig. 100: Staurois tuberilinguis BOULENGER, 1918 from Mt. Kinabalu, Sabah, endemic to Borneo.
Fig. 101: Indirana phrynoderma (BOULENGER, 1882) from the Anamalai Hills, endemic to the Western Ghats, India.

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Rhacophoridae



Fig. 102: Beddomixalus bijui Zachariah, Dinesh, Radhakrishnan, Kunhikrishnan, Palot & Vishnudas, 2011 from Munnar, Kerala. The frog is known only from the western slopes of the High Ranges and the Valparai plateau in the Southern Western Ghats in the states of Kerala and Tamil Nadu, India. © A. Das Fig. 103: Chiromantis doriae (BOULENGER, 1893) from Yunnan, furthermore distributed in Guangdong, and Hainan (China), NE India (Arunachal Pradesh), NE Bangladesh, through N Myanmar, N Thailand, Laos, SW Cambodia, and N Vietnam. © K. NISHIKAWA Fig. 104: Feihyla kajau DRING, 1983 from Gunung Mulu NP, Sarawak, East-Malaysia; endemic to Borneo. © M. DEHLING Fig. 105: Ghatixalus asterops BUU, ROELANTS & BOSSUYT, 2008 from Munnar, Kerala. India. © A. Das Fig. 106: Ghatixalus variabilis (JERDON, 1854 "1853") from the Nilgiri Hills, Western Ghats, India. © A. Das Fig. 107: Kurixalus naso (Annandale, 1912) from Mawphlang (Meghalaya); only known from © K. DEUTI Meghalaya and Arunachal Pradesh, NE India.





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Fig. 114: Polypedates colletti (BOULENGER, 1890) from Santubong, Sarawak, East Malaysia; known from	
S Vietnam and Peninsular Thailand to Sumatra, Borneo and Natuna Is.	© U. Manthey
Fig. 115: Polypedates otilophus (BOULENGER, 1893) from Kubah NP (Sarawak); distribution is restricted t	0
Borneo and Sumatra.	© S. K. Dutta
Fig. 116: Polypedates pseudocruciger Das & Ravichandran, 1998 from Kerala, India; widely distributed	
throughout the southern Western Ghats.	© S. K. Dutta
Fig. 117: Polypedates zed (DUBOIS, 1986) from Namthing, Darjeeling District, West Bengal, India.	© K. Deuti
Fig. 118: Pseudophilautus macropus (GÜNTHER, 1869) from the Knuckles, Sri Lanka.	K. D. B. UKUWELA
Fig. 119: Raorchestes agasthyaensis Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot &	
KALESH, 2011 from Agasthyamala Biosphere Reserve, Western Ghats, India.	© S. Das



	India	Iran	Afghanistan	Sri Lanka	Indonesia	China	Pakistan	Malaysia (Peninsula)	
Number of endemic species	167	4	1	91	175	169	1	46	
extinct	1			21		1			
critically endangered	17	3	1	35	3	11			
endangered	32			26	10	49			
vulnerable	24	1		10	26	118		2	
near threatened	9	2		3		69		9	
least concern	103	13	8	15			18		
data deficient	81	1	1	10	110			16	
Total number of species	342	22	10	120	336	417	22	103	

Tabble 1: We have followed the IUCN Red List of Threatened Species v. 2013.2, Table 8, for the total of endemic species per country. We also used Frost (2013) (last accessed: 22 Dec. 2013) for Red List Categories and Criteria and the total number of species. Some species are yet not evaluated as per their IUCN Categories and Criteria. For India, we have followed "A checklist of Amphibia of India with IUCN Red list status" as of April 2013. Kaiser et al. (2011) recorded 100 amphibians from Timor.

global conservation impact. Out of these 17 areas, 14 contain a high diversity of terrestrial species, including amphibians, and comprise approximately 400 protected areas. In China, the Oriental Realm is richer in amphibian diversity than in the Palaearctic Realm. The greatest richness in amphibian diversity occurs in the southwestern mountains and the western mountains and plateau, with both hosting more than 100 species; the next-richest area is the eastern plains and upland of southern Yunnan, both with more than 80 species; areas with a lower richness, but still with more than 30 species, are encountered in the Himalayas, coastal Fujian-Guangxi-Guangdong, on Hainan and on Taiwan. The remaining regions contain fewer species.

In 1995, the Forestry administration of China conducted a nationwide wildlife survey. Nearly 100 amphibians were catalogued and considered important wildlife resources. In 2008, the IUCN/ SSC Amphibian Specialist Group-China Region proposed a China National Action of Amphibian Conservation and a corresponding monitoring project was subsequently set up by the Chinese government. Dedicated nature reserves have been established for conserving *Hynobius amjiensis* GU, 1992, *Tylototriton* spp., *Echinotriton chinhaiensis* (CHANG, 1932), *Ranodon sibiricus* KESSLER, 1866, and *Andrias davidianus*. China began protecting amphibians in 1959 when *Andrias davidianus* was listed as grade II of state-protected animals. In 1988, *Tylototriton as*- perrimus UNTERSTEIN, 1930, T. kweichowensis FANG & CHANG, 1932, Liangshantriton taliangensis (LIU, 1950), T. verrucosus Anderson, 1871, Echinotriton chinhaiensis (CHANG, 1932), and Hoplobatrachus chinensis (OHLER, SWAN & DALTRY, 2002) were also listed as grade II. In 2000, the State Forestry Administration issued a "List of terrestrial wildlife under state protection, which are advantageous or of important economic or scientific value". The list includes 291 species of 10 families in 3 orders of amphibians. At the same time, the "Law of the People's Republic of China on Protection of Wildlife" was signed into effect. Recently, herpetologists in China have been proposing to list more amphibian species as state-protected. After 10 years of the first Red List of Amphibians in 2002, there is an urgent need for updating it. For the sustainable use of amphibian resources within China, farming amphibians of economic importance has been successful for a few species such as Andrias davidianus, Rana dybowskii GÜNTHER, 1876, Hoplobatrachus tigerinus, and Quasipaa spinosa (DAVID, 1875).

Discussion

The four biodiversity hotspots in South Asia (Eastern Himalayas, Indo-Burma, Western Ghats and Sri Lanka) and another four in Southeast Asia (Wallacea, Sundaland, Indo-Burma, and the Philippines) make the region important for amphibians. In South Asia, India and Sri Lanka are evidently rich in amphibians



Nepal	Bhutan	Timor Leste	Brunei	Singapore	Philippines	Cambodia	Laos	Myanmar	Bangladesh
3	1	0	0	1	79	3	13	8	0
								0	
								0	
					13				
3	1				31	2		4	
3			1	5		3	6		1
33	5		9	21	27	35	52	57	25
3	1		1	2	13	5	17		3
44	14	100	12	28	112	48	92	91	33

and species numbers are expected to also increase in the future in Bangladesh and Pakistan due to new discoveries and more detailed research. Sri Lanka, over the past century, has lost 20% of its amphibian fauna, and more than 50% of the remaining amphibians are facing the risk of extinction. In the last 10 to 15 years, amphibian research and field surveys have increased remarkably.

At present, almost one-fifth of Southeast Asian amphibians are listed as threatened, and most of the species in this region remain poorly known. Mentoring local biologists in matters amphibian is part of the long-term amphibian biodiversity conservation policy in Vietnam - one of the most topographically diverse countries in Southeast Asia. Living in an island archipelago, Philippine amphibians have naturally been restricted to clearly delimited geographic ranges. This becomes a particular challenge for assessing amphibian species diversity and individual conservation status. There is little knowledge about many amphibian species in the wilds of Cambodia and Laos, and more fieldwork is required to understand their status. Conservation measures are required to protect the amphibians from habitat destruction in Vietnam, Cambodia and Laos just as elsewhere.

Overharvesting, loss of forest and wetlands, pollution, disease, introduction of exotic species, and malformation are the six factors identified as the potential causes of the amphibian decline in Indonesia (KUSRINI 2007). Lack of knowledge about the importance of amphibians amongst the general public is the major conservation issue in this country. About 350 amphibian and reptile species have been recorded from Myanmar, which may be an underestimation of the factual number of species represented in this country (http://research.calacademy. org/herp/expeditions). Declining amphibian populations, including population crashes and localized mass extinctions have been noted since the 1980s from locations all over the world. These declines are perceived as one of the most critical threats to global biodiversity, and several causes are believed to be involved, including disease, habitat destruction and modification, exploitation, pollution, pesticide use, invasive species, and an increased level of ultraviolet-B radiation. However, many of the causes of amphibian declines are still poorly understood, and the topic is currently a subject of ongoing research. Calculations based on current figures suggest that the current extinction rate of amphibians could be 211 times the background extinction rate and the estimate goes up to 25,039-45,474 times if endangered species are also included in the computation (McCALLUM 2007).

Conclusions and recommendations

Conservation and protection of amphibians from anthropogenic threats is the most challenging task and needs to address the following:

- In-country training for students and support personnel (e.g., park rangers, etc.) is important to motivate younger generations all over the world to become passionate about biodiversity, particularly *their local* biodiversity.
- Regular collaboration of experienced experts and students at research centres and in the field should be encouraged.
- Workshops should be organized for students and young researchers.
- Amphibian field surveys should be conducted in remote areas and areas that have not been surveyed in the last decade.
- Genetic barcoding should be employed to identify amphibians and delimit species.



Rhacophoridae



Fig. 120: Raorchestes annandalii (BOULENGER, 1906) from Kurseong (Darjeeling, West Bengal). Furthermo	ore it is
present in Assam, Arunachal Pradesh, Sikkim, Meghalaya and Nagaland, all NE India and in E Nepal.	© K. Deuti
Fig. 121: Raorchestes beddomii (Günther, 1876) from Munnar, Kerala, India.	© S. Das
Fig. 122: Raorchestes bobingeri (Buu & Bossuvt, 2005) from Agasthyamala Biosphere Reserve,	
Western Ghats, India.	© S. Das
Fig. 123: Raorchestes chalazodes (GUNTHER, 1876) from Agasthyamala Biosphere Reserve,	
Western Ghats, India.	© S. Das
Fig. 124: Raorchestes charius (RAO, 1937) from Wayanad District, Kerala, India.	© S. Das
Fig. 125: Raorchestes chlorosomma (Buu & Bossuyr, 2009) from Munnar, Kerala. India.	© S. Das





Fig. 126: Raorchestes chromasynchysi (BIJU & Bossuyt, 2009) from Wayanad District, Kerala, India.	© S. Das
Fig. 127: Raorchestes coonoorensis (BIJU & Bossuyt, 2009) from the Nilgiri Hills, Western Ghats, India.	© S. Das
Fig. 128: Raorchestes dubois (Вии & Bossuyт, 2006) from Munnar, Kerala. India.	© S. Das
Fig. 129: Raorchestes glandulosus (JERDON, 1854) from Wayanad District, Kerala, India.	© S. Das
Fig. 130: Raorchestes graminirupes (Buu & Bossuvr, 2005) from Agasthyamala Biosphere Reserve,	
Western Ghats, India.	© S. Das
Fig. 131: Raorchestes kadalarensis Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot & Kalesh, 2011	
from Munnar, Kerala. India.	© S. Das



Rhacophoridae



Fig. 132: Raorchestes kaikatti (BIJU & BOSSUYT, 2009) from the type locality Nelliyampathy Hill Kerala, India.	© S. Das
Fig. 133: Raorchestes jayarami (Вии & Bossuyт, 2009) from Munnar, Kerala. India.	© S. Das
Fig. 134: Raorchestes johnceei Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot & Kalesh, 2011	
from Agasthyamala Biosphere Reserve, Western Ghats, India.	© S. Das
Fig. 135: Raorchestes manohari Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot & Kalesh, 2011	
from Agasthyamala Biosphere Reserve, Western Ghats, India. This species is found at about 600 m elevatic	on
amidst highland reeds in the Western Ghats, India. Specifically, it has been found in various parts of the so	uthern
Indian state of Kerala.	© S. Das
Fig. 136: Raorchestes munnarensis (BIJU & BOSSUYT, 2009) from Munnar, Kerala. India.	© S. Das
Fig. 137: Raorchestes ochlandrae (Gururaja, Dinesh, Palot, Radhakrishnan & Ramachandra, 2007) from	
Wayanad District, Kerala, India.	© S. Das





Fig. 138: Raorchestes ponmudi (Βυυ & Bossυντ, 2005) from Wayanad District, Kerala, India.	© S. Das
Fig. 139: Raorchestes ravii Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot & Kalesh, 2011 from	
the Nilgiri Hills, Western Ghats, India.	© S. Das
Fig. 140: Raorchestes signatus (BOULENGER, 1882) from the Nilgiri Hills, Western Ghats, India.	© S. Das
Fig. 141: Raorchestes sushili (Buu & Bossuyr, 2009) from Valparai on the Anaimalai Hills, Western Ghats, India.	© S. Das
Fig. 142: Raorchestes cf. terebrans (Das & Chanda, 1998) from Araku, Andhra Pradesh, India.	© K. Deuti
Fig. 143: Raorchestes tinniens (JERDON, 1854) from the Nilgiri Hills, Western Ghats, India.	© S. Das





Fig. 144: Raorchestes travancoricus (Boulenger, 1891) from Periyar NP and WLS, Kerala, India. Fig. 145: Raorchestes uthamani Zachariah, Dinesh, Kunhikrishnan, Das, Raju, Radhakrishnan, Palot & Kalesh, 2011 from Periyar, Kerala, India.



Fig. 146: Rhacophorus bipunctatus AHL, 1927 from Nongkhellym, Meghalaya, India. Widely distributedfrom NE India (Meghalaya, Arunachal Pradesh, Assam, Nagaland, Tripura, Mizoram and Manipur) andBangladesh, through Myanmar (Boulenger 1893), W and S Thailand (Taylor 1962; INGER & Colwell 1977),S China (S Xizang) [Fei et al. 1999], to Peninsular Malaysia (BERRY 1975; MANTHEY & GROSSMANN 1997).G A. DasFig. 147: Rhacophorus calcadensis AHL, 1927 from Munnar, Kerala, India.







Fig. 148: *Rhacophorus lateralis* BOULENGER, 1883/*Rhacophorus malabaricus* JERDON, 1870 from Wayanad District, Kerala, India. **Fig. 149:** *Rhacophorus lateralis* BOULENGER, 1883 from Wayanad District, Kerala, India.

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Fig. 150: Rhacophorus maximus GÜNTHER, 1858 from Meghalaya. Furthermore this species is known in India from Assam, Meghalaya, Nagaland, Arunachal Pradesh, Sikkim, West Bengal and Manipur, E Nepal, N Myanmar and W Thailand. © S. K. DUTTA

Fig. 151: Rhacophorus paradalis GUNTHER, 1859 from Kubah NP (Sarawak), It occurs in Peninsular Malaysia, on Borneo and Sumatra, and the Philippines. © S. Das

Fig. 152: Rhacophorus pseudomalabaricus VASUDEVAN & DUTTA, 2000 from Kerala, India.

© S. Das





 Fig. 153: Rhacophorus rhodopus Liu & Hu, 1960 from Kamlang WLS, Arunachal Pradesh, India.

 Additional records in this Province are Dibang WLS, Mouling NP, Namdapha NP, and N West Siang District.

 More populations are known from S Xizang, S Yunnan, Guangxi, and Hainan (China), N Myanmar, E Thailand,

 Cambodia, Laos, and Vietnam (INGER et al. 1999, ZIEGLER et al. 2004, ORLOV et al. 2008).
 © A. Das

 Fig. 154: Theloderma moloch (ANNANDALE, 1912) from Jeypore, Assam, India, this species has isolated populations in
 © A. Das

 NE India and S Xizang.
 © A. Das

 Fig. 155: Theloderma corticale (BOULENGER, 1903) is hitherto known only from N Vietnam.
 © T. ZIEGLER





SAURIA

- A frozen-tissue bank of all taxa is urgently needed for molecular research.
- Critically Endangered and Endangered species should be re-evaluated at regular intervals.
- Least Concern and Data Deficient taxa should also be re-evaluated regularly for conservation purposes.
- The publication of field guides in local languages for use by local people and students should be encouraged and supported.

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Summary

Diversity and conservation of Amphibians in South and Southeast Asia

About 41 % of the 7,215 amphibian species (as of 22.Dec.2013 [FROST 2013]) are at risk of extinction or already extinct. New and old species are partly poorly known, often only from a single population, and many are from areas with limited habitats that are under intense pressure due to various factors. The rate of new descriptions is astounding, with 146 new taxa having been added in 2013 alone (FROST 2013). Updated information for South and Southeast Asia: **S Asia:** 4 biodiversity hotspots (Eastern Himalayas, Indo-Burma, Western Ghats, Sri Lanka); 348 amphibian taxa in total for the region.

Afghanistan: 10 spp. (5 Bufonidae, 3 Dicroglossidae, 1 Ranidae and 1 Hynobiidae), 8 Least Concern, 1 Data Deficient; *Duttaphrynus olivaceus* and *Bufotes surdus* are possibly present; *Afghanodon mustersi* (Paghman Mountain salamander) is endemic, *critically endangered*, *but there are* no conservation measures due to ongoing unrest; impact of war is not completely known, but renders surveys and conservation efforts very difficult.

Bangladesh: 33 spp. (2 Bufonidae, 14 Dicroglossidae, 3 Megophryidae, 5 Microhylidae, 3 Ranidae and 6 Rhacophoridae), 25 Least Concern; habitat destruction, pesticides, climate change, and human population expansion are main causes of amphibian decline; amphibian conservation is ignored; *Duttaphrynus melanostictus, Euphlyctis cyanophlyctis, Fejervarya limnocharis, Hoplobatrachus crassus, H. tigerinus, Kaloula pulchra, Microhyla ornata, Microhyla rubra, Uperodon globulosus, Uperodon systoma, Polypedates leucomystax*, and *Polypedates maculatus* widely distributed; *Chiromantis doriae* rare in India and Bangladesh; *Micryletta* sp. indet. from NE, *M. inornata, M. stejnegeri; Hylarana temporalis* populations declining; spp. numbers are expected to increase.

Bhutan: herpetofauna poorly known; 7 spp. (2 Bufonidae, 2 Dicroglossidae, 1 Megophryidae, 1 Rhacophoridae and 1 Salamandridae), 5 Least Concern, 1 Vulnerable and 1 Data Deficient; Himalayan newt needs urgent conservation measures; amphibians typically recorded from rice paddies, roadside habitats and forests around Toebisa, Kabjisa, and Kazhi; *Polypedates maculatus, Nanorana liebigii, Megophrys* cf. *nankiangensis*, and *Amolops* cf. *monticola* recorded only recently. *Scutiger bhutanensis* is endemic.

India: forests are one of 12 global mega-biodiversity regions; Western Ghats and Eastern Himalayas are amongst the 32 biodiversity hotspots on earth; 311 spp. (DINESH et al. 2010), 46 spp. in West Bengal alone; 133 new spp. described and 109 new locality records added in 2012; Duttaphrynus beddomii, D. brevirostris, D. hololius, D. parietalis, D. silentvalleyensis, Xanthophryne koynayensis, and Gegeneophis carnosus endemic to Western Ghats, Raorchestes terebrans endemic to Eastern Ghats; Limnonectes khasianus, L. mawlyndipi and Fejervarya orissaensis endemic to the country. 75 spp. are yet to be evaluated and 81 still classified as Data Deficient; "Lost Amphibians of India" (LAI) is a nation-wide campaign aiming at rediscovering more than 50 "lost" species; shocking cruelty involved in trade of live frogs for consumption; NE region important part of the Indo-Burma biodiversity hotspot with 126 spp. (excl. Sikkim-Darjeeling), incl. 45 endemics; NE for-



ests are now destroyed primarily for jhoom cultivation (a form of tribal agriculture), amongst other reasons. **Iran:** about 15 spp. frogs & toads, 7 spp. salamanders; no effective conservation system in place; *Bufotes luristanicus, Rana pseudodalmatina, Iranodon gorganensis, Neurergus kaiseri*, and *N. derjugini are endemic.*

Maldives: 2 spp. (*Duttaphrynus melanostictus* and *Hoplobatrachus tigerinus*, the former more widespread); illegal trade in wildlife is one of the challenges of nature conservation; no specific conservation measures exist to protect amphibians.

Nepal: 43 spp. (3 Bufonidae, 21 Dicroglossidae, 1 Microhylidae, 5 Megophryidae, 7 Ranidae and 6 Rhacophoridae), 25 classified as Least Concern; Scutiger nepalensis, Amolops marmoratus, Hylarana chitwanensis, Nanorana rarica, and N. rostandi, are endemic; AR-CO-Nepal (Amphibian and Reptile Conservation) has been working since 1997 to promote the knowledge of the local herpetofauna and conservation in general. Pakistan: 25 spp. (10 Bufonidae, 1 Megophryidae, 2 Microhylidae, 12 Ranidae); Allopaa and Chrysopaa spp. and several high-altitude Duttaphrynus and Bufotes spp. dominate the western, central, and eastern Himalayas, 8 wide-ranging plains species are mostly concentrated in the Indus Valley, a few of these extend to higher altitudes of the sub-Himalayas; Bufotes pseudoraddei and Sphaerotheca strachani are endemic; threats comprise environmental changes that incur a rise in temperatures, dryness, increasing human encroachment on natural habitats, pollution, and the destruction of wetlands; riparian habitats in the Indus Valley are now nearly devoid of amphibians; frogs & toads are distributed from sea level to almost 4,000 m above with no single species encompassing the entire range; Duttaphrynus olivaceus, Bufotes surdus and Zakerana syhadrensis restricted to relatively low areas, while Duttaphrynus himalayanus, Scutiger nyingchiensis, and Bufotes pseudoraddei baturae are restricted to high altitudes; the remaining species have broad vertical ranges; Duttaphrynus stomaticus has the greatest vertical distribution (0>2,400 m); Bufo olivaceus, ranges from N Himalayan foothills to Indus Valley, where it is rare and spottily distributed; dicroglossid genera Euphlyctis, Fejervarya, and Hoplobatrachus are typical of riparian Punjab; Sphaerotheca breviceps descends into the plains, spottily distributed in Punjab, more common along river courses and even reaching the coast; Limnonectes limnocharis from the upper Indus Valley is replaced by Z. syhadrensis in the lower parts; Duttaphrynus olivaceus, D. stomaticus, wide-ranging, occurring from the plains to the northern and western foothills; Duttaphrynus himalayanus and Allopaa hazarensis are sub-Himalayan, Bufotes pseudoraddei *baturae* and *B. latastii* are NE Himalayan highland forms, and *B. surdus* and *B. zugmayeri* are SW Baloochistan spp.; Tibetan *Scutiger nyingchiensis* extends into meadows and wetlands in the NE parts of the country; *Microhyla ornata* ranges from upper Indus Valley to sub-Himalayas, but does not extend into Baloochistan and the lower Indus Valley; *Uperodon systoma* is a fossorial species that has been collected at Islamabad in the Potohar Tablelands; spp. numbers are expected to increase.

Sri Lanka: 119 spp., 103 (86.5 %) endemic incl. 3 endemic Ichthyophis spp.; 6 anuran families (Bufonidae [8 spp. in 2 genera], Dicroglossidae [12/5], Microhylidae [10/4], Nyctibatrachidae [1/1], Ranidae [3/1], Rhacophoridae [81/3]); most speciose rhacophorid genus, Pseudophilautus, contains 75 endemic species, and Taruga with 3 species is also endemic; 35 spp. Critically Endangered and 26 Endangered; majority of amphibians restricted to SW wet zone lowlands and central hills, which have by now lost nearly 95% of their tropical lowland and montane rainforest habitats with fragments left mainly in Singharaja MAB Reserve, Kanneliya-Dediyagala-Nakiyadeniya Complex, Knuckles Forest Reserve, and Peak Wilderness Sanctuary; nearly 65 % of amphibians threatened with extinction and 19 spp. already extinct, but 3 of these were rediscovered recently; habitat loss is major threat to amphibians; forest dieback, possibly from air pollution and acid rain reported from montane rainforests (Hortain Plains National Park, Knuckles Forest Reserve and Peak Wilderness Sanctuary).

Himalayas: 88 spp. in 29 genera; about 51 spp. in Nepal, about 34 in Bhutan, and about 50 in the Tibetan Highlands of China; 20 spp. common to Nepal and China, 6 of which are high-altitude species found at 3000–5000 m a.s.l.

SE Asia: 4 major biodiversity hotspots: Wallacea, Sundaland, Indo-Burma, and the Philippines (MYERS et al. 2000) in 2 geographic regions (mainland SE Asia, aka. Indochina, and maritime); > 700 amphibian species.

East Timor: 100 spp.; *Duttaphrynus melanostictus* most common; *Limnonectes timorensis* endemic; lost 50–70 % of its original forest cover to cultivation and industrialization.

Brunei: 12 spp. (2 Bufonidae, 4 Dicroglossidae, 1 Megophryidae, 3 Ranidae and 2 Rhacophoridae), 9 Least Concern; *Meristogenys kinabaluensis, Pedostibes rugosus, Ansonia platysoma, Limnonectes paramacrodon*, and *Rhacophorus dulitensis* are found in Brunei, but *Rhacophorus belalongensis* is the only endemic sp.; losing its rainforests faster than any other region in the Tropics. **Indonesia:** 392 spp.; largest amphibian populations in Asia; second highest No. of endemics (175 spp.); has lost ~80 % of its natural forests to rubber, oil palm, pulp and other plantations. **Philippines:** one of the world's 17 "mega-diverse" countries; 112 amphibian spp., with 79 % being endemic; 1 Critically Endangered, 15 Endangered, and 32 Vulnerable.

Singapore: 28 spp. (3 Bufonidae, 6 Dicroglossidae, 2 Megophryidae, 6 Microhylidae, 5 Ranidae, 4 Rhacophoridae and 2 Ichthyophiidae), 21 Least Concern; most common are *Duttaphrynus melanostictus* and *Kaloula pulchra; Ichthyophis singaporensis* is endemic; chytrid fungus recorded from wild and captive frogs suggesting link between traded exotic frogs and disease in wild frogs.

West Malaysia: 103 spp. (Bufonidae [17 spp. in 8 genera], Dicroglossidae [17/4], Megophryidae [11/4], Microhylidae [21/8], Ranidae [18/6], Rhacophoridae [21/8]); rate of deforestation accelerating.

East Malaysia: 138 spp. (Bufonidae [31/8], Ceratobatrachidae [1/"Ingerana"], Dicroglossidae [17/4], Ranidae [28/5], Megophryidae [22/6], Microhylidae [25/7], Rhacophoridae [40/6]); some spp. with very restricted ranges (e.g., *Philautus saueri* at 5 locations in Sabah); "lost" *Ansonia latidisca* rediscovered on Gunung Penrissen, W Sarawak.

Myanmar: 388 amphibian and reptile spp. recorded, but expected total number is estimated to be closer to 500; 15 amphibian spp. are endemic; some spp. in common with the western parts of Thailand; close coordination and cooperation with neighbouring countries is urgently needed to control illegal trade in wildlife.

Thailand: 141 spp. in 8 families and 3 orders; Isthmus of Kra is the limit of the distribution of some spp.

Laos: 90 spp., 53 are "Least Concern"; 9 new taxa discovered since 2002, all of them already threatened by human interference, habitat destruction, and wildlife trade.

Cambodia: 47 spp., 5 of which (*Megophrys auralensis, Hylarana faber, Chiromantis samkosensis,* and *Philautus cardamonus* are endemic.

Vietnam: 189 spp., with count increasing rapidly; mentoring local biologists in matters amphibian part of long-term conservation policy; one of the most topographically diverse countries.

China: one of top 12 global mega-biodiversity hotspots, mountains of SW China, Tibet and S China (incl. Hainan) are 3 of 32 global biodiversity hotspots; > 410 spp. of amphibians, 50 % endemic; nearly 1/3 threatened through habitat destruction, pesticides, climate change, and overexploitation; 17 regional biodiversity hotspots (comprising appr. 400 protected areas) with a global conservation impact declared with 14 containing amphibians, greatest diversity in SW mountains and W mountains and plateau (both >100 spp.), E plains and upland of S Yunnan (both >80 spp.), areas with lower richness, but still >30 species in Himalayas, coastal Fujian-Guangxi-Guangdong, on Hainan and Taiwan; dedicated nature reserves exist for *Hynobius amjiensis*, *Tylototriton* spp., *Echinotriton chinhaiensis*, *Ranodon sibiricus*, and *Andrias davidianus*; *Andrias davidianus*, *Tylototriton asperrimus*, *T. kweichowensis*, *Liangshantriton taliangensis*, *T. verrucosus*, *Echinotriton chinhaiensis*, and *Hoplobatrachus chinensis* are grade-II state-protected animals; 291 spp. in 10 families and 3 orders are otherwise state-protected; Red List of Amphibians needs an update urgently; farming of amphibians has been successful for a few species (*Andrias davidianus*, *Rana dybowskii*, *Hoplobatrachus tigerinus*, and *Quasipaa spinosa*).

Conservation: large portion of species still undiscovered; contemporary rate of temperature increase unparalleled and faster and will almost certainly be beyond the ability of many species to adapt, with possible results ranging from individuals changing in size, declining populations, and distorted community structures to widespread trophic cascades, extinctions, and loss of ecosystem services; organisms are at the highest risk in biodiversity hotspots; the pathogen Batrachochytrium dendrobatidis needs to be monitored very closely; fauna threatened with habitat loss from deforestation aggravated by climate change; conservation measures are urgently necessary to preserve amphibian biodiversity, incl. identification, establishment and strict protection of Important Amphibian Areas (IAAs); captive preservation breeding should be considered on a case-by-case basis when major habitat loss is likely to occur along with lethal infectious diseases; changing human attitudes and behaviour towards the environment and increasing understanding of biodiversity will be instrumental to meeting future needs; geographic distributions of many amphibians are poorly known, and lack of knowledge obstructs conservation.

Recommendations:

• In-country training for students and support personnel (e.g., park rangers, etc.) is important to motivate younger generations all over the world to become passionate about biodiversity, particularly *their local* biodiversity.

• Regular collaboration of experienced experts and students at research centres and in the field should be encouraged.

• Workshops should be organized for students and young researchers.

• Amphibian field surveys should be conducted in remote areas and areas that have not been surveyed in the last decade.

• Genetic barcoding should be employed to identify amphibians and delimit species.

• A frozen-tissue bank (bio-bank) of all taxa is urgently needed for molecular research.

• Critically Endangered and Endangered species should be re-evaluated at regular intervals.

• Least Concern and Data Deficient taxa should also be re-evaluated regularly for conservation purposes.

• The publication of field guides in local languages for use by local people and students should be encouraged and supported.

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