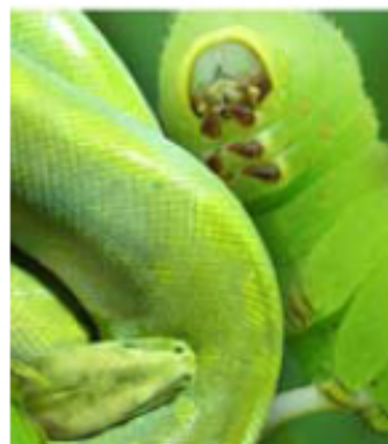
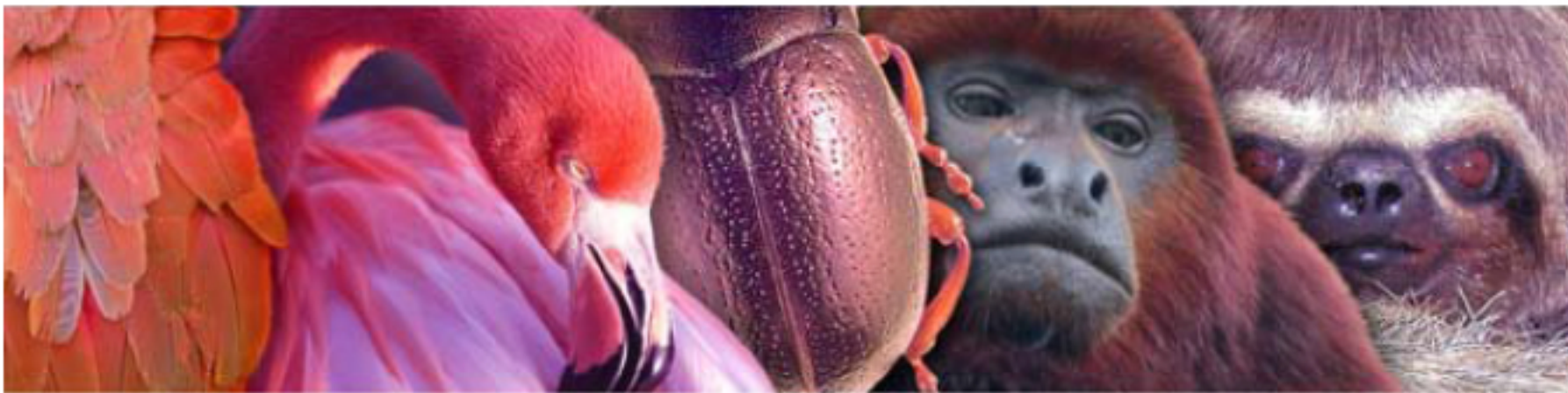
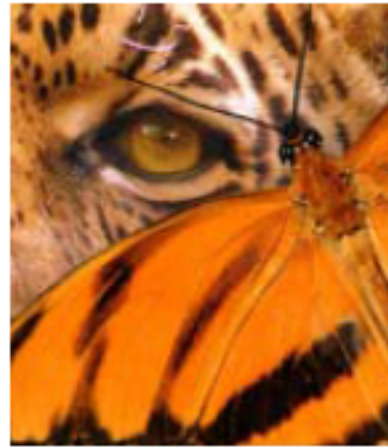


Building a Future for Wildlife



World Association of
Zoos and Aquariums
WAZA | United for
Conservation

Zoos and Aquariums Committed to Biodiversity Conservation

Edited by Gerald Dick & Markus Gusset

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“...we need to make known a new zoo vision...
captive propagation and reintroduction are last resorts.
Zoos must increase support for studies essential
to sustaining wildlife in the wild.”

Dr William G. Conway

Former director of Bronx Zoo,
former president and general director of the
Wildlife Conservation Society, New York

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Preface

The world's zoos and aquariums are committed to biodiversity conservation, not only within their own institutional boundaries (called *ex situ* conservation), but also of wild species and habitats (correspondingly known as *in situ* conservation). Although *ex situ* conservation achievements are widely recognised, *in situ* conservation efforts receive much less public recognition. In fact, zoos and aquariums are amongst the most important conservation organisations, and are leaders in public outreach and funding of conservation projects. For this reason, in the year of its 75th anniversary, the World Association of Zoos and Aquariums (WAZA) has chosen the year 2010, which is dedicated to biodiversity conservation globally by the United Nations, to highlight the role of zoos and aquariums in wildlife conservation and to present conservation success stories.

WAZA maintains a growing list of conservation projects, which WAZA supports by communication, marketing and financial contributions. Enclosed, you will find portraits of 25 exemplary conservation projects from around the globe. In addition, we have invited our international partners to present their views on biodiversity conservation and the role of zoos and aquariums as they perceive it. It is WAZA's policy to form partnerships, to look for synergies and to magnify conservation outcomes. A good example of recent collaborative efforts is the International Year of the Gorilla, where cooperation ranged from public awareness work to field project support. Another section of the book is dedicated to strategic approaches to conserving biodiversity and related policies. The book at hand is thus unique in its scope.

The ultimate question of all conservation efforts globally is: can we halt the loss of biodiversity or divert the current negative trends into another situation where the environment is used sustainably and still worth living in? You will not find a definitive answer to this very complex issue in this book, but you will discover ways towards achieving this goal, and the role of the world zoo and aquarium community in this endeavour is presented.

Acknowledgements

Many people were involved in the preparation of this book and without their dedication and efforts, the production of the book at hand would not have been possible. First of all, I wish to thank all the WAZA member institutions that have submitted conservation projects and especially those persons who participated in our survey assessing these projects' conservation impact. I wish to sincerely thank my co-editor, Dr Markus Gusset, for compiling the chapters and coordinating with the 86 authors who are represented in this book. A very big thank you goes to all the contributors of this book and their respective institutions as well as to the photographers for providing excellent images.

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Dr Gerald Dick
WAZA executive director

Introduction

“Biodiversity” appears at first sight to be a fairly straightforward concept. In one context it refers to the immense global variety of wildlife, some of which is cared for in zoos and aquariums. But biodiversity can additionally be understood in terms of microorganisms, and the complex genetic variation in animal and plant chromosomes, genes, DNA and other biochemistry. Such intricate microscopic or molecular variation ultimately determines the uniqueness and success of individuals, species and higher-level taxa. This contrasts with an equally complex macroscopic biodiversity, including in the large range of habitats, landscapes and ecosystems.

Focusing on wildlife diversity much has changed since the 18th century. Carolus Linnaeus (1707–78) described some 12,100 species in his lifetime, of which 4,400 were animals and 7,700 were plants. He confidently predicted that the complete eventual plant list would not exceed 10,000. However, the present rate of discovery of species is extremely high. At least 2,057 new vascular plants were named in 2006, along with 8,995 insects and 486 fishes. Since 2004, more than 13 new amphibian species were recognised each month, with above 6,000 so far named from a total list of perhaps 9,000. Indeed, there has been an extraordinary explosion of knowledge across all major

taxa, with new species being discovered daily. There is no absolutely agreed projected total, or easy scientific means of establishing a figure. The current global biodiversity assessment recognises 1.8 million described species as possibly being valid, with a final projected total of perhaps 14 million. If true, this means that less than 13% of all species have scientific names and a staggering 12.2 million remain to be formally described.

Considering also our limited knowledge of microscopic and macroscopic biodiversity, then we have a heady brew of ignorance! For example, only comparatively few vertebrate species have had their conservation status assessed in any scientific detail. The 2008 IUCN Red List of Threatened Species finds that 23% of all mammal species are threatened, alongside 12% of birds, 32% of amphibians and 43% of freshwater fishes. While there are many notable species conservation successes, the general situation as far as documented steadily gets worse with each advancing year. Clearly, zoos and aquariums must do much more to conserve vertebrates and pay far more attention to the equally imperilled invertebrates and plants.



Vervet monkey (© Nicole Gusset-Burgener).

“Conservation” can be defined as actions that substantially enhance the survival of species and habitats, whether conducted in nature or outside the natural habitat. From this, “United for Conservation” is a headline statement used to communicate the central purpose of the World Association of Zoos and Aquariums (WAZA). Certainly, a biodiversity conservation and environmental sustainability ethos pervades the vision, mission and values of the separate membership components of WAZA – ranging through regional and national associations to individual institutions. Clearly, the 1,300 or more representative, mainstream zoos and aquariums on our planet serve a vital, serious but not always well-publicised purpose.

This substantial conservation role sits alongside providing the visiting public (some 600 million of them each year, worldwide) a fun-filled and educational day out in a leisure context. Collectively, this creates very many millions of dollars of financial surplus that are applied to worthwhile conservation projects at home and abroad operated by zoos and aquariums, or conducted in partnership with them. WAZA zoos and aquariums and associations are becoming major conservation implementation and funding agencies. Collectively, this can match or surpass the contributions of some other leading global conservation organisations, both governmental



Lion (© Nicole Gusset-Burgener).

and non-governmental. Such activities are often targeted directly at practical issues in biodiversity conservation both in nature (*in situ*) and off-site (*ex situ*), at home and abroad. Increasingly, these separate designations are dissolving into a continuum where threatened species are managed extensively (mainly in the wild) and intensively (mainly in captivity), with every sort of management combination in between.

This growing vocational ethos reflects the many cooperative initiatives of zoos and aquariums in supporting endangered species and habitats; and may, for example, involve breeding programmes, studbook management, assisted reproduction, species reintroductions or translocations, educational outreach and benign (non-invasive and non-intrusive) scientific research. Often this now

involves an integrated approach that takes in rapidly advancing disciplines such as conservation medicine, ecological restoration and the sociology, ethnology and psychology of “human–animal conflict”. Sometimes this entails a need to address chronic worldwide issues in human development and poverty alleviation, which are a major root cause of the global decline in biodiversity. Strategy planning and stakeholder support for these exercises is often supplied by the IUCN/SSC Conservation Breeding Specialist Group and the Re-introduction Specialist Group, while bulk electronic data-handling is expertly covered through the Zoological Information Management System of the International Species Information System organisation.



Yellow mongoose (© Nicole Gusset-Burgener).



Dr Gordon McGregor Reid, B. Sc., Ph. D., D. Sc., C. Biol., F. I. Biol., joined Chester Zoo (North of England Zoological Society) in 1992 as curator-in-chief, becoming director general in 1995. He

has held senior positions in both the university and museum sectors, working on systematic biology, zoogeography, ecology and conservation. He has also held many senior board positions from his wider professional activities, stemming from a diverse international career involving scientific research, conservation, animal welfare, education and public recreation. He is a former trustee of the National Museums Liverpool, immediate past president of the Linnean Society of London and immediate past president of the World Association of Zoos and Aquariums.

The increasingly more intricate, challenging and multifaceted role for zoos and aquariums is indicated in "Building a Future for Wildlife: The World Zoo and Aquarium Conservation Strategy", published by WAZA in 2005 and now translated into nine further languages. A sub-theme of the 2005 conservation strategy is the publication "Turning the Tide: A Global Aquarium Strategy for Conservation and Sustainability", published by WAZA in 2009. Regional zoo and aquarium associations have also published supportive documents in response to the 2005 conservation strategy, such as "Developing the Research Potential of Zoos and Aquaria" by the European Association of Zoos and Aquaria (2008).

The expert contributors to this present new WAZA-edited volume on "Building a Future for Wildlife: Zoos and Aquariums Committed to Biodiversity Conservation" carefully express, in sophisticated but easily understood terms, the contemporary aspects or issues and the actual and possible contributions of zoos and aquariums to conservation and sustainability. On behalf of WAZA, I warmly thank them for their most thoughtful and useful contributions. I know that the international zoo and aquarium community who will read this fine book will be inspired to take even more action! Because 2010 also marks WAZA's 75th anniversary year, many decades of inspiring action by zoos and aquariums in the service of species survival are commemorated and celebrated via the publication of this book.

Part I

Partners in biodiversity conservation



Convention on Biological Diversity: conservation of biodiversity through 2010 and beyond



Human beings are becoming increasingly cut off from nature. More than 50% of the world's population currently lives in cities, and 70% will by 2030. As a result, the majority of the population does not appreciate that biodiversity is their ultimate source for goods like food, timber and medicines, and provides society with irreplaceable ecosystem services like crop pollination, air and water purification, erosion control and the renewal of soil fertility.

This estrangement from nature makes it difficult for people to see the dangers inherent in the ongoing loss of biodiversity. Human activities are currently driving species extinct at up to 1,000 times the natural background rate. In the long term, this loss will radically undermine attempts at sustainable development, exacerbating poverty and fostering conflicts over dwindling resources.

To prevent worst-case scenarios, we need to forge a global partnership of governments, institutions and concerned citizens, a coalition that will educate people about the value of biodiversity and motivate them to preserve our biological heritage. The Convention on Biological Diversity (CBD) is the premier international treaty devoted to the preservation and sustainable use of biodiversity, and it has long been engaged in this task. In 2002, parties to the CBD set a target to significantly slow biodiversity loss worldwide by 2010 as a contribution to poverty alleviation and to the benefit of all life on Earth. The 2010 target was endorsed by the Johannesburg world summit on sustainable development and the United Nations general assembly, and was incorporated as a new target under the United Nations millennium development goals. Following declarations of support by meetings of G8 environment ministers, biodiversity loss was put on the agenda at the last three G8 summits. To further emphasise the importance of biodiversity, the United Nations general assembly has declared 2010 to be the "International Year of Biodiversity" and is convening a special session of heads of state in September 2010 on the topic.



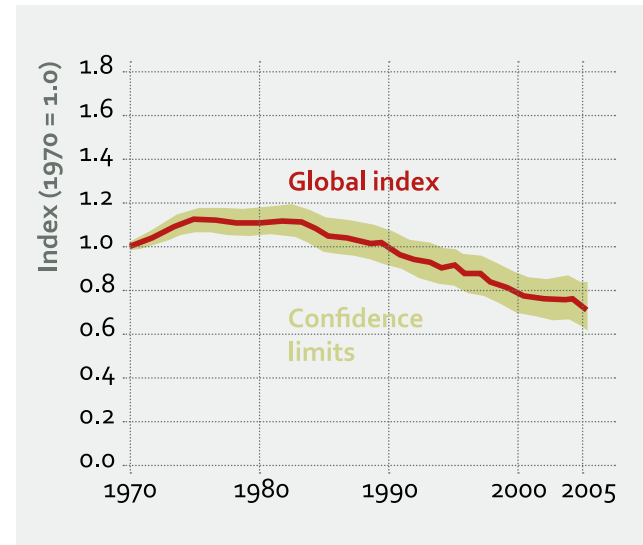
Human activities endanger the survival of species, such as this snake eagle, on an unprecedented scale
(© Nicole Gusset-Burgener).

A turning point will occur in October 2010, when representatives of the 192 member nations of the CBD will meet at its tenth conference of the parties (COP10) in Nagoya, Japan, to assess how close we have come to achieving the 2010 biodiversity target. In the coming months, Global Biodiversity Outlook 3 will provide us with a first detailed, scientific assessment of our efforts to date. In the meantime it is fair to conclude that we will fall short of the mark: despite our initial start at tackling the problem, we still have a long way to go before the current extinction crisis will be resolved. One of the mandates of COP10 in Nagoya will be to take our successes and failures into account and formulate a comprehensive, post-2010 strategy for slowing and ultimately stopping biodiversity loss in the years to come. Because of their expertise and abilities, the involvement of zoos and aquariums needs to be a part of this strategy.

This is nowhere truer than in the preservation of individual species and the reduction of overall loss rates, one of the focal areas of the 2010 target. The 2008 Living Planet Index showed that vertebrate population sizes have on average declined by almost 30% over the last 35 years, while the 2008 IUCN Red List of Threatened Species revealed that 38% of all examined species worldwide currently face a high risk of extinction. To help counter these trends, COP10 is likely to set quantitative post-2010 short and long-term biodiversity targets – possibly for 2020 and 2050, respectively – as well as push for the continued development of more detailed and comprehensive biodiversity indicators. The ultimate goal of these measures will be to strengthen our efforts on the ground, which is why the CBD wants to work more closely with zoos and aquariums to keep individual species from becoming extinct.



A princess kisses a frog with audience appeal to mobilise the public for amphibian conservation (© Leipzig Zoo).



The Living Planet Index of global biodiversity, measured as the relative aggregate population size of 1,686 vertebrate species across all regions of the world over time, with 1970 as the baseline (© WWF International).

One area where the assistance of zoos and aquariums will be invaluable is the coordination of *in situ* and *ex situ* conservation measures. Article 8 of the CBD calls for the development of protected areas as a primary *in situ* conservation tool, while Article 9 calls for complementary *ex situ* measures aimed at the recovery of threatened species and their reintroduction into natural habitats. Zoos and aquariums are repositories of genes and species that have been lost in the wild, a modern Noah's ark of life on Earth. As species continue to become extinct in the short to mid-term, there will be an increasingly pressing need to preserve biodiversity in zoos and aquariums and to draw on the expertise of these institutions for eventual possible reintroductions into the wild. The successful reintroduction of the Prezwalski's horse (*Equus ferus przewalskii*) into Mongolia and the reinvigoration of Mauritius kestrel (*Falco punctatus*) populations when the species was only four individuals away from extinction are classic examples of how captive breeding programmes in zoos, when effectively coordinated with protective measures in the wild, can help re-diversify life on the planet.

As previously mentioned, another main issue we face is a lack of awareness about the value of biodiversity. Zoos and aquariums are well placed to educate the public on this score. They are the main places where an increasingly urban population can come into contact with and learn about biodiversity – and not only exotic or distant flora and fauna, but also local species and ecosystems that are becoming just as unfamiliar to the average city dweller. Zoos and aquariums are also well positioned to mobilise public support for biodiversity-friendly legislation. The CBD has been increasingly successful in generating political momentum at the international level, but the willpower to follow through on international commitments can only develop through public engagement at national and local levels. Zoos and aquariums, as the face of nature for so many people, can help motivate the public to act.



Captive-bred Przewalski's horses were successfully reintroduced into Mongolia (© Petra Kaczensky/International Thaki Group).

Another issue slowing our progress is a lack of capacity in developing countries. Many of them simply do not have the know-how or resources to be able to effectively implement biodiversity preservation policies and programmes. To address this problem, the CBD actively strives to facilitate cooperation between developed and developing nations. Zoos and aquariums have a long history of just such work, assisting the efforts of conservation agencies in financially poor, biodiversity-rich nations. Closer collaboration between the CBD and zoos and aquariums in this area will increase the effectiveness and reach of our efforts.

With COP10 approaching, the CBD and its partners are redoubling their efforts. We look forward to working more closely with zoos and aquariums in the future. Only by combining our efforts will we be able to preserve biodiversity and pass on a rich and stable environment to our children.



An Algerian national, Dr **Ahmed Djoghla** has pursued a distinguished diplomatic career that has included postings with the government of Algeria and the United Nations Environment Programme (UNEP). He assumed the position of executive secretary of the Convention on Biological Diversity in January 2006. He was named to his previous position as assistant executive director of UNEP in June 2003, following his success as director and coordinator of UNEP's division of the Global Environment Facility, where he played a key role for some seven years and successfully raised UNEP's profile.

Simon N. Stuart
International Union
for Conservation
of Nature Secretariat

Dena Cator
International Union
for Conservation
of Nature Secretariat

Jane Smart
International Union
for Conservation
of Nature Secretariat

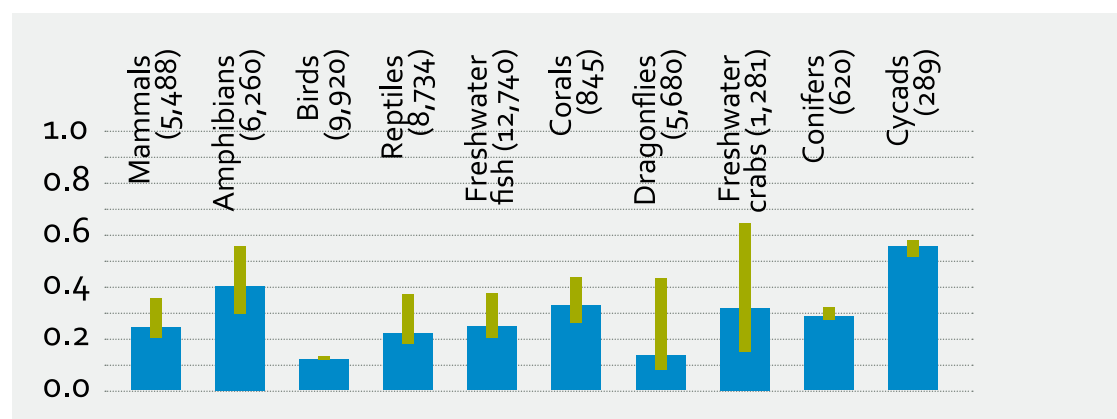
International Union for Conservation of Nature: global species crisis and conservation challenges



The rapid disappearance of species, and thus biodiversity, is often referred to as one of the world's greatest environmental concerns. The Red List of Threatened Species, compiled by the International Union for Conservation of Nature (IUCN) and accepted as the most objective and authoritative system for assessing the conservation status of species, shows that the status of the world's species is deteriorating in all regions and in all taxonomic groups. However, three major ongoing extinction crises stand out in particular: amphibians, corals and Asian large animals. Nearly one-third of the planet's amphibians (31.1%), one-quarter of its reef-building corals (27%) and nearly one-quarter of its mammals (22.2%) are threatened or extinct.

Amphibians, representing over 6,200 species worldwide, are one of the most threatened major taxonomic groups on the IUCN Red List. At least 42% of amphibian species have populations that are declining, indicating that the percentage of threatened species will likely only rise in the future. In contrast, less than 1% of amphibian species have populations that are increasing. Overall, there is strong evidence that the pace of amphibian extinctions is increasing – of the 38 known extinctions since 1500, 11 have occurred since 1980. Also, 120 species of amphibians have been listed as possibly extinct, most having disappeared and not been seen since 1980. The most severe impacts have been in Mesoamerica, the northern Andes and the Greater Antilles.

Proportion of species threatened with extinction in different taxonomic groups.
Error bars show minimum and maximum estimates (© IUCN).





The golden mantella, categorised as “critically endangered” on the IUCN Red List, has a very restricted distribution in east-central Madagascar. Amphibians are one of the most threatened groups of species worldwide (© Jean-Christophe Vié).



The threat status of the world’s reptiles is currently being assessed (© Nicole Gusset-Burgener).

Habitat loss is the greatest threat to amphibians, affecting nearly 61% of all known species and a very large percentage (87%) of those species that are threatened. However, the fungal disease chytridiomycosis is the major driver of known and suspected amphibian extinctions over the past three decades.

In response to the amphibian crisis, the Amphibian Specialist Group of the IUCN Species Survival Commission (SSC) and other partners have developed the amphibian conservation action plan. It provides a comprehensive framework for combating amphibian declines and extinctions. A major priority is to protect the habitat of the many threatened amphibian species that do not occur in any protected areas. Another priority is working with zoos, aquariums and other centres to shelter and breed amphibians threatened by chytridiomycosis, which cannot yet be treated in the wild and which can cause up to 100% mortality in certain species. The Amphibian Ark project is a global programme created by IUCN/SSC and the World Association of Zoos and Aquariums to manage threatened amphibians in captivity until it is safe to reintroduce them into the wild.

Warm-water, reef-building corals provide essential habitat for many species of fishes and invertebrates, making them the most biologically diverse ecosystems in the ocean. Similar to amphibians, all 845 species of reef-building corals in the world have been assessed on the IUCN Red List. More than one-quarter (27%) have been listed as “threatened” or at a high risk of extinction, with an additional 20% listed as “near threatened”, meaning that many species will likely join a threatened category in the future. Moreover, reef-building corals are declining at a faster rate than any other group of species currently on the IUCN Red List. Just 15 years ago the overall level of threat to reef-building corals was very low.

The catastrophic decline in the abundance of reef-building corals stems primarily from increased bleaching and disease events linked to higher sea temperatures, due to global warming. Coastal development and other human activities such as coral extraction and pollution have also contributed to dramatic declines since the mid-1990s. Ocean acidification resulting from increased levels of atmospheric carbon dioxide (CO₂) is further impacting reef-building coral species.

Amphibians	Threatened			
		YES	NO	Total
Climate Change Susceptible	YES	1,488 24%	1,729 28%	52%
	NO	503 8%	2,502 40%	48%
	Total	32%	68%	6,222

Corals	Threatened			
		YES	NO	Total
Climate Change Susceptible	YES	155 19%	411 51%	71%
	NO	68 9%	165 21%	29%
	Total	28%	72%	799

The numbers and percentages of (threatened) amphibian and warm-water, reef-building coral species assessed for susceptibility to climate change (© IUCN).

The highest number of threatened species according to the IUCN Red List is in the Indo-Malay-Philippine Archipelago or the “Coral Triangle”, which is the epicentre of marine biodiversity globally with the highest number of coral species. In all regions, the loss of coral ecosystems will have huge cascading effects for reef-dependent species as well as for the large number of people and nations that depend on coral reef resources for economic and food security. *Ex situ* conservation may be necessary for corals and other coral-dependent species since measures to reduce the level of CO₂ in the atmosphere are still a long way from having an effect.

The third extinction crisis revealed by the IUCN Red List is for animals in South-East Asia. Globally almost one-quarter of mammals (22.2%) are threatened with extinction but Asian countries are showing the most impact. Of the top 20 countries with threatened mammal populations, 10 are in Asia where there have been massive population declines over the past two decades. The Indo-Malayan region shows rapid declines in both birds and mammals, driven by deforestation, habitat loss and high rates of hunting for

mammals. Large-bodied taxa throughout Asia, including mammals, birds, fishes and reptiles (such as turtles) are being impacted by massive and largely uncontrolled overexploitation. Two mammalian extinctions have likely resulted in the last few years: the baiji or Yangtze River dolphin (*Lipotes vexillifer*) and the kouprey (*Bos sauveli*).

There is an urgent need throughout Asia to address the overexploitation of wildlife through anti-poaching measures and the control of trade in wildlife products. Initiatives are needed that not only focus on anti-poaching but also on providing alternative livelihoods for local people – allowing the root causes of poaching to be addressed through such measures as providing alternative protein sources and implementing capacity building and training programmes. The conversion of lowland forests for oil palm and other biofuels also needs to be urgently addressed, especially in Indonesia and Malaysia.



Partners in biodiversity conservation

There is growing evidence that climate change will become one of the major drivers of species extinctions in the coming years. IUCN recently completed the first phase of a project to identify species most vulnerable to climate change. The results showed that 52% of all amphibian species and 71% of warm-water, reef-building corals are potentially susceptible to climate change. This information will highly influence our approach to species conservation in the future. However, other more “traditional” threats such as habitat loss, invasive species and overharvesting remain critically important and should not be overlooked because of the current attention being given to climate change by many of the world’s leading environmental donors.

Stemming the tide of global extinctions requires urgent action by all of society. Ultimately, species should be saved because they have an intrinsic right to share this planet with us. However, species are also of enormous importance to human livelihoods, and these benefits will continue in perpetuity if we learn to manage biodiversity sustainably. The year 2010 is upon us and the world has failed to meet the so-called 2010 biodiversity target. In the next decade the tide must turn for species conservation and society must respond to the “wake-up call” that the IUCN Red List represents. This is the challenge that we must all address in the next decade if future generations are to have the chance not only to enjoy the full diversity of the world’s species but, ultimately, to survive.



Before becoming chairman of the SSC in 2009, Dr **Simon N. Stuart** held a number of positions with IUCN from 1986 onwards, including head of species programme, senior species scientist and acting director general. He led the Global Amphibian Assessment, oversaw the Global Mammal Assessment and launched the Global Reptile Assessment and Global Marine Species Assessment. He also started a new Biodiversity Assessment Unit, as a joint initiative of the Centre for Applied Biodiversity Science of Conservation International and IUCN/SSC. He holds a Ph. D. degree from the University of Cambridge.



Dena Cator holds a B. Sc. degree in biology and geography from the University of Victoria and an M. Sc. degree in environment and development from the London School of Economics and Political Science. She works as an SSC network support officer in the IUCN species programme, supporting the more than 100 specialist groups and their chairpersons that comprise the SSC. In addition, she conducts Red List training, facilitates communications work and represents IUCN at international forums.



Dr **Jane Smart**, Ph. D., OBE, has a lead role in the IUCN secretariat’s engagement in species, invasive species, protected areas and marine conservation as director of the Conserving Biodiversity Group. She is also head of the species programme. The species programme works closely with the SSC and IUCN Red List partners, compiling, managing and producing the IUCN Red List of Threatened Species. She joined IUCN in 2005. Prior to joining the IUCN secretariat she was chairwoman of the IUCN UK national committee, as well as a long-standing member of the IUCN/SSC Plant Conservation Committee. In 2003 she was awarded the OBE for services to international conservation.

Robert Hepworth
Convention on Migratory
Species Secretariat

Aline Kühl
Convention on Migratory
Species Secretariat

Convention on Migratory Species: conservation of migratory wild animals



The world is covered with invisible pathways used by millions of migratory animals each year. Flocks of waterbirds, herds of wildebeest, schools of whales and vast swarms of insects, such as butterflies and even dragonflies, move with the seasons from one place to another and back, often between breeding and non-breeding locations. On land, in the sea, in freshwater rivers and lakes, in the air – migratory species exist in all ecosystems and often clock up thousands of kilometres per year. They are the record breakers of the animal world: Arctic terns (*Sterna paradisaea*) fly from their northern hemisphere breeding grounds around Antarctica and back covering more than 35,000 km, and sooty shearwaters (*Puffinus griseus*) have been recorded to traverse more than 60,000 km on their annual journeys. A species of dragonfly, the globe skimmer (*Pantala flavescens*), was recently discovered to fly thousands of kilometres between southern India and Africa covering 14,000 to 18,000 km on its annual round trip.

Animal migrations include some of the most awe-inspiring spectacles of the natural world that have fascinated people for thousands of years. Because of their opportunistic behaviour, migratory species often come together in huge numbers to feed or breed. From one day to the next the otherwise quiet Eurasian steppe, for example, is filled with thousands of baaing saiga antelopes (*Saiga tatarica*), as the heavily pregnant females come together to give birth within a single week in May. Countless other species such as wildebeest or marine turtles display similar mass aggregations. Whether it is pollination, seed dispersal, grazing or providing food for predators – it is evident that migratory species play a vital role in ecosystem functioning, not least due to their mass migrations. To date we only understand a fraction of these complex systems, but when a migratory species has declined we can often observe the negative effects of this change on other species or even on the local economy.



Partners in biodiversity conservation



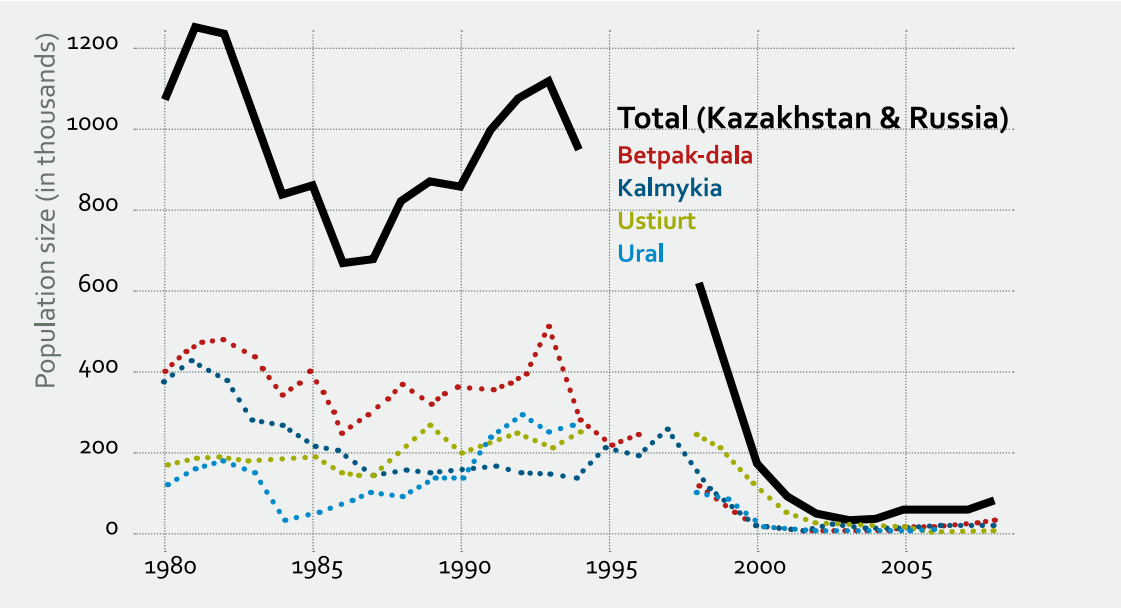
Gorilla conservation has become a recent focus of CMS' work (© Nicole Gusset-Burgener).



The saiga antelope is an example of a critically endangered migratory species (© Aline Kühl).

Ironically, our still illiterate but resourceful ancestors in Palaeolithic and Mesolithic prehistory probably appreciated the importance of migratory species more than we do in the 21st century. This was the force of necessity – many early humans depended on the migratory species they hunted for food, clothing, traditional medicine and other materials. Migratory species also feature in the earliest surviving examples of human art and religious practices. Later on in the Bronze Age, the extraordinary empathy between the Cretans and dolphins revealed by Minoan art suggests that from the earliest times, humans have been both exploiters and admirers of migratory species.

Yet the ultimate success of humans in terms of their mastery of planetary resources has now made nomadic, migratory species particularly vulnerable. Firstly, migratory populations are dependent on the functioning and connectivity of many habitats. If any of the stopover sites, breeding or wintering areas is threatened, for example through deforestation or pollution, the whole population is likely to be affected. Barriers to migration, such as roads and fences, are likely to have detrimental consequences for terrestrial migratory species. Secondly, migratory species are critically dependent on the availability of resources at certain times of the year, when they are in the area. Climate change is already leading to shifts in resource availability and migratory species are already experiencing difficulties in adapting to these recent changes. Such knock-on effects are likely to be amplified even under the most conservative climate change predictions. Thirdly, migratory species such as the saiga antelope are often vulnerable to overexploitation because of their aggregative behaviour and due to their large range, making them especially prone to human exploitation.



Changes in population size of the saiga antelope over time; the estimate for 2008 is 3,240 animals (data used with kind permission of the Institute of Zoology of the Kazakhstan Ministry of Education and Science and the Institute of Ecology and Evolution of the Russian Academy of Sciences).

Engaging people worldwide to address the factors driving the global decline of migratory populations has to be a priority for conservation policy in the decades to come. Whether one considers the threat of climate change or overfishing, the anthropogenic impact on migratory populations is such that solutions to conservation problems need to be built around creating incentives for people to become involved, to bring everyone to one table. Our world is moving faster and more closely together on a daily basis and awareness raising needs to adapt accordingly. From 2004 to 2009 the Convention on Migratory Species (CMS) doubled its regional species agreements for migratory species, which include dolphins, seals, elephants, flamingoes, sea turtles and antelopes. Many of these species can be seen in zoological institutions and there is no doubt that zoos and aquariums have a major part to play in outreach, captive breeding and research. CMS's flagship project for critically endangered, north-west African antelopes has been dependent on the co-operation from several zoos that have successfully bred surplus stock, which is now being reintroduced into the wild.

Zoos and aquariums can also play a key part in supporting (and benefitting from) the new annual United Nations species campaigns that CMS initiated in 2006. These have now become truly global campaigns, which are unique in combining international conservation policy work with the applied action that takes place in the range states. Following the "Year of the Turtle" in 2006 and the "Year of the Dolphin" in 2007/2008, the World Association of Zoos and Aquariums and the Great Apes Survival Partnership have joined forces with CMS under the patronage of Jane Goodall for the United Nations "Year of the Gorilla" campaign in 2009.



The Serengeti ecosystem is place of the world’s greatest animal migration (© Nicole Gusset-Burgener).

The zoo community is ideally placed in connecting with research and implementation matters in the gorilla range states, while raising awareness amongst visitors and members of the plight that these gentle giants face in Africa. This momentum was particularly visible when the Frankfurt Gorilla Declaration was drafted by 160 government officials, scientists and conservationists from 20 countries, who came together to discuss and prioritise urgent applied and political action. This road map together with concrete commitments by range states and the continued support of our partners is well placed to pave the way towards gorilla conservation in years to come.



Robert Hepworth joined the United Nations Environment Programme (UNEP) at director level in August 2000. He worked at the UNEP headquarters in Nairobi from 2000 to 2004 as deputy director for environmental conventions. From 2004 to 2009 he was chief officer (“executive secretary”) of the UNEP secretariat to the Convention on the Conservation of Migratory Species of Wild Animals. He has created an effective working partnership between the Convention on Migratory Species and non-governmental organisations right across the animal welfare, conservation and sustainable use spectrum, including the World Association of Zoos and Aquariums.



Dr **Aline Kühl** joined the secretariat of the Convention on Migratory Species at the start of 2008 to assist the executive secretary with a wide range of environmental policy and research matters. Her duties range from the coordination of several agreements, such as the one of her Ph. D. study on the saiga antelope, to acting as climate change focal point for the convention. In addition to her policy work, she is currently a visiting scientist at the Institute of Zoology in London, focusing on exploited species and the incentives experienced by rural resource users.

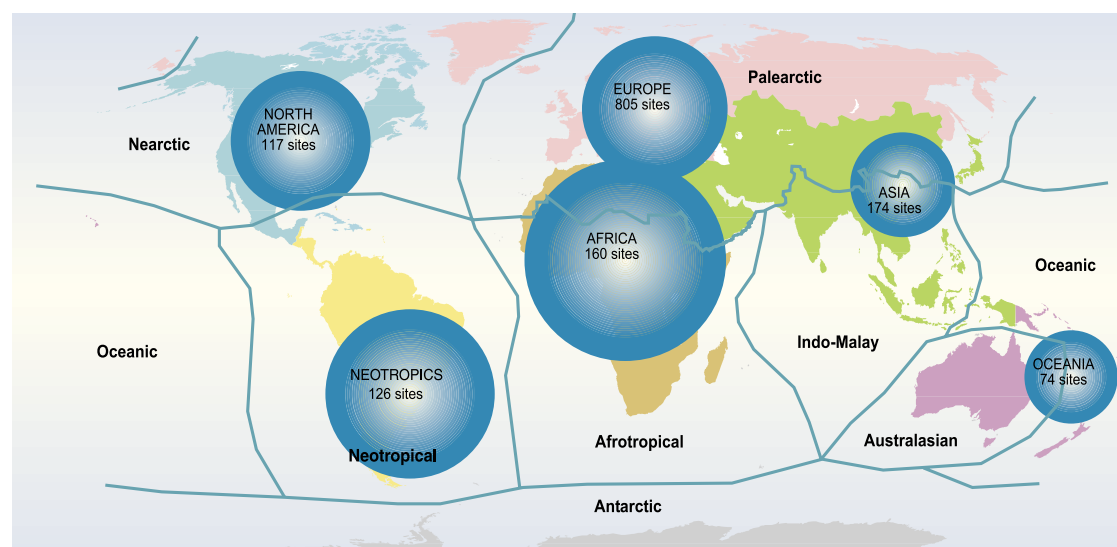
Ramsar Convention on Wetlands: committed to the conservation and wise use of water and wetlands



Water was the critical element for the appearance of life on Earth, and it is crucial for its survival. Conserving biodiversity of inland and coastal waters is essential to maintain the goods and services that such wetland ecosystems provide. For centuries humankind viewed wetlands as places to drain and convert to more obvious uses such as agriculture. The process had gone so far that the disappearance of wetlands was leading to undesirable consequences – to the loss of groundwater reserves and the consequent need

for irrigation, to flash floods, to shoreline destruction, to the accumulation of pollutants and to other more subtle disturbances. Many useful plants and animals dependent on wetlands were disappearing with them and continue to do so until today. The present global amphibian extinction crisis is a stark reminder that the process still has neither been stopped nor reversed, nor hardly been slowed down.

Wetlands listed as internationally important (Ramsar sites) in the different Ramsar regions
(© Millennium Ecosystem Assessment/Wetlands International).





Delta of the Danube River (Romania and Ukraine), one of the largest Ramsar sites in Europe (© Tobias Salathé).

People interested in the conservation of wild-fowl and fish – hunters, fishermen and naturalists – took the lead in calling for a halt to wetland destruction in the 1960s, recognising that international action was necessary for several reasons. Many wetlands span across national boundaries or derive their water supplies from neighbouring upstream countries. The circulation of water in the atmosphere is truly international. Fish hatch in wetlands of one country and might be caught as adults in those of another, or on the high seas. Waterbirds, migrating over thousands of kilometres twice a year, ignore boundaries and need wetlands of many countries in which to rest, feed and breed.

The pioneering conservationists, focusing on such important ecological inter-linkages, met in the little Iranian town of Ramsar, at the southern shores of the Caspian Sea, where they signed on 3 February 1971 the text of a remarkable treaty. The Ramsar Convention on Wetlands was the first of the modern instruments seeking to conserve natural resources on a global scale. It provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources, as a contribution towards achieving sustainable development throughout the world.



Boat crossing at the Mabamba bay Ramsar site in Uganda (© Tobias Salathé).

Wetland ecosystems include swamps and marshes, lakes and rivers, wet grasslands and peatlands, oases, estuaries, deltas and tidal flats, near-shore marine areas and cliffs, mangroves and coral reefs, and human-made sites such as fish ponds, rice paddies, reservoirs and salt pans. Together, these ecosystems cover a substantial part of the Earth's surface. Currently, around 182 million wetland hectares are designated for the Ramsar list of wetlands of international importance, incorporating nearly 1,900 specific sites. The Ramsar list forms the largest global network of protected areas, and includes well-known biodiversity hotspots such as the Everglades (USA), Pantanal (Bolivia, Brazil), Wadden Sea (Netherlands, Germany, Denmark), Okavango Delta (Botswana), Lake Naivasha (Kenya), Banc d'Arguin (Mauritania), Sundarbans (Bangladesh), Lake Dalai (China), Kakadu National Park (Australia) and many others.

Wetlands are among the most productive life-support systems. Marine and coastal wetlands such as mangrove forests, coral reefs, seagrass beds, river deltas and estuaries harbour among the highest biodiversity on Earth. They produce a range of animals of commercial importance, particularly for food, skins and for sport and the ecotourism industry.

In 2005, the Millennium Ecosystem Assessment provided increasing evidence for a rapid and widespread decline in many populations of wetland-dependent species, including molluscs, amphibians, fishes, waterbirds and mammals. Even in the case of more poorly known invertebrates, the latest assessment shows that many species are significantly threatened with extinction. Habitat loss is the primary cause, followed by the introduction of non-native invasive species as the second most important factor.



Urban spill on the Nakdong estuary Ramsar site at Changwon in South Korea (© Tobias Salathé).



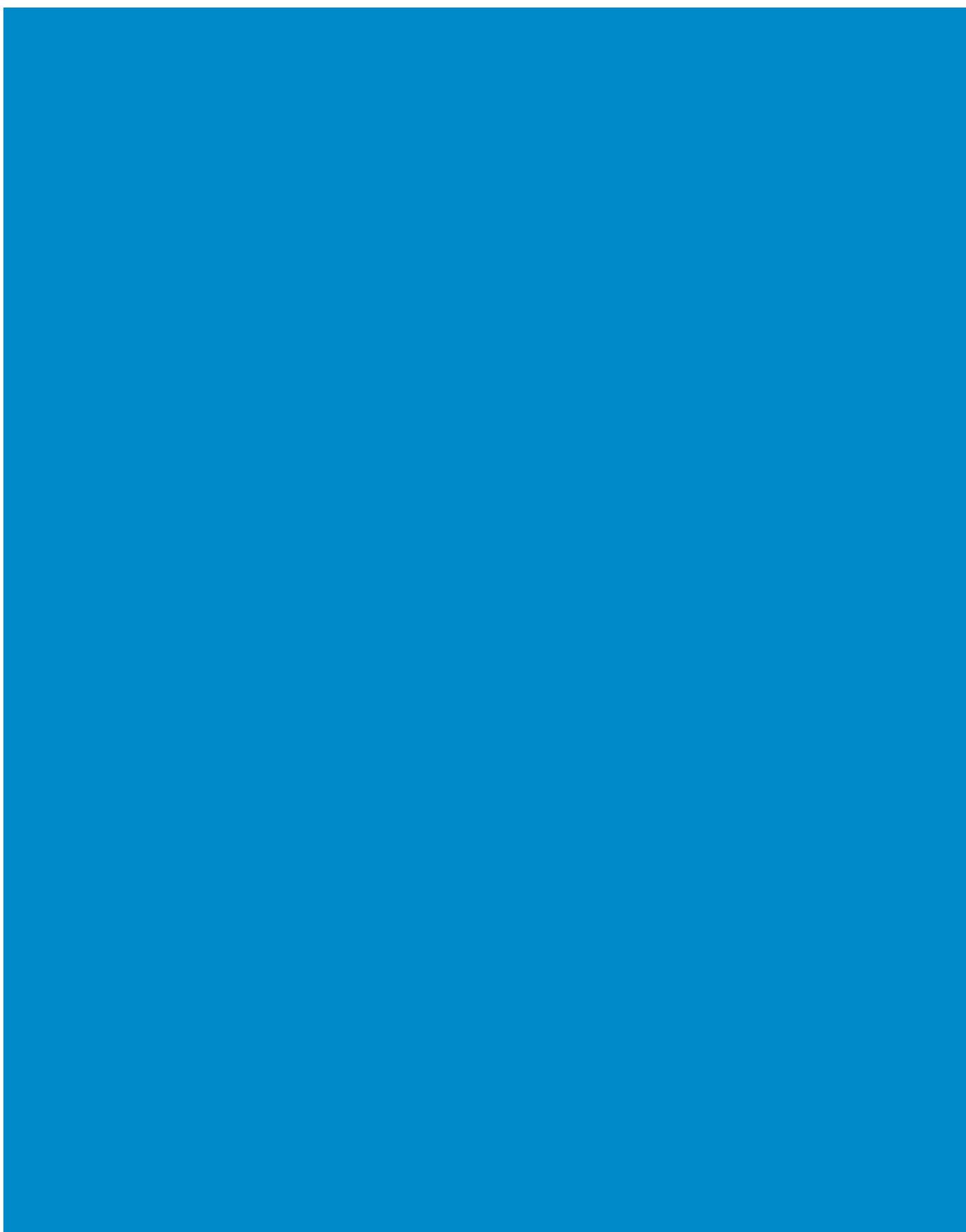
Dr Tobias Salathé, Ph. D., is from Switzerland and works as senior adviser in the Ramsar Convention Secretariat. Earlier, he worked as a freelance conservation expert, and for the European Commission, Mediterranean Wetland Initiative, Tour du Valat Foundation and BirdLife International.

The Ramsar Convention is very pleased to rise, together with the World Association of Zoos and Aquariums, to the biodiversity challenge of achieving a significant reduction of the current rate of biodiversity loss, as a contribution to poverty alleviation and to the benefit to all life on Earth. Zoos and aquariums are particularly well suited to make the wider public aware of ongoing wetland loss, species decline and the need to counteract this disastrous trend through conservation and restoration of these threatened ecosystems. Zoos and aquariums have great education potential and often substantial capacities.

Threatened species are excellent communication tools to create a better understanding of complex ecological processes and to obtain public participation and engagement in conservation projects. We look forward to working together with the world’s zoos and aquariums. In these times, where climatic change may bring us more droughts and more flooding, more species decline and more extinctions, working in partnership and reaching out to a maximum number of people and stakeholders is crucial.

Part II

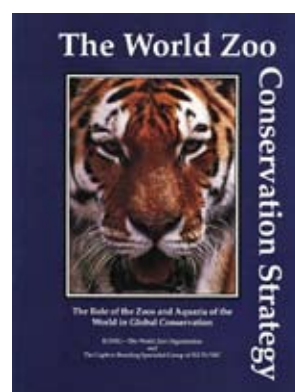
Zoos, aquariums and biodiversity conservation



The world zoo and aquarium conservation strategy: where do we go from here?

In 1993, the first World Zoo Conservation Strategy was published. It was jointly produced by the then International Union of Directors of Zoological Gardens (IUDZG) and the IUCN/SSC Conservation Breeding Specialist Group.

In the foreword, HRH the Duke of Edinburgh, then president of WWF International, wrote the following: "Much can be done by establishing and managing protected areas, but there are many species whose natural habitats have already been degraded or destroyed. For these, the only hope of survival is the direct stewardship and human care in zoological and botanical gardens in captive breeding centres". Note the emphasis on "human care ... in captive breeding centres".



Cover of the 1993 World Zoo Conservation Strategy (© WAZA).

The document itself contained eleven chapters:

- (1) Introduction: zoos in a changing world;
- (2) The world conservation strategy and zoos;
- (3) The global zoo network; (4) Education;
- (5) Zoo animal collections and their conservation;
- (6) *Ex situ* conservation of animal populations;
- (7) Capacity: space limitations and choice of species;
- (8) Artificial reproduction and cryopreservation: biotechnology in support of conservation;
- (9) Back to nature: animals for reintroduction and restocking;
- (10) Knowledge and research; and
- (11) The way forward: towards a new integration.

A notable feature of this list is that it concentrates almost exclusively on ways in which zoos can maintain sustainable populations within their institutions, with the notion that reintroductions or restocking are the principle objects of the exercise. Perhaps even more striking is that it contains no explicit (or even implicit) reference to zoos' support for conservation activity in the wild.

The world has moved on. In 2002, the council of the World Association of Zoos and Aquariums (WAZA) (formerly known as IUDZG) decided that the strategy needed very substantial revision. At its annual meeting in Vienna that year, under the auspices of its newly formed conservation committee, a workshop was held to discuss what a new World Zoo and Aquarium Conservation Strategy might contain.

At that meeting, we constructed that most powerful of consensus-forming tools, the mind map. For those unfamiliar with this rather simple but hugely illuminating technique, the following occurs. In the middle of a very large sheet of paper on a wall, a question is posed; in our case, the question was: “What should zoos be doing for conservation in 10 years’ time?” A facilitator then goes around the room, one person at a time, asking for a short answer to the question.

The first time a broad topic is raised (say “education”), the answer is written along a radiating line from the centre in a particular colour. Subsequent answers relating to education are then added on branches to the original. A new topic (say “reintroductions”) produces a completely new branch radiating from the centre. The facilitator carries on going around the room, one person at a time, until there is absolutely nothing left to be said. In our workshop of more than 60 people, we took about 90 minutes to get to the point where no one could think of anything more that zoos might be doing for conservation in 10 years’ time, which had not already been said.

Left: Mind map of the 2002 conservation strategy workshop (© Jo Gipps).

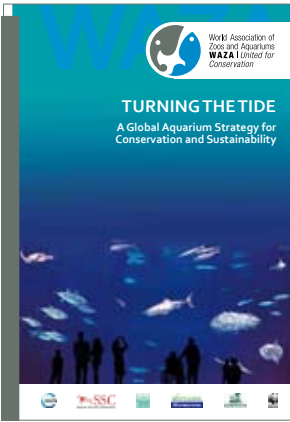
Middle: Cover of the 2005 World Zoo and Aquarium Conservation Strategy (© WAZA).

Right: Cover of the 2009 Global Aquarium Strategy for Conservation and Sustainability, implementing the WZACS by the WAZA aquarium community and partners (© WAZA).

The mind map produced from that exercise in 2002 in Vienna is reproduced here. After a bit of sorting out, our small editorial team decided that the mind map suggested nine distinct areas of activity. The most important point is that those nine areas correspond precisely to the nine chapters of the final strategy document, “Building a Future for Wildlife: the World Zoo and Aquarium Conservation Strategy” (WZACS), published by WAZA in 2005.

The chapters in that document, and the vision statements at the beginning of each chapter, are:

1. Integrating conservation: the major goal of zoos and aquariums will be to integrate all aspects of their work with conservation activities. The fundamental elements of each organisation’s culture will be the values of sustainability and conservation, and social and environmental responsibility. These values will permeate all areas of their work and will be understood and promoted by all those working within the WAZA network.
2. Conservation of wild populations: zoos and aquariums will make further contributions to conservation in the wild by providing knowledge, skills and resources through initiatives in zoo breeding, translocations and reintroduction, wildlife health, research, training, education and by funding field activities. Zoos and aquariums will be an important force for worldwide conservation by their employment or support of field workers active in the conservation of wild animals and their habitats.





3. Science and research: zoos and aquariums are fully and actively integrated into the research community and into public consciousness and understanding of science, as serious, respected scientific institutions that make significant contributions and sound scientific decisions for wildlife worldwide.

4. Population management: all zoos and aquariums will be primary centres of expertise in small population management and will be involved in global or regional cooperative breeding programmes. All such programmes will be based on sound knowledge using the latest available data on population management, reproductive biology, genetics, behaviour, physiology, nutrition, veterinary care and husbandry.

5. Education and training: zoos and aquariums with their unique resource of live animals, their expertise and their links to field conservation will be recognised as leaders and mentors in formal and informal education for conservation. The educational role of zoos and aquariums will be socially, environmentally and culturally relevant, and by influencing people's behaviour and values, education will be seen as an important conservation activity. Zoos and aquariums will expand the training of their own staff and of others engaged in *in situ* and *ex situ* work.

6. Communication: marketing and public relations: zoos and aquariums and their national and regional associations will become highly effective in communicating conservation issues and their role in conservation. They will become better recognised as one of the major and most trusted voices speaking on behalf of wildlife and wild places.

7. Partnerships and politics: through increased cooperation and judicious encouragement, zoos and aquariums will continue to raise standards of animal management, educate the public to act on behalf of conservation issues, and assist in field projects. Partnerships will strengthen global cooperation and help all zoos, aquariums and other conservation organisations to improve and to achieve their conservation goals. Zoos and aquariums will be encouraged to help one another, particularly those that have fewer resources and/or expertise.

8. Sustainability: all zoos and aquariums will work towards sustainability and reduce their "environmental footprint". They will use natural resources in a way that does not lead to their decline, thus meeting the needs of the present without compromising future generations. All zoos and aquariums will serve as leaders by example, using green practices in all aspects of their operations and by demonstrating methods by which visitors can adopt sustainable lifestyles.

9. Ethics and animal welfare: all zoos and aquariums will follow ethical principles and maintain the highest standards of animal welfare in order to establish and sustain viable populations of healthy animals for conservation purposes and to convey credible conservation messages to the public.

What is particularly striking about this list of chapters is that, although there is much overlap with the contents of the 1993 strategy (particularly with respect to the conservation education role of zoos), there is also a strong degree of divergence. In particular, the conservation of wild populations has become a core element of the new strategy, because it is now a core element of the conservation work (both action and research) that zoos do.

The introduction to the 2005 World Zoo and Aquarium Conservation Strategy is littered with references to conservation in the wild. For example, the definition of conservation is given as "conservation is the securing of long-term populations of species in natural ecosystems and habitats wherever possible". This definition is followed by an explanatory note that says that the words "natural ecosystems and habitats" signify that "no amount of worthy endeavour is of ultimate value if it doesn't translate into animals and plants surviving in the wild".

Apart from the change in emphasis of the new 2005 strategy compared with that of 1993, the world has changed in another hugely important way; we now live in the age of the Internet. A few thousand copies of the World Zoo Conservation Strategy were printed in 1993 and basically, that was it. Most major zoos in the world bought several copies, and some copies went to government and non-government conservation agencies around the world. But, if you had not got a printed copy, you probably did not see it.

The contrast between the 1993 and 2005 documents is astonishing. The WZACS has now been translated into Chinese, Czech, German, Hungarian, Polish, Portuguese, Russian, Spanish and Swedish and has, at the date of writing, been downloaded from the WAZA website more than 250,000 times, in addition to 10,000 printed copies of the English version plus many more thousand copies in the other languages. Clearly, this is a document that has been seen and used by a very large number of people. Indeed, the conservation strategies of many regional zoo associations, and many of their institutional members (including ours!), are based on the WZACS.

We believe that the WZACS has been, at least in part, instrumental in the way that zoos have changed how they view their role in the wider world of conservation. Zoos all over the world now believe their role in helping to conserve wild populations of animals (and plants) to be as important as conservation breeding programmes and the possibilities of reintroductions. Of course, the two processes remain inextricably linked; zoos are, after all, an astonishingly powerful and large resource for maintaining assurance populations of species threatened in the wild.



Dr Jo Gipps joined Bristol Zoo Gardens as director in September 2001. Before that, he worked at London Zoo, first as curator of mammals, then as senior curator, and finally as director between 1993 and 2001. He was awarded the OBE in 2000. He currently chairs the conservation and sustainability committee of the World Association of Zoos and Aquariums and is on its council. He is a council member of the British and Irish Association of Zoos and Aquariums and a member of the steering committee of the IUCN/SSC Conservation Breeding Specialist Group.

But, in the modern world, zoos acknowledge that breeding programmes and reintroductions are not, and never will be, enough. I know of no responsible zoo director who would regard the existence of the last remnants of a population of a species close to extinction, held solely in human care in a breeding centre, as any sort of success. Rather, the conservation world at large, which includes all those zoos committed to conservation, would count that as a sad, and indeed abject, failure.

The WZACS will be five years old in 2010, and was intended to have a life of 10 years; we shall mark this halfway point with a review – not a complete rewrite, but a careful scrutiny to see what is different and new five years on, and to start thinking about where we shall be in another five. Then, I am sure we shall need another new strategy for a markedly changed world.

Our sincere hope is that we shall have been able to put a halt to, or at least slowed down the current rate of biodiversity loss worldwide. In a depressing world, conservationists have to remain optimists. I am particularly fond of the saying (variously attributed to Confucius, Eleanor Roosevelt and others): "It is better to light one small candle, than to curse the darkness". So true.

Aquariums and the conservation of water-dependent species

When recalling early childhood memories, so many of us will remember exploring muddy puddles of water and collecting tadpoles in glass jars, watching in awe as these amazing creatures transform into frogs. Those of us lucky enough to spend time near the sea may remember long walks along the beach in the early morning in search of cuttlefish floats or pretty shells, or perhaps exploring the rock pools teeming with small fish, in search of the elusive octopus. There is no denying the allure of the sea, of lakes and of rivers – many mums and dads will describe the glee and enthusiasm with which children embark on fishing expeditions or lakeside camping excursions. When one considers how miniscule a proportion of our planet's aquatic biodiversity even the most avid young explorer is exposed to, one begins to see the immense value of public aquariums.

Despite some 60% of the world's population living within 60 km of the sea, and many more living in river catchment areas, a relatively small proportion of humankind is exposed to the extraordinary range of living organisms in the Earth's waterbodies. Only a privileged few are able to don an aqualung to explore and appreciate the coral reefs that teem with marine life, while just a handful of scientists are able to explore the ocean depths where the sunlight never shines. For most people, their only exposure to aquatic biodiversity is seeing what comes out of a fisherman's net. Aquariums have an enormous role to play in showing us air-breathing creatures the wonders of our extraordinary and mysterious blue world.

This planet that we know as "Earth" could just as easily have been named "Water". Water takes up more than 70% of the planet's surface, existing almost entirely in our oceans but for a small percentage in freshwater lakes, rivers, glaciers and ice caps. Water is our lifeblood and makes our planet suitable for human life. The Earth's climate is driven by the ocean currents that carry heat around the planet and dictate the weather. Many of us understand the role played by forests in generating oxygen for us to breathe, but how many of us know that some 70% of the oxygen we breathe is generated by tiny marine organisms in our oceans? Waterbodies support an astonishing diversity of natural organisms with some 70,000 mollusc, 40,000 crustacean, 29,300 fish and 5,743 amphibian species listed. Some 80% of the world's biodiversity is found in the oceans, yet the truth is we spend more money studying other planets than we spend studying the abundance of life in our oceans.



Thanks to a growing number of aquariums around the world, people of all ages, cultures and backgrounds now have a window into this extraordinary world, and opportunities to meet the fascinating creatures that serve as ambassadors for their kind. What better way to foster an appreciation of aquatic habitats than to showcase these extraordinary creatures in aquariums, and to explain the interdependence of the species that make it their home? Seeing these creatures and appreciating them is the first step to understanding them, and through understanding follows caring, and a belief that these creatures deserve to take up their place on our planet.

Aquariums in one form or another have been popular for centuries. In Asia, fish keepers of old kept colourful fish in ceramic urns, selecting and breeding fish for their distinctive colours or patterns. Even Roman emperors put aquatic animals in elaborate pools for the entertainment of their guests. Today there are more than 300 public aquariums worldwide, which host in the region of 200 million visitors each year. The term “aquarium” was first used in the mid-1800s, and these popular institutions can now be found in almost every major city in the world. As with zoos, the early aquariums were grand architectural structures with selections of aquatic creatures displayed for the entertainment and amusement of a curious public.



Open ocean exhibit
at Monterey Bay Aquarium,
with great white shark
(© Dennis King).

The modern aquarium has evolved into an education and entertainment centre drawing expertise from a variety of disciplines including engineering, marine biology, veterinary science, field ecology, educational theory, animal husbandry, animal training, horticulture and stagecraft. Dramatic advances in life-support technology, tank design and the use of large acrylic panels instead of glass have allowed aquarium designers far greater scope and more opportunities in creating these remarkable blends of theatre, art, science and technology. But in line with the reality of modern life, the modern aquarium must be financially viable and able to successfully compete with the bright lights and excitement of shopping malls, theatre performances, sporting events and other trappings of our society, to draw people in through the front door.

It is often argued that the primary role of a public aquarium is to expose the visiting public to the fascinating aquatic environment, and touch the hearts and minds of those visitors and foster in them a true appreciation of aquatic life. Achieving this depends on creating a balance between exciting entertainment and interaction, between formal and informal education, and the provision of time and space for observation and reflection. But the role of the modern aquarium does not stop there! Aquariums can be powerful drivers of social change, and can play a valuable role in conservation by facilitating a change in attitude and behaviour in its visiting public.



Diver explaining a sustainable seafood programme at Monterey Bay Aquarium (© Mark Penning).

The threats to the world's oceans and freshwater bodies are numerous, but the most obvious and significant is overfishing. Nearly 40 million people generate all or a substantial part of their livelihood from fishing around the world, and the consumption of seafood has increased over the years. According to the United Nations Food and Agriculture Organisation, almost 100 million tons of seafood is consumed each year, an average of 16 kg per person on the planet. Despite substantial technological advancement in the fishing industry and greater fishing capacity, global catches are decreasing from year to year. This, together with rampant illegal fishing and destructive fishing practices, present a dire threat to food security on our planet. Conservation and sustainable harvesting are easy concepts to sell to people living in relative comfort, but very difficult to sell to a hungry person with a family to feed.

Aquariums have seen the need for social change to protect the future of our oceans and lakes, and in turn our own well-being. Several have developed sustainable seafood initiatives, which help visitors to make sensible seafood choices both in restaurants and in the supermarket. Society is becoming increasingly aware of the burden we place on our planet's resources, and by providing accurate and relevant information, aquariums influence the shopping habits of millions of people.

The modern aquarium strives to integrate conservation activities into all aspects of aquarium practice. The conservation of wild populations of aquatic animals is becoming increasingly important, and the modern aquarium strives to play a meaningful role in field conservation efforts, with many formally adopting field projects and providing expertise, training, interpretation, education or fundraising capacity. It collaborates with conservation management agencies to conserve local aquatic ecosystems, and plays a leading role in clean-up operations on lake and sea shores. Thousands of aquarium visitors contribute towards these projects, and in so doing, the aquarium helps society to develop a conservation conscience.



Touch pool at John G. Shedd Aquarium (© Mark Penning).

Public aquariums operate in the context of a very large international hobbyist trade, and it is estimated that there are between 1.5 and 2 million marine home aquarists. The majority of freshwater fish in the trade are derived from captive breeding or aquaculture, but nearly all the tropical marine aquarium fish are taken from on or around coral reefs. Importantly, this fishery provides jobs and income in rural low-income coastal areas that have limited resources. By forming strategic partnerships, comprehensive programmes have been developed to certify that animals are collected using environmentally appropriate methods. The Marine Aquarium Council, for example, is an international non-profit organisation that brings together the aquarium industry, fishers and their communities, conservation organisations, public aquariums, hobbyists and others to develop standards for the collecting industry and a certification process.

Another example is Project Seahorse, based at the University of British Columbia in partnership with the Zoological Society of London and the John G. Shedd Aquarium in Chicago. Seahorses are harvested globally for the ornamental, curio and especially the traditional medicine trades, and Project Seahorse does extensive work with fishing communities in the Philippines to ensure that traditional harvesting is done without over-exploiting the wild seahorse populations.

Other collaborative projects include CORALZOO, a research project aimed at developing methods for breeding and caring for hard corals in order to set up breeding and exchange programmes, and to facilitate the training of aquarium staff. Similarly, Project SECORE is a network of public aquariums and research institutes applying sexual reproduction techniques to enhance the sustainability of coral populations both in aquariums and in the wild. The conservation role of the modern aquarium extends far beyond what the visitor sees through the window.

In the field of science and research, we are in a truly remarkable era. The depths of the oceans have hitherto remained largely unexplored, but tremendous advances in technology now allow us access to some of the fabulous creatures that myths and legends are made of. Our ability to hold some of these creatures has been increased through dramatic developments in life-support technology, and several aquariums can now exhibit the majestic manta ray (*Manta birostris*), and the biggest fish on our planet, the incredible whale shark (*Rhincodon typus*). How many people would ever be fortunate enough to see one of these awesome beasts with their own eyes? For aquariums, this truly is the age of discovery.



Bottlenose dolphins at uShaka Marine World
(© Mark Penning).

The much-maligned sharks of our seas have attracted all the wrong attention over the last few decades. Relentlessly persecuted for their apparent risk to bathers, these remarkable creatures face the further threat of being killed for their fins. Thanks to better knowledge and improved husbandry techniques, many species of shark can be displayed in public aquariums. What better way to dispel the myth of the voracious single-minded human-eating monster than affording visitors an opportunity to watch sharks interact with divers in a tank? Even the mighty great white shark (*Carcharodon carcharias*) has been kept successfully, and thousands of visitors watched in awe of its grace and power. There is no denying it – these creatures fascinate us, and our knowledge and understanding have increased immeasurably through the collective efforts of the world’s aquariums.

The human race is in the process of bringing about potentially catastrophic change to our world, and it will require a concerted effort by a passionate and dedicated group of individuals to halt these changes. The battle is not lost – and the aquariums of the world have taken up arms.



Dr **Mark Penning** is a veterinarian by training, with an indomitable passion for wild animals and wild places. He grew up near Johannesburg, and worked in Pretoria as a veterinarian before joining the zoo and aquarium industry in 1997. He is currently executive director of the South African Association for Marine Biological Research, a non-profit organisation that operates the Oceanographic Research Institute, uShaka Sea World and the Sea World Education Centre in Durban. He became president of the World Association of Zoos and Aquariums in October 2009.

We are not just keepers of fish – we are conservators, educators, scientists and powerful tools for social and political change. We will focus our efforts on inspiring people the world over to appreciate life in the oceans, the lakes and rivers, and guide society through the changes needed to preserve these habitats. The task is enormous, but try it we must – our lives depend on it.

International conservation policy and the contribution of the zoo and aquarium community

The public perception of “nature conservation” has always been and still is focusing on rare animals, especially charismatic or at least colourful, and on wonderful but endangered plants, possibly with nice flowers or at least with an extraordinary shape. But new words have entered the vocabulary of conservationists and are dominating the global discussion: access and benefit-sharing, intellectual property rights, poverty alleviation, genetic resources and many more.

In fact, with the still poor but rapidly increasing knowledge about the linkages and interdependencies between biological diversity and ecosystem services (such as drinking water, clean air, fertile soils, climate and both natural and cultural landscapes for recreation), it has become evident that conservation and conservation organisations have to broaden their efforts from species conservation projects to the safeguarding of genetic resources and ecosystems. General experience and a growing body of scientific

studies show everywhere on Earth that the main driver for environmental destruction and species loss is human poverty, and vice versa that the loss of biological diversity is one of the principal causes for poverty – especially in countries with a high percentage of subsistence economies. No matter if on the island of Sumatra or in the Amazon basin, the loss of tropical forests has not led to prosperity for a large number of people, to the contrary: benefits remain with a few, and the poor are often cut off from the biological resources they depend upon. The same is true for the coasts of South-East Asia where shrimp ponds are expanding and for the East African coasts where commercial overfishing is driving local fishermen into piracy.



With the increased logging of forests, this rattan collector in Vietnam fears to lose his only source of income (© Manfred Niekisch).



Shrimp ponds behind the mangrove belt in Vietnam's Mekong Delta: a completely unsustainable product for export leaving no benefits for the poor farmers, rather increasing their problems (© Manfred Niekisch).

An international regime called ABS on the access to genetic resources and fair and equitable sharing of benefits arising out of their utilisation is under construction since the United Nations' world summit on environment and development in 1992. ABS is hoped to bring more justice into the worldwide use of biological diversity and to stop its loss. So, nature conservation must be seen and used as an important instrument against poverty, not in every case but wherever possible. Poor people will not always have direct benefits from a conservation project, but this aspect should at least be considered and the potential realised. Field projects of the Frankfurt Zoological Society and a few other non-governmental organisations are proving that species and habitat conservation is more successful when combined with poverty-related activities.

But what can be the role of zoos and aquariums in such a new, complex task that "nature conservation" is taking on? People come to a zoo first and foremost to see animals and not "genetic resources". They want to see, enjoy and observe animals and not necessarily contribute to the fight against poverty. And ABS has become such a complicated issue that even delegates at the conference of the parties of the Convention on Biological Diversity get stuck – and sometimes lost – in the discussions around it.



In Vietnam's Mekong Delta many people live from fisheries. The techniques are simple but seem to be sustainable – at least as long as shrimp ponds do not contaminate the coastal waters with their waste water (© Manfred Niekisch).

Zoos certainly have not been built to present ABS and its implications to their visitors. But any zoo animal can be seen and must be used as an ambassador for its wild relatives. Zoos talk about the places where these animals dwell in nature, that is their habitats. From there it is just a small step to explaining the threats species and ecosystems are facing. A zoo that is not offering information about the IUCN Red List of Threatened Species and the conservation status of the species exhibited, has not understood the responsibility zoos have in a world where the extinction crisis is a much more serious problem than any economic or financial crisis. The latter ones can and will be solved rather easily, but extinction is for ever.

From there it is just another minor step to present to the visitors facts about the consequences of species loss for ecosystem services and human well-being. Frankfurt Zoo fortunately finds itself today in a fast growing community of zoos striving to teach their visitors the way forward: how to avoid products in the supermarket that do harm to nature and which are produced in an unsustainable way. Palm oil, soy beans, shrimps and tropical timber are among many other products where a "buyer beware" applies. Frankfurt Zoo and the Frankfurt Zoological Society also started a campaign to collect and recycle cell phones because of the effects of coltan mining on gorilla habitat in the Congo. One step further is the issue of the consequences of environmental degradation on primarily the poor people.



Soy beans where a few years ago stood tropical forest rich in species in Brazil's Mato Grosso. The small farmers therefore had to move deeper into the Amazon basin (© Manfred Niekisch).

The classic – and still important – approach of zoos to conservation, to breed animals *ex situ* and potentially to reintroduce some of them into the wild, is – at least in principle – known to most zoo visitors. Modern zoos must and do take on the challenge to go beyond that. Not only are most scientifically managed zoos today involved in a large number of field research and conservation projects. Also, zoos through their educational work provide the chance to learn how animals live and whether they are endangered. If the more than 600 million zoo visitors start understanding what the relevance of “biological resources” and ecosystems is and where the relevance of biological diversity lies not only for people from other cultural, social and economic realities all over the world but also for their own existence, then they will be prepared to start thinking about what they can do to help our planet under pressure. A relaxed atmosphere, an enjoyable experience with animals: well-managed zoos are the ideal places for helping people find their way into the priorities and needs of modern nature conservation.



Dr **Manfred Niekisch** is a biologist. He did his Ph. D. on amphibian ecology and started his professional career in nature conservation as director for species conservation of WWF Germany and TRAFFIC Germany in 1983. In 1990 he co-founded OroVerde, a foundation for the conservation of tropical forests, of which he is chairman of the board up to the present. In 1998 he became the first professor for international nature conservation in Germany at Greifswald University, where he continued his practical and scientific work related mainly to protected areas and tropical forest conservation in Asia and South America. Since 2008 he has been director of Frankfurt Zoo. He holds several honorary positions in international biodiversity conservation.

Thomas Althaus
World Association
of Zoos and Aquariums
Executive Office

Laurie Bingaman Lackey
International Species
Information System

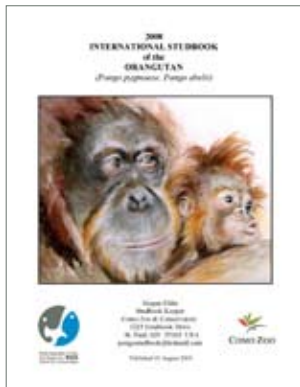
Fiona A. Fisk
Zoological Society
of London

Dave Morgan
African Association
of Zoos and Aquaria

The role of international studbooks in conservation breeding programmes

Animal collections in individual zoos and aquariums are typically too small, by themselves, to be of much value to long-term conservation. Therefore, cooperative international or regional *ex situ* breeding programmes are required to form larger, viable populations. These cooperative breeding programmes serve many purposes: providing animals for public educational and/or exhibit opportunities; providing fundraising material; providing research collections from which to gain basic knowledge of animal biology and husbandry; and, on a larger scale, providing demographic and genetic backup to wild populations. To serve fully in all of these roles, these populations must be viable over the long term. This requires that they be demographically stable, genetically healthy, well maintained and capable of self-sustaining reproduction, distributed among several institutions to lessen the risks of catastrophic loss and of sufficient size to maintain high levels of genetic diversity.

The most important tool in scientifically managing *ex situ* populations of wild animals, ensuring in particular their sufficient size, demographic stability and high level of genetic diversity, is studbooks, wherein all data relevant to the captive population of a certain species are collected and continuously updated. The studbook keeper maintains the pedigree and demographic history of a specifically defined taxon such as a genus, species, sub-species or other specific captive population. Studbooks contain the registration number of each animal of the particular species in captivity, its sex and birthdate, the identity (registration numbers) of its parents, where it was born and where (and when) it was transferred to, ownership information, as well as its house name and its identifiers (such as transponders, tattoos and tags). The update section of the studbook compiles any births, captures, transfers, deaths and releases during the reporting period. Other information important to the management of the species is also included such as rearing information or behavioural traits affecting the ability to be used in a breeding programme, and causes of death. A location glossary, including the names, addresses and contact information for all historic and current holders, allows communication between the various holders and the studbook keeper.



Cover of the 2008 international studbook of the orang-utan (© WAZA).



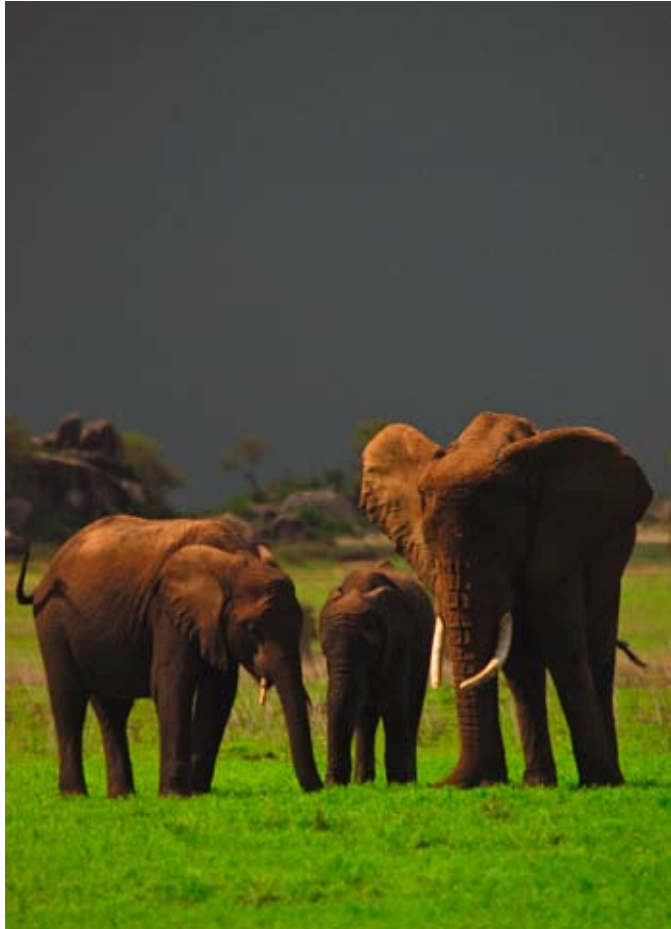
Cheetahs have their own international studbook (© Nicole Gusset-Burgener).

In considering the ownership of the studbook data and the subsequent availability of the studbook dataset, the World Association of Zoos and Aquariums (WAZA) concluded that all studbooks managed under the auspices of, and on behalf of, a recognised studbook authority (whether WAZA or a WAZA member association) are to be developed for the collective benefit. The data in such studbooks are to be held under the stewardship of the studbook authority. The studbook keeper is the curator of the data and neither the studbook keeper nor the institution at which that person is employed owns the dataset. The studbook dataset should be made available to the zoo and aquarium community in the most useful and globally compatible format.

This information may then be used to manage the captive population on several levels; quantitative analyses of the genetic and demographic data in particular are used to develop a management plan that is carried out through specific recommendations for each specimen in the population. In general, managers try to minimise inbreeding, grow populations to a level suitable for maintaining sufficient levels of genetic diversity and maintain these populations at a size that does not impact on the ability of programmes for other species to achieve their goals. Indeed, a study on various captive deer species suggested that individuals from those species managed by an international studbook had a higher relative life expectancy.

Since the exchange of animals between regions is expensive and – mainly due to veterinary restrictions – sometimes quite difficult, conservation breeding programmes are typically established and administered at the level and under the auspices of the regional associations. The measures implemented by regional associations may be limited to the collection of data (regional studbooks), they may aim to maintain a long-term *ex situ* population or they may be linked to *in situ* conservation, for example by producing animals for reintroduction into the wild. To manage their programmes and to assist the studbook keepers in their work, the associations have established special committees, taxonomic advisory groups and scientific advisory groups. The following two examples show what is meant by such regional breeding programmes.

The Species Survival Plan (SSP), an Association of Zoos and Aquariums (AZA) copyrighted breeding and conservation programme, is designed to maintain a healthy, self-sustaining, genetically diverse and viable, as well as demographically stable population of a species in human care, and to organise zoo and aquarium-based efforts to preserve the species *in situ*. Each SSP manages the breeding of one species. Currently, 107 SSPs covering 161 individual species are administered.



African elephants have their own global species management programme (© Nicole Gusset-Burgener).

New SSPs are approved by the appropriate AZA taxon advisory group, which manages conservation programmes for related groups of species (apes, raptors, freshwater fishes, etc.) or by the AZA wildlife conservation and management committee. Each SSP has a qualified species coordinator who is responsible for managing day-to-day activities. Management committees composed of elected experts assist the coordinator with the conservation efforts for the particular species. The overall programme is administered by the AZA conservation and science department in Silver Spring, Maryland, in consultation with the AZA wildlife conservation and management committee.

The European Endangered Species Programme (EEP) is the most intensive type of population management for a species kept in European Association of Zoos and Aquaria (EAZA) zoos. Each EEP has a coordinator who is assisted by a species committee. The coordinator collects information on the status of all the animals kept in EAZA zoos and aquariums of the species for which he or she is responsible, produces a stud-book, carries out demographical and genetic analyses, produces a plan for the future management of the species and provides recommendations to participating institutions.

In addition, at its 2003 annual meeting, WAZA adopted a procedure for establishing inter-regional programmes, which may concern a number of species for which international studbooks have been established. These programmes, called global species management programmes, are those officially recognised and endorsed by WAZA. International studbooks for endangered and rare species are kept under the auspices of WAZA. They represent the highest level of global monitoring/management and are to provide a valuable service to the zoological community, offering the most complete and accurate global data on the *ex situ* population's pedigree and demography, where possible including husbandry and veterinary guidance, thus enhancing the management of the population through analysis of the stud-book data. In most cases, staff of WAZA member institutions serves as studbook keepers. Within WAZA the international studbook programme is overseen by the committee on population management and is coordinated by a nominated employee at the WAZA Executive Office, in collaboration with the International Species Information System (ISIS). The Zoological Society of London regularly publishes the updated list of current international studbooks in the International Zoo Yearbook. As of March 2009, there were 121 active international studbooks, including 166 species and/or sub-species. ISIS maintains a library of active Single Population Analysis & Records Keeping System (SPARKS) datasets for 162 species and/or sub-species, and archived SPARKS datasets for 34 species and/or sub-species.



Dr Thomas Althaus studied biology at the University of Berne and at Colorado College. He did his Ph. D. on the behavioural development of domestic dog pups. From 1986 to 2006 he was head of the Swiss CITES management office and responsible for the implementation of the legislation on the keeping of wild animals at the Swiss Federal Veterinary Office. Since 2002 he has been chairman of the CITES animals committee. He has been international studbook coordinator at the WAZA Executive Office since 2005.



Laurie Bingaman Lackey received her B. Sc. degree from Davidson College and her MA degree from George Washington University. Since 1972, she has worked as a keeper, registrar and biotechnician for various zoos in the USA and Europe and for the U.S. National Park Service. Since 1993, she has worked for the International Species Information System as a programmer, systems analyst and technical supporter. Her main areas of expertise include studbooks, population management and taxonomy.



Fiona A. Fisk holds a B. Sc. degree in biological sciences. She completed three years training in publishing scientific journals at Blackwell Scientific Publications in Edinburgh. In 1989 she joined the Zoological Society of London to work on the International Zoo Yearbook. She is accomplished in the peer-review process, managing data collection and collation, and publishing an annual reference book that is an international forum for the exchange of information on the role of zoos and aquariums in the conservation of biodiversity, species and habitats.



Although Welsh by birth, **Dave Morgan**'s early and formative years were spent in Malawi before moving down to Pretoria, where he presently resides. He attended Rhodes University in Grahamstown and, following this, took up the post of assistant curator of the Transvaal Snake Park, Halfway House, in 1981. Over the years he worked up through the ranks, becoming curator of the park in 1987 and finally CEO in 1995. In 2000 he became CEO of Montecasino Bird Gardens. He moved on in 2003 to become the first professional executive director of the African Association of Zoos and Aquaria, the position he currently holds.

Altogether, there are studbooks (international and regional) and/or breeding programmes for more than 850 different taxa, some taxa having studbooks in more than one region. ISIS regularly publishes and distributes the WAZA/ISIS studbook library DVD. The 2008 edition (published in June 2009) contains 1,440 total studbooks, including regional and international studbooks, plus 235 husbandry manuals.

This is a significant fraction of the approximately 1,600 assigned studbooks and represents 99% of the published studbooks. More than 850 studbook keepers from 360 institutions in 54 countries have contributed their work.

Zoos and aquariums committing to conservation

Already back in 1992, Dr William Conway said: "Given the world extinction crisis, the future of zoos and aquariums will be determined by their ability to effect a new synthesis of their assets and to become proactive 'conservation parks'."

Zoos and aquariums have been claiming to be conservation organisations for many decades, but until recently (the past 20 to 25 years) their primary focus has been on breeding animals in captivity. While *ex situ* propagation can prevent species extinction it cannot save animal populations in nature. With the exception of a few institutions like the New York Zoological Society (Wildlife Conservation Society), the Frankfurt Zoological Society and the Zoological Society of London, most zoos and aquariums traditionally had poor track records when it involved direct support of *in situ* conservation.

Beginning in the 1980s there has been a gradual shift in philosophy for zoos and aquariums that involves a greater commitment to supporting conservation programmes beyond their gates. While zoos and aquariums have improved and expanded their conservation programmes, they are still not recognised by the public as true conservation organisations. One model (in the USA) that is helping to highlight the roles of zoos and aquariums in this arena are the "Zoos and Aquariums Committing to Conservation" (ZACC) conferences.

A small group of dedicated staff from Columbus Zoo and Aquarium conceived and organised the first ZACC conference in 1995. The goal was to promote the critical role that zoos and aquariums play in supporting conservation activities worldwide. Conference participants included representatives from zoological institutions, conservation organisations, non-governmental organisations, government agencies, funding organisations and field biologists. This first conference was so successful that it became a biannual event hosted by other zoos accredited by the Association of Zoos and Aquariums (AZA) (Busch Gardens, San Diego Zoo, Brevard Zoo and Houston Zoo).



Proyecto Titi is a WAZA-branded project for the conservation of cotton-top tamarins in Colombia (© Proyecto Titi).

The mission for ZACC conferences is more than just promoting and recognising our conservation efforts, but also serves to strengthen networks and build partnerships between zoological facilities and field projects. Bringing together individuals from different countries and disciplines, ZACC conferences help to establish direct links between *ex situ* and *in situ* conservation initiatives. This has resulted in a more holistic approach to zoo and aquarium-based conservation that is not just science-based, but people and market-driven. Conservation has now become an integral part of almost every AZA institution's business plan and not just words in a mission statement.



Modern zoos and aquariums are committed to supporting conservation programmes beyond their gates, such as for southern ground hornbills (© Nicole Gusset-Burgener).

The past two ZACC conferences hosted by Houston Zoo clearly demonstrated the new emphasis on cultural sensitivity and business savvy to better accomplish conservation science. As one speaker articulated in the 2009 ZACC conference, science alone will not save a species.

One excellent example of this innovative strategy is Proyecto Titi for the critically endangered cotton-top tamarin (*Saguinus oedipus*) in northern Colombia. Working with local communities this zoo-led project (Dr Anne Savage of Disney's Animal Kingdom) has developed an eco-friendly business alternative to mass deforestation. Handicrafts and artwork produced by local communities are shipped and sold in the zoo and aquarium gift shops throughout the USA. With 100% of the proceeds going back to the communities, this provides an economic incentive to care for and protect local wildlife.



The Snow Leopard Trust, with its WAZA-branded Snow Leopard Enterprises project, strives to conserve snow leopards in Mongolia and Kyrgyzstan (© Snow Leopard Trust).

This entrepreneurial conservation marketplace has tremendous potential. Organisations like the Snow Leopard Trust have taken this cause-related marketing idea to new levels with a whole menu of locally produced items from Mongolia and Kyrgyzstan to support the conservation of snow leopards (*Uncia uncia*). At the 2009 ZACC conference the Zimbabwe African wild dog (*Lycaon pictus*) project raised significant funds from the sale of wire figures made from snares that were removed from the wild before they killed their intended victims.

The recent ZACC conferences have expanded the small immediate grant awards programme so that seven to ten of the field conservationists in attendance received US\$1,000 to 3,000 awards on the last day of the conference. The selection process was based on proposals submitted by the speakers as to who best met the predetermined criteria set forth in the application. The funds for these grants came from conference sponsors, registration revenue and proceeds from the silent auction.

In addition to these small grants a new award was established at the 2009 ZACC conference – the “William Conway Lifetime Achievement Award”. This special award recognises unequalled vision, commitment and leadership in wildlife conservation. It also has a US\$5,000 honorarium for the recipient. The first lifetime achievement award went to its namesake, Dr William Conway – former director of Bronx Zoo and the New York Zoological Society (Wildlife Conservation Society).



Painted Dog Conservation is a WAZA-branded project for the conservation of African wild dogs in Zimbabwe (© Painted Dog Conservation).



Rick Barongi has been working in the zoo and wildlife conservation field for over 35 years. He holds a B. Sc. degree from Cornell University and an M. Sc. degree from Rutgers University. He has been director of Houston Zoo since 2000 and led the effort to privatise the zoo in 2002. Prior to Houston, he held the position of director of animal programmes for Walt Disney World. He created the first Disney advisory board for the Animal Kingdom Park and helped to engineer the concept and formation of Disney’s Wildlife Conservation Fund. Preceding Disney, he held managerial positions at San Diego Zoo and Miami Metrozoo. He currently serves on several AZA and conservation boards, has consulted on numerous international conservation projects and has led over 25 eco-tours to Africa and Central America.

The underlying goal of ZACC conferences and other zoo and aquarium conservation initiatives is to support field projects and the people working on the front lines of wildlife conservation. The next challenge is to expand the ZACC audience to more than 200 participants, and invite more media and donor prospects to attend.

While this is only one model for our zoological institutions it has been extremely effective for many field biologists in broadening their support base and increasing their appreciation for zoos and aquariums as “conservation parks”.

The next ZACC conference is scheduled for March 2011 at Seattle’s Woodland Park Zoo.

Markus Gusset
World Association
of Zoos and Aquariums
Executive Office

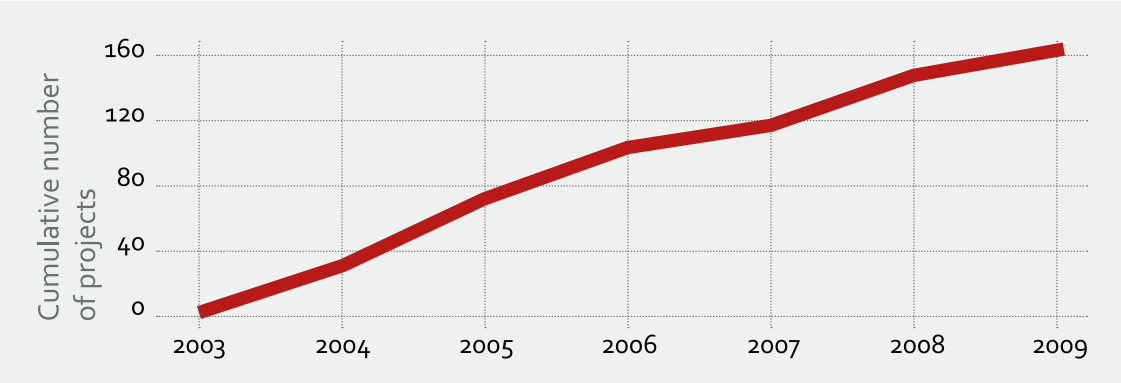
Gerald Dick
World Association
of Zoos and Aquariums
Executive Office

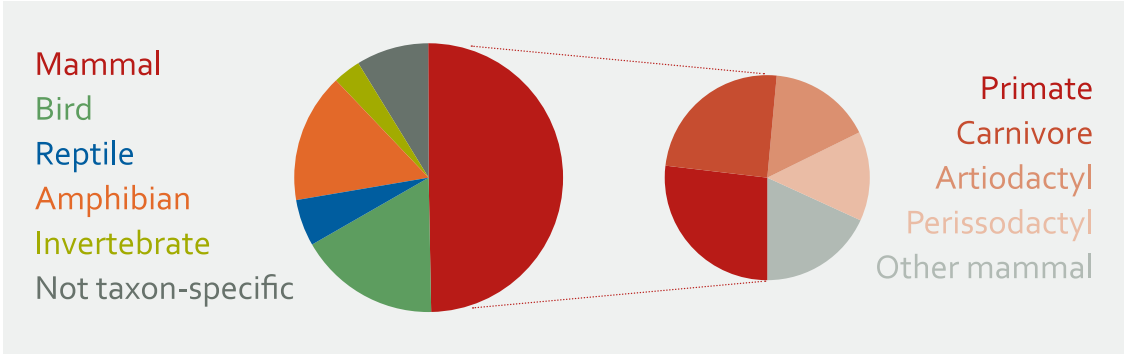
Biodiversity conservation projects supported by the world zoo and aquarium community

Many zoos and aquariums claim to have conservation of wild species and habitats as the overarching principle of all their activities, as stipulated in the revised World Zoo and Aquarium Conservation Strategy of 2005. This strategy bears the title “Building a Future for Wildlife”. However, these wildlife conservation efforts are often criticised for being public relations stunts, superficial and ineffective. In fact, to date there has been no compilation and assessment of the world zoo and aquarium community’s contribution to *in situ* conservation from the perspective of supported projects.

In the years 2000/2001, the World Association of Zoos and Aquariums (WAZA) organised three *in situ* conservation workshops searching for a strategy on how WAZA should become involved in *in situ* conservation. One recommendation was that WAZA (with the goal of becoming a globally recognised conservation organisation) should brand suitable conservation projects. The idea behind the WAZA branding is to create a win-win situation: the brand promotes the project, and the brand allows WAZA to use the project to convey what zoos and aquariums do for conservation. Projects (or programmes) are branded on application, with three sets of endorsement criteria, focusing on biological, operational, and institutional and partnership issues. Applications may be submitted by either the project organisation or a WAZA member supporting the project. Since inception of the scheme in 2003, the number of WAZA-branded projects has steadily increased to 163 in September 2009.

Development of the number of WAZA-branded conservation projects since inception of the scheme in 2003 (© WAZA).





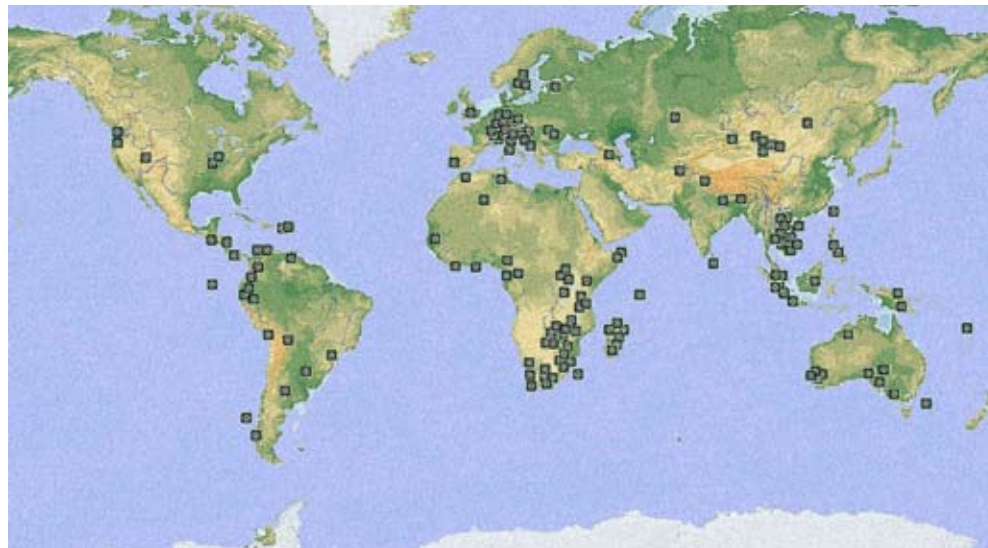
Taxonomic distribution of *in situ* conservation projects supported by the world zoo and aquarium community (© WAZA).

In light of the United Nations “2010 International Year of Biodiversity”, we considered it timely to compile and assess these conservation projects supported by the world zoo and aquarium community. We thus sent a questionnaire to experts from the WAZA-branded projects, of which 113 responded as follows.

The majority of projects had their main focus on species protection. Projects mainly focused on mammals, among them mostly on charismatic primates and carnivores. Most projects worked on taxa classified as globally threatened with extinction according to the 2008 IUCN Red List of Threatened Species. Amphibians and fishes were under-represented in the number of projects relative to the percentage of threatened species described in these taxa. Projects were primarily active in the Eurasian, sub-Saharan African or South-East Asian regions. Projects strongly focused on terrestrial habitats, among them chiefly on tropical and subtropical forests. Terrestrial habitats at high conservation risk, especially Mediterranean woodlands and temperate grasslands, were under-represented in the number of projects.

Projects typically applied for WAZA branding to increase publicity or credibility for the project, or to attract support from zoos and aquariums. However, projects were generally undecided whether the WAZA branding resulted in the desired outcome. Projects mainly received support from one or two to five zoos and aquariums. Zoos and aquariums primarily became involved in a project because they initiated it or because projects requested support from them. The main source of project support provided by zoos and aquariums was monetary funding. The contribution made by zoos and aquariums (including non-monetary support) often covered more than half of the total financial expenditures of a project per year. Most projects would not be viable without the support from zoos and aquariums. The financial expenditures of projects were typically in the range of US\$10,000 to 100,000 per year, with the duration of projects often being longer than 10 years.

By assessing a project’s conservation impact, we also asked how much the projects improved the conservation status of their target species or habitat. Projects on average reached a self-assessed impact score of three out of four possible points. We then did an evaluation of the concurrent influence of all of the above project attributes on the impact score for a project. This analysis revealed that the higher a project’s financial expenditures and the higher the contribution made by zoos and aquariums to these financial expenditures, the higher was the impact score for a project.



Geographic distribution of *in situ* conservation projects supported by the world zoo and aquarium community (© WAZA).

Do zoos and aquariums contribute to achieving the international “2010 Biodiversity Target” of significantly reducing the current rate of biodiversity loss by 2010? The present first global appraisal of the contribution of the world zoo and aquarium community to *in situ* conservation from a supported project’s perspective shows that an increasing number of WAZA-branded projects are helping to improve the conservation status of high-profile threatened species and habitats in biodiversity-rich regions of the world. In particular, tropical and subtropical forests represent global biodiversity conservation priorities.

We are aware that our sample is biased towards projects already supported by zoos and aquariums, with the sample being restricted to WAZA-branded projects. But not the least thanks to the investment made by zoos and aquariums, particularly financial, these projects reached impact scores of a magnitude suggestive of an appreciable contribution to global biodiversity conservation. Nevertheless, for individual zoos

and aquariums to fulfil their claim to have conservation of wild species and habitats as the overarching principle of all their activities, and for WAZA to become a globally recognised conservation organisation, current efforts need to be intensified. The amount of resources (including non-monetary support) allocated by most zoos and aquariums to *in situ* conservation is still relatively small, which may limit a project’s conservation impact. This may also fuel criticism of the stated conservation mission of zoos and aquariums, to which they should be held accountable. To maximise the global contribution of the world zoo and aquarium community to *in situ* conservation, increased pooling of resources among zoological institutions appears advisable, as differences in the impact score among projects result primarily from variation in financial investment.



Increased pooling of resources among zoological institutions appears advisable to save endangered species like African wild dogs (© Markus Gusset).

Zoos and aquariums, at least those supporting the projects evaluated here, seem to be on track for “Building a Future for Wildlife”, but the community at large could make an even stronger contribution to *in situ* conservation. For example, zoos and aquariums could apply their extensive expertise on coordinated management of small and fragmented captive sub-populations to the increasingly important meta-population management (i.e. conserving spatially separated populations) of free-ranging animals, possibly including an *ex situ* component. The presently under-represented taxa (amphibians and fishes) and habitats (aquatic systems, Mediterranean woodlands and temperate grasslands) merit special conservation attention. Within the world zoo and aquarium community, zoo-based conservation organisations and conservation-focused zoo consortiums might be particularly well suited for tackling the task of halting global biodiversity loss.



Dr **Markus Gusset** received his Ph. D. degree in 2006. He is a conservation biologist with expert knowledge in researching and protecting wildlife both in its natural habitat and in captivity.

He has been a research associate at the Wildlife Conservation Research Unit, University of Oxford, since 2008. He was employed at the WAZA executive office for evaluating the WAZA-branded conservation projects (this chapter) and for editing the book at hand.



Dr **Gerald Dick** did his Ph. D. under the supervision of Hans Winkler and the late Konrad Lorenz. After working in applied nature conservation, he was responsible for international conservation

projects and relationships in the Austrian Ministry of the Environment and was lecturer for international conservation at the University of Vienna. After working for environmental development co-operation projects in Thailand and Nicaragua, he joined WWF Austria in 1995 and later was responsible for WWF International's species programme in Europe and the Middle East. He became executive director of WAZA in 2008.

This chapter is a summary of our evaluation published in the 2010 issue of the *International Zoo Yearbook*. The following 25 chapters present examples of conservation success stories from the WAZA-branded projects. The projects were selected primarily based on the results of the above evaluation, representing projects that reached top impact scores. The sample was complemented by a number of selected projects on conservation flagship species. A comprehensive list of all conservation projects branded by WAZA is provided following the project chapters.

Part III

Biodiversity conservation projects



Peter Sampson
Wildlife Heritage Foundation
and Paradise Wildlife Park

Lynn Whitnall
Wildlife Heritage Foundation
and Paradise Wildlife Park

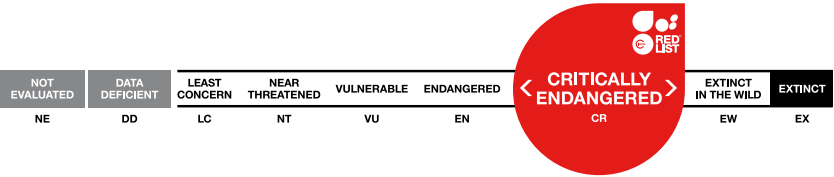
Sarah Christie
Zoological Society of London

The Russian “love leopard”: a key species for zoo support

Species	Amur leopard (<i>Panthera pardus orientalis</i>)
Range	Russian Far East
Population	35
Threats	Poaching, habitat destruction



© Fraser Stroud



Actually nothing to do with love but named after the Amur River, the Amur leopard (*Panthera pardus orientalis*) is arguably the world's most endangered big cat. Only about 35 survive in the southernmost tip of the Russian Far East, bordering China in south-west Primorskii Krai. The area is important for wildlife, containing over 100 endangered taxa of which nearly half are unique to the region.

This leopard population is in grave danger, primarily because of habitat loss from fires and development, poaching of both leopards and their prey, and factors such as inbreeding depression and disease to which small populations are particularly vulnerable. Russia is a hunting culture and leopards are shot opportunistically in the belief that they are competition for hunters, or in retaliation for taken livestock; their bones are then sold for use in Chinese medicine, and there is also a market for skins. Fires lit to uncover scrap metal or stimulate growth of grass threaten to permanently convert the forest to species-poor grasslands, while the region is a key one for economic development, containing the city of Vladivostok and other ports handling, for example, oil export.

Given the tiny population and that the area is surrounded by China, Korea, the Sea of Japan and a developed region of Russia, it is not surprising that this is the only big cat for which the IUCN/SSC Cat Specialist Group has endorsed a reintroduction from zoo stock. Only on the Chinese side is there any hope for expansion of the current range.

Zoos began to target Amur leopard conservation in the mid-1990s, thanks largely to the efforts of Michiel Hötte of the Tigris Foundation and the Zoological Society of London (ZSL). As a result it is better known than it used to be, but funding remains scarce and so it has become a major focus for the non-governmental organisations making up the Amur Leopard and Tiger Alliance (ALTA). ALTA includes both donors and implementers, with funds raised by all partners channelled to



Fires present one of the most serious threats to Amur leopards, but funding to tackle them is very difficult to find (© Phoenix Fund).

the Wildlife Conservation Society (WCS), Phoenix Fund, Tigris Foundation and ZSL on the ground, while Moscow Zoo, the International Fund for Animal Welfare and AMUR have offices in Moscow and provide political liaison and in-country fundraising. ZSL and Minnesota Zoo coordinate the zoo breeding programmes for Europe and the USA respectively, thus bringing all zoos holding Amur leopards into the partnership.

WWF Russia also has an Amur leopard conservation programme, and is working with ALTA partners in many arenas.

Key aims for the ALTA Amur leopard programme include reducing poaching of both leopards and their prey, preventing forest fires, monitoring wild leopard numbers, checking for effects of inbreeding in the wild, changing public attitudes to leopards, expanding leopard range into China, and finally establishing a second population at another site through reintroduction. Plans for the latter have been in development since a meeting in 2001 agreed it to be a necessary conservation action, but the major hurdles of government approval and suitable funding remain.



Camera traps set on rocky ridges capture images useful for awareness work, and the number estimates they provide tally well with those from pugmark surveys (© WCS).

WCS monitors leopard numbers and range using pugmark surveys and camera traps, and this knowledge helps to focus anti-poaching patrols run by the Phoenix Fund, which often double as educational teams with rangers visiting local schools and villages. Fire prevention centres on firebreaks around the core habitat in the UNESCO Biosphere Reserve Kedrovya Pad. The health of the wild leopards is being studied through WCS's capture programme, while ZSL is collecting samples from various species to research wildlife diseases in the region, mainly in the best potential site for Amur leopard reintroduction. Clearly, it will be crucial for any reintroduction to also have good information on the health of cats for release, and so the disease work includes sampling zoo cats and gathering information on their veterinary histories. Training for Russian veterinarians is provided along the way.



Phoenix Fund is working with local schools to generate enthusiasm and change attitudes; these kids are dressed up for the annual "Tiger and Leopard Day" festival (© Phoenix Fund).

Hard data on wildlife crime are difficult to obtain, but reports of poaching are reduced and the monitoring shows that the leopard population is stable at about 35 animals. This is encouraging, but at such low numbers the cats could be badly hit by inbreeding depression, a disease outbreak or even a sex ratio imbalance – if too many more males than females were born, there would be more fighting than mating! The planned reintroduction is a safeguard, but increasing the current range is also important and a new protected area has been established in Hunchun across the border in China, which is encouraging. Local attitudes are of course also key to the leopard's future; Phoenix Fund survey children's views and have shown clear increases in support for wildlife conservation following their educational programmes.

Studies of wild and zoo leopards' health are not yet complete, but so far show no serious problems, while practical veterinary training workshops and lectures have helped both students and practitioners and the star pupil Dr Mikhail Goncharuk, already qualified, is now employed by ZSL.

Zoo support has been and remains crucial to the survival of the Amur leopard, which has benefited via all four possible channels. Zoos have generated perhaps half the funds spent on these leopards to date, whether as direct donations from many zoos (most notably Helsinki and Minnesota zoos) or via grants obtained by zoos and funds raised from the public through the ALTA website. The website also provides all supporters with pictures and reports to use in awareness and education campaigns, while zoos in both Russia and the west have allowed veterinary training using their leopards and/or provided material for genetic, taxonomic and veterinary research. Finally, careful management of the zoo leopards – over 200 animals at present – is laying the foundations for (we hope) eventual provision of leopards for reintroduction.

One of the key zoo contributions is support (particularly from Colchester, Twycross, Thrigby and Marwell zoos and the Friends of Paradise Wildlife Park) for the work of Dr John Lewis of Wildlife Vets International. John has been the veterinary advisor to the Amur leopard breeding programme in Europe for over a decade. It was a natural progression to appoint him, in 2006, as the veterinary consultant on ZSL's Darwin Initiative wildlife disease sampling and veterinary training project in Russia; and then as the key veterinarian on WCS's leopard capture team. John now compiles all the information from both zoo and wild cats in a database and is producing a disease risk management strategy for the wild leopards.



Anuy and Argun, two Amur leopards at the Wildlife Heritage Foundation breeding centre (© Jackie Thomas).

Studies on zoo leopards can also be directly relevant to their wild relatives. A heart murmur has been detected in four of the wild leopards, giving rise to fears of a heritable defect related to inbreeding, as has occurred in the Florida panther (*Puma concolor coryi*); but study of zoo leopards also presenting a murmur indicates that it may be caused by the anaesthesia. Keeping staff at Colchester Zoo have responded to this challenge by training one of their leopards to have his heart monitored through the bars without anaesthetic, and a video of the necessary training is available via the ALTA website for other zoos' use.



John Lewis of Wildlife Vets International with an Amur leopard immobilised for the Wildlife Conservation Society; the breathing equipment is a specialised set-up allowing the use of isoflurane under field conditions (© John Goodrich).

ALTA continues to focus on fundraising and cooperative projects tackling all aspects of Amur leopard conservation. The European zoo programme is growing nicely but still needs new holders, particularly those keen to get involved in all aspects of conservation support. There is already a strong case to be made that this cat would be extinct in the wild by now without the funds provided by zoos; add to that the unique potential for reintroduction from zoo stock and it is hard to think of an animal more important for zoos to target. As this chapter suggests, a great number of individuals and organisations are working together to fight for the survival of the "love leopard". It is a multinational project crossing many borders, with scientists, protection groups, educators and fundraisers working side by side, proving really that love is all you need.

Members of ALTA are 21st Century Tiger, AMUR, David Shepherd Wildlife Foundation, Helsinki Zoo, International Fund for Animal Welfare, Minnesota Zoo, Moscow Zoo, Phoenix Fund, Wildlife Alliance, WCS, Wildlife Vets International, Tigris Foundation and ZSL. Additional partners and supporters include Primorskii State Agricultural Academy, Paradise Wildlife Park, Wildlife Heritage Foundation, Twycross Zoo Conservation and Welfare Fund, Colchester Zoo, Thrigby Hall Wildlife Gardens, Marwell Zoo, Copenhagen Zoo, Antwerp Zoo, Hogle Zoo, Tallinn Zoo, Utah Zoological Society, Conservation des Espèces et des Populations Animales, Dutch Zoo Association Fund, Feline Conservation Centre (Rosamond), Boise Zoo Conservation Fund, Korean Amur Leopard Conservation Fund, Darwin Initiative and Panthera Foundation.



Biodiversity conservation projects



Zoos can contribute in many ways to Amur leopard conservation; here specialists from Nottingham University Veterinary School examine blood flow in the heart at Twycross Zoo, investigating whether heart murmurs are caused by anaesthesia (© John Lewis).



Peter Sampson is managing director of Parkside Leisure Ltd., which is the holding company of Paradise Wildlife Park in Broxbourne and the Wildlife Heritage Foundation in Kent. He established Paradise Wildlife Park in the mid-1980s with his family and became deeply involved in conservation over the years. He is also chairman of the trustees of the Wildlife Heritage Foundation, which is a full charity and breeding centre for endangered cats. They have had success in breeding Sumatran tigers and in particular Amur leopards, which they have made their flagship species.



Lynn Whitnall is director of Parkside Leisure Ltd., which is the holding company of Paradise Wildlife Park of which she is also a director. She is a trustee of the Friends of Paradise Wildlife Park and a trustee of the Wildlife Heritage Foundation. Formally trained in travel and tourism, her main roll at Paradise Wildlife Park now is overseeing the animal collection, human resources, and assisting with corporate events and business development. She is also heavily involved in fundraising work in the UK and around the world.



Sarah Christie is conservation programme manager for East and South-East Asia at the Zoological Society of London. She manages the European Endangered Species Programme for Amur leopards alongside Tanya Arzhanova from Moscow Zoo. She was a founder of, and continues to manage, 21st Century Tiger, a fundraising group that specialises in providing channels for zoos to support tiger conservation. She manages field projects for Amur leopards and tigers in Russia, tigers in Bangladesh and Sumatra, and elephants in Thailand, and continues to maintain a strong focus on connecting *in situ* and *ex situ* conservation work.

Peter J. Tolson
Toledo Zoo

Miguel A. García
Departamento de Recursos
Naturales y Ambientales
de Puerto Rico

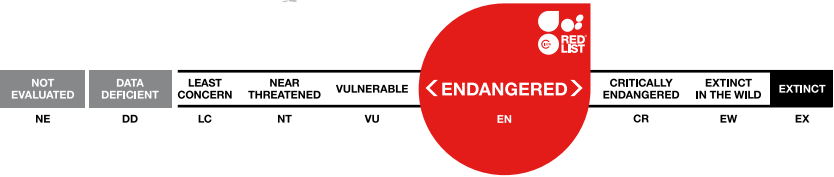
Judy J. Pierce
U.S. Virgin Islands Division
of Fish and Wildlife

Reintroduction of the Virgin Islands boa to the Puerto Rico Bank

Species	Virgin Islands boa (<i>Epicrates monensis granti</i>)
Range	Puerto Rico, U.S. and British Virgin Islands
Population	1,500
Threats	Habitat destruction, invasive species



© Peter Tolson





A large Virgin Islands boa peeks out from a fallen tree (© Peter Tolson).

The Puerto Rico Bank – Puerto Rico and the Virgin Islands – stretches eastwards from Hispaniola and is a constellation of islands and cays that are home to an imperilled snake: the Virgin Islands boa (*Epicrates monensis granti*). This small, approximately 1.0 m snout-vent length (SVL) snake is endemic to the Puerto Rico Bank, where it presents a disjunct distribution from Puerto Rico eastwards into the British Virgin Islands. It is an attractive chestnut brown boa with black chevron-like blotches, inconspicuous and rarely seen because of its nocturnal habits and retiring nature.

Geological processes have shaped the Puerto Rico Bank and – for better or worse – the future of this little snake. The boa is rarely the victim of human persecution, but rising sea levels, large-scale habitat destruction and the introduction of exotic mammalian predators – the black rat (*Rattus rattus*), the domestic cat and the small Indian mongoose (*Herpestes auropunctatus*) – have severely fragmented the populations and have placed this species in extreme peril. Consequently, the Virgin Islands boa was listed as “endangered” under the U.S. Endangered Species Act in 1970 and remains there today.



Beth Stark-Posta snatches a boa from a branch in the U.S. Virgin Islands (© Peter Tolson).

The discovery of the snake in 1932 by Major Chapman Grant on the island of Tortola, British Virgin Islands, created a puzzle. It was originally described (by Olive Griffith Stull at the University of Michigan) as a sub-species of the Puerto Rican boa (*Epicrates inornatus*) and Grant gave no detailed habitat information, remarking in his field log only that the boa “inhabits rocky cliffs on Tortola and Guana islands”. It remained somewhat of a mystery well into the latter part of the 20th century, and only six specimens were known to science until we began our research. It was later determined that the boa inhabits several islands and cays throughout the Puerto Rico Bank, but its extremely disjunct distribution provides ample evidence for a long history of extirpation on the Puerto Rico Bank since the Pleistocene, when sea levels were lower, the climate was drier and populations were unfragmented.



The reintroduction crew unloads gear to the release site in the U.S. Virgin Islands (© Peter Tolson).

Because of the availability of protected, relatively undisturbed cays on the Puerto Rico Bank, administered by the Departamento de Recursos Naturales y Ambientales de Puerto Rico and the Division of Wildlife, U.S. Virgin Islands, we all believed reintroduction was a reasonable strategy in implementing recovery of the boa. Our goals for recovery were taken from the draft U.S. Fish and Wildlife Service Virgin Islands tree boa recovery plan published in 1986, and which embraced three primary elements: surveys, ecological research and conservation breeding/reintroduction.

As a first step, we needed to fill in the huge gaps in our knowledge of the snake, so in 1984 we began to survey all likely dry and littoral forest habitats on the Puerto Rico Bank, including the offshore cays of Puerto Rico and the U.S. Virgin Islands. While doing so, we collected the ecological and demographic data necessary for formulation of a reintroduction strategy. This nine-year study resulted in more than 650 captures of more than 300 marked individuals. A statistical analysis revealed that boas were most successful in densely vegetated habitats with an interlocking canopy that had few or no exotic predators. Further study revealed that the snakes fed primarily

on crested anoles (*Anolis cristatellus*) and hatchling green iguanas (*Iguana iguana*). These data were subsequently incorporated in the recovery plan. To provide boas for reintroduction, Toledo Zoo and 12 other Association of Zoos and Aquariums (AZA) institutions commenced a cooperative breeding programme that resulted in the first successful conservation breeding of the species in 1986, publication of the AZA-sanctioned regional studbook in 1987 and the creation of the Species Survival Plan in 1990. As boas from Puerto Rico show significant phenotypic differences from those in the Virgin Islands, we manage them as separate populations for conservation breeding.

Based on a statistical analysis, we selected four potential cays as reintroduction sites and then began efforts to eradicate black rats from two of the cays by placing eight to ten blocks of anticoagulant rodenticide at each interstice of a 10 m² grid that covered the entire cay. Baits were replenished as they were consumed for a period of three days. This regimen was repeated on two successive visits spaced six months apart, over one wet and two dry seasons. Pre-poisoning and post-poisoning activity by rats at the sites was monitored by removal trapping along three 100 m transects for three successive nights. The pre-poisoning rat indices of about 0.16 rats per trap and hour at the primary site, calculated from three days of removal trapping, dropped to activity levels of zero rats on the next two visits after the initial poisoning. To detect low population levels of rats, vegetable oil-soaked chew sticks were placed for one week in each habitat type on the islands and were checked for rat chew marks. No rats were detected using this method and the rats were presumed eradicated. There were no resident populations of boas at either site.



Candee Ellsworth with a recaptured Virgin Islands boa (© Peter Tolson).

By late 1991 we had more than 100 boas in captivity and began to prepare the snakes for release. Snakes underwent a 30-day quarantine period prior to release and none presented with any parasites or medical problems. Some snakes tested positive for *Salmonella arizonae*, so we delayed release of these animals until a survey of wild boa populations was completed. Wild snakes at every extant locality tested positive for *Salmonella*. We originally fed neonate boas with small green anoles (*Anolis carolinensis*), later switching the diet to neonate mice, but as the boa feeds primarily on crested anoles in the wild, we tested each sub-adult and adult boa destined for release for willingness to feed on dead crested anoles, and all fed immediately. We then tested them for their ability to capture living crested anoles in a 2.0 x 2.0 x 1.5 m screened enclosure at a pre-release evaluation facility at the University of Puerto Rico – Humacao. Only two snakes of the 31 tested failed to capture prey during the first overnight trial.



Miguel García reaches high to capture a boa in the U.S. Virgin Islands (© Peter Tolson).

During each visit we monitored crested anole densities at the release sites twice daily using line transects, and by June 1993 these data indicated that the sites had adequate food resources (more than 5,000 anoles per ha) for a reintroduction attempt. After transport to the release sites, snakes were implanted with transponders and released. During 1993, 28 captive-born boas from seven different zoos were released; an additional 13 snakes were released through 1995. Three age classes were used for releases: completely naive neonates, sub-adults with 500 to 600 mm SVL and reproductively mature adults with more than 700 mm SVL. In 1996 we began boa translocations from St. Thomas, U.S. Virgin Islands, to the second reintroduction site. Thirty-one snakes were translocated from 1996 to 2002. These were joined by an additional 11 captive-born snakes from Toledo Zoo in 2002.



The reintroduction crew weighs a recaptured Virgin Islands boa prior to re-release (© Peter Tolson).



Peter Tolson with a Bimini boa on South Bimini, Bahamas Islands (© Peter Tolson).

We evaluated success of the reintroductions by repeated population surveys of the release sites. Boas were monitored quarterly the first year and biannually for the first five years. A 10-year evaluation at the Puerto Rican site revealed that the population had increased from the original 41 snakes to nearly 500 snakes. In the U.S. Virgin Islands, the population had increased from the original 42 snakes to nearly 170 snakes in 2004. A 10-year evaluation will be performed in the U.S. Virgin Islands in 2012 and a 20-year evaluation in Puerto Rico in 2013. First year minimum survival was phenomenal, exceeding 54% for all age classes and 89% for the 13 neonates released. Actual survival was probably much higher. Most of the recaptured neonate and sub-adult animals doubled or tripled their body masses in the first year after their release. At least one pair of adults reproduced successfully during the very first year and produced five offspring.

Given the apparent bleak outlook for the snake on the main islands, especially St. Thomas, our future plans include at least two more reintroductions – one each to Puerto Rico and the U.S. Virgin Islands. Our focus in Puerto Rico will be a small population of boas in the foothills of the Sierra de Luquillo near Río Grande threatened by spiralling development on the north-east coast. In the U.S. Virgin Islands, the Division of Wildlife is working with the U.S. Department of Agriculture to clear additional cays of the black rat, especially those with higher elevations and more complex topography.



We are gratified by the results our project has shown thus far. We attribute our success to the significant amount of preparatory work done by all the partners prior to the actual release, ample prey and release cohorts far below the carrying capacities of the reintroduction sites (in suitable habitat this species reaches densities of 125 boas per ha). Perhaps most significant is the nature of the snake itself. Hard-wired from birth as efficient little predators, our snakes apparently had no problems adjusting from the confines of 30 l terrariums to life in the wild.

Zoos and aquariums participating in this conservation project include Toledo Zoo, Audubon Zoo, Buffalo Zoo, Fort Worth Zoo, Houston Zoo, Knoxville Zoo, Lincoln Park Zoo, Milwaukee County Zoo, National Aquarium in Baltimore, Riverbanks Zoo & Garden and Saint Louis Zoo.

Biodiversity conservation projects



Dr **Peter J. Tolson** received his B. Sc. degree in zoology from Michigan State University and his Ph. D. degree from the University of Michigan. After teaching briefly at university he began employment at Toledo Zoo as curator of amphibians and reptiles in 1981. He became conservation biologist at the zoo in 1989 and director of conservation and research in 2001. He has been working on the ecology and conservation of Antillean boas of the genus *Epicrates* since 1974. He is species coordinator and studbook keeper for the Association of Zoos and Aquariums' Mona/Virgin Islands boa Species Survival Plan and is a member of the IUCN Iguana Specialist Group and the IUCN Re-introduction Specialist Group.



Dr **Miguel A. García** received his B. Sc. and M. Sc. degrees in biology from the University of Puerto Rico – Río Piedras and his Ph. D. degree from the University of Michigan. He began employment at the Departamento de Recursos Naturales y Ambientales de Puerto Rico in 1991 as a wildlife biologist, became director of the Division of Wildlife in 2004 and director of the Bureau of Fisheries and Wildlife in 2008. He is also a research affiliate at the Centre for Applied Tropical Ecology and Conservation of the University of Puerto Rico. He has been working on the ecology and conservation of Antillean boas of the genus *Epicrates* since 1987. He is currently co-chairman of the IUCN Iguana Specialist Group and a member of the IUCN Invasive Species Specialist Group.



Judy J. Pierce received her B. Sc. degree in pathobiology from the University of Connecticut and her M. Sc. degree in zoology from the University of South Florida. She began employment at the U.S. Virgin Islands Division of Fish and Wildlife as a wildlife biologist in 1986 and became chief of wildlife in 2001. She has been working on the eradication of exotic and invasive species on Virgin Islands offshore cays since the mid-1990s and has assisted in the reintroduction efforts for the Virgin Islands boa since 2002.

Helen Robertson
Perth Zoo

Pamela Smith
Perth Zoo

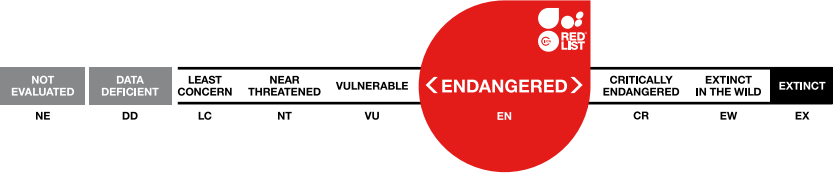
Daniel Scaporolo
Perth Zoo

Perth Zoo: living and working in a biodiversity hotspot

Species	Numbat (<i>Myrmecobius fasciatus</i>)
Range	South-west Australia
Population	1,000
Threats	Invasive species, habitat destruction



© Perth Zoo





Biodiversity conservation projects



Dibbler (© Perth Zoo).



Numbat pouch young (© Perth Zoo).

Perth Zoo is situated in the south-west of Western Australia, an area of about 356,717 km² and one of the world's 25 recognised biodiversity hotspots, which means we are well placed to have an impact on our local biodiversity conservation.

Of the 41 mammal, 45 bird, 23 reptile and three amphibian species declared as "threatened" in Western Australia by the state government, Perth Zoo has been or is currently involved in the breeding, research and/or conservation of: all three threatened frog species (white-bellied frog, *Geocrinia alba*, orange-bellied frog, *G. vitellina* and sunset frog, *Spicospina flammocaerulea*); three of the bird species (Carnaby's black cockatoo, *Calyptrorhynchus latirostris*, Baudin's black cockatoo, *C. baudinii* and forest red-tailed black cockatoo, *C. banksii naso*); seven of the mammal species (Shark Bay mouse, *Pseudomys fieldi*, central rock rat, *Zyzomys pedunculatus*, dibbler, *Parantechinus apicalis*, western quoll, *Dasyurus geoffroyi*, sandhill dunnart, *Sminthopsis psammophila*, brush-tailed bettong, *Bettongia penicillata* and Western Australia's faunal emblem, the numbat, *Myrmecobius fasciatus*); and two of the reptile species (Lancelin Island skink, *Ctenotus lancelini* and western swamp tortoise, *Pseudemydura umbrina*).

In 1996, Perth Zoo established a section dedicated to working exclusively with threatened species, the native species breeding programme, to focus our efforts on local conservation work. The primary goal of the programme is to support threatened species recovery programmes by providing animals for release to the wild by the responsible government wildlife agency, the Department of Environment and Conservation, and also by conducting the underpinning scientific research into the reproduction and other aspects of the biology of threatened fauna, required to assist in their recovery. Since the commencement of the programme in 1996, nearly 2,000 threatened animals have been bred at Perth Zoo for release into protected habitat. Numbers to date include 315 western quolls, 346 Shark Bay mice, 470 western swamp tortoises, 149 numbats, 179 Lancelin Island skinks and 442 dibblers.



Western swamp tortoise (© Perth Zoo).

This short sentence makes it all sound very easy, but it is not always so. Most times we commence working with a species about which very little is known other than the taxonomy. Other times some of the species' biology may be known; however, usually there is very little information available and predominantly no previous history of captive management of the species. For example, very early in the history of the western quoll breeding programme, staff learned that it was always better to introduce a male into a female's enclosure for breeding, rather than place the female into the male's enclosure. This species is solitary in the wild and they defend their territory valiantly against others. If the smaller female is placed into the male's enclosure, he might kill her before he realises that she might have been interesting to know better. When they are introduced the other way around the female defends herself more vigorously as it is her territory and the male is less aggressive as he is in unfamiliar surroundings. So while they stand off and hiss at each other, with fur on end, the male gets time to catch the female's oestrus scent and the female gets time to settle to the idea of a mate.

The Shark Bay mice presented a different type of challenge. Like many rodents, they are boom/bust breeders. That is, they can continue to breed while conditions are good but can then cease breeding during hard times when resources are poor. During our work with this species we were asked by the wildlife agency to separate the pairs and produce no further young until a new release site was cleared of feral domestic cats, which would have been a threat to the introduced mice. Twelve months later when the breeding programme was to proceed we re-paired the animals; however nothing happened. The usual cues to stimulate reproduction experienced by the animals in the wild were not present in captivity. We then instigated a process called "flushing" to see if we could mimic a breaking drought in captivity. First we greatly reduced their daily food and water allowance for a few weeks to mimic a period of drought. After this we introduced abundant food items, including plenty of green seeding grasses to mimic the flush of growth after rain in the desert. Soon we had the mice breeding again!



Orange-bellied frog (© Perth Zoo).

The western quoll and Shark Bay mouse breeding programmes have ceased as the goals for the recovery of these species have now been met. The Shark Bay mice now have two new secure populations on North West and Faure islands and recent monitoring of the new western quoll populations indicate that they are faring very well and have even withstood a recent severe drought. This species has now been down-listed from “endangered” to “vulnerable” and it is anticipated that it will soon be removed from the threatened list. Others of our programmes have been more long term.

The western swamp tortoise presents different challenges. This species is very long lived (to at least 80 years of age), is very slow growing and only reaches sexual maturity at about 12 years of age. It also only produces two to four eggs each year, rather than the larger numbers of young produced by the quolls or mice. The recovery of this species will be such a long-term process.

The breeding programme commenced in 1988 with a very small number of founders. At the time the total number of individuals alive probably counted less than 30. With limited early success while captive husbandry was developed, it is only during the last couple of years that the captive-bred females have reached maturity and commenced laying eggs for the first time. This species has declined through habitat destruction (the city of Perth, the capital of Western Australia, now covers much of its previous habitat) and the impact of introduced predators – red foxes (*Vulpes vulpes*) and domestic cats. The species also faces an additional threat – climate change. Western swamp tortoises are active in winter and live in ephemeral swamps that are filled by winter rains. When these dry up the tortoises aestivate over the long hot summer. With less rain falling each year, the water table below Perth is dropping. As a consequence the ephemeral wetlands do not always fill with water. Currently, one of the four habitats of this species is managed artificially to maintain water in the wetland, through constant pumping of bore water. Another has plastic-lined pools built into it to ensure some water is available for the tortoises in the drier winters.



Housing of *Geocrinia* species (© Perth Zoo).

The dire circumstances of this species have initiated a new collaborative research programme. This aims to establish the physiological parameters required for the species' survival and couple this with climate modelling to identify where new ephemeral wetlands may develop in the future, as the region becomes drier. In other words, we are looking into the future to identify future suitable habitat for this species given the effect of climate change on the existing habitat.



Swabbing a sunset frog for chytrid fungus testing (© Perth Zoo).

As mentioned, often we are presented with species about which very little is known. In 2006, a new research programme began at Perth Zoo to study the reproductive biology of the threatened Western Australian frog species to be able to maintain and breed them in captivity. We applied for and received a grant of \$450,000 over four years from the Western Australian Office of Science, Technology and Innovation. As is common with many new programmes we commenced first with a common relative or analogue species, the roseate frog (*Geocrinia rosea*). Two years into the project we had bred roseate frogs to the second filial generation in captivity and were ready to apply our newly developed techniques on the endangered white-bellied frog. Now we have two batches of young metamorphs developing. Already we are seeing differences between them and their common cousins. While the roseate frogs were able to breed in their first year, the white-bellied frog metamorphs are growing far more slowly (although kept under the same conditions) and clearly they will not be breeding until at least two, perhaps even three years of age. Could this aspect of its biology be one reason why this species is faring worse than its more common relative in the wild?

Although a few of us have written this chapter describing our work, at Perth Zoo we consider that every staff member contributes to our conservation outcomes. As such we would like to recognise this through attributing authorship to the zoo, with a picture of all of our staff rather than just a few of us.



How does a zoo take an active role in species conservation such as the work undertaken at Perth Zoo? The key success factors to our projects have been firstly, the excellent communication and collaboration with our conservation and research partners and secondly, the dedication and commitment of our zoo staff. Building a common vision for conservation within the zoo, with stakeholders and partners, to consolidate our active involvement in conservation of native species has been vital in our work. All partner organisations involved (Department of Environment and Conservation, Australian Wildlife Conservancy,

University of Western Australia, Curtin University, Murdoch University, Western Australian Museum, Australasian Regional Association of Zoological Parks and Aquaria to name a few) have maintained their focus on the needs of the threatened species, rather than individual organisational or personal agendas. We wish to acknowledge and thank all involved.

Jörg Junhold
Leipzig Zoo

Christophe Boesch
Max Planck Institute for Evolutionary
Anthropology Leipzig

Chimpanzees at Pongoland in Leipzig Zoo: ambassadors for *in situ* conservation in West Africa

Species	West African chimpanzee (<i>Pan troglodytes verus</i>)
Range	West Africa
Population	40,000
Threats	Habitat destruction, poaching, disease



© MPI-EVA





Outside enclosures and tropical hall at Pongoland (© Leipzig Zoo).

In April 2001 Pongoland, a 30,000 m² facility for the presentation of all four species of great apes, was opened at Leipzig Zoo. According to the zoo's principles, which are outlined in its master plan, the inside and outdoor enclosures are landscaped in a perfectly naturalistic way. The actual walls of the tropical hall and the necessary technology are hidden behind artificial rocks and plants. By these means the animals are living in a landscape similar to their natural habitat in Africa and Asia, which reflects the zoo's philosophy of interlinking a themed discovery park with applied science, edutainment and *in situ* conservation. About 50 great apes in five groups act as ambassadors for their endangered relatives in nature. The two largest groups consist of West African chimpanzees (*Pan troglodytes verus*), which inhabit an area of 420 m² inside and 4,200 m² outdoor enclosures bordered by natural or nature-like barriers like water channels. All four species of great apes are managed in European Endangered Species Programmes in order to conserve distinct and genetically diverse populations of these animals for a possible reintroduction into the wild. Leipzig Zoo actively takes part in all of these programmes.

Pongoland is a joint project between Leipzig Zoo and the Max Planck Institute for Evolutionary Anthropology Leipzig (MPI-EVA), which was established in 1997 to investigate the evolution of humankind in various fields of research. One approach is behavioural research on western gorillas (*Gorilla gorilla*), orang-utans (*Pongo pygmaeus*), bonobos (*Pan paniscus*) and chimpanzees at Leipzig Zoo under the direction of Dr Michael Tomasello. Zoo visitors can observe some of these studies through windows in the tropical hall – a modern way to open the world of scientific work to the public.



Chimpanzee in outside enclosure at Pongoland (© Leipzig Zoo).

Christophe Boesch, one of the directors of the Max Planck Institute for Evolutionary Anthropology, is conducting studies on wild chimpanzees, bonobos and gorillas. One of his main interests is the study of social and cultural behaviour and learning patterns of free-ranging but habituated chimpanzees at Taï National Park in Côte d'Ivoire. During the past 30 years, he has witnessed the dramatic destruction of the chimpanzees' natural environment, mainly due to deforestation that led in consort with the bushmeat trade to an 86% to 99% decrease in chimpanzee numbers in Côte d'Ivoire over the last 17 years. The reasons are known and manifold, and the political situation with unrest and civil wars has regularly forced staff of conservation projects to temporarily leave the region around Taï National Park.



Chimpanzee with juvenile in Taï National Park (© MPI-EVA).

Christophe Boesch is one of the founders of the Wild Chimpanzee Foundation (WCF), a non-profit organisation based in Geneva, Switzerland. A German and French branch was founded in 2006 and 2009, respectively. The mission of the foundation is to enhance the survival of the remaining wild chimpanzees and their habitat, the tropical rain forests, throughout tropical Africa. With the opening of Pongoland, Leipzig Zoo became a member of WCF to help reach this ambitious goal. WCF's conservation work includes population monitoring, surveys and education and awareness actions in the field. Today WCF is not only working in Côte d'Ivoire but also in national parks and forest reserves in Guinea, Sierra Leone and Liberia. A long-lasting cooperation agreement between Leipzig Zoo and WCF guarantees an annual financial contribution that is mainly used for educational work.



Theatre presentation *We and the chimpanzees, our brothers* (© WCF).

The most important conservation measures include regular visits to local people living in the surroundings of large extant chimpanzee populations to raise awareness of forest degradation and the chimpanzees' plight. It is important for local people to know about the life and behaviour of chimpanzees and how closely related they are to humans. Through theatrical presentations, a newsletter, video presentations and classes in local schools an educational outreach programme is conducted.

The performance of interactive theatre plays is particularly attractive to local people in remote places. Professional actors as well as children of local schools perform plays that deal with the lost harmony between chimpanzees and humans. *We and the chimpanzees, our brothers*, a play with drama, songs and dances, touches the hearts of the sometimes hundreds of spectators who have to decide whether or not to kill a chimpanzee. The performances are followed by lively discussions moderated by the WCF team, and questions such as "What would you do when a chimpanzee destroys your harvest?" are hotly debated.



Juvenile chimpanzee Kirikou (© MPI-EVA).

To evaluate the sustainability and effectiveness of these activities, WCF is sending sociologists to the villages before the performances as well as a few months after to question the people. They found that the opinion of people about killing chimpanzees and eating their meat has changed greatly with increased knowledge about the species, which is a very encouraging result for the future of the chimpanzees at Taï National Park. These efforts and the ongoing presence of researchers have led to a relatively stable chimpanzee population in the park, whereas in most other parts of Africa there is an ongoing dramatic decline in chimpanzee numbers.



Environmental education in a school outside of Taï National Park (© WCF).



Illegal hunting for bushmeat threatens the survival of chimpanzees (© WCF)

The newsletter *Forest Wisdom* contains lots of information in drawn comic-style stories that bring up problems between chimpanzees and people and the everyday behaviour of the apes. This method is highly appreciated and easy to understand for readers in the small villages surrounding the park and it is regularly used by school teachers in their courses.

The Club P. A. N., which was set up by students at the Max Planck Institute for Evolutionary Anthropology and the WCF team, is organising environmental education in local schools by supporting nature-based classes, providing printed education materials and training of teachers. Leipzig Zoo supported Club P. A. N. in addition to its contribution to WCF activities.

Leipzig Zoo includes visitors and the general public in its conservation efforts in different ways in order to raise awareness of conservation issues. Pongoland contains several panels and interactive devices designed to look like pages of a researcher's diary that explain facts about great apes. Visitors can act as researchers themselves, listen to chimpanzee calls made in different situations, smell scents of the rain forest, use touch boxes with products of the forest or compare the size of their hands with footprints of the great apes. Together with the presentation of the animals in naturalistic enclosures, visitors get a strong impression of sharing a common environment with the great apes that will sensitise them to the needs of wildlife conservation.

In 2001 Leipzig Zoo took part in the European Association of Zoos and Aquaria's bushmeat campaign by setting up a special exhibition in an African style hut at the entrance to Pongoland. Visitors could sign a petition against the bushmeat trade and donate money. In total, 64,000 signatures and €6,000 were collected within seven months.

Since 2002, the “Explorers’ House Ark” has served as an information and education centre with a 550 m² interactive exhibition about the zoo and its conservation efforts. Here you will find, for example, a game that explains the possible threats chimpanzees face and information about the work of WCF. In order to foster the spread of information about conservation projects, Leipzig Zoo has produced a brochure and a compact disc, is periodically distributing press releases about the topic, is using its journal *Zoo Live* and its annual printed report *Panthera* to place articles about the work of WCF and has pages on its website dedicated to *in situ* conservation, including WCF’s work.

WCF is cooperating with numerous partners in various African countries, most of them state agencies, universities and non-governmental organisations, and obtains financial support from several conservation agencies. Besides Leipzig Zoo, there are several other institutions contributing to WCF’s activities, among them Columbus Zoo, Cleveland Metroparks Zoo, Brevard Zoo, Rufford Foundation, Minnesota Zoo, Sweden Chimpanzee Trust, Oregon Zoo and Bremerhaven Zoo.



Dr **Jörg Junhold** received his doctoral degree in veterinary medicine from the University of Leipzig in 1994. He acted as market activity manager for the animal nutrition company Effem (Mars) from 1992 to 1997. In 1997, he became director of Leipzig Zoo. He is a member of the advisory board of the International Species Information System, of the European Association of Zoos and Aquaria and of the Federation of German Zoo Directors. He has been a council member and chairman of the marketing committee of the World Association of Zoos and Aquariums (WAZA) since 2005. He is president elect of WAZA for the period 2009 to 2011.



Dr **Christophe Boesch** is a biologist and received his habilitation from the University of Basel in 1994. He has been involved in a long-term study of wild chimpanzees in West Africa since 1979. He has been one of the directors of the Max Planck Institute for Evolutionary Anthropology Leipzig since 1997 and honorary professor at the University of Leipzig since 1999. In 2000, he was one of the founders and still serves as president of the Wild Chimpanzee Foundation. He carries out advisory work for WWF International, IUCN/SSC Primate Specialist Group and its Section on Great Apes, the Great Apes Survival Project and others.

Jens-Ove Heckel
Landau Zoo

William L. R. Oliver
Philippines Biodiversity
Conservation Foundation

Jean-Marc Lernould
Conservation des Espèces
et des Populations
Animales

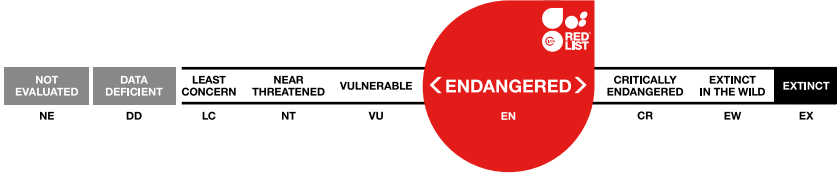
Roland Wirth
Zoological Society for the
Conservation of Species
and Populations

Saving one of the world’s most endangered deer species in the Philippines from the brink of extinction

Species	Philippine spotted deer (<i>Cervus alfredi</i> or <i>Rusa alfredi</i>)
Range	Central Philippines
Population	2,500
Threats	Habitat destruction, poaching



© Jens-Ove Heckel





Biodiversity conservation projects



Intact tropical forests are the key habitat of Philippine spotted deer (© Jens-Ove Heckel).

The Philippine spotted deer (*Cervus alfredi* or *Rusa alfredi*) owes its scientific name to Duke Alfred of Edinburgh, who lived in the 19th century. Unfortunately, this noble connection did not prevent it from becoming one of the globally most threatened deer species today.

Originally occurring on all five of the larger Central Visayan Islands in the Philippines, it is now extinct on three of these islands, whereas on the remaining two islands (Panay and Negros) its forest habitat has declined by more than 95%. Further, the little remaining habitat is heavily fragmented, and the last few existing sub-populations of the species are still subject to poaching. Not surprisingly, therefore, the IUCN lists the species as “endangered”. In order to save the species from extinction, Mulhouse Zoo, in cooperation with the German conservation organisation Zoological Society for the Conservation of Species and Populations and with William Oliver, at that time director of the Philippines programme of Fauna & Flora International, initiated a conservation



Adult male and juvenile Philippine spotted deer at Landau Zoo (© Gerhard Steinmetz).

project, which has a breeding programme in the Philippines and in Europe as one of its components. A first group of Philippine spotted deer of Negros origin arrived in Mulhouse from the Philippines in 1990. The animals settled in well and soon started breeding. In 2001, a second group of animals was imported to Europe via quarantine in Poznań Zoo. By early 2009, 18 zoos in France, Germany, Italy, the United Kingdom, the Netherlands, Poland, the Czech Republic, Luxembourg, Spain and Portugal became partners in the programme. The captive population in Europe has increased to 110 individuals to date. Landau Zoo runs the international studbook for the captive population of Philippine spotted deer originating from the island of Negros.



Philippine spotted deer at a breeding centre in the Philippines (© Jens-Ove Heckel).

Philippine spotted deer are relatively easy to maintain in zoos and provide few management problems. Unlike many other deer, however, they need heated winter quarters in northern and central Europe and, again unlike many other deer, females can be rather aggressive to each other. Breeding herds of up to five or six females are possible, but usually only by building up numbers from a founder female and her daughters and granddaughters. Such female groups may be stable for years, but sudden aggression directed against one particular female, requiring its separation, or the restructuring of herds is always possible. On the positive side, enclosure size can be smaller than for many other deer species, and as this species is not a very good jumper, fences can be lower than for most other similar-sized deer.

An integral component of the programme is financial and scientific support for local rescue and breeding centres in the Philippines. On Negros Island these are the Centre for Studies in Tropical Conservation of the Silliman University,

Dumagete City and the Biodiversity Conservation Centre of the Negros Forest and Ecological Foundation, Bacolod City. A separate programme, mainly supported by U.S. and Australian zoos, has been established for Philippine spotted deer originating from the island of Panay at the Mari-it Conservation Park at the College of Agriculture and Forestry of the West Visayas State University in Lambunao, Iloilo. Colonies of the deer were founded with specimens rescued, confiscated and donated. Under the leadership of William Oliver and with the continuing support received from zoos participating in the breeding programme, various conservation organisations and other sources, these local rescue centres have evolved, over nearly two decades, into leading local conservation centres. These centres continue to function as rescue, breeding and conservation education centres for endangered Philippine wildlife species. The captive deer population in the Philippines was reported to be about 30 animals at the beginning of 2009.

Biodiversity conservation projects



Entrance gate of the Negros Forest and Ecological Foundation in Bacolod (© Jens-Ove Heckel).



Agriculture enters the tropical forests in the Philippines (© Jens-Ove Heckel).

As the largest mammal species on the West Visayas, the Philippine spotted deer plays an important role as ambassador for the alarming situation of the entire island ecosystem. The massive habitat destruction does not just affect the wildlife. Nowadays the local people also feel the effects of erosion caused by the continuing massive forest loss, for example in the increasing number of scree landslides and shortage of water. Effective conservation measures for the Philippine spotted deer do not only target species conservation, but will help to improve the local people's standard of living at the same time. Therefore, besides captive breeding, this project puts further main emphasis on several activities, including lobbying for the installation of conservation areas, intensifying information campaigns and environmental education of the local people and training of Philippine biologists and veterinarians on site, to enable local specialists to take on jobs that have been established as part of the conservation project.

What started off as a recovery programme for the Philippine spotted deer has expanded over the years to other highly endangered endemic Philippine species, such as the Visayan warty pig (*Sus cebifrons*, one of the two most endangered pig species in the world), Panay cloud rat (*Crateromys heaneyi*), Visayan wrinkled hornbill (*Aceros waldeni*, the world's most endangered hornbill species), Negros bleeding-heart pigeon (*Gallicolumba keayi*), Philippine eagle owl (*Bubo philippensis*), Philippine hawk eagle (*Spizaetos philippensis pinskeri*), endemic populations (probably representing undescribed species or sub-species) of Philippine sail-fin lizards (*Hydrosaurus pustulatus*) and others. Other organisations have joined in over the years and have become long-term funding partners in this multi-species conservation and recovery programme in one of the globally most endangered biodiversity hotspots – the central Philippine islands. Planning for a first reintroduction of captive-bred Philippine spotted deer and some of the other species into privately owned forest fragments on the island of Panay is well advanced and is hoped to commence in 2010/2011.



Young male Philippine spotted deer
at Landau Zoo (© Jens-Ove Heckel).

Partner zoos in the programme are expected to make a one-off or yearly financial contribution to the continuation and expansion of the conservation activities in the Philippines. Participation of each new zoo in the Philippine spotted deer conservation programme will have to be endorsed by the wildlife authorities of the Philippines, the Department of Environment and Natural Resources, with its Protected Areas and Wildlife Bureau, as all deer and their progeny are within the ownership of the government of the Philippines.

The authors would like to acknowledge the continuous support over all the years provided by the Philippine project partners as well as the Philippine Department of Environment and Natural Resources – Protected Areas and Wildlife Bureau.



Biodiversity conservation projects



After an agricultural apprenticeship and temporary occupation as zookeeper, Dr **Jens-Ove Heckel** studied veterinary medicine in Hanover. During a three-year appointment as assistant zoo veterinarian at Stuttgart Zoo, he performed the research for his doctoral thesis on Hepatitis B virus in captive and wild primates. He then worked as zoological or wildlife veterinary consultant in several German institutions and in Uganda. In 2000, he was appointed as director and zoo veterinarian of Landau Zoo. He became keeper of the international studbook for Philippine spotted deer in 2004. He also serves as regional coordinator for the Horn of Africa of the IUCN/SSC Antelope Specialist Group.



William L. R. Oliver was born in England and educated at London and Liverpool universities. He has worked in leading conservation breeding centres in England and Jersey (Channel Islands), initially as a keeper but later in charge of research, a post that led him to conduct field research on various highly threatened species. Ever since his first visit to the Philippines in 1990, he has been back every year and now spends about 10 months a year there in his capacity as a founding board member and director of the Philippines Biodiversity Conservation Foundation's Philippines biodiversity conservation programme. He has also chaired the IUCN/SSC Pigs, Peccaries & Hippos Specialist Group since its inception in the early 1980s and is an active member of several other specialist groups.



Dr **Jean-Marc Lernould** is a French veterinarian with a post-university degree in tropical medicine and animal husbandry. He started his professional life as field veterinarian in Ethiopia and was then appointed manager and veterinarian of the Primatology and Equatorial Ecology Laboratory of the French National Scientific Research Centre in Gabon. He finally fulfilled his wish to work in a zoo, first as curator and veterinarian at Walsrode Bird Park, and then as director of Mulhouse Zoo for 26 years. He is also chairman and, in 1997, was one of the founders of Conservation des Espèces et des Populations Animales, a French association of zoos and private persons supporting the *in situ* conservation of highly endangered and often neglected species.



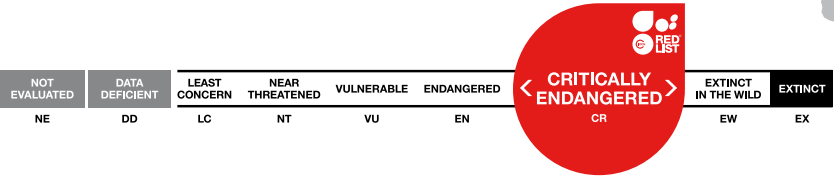
Roland Wirth was a co-founder of the Zoological Society for the Conservation of Species and Populations (ZGAP) in 1982 and has been the society's chairman since 1984. ZGAP's main interest is the conservation and recovery of lesser known endangered species. He has also been a member of several IUCN/SSC specialist groups for over 20 years and is a board member of Stiftung Artenschutz and the Loro Parque Foundation on the island of Tenerife.

Neil Maddison
Bristol Conservation
and Science Foundation

Wanted dead or alive: working with communities to address the illegal bushmeat trade in Cameroon

© BCSF/Living Earth Foundation

Species	Western gorilla (<i>Gorilla gorilla</i>)
Range	Central Africa
Population	95,000
Threats	Poaching, disease



Biodiversity conservation projects



Dja Biosphere Reserve in Cameroon
(© BCSF/Living Earth Foundation).



Bushmeat extracted from Dja Biosphere Reserve
(© BCSF/Living Earth Foundation).

Located between 10° and 2°N, Cameroon borders on Chad to the north, Nigeria to the west, Central African Republic and the Democratic Republic of Congo to the south-east, and Equatorial Guinea and Gabon to the south. Cameroon is politically stable. His Excellence Paul Biya has been president since 1982, as head of the Cameroon People's Democratic Movement. Its economy is based on extraction industries (timber, oil and minerals). At its northern tip, the country has its head firmly in the lower reaches of the Sahara desert. Between the savannah of the north and the forests to the west and south lies a mountainous region. The country is split by the Sanaga River – to the north and west lies the Guinea forest, to the south and east lies the Congo basin.

Research carried out by Bristol Zoo and the Living Earth Foundation in 2003 indicated that communities around the Dja Biosphere Reserve in the south of Cameroon are inclined to disengage from wildlife protection efforts because (1) they see no benefits for themselves, and (2) there is no mechanism for their participation in management.

It is known that the biodiversity of the reserve is under pressure from people living in its periphery who hunt not only for subsistence, but also frequently for trade. Commercial hunting is conducted to satisfy the demands of the markets located close to the reserve, as well as the urban centres. It was also thought that villagers viewed bushmeat hunting as one of the few ways to gain income. The area is highly important for the conservation of wildlife. Previous studies have shown that the reserve still holds vital populations of western gorillas (*Gorilla gorilla*) and chimpanzees (*Pan troglodytes*), despite the intense hunting pressure.



Chimpanzee at Dja Biosphere Reserve (© BCSF/Living Earth Foundation).

Our earlier research showed that local people often feel that they are being deprived of their livelihood, either by hunters from outside the area who come for “their meat” or by the presence of government agents and/or conservation organisations who limit hunting activities. Living around a protected area was evidently creating a substantial amount of conflict between the local populations, the government representatives and outside organisations present in the area. The villagers felt they had been abandoned by the outside world and that their basic needs are of little importance to the authorities. To add to the feeling of abandonment, villagers also believed that they come far behind the animals in the area in terms of consideration. They felt that outside organisations should help them with their development initiatives as they suffer from living next to a protected area.

Awareness-raising activities on the laws protecting certain species have previously been conducted in villages in the periphery of the reserve. Fieldwork discussions have established that villagers are highly aware of these laws. However, the majority of participants referred to these laws in a negative way and generally considered that conservation activities in the area were having a negative effect on their lives. It was evident that local people had no ownership of these issues. Whilst they were aware of which animals they should not hunt, they seemed largely unaware of why they might want to protect them. Several outside organisations have used protectionist measures based on values that are not inherent in local culture, for example the concept that the other great apes are close relatives of humans. It could be argued that any “educational” measures based on such arguments may fail, because the audience distrusts the motives for such messages or does not engage with information that is based around such a different set of values.



Interviews conducted in the periphery of Dja Biosphere Reserve (© BCSF/Living Earth Foundation).

The Dja periphery community engagement and support project complemented other activities being carried out in the area; earlier research indicated that “education” was unsuccessful in engendering ownership or giving “value” to wildlife. The project was, therefore, based on a model taken from socio-economic development work in other parts of the world, namely participatory learning and action. The strategy has been to develop local ability to make decisions, and the confidence to act upon them. It is also through this method that messages could be developed by villagers to give them a greater ownership of the issues and solutions. An important aspect of the project was to ensure that the voices of those whose lives are most affected by depletion of wildlife resources are heard by those who can influence unsustainable consumption, for example governments and non-governmental organisations.



Gorilla at Dja Biosphere Reserve (© BCSF/Living Earth Foundation).

The goal of the project is to assist local communities living around Dja Biosphere Reserve to engage more effectively with biodiversity protection agencies, particularly for the conservation of great apes. The internal network of communities was identified and then used to facilitate a dialogue (1) allowing government and conservation agencies to hear community “voice” and (2) enabling the spread of conservation and sustainable development messages within the communities through “trusted methods”. Ministry field staff was trained in effective participatory communication techniques. Isolated communities were linked to ongoing development initiatives to provide alternative incomes to poaching and the bushmeat trade. The project was linked with Mvog-Betsi Zoo, Mefou National Park and Yaoundé schools through an integrated environmental education programme, thus addressing the demand side of the bushmeat market.



Breeding cane rats as an alternative meat source
(© BCSF/Living Earth Foundation).

About 30% (2,280 people) of the population of the Dja periphery benefited directly or indirectly from the project. There were a significant number of planned outputs and outcomes from the project, including: knowledge, attitudes and practice surveys were conducted and documented, giving valuable qualitative data on how conservation, bushmeat, development and great apes are viewed by communities. Over 60 game guards were trained in community consultation and communication. A game guard training module was developed and published. Leaflets on key issues in conservation were produced and distributed. A compact disc of popular songs reflecting the “voice of the people” was recorded, printed and distributed. Four short films were produced and uploaded to the Internet. School teachers were trained in environmental education. And interpretation materials at Mefou National Park and Mvog-Betsi Zoo were enhanced through the leaflets, films and music described above.

The shift to a focus on tangible benefits during the second year of the project produced the following unplanned effects: 35 “groupes d’initiative commune” were formed and registered as legal entities. Village development plans were developed in 22 villages. Four hundred villagers were trained in various livelihood activities. Links were forged with external organisations for project partnerships and ongoing support.



Village women in the periphery
of Dja Biosphere Reserve (© BCSF/Living Earth Foundation).

A number of impacts can be clearly discerned, including: a high degree of trust has been built between communities and conservationist staff on the ground. Previously the (often justified) mistrust of outsiders by villagers has hampered their ability to engage in discussions about their development. There has been increased engagement in conservation by communities. The beginning of a shift from confrontation to cooperation between communities and game guards has been discerned. There has been improved household income levels among those families involved in the 35 “groupes d’initiative commune”. This will translate to a general increase in trade and an improvement in the economy at the micro level. A reduction in illegal bushmeat hunting has been reported. Those hunters who are now engaged in alternative or non-traditional livelihood activities are happy to forsake poaching. Although necessarily small, given the scope of the project, this impact provides clear evidence that the livelihoods approach is fundamental to effective conservation. There is greater self-reliance at the village level. The capacity to plan, implement and manage projects using available resources is now present. The sense of dependence on outside “saviours” is gradually dissipating. There is clear evidence of the willingness of others, particularly orthodox conservation organisations, to integrate people-centred approaches into their programmes. Most importantly, the project has provided credible evidence to the debate about the key, active role that local communities should play in the conservation of threatened natural resources.



Neil Maddison (left) discussing gorilla tourism in Karagoua, near Dja Biosphere Reserve (© BCSF/Living Earth Foundation).

We utilise the conservation education programmes run by Ape Action Africa (a primate rescue centre organisation) to convey the messages via Mvog-Betsi Zoo and at Mefou National Park. Mefou already receives considerable local, national and international attention as a wildlife sanctuary and is one of the few attractions available for the international tourist to Cameroon. Ape Action Africa has been implementing conservation education messages at Mvog-Betsi Zoo for over a decade, supported by Givskud Zoo in Denmark. Due to the massive effect of the illegal bushmeat trade on the primates of Cameroon, fuelled mainly by the demand from urban dwellers, Ape Action Africa has focused its attention on highlighting the plight of gorillas, chimpanzees and other primates to the various visitors and school groups that come to the zoo.

In future, we are helping local people to play a role in law enforcement. Community leaders are now looking at the various options available to them, so that illegal activities can be reported quickly to the relevant authorities. In addition, we propose the establishment of community forests, involving a range of interrelated activities including meeting statutory legal requirements, building community capacity through training and establishing participatory management and planning for equitable distribution of benefits.

Partner institutions in this conservation project include the Living Earth Foundation (UK and Cameroon) and Ape Action Africa (formerly known as the Cameroon Wildlife Aid Fund).

Neil Maddison (photo above) is a zoologist with an MBA degree. He is currently employed by the Bristol, Clifton and West of England Zoological Society, which is best known for operating Bristol Zoo Gardens, the fifth oldest zoo in the world. He was instrumental in setting up the Bristol Conservation and Science Foundation, a sister operating unit to Bristol Zoo, where he has been head of conservation programmes since 2003. He has a special interest in community-based conservation initiatives, especially in the creation and delivery of “additional value” services to local communities, linked to the protection of wildlife, and developing “trade-out” solutions to counter unsustainable activities.

Harald M. Schwammer
Vienna Zoo | Austrian
Sri Lankan Elephant Research
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Gaby V. Schwammer
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Lalith M. Seneviratne
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Conservation of Asian elephants in Sri Lanka: a holistic ecological, educational and socio-economic approach

Species	Asian elephant (<i>Elephas maximus</i>)
Range	South-East Asia
Population	50,000
Threats	Habitat destruction, poaching



© Harald Schwammer



Biodiversity conservation projects



Harald Schwammer (left) at the elephant management training workshop in Pinnawala (© Harald Schwammer).



Elephant orphans at Transit Home near Udawalawe National Park (© Harald Schwammer).

The island of Sri Lanka is situated south of the Indian sub-continent, covers about 65,000 km² and has a tropical climate. The human population is about 20 million and the government is democratically elected. The island recently suffered a three-decade-long civil war conflict. Agriculture is the main source of income and Colombo is the commercial capital. Sri Lanka is a global hotspot of biodiversity, but no wild species is the focus of greater affection or concern than the Asian elephant (*Elephas maximus*).

The Asian elephant is one of the most endangered species of large mammals in the world, and *Elephas maximus maximus*, the sub-species in Sri Lanka, has enormous cultural and religious significance. The conflict between humans and elephants has become a serious conservation problem in Sri Lanka, where a combination of deforestation, agricultural expansion and human population growth has substantially reduced the available elephant habitat. The conflict has escalated in the recent past, with 160 to 170 elephants and 50 to 60 humans dying per year. According to the Sri Lankan Department of Wildlife Conservation, 238 elephants died due to intruding on human habitat in 2008 alone.

In 2003, the Vienna Zoo elephant and education team was invited to hold an elephant management training workshop at Dehiwala Zoo in Colombo and at the Elephant Orphanage in Pinnawala. Thereafter, Vienna Zoo supported Dehiwala Zoo, Pinnawala Elephant Orphanage and Elephant Transit Home (an elephant rescue centre) with medications and veterinary equipment, from blowpipes to high-tech equipment such as a device for narcosis control and one for blood analysis, basic elephant care equipment, as well as various binoculars.

In December 2004, the tsunami catastrophe hit Sri Lanka, shaking the entire country. With international help, reconstruction began. Vienna Zoo played an active role here as the Friends of the Vienna Zoo funded not only private homes of park rangers, but also the construction of a ranger office at the eastern entrance to Yala National Park. Thereafter, the government extended the protected area.



Chief Mahout Sunamabanda with Harald Schwammer (left) at Pinnawala Elephant Orphanage, pictured with famous Raja who was shot blind by poachers (© Harald Schwammer).



Elephant Transit Home (© Harald Schwammer).

In July 2005, the Austrian Sri Lankan Elephant Research & Conservation (ASERC) project was founded by Harald Schwammer, Gaby Schwammer, Brigadier H. A. N. T. Perera (former director of the Sri Lankan Department of National Zoological Gardens) and Lalith Seneviratne. ASERC marks a cooperative effort between Vienna Zoo and Sri Lankan experts in elephant research and management, veterinary medicine and technical resources. It conducts research and conservation on elephants *in situ* and *ex situ* and is designed to guarantee species-appropriate management and to help settle animal–human conflict in habitat use.

Moreover, ASERC helps fund the elephant care centres in Sri Lanka and provides expertise support in the veterinarian and management sectors. In addition, ASERC funds the work of teachers, field excursions and workshops in rural areas to better educate local residents and children in schools. Biologists, veterinarians and park rangers were sent to special training workshops and international conferences. Examples of successful programmes, including awareness and conservation education, include the following:

The tripwire elephant alarm system utilises a trip line approach to signal elephant intrusion. It was conceived and tested by several ASERC founders at the ASERC field station in Pokunatenna, bordering Udawalawe National Park. This system enables villagers to get to any point along the line within minutes of the alarm signalling an intrusion, allowing them to chase the elephant away before it begins to feed. Communities where human–elephant conflict is prevalent are typically hamlets or villages with around 25 to 50 houses and a mixed rice paddy and chena (slash-and-burn) cropland of up to 20 ha. By late 2008, 11 new systems were introduced in the Neralu Wewa area on the north-eastern border of Udawalawe National Park.



Lalith Seneviratne with the tripwire installation in Pokunatenna (© Harald Schwammer).

Lanka Gasifiers Ltd. (LGL) is a company that provides distributed energy solutions that the rural populations can implement for themselves. Currently, LGL designs, develops, manufactures and deploys biomass gasifier generators. LGL implemented Sri Lanka's first village biomass electrification systems. Now it implements such projects through independent entrepreneurs or developers. Good lighting keeps elephants away. Therefore, LGL encourages conservation and elephant conservation in particular, as part of its broader mission. ASERC and LGL have some founders in common. This creates synergies between the two and provides pro bono logistical support to ASERC's work in Sri Lanka.

In July 2009, the Elephant Health Trust was founded in Sri Lanka. Its goal is to monitor and improve the situation of elephants under human care. A total of 127 elephants currently work as draft animals or as temple or tourist elephants. Dr Ashoka Dangolla of the University of Peradeniya is the responsible veterinarian of this project. Partner organisations now include the Sri Lanka Captive Elephant Owners' Association, the Millennium Elephant Foundation and the ancient, sacred Buddhist temple "Temple of the Tooth".



Pinnawala Elephant Orphanage (© Harald Schwammer).

The level of teaching in subjects such as science (biology), mathematics and English is poor in rural schools in human–elephant conflict areas. Competence in these subjects will enable rural children to be more inquisitive and aware of their surroundings, leading them to be sensitive to the environment. This programme is aimed at grade 10 and 11 students of Laginagala Junior College near the northern part of Udawalawe National Park. ASERC pays teacher salaries for this special programme. Intensive work started in 2007, with 2008 being the programme's first full year. The national average pass rate is around 60% of the student population, with rural schools like Laginagala Junior College having much lower rates. The successful results after one year of this conservation education were presented during a meeting in February 2009. Around 20 students (grade 11) took the national general certificate of education, ordinary level examination. We can predict that the pass rate will exceed the national average. The classes for 2009 started again in February.



Pinnawala Elephant Orphanage (© Harald Schwammer).

The people around the periphery of Udawalawe National Park are typically rural farmers. Their awareness of the value of the park directly impacts the park's health. Unfortunately, most local residents have never even visited the park. This programme organises field excursions for grade 10 and above students from 10 schools near Pokunatenna. The newly constructed visitor information centre at Udawalawe National Park provides valuable ecological information to the students. They are also introduced to the programme of Elephant Transit Home, where orphaned elephants are cared for and released back into the wild. They are also taken on a tour inside the park. The first trip was held in January 2008 for students of Laginagala Junior College. Excursions are also organised to Colombo. The itinerary includes Dehiwela Zoo, the Natural Science Museum and Pinnawala Elephant Orphanage. For many of the participants it marks the first trip to the capital city.



Gaby Schwammer with the education project for schoolchildren at Laginagala Junior College (© Harald Schwammer).

A special handwritten book with colour-painted pictures by students and teachers from Laginagala Junior College presents their knowledge about life, culture and nature in Sri Lanka. This is no doubt the first time that students from rural areas had an opportunity to produce such a magazine in English, including their thoughts on their environment and how to protect it. Every article and each piece of artwork is an amazing document by people – mainly young children – who are enthusiastic about showing their newly acquainted knowledge about their environment and wildlife.

After a few years of conservation education work in the Udawalawe National Park area, it is amazing how intensive and effective the results are. New awareness has been created under the umbrella of ASERC. This gave rise to the first ASERC drawing contest in spring 2009, held at Laginagala Junior College. The students were invited to participate under the specific topic "elephant, the big grey one and his environment". The contest is divided into two age groups and runs until the end of July, when the winners will be presented during a big award ceremony.



Biodiversity conservation projects



Monitoring elephants at Yala National Park is sometimes not so easy (© Harald Schwammer).

ASERC has a special association with Yala National Park and sponsored a book by Gaminie V. Samarakoon from the Sri Lankan Department of Wildlife Conservation, describing the park and its history. One thousand copies were distributed to regional schools, libraries and officers of the Department of Wildlife Conservation, promoting the preservation of this pristine area. In a next awareness-building step, the plan is to support the distribution of a book by wildlife veterinarian Vijitha Perera, outlining his conservation work for elephants.

ASERC pursues a holistic approach for *in situ* and *ex situ* conservation, awareness and education programmes, and is cooperating with the government and non-governmental organisations coordinated by the authors of this chapter. By involving local residents in rural areas, it also has socio-economic aims. In the future, these activities will be extended to other regions in Sri Lanka.

The ASERC project has been supported by Halle Zoo, Zoo Le Pal, Tradewind Pictures and Four Paws.

Dr **Harald M. Schwammer** (photo page 100) is a zoologist and deputy director of Vienna Zoo. He is a founder and president of the European Elephant Keeper and Manager Association, member of the board of directors of the International Elephant Foundation, a founder of the Austrian Sri Lankan Elephant Research & Conservation Project, chairman of the Global Elephant Management Programme and keeper of the European Association of Zoos and Aquaria's studbook for African elephants. As a legally accredited expert he has been active as a consultant for various projects.

Gaby V. Schwammer (photo page 103) has been head of the education department at Vienna Zoo since 1983. She works in close cooperation with zoo educators from around the world and is responsible for educational issues, labels and signs, exhibitions, scientific collections, archives and publications. She was a teacher at the state institute for professional training of animal keepers from 1986 to 1993, secretary of the International Association of Zoo Educators (IZE) from 1996 to 2000, IZE regional representative for Europe and the Middle East from 2004 to 2008, and has been a board member of the European Association of Zoos and Aquaria's exhibit design and education committee since 2002.

Lalith M. Seneviratne (photo page 102) completed his B. Sc. degree in electronics at the University of Kent and his M. Sc. degree in electrical engineering at the University of Calgary. He implemented Sri Lanka's first biomass village electrification system that led to him co-founding an enterprise to provide rural renewable energy electrification in Sri Lanka in a sustainable and evenly distributed way. The Austrian Sri Lankan Elephant Research & Conservation Project, of which he is also a co-founder, is a similar and interlinked initiative in the conservation arena. He has been honorary director of the Sri Lankan Department of Wildlife Conservation since 2004.

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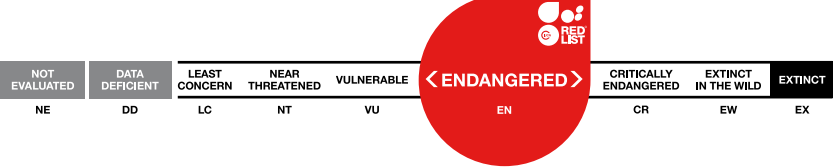
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A “life raft” for amphibians in Ecuador

Species	Suro stream frog (<i>Hyloscirtus pantostictus</i>)
Range	Northern Ecuador, southern Colombia
Population	Few
Threats	Habitat destruction, pollution, disease



© Luis Coloma





Uco, a species last seen in December 1994 at Laguna Negra of Atillo, Chimborazo Province, Ecuador (© Luis Coloma).

Imagine a place where you can explore from beaches, mangroves and dry forests, to snow-capped mountains and vast inter-Andean valleys, in which the forests and páramo habitats contrast with the lush tropical rainforest. This is Ecuador, a small natural paradise located in the equatorial line, in north-western South America, and bordered by the Pacific Ocean. Ecuador concentrates 5% to 10% of the global biodiversity in a small fraction of territory (256,370 km²). This natural wealth of Ecuador is enhanced by its enormous diversity of amphibians. Here, about 680 to 730 (475 described, plus about 255 yet undescribed for science) amphibian species occur. Among the described species, 38% (182 species) are endemic to Ecuador, especially in the Andean region.

In the late 1980s, researchers noticed that several species of frogs and toads were mysteriously disappearing at unprecedented rates, even from protected natural reserves, and mostly from the Andean region. Recent assessments indicate that among the described species at least 146 are threatened in Ecuador, 11 of which are probably extinct. Flagship species of these disappearances are the once extremely common Jambato toad (*Atelopus ignescens*), the Guanujo harlequin frog (*A. guanujo*) or the uco (*Telmatobius niger*).



Jambato toad, a species that formerly was common in inter-Andean valleys and páramos; it was last seen on 30 March 1988 in Napo Province, Ecuador (© Luis Coloma).

But what happened to these abundant animals that inhabited the mountains of Ecuador? In recent decades, the Andean region has been dramatically affected by climate change (e.g. abnormal patterns of rainfall and temperature), the presence of pathogens deadly to amphibians (e.g. chytrid fungus), the loss and fragmentation of habitat on a large scale, and a cocktail of other factors. The synergistic action of these factors was the cause of these catastrophic declines and extinctions.



Guanujo harlequin frog, a species last seen on 10 April 1988 near Guanujo, Bolívar Province, Ecuador (© Luis Coloma).

In 2005, for the purpose of increasing public awareness of the global and local amphibian crisis, the Museum of Zoology of the Pontificia Universidad Católica del Ecuador (PUCE) held the public exhibition "Sapari, an adventure into the world of frogs". This successful event increased the public conscience and opinion, and frogs gained a better appreciation by Ecuadorians, who then gave overwhelming support for the implementation of urgent conservation actions.

The Museum of Zoology embarked on an ambitious project with a new vision of being proactive rather than reactive, or simply post-mortem. It was the implementation of a modern Noah's ark (with scientists, conservationists, the public and frogs on board) designed to mitigate and prevent the accelerated loss of frogs and toads.

With a great deal of idealism, and some knowledge and experience acquired by the herpetology laboratory of the Museum of Zoology during the three decades of its existence, we developed a strategic plan for research and conservation of Ecuadorian amphibians at risk of extinction. This project is known as the "life raft" for frogs – an Ecuadorian local name that emulates Noah's ark.

This strategic plan was designed with the aim of catalysing the conservation of threatened amphibians in Ecuador. Six programmes (with numerous projects) were set to mark the direction of navigation of this ambitious plan: (1) research and monitoring of native amphibians, (2) strengthening of local capacities, (3) management and *ex situ* conservation of species at risk, (4) *in situ* conservation, (5) public education, and (6) bioinformatics and sharing of information. In our trip some progress has been made in each of these programmes as indicated below.



Frog room in the amphibian conservation centre at PUCE (© Luis Coloma).



A male Cuenca's rocket frog carries its offspring on its back to deposit them in water. This species is breeding in the laboratories at PUCE (© Luis Coloma).

(1) New inventories of diversity in little explored areas, the use of molecular analyses and the study of specimens deposited at museums have led to the continuous discovery of many new species, not yet recorded for science. Examples include dozens of unknown species of poison dart, harlequin, stream and glass frogs. It is estimated that about 255 species are awaiting either their discovery or description as new to science. Description rates of new species are increasing as a result of our plan. Also, studies are conducted on the population dynamics, reproductive biology and the effects and interactions of infectious diseases in remnant populations of harlequin frogs: *Atelopus* sp. (from south-eastern Ecuador) and *A. spumarius* in the Ecuadorian Amazonia. Additionally, through the use of geographic information systems, the role of the main threatening factors was evaluated. Thus, most vulnerable species and geographic locations were identified and priority species and locations were defined. Research on Ecuadorian amphibians is rapidly increasing. For example, the herpetology laboratory at PUCE has published over 40 scientific and numerous popular articles since 2005. Among them, an updated Red List of amphibians in Ecuador was released in electronic format in 2008.

(2) In 2006, we established the infrastructure for a pilot centre for *ex situ* conservation of amphibians at risk of extinction, with the generous support of Saint Louis Zoo. Also, in 2008 a molecular laboratory was set up with funding from the Ecuadorian government. The latter currently helps with the diagnosis of infectious diseases, the discovery of cryptic species (those species difficult to diagnose only by morphological features) and studies of the evolution of frogs. Our genome and tissue bank has increased enormously and currently holds about 12,000 samples. Human capacity also has grown accordingly, and a large team of scientists, conservationists, frog keepers, assistants and students currently work in amphibian research and conservation at PUCE.



Andean glass frog, an endangered species that is maintained in the laboratories of PUCE for eventual reintroduction into its natural habitat (© Luis Coloma).

(3) The pilot amphibian conservation centre at PUCE currently maintains about 1,000 individuals of 18 species: *Atelopus exiguus*, *A. nanay*, *A. spumarius*, *A. sp. nov.* (Limón), *A. sp.* (Cóndor), *A. sp.* (Morona Santiago), *Centrolene buckleyi*, *Ceratophrys stolzmanni*, *Gastrotheca litonensis*, *G. plumbea*, *G. pseustes*, *G. testudinea*, *G. riobambae*, *Hyloscirtus pantostictus*, *H. sp.*, *Hyloxalus jacobuspetersi*, *H. vertebralis*, *H. delatorreae*, *Nelsonophryne aequatorialis* and *Osornophryne guacamayo*. Our past fears that, for some endangered species, we would not find them fast enough to save them, became true.

Thus, for some species (e.g. *A. nanay* and *A. exiguus*) only few parental and lonely individuals were found. Nonetheless, enormous field efforts are currently conducted on trying to find additional and enough founders to keep genetically viable populations. Among the species kept, stories of success are the breeding of *G. riobambae*, *C. stolzmanni*, *H. delatorreae* and *H. vertebralis*. Additionally, backup colonies of *C. stolzmanni* and *H. vertebralis* were sent to Amaru Zoo (our partner institution in southern Ecuador, Azuay Province). Breeding essays of most species are being conducted.

(4) The "life raft" has been involved in land protection, with a vision to preserve critical habitats. For example, 58 ha of forest were acquired in Alto Tambo, Esmeraldas Province, for the conservation of a unique lowland community of amphibians in an area of high diversity and endemism in north-western Ecuador, which is currently severely affected by deforestation. This land is currently managed by Fundación Otonga, a partner institution working in habitat protection and environmental education of local communities.

(5) The "life raft" has supported a frog art exhibition "Ranas-Sanar" by Paul Jauregui, held in Quito in 2008, as well as a public exhibition of the Andean marsupial frog displayed by Quito Zoo. In addition, it published the book *Sapos*, a coffee-table book that promotes the beauty of these animals as flagships for conservation. These activities have elevated amphibians to new levels of importance and public awareness in Ecuador and around the world.

(6) Finally, an integrated biodiversity information system is being developed to offer access to specimen databases (e.g. 42,000 specimens at the Museum of Zoology, 10,000 specimens at the amphibian collection of Escuela Politécnica Nacional), maps, photographs, sounds and other information. This website is open to the public through AmphibiaWebEcuador, a free access electronic encyclopaedia.



Biodiversity conservation projects



Tumbez big mouthed frog, a rarely seen species endemic to coastal Ecuador. It reproduced for the first time in captivity at PUCE (© Luis Coloma).

Undoubtedly, research and conservation of Ecuadorian amphibians certainly are long-term tasks. However, accelerating diversity inventories, monitoring of populations of endangered species, the establishment of a new institute for research, management and *ex situ* conservation of amphibians (in a new PUCE campus on the outskirts of Quito) and new public exhibits are some of the goals for the near future. The *ex situ* management of all species at risk will be critical.

The “life raft” has been sailing with the strong support of PUCE. Our partners that have provided funding and support are Saint Louis Zoo, Secretaría Nacional de Ciencia y Tecnología del Ecuador, JRS Biodiversity Foundation, Conservation International, Zoo Conservation Outreach Group and Amphibian Ark. Also, the “life raft” has benefited from funding by private enterprises such as Repartos Alimenticios (Reparti), Casa Baca, Telefónica Movistar, Primera Línea, Sánchez Bellolio Mercadeo SA, Gamaproductos and personal donations.



Dr **Luis A. Coloma** holds a Ph. D. degree in systematics and ecology from the University of Kansas. He is director of the “life raft” at the Museum of Zoology and is a professor in the School of Biology at PUCE. His research focuses on the evolution, behaviour and decline of amphibians. He has published numerous scientific and popular articles; among the later are the photographic books *Megadiverse Ecuador* and *Sapos*. In 2007, he received the Sabin Award for Amphibian Conservation instituted by the IUCN and the Saint Louis Conservation Award in 2008.



Verónica Cano holds an M. Sc. degree in biological sciences from PUCE. She is responsible for the fundraising activities of the “life raft” and the School of Biology at PUCE. Her research focuses on otters and conservation biology, and she has worked on issues of environmental management. Her interest in the conservation of endangered species led her to collaborate on the conceptualisation of the “life raft”.



Miguel Ángel Rodríguez is a biologist and project manager of the “life raft”. He is also an associate researcher at the School of Biology at PUCE. His research focuses on otters and conservation biology. He designed and led the implementation of the pilot amphibian conservation centre.

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University of Missouri –
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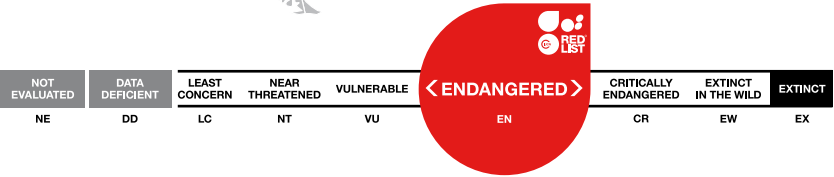
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Pathogens and parasites of Galapagos birds: a proactive approach to conservation

Species	Galapagos flightless cormorant (<i>Phalacrocorax harrisi</i>)
Range	Galapagos Islands
Population	1,500
Threats	Disturbance, invasive species



© Caroline Duffie





A team of international and local partners processes birds on Isabela (© Sharon Deem).

The Galapagos Islands, Ecuador, straddle the equator 1,000 km west of the coast of South America. Most of the animal species there are endemic (occur nowhere else) and humans reside on only five of the 16 main islands, the remainder being protected with the surrounding waters as the Galapagos National Park and Marine Reserve. The birds of Galapagos include all species ever known to exist there, having suffered not one extinction. However, diseases pose greater threats to wildlife populations today than ever before. This is attributed largely to increased movement of pathogens caused by human travel and movement of domestic animals, exposing wildlife populations to diseases to which they are immunologically naïve.

Possibly the clearest examples of extinctions due to diseases are those of many species of endemic Hawaiian honeycreepers that have succumbed to either avian malaria caused by the blood parasite *Plasmodium relictum*, the avian poxvirus, or a combination of the two pathogens. As the resident human population in Galapagos and tourism grow exponentially, increased travel from the mainland will undoubtedly bring new pathogens. The Galapagos National Park and Charles Darwin Foundation (an international science advisory group residing on the islands) expressed these concerns in autumn 2000. In spring 2001, the University of Missouri – St. Louis and Saint Louis Zoo began collaborating with the Galapagos National Park and Charles Darwin Foundation to address these concerns.



Two Nazca boobies, a Galapagos endemic seabird, in front of Darwin's Arch near the island of Darwin in the extreme north-west of the archipelago (© Iris Levin).

All of our studies involve the safe capture and handling of wild birds by teams led by graduate students or veterinary professionals (including U.S., Ecuadorian and international partners). Depending upon the objective of the project, we take small blood samples by venipuncture of the brachial vein, never taking more than 1% volume per mass (e.g. 1 ml from a 100 g bird). Thin blood smears are made immediately and a drop of whole blood is stored in a preservative for genetic studies. Any remaining blood is spun shortly after collection for frozen storage as serum or plasma for later serological tests. Birds are given physical examinations and for some studies, ectoparasites are removed by dusting with a plant-derived insecticide powder.



Domestic chickens are kept in Galapagos on four inhabited islands as backyard chickens; and these broiler chickens are brought in at one day of age and slaughtered at around eight weeks. Both kinds of chickens interact regularly with wild birds, as shown here with Darwin's finches (© Marilyn Cruz).

Serological tests are conducted through veterinary diagnostic laboratories, and genetic studies are undertaken at the University of Missouri – St. Louis. We invite collaborations with international experts for particular pathogen or parasite taxa to insure rigor in identification, handling and documentation. Since 2003, we have published 42 peer-reviewed articles, which represent results from Master's theses, doctoral dissertations and veterinary residency reports, and review articles involving 62 different authors, using analytical approaches of clinical veterinary medicine, pathology, epidemiology, population genetics, phylogeography, molecular systematics and field ornithology.

The Galapagos hawk is the only diurnal raptor on the archipelago, living in eight island populations that are highly genetically and morphologically distinct. Shown here is natural habitat on the western coast of Santiago (© Jennifer Bollmer).

We have examined more than 7,000 individuals representing 27 species on 17 islands. In addition, we have tested three introduced species as possible sources of introduction of pathogens. Domestic chickens in the agricultural zones of human-inhabited islands test positive for a number of pathogens of concern, most notably *Mycoplasma gallisepticum* and Paramyxovirus 1. We have documented the establishment of the disease vector mosquito *Culex quinquefasciatus* and characterised the strains of avian poxvirus present in wild and domestic birds, showing that the virus strains in wild birds and chickens are distinctly different. We have produced baseline health studies for several seabird species, documenting the common occurrence of blood parasites not thought to normally occur in these species. We have discovered the first Plasmodium parasite ever described in a Galapagos bird and ongoing studies examine whether it occurs in species other than the penguins in which it was first described. We have also described a new microfilariid nematode that infects both the penguins and flightless cormorants in their overlapping ranges.



Biodiversity conservation projects



Juvenile Galapagos mockingbird showing skin lesions caused by the avian poxvirus. Mockingbirds and finches are particularly susceptible to this virus, which was introduced in the late 1800s (© Sharon Deem).

We study each of these within the context of the history and current movement patterns of the avian host on the islands. For example, the Galapagos hawk (*Buteo galapagoensis*) is a recent arrival, estimated to have colonised about 125,000 years ago, and today is highly sedentary on its eight-island breeding range. In contrast, the Galapagos penguin (*Spheniscus mendiculus*) is estimated to have colonised more than two million years ago, and individuals move broadly throughout the archipelago. These patterns, accumulated across bird species and pathogens, inform us of opportunities for pathogen movement throughout the archipelago and opportunities for parasites to move from one population and from one bird species to another.



Dr Hernan Vargas, a native of Galapagos, has conducted censuses of Galapagos penguins and cormorants for many years, and has been our close collaborator on health studies of these species. Here he weighs a Galapagos penguin as part of those studies (© Erika Travis).

We have described a range of pathogens and parasites in Galapagos endemic and introduced birds. Several are known to have caused major population declines or extinctions in wild bird populations elsewhere (e.g. *Plasmodium* sp., avian poxvirus, *Mycoplasma gallisepticum*, Paramyxovirus 1) and others are of unknown pathogenicity (e.g. the microfilarid nematode, trypanosomes, *Chlamydophila psittaci* and haemoproteus-like blood parasites). These pathogens fall into three general categories: (1) Those that appear to have colonised with their avian hosts and have long histories with those hosts (e.g. several ectopara-



The endangered Floreana mockingbird lives today only on the islets of Gardner and Champion off the island of Floreana, their former home and namesake (© Sharon Deem).

sites of hawks and seabirds); (2) those that have switched hosts from one native species to another since their colonisation of the islands (e.g. the microfilarid nematodes in both penguins and cormorants); and (3) those that are more recent arrivals since human colonisation and which have the largest impact (e.g. the avian poxvirus and *Plasmodium* sp. in the penguins). Of the last category, only the avian poxvirus is known to have current significant mortality impact on some particularly susceptible species. However, others that are present may cause more harm under more stressful conditions (e.g. El Niño events), and any that cause the immediate death of a host would be difficult to detect.

Disease surveys are essential for the prospective reintroduction of populations such as the critically endangered Floreana mockingbird (*Mimus trifasciatus*), which has not resided on the main island of Floreana for more than 100 years. We must understand what pathogens any translocated birds will encounter and attempt to anticipate which may present the greatest threats to their successful re-establishment. This will require not only listing which pathogens are present on Floreana (and currently absent in the source mockingbird population), but also developing a set of predictions for which may be the greatest threats based on general principles of disease ecology.

We are moving towards those general predictions in evolutionary ecological studies of the hosts and parasites themselves, as we better understand the relationships between population size and susceptibility, time in isolation and susceptibility, host shifts and community structure, and other features of the complex evolutionary dynamics between disease-causing organisms and their hosts, to predict which species should be most vulnerable under different circumstances. For example, hawk populations on small islands were genetically depauperate compared to those on larger islands, and this correlated with their level of ectoparasitism. Hawks in genetically diverse populations had stronger immune function and fewer parasites than those in populations that were genetically monomorphic with weaker immune function, illustrating one important mechanism by which small populations become increasingly susceptible to novel pathogens.

One general hypothesis that we are now testing predicts that the avian lineages that have been in isolation the longest (descendants of the earliest colonists) will be most susceptible to exposure to new pathogens, as their ancestors for many generations will have had little exposure to pathogens. This test requires knowing not only which pathogens reside on Galapagos, but a careful analysis of their relative impacts, and thorough phylogeographic studies of each avian lineage to estimate colonisation times with confidence.



Dr **Patricia G. Parker**, Ph. D., is the Des Lee professor of zoological studies at the University of Missouri – St. Louis. She is also a senior scientist at the WildCare Institute, Saint Louis Zoo. She has studied the behavioural ecology, evolutionary ecology, population genetics and disease ecology of wild bird populations for more than 30 years, and of Galapagos species for 20 years.



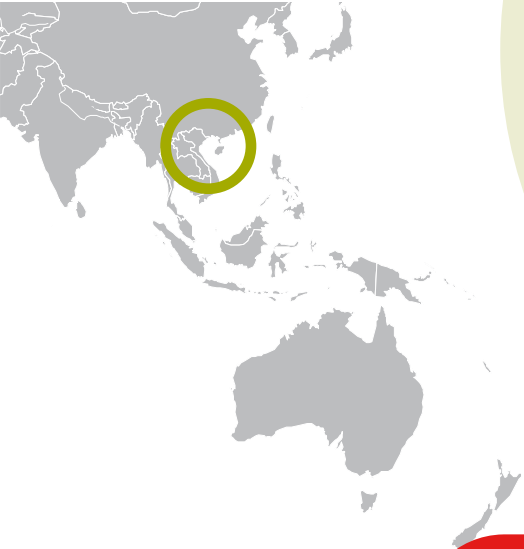
Dr **Sharon L. Deem**, DVM, Ph. D., DACZM, is the veterinary epidemiologist on the Galapagos Islands for the WildCare Institute, Saint Louis Zoo. She has studied wildlife diseases in captive and free-living animal populations globally, with an increasing emphasis on the impacts of anthropogenic change on the health status of wild populations. She has been based on Galapagos since September 2007.



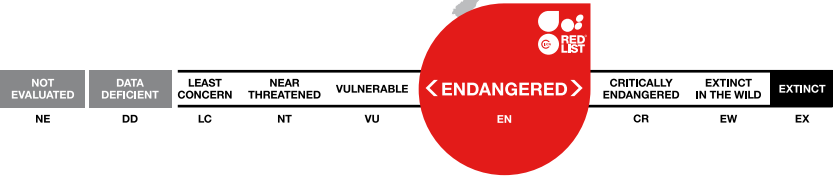
Dr **R. Eric Miller**, DVM, is senior vice-president for zoological operations at Saint Louis Zoo and is director of the zoo's WildCare Institute. He has been at the zoo for 28 years. He has studied diseases of black rhinoceroses and served as co-editor of the 4th to 7th editions of the textbook *Zoo and Wild Animal Medicine*.

Amphibian and reptilian diversity research, conservation and breeding projects in Vietnam

Species	Vietnamese mossy frog (<i>Theloderma bicolor</i>)
Range	Northern Vietnam
Population	Unknown
Threats	Habitat destruction



© Thomas Ziegler





Karst forest of Phong Nha – Ke Bang National Park in the Annamite Mountains, the so-called Truong Son Mountain Range (© Thomas Ziegler).

The Socialist Republic of Vietnam is the easternmost country on the Indochinese peninsula of South-East Asia, bordered by China, Laos, Cambodia and the South China Sea. Vietnam has a mainland area of 330,591 km² and its curved hourglass shape widens to flat deltas in the north and south, which are connected via a narrow central region. One-fourth of the country lies at moderate elevations below 20 m, primarily the two delta regions (Red River and Mekong deltas) and the coastal plains in Vietnam's central region. The topography of the remaining three-quarters is of hilly and mountainous nature, with Fan Si Pan in the north being the highest mountain (3,143 m). Vietnam also shows a substantial cultural diversity with more than 50 ethnic groups. With a population of over 86 million it belongs to the most populous countries in the world.

Due to war and political turmoil, the country's biodiversity was not or only scarcely studied for a long period, which is impressively shown by remarkable recent vertebrate discoveries. Especially Vietnam's remaining forest ecosystems harbour a very rich and in part endemic biodiversity, which is threatened among other factors by rapid habitat destruction, logging and animal trade. As one of the global hotspots of biodiversity – Vietnam is generally recognised as one of the 25 most biodiverse countries accounting for some 10% of global species – it is therefore essential to engage with diversity research and adequate conservation measures.

Since 1999 – the opening of Cologne Zoo's Asian tropical house "The Rainforest" – Cologne Zoo has engaged in an *in situ* conservation project in Vietnam. The project is managed together with our partners from the Vietnam National University in Hanoi, the People's Committee of Quang Binh



The recently described viperid snake species *Viridovipera truongsongensis* is only known from the Phong Nha – Ke Bang region (© Thomas Ziegler).

Rhacophorus orlovi is one of the numerous recently described new amphibian species that occur in Phong Nha – Ke Bang National Park (© Thomas Ziegler).

and Phong Nha – Ke Bang National Park to preserve a unique karst forest region in central Vietnam. Meanwhile, the national park was declared a world heritage site by UNESCO and recently was increased to about 120,000 ha. Together with our long-term partners and Cologne Zoo staff in Vietnam we concentrate on (1) forest protection (i.e. optimisation of ranger work), (2) supervising a rescue centre for confiscated animals, (3) running, together with Frankfurt Zoological Society, a reintroduction programme for endangered primate species, and (4) biodiversity research.

Biodiversity research is one of our most important project goals, because we can only protect what is well known to us. We mainly focus on the herpetofauna because amphibians and reptiles are relatively easy to study and serve as valuable bio-indicators. In the past decade, our team discovered 13 new amphibian and reptilian species from this geographically isolated area, and further new species still await scientific description. This does not only impressively exemplify how little is known even from “well-studied” regions, but also how many in part cryptic species have to be described from all over the tropics before we finally will be able to adequately protect them.



Biodiversity conservation projects



The recently discovered Cat Ba tiger gecko is endemic to Cat Ba Island (© Thomas Ziegler).

To investigate diversity is only the first step for long-term species protection. In a second step we must learn more about the species’ adaptations and their natural history, which will finally serve as a basis for proper conservation measures. To be as effective as possible in times of rapid global habitat loss and destruction, and because many species from Vietnam are still only poorly known, we thus increase our scope by student theses dealing with Vietnam’s biodiversity. As there is also a high demand for such studies from other national parks, we additionally have, together with our Vietnamese partners, built up a network beyond the borders of Phong Nha – Ke Bang.



The rare Vietnamese crocodile lizard; the species was previously only known from southern China (© Thomas Ziegler).

In total, our team described more than 20 new vertebrate species from all over the country, among them the beautiful Cat Ba tiger gecko (*Goniurosaurus catbaensis*), an endemic of the Biosphere Reserve Cat Ba Archipelago in the north-east of the country, or the Cat Tien bent-toed gecko (*Cyrtodactylus cattienensis*), which was only recently discovered from Cat Tien National Park in southern Vietnam, which houses Vietnam’s last Javan rhinoceroses (*Rhinoceros sondaicus annamiticus*). However, not only new species but also remarkable new records like the first country record of the highly endangered crocodile lizard (*Shinisaurus crocodilurus*) can be of tremendous help to preserve certain habitats or at best to promote the establishment of new protected areas. Thus, together with our Vietnamese partners, we will continue and even extend our herpetodiversity research and conservation approaches in Vietnam.



The Cat Tien bent-toed gecko is similar to the Phong Nha – Ke Bang bent-toed gecko and thus was only recently identified by our team as a previously overlooked ("cryptic") species (© Thomas Ziegler).

In the 2008 "Year of the Frog", a worldwide campaign pointed to the alarming global amphibian decline. Cologne Zoo does not only engage with numerous *ex situ* amphibian breeding projects, but also engages together with the Institute of Ecology and Biological Resources in developing and running a breeding station on the outskirts of Hanoi. The main focus of this breeding station, which was established by the institute in 2004, is to keep, breed and study Vietnamese amphibians in an *in situ* facility. Here, we have the possibility to study the natural history of endangered, rare or poorly known species in captivity.

In the past decade, about 40 new amphibian species have been described from Vietnam. However, the ecology of most of these species is virtually unknown. But knowledge about habitat requirements, especially of the mostly unknown

larval stages, is of high importance for respective conservation measures. Beyond documenting larval stages and reproductive biology of selected amphibian species, we can also learn more about breeding in captivity. This is a prerequisite for maintaining a captive insurance population especially in times of worldwide emerging, hazardous chytridiomycosis (a fungal disease), and to be prepared for subsequent release of offspring into the wild, if required. Further, by providing a surplus of offspring of certain species for the trade, the number of wild-caught specimens decrease and long-term maintenance and self-financing of the breeding station is guaranteed. Since July 2007, eight amphibian species were successfully bred in the station. Also initial reptilian breeding successes, for example the first breeding of the crocodile lizard, confirm the current husbandry concept of the breeding station.



Juvenile *Rhacophorus dennysi* at the breeding station of the Institute of Ecology and Biological Resources in Hanoi (© Thomas Ziegler).

Main sponsors of the conservation project are Alexander Koenig Gesellschaft, Alexander Koenig Stiftung, BIOPAT, Deutsche Gesellschaft für Herpetologie und Terrarienkunde, European Union of Aquarium Curators, GEO schützt den Regenwald (forest protection programme), Kölner Kulturstiftung der Kreissparkasse Köln, World Association of Zoos and Aquariums and Zoological Society for the Conservation of Species and Populations. Partner institutions are Vietnam National University, Frankfurt Zoological Society (endangered primate reintroduction programme), Institute of Ecology and Biological Resources, Vietnamese Academy of Science and Technology, Muséum d'Histoire Naturelle Genève, Zoologisches Forschungsmuseum Alexander Koenig Bonn and Technical University of Braunschweig.



Dr **Thomas Ziegler** commenced with biodiversity research in Vietnam in the framework of his Ph. D. study in 1997. Since 2003 he has been curator of the aquarium and terrarium section at Cologne Zoo and is coordinator of the zoo's biodiversity and nature conservation projects in Vietnam. Since 1994 he has published more than 190 scientific articles and books, of which about 70 deal with Vietnam's biodiversity. Since February 2009 he has been associate professor at the Zoological Institute of the University of Cologne.

Chris Walzer
University of
Veterinary Medicine
Vienna | International
Takhi Group

Petra Kaczensky
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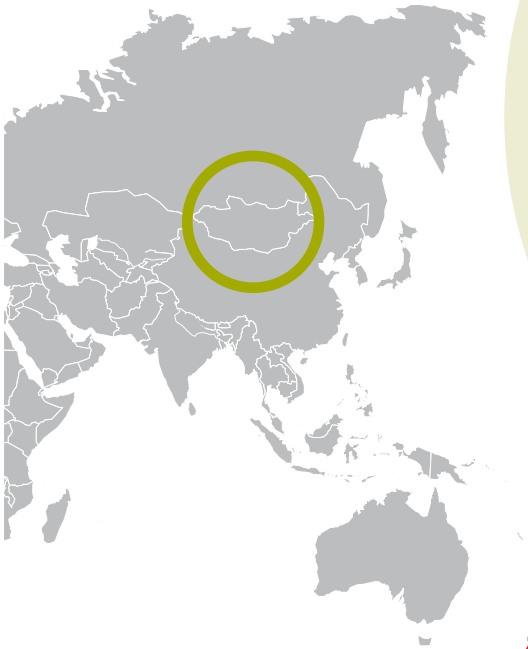
**Oyunsaikhan
Ganbataar**
Great Gobi B Strictly
Protected Area
Administration

**Namtar
Enkhsaikhan**
International
Takhi Group

**Christian
Stauffer**
Zurich Wilderness Park
Foundation | Interna-
tional Takhi Group

Coming home: the return of the Przewalski’s horse to the Mongolian Gobi

Species	Przewalski’s horse (<i>Equus ferus przewalskii</i>)
Range	Mongolia
Population	300
Threats	Habitat destruction, hybridisation, competition, disease



NOT EVALUATED	DATA DEFICIENT	LEAST CONCERN	NEAR THREATENED	VULNERABLE	ENDANGERED	CRITICALLY ENDANGERED	EXTINCT IN THE WILD	EXTINCT
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© Chris Walzer/ITG



A Przewalski's horse mare and her newborn foal crossing the plains (© Chris Walzer/ITG).

The Przewalski's horse (*Equus ferus przewalskii*), "takhi" in Mongolian, became extinct in the wild during the 1960s. The very last recorded sightings of the Przewalski's horse in the wild occurred in the Dzungarian Gobi of south-western Mongolia. The takhi only survived thanks to captive breeding based on 13 founder animals. The reasons for the extinction of Przewalski's horse are seen in the combined effects of pasture competition with livestock and overhunting. Subsequent to the establishment of the Przewalski's horse studbook at Prague Zoo and the initiation of a European Endangered Species Programme under the auspices of Cologne Zoo, the captive population grew to over 1,000 individuals by the mid-1980s. This fact was an important prerequisite to initiating a reintroduction programme.

With Mongolian independence in 1990, the "Takhiin Tal" project was initiated with the support of various international sponsors. By the late 1990s project leadership and management was overhauled with research and scientific data firmly integrated into the decision-making process. In 1999, the International Takhi Group (ITG) was established as a non-governmental organisation to continue and extend this project in accordance with the IUCN reintroduction guidelines. The vision of ITG is the integral protection of the Gobi habitat and to conserve the Great Gobi B Strictly Protected Area (SPA) as a biosphere reserve in the sense of the IUCN.



Release of Przewalski's horses in Takhi Us after translocation from the Takhiin Tal area (© Chris Walzer/ITG).



Unloading a crate with a newly arrived Przewalski's horse at Takhiin Tal (© Chris Walzer/ITG).

The 9,000 km² Great Gobi B SPA was chosen as the reintroduction site. This SPA was established in 1975 and encompasses some 9,000 km² of desert steppes and semi-deserts. Plains in the east and rolling hills to the west dominate the landscape, with the mighty Altai Mountains flanking the park in the north. The Takhiin Shar Naruu mountain range in the south forms the international border with China. Elevations range from 1,000 to 2,840 m. The climate is continental with long cold winters and short hot summers. Average annual temperature is a frigid 1 °C and average annual rainfall a mere 96 mm. Snow cover lasts an average of 97 days. Defining factor for this landscape is that rain and snowfall are highly variable in space and time. Open water (rivers and springs) is unevenly distributed with almost no water in the central and western part of the SPA.

In 1992 the first group of captive-born takhi were selected from various zoos and then airlifted to Takhiin Tal at the edge of the Great Gobi B SPA. The logistics were a nightmare at the time and the journey for the horses was long and exhausting. Five years later a harem group was released into the wild from the adaptation enclosures, and in 1999 the first foals were successfully raised in the wild. In the following years several further airlifts occurred and a total of 88 horses from various European zoos were brought to the Gobi. Today some 150 takhi roam over 3,000 km² in the SPA. Although it would be short-sighted to judge the project a success, the positive trend in the free-ranging Przewalski's horse population is encouraging. Initially largely confined to the north-eastern corner of the SPA, range use of the reintroduced horse population increased gradually. In 2005 one harem group was successfully translocated to the Takhiin Us water point about 120 km west of the original release site to speed up the expansion of the distribution range within the area.



Two young Przewalski's horse bachelors testing each other's strength (© Petra Kaczensky/ITG).

Public and media interest focused heavily on the international transports from Europe to Mongolia. However, the establishment of a permanent field station with the necessary infrastructure (solar power, laboratory, office, vehicles and petrol) and communication abilities (VHF communication, satellite-based e-mail and telephone) proved equally important. In 2004 the Takhiin Tal camp hosted the second international workshop on the reintroduction of the Przewalski's horse. In 2005 facilities at the Takhiin Tal camp were further upgraded with the construction of the SPA headquarters funded by the Austrian Ministry of the Environment and ITG. Facilities now allow year-round living and research. The camp provides training possibilities for young Mongolian and international scientists, has created local employment options and is run by well-trained and motivated local staff.

For this reintroduction programme to be successful in the long run it is necessarily embedded in a broader context of ecosystem conservation. Over the years the project greatly expanded on various fronts. Early scientific input was focused on the Przewalski's horse and concentrated on determining causes of death and low reproductive rates. The elucidation of the effects of an endemic parasite disease (piroplasmiasis) on the population and subsequent management changes led to remediation of this deadly problem. Horses were fitted with satellite-tracking collars in order to determine their position, home range and habitat preferences. Ten individual Przewalski's horses were monitored with such positioning devices. Home range sizes based on telemetry showed that individual horse groups cover non-exclusive areas of 152 to 826 km². Simultaneously, the Asiatic (Mongolian) wild ass (*Equus hemionus*) and the grey wolf (*Canis lupus*) have been studied with these methods in the shared habitat. Satellite-based technologies provide the backbone for all habitat-related project issues. At the onset data collection was restricted to the eastern part of the SPA but today the spatial scale encompasses the entire Gobi region in Mongolia and northern Xingjian in China.



Two young Przewalski's horse mares keeping an eye on the researcher (© Chris Walzer/ITG).

Research has also focused on socio-economic aspects of local herders, their impact on the SPA and its surroundings, and their attitude towards wildlife and management issues. In 2005 training workshops on the construction and application of fuel-efficient stoves was conducted in order to reduce the pressure for illegal saxaul and juniper collection. In 2006 a concept for environmental education for children in Takhiin Tal was developed, yet still needs to be implemented. In 2007, with support from the Italian region of Lombardia and under the lead of the Instituto Oikos, a trans-boundary project in collaboration with the Xinjiang Institute of Ecology and Geography of the Chinese Academy of Sciences was initiated. This project aims to support rural communities of nomadic pastoralists living in the trans-boundary area of the Dzungarian Gobi in China and Mongolia and investigates the possibilities of expanding the ranges of the Przewalski's horses and the Asiatic wild ass across the international border. Local livelihoods will be improved through the strengthening of international collaboration on sustainable development issues and the integration of an environmental component in the respective development processes. The project currently seeks additional funds to further strengthen local involvement and community development in the project area.

Mongolia, often called the "land without fences", provides the last remaining refuge for a number of migratory species that require large areas of habitat. This region also supports a growing human population, including a large number of livestock herders, who maintain a fragile grip on survival after enduring the political and economic upheaval wrought by the collapse of the socialist command economy. With Mongolia's transition to a privatised market economy, more people and exploitative economic activities – notably mining and road construction – could further impact environmental security and habitat needs of the wildlife in the Gobi region.

Starting out initially as a single-species reintroduction project, the magnitude of the conservation activities has greatly expanded in recent years. Seen from a species perspective, integrated research projects dealing with the Asiatic wild ass, grey wolf, wild Bactrian camel (*Camelus ferus bactrianus*), various rodent species and the vegetation have been implemented. Whereas the initial reintroduction efforts were driven mostly by health concerns for the horses, the disciplinary scope has significantly broadened with zoologists, biologists, botanists and remote sensing experts performing habitat mapping and assessment, and with community development experts establishing a socio-economic framework for future project development. Away from the field an important aspect for project advancement has proven to be lobbying activities both in Ulaanbaatar and among the international community. Lobbying activities not only enhance information flow and political support for the project, but also create collaborative opportunities and necessary alliances.

Comprehensive interdisciplinary monitoring and research are the foundation for management decisions at the present, but a sustainable financial base, training, capacity building and empowerment of local scientists and residents constitute the future of this programme.



Biodiversity conservation projects



A Przewalski's horse stallion waiting out a snowstorm
(© Chris Walzer/ITG).



Dr **Chris Walzer** was educated at the University of Economics and the University of Veterinary Medicine, Vienna. He received his veterinary degree in 1989, became DVM in 1993 and obtained his habilitation in 2003. He has been university professor (chair of conservation medicine) and co-director of the Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna since 2005. He has been a board member and director of science in the International Takhi Group since 1999. He has internationally recognised expertise working with wildlife, especially wild equids and carnivores, gained from combined years of work and study in Europe, Asia and Africa.



Dr **Petra Kaczensky** studied biology at the universities of Regensburg, Colorado and Munich. She graduated in 1991 and received her Ph. D. degree in 2000. She is a senior researcher at the Research Institute of Wildlife Ecology, University of Veterinary Medicine Vienna. She has internationally recognised expertise working with wildlife, especially wild equids and carnivores, gained from combined years of work and study in Mongolia, Europe and North America.



Oyunsaikhan Ganbataar studied biology at the National University of Mongolia and graduated in 2003. He is director of the Great Gobi B Strictly Protected Area and a Ph. D. candidate at the National University of Mongolia. He has internationally recognised expertise working with Przewalski's horses and in protected area management in Mongolia.



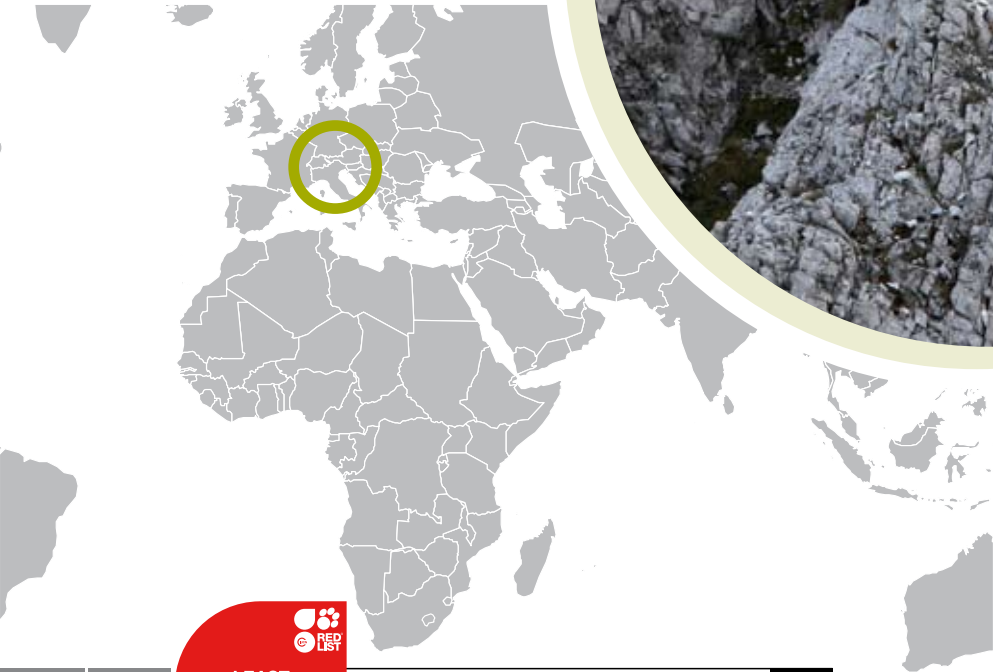
Namtar Enkhsaikhan received his B. Sc. degree in biology from the National University of Mongolia in 1999 and his M. Sc. degree in sustainable resource management from the Technical University of Munich in 2006. He has worked as office manager for the International Takhi Group since 2006.



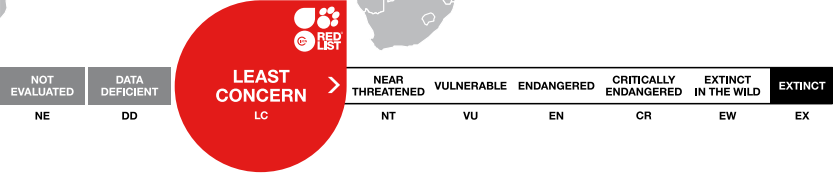
Christian Stauffer studied zoology at the University of Zurich and received an MBA degree for non-profit organisations from the University of Fribourg. He is director of the Zurich Wilderness Park Foundation, which runs Langenberg Animal Park and a small nature reserve. He acts as secretary of the International Takhi Group.

The return of the Alpine ibex in Tyrol: the role of Innsbruck Zoo

Species	Alpine ibex (<i>Capra ibex</i>)
Range	Alpine arch
Population	40,000
Threats	Inbreeding, hybridisation, competition, disease



© Innsbruck Zoo





Release of Alpine ibex in Austria (© Innsbruck Zoo).

It took humankind about 400 years, mainly between the 16th and 19th century, to nearly extinguish the previously widespread Alpine ibex (*Capra ibex*). The main cause of this near-extinction was intensive hunting, which had been justified in many different ways. There was great demand not only for the meat but for nearly all body parts, especially horns, bones and bezoars. Ibex blood played an important role in traditional folk medicine and the animal was considered a walking pharmacy. Increasingly sophisticated firearms enabled larger parts of the non-aristocratic population to hunt the sought-after game. Regulations protecting the disappearing ibex stocks were issued too late and, as the rare ibex went up in value, the few remaining stocks became more and more coveted by poachers.

At the beginning of the 19th century only one small colony of about 50 to 100 ibexes had survived in Italy's Gran Paradiso National Park, protected by royal decree from King Viktor Emmanuel II and by 150 rangers. The stock at Gran Paradiso subsequently increased rapidly (2,000 individuals in 1878). In 1906 paid poachers succeeded for the first time in smuggling three newborn fawns into the private Peter and Paul Animal Park in Switzerland. They were bottle-fed with goat's milk. Further "illegal immigrants" followed, and by 1915, the ibex stock at Peter and Paul Animal Park had increased to 105 individuals, many of which were born and parent-reared there and at another Swiss site, the Harder Animal Park. This first group formed the foundation for all following breeding and reintroduction projects. In 1911 the first ibexes were released into the Swiss Alps, which makes it one of the longest running reintroduction projects worldwide.



Ear-marked Alpine ibex after release in Austria
(© Innsbruck Zoo).



Distance immobilisation of Alpine ibex, darted animal and veterinary check at Innsbruck Zoo (© Innsbruck Zoo).

In Austria, the initial releases started in the 1950s. In 1952 a first attempt in Tyrol failed, but in 1953 a further try in the Pitztal succeeded, and this colony still exists. For these first releases ibexes were taken both from the wild and captivity in Switzerland. The total *in situ* Alpine ibex stock steadily increased and consolidated. Today's total population is estimated at 40,000 individuals. About 5,000 ibexes are living in Austria, nearly 3,000 of them in Tyrol. These 3,000 ibexes are partitioned in 37 herds, some of which interact with others in their neighbourhood.

Not only breeding and reintroduction, but also monitoring and ongoing protection of this imposing species yielded positive results. An interesting aspect of this conservation success story is that there was no centralised programme management. The various large endeavours and different projects worked on many different levels with many different institutions over the whole distribution range.

Only few animals were observed using radio-telemetry and GPS transmitters, for example in Styria (Austria) and the Julian Prealps (Italy). The greater part of the ibex monitoring was carried out with precisely planned and coordinated game counts, which involved a great number of staff and led to highly accurate results. Contractors were to be found amongst national parks, universities, corps of foresters and hunting associations of all the Alpine countries Germany, France, Italy, Liechtenstein, Austria, Switzerland and Slovenia.

The role of the zoos in this programme has been to preserve and breed this species threatened with extinction. The vast experience accrued from keeping ibexes, knowledge of their biology, immobilisation and logistics resulted in know-how that is of great advantage when releasing ibexes back into the wild.

Between 1987 and 2009, Innsbruck Zoo set free 233 individuals (108 males and 109 females plus 16 unsexed animals) mainly in Tyrol, but also in the so-called Dreiländereck (Lower Austria-Salzburg-Styria). About 95% were aged between one and three, one-third originated from the ibex stock at Innsbruck Zoo, the rest came from different zoological institutions, including Peter und Paul Animal Park and zoos in Salzburg, Herberstein, Berne, Goldau, Zurich-Langenberg, Augsburg, Berlin-Friedrichsfelde, Kronberg, Münster, Nuremberg, Munich, Stuttgart, Amsterdam and Chomutov.



Release of Alpine ibex in Austria (© Innsbruck Zoo).

The young ibexes were always set free between May and July in groups varying from two to 13 individuals. As their habitat is free of snow at that time of the year, the ibexes have the whole vegetation period to become acclimatised to the release area. Innsbruck Zoo does not create new colonies in Tyrol, but aims at stabilising existing colonies that were decimated by stochastic climatic events, such as snowy winters with many avalanche-caused deaths. By request of the foresters and keepers, the ibexes are identified using earmarks and/or micro-transponders. All animals coming from zoological institutions are under veterinary observation and checked for diseases before release. The number of ibexes that died within the first year after their release was eight, amounting to only 3% of the released animals.

The release of animals into a new habitat cannot be compared with natural immigration. Animals need to settle and orient themselves first, which may be stressful. Additionally, the drastic change in food may affect the physiology and constitution of the animals. In the best case, successful adaptation will only take a few days, whereas in all cases of recorded death, noticeable physical deterioration was observed. Factors negatively affecting a release include continuous precipitation for one or two weeks and social disruption in the group. Individuals that split from the group to explore the new habitat on their own sometimes



Dirk Ullrich studied biology at the Johannes Gutenberg University in Mainz. He did seven traineeships in six different German and Austrian zoos between 1993 and 1995. He has been curator of mammals and birds at Innsbruck Zoo since 1996.

seek their herd in bad weather conditions, which may cause severe stress and lead to exhaustion. This explains the death of the eight animals. However, when considering all release events, the positive results are by far in the majority.

After sufficient time during summer to get accustomed to their new habitat, the animals are usually accepted by the resident groups and colonies. Also, we often hear reports about captive-born ibexes reproducing in the years following their release. The quality and quantity of feedback that reaches Innsbruck Zoo varies from one area to another. Apart from geophysical and biological stress factors, the development of the ibex colonies is also influenced by growing tourism exploitation in the mountains and by hunting. In all Alpine countries ibexes can be legally hunted. In Tyrol, however, they are protected up to old age by strict regulation enforced by the hunting authorities.

Bernhard Forster
Frankfurt
Zoological Society

Martina Vogt
Cologne Zoo
Conservation Project

Thomas Ziegler
Cologne Zoo

Daniela Schrudde
Cat Ba Langur
Conservation Project

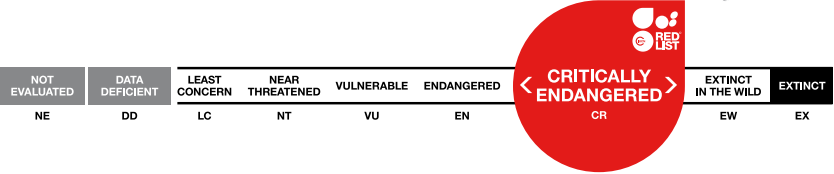
Martina Raffel
Münster Zoo

Langurs in Vietnam: rescued at the very last minute?

Species	Cat Ba langur (<i>Trachypithecus poliocephalus poliocephalus</i>)
Range	Cat Ba Island
Population	70
Threats	Poaching, habitat destruction, disturbance, inbreeding



© Jörg Adler



Vietnam is situated within the Indo-Burma biodiversity hotspot, one of the most threatened on Earth. Despite the establishment of several national parks and nature reserves decades ago, nature and wildlife protection continues to be largely deficient due to a lack of financial resources and management capacity. Thus, currently only about 5% of the natural habitats remain in relatively pristine condition. These regions are housing several endemic species, among them the rarest of all primates. Many of the Asian langurs are now severely threatened, reasons for this being mainly hunting and habitat loss.

According to the IUCN/SSC Primate Specialist Group, 11 of the 25 most endangered primate species in the world are from Asia. Vietnam is heading the current country list together with Madagascar with four species each. Efforts to effectively conserve langurs and their habitat face major obstacles due to the need to better address the local community's aspirations for economic development, and due to the steadily increasing human population, besides persistent and severe deficiencies in law enforcement. As elsewhere in the region, poaching is driven by increasingly attractive commercial gains in satisfying the immense local and regional demand for wildlife and animal parts, while conservation awareness among, partnership with and commitment by the local communities are only slowly increasing.

Here, we present two approaches to langur conservation in Vietnam, reintroductions in central Vietnam (by Bernhard Forster, Martina Vogt and Thomas Ziegler) and protection on Cat Ba Island (by Daniela Schrudde and Martina Raffel).



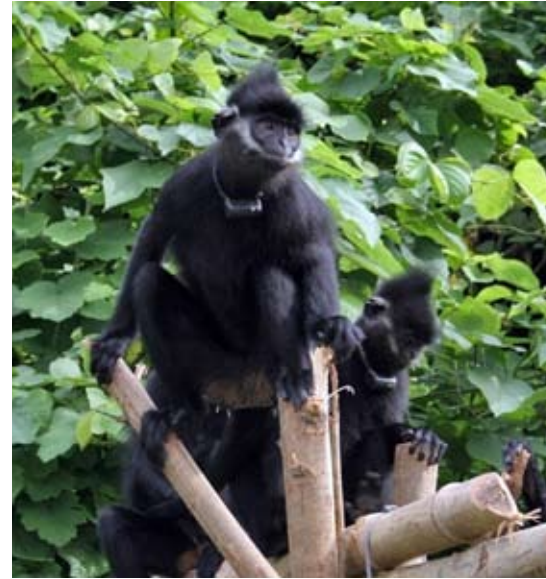
The extensive karst forest of Phong Nha – Ke Bang National Park (© Bernhard Forster).

Langur reintroduction in central Vietnam

In 2005, Frankfurt Zoological Society, as part of their Vietnam primate conservation programme, in cooperation with Cologne Zoo initiated a primate reintroduction programme in Phong Nha – Ke Bang (PNKB) National Park in central Vietnam. The overall goal of this long-term project is the protection of two endangered primate species, the Hatinh langur (*Trachypithecus hatinhensis*) and red-shanked Douc langur (*Pygathrix nemaeus*). Hatinh langurs and red-shanked Douc langurs occur in the karst forests of the Annamite Mountains in central Vietnam and Laos. Mainly threatened by poaching, their natural populations suffered severe declines and fragmentation over the past decades. PNKB National Park, located along the border to Laos in Quang Binh Province, comprises 125,000 ha and is an important site for the conservation of Indochina's rich and unique biodiversity. Declared a world heritage site by UNESCO in 2003, it also represents one of the last remaining sites of retreat for both Hatinh and red-shanked Douc langurs.



With the primate reintroduction programme we strive to enforce and link currently isolated populations of both langur species. The animals for reintroduction come from the Endangered Primate Rescue Centre (EPRC) in Cuc Phuong, northern Vietnam. Founded in 1993, the centre today is the operational basis for Frankfurt Zoological Society's Vietnam primate conservation programme. Since its establishment, EPRC has received among others numerous confiscated Hatinh and red-shanked Douc langurs. The animals were successfully composed into a number of breeding groups, and both species have bred to the second generation.



Hatinh langur (© Bernhard Forster).

Red-shanked Douc langur (© Bernhard Forster).

The reintroduction programme encompasses two main steps. First of all, small groups of both langur species are transferred to a selected site in PNKB, where they are maintained, protected and observed under semi-wild conditions for an appropriate period of time. After a sufficient preparation phase, the animals will be released into specified areas of the national park.

Hence the initial step of the programme was to establish a semi-wild enclosure in PNKB. A single forested limestone hill of 20 ha in size at the border of the national park was selected as an appropriate site and local workers were hired to set up an electrical fence, bridges, a cage inside the enclosure as well as a field station nearby. The first langur transfer from EPRC to PNKB took place in early September 2007. Two groups of Hatinh langurs, comprising four individuals each, were released into the semi-wild enclosure.



Education day at the primary school in Phong Nha (© Martina Vogt).

With regard to the final release, forest protection is another important component of the project. From the beginning we have closely cooperated with and supported the forest protection unit and the ranger stations of the national park, in order to prepare them for the protection of the planned release sites. As a successful reintroduction programme also requires information on the remaining wild primate populations in PNKB, primate surveys are carried out. The collected data help us not only to assess the current population size and distribution of both langur species in PNKB, but also to estimate the degree of the sub-populations' fragmentation and therefore to identify potential release sites. Last but not least, education and awareness programmes are implemented as well.

The primate reintroduction programme is a long-term project and its various approaches have to be continued. The first langur group is prepared for final release and a special forest protection league will be trained and assigned for the protection of the reintroduction areas. At the same time, further animals will be transferred to the semi-wild enclosure. The surveys in the national park will go on, and awareness and education projects for locals, tourists and surrounding areas will be extended.



Cat Ba Archipelago is of outstanding beauty besides its global value for biodiversity conservation (© Roswitha Stenke).

Cat Ba langur conservation

Cat Ba Island is the heart of the UNESCO Biosphere Reserve Cat Ba Archipelago in northern Vietnam, designated in 2004. This is the largest (140 km²) of the 366 islands in the archipelago and is located 50 km east of Hai Phong City. It is made of steep karst and the surface is mainly covered by primary and secondary limestone forest or shrub vegetation. Cat Ba National Park was established in 1986 and was Vietnam's first national park to include both terrestrial and marine ecosystems. In 2006 its boundaries were expanded. Since then it covers more than 50% of Cat Ba Island.

The most remarkable endemic species is the Cat Ba langur or golden-headed langur (*Trachypithecus poliocephalus poliocephalus*). Due to its restricted range and small population size, it has been listed on the IUCN Red List of Threatened Species and the Vietnam red data book as "critically endangered" and as one of the world's 25 most endangered primates since the first publication of the list in 2000.



Cat Ba langurs moving in the steep karst landscape
(© Jörg Adler).



Project managers Daniela Schrudde and Pieter Levelink
with a forest protection group (© Dai Kurokawa).

According to reports of indigenous people, the entire island and some smaller offshore islands were previously densely populated by langurs. Hunting – as a kind of leisure-time activity – has been the sole cause for the dramatic and rapid population decline from an estimated 2,400 to 2,700 in the 1960s to a maximum of 135 individuals estimated after a three-month survey in 1999. Alarmed by these dramatic results, Münster Zoo and the Zoological Society for the Conservation of Species and Populations started the Cat Ba Langur Conservation Project (CBLCP) in November 2000. In July 2008 the former project manager Dr Roswitha Stenke, who established the project and achieved major milestones, resigned and was replaced by Daniela Schrudde. At the beginning of 2009, an additional position for a deputy manager was established and filled with the Dutch wildlife manager Pieter Levelink. In addition, two to three Vietnamese project assistants have been employed by the CBLCP.

First surveys led by Roswitha Stenke in 2001 found evidence for merely 53 langurs left on Cat Ba Island. Because of the enormous hunting pressure in the past, the population has also become severely fragmented into small sub-populations. Another serious threat is the fragmentation of the habitat. The human population and the number of tourists visiting Cat Ba Island are increasing rapidly and continuously. Besides

the negative impact upon the habitat through unsustainable use of resources and environment pollution, the langur groups are trapped between new roads, settlements and agricultural areas.

The establishment of a strictly protected area, support of national park staff and community involvement have culminated in bringing hunting of langurs to a halt. Currently 60 to 70 individuals are left in the wild, divided into 11 groups in seven separate areas on Cat Ba Island. All reproductive social units are located in the south of the island; no reproductive social units remain in the north, and at least two groups contain only females. Thus, a translocation plan was designed as part of the long-term strategy.

All these measures have resulted in the Cat Ba langur being considered as a flagship species on Cat Ba Island, which therefore influences governmental decisions and guarantees greater conservation efforts and raised awareness on all levels. Nevertheless, more education and strengthened implementation of conservation measures must take place. Only if Cat Ba's residents can be persuaded to realise that the langur and Cat Ba's exceptional nature are unique and something to take pride in and make sustainable use of, does the enormous biodiversity in this area have a chance to persist.



Bernhard Forster is actually a software engineer, but has always been fascinated by nature and wild animals. In 1998 he accompanied his wife Martina Vogt to Bali to support her with her Ph. D. study on the behavioural ecology of span-gled ebony langurs. Spending two years in West Bali National Park, in the close vicinity of these fascinating primates, aroused his special interest in langurs. Since November 2004 he has been project manager of the primate reintroduction programme in Phong Nha – Ke Bang National Park, which is part of the Vietnam primate conservation programme of the Frankfurt Zoological Society.



Dr **Martina Vogt** studied zoology with special emphasis on primatology and eco-ethology. Passionate about field research on wild animals, her strongest interest always has been to combine this work with nature conservation. For her Ph. D. study, she and her husband Bernhard Forster went to Indonesia for two years to study the behavioural ecology of free-ranging ebony langurs in West Bali National Park. Later on she worked for several months in the Siberut conservation project of the German Primate Centre on Siberut Island, Indonesia. In November 2004 she became project manager of the Phong Nha – Ke Bang conservation project of Cologne Zoo in central Vietnam.



Dr **Thomas Ziegler** commenced with biodiversity research in Vietnam in the framework of his Ph. D. study in 1997. Since 2003 he has been curator of the aquarium and terrarium section at Cologne Zoo and is coordinator of the zoo's biodiversity and nature conservation projects in Vietnam. Since 1994 he has published more than 190 scientific articles and books, of which about 70 deal with Vietnam's biodiversity. Since February 2009 he has been associate professor at the Zoological Institute of the University of Cologne.



Dr **Daniela Schrudde** is a veterinarian who studied at the Free University of Berlin after completion of her apprenticeship as a nurse, various internships in zoos, national parks and wildlife conservation projects. Since May 2008 she has been project manager of the Cat Ba langur conservation project contracted to Münster Zoo.



Dr **Martina Raffel** is a biologist who studied and received her Ph. D. degree in behavioural ecology at the University of Bielefeld. She has been curator for *in situ* conservation at Münster Zoo since November 2000. She is responsible for the various conservation projects of the zoo and is keeper of the international studbook for the Persian leopard.

Ingrid Porton
Saint Louis Zoo |
Madagascar Fauna Group

Karen Freeman
Madagascar Fauna Group

The Madagascar Fauna Group: zoos working together do make a difference

Species	Diademed sifaka (<i>Propithecus diadema</i>)
Range	Eastern Madagascar
Population	6,000
Threats	Habitat destruction, poaching



© MFG



Betampona, one of Madagascar's last vestiges of intact lowland rainforest (© MFG).

Madagascar, the fourth largest island in the world, is a biodiversity hotspot due to the island's levels of endemism and a conservation hotspot due to the number of plant and animal taxa threatened with extinction. Although rich in biodiversity, Madagascar has been historically recognised as among the world's poorest and least developed countries. The conservation challenge is how to increase the Malagasy people's standard of living while decreasing environmental degradation and loss of biodiversity.

The Madagascar Fauna Group (MFG) was born from the vision that zoos were perfectly placed to link *ex situ* with *in situ* initiatives for the broad goal of conserving Madagascar's biodiversity. Twenty-one years ago the founding members understood that uniting zoos under one umbrella and one unified voice would significantly increase the contribution any one institution could make on its own. MFG's approach has always been collaborative and our conservation action plan is centred on the environmental objectives identified and prioritised by the Malagasy government. Our strength is derived from institutions' consistent and reliable payment of membership dues, which has enabled the creation of a sustainable, long-term conservation programme that is managed by on-site staff. The financial foundation afforded by members is critical to maintaining the infrastructure that has established MFG as an integrated and participating member of the community we serve.



Saturday-school students learning about their natural heritage; here, the tomato frog (© MFG).



Saturday-school students going batty! Learning about bats' role in pollination the fun way (© MFG).

When MFG first began working in Madagascar we were invited by the governing authorities to assist with the renovation of Parc Zoologique Ivoloïna, located outside the east-coast port city of Toamasina. This region encompasses the largest share of Madagascar's rainforest habitats and therefore its biodiversity. As our partnership with community officials and leaders strengthened and our attention expanded to Betampona Natural Reserve, MFG established its headquarters in and focused on the conservation issues affecting this region. Subsequent years of experience and immersion in the community have underscored our belief that effective conservation requires identifying and addressing divergent stakeholders' interests who are either impacted by or can influence the outcome of a conservation programme. Accordingly, MFG has evolved a holistic, multidisciplinary and integrated approach that we have broadly classified as the four pillars essential to advancing our conservation vision: education, research, capacity building and conservation action. Below are examples of MFG's achievements.

Environmental literacy can only be achieved when a community's citizens have the opportunity to attend good schools and obtain a basic education. Because the majority of MFG's employees are local residents, they are familiar with and attuned to shortcomings in their district's education system. Through meetings with local parents and teachers, the staff learned that too many children failed the national exam required to graduate from primary to secondary school and identified supplementary lessons in core curricula subjects as a critical need. The Saturday-school programme was initiated in 1996 by MFG's first programme managers, Andrea Katz and Charlie Welch, as a direct outcome of this community discourse. At first the programme was limited to village children surrounding Ivoloïna; however, as word of the Saturday school's record of increasing exam pass rates from under 15% to over 70% spread, villagers living along the borders of Betampona requested similar programmes for their children. Two additional Saturday classes have been established with even more planned.



Grass-roots conservation: learning to compost with Dr Christof den Biggelaar (© MFG).

Madagascar's rainforest ecosystems have shrunk to about 10% of their original extent, with remaining patches of natural vegetation increasingly reduced to isolated habitat islands in a matrix of agricultural land. Although farmers realise that their slash-and-burn practices expose fragile soils to erosion and productivity losses, they often feel powerless to redress the situation in their struggle for survival. Understanding that ecological degradation resulting from agriculture cannot be stopped solely by conservation measures, MFG developed a partnership with Dr Christof den Biggelaar, Appalachian State University, who specialises in tropical agro-forestry practices. Initially funded through a grant from the Association of Zoos and Aquariums' Conservation Endowment Fund, Christof has been working in close collaboration with the University of Toamasina, local agriculture organisations and farmers to examine how more intensive agricultural systems could be adopted in this region.

His approach was to first understand the natural resource management systems practised in the region since it represents the collective knowledge acquired by the local people over generations. Rather than simply retrofitting agro-forestry curricula or technologies developed in other countries, he applied what he and the MFG team learned to initiate experiments testing whether modifications of key components could increase current productivity without undermining production potential. At the same time, he advanced MFG's capacity-building efforts through formal (university level) and non-formal education (training of farmers, etc.) initiatives in both research and the application of ecological agriculture approaches and methods. Major accomplishments have already been achieved



One of MFG's locally established nurseries providing native and crop trees to villagers (© MFG).

including development of a curriculum for a new Master's programme in natural resource management at the University of Toamasina and the signing of a Memorandum of Understanding further solidifying the partnership between Appalachian State University and University of Toamasina. He has tallied over 500 hours of "training-the-trainers" by providing the MFG team with hands-on instruction in eco-agriculture techniques and methods. Together they have held 19 workshops and directly assisted scores of local farmers.



The team works! MFG working with local schools to promote reforestation (© MFG).

MFG's approach to conservation often incorporates a research component to aid in defining or elucidating conservation problems and/or evaluating conservation action. MFG expanded its early conservation/research focus from the 1997 black-and-white ruffed lemur (*Varecia variegata*) restocking project in Betampona to a more holistic one that addresses core questions vital in targeting management practices to protect the high level of biodiversity found within the reserve's 2,228 ha of lowland rainforest.

Because it is difficult to conserve what you do not know exists, MFG initially carried out simple floral and faunal inventories that have been improved over the years to produce more systematic, reliable and comparable data. In collaboration with invited experts, MFG has identified new species of snails, moths, ants, trees and an estimated 20 to 30 amphibians. Based on inventory results, we are now targeting our efforts to map distributions and study the microhabitat requirements of the reserve's rarest species. Research director Karen Freeman initiated studies to identify and evaluate what anthropogenic factors may be contributing to a loss of Betampona's biodiversity. One such project conducted by a Malagasy graduate student evaluated the effect of two invasive plants, strawberry guava (*Psidium cattleianum*) and wild ginger (*Aframomum angustifolium*) on the reserve's native flora. The study identified that, alongside deforestation for illegal slash-and-burn agriculture, invasive plants pose one of the most immediate and pervasive threats to Betampona.

This finding led to another graduate student’s controlled experiment assessing the efficacy and biological impact of weeding as a control method. Other options will be evaluated by a staff member’s Ph. D. research topic and information provided to Betampona’s governing authorities to help inform and guide future invasive plant eradication plans. Similarly, socio-economic research carried out in the villages bordering Betampona highlighted an urgent need for renewable wood sources for cooking and construction. Through a grant from the European Association of Zoos and Aquaria’s Madagascar campaign, MFG responded by collaborating directly with the affected villagers to establish an innovative reforestation programme addressing this basic yet vital need. In the first year, MFG staff selected two villages to begin the programme, which included identifying a mixture of native and non-invasive cash crop species to meet the people’s needs, identifying and training of selected, motivated villagers to assume responsibility for setting up and managing tree nurseries and providing the seedlings and equipment to accomplish the work. Following very encouraging results in the first phase, MFG has expanded its reforestation activities to now cover the entire periphery of Betampona.

MFG is an example of the *in situ* conservation impact zoos can make when they collaborate for a common goal. Led by programme manager Dr An Bollen, our Malagasy project managers and staff, MFG will continue to utilise its multidisciplinary approach to assist the Malagasy government conserve its biodiversity.

Zoos participating in this conservation project for 2008 and 2009 include MFG member zoos in three membership categories (depending on the amount of annual dues) and Friends of the MFG. Managing members (US\$10,000) are Chicago Zoological Society, Duke Lemur Centre, Houston Zoo, Lemur Conservation Foundation, Missouri Botanical Garden, Naples Zoo, Philadelphia Zoo, Saint Louis Zoo, San Antonio Zoo, San Diego Zoo, Wildlife Conservation Society, Zurich Zoo and

Zoological Society of London. Sponsoring Members (US\$5,000) are Cleveland Metroparks Zoo, Hogle Zoo, Isle of Wight Zoo and San Francisco Zoo. Contributing members (US\$2,500) are Münster Zoo, Biodome de Montreal, Cleveland Metroparks Zoo AAZK, Dickerson Park Zoo, Dudley Zoological Gardens, Los Angeles Zoo, The Living Rainforest, Royal Zoological Society of Antwerp, Seneca Park Zoo, Ueno Zoological Gardens and Wild4Ever/Akron Zoo. Friends of the MFG (under US \$2,500) are Baltimore Zoo, Bingamton Zoo at Ross Park, Indianapolis Zoo, Milwaukee County Zoo, Northern Lights chapter of AAZK, Sacramento Zoo, Shepreth Wildlife Park and Tulsa Zoo AAZK.



Ingrid Porton holds B. Sc. and M. Sc. degrees in wildlife ecology. She has over 30 years’ zoo experience, is primate curator at Saint Louis Zoo, coordinator of the Association of Zoos and Aquariums’ (AZA) Species Survival Plan for ruffed lemurs and a member of the AZA contraception advisory group. She is MFG’s vice-chairwoman, with a focus on social mammals and conservation of Malagasy fauna.



Dr Karen Freeman holds a BA degree in natural sciences from the University of Cambridge and a Ph. D. degree in ecology and conservation genetics from the University of London. She spent five years with the Mauritian Wildlife Foundation with a focus on the conservation of critically endangered bird and reptile species and four years as MFG’s in-country programme manager before assuming her current position as MFG’s research director.

Tiit Maran
Tallinn Zoo

Small, brown but worth the effort: recovery of the European mink in Estonia

Species	European mink (<i>Mustela lutreola</i>)
Range	Eastern Europe
Population	20,000
Threats	Invasive species, habitat destruction



The European mink (*Mustela lutreola*) is a small carnivore and original dweller of European rivers and streams. Today, no viable population is known to exist. The story of European mink conservation is typical of many small and seemingly non-attractive species – easily forgotten and overlooked. Yet, the European mink, so disregarded by humans, is a flagship species for riverine habitats.

As a rule, several factors contribute to the decline of a species. In the case of the European mink, extensive landscape modification has resulted in the loss of small streams and rivers – the key habitats of the European mink. And of course, its warm fur is a valuable market product. Extensive trapping, combined with the invasion of the American mink (*Neovison vison*), have pushed the species so close to extinction that minor incidental environmental and population fluctuations, or just a slight increase in negative human impact, may trigger local, perhaps even global extinction.

In most of Europe the original mink disappeared so long ago that its very existence was nearly forgotten. Its namesake, the American mink, started occupying most of the continent and became a negative symbol of an invasive alien species, pushing the fate of the European mink even deeper into oblivion.

The first breeding efforts at Tallinn Zoo came to light in the early 1980s. Several field trips to Russia and the goodwill of Moscow Zoo resulted in 14 much-needed additional wild founders. Visits to the Russian research centre in Novosibirsk and to the black-footed ferret (*Mustela nigripes*) breeding centres in the USA equipped us with the necessary experience, and regular breeding of European minks was achieved by the mid-1990s. In 1992, a European Endangered Species Programme for the European mink was started. Tallinn Zoo presently holds approximately half of the global captive population – around 100 animals.



The European mink is a slender, chocolate brown, fur-bearing carnivore (© Tiit Maran).

Estonia has two features that, if combined, could be beneficial for European mink recovery – the breeding population at Tallinn Zoo and two large islands, Hiiumaa (1,000 km²) and Saaremaa (2,400 km²), both inaccessible to American minks and capable of holding viable populations of our target species. These considerations defined our goals, which are to hold a captive population consisting of 200 minks at Tallinn Zoo and to establish safe island populations by releasing captive-born minks.



European mink habitat on Hiiumaa (© Tiit Maran).



European mink releases started with hard releases; this procedure proved to be ineffective (© Tiit Maran).

Hiiumaa Island, with 70% of forest cover and a number of small streams and rivers, was a promising site. Unfortunately, escapees from a now-closed mink farm gave rise to a feral population of American minks. In late 1998 their removal was started in collaboration with the Wildlife Conservation Research Unit at the University of Oxford. For many this looked like a "mission impossible". Local hunters were the first invited to perform the removal. However, their lack of experience with minks led to a partly expected removal failure. Thereafter, the local community readily agreed to invite an outsider to assist with the removal. It took months of long trapping sessions by Byelorussian researcher Dr Vadim Sidorovich before the island could be declared free of American minks.

The removal of alien minks seemed the most challenging task. However, after 10 years of re-releases, we have discovered that getting rid of one species is much easier than reintroducing another back into the ecosystem. The establishment of a new island population was a long learning process. We started with hard releases, by directly releasing animals from their transport crates, but soon realised that this was not the key to success. After many attempts we discovered the best approach, called a soft release: the release of litters from riparian enclosures at the time of juvenile dispersal. Since 2000 more than 400 minks have been released. The number of wild-living minks has steadily increased to 20 to 35 animals after the winter bottleneck and to 50 to 60 during autumn. Several minks have survived for more than four years and a number of them breed. Hikers on Hiiumaa now frequently encounter tracks of European minks on riverbanks.



Release enclosure for the soft release of European minks (© Tiit Maran).

The biological considerations are important but the human dimension cannot be underestimated. The way our project has affected the 10,000 locals was not overlooked. We openly shared information with locals and involved them in what we were doing. The results of the releases were regularly highlighted both in local and national media. For tourists, signs and posters were erected in protected areas. Whenever possible, the locals were contracted by the project, for example for general management, for the husbandry of litters in release enclosures or for the construction of enclosures. Our study on public opinions in 2004 showed that the majority of locals (some 97%) were well-informed about the project and more than 85% of them had positive feelings about it.

The establishment of the wild population has raised new challenges. We have realised that we need a more holistic approach. The most important rivers on the island were designated as protected areas for European minks. However, these designated areas were clearly not sufficient to ensure mink survival. The entire running-water regime had to be taken care of: some of the streams needed restoration, the quality of others needed improvement and, most importantly, the ongoing procedures for drainage system maintenance needed change. The flood of one canal was directed back to its original riverbed, thus creating a perfect habitat for minks. Artificial rapids and sediment ponds improved the quality of mink habitats in several human-made water-courses.



This stream was restored in 2008 and now provides improved habitat for European minks (© Tiit Maran).



Young European minks born in a release enclosure (© Tiit Maran).

Most of the rivers and streams on the island are recipients of the overall drainage system and therefore under regular maintenance. The traditional dredging of riverbeds and the clear-cutting of banks at 10-year intervals cause serious damage to mink habitats. Relationships with the local land-improvement board led to a mutual understanding that there were other ways to do things. Building rapids and digging sediment ponds reduced the need for traditional maintenance; even the usual clear-cutting of trees on banks was largely substituted with selective cutting, leaving critical vegetation in place. As a result, the landscape is now more appealing and biodiversity is recovering. The historical over-drainage results in spring overflows, followed by early summer droughts. As a result, a number of amphibian spawning ponds dry out before froglets can leave, causing a decrease in the abundance of amphibians – an important food source for mink. Re-establishing 17 spawning ponds was beneficial to both frogs and minks.

The release operation greatly widened our understanding of the complexities of reintroductions. Therefore, we plan to start releasing minks on Saaremaa Island. This should commence in 2010 and will take about five years. Further promotion of captive population management requires species-specific research on reproductive physiology, environment-induced stress and behavioural types. Collaborative research programmes are currently under development and some have already been launched. However, as always, all these great ideas depend on the funds available.



Thinking of mink, thinking of water... (© Tiit Maran).

The European mink conservation project in Estonia is not a “lonely rider” any more. In Romania, conservation breeding and promotion of *in situ* conservation is now being considered. The German initiative “Euronorz” has been the most active partner in the breeding programme and the release operations in Saarland is a spin-off of their work. In Spain, a breeding programme was launched and has resulted in two experimental releases. Clearly, it all has been worth the effort.

Partner institutions involved in this conservation project include Wildlife Conservation Research Unit at the University of Oxford, Helsinki Zoo, Rotterdam Zoo, Thoiry Zoo, La Torbiera Zoo, Gaia Park, Zoos Help Foundation, Rotterdam Zoo Conservation Fund, Zoological Society for the Conservation of Species and Populations, Riga Zoo, Moscow Zoo, European Union LIFE Programme, Darwinian Initiative, State Environmental Board and Environmental Investment Centre.



Dr **Tiit Maran** graduated as a biologist from Tartu University in 1983. Later he received an M. Sc. degree in zoology and a Ph. D. degree in ecology. He is working at Tallinn Zoo as head of the species conservation research laboratory and as scientific secretary. He is also part-time associate professor in conservation biology at Tallinn University. The European mink conservation has always been a central issue in his work, involving practical conservation management, research and policy. He is coordinator of the European Endangered Species Programme for European minks, director of the Lutreola Foundation and a member of the Estonian scientific authority on CITES.

Biswajit Guha
Wildlife Reserves Singapore

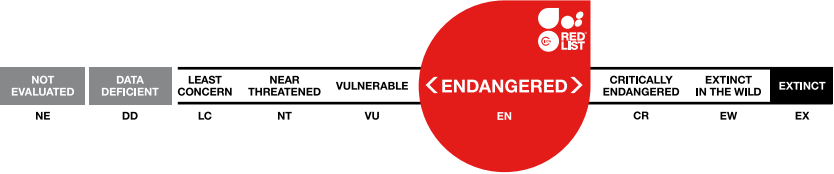
John Sha Chih Mun
Wildlife Reserves Singapore

Proboscis monkeys on Borneo: who “nose” what the future holds?

Species	Proboscis monkey (<i>Nasalis larvatus</i>)
Range	Borneo
Population	6,000
Threats	Habitat destruction, poaching



© John Sha





Crop plantations like oil palm are replacing and fragmenting suitable proboscis monkey habitats (© John Sha).

Sabah is a Malaysian state situated on the northern tip of Borneo. Its landform is made up of lowland plains and numerous hilly mountain ranges, the most prominent of which is the Crocker Range that runs almost parallel to the west coast; at its northern limits lies Mount Kinabalu, the highest mountain in South-East Asia at 4,095 m. Sabah's climate is marine equatorial, with high rainfall. Relative humidity on the lowlands is high (usually exceeding 80%), with night and day temperatures ranging from 20 to 34 °C. The inland vegetation of Sabah is dominated by lowland tropical rainforests and floodplains closer to the coast and river deltas. These floodplains support particularly rich ecosystems, both in quantity and diversity. Human activities like logging and clearing of forests for plantations and human habitation have had a considerable impact on Sabah's vegetation, having reduced its natural forest cover from an estimated 86% in the 1950s to 57% by 2001. The economy of Sabah is still predominantly agrarian, with 70% of the population still residing in rural areas. These are mainly indigenous communities who still rely on forest resources for subsistence. The Sabah state government balances forest resource use with economic necessities by establishing many forest conservation areas to protect its rich natural heritage by law, and forest reserves in Sabah now total 4.8% of its land area.



Male proboscis monkey (© John Sha).

Sabah is home to the proboscis monkey (*Nasalis larvatus*), a unique and little-known species of leaf-eating monkey, endemic to Borneo. From 2004 to 2006, Wildlife Reserves Singapore, in collaboration with the Zoological Society of San Diego, supported a project to investigate the status and threats to proboscis monkeys in Sabah. The study revealed that although proboscis monkeys in Sabah are more abundant and widespread than previously thought, with an estimated 6,000 individuals still surviving in the forests of major river systems throughout Sabah, it is now highly threatened by habitat loss and fragmentation. Only five major centres of continuous populations exist – four on the east coast and one on the west coast, entirely isolated from the east coast populations by mountainous ranges. The habitats for these major populations are also not sufficiently protected under the existing forest reserves system with only an estimated 15% within protected reserves.



Small fragmented forests are supporting dense populations of proboscis monkeys (© John Sha).

Proboscis monkeys are closely associated with forests along waterways, resting in trees adjacent to waterways at night, which are also the areas most frequently used by humans. Monkey populations thus are now surviving in increasingly small, disturbed and sub-optimal habitats. In particular, plantation activities that extend from inland forests to the riverbanks are replacing important habitats of the proboscis monkey. Reduction and fragmentation of suitable habitats for the proboscis monkey have resulted in very dense populations in some areas, whereby the effects of overcrowding and reduced genetic variability may become evident over a longer period of time. Aided by satellite imaging, the study revealed more immediate threats – many groups of proboscis monkeys exist in small forest patches that are completely isolated from one another and the major populations by urban areas and agricultural land that impedes any possibility of interaction and gene flow between these groups of arboreal monkeys. Recent local extinctions have been recorded and many other populations are at immediate or impending risk of a similar fate.

Although there has been speculation of increasing threats to proboscis monkeys by independent observers over the past couple of years, revelations from this study present overarching and startling evidence pointing to the immediate and longer-term threats to proboscis monkeys. These have rung alarm bells for conservationists, government authorities and researchers to re-evaluate the urgency to implement conservation strategies to safeguard the proboscis monkeys.

In 2006, the United Nations Development Programme commissioned a proboscis monkey protection plan for the fragmented Klias Peninsula population on the west coast as part of the Klias peat swamp forest project and successfully gazetted an extension area connecting three smaller reserves containing proboscis monkey populations. The Sabah Wildlife Department has also stepped up its monitoring and translocation programmes for isolated proboscis monkey populations at risk of local extinction. The Sabah Forestry Department is also working on rehabilitation of riverine habitats fragmented by plantation activities like oil palm cultivation and extending better protection for these habitats. On the research front, genetic studies by the University of Malaysia Sabah are under way to determine the effects of fragmentation on geographically isolated proboscis monkey groups.



The arboreal proboscis monkey traverses its habitat by jumping from tree to tree (© John Sha).

Despite these efforts, loss and fragmentation of proboscis monkey habitats are expected to continue due to inevitable human resource demands. This presents a catch-22 situation where there are still healthy populations of proboscis monkeys but decreasing habitat availability for their continued persistence. The feasibility of translocation of threatened populations is also diminished because there is simply no habitat for them to go to.

With this realisation, zoological institutions will play an increasingly prominent role in the conservation of this endangered species. Zoos in the past have had limited success in maintaining captive populations of sensitive leaf eaters like proboscis monkeys, which are notoriously difficult to keep in captivity due to their specialised diet and habitat preferences. The first pair of proboscis monkeys was sent to San Diego Zoo in 1956 and there was a subsequent influx of proboscis monkeys into zoos in Europe and the USA. However, none of these zoos was able to further maintain long-term viable populations and by 1997, only Bronx Zoo in New York had proboscis monkeys left, with the last two eventually sent to Singapore Zoo in 2003. Outside its range country, Singapore Zoo now has the largest population containing 17 individuals, with 17 successfully raised offspring from its captive population.



Infant proboscis monkey born in Singapore Zoo (© John Sha).



Boat census at dawn (© Lester Ledesma).

Establishing a well-strategised *in situ* and *ex situ* collaborative link will become increasingly important in safeguarding the long-term future of proboscis monkeys. Support for coordinated and applied *in situ* research work has to be intensified. This includes important aspects like long-term continuous monitoring of basic data on population numbers and distribution for important and threatened populations, and standardisation and improvement of rapid census methods for related studies across the proboscis monkey range; more accurate and updated habitat and land use classifications important for more detailed habitat and land use pattern analyses; habitat and site-specific ecology to determine important factors that contribute to the long-term viability of populations; and population genetics to determine genetic status and effects of fragmentation. Support for protected areas conservation and enforcement activities are also necessary.

On the *ex situ* front, maintaining a sufficiently sized and genetically viable proboscis monkey population in captivity in zoological facilities around the world will be important to mitigate the possible eventuality of proboscis monkey extinction in the wild. Captive-based research has contributed and can continue to contribute to important knowledge on proboscis monkeys that could not be obtained from *in situ* research; for example, aspects of diet, nutrition, disease and life history. Zoological institutions with proboscis monkeys can also provide the necessary impetus for conservation education and awareness-related initiatives, which will be beneficial to the long-term conservation of the species.

Partner institutions involved in this conservation project include Wildlife Reserves Singapore, Zoological Society of San Diego, University of Malaysia Sabah and the Sabah Wildlife Department.



Biodiversity conservation projects



Juvenile proboscis monkey (© John Sha).



Biswajit Guha graduated from the National University of Singapore in 1993 with a B. Sc. degree with honours in zoology, specialising in invertebrate zoology. He joined Singapore Zoo as a keeper in 1993 and was involved in setting up the zoo's first invertebrate and forest ecosystem habitat. He now heads the zoology department at Singapore Zoo and the conservation and research department of Wildlife Reserves Singapore. The main areas of interest and thrusts that he hopes to continue with include raising public awareness and education on conservation and green-related issues amongst Singaporeans and in the South-East Asian region, as well as sharing best practices with other zoos in the region.



John Sha graduated from the National University of Singapore with a B. Sc. degree in 2002 and joined Singapore Zoo as research and conservation officer. In 2004, he embarked on his research on proboscis monkeys in Sabah and completed his M. Sc. degree in wildlife conservation and management at the University of Malaysia Sabah in 2006. He subsequently spent short stints with the United Nations Development Programme and the National Parks Board Singapore before rejoining Wildlife Reserves Singapore in 2008 where he is currently conservation and research curator. His interest is in primates and his research approach is through basic applied science that is relevant to the holistic conservation of primates and other species both in the wild and in captivity.

Jeffrey C. Mangel
Pro Delphinus |
University of Exeter

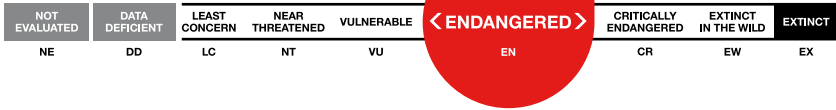
Joanna Alfaro-Shigueto
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Rebecca Rose
Columbus Zoo
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Gerald W. Borin
Columbus Zoo
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Marine otters at home in Peruvian fishing ports: their behaviour, prey and interactions with human communities

Species	Marine otter (<i>Lontra felina</i>)
Range	Coastal Argentina, Chile and Peru
Population	1,000
Threats	Habitat destruction, pollution, poaching



© Cyril Ruoso



The port of Morro Sama. Marine otters use the artificial breakwater as a den and often patrol the harbour looking for fish refuse on boats and in nets (© Jeffrey Mangel).



Collecting faecal samples of marine otter to identify prey (© Cyril Ruoso).

Much of the coast of Peru is unforgiving, arid desert. It is all the more surprising, therefore, to find that an otter species – the marine otter (*Lontra felina*) – makes this environment its home. The marine otter, known locally as “chungungo” or “gato marino” (sea cat), can be found inhabiting rocky coastal habitat in Peru, north to approximately Chimbote and south along the coast of Chile. Marine otters are the smallest of the marine mammals. At 4 kg they are about the size of a river otter, and are much smaller than the 45 kg sea otters (*Enhydra lutris*) found off the Pacific coast of North America.

Very little is known about the biology, behaviour and distribution of marine otters and even less is understood about marine otter ecology in Peru. The species is listed as “endangered” according to the IUCN Red List of Threatened Species, largely as a result of historical poaching for their fur and alleged damage to fisheries.

In Peru, some of the largest concentrations of marine otters have been identified along the southern coast near the border with Chile. Two of these concentrations occur in the fishing communities of Morro Sama and Vila Vila – where marine otters make their dens in the artificial breakwaters that protect the ports. Thus, living near these communities has provided the otters with food and shelter. These human communities have few economic and educational resources and are totally dependent upon fishing for their livelihoods. As a result, they are not aware of the endangered status of marine otters. Yet marine otters have been, and continue to be, negatively impacted by interactions with the community. Otters sometimes become entangled in fishing lines and may even drown in fishing nets. There is also the risk of disease transmission from stray domestic cats and dogs as well as injuries or fatalities from dog attacks. With such a small population, the loss of even one otter may jeopardise the survival of the local population.



A marine otter returning to shore with a large meal (© Cyril Ruoso).

Given what little is known about the endangered marine otter in Peru and its known overlap with human fishing communities we began a research and education programme in 2003 in the port towns of Morro Sama and Vila Vila. Thanks to the enthusiastic support of Columbus Zoo and Aquarium, the programme has operated continuously ever since. One of the project's main focuses has been to improve our basic understanding of marine otter biology and ecology. Through repeated, daily observations of marine otters we seek to answer basic questions about the potential risks posed by human interactions such as "Do otters compete with people for prey?" and "What are the specific risks to otters from living so close to humans?"

Since community awareness about marine otters is limited, this project, from its inception, has also emphasised environmental education within these communities – including fishermen, school-children and local residents. In the end, we hope that, by developing a greater understanding of marine otters and the habitats they share with human communities, we can promote a more sustainable future for the species and encourage local interest in their conservation. These awareness-raising activities also use the marine otter as a flagship species to focus attention on the marine environment generally. This has taken many forms, including regularly scheduled classes at the local elementary schools discussing themes related to marine conservation, annual Earth day celebrations and festivals, and focused discussions with fishermen about their perceptions of marine otters and steps they would like to see to promote their conservation.



Left: Teaching schoolchildren in the port of Vila Vila about marine otters (© Jeffrey Mangel).



Right: A class about the marine environment held at a school in Morro Sama (© Joanna Alfaro-Shigueto).

A marine otter conservation mural located in Vila Vila that says "The marine otter's home is the sea. The marine otter is an endangered species, we protect its home, Vila Vila is its home" (© Joanna Alfaro-Shigueto).



As a result of this project, our understanding of the marine otter in Peru and their interactions with human fishing communities has been greatly improved. Hundreds of hours of direct observations of otters have provided a detailed account of their activity patterns and revealed that Peru's otters are primarily fish eaters (unlike populations in Chile that specialise in crabs). These observations have also shown that otters are eating some of the same species that people are exploiting, raising important questions about resource depletion and competition. Our work has also been able to document otter fatalities as a result of drowning in fishing nets and dog attacks, thus beginning to quantify the dangers to otters of direct human interaction.

Our education programme has also met with considerable success and local interest. Many hours in the classrooms in Vila Vila and Morro Sama have been rewarded by the enthusiastic response and participation of students and teachers alike. This work has also drawn the attention of the Tacna state government that has now made marine otter work a priority conservation initiative. Perhaps most encouraging has been the response of fishermen who have worked with us to identify what they see as the main threats to marine otters and who have agreed to continue to work towards better understanding and reducing these threats.



A marine otter at the port of Morro Sama peering out from the rocks of the breakwater (© Cyril Ruoso).

Over the course of this project we have learned much about marine otters, but there is still more challenging work to do. Risks to the species continue as its coastal habitat in both Chile and Peru is increasingly degraded due to human development. In response, our work with fishing communities will continue striving to better understand how common this otter/human overlap is and the threats this overlap poses. We will also continue to work side by side with members of these communities to raise awareness of these marvellous and secretive animals and to provide them with the information necessary to develop sustainable fishing practices and otter-friendly communities.

Partners in this conservation project include Columbus Zoo and Aquarium, Fulbright Commission, the People's Trust for Endangered Species, Société d'Encouragement pour la Conservation des Animaux Sauvages, local fisher associations in the towns of Ilo, Morro Sama and Vila Vila, Vila Vila and Morro Sama elementary schools and the state government of Tacna.



Biodiversity conservation projects



Pro Delphinus researcher **Jeffrey C. Mangel** is originally from New York State. He graduated with an MA degree in environmental management from Duke University in 2003. In the same year, he was awarded a Fulbright scholarship to work with Pro Delphinus to study marine otters in southern Peru. He has worked with Pro Delphinus since 2001, where he helps coordinate Pro Delphinus’ ongoing small cetacean, seabird, sea turtle and shark projects. He is now also pursuing a Ph. D. degree at the University of Exeter.



Joanna Alfaro-Shigueto has an M. Sc. degree in biology from the Universidad Ricardo Palma in Lima. She is currently president of Pro Delphinus. She has been dedicated to promoting marine conservation since her years working as a field researcher at fishing ports along the Peruvian coast. From spending time in small fishing villages she learned the importance of collaboration between communities, researchers and government in dealing with conservation matters. She is working towards her Ph. D. degree at the University of Exeter.



Rebecca Rose is field conservation coordinator at Columbus Zoo and Aquarium. In 2008 Columbus Zoo provided grants to 70 projects in 34 countries. She is the zoo’s representative to the bushmeat crisis task force, the human–wildlife conflict collaboration and serves on the field conservation committee for the Association of Zoos and Aquariums. She is a board member for Friends of Bonobos and serves on the steering committee for the Pan African Sanctuary Alliance.



Gerald W. Borin joined Columbus Zoo and Aquarium in 1985 as general manager after a 14-year career in public service with the City of Columbus. In 1992 the zoo board named him executive director. He serves on over half a dozen national and international zoo and conservation boards and currently is a member of the governing council of the World Association of Zoos and Aquariums. When he retired as the zoo’s executive director in July 2008 he took the title of special projects director and continues to work on the zoo’s behalf on several ongoing projects.

Olivier Pagan
Basel Zoo

Friederike von Houwald
Basel Zoo

Susie Ellis
International
Rhino Foundation

Dipankar Ghose
WWF India

Amit Sharma
WWF India

Basel Zoo and Indian rhinos: how a zoo can help to secure the future of an endangered species

Species	Indian rhinoceros (<i>Rhinoceros unicornis</i>)
Range	Northern India, Nepal
Population	2,800
Threats	Habitat destruction, poaching



© Randy Rieches

Distribution of Indian rhinos in Assam (© IRF). – Source file is too small.



Indian rhinos mating at Basel Zoo (© Basel Zoo).

Assam, home of the famous Indian or greater one-horned rhinoceros (*Rhinoceros unicornis*), is situated in the north-eastern corner of India and covers an area of 78,523 km². The most dominant feature of Assam is the elongated valley of the large river Brahmaputra. Most of the 25 million people living in Assam reside in this valley. Agriculture and to some extent tourism are important sources of income. The current political situation has been rather unstable with the United Liberation Front of Assam fighting for independence from India. Additionally, more than 200 ethnic groups live in Assam, giving rise to serious ethnic debates and unrest with strong impacts not only on the economy of the state but also on natural resources such as wildlife.

The Brahmaputra valley is not only home to millions of humans but also to a large number of animal species. The current number of wild Indian rhinos in India and Nepal ranges between 2,700 and 2,800. There are 2,300 to 2,370 rhinos living in India and around 400 to 430 in Nepal. The stronghold of Indian rhinos is Assam. Currently 2,048 rhinos live in Kaziranga National Park, 84 in Pobitora Wildlife Sanctuary and 64 in Orang National Park.



Entrance of Orang National Park in Assam (© Basel Zoo).

Right: Two motorised boats were purchased for patrols in and around Orang National Park. Bicycles and motorbikes were bought for the staff in Orang National Park (© NBL/WWF India).

The uneven distribution of Indian rhinos in Assam as well as constant threats such as poaching, habitat loss and human–wildlife conflicts have led to a very unstable and difficult situation for the Indian rhino. With too many animals living in one area and too few protected areas for the remaining ones, the future of the Indian rhino is facing serious problems despite former conservation successes. Several centuries ago, this species was very numerous and had a broad distribution. At the end of the 19th century, however, Indian rhinos were almost hunted to extinction. Only rigorous conservation efforts in the 20th century saved this species. Now, one hundred years later, Indian rhinos are again seriously threatened.

In 2005, the International Rhino Foundation (IRF) in collaboration with WWF India signed a long-term agreement with the Assam Forest Department called the Indian Rhino Vision 2020. The aim of this vision is to increase the total rhino population in Assam until the year 2020 from its current numbers to 3,000 and to expand their distribution to at least seven protected areas. The goal will be achieved by a combination of rhino translocations and improved protection. To meet these goals, IRF and WWF India have started to look for sponsors willing to participate in this conservation effort.



The Rajiv Gandhi Orang National Park harbours the last remaining viable population of Indian rhinos on the northern bank of the river Brahmaputra. The area currently holds 64 rhinos under the jurisdiction of the Mangaldoi Wildlife Division of the Assam Forest Department and covers an area of about 78 km². Official figures for the rhino population in the park are available from 1985 onwards and it has been observed that 60 to 70 rhinos were found in the park for most estimates. The carrying capacity of the Orang National Park ranges around 90 rhinos.

Geographically, this park does not have any buffer zones and faces pressure from all sides. The southern boundary line is the Brahmaputra, posing a great challenge to fight off poachers as the waterway perforates the security network and makes the park very vulnerable. The other three sides are bordered by densely populated villages and smaller rivers. Between 2000 and 2008, 53 rhinos died. Of those, 55% resulted from poaching activities, with numbers increasing since 2006. This large number calls for the necessity to optimise measures for the protection of rhinos.



A newly constructed camp at Orang National Park
(© NBL/WWF India).

Basel Zoo has a long history of keeping and breeding Indian rhinos. The first Indian rhino arrived at Basel Zoo in 1951. In 1956, the first captive calf ever was born in Basel. Since then, almost 30 Indian rhinos have been raised. Due to successfully managing and breeding this threatened species, Basel Zoo was given the high responsibility to coordinate the European Endangered Species Programme as well as the international studbook. In 2007, Basel Zoo signed a memorandum of understanding with WWF India and IRF stating that Basel Zoo will fully support the conservation measures necessary for the protection of Indian rhinos in Orang National Park.

WWF India, IRF and the Assam Forest Department elaborated a support programme for improving protection measures in Orang National Park. (1) Communication: to improve communication, the needs identified in the park were wireless sets, vehicles, boats, motorcycles and patrolling roads. To increase mobility and to guard the open water fronts, two motorised boats were bought. In addition, motorcycles and bicycles were provided to all camps.

(2) Anti-poaching and patrolling: Orang National Park has various gaps in terms of anti-poaching camps and patrolling roads. As a first step, one camp was built and more are planned. Furthermore, grants were given to clear and maintain strategic patrolling roads as well as to provide fuel for at least 12 months. Powerful searchlights were handed out for patrols at night.



Biodiversity conservation projects

(3) Intelligence and trade control: efforts were undertaken to control poaching and to catch poachers by strengthening the intelligence network. This initiative has been undertaken with the help of TRAFFIC (the wildlife trade monitoring network, a joint programme of IUCN and WWF India). The last year already showed a first success when more than ten poachers and traders were arrested and several firearms confiscated.

(4) Staff welfare and training: to ensure proper service and sustained motivation of the frontline staff, their needs have to be taken into account. As a first step, protection clothing including rain suits and field boots were provided. Further equipment (caps, T-shirts, etc.) is on its way. In addition, staff training using firearms as well as monitoring rhinos in the field has started.

In the future, it is envisaged to further strengthen the patrols, to optimise operational methods and the overall morale. The training of scouts has already started and will continue. It is also planned that tourism will be established in this region. Visitors should not only visit the beautiful Orang National Park but should also make use of the newly built lodge nearby. This will provide more employment for locals and will show the people living next to Orang National Park that conservation can become a very important and sustainable employer of their region. Basel Zoo has “adopted” Orang National Park within the Indian Rhino Vision 2020, with the intention of supporting this project on a long-term basis.

Further partner institutions involved in the support of the Indian Rhino Vision 2020 are U.S. Fish and Wildlife Service, Zoological Society of San Diego, Cincinnati Zoo, Los Angeles Zoo, Philadelphia Zoo, Woodland Park Zoo, Fondation Ensemble, CERZA, Amersfoort Zoo, Disney Worldwide Services and the 2006 rhino campaign of the European Association of Zoos and Aquaria.



Dr **Olivier Pagan** studied veterinary medicine at the University of Berne, where he then worked at the Centre for Fish and Wildlife Health. In 1993 he joined Basel Zoo as zoo veterinarian and curator for elephants. He has been director of Basel Zoo since 2002.



Dr **Friederike von Houwald** studied veterinary medicine at the Free University of Berlin and did an M. Sc. course in wild animal health at the University of London/Zoological Society of London. She has been working at Basel Zoo as curator for birds and mammals since 2001. In 2009 she became keeper of the international studbook for Indian rhinos.



Dr **Susie Ellis** holds a BA degree in liberal studies from San Diego State University, an MA degree in comparative psychology from the University of California at Davis and a Ph. D. degree in comparative psychology from the University of California at Davis. She has been executive director of the International Rhino Foundation since 2006.



Dr **Dipankar Ghose** holds a Ph. D. degree in zoology from the University of Calcutta, achieved under a fellowship from the World Pheasant Association. He has been working for WWF India since 2005, presently heading the eastern Himalaya and Terai Arc programme.



Amit Sharma holds an M. Sc. degree in geography from Gauhati University. He is trained and experienced in conservation GIS and remote sensing. He is experienced in working at the landscape level on large mammals like elephants, rhinos and tigers. He has been working for WWF India in north-east India since 2001, presently as rhino conservation coordinator.

Paul Pearce-Kelly
Zoological Society
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Ric Brewer
Woodland
Park Zoo

Trevor Coote
Partula Global
Species Management
Programme

Donald McFarlane
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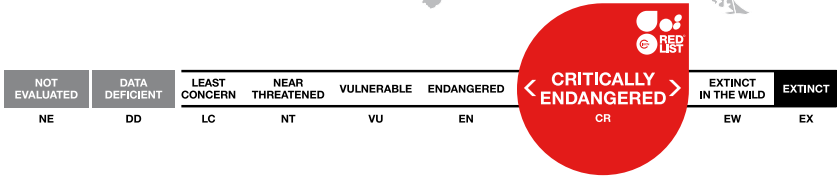
Mary Noell
Cincinnati Zoo and
Botanical Garden

Conservation in a snail shell: working together to save some of Polynesia’s most remarkable species

Species	Moorean viviparous tree snail (<i>Partula taeniata</i>)
Range	Society Islands
Population	Unknown
Threats	Invasive species, habitat destruction



© Carole Hickman





Introduced giant African land snail on Moorea Island (© Trevor Coote).

Partulid snails are endemic to many of the volcanic islands of the South Pacific and have their centre of species diversity in the Society Islands of French Polynesia. The political status of French Polynesia is that of Overseas Country and is governed by the Assembly of French Polynesia. There is a relatively high level of health and socio-economic development, with tourism and local government comprising the largest employment sectors. Partulids inhabit the valleys and forested slopes of many islands, occurring on the stems, trunks and undersides of leaves of many plant species. The snails remain fastened to leaves during dry periods but emerge to feed and mate when it rains, mostly at night.

The famous Polynesian tree snails of the Partulidae family comprise around 125 species belonging to three genera, *Eua*, *Samoana* and *Partula*. First described from specimens collected on Captain Cook's voyage, these snails have been the subject of extensive field and laboratory studies into evolutionary processes.



The American predatory rosy wolf snail was introduced in the mid-1970s to Moorea and Tahiti and quickly spread to many other islands in the region (© Trevor Coote).

In the mid-1970s the predatory rosy wolf snail (*Euglandina rosea*) was introduced to a number of Pacific islands as a biological control agent for the equally introduced giant African land snail (*Lissachatina fulica*). Unfortunately the predator largely ignored its intended victim but had a disastrous impact on the region's endemic snail fauna, being responsible for the extinction of over 50 documented partulid species.

In response to this unfolding extinction crisis, in 1986 the international zoo community, Nottingham and Virginia universities, French Polynesian environmental agencies and the IUCN/SSC Conservation Breeding Specialist Group developed a conservation plan to save as many species as possible before the predator swept through their entire range. A formalised action plan was developed in 1994.



Partula rosea from the island of Huahine. This species was used for traditional welcoming necklaces ("lei") before being eradicated by the rosy wolf snail. Fortunately, they still survive in the breeding programme (© Trevor Coote).



Partula suturalis is endemic to Moorea Island and one of the many species extinct in the wild being maintained in the international breeding programme (© Dave Clarke).

In addition to a formalised working partnership with the French Polynesian Environmental Department, local collaborators include school teachers, mountain guides, pig hunters and landowners. These endemic snails are also part of Polynesia's rich cultural heritage, most notably through the traditional production, at a sustainable rate, of shell jewellery ("hei" in Tahitian) by local artisans. These snails also play a role in the ecology of the forests as recyclers of nutrients and as components of food chains.

The conservation imperative of this programme has been to halt the extinction of partulid species and to see as many species successfully re-established in their former natural ranges as possible. To this end, the programme has developed through a number of distinct phases: the initial crisis rescue phase involved the rescue and setting up of breeding populations. The second phase involved intensive field investigations to clarify the predator threat and conservation options. The final phase has involved the development and implementation of a long-term conservation management plan.

From the outset, a close collaboration between all of the programme partners was essential for making progress. This included the formation of a support consortium arrangement between the French Polynesian Environment Department and the international zoo community to enable the essential field survey and research work necessary for developing and implementing the conservation plan.



Partulid breeding facility at Marwell Zoo (© Geoff Reid).



The world's first reserve for snails was constructed on Moorea Island in the mid-1990s. It proved the effectiveness of this conservation strategy. New reserves are planned as part of the 10-year conservation plan (© Dave Clarke).

Nearly 20 species were rescued and an international breeding programme established for them. Although some of these species, such as *Partula turgida*, unfortunately died out, the majority have been maintained through to the present day. They have their own global studbook and husbandry guidelines, which are also helping other mollusc species conservation efforts.

Extensive survey work has clarified the status of the surviving remnant partulid populations and greatly enhanced understanding of the predator species status and interaction with the native mollusc species. Other invasive species, including the New Guinea flatworm (*Platydemus manokwari*), the little fire ant (*Wasmannia auropunctata*) and the Cuban slug (*Veronicella cubensis*) have also been studied.

Key endemic snail habitat sites have been included in the French Polynesian Government's biodiversity priority areas schedule and there is much greater public awareness of the partulid snails' story and the danger of introduced predators.

Building on the pioneering work of Nottingham, Virginia and Perth universities, important taxonomic and local population issues have been clarified by the molecular genetics group at the University of Michigan.

A trial reintroduction of three partulid species into a predator exclusion forest reserve on the island of Moorea proved the viability of the snail reserve strategy as well as the ability of long-term *ex situ* managed populations to readapt to natural habitat conditions.



The partulid programme's conservation field biologist Trevor Coote surveying in the Society Islands (© Karen Entwistle).

A comprehensive long-term action plan has been developed and is in the process of being implemented.

In addition to caring for the rescued partulid species, the zoo community has undertaken much of the *in situ* conservation work and in partnership with the French Polynesian government continues to provide the essential resources for taking that work forward.

Because of this highly collaborative and sustained endeavour the future for the remaining species of partulids looks healthier than at any time since the introduction of the predator and the extinction crisis. The implementation phase of the 10-year conservation action plan is set to continue through to its completion in 2018 when it is envisaged that all surviving partulid species will have been successfully reintroduced into their island homes.

The ongoing strategy of pooled resource support to realise conservation objectives beyond the capacity of individual programme partners provides a valuable case study for how species conservation needs can be realised.

Partner institutions involved in this conservation project include Akron Zoo, Blackbrook Zoological Park, Cincinnati Zoo, Clifton and West of England Zoological Society, Copenhagen Zoo, Délégation à la Recherche (Polynésie française), Detroit Zoological Institute, Direction de l'Environnement de la Polynésie française, Durrell Wildlife Conservation Trust, Fenua Animalia, Imperial College London, IUCN/SSC Conservation Breeding Specialist Group, Poznań Zoo, North of England Zoological Society, Parc Zoologique de Thoiry, Riga Zoo, Roger Williams Park Zoo, Saint Louis Zoo, Marwell Zoo, Royal Zoological Society of Scotland, University of California at Berkeley, University of Michigan, University of Nottingham, University of Virginia, Woodland Park Zoo and Zoological Society of London.



Biodiversity conservation projects



Typical partulid habitat of Freycinetia forest (© Dave Clarke).



Paul Pearce-Kelly is senior curator of invertebrates and lower vertebrates at the Zoological Society of London and coordinator of the partulid global species management programme.



Ric Brewer is coordinator of the Species Survival Plan partulid programme at Woodland Park Zoo.



Dr Trevor Coote is conservation field biologist of the partulid global species management programme.



Donald McFarlane is studbook keeper of the partulid global species management programme at the Zoological Society of London.



Mary Noell is studbook keeper of the Species Survival Plan partulid programme at Cincinnati Zoo and Botanical Garden.

This chapter is dedicated to the memory of our programme colleague Ron Goellner (1945–2006).

Tom McCarthy
Snow Leopard Trust

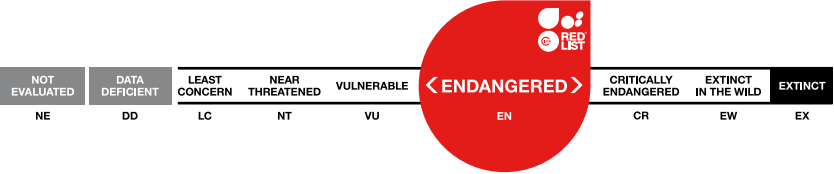
Agvaantseren Bayarjargal
Snow Leopard Trust

Saving snow leopards in Mongolia: one felt carpet at a time

Species	Snow leopard (<i>Uncia uncia</i>)
Range	Central Asia
Population	6,600
Threats	Poaching, prey depletion



© Tom Hadley





One of the snow leopards studied in Mongolia (© Snow Leopard Trust).

Snow leopards (*Uncia uncia*) are one of the least understood of the great cats, living in some of the most remote and harsh habitat in the world. High in the mountains of central Asia, such as the Kun Lun, Altai, Tien Shan, Pamirs and Himalayas, the cats are rarely seen, much less studied. That is until the early 1990s when one of the world's leading field biologists, Dr George Schaller, initiated a study of the mythically elusive cats in an almost equally mythical setting – the edge of Mongolia's Great Gobi desert. Some 20 years earlier, George had taken the first photograph ever of a snow leopard in the wild in Chitral Gol, Pakistan. Now, through a radio-collaring study in Mongolia he intended to share much more about the cat's ecology and threats with the world. With projects around the world to tend to, George brought on a Ph. D. student, Tom McCarthy, to run the five-year study.

The snow leopard study was launched at a unique time in Mongolia's history. Shortly after the fall of communism the nation was in a deep economic crisis. With a crumbling infrastructure and no food or technical support from its former protector, the Soviet Union, Mongolia's shelves were very literally bare. Attempting to outfit a research project in the Gobi, all Tom could find in the capital, Ulaanbaatar, was three cans of peas and the last few bars of eastern European chocolate. But the Mongolian team was unfazed. With a long history of nomadic existence to draw from, a simple ger (yurt) base camp was opened in 1993 high in the Altai Mountains overlooking the Great Gobi.



Mongolian yurts against the mountains; in Mongolia, semi-nomadic herders live in extremely remote regions (© Charles Dye).



Domestic livestock can outcompete natural snow leopard prey, and snow leopard predation on domestic livestock is a primary contributor to human–wildlife conflicts (© Charles Dye).

While understanding the ecology of snow leopards was a primary focus of the study, so was determining the threats facing the cats and finding ways to ameliorate those. As with many large predators that exist in a setting of extensive pastoralism, most threats to snow leopards in Mongolia likely came from humans who wanted to defend their livestock. Especially during a time when livestock was all most Mongolians had to live on. But trying to discuss this very delicate issue with nomadic herders, who had never seen a westerner before, was not working. So, McCarthy hired a young female interpreter, Bayara (Mongolians generally go by one name) to conduct the extensive herder interviews needed to understand the situation. For over a year they criss-crossed the 1,000 km² of snow leopard range in the country, sitting in ger after ger, drinking cup after cup of salted tea, and hearing much the same story. Yes, snow leopards killed their sheep, goats and even their yaks, but not so often. Still that was enough to make them want to kill any snow leopard they saw. Life was that hard.

But Bayara also asked about other problems herders faced, and again a common theme emerged – we have no market for our wool and must accept the few pennies passing traders offer. How else to buy the basic needs of a nomad's life such as tea, sugar and flour – about the only supplements to the meat and cheese their herds provided? While Bayara was busy fact-finding, Tom was usually playing with the children or bartering for unique home-made camel wool mittens, hats and scarves to send back to the USA as gifts. At some point Bayara realised that if Tom loved these woollen handicrafts so much, maybe other foreigners would, too. And if she could get the herders to agree to tolerate a few livestock losses to snow leopards in exchange for buying all of the handicrafts they could make, perhaps there was an easier than expected way to save these cats.

And with that realisation, Snow Leopard Enterprises (SLE) was born.



Biodiversity conservation projects



In Mongolia, women process wool in order to spin it into yarn or turn it into felt (© David Mallon).



The Snow Leopard Trust is spreading awareness about snow leopard conservation; here, a herder in Mongolia displays information about snow leopards (© David Mallon).

The early days of SLE were not easy. The coarse and poorly made handicrafts were barely marketable. Shops in Ulaanbaatar, who took them on consignment, returned more than they sold. So training of the herder artisans was provided by volunteers from Europe and the USA. Strict product quality measures were put in place. But most importantly the programme was adopted by the Snow Leopard Trust in 2000 when Tom joined their staff as conservation director. The first decision was to import the handicrafts to reach a broader market, mostly zoo stores.

In the ensuing nine years SLE has grown from a few small villages in Mongolia and a handful of participants, to an award-winning programme operating in three countries and bringing economic benefits to well over 400 herding families in more than 26 communities in snow leopard range. But importantly, snow leopards are being saved in many key places.

How exactly does SLE work? One of the earliest provisions of the programme was that SLE communities had to sign a conservation contract ensuring that snow leopard conservation was a goal of the entire community. The contract also placed obligations on the programme managers (now the Snow Leopard Trust) to provide the basic tools needed to make handicrafts, give training in product design and manufacture, assure a constant demand for the products, and to pay a fair market price that was agreed to each year. Another key term of the contract was the bonus. At the end of each year, if no snow leopards or primary prey species – large wild sheep and goats such as Siberian ibex (*Capra sibirica*), argali (*Ovis ammon*) or markhor (*Capra falconeri*) – were killed, then the entire community would receive a 20% bonus on top of the agreed product price. But if a single violation occurred, then the entire community would forfeit the bonus. This peer pressure helped ensure compliance.



Young snow leopard at Zurich Zoo (© Emmanuel Keller).

A woman makes crafts out of felted wool as part of the Snow Leopard Trust's conservation programme; each product she makes contributed income to her family, and in turn her family agrees to help protect snow leopards (© Charles Dye).

How well has that worked? In the 12 years SLE has operated there have been a few ibexes poached and bonuses lost. The village men responsible for shooting the ibex were confronted by the SLE women in the community demanding they pay them the bonus they had lost them! This is an example of how SLE has also empowered women by making them the earners in the family. They take great pride in being able to provide cash for food, medicine and education for their children. It also gives them a great sense of pride knowing their small handicrafts are being sold in Europe and the USA. But it also instils a greater understanding of the value of a snow leopard in their ecosystem. Through community education, teams of the Snow Leopard Trust explain the ecological role of the top predator in the high mountains, and SLE members now take great pride in saving them.

But no success story is completely perfect and this past year a snow leopard was killed by a herder in an SLE area. Although his family was not part of the programme, the community bonus was withheld. SLE members are responsible for not just their members, but for ensuring that the entire area they live in is safe for snow leopards. The herder had caught the cat in a trap set for grey wolves (*Canis lupus*), which is legal across most of snow leopard range. This highlighted a problem that SLE had not previously addressed: the accidental killing of snow leopards in these widely used steel jaw traps. Now we have a new challenge and staff of the Snow Leopard Trust is working in that very village to find options for reducing or eliminating the use of these traps so that we can take away one more threat to snow leopards.



Biodiversity conservation projects

The role of European and U.S. zoos in this conservation success story cannot be overstated. While SLE products are sold online at the Snow Leopard Trust’s website, a huge volume is sold in more than 30 zoo stores on both continents. SLE sales worldwide are expected to reach US\$150,000 in 2009. In addition, participating zoos are sharing the conservation success story with their visitors through signage and other media developed jointly by the Snow Leopard Trust and the zoos. Many zoos also contribute funding to expand the programme to new villages in critical snow leopard habitat. SLE is now helping to protect snow leopards in just three of the twelve countries in which they occur, and we will not be satisfied until we are conserving far more of the cats than we are today. Zoos should take pride in conserving this amazing cat through the sale of everything from skeins of Mongolian camel wool yarn, to beautiful felted Kyrgyz carpets – one product at a time.

Partner institutions supporting SLE include Woodland Park Zoo, Kolmarden Zoo, Alaska Zoo, Alexandria Zoo, Big Cat Rescue, Binder Park Zoo, Brecks Baton Rouge Zoo AAZK, Bronx Zoo, Brookfield Zoo, Calgary Zoo, Chattanooga Zoo, Cheyenne Mountain Zoo, Cleveland Zoo, Denver Zoo, Houston Zoo, Jackson Zoo, Lake Superior Zoo, Lincoln Park Zoo, Louisville Zoo, Oklahoma City Zoo, Omaha Henry Doorly, Parc Zoologique de Doue, Parco Zoo Punta Verde, Philadelphia Zoo, Roger Willams Park Zoo, Rosmond Gifford Zoo, Santa Barbara Zoo, Sequoia Park Zoo, Sunset Zoo, Tautphaus Park Zoo, Toronto Zoo, Utah’s Hogle Zoo, Valley Zoo, Zoo Granby, Zoological Society of Manitoba, Disney Worldwide Conservation Fund and David Shepherd Wildlife Foundation.



A strong interest in international conservation led **Dr Tom McCarthy** to Mongolia in 1992, where he took over the management of a long-term snow leopard research project.

The six-year study was the basis for his Ph. D. degree and he became the first to use satellite tracking collars on the cats. He became science and conservation director of the Snow Leopard Trust in 2000 and has since led their extensive science and community-based conservation programmes across much of snow leopard range in Asia. In 2008 he added the position of director of snow leopard programmes with the new organisation Panthera.



Agvaantseren Bayarjargal (Bayara) received her B. Sc. degree from the Mongolian National University in Ulaanbaatar in 1991 and her M. Sc. degree in development studies from the Development

Studies Centre in Dublin in 2004. She co-founded Snow Leopard Enterprises in 1998, and is currently director of Snow Leopard Trust Mongolia and its in-country arm, the Snow Leopard Conservation Fund. In her role as director she oversees all Mongolian staff members, and the overall financial, logistical and personnel management of Snow Leopard Enterprises.

Kristel de Vleeschouwer
Royal Zoological Society
of Antwerp

Linda van Elsacker
Royal Zoological Society
of Antwerp

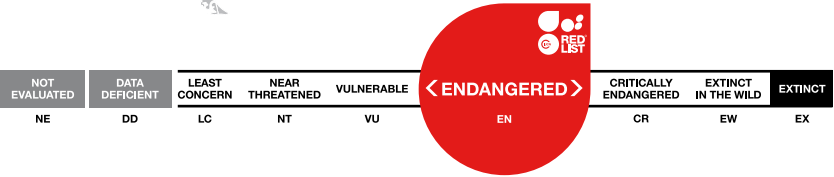
Kristin Leus
IUCN/SSC Conservation Breeding
Specialist Group Europe | Royal
Zoological Society of Antwerp

Golden-headed lion tamarins in focus: Project BioBrasil, a Belgian–Brazilian collaboration on biodiversity

Species	Golden-headed lion tamarin (<i>Leontopithecus chrysomelas</i>)
Range	Eastern Brazil
Population	10,000
Threats	Habitat destruction, inbreeding



© Linda van Elsacker





Fragmentation of the landscape around Una Biological Reserve (© Kristel de Vleeschouwer).

The Brazilian Atlantic forest is one of the most unique and biologically diverse ecosystems on our planet. Continuing deforestation has reduced its surface to less than 7% of its original size. What remains is highly fragmented and degraded. Golden-headed lion tamarins (*Leontopithecus chrysomelas*), small arboreal primates endemic to the Atlantic forests of South Bahia, are classified as “endangered” due to habitat destruction. Habitat degradation and fragmentation cause changes in resource availability and predation risk, and may also affect genetic diversity and inbreeding, causing reproductive and health problems. To survive in these changed environments, tamarins have to alter many aspects of their biology and behaviour.

The tamarins’ distribution range covers approximately 19,462 km² in the south of Bahia, and the extreme north of Minas Gerais. Less than 2% of this area is under some form of protection, the largest protected area being Una Biological Reserve (REBIO-Una), which is 18,500 ha in size. The remaining populations live on privately owned fragments, some extremely small. Two different vegetation types are found within this range: lowland non-seasonal humid forest in the east and inland seasonal semi-deciduous forest in the west. Whereas shade-cocoa plantations (“cabruca”) and agriculture dominate in the east, cattle ranching is the main economic activity in the west. Most fragments in the west are extremely small and isolated. Some relatively large forest fragments still exist in the east, but decreasing cocoa prices and a fungus disease (witch’s broom) force many landowners to convert their “cabruca” into cattle ranches or other crops, causing more forest degradation and fragmentation. Saving the remaining wild tamarin populations will require more protected areas and connecting existing forest fragments.



Golden-headed lion tamarin from one of the study groups, eating an insect during observations (© Linda van Elsacker).



Degraded habitat inside the project's study area within Una Biological Reserve (© Kristel de Vleeschouwer).

The Royal Zoological Society of Antwerp has long been involved in conservation initiatives for the Atlantic forest and tamarins. As coordinator of the international conservation breeding programme, the Royal Zoological Society of Antwerp has managed the worldwide captive population since 1992 and is a member of the international committee for the conservation and management of the lion tamarins, an official technical advisory organ to the Brazilian Institute for Biodiversity. Kristin Leus acts as species coordinator in the international committee. She was also a member of the organisation committee of the 2002 rainforest campaign of the European Association of Zoos and Aquaria, focusing on raising awareness on the problems of the Atlantic forest.

Research on tamarins housed at the Royal Zoological Society of Antwerp has been ongoing since 1987 under coordination of the then research coordinator, Linda van Elsacker, with research topics inspired by the needs of the conservation breeding programme. Kristel de Vleeschouwer conducted her Ph. D. study on tamarins at the Royal Zoological Society of Antwerp from 1995 to 2000.

In 2002, wishing to contribute even more to the conservation of tamarins, the Royal Zoological Society of Antwerp started Project BioBrasil, a conservation research project in REBIO-Una, coordinated by Kristel de Vleeschouwer. Project BioBrasil aims to study tamarins in their natural habitat and participate in science-based conservation initiatives for the Atlantic forest. Its scientific objectives are shaped by the results of a population and habitat viability analysis conducted in 1997. Back then, most data on tamarin biology and ecology came from a tamarin project coordinated by Dr B. E. Raboy and Dr J. M. Dietz from the University of Maryland in relatively well-conserved areas of REBIO-Una. Since most of the habitat left within the tamarin range is degraded and fragmented, data on tamarin ecology and biology from such degraded areas are imperative for developing conservation measures.



Kristel de Vleeschouwer presenting a talk about golden-headed lion tamarins and the project's activities to a local school in a community on the border of Una Biological Reserve (© Lilian Catenacci).



A field assistant from the project and a botanist from the Cocoa Research Centre collecting botanical material for identification (© Michaele de Souza Pessoa).

Project BioBrasil's study area is located in the western part of REBIO-Una, where the forest was exploited by squatters living inside the reserve boundaries until 2001. As a result, most of it is selectively logged or regenerating secondary forest, interspersed with abandoned agricultural areas ("cabruca", rubber and jackfruit) and some small patches of mature forest. The project studies the behaviour and ecology of tamarins in degraded areas and different forest habitats, in order to understand the species' response to forest disturbance, and to provide basic information essential for the development of a conservation management and research plan. Data on the kind of forest that the tamarins use and how they live in degraded areas permit evaluation of the suitability of different forest types and fragments, which is important when choosing areas for conservation, and the location and structure of corridors. The project intends to run for several years, providing long-term data on population dynamics and ecology.

Efficient conservation projects should encompass more than just research: education, local capacity building and integration within a socio-economic context are equally important. Project BioBrasil's strategy follows the general research strategy of the Royal Zoological Society of Antwerp, with the society being responsible for scientific coordination, logistics and administration of the project's activities. Non-science components are pursued through strategic partnerships with local partners. The ultimate goal is to create a self-sustaining project run by in-country staff, independent of further personnel or financial input from the Royal Zoological Society of Antwerp. With this in mind, since its onset the project has actively sought the participation of Brazilian students. Since February 2002, a Brazilian field coordinator oversees the project's daily field activities, a first step towards Brazilian project coordination.



Golden-headed lion tamarin in the forest
(© Linda van Elsacker).

Seedlings from germination experiments conducted by Lilian Catenacci, donated to a local community for reforestation of a river border (© Kristel de Vleeschouwer).

The project's principal local partner is the non-governmental organisation Institute for Socio-Environmental Studies of South Bahia. All in-country staff is employed by the institute within the appropriate legal and social framework. The collaboration with the institute also facilitates application of research results to local conservation actions. Contacts between researchers of Project BioBrasil and the institute have resulted in presentations about tamarins to school groups and the donation of native tree seedlings to a local reforestation programme. The seedlings resulted from germination experiments using seeds extracted from the faeces of tamarins (seed dispersal study by L. Catenacci).

The project has contributed considerably to local capacity building: 21 Brazilians have worked in the project as interns or researchers, and two completed their Master's project (L. Catenacci and M. Pessoa). The Royal Zoological Society of Antwerp also supported C. Guidorizzi's Master's project in the western part of the tamarin distribution area, a study considered of high conservation importance by the population and habitat viability analyses of 1997 and 2005. The data collected by the project team will be instrumental for accurate population and landscape modelling.

The Royal Zoological Society of Antwerp acts as general scientific coordinator, and financial support through the society has been critical for the project's continuation. In addition, donations by several zoos and aquariums, through the Lion Tamarins of Brazil Fund, have supported various project activities over the years. The Scott Neotropical Fund of Cleveland Metroparks Zoo provided financial support to L. Catenacci's Master's project.

Since the 1997 and 2005 population and habitat viability analyses, many new data on tamarin biology have become available. Our understanding of how tamarins use different habitats has improved considerably. These data, along with information on the status of the landscape, genetic structure, health, population dynamics, ecology and behaviour of the different sub-populations, serve as a basis for population and landscape modelling to assess the long-term survival and maintenance of genetic diversity of the tamarin meta-population. Such modelling is an essential tool for defining scientific objectives and elaborating a management plan that defines adequate conservation practices for the meta-population and its landscape.

The Royal Zoological Society of Antwerp now aims to increase its conservation efforts for tamarins by providing its expertise to a multi-disciplinary team of researchers and conservationists that works towards the development and implementation of a tamarin conservation management plan. For several years, a lot of time, money and research effort has been put into collecting a huge dataset. It is now time to collect the last bits of essential information and use these data in one big joint meta-analysis, which will generate a conservation management plan to be implemented in the years to come.

Partner institutions involved in this conservation project include Institute for Socio-Environmental Studies of South Bahia, Cacao Research Centre, Universidade Estadual de Santa Cruz, Universidade Estadual de Norte Fluminense, Universidade Estadual Paulista/Botucatu, Instituto Chico Mendes de Conservação da Biodiversidade (formerly IBAMA), Golden Lion Tamarin Association, University of Maryland and Smithsonian Institution. Sponsors include National Lottery of Belgium, Flemish Ministry of Science, Conselho Nacional de Pesquisa, Deutscher Akademischer Austauschdienst, Lion Tamarins of Brazil Fund, Primate Action Fund/Conservation International, Zoological Society of London and Scott Neotropical Fund of Cleveland Metroparks Zoo.



Dr Kristel de Vleeschouwer graduated as a biologist from the University of Antwerp in 1993. She has been affiliated with the Royal Zoological Society of Antwerp since 1992 and has been involved in conservation-related research on tamarins since 1995, including her Ph. D. study and subsequent postdoctoral research. In September 2002, she started up Project BioBrasil in Brazil. After years of basic scientific research, she now works to move her conservation efforts for tamarins to the next level, by using research data to develop science-driven conservation actions.



Dr Linda van Elsacker received her Ph. D. degree from the University of Antwerp in 1988. She has been working for the Royal Zoological Society of Antwerp since 1988, first as an ethologist and then as head of scientific research (since 2001 named Centre for Research and Conservation) from 1992 to 2004. In March 2004 she became director of research and development, the position she currently holds.



Dr Kristin Leus received her Ph. D. degree from the University of Edinburgh in 1994. From 1996 to 2007 she worked for the Royal Zoological Society of Antwerp, where she was head of the Centre for Research and Conservation from 2004 to 2007. She then took up a position at Copenhagen Zoo as programme officer for the IUCN/SSC Conservation Breeding Specialist Group Europe and as population management advisor for the European Association of Zoos and Aquaria, while remaining a scientific associate at the Royal Zoological Society of Antwerp.

Jim Thomas
Tenkile Conservation
Alliance

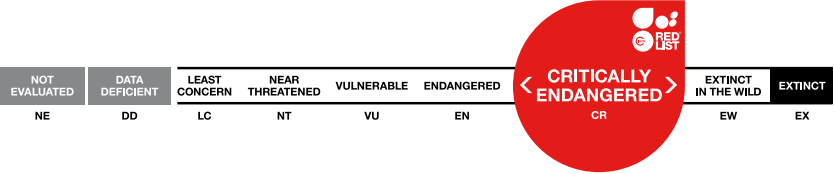
Jean Thomas
Tenkile Conservation
Alliance

Tree kangaroo and biodiversity conservation in Papua New Guinea

Species	Golden-mantled tree kangaroo (<i>Dendrolagus pulcherrimus</i>)
Range	Northern New Guinea Island
Population	Few
Threats	Poaching, habitat destruction



© Matt West





Biodiversity conservation projects



Rabbit husbandry training workshop in Lumi
(© Jean Thomas).

When you think about biodiversity conservation you may be thinking “research”, well so did we before leaving Zoos Victoria in 2003 to become volunteers for the Tenkile Conservation Alliance (TCA), a recently established non-governmental organisation based in Lumi, Sandaun Province, Papua New Guinea. We soon realised that the cool research and cuddly animal focus was just a romantic ideal we would have seen in documentaries. The reality soon hit us that in order to save the tree kangaroos of the Torricelli Mountains we needed to help the people.

We, Jim and Jean Thomas, began a new life of adventure and passion to save one of the most endangered animals in the world, the Scott’s tree kangaroo (*Dendrolagus scottae*), locally known as tenkile. At the time there were thought to be as few as 100 animals remaining in the wild. As of July 2009, we work with 39 villages in the Torricellis. There are 18 tenkile villages and 21 weimang. The weimang (or golden-mantled tree kangaroo, *Dendrolagus pulcherrimus*) is also critically endangered and found here. The Torricellis is the only place where three species of tree kangaroos occur, the grizzled tree kangaroo (*Dendrolagus inustus*) being the third. The human population is about 10,000 and we work in an area of about 200,000 ha.



Wigote village transports cargo on foot for four hours as part of the rural water supply and sanitation project (© Patrick Ikon).

So the big question we had to ask ourselves was how do we protect biodiversity without compromising the diet and needs of local people? We started out by visiting every village and giving lots of awareness on who we were and what we were doing in these remote villages of Papua New Guinea. Over time we gained trust and respect from the people. Only then were we in a position to start implementing various projects including an alternative protein source – rabbits! Now before you all start jumping up and down and start calling us crazy, to us rabbits were the best alternative available, for these reasons: (1) They are easy to feed and live on grass and leaves that are not eaten or needed by people; (2) they breed really well, one female rabbit can produce up to 20 young in a year so given that, one family would only require three female rabbits and a breeding male in order to eat one young a week; (3) the manure produced by rabbits is great fertiliser; and (4) their fur can be used as a replacement to cuscus fur in traditional sing-sing dress. Basically, the rabbit as a mammal would replace other threatened marsupials (mammals) that are most likely to become extinct due to their low breeding rates. Since 2004 the rabbit project has succeeded in some villages and completely failed in others. Although disheartening, the successful villages are so successful that it makes up for the failures. One village in particular, Wigote, stands out with having bred over 300 rabbits. Wigote’s success has led to other villages taking up the challenge of rabbit farming.



Scott's tree kangaroo (© Jean Thomas).

TCA undertook the European Union's rural water supply and sanitation project in 2007 and 2008. We delivered 60 water tanks and improved the health and hygiene of our 18 tenkile villages. This project has helped inspire people to work together and identify the communities' real needs. "Seeing is believing", and this project has shown that we are making a difference. Therefore "non-believers" of conservation have climbed on board and there is a great strength to protect the biodiversity of the Torricelli Mountains.

TCA is also establishing a conservation area. Legal protection of the primary rainforest will provide assurance against major destruction of habitat, which is currently occurring in nearby coastal areas in logging and oil palm projects. All 39 villages have provided written agreements showing their intention to protect their land. Sketch maps, rules and penalties have been written by village communities and once a committee is established, they have been attending a conservation area management training course developed by TCA. Hundreds of people have already attended the workshops and the results have been a major win for us. For example, 91% of people no longer support logging, 97% of people are happy with TCA and the protein projects and 96% of people showed concern for tenkile and weimang.

The workshop uses a combination of scientific and traditional knowledge to illustrate best practices for natural resource use. The participants, who form each village's conservation area management committee, are responsible for encouraging and endorsing changes in their community. Proposed changes include hunting in the designated hunting and gardening zones, adhering to catch limits and transplanting trees. With future management training TCA hopes that these committees will be capable of developing their own eco-tourism ventures and assist visiting researchers.

TCA has established 10 distance-sampling research sites in the Torricelli Mountains to monitor the tenkile populations since 2004. There are now 26 distance-sampling officers and 10 research officers who have been trained in the scientific technique and they now lead local workers in the collection of animal scats each year. We choose to use the distance-sampling technique because it is non-invasive. Our results indicate that the population of tenkile has increased from about 140 (2004) to about 300 (2008). These results coincide with four villages seeing tenkile on their land for the first time in over 20 years.



Biodiversity conservation projects



Jim Thomas is director of the Tenkile Conservation Alliance and holds a B. Sc. degree with honours. He has been the diplomat in solving land disputes in order for him to conduct the field research. Listening and acknowledging people has been essential in achieving the programme’s goals, he says.



Jean Thomas is capacity building officer of the Tenkile Conservation Alliance and holds a B. Sc. degree and a diploma in education. She is responsible for creating and conducting all of the education and training programmes. She says: “Everything we do only gets done if the people want that and are happy. If they don’t want it we don’t do it.”

Mid-montane rainforest in the Torricelli Mountains
(© Thomas Schmid).

Over the years our school education programme has involved a three-day school visit, teacher training and a pen-pal pilot project. TCA has also supplied schools with books, posters and stationery. There are 10 major schools in the project area that TCA has visited and worked with over the years and has developed a good working relationship. TCA is currently in the process of establishing a scholarship programme.

In seven years we have established strong relationships with the villages and the people. People say they want us to die here and be buried in the mountains. This is a good thing we hope. We also have six baby Jeans and four baby Jims named after us. We believe the word of conservation has spread and this is reflected in the conservation songs that have been written by the locals themselves. Words like: look after the animals and bush, think about what TCA is saying so there will not be any “bugger-up” later.

We are often asked, “So, will you ever leave?”. We are devoted conservationists and TCA has achieved more real outcomes than any other programme we have been involved with before. We have saved the tenkile from becoming extinct and it is looking that way for the weimang, too. We are part of the community and we have named our son Tadjji, a Papua New Guinean name meaning “belonging to you”. We have helped so many people and there is still so much work that needs to be done.

So our response is, “Why would we want to leave?”.

We are most grateful to Zoos Victoria, not only because we are former employees but also because they have stuck with us from the beginning and remain our biggest sponsor. It is always comforting to have that strong link.

Debbie Martyr
Fauna & Flora International

Dian Risdianto
Kerinci Seblat
National Park Authority

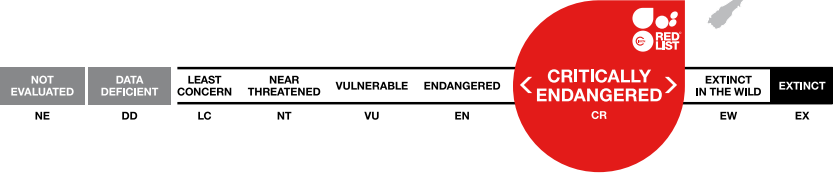
Esther Conway
21st Century Tiger

Just do it: tiger protection and conservation in Kerinci Seblat National Park, Sumatra

Species	Sumatran tiger (<i>Panthera tigris sumatrae</i>)
Range	Sumatra
Population	560
Threats	Habitat destruction, poaching, prey depletion



© Harald Löffler



Biodiversity conservation projects

Snares are entirely indiscriminate and even where an animal survives, as with this island clouded leopard, intensive veterinary work is needed before the animal is released. Veterinary emergency training and tools – including dart guns and anaesthetics – for rangers and local veterinarians are crucial for any anti-poaching unit that wants to be able to respond immediately and effectively (© FFI/TNKS).

Opposite side:
Outside the national park borders, the PHS team usually conducts law enforcement in partnership with local police officers. Dealers form complex networks extending across provinces far from the national park and this case involved a tiger cub from south Bengkulu and the bones of three different tigers, while the suspect was also an agent for an elephant poaching syndicate operating in Riau Province in eastern Sumatra (© FFI/TNKS).



Covering almost 14,000 km² of tropical rainforest in central western Sumatra, Indonesia, Kerinci Seblat National Park (KSNP) is the largest national park in Sumatra, an ASEAN heritage site and a UNESCO world heritage site. The area is a global priority for tiger conservation with approximately 136 Sumatran tigers (*Panthera tigris sumatrae*) in the park (about one-fourth of the estimated total of wild Sumatran tigers), and other important populations in neighbouring forest blocks. The mainly mountainous park – altitude range of 300 to 3,805 m – protects the watershed of some of Sumatra’s largest rivers. The area around the park is predominantly rural, but even in the most isolated areas, development pressures are increasingly apparent – particularly from palm oil, timber plantation companies and mining interests.

Sumatran tigers have been strictly protected under Indonesian law since 1975. However, by late 1998 Fauna & Flora International researchers knew, from snare encounters and local information, that tigers in KSNP faced serious threats. We worked with park rangers to identify the practical responses required and draft a framework for field actions.

The Kerinci Seblat tiger protection and conservation programme – locally known as PHS – became active in May 2000. The team’s primary focus is unchanged – protection and conservation of Sumatran tigers, tiger prey and habitat and, through reduced threat, long-term conservation of Sumatran tigers in the KSNP landscape. Activities are primarily conducted by four-man tiger protection and conservation units (TPCU), each led by a KSNP ranger and supported by young national park officers on secondment to the programme. The units have a mandate to take immediate decisions, including law enforcement, and KSNP has a strong sense of ownership and pride in the programme. The 17 community rangers of the team bring exceptional forest skills and act as ambassadors for tiger conservation in their home communities.



Although we knew tiger poaching was occurring, the new approach quickly revealed that the threat was far higher than feared, with tigers being poached and sold through a complex web of hunters, brokers and dealers. To date, more than 1,400 deer, elephant and tiger poachers and 400 traders or brokers of tiger have been identified. Thanks to the deterrent effect of this programme many of these individuals no longer pose an active threat to tigers.

Investigations confirmed that few people involved in the tiger trade are "poor". Many have criminal records and were not individuals in need of education but criminals gambling on a high return for minimum risk. Money was also behind the surge in deer poaching before the great Islamic festival of Hari Raya at the end of Ramadan, when families break their fast with a celebratory meal and poaching peaks as hunters cash in on demand for meat. Although snares are primarily set for protected Sambar deer (*Cervus unicolor*), tigers are also threatened by the poaching frenzy.

A tiger carcass comprises both skin and bones – we soon learned that while tiger skins are mainly for the domestic market, bone is primarily for export. This means events far from the park influence prices, which soared in 2005/2006 when the People's Republic of China considered legalising domestic tiger bone trade. Within weeks of dropping the proposal, prices fell sharply in all areas of KSNP.

It was also quickly clear that not only was human–tiger conflict around KSNP grossly under-reported but that unresolved conflict was a major factor behind the illegal tiger killings. Once the programme appreciated this, swift mitigation became a programme priority.



Biodiversity conservation projects



An example of a wildlife emergency in Kerinci Seblat – this tigress was caught in a snare allegedly set for wild boar by a local hunter in forests bordering the national park. The tigress was darted and evacuated but gangrene had already set in and despite intensive veterinary treatment she subsequently died from the snare injuries (© FFI/TNKS).



Human–tiger conflict requires an immediate response – if possible, before livestock predation has occurred – to protect both villagers’ livelihoods and tigers. Bamboo or steel noise-making “cannons” are often used to drive curious tigers out of farmland (© FFI/TNKS).

In a long-running project, challenges and threats change, thus the programme is adaptive and flexible while always adhering to its primary mission and goals. Until 2004, the major threat to tiger habitat was from illegal logging – replaced, since 2005, by escalating forest conversion. In response the programme facilitates and collaborates with local conservation non-governmental organisations to secure village and local government support for habitat conservation in and around KSNP. Fauna & Flora International also joined with the Durrell Institute of Conservation and Ecology at the University of Kent to facilitate a tiger and prey species research and monitoring programme, providing invaluable scientific data on tiger and deer populations.

Primary activities include investigations to identify poachers and traders; secure evidence for law enforcement and/or identify priority patrol sites; forest patrols; law enforcement; and human–wildlife conflict mitigation, wildlife rescues and relocations.

In 2000, when this programme launched, there was no clear information on either the number of tigers in KSNP or the extent to which tigers and tiger prey were threatened by wildlife crime or human–wildlife conflict. This has changed quantifiably. More than 4,500 active deer snares and 112 active tiger snares have been destroyed by rangers on patrols covering more than 13,000 km. Poaching threat peaked in 2006 – when 27 active tiger snares and more than 1,156 deer snares were found and destroyed. In comparison, in 2008/2009, only four tiger snares and just over 200 deer snares were found and destroyed. When active tiger snares are found, it is almost invariably on new patrol routes.



All evidence seized by PHS rangers in law enforcement operations must be carefully documented for the subsequent legal process and also to establish how the animal died and, where possible, when. In this case, as in most seizures, the tigress was snared and then shot by the poachers, one of whom claimed to have already poached not fewer than 10 Sumatran tigers in recent years in an area to the north of the national park (© FFI/TNKS).

KSNP is now one of the few national parks in Asia where the decline in tiger populations appears to have been stemmed. TPCU rangers recorded tiger presence every 20 patrol km in the first six months of 2009 compared with 24 km in 2002. Tigers were present on three out of four patrols in 2009 compared with only just over half the patrols in 2002. TPCU rangers have secured the successful prosecution of 41 wildlife poachers or traders and seized the pelts and other body parts of 23 tigers. Many of these men were arrested in carefully engineered "sting" operations that have widely disrupted the illegal trade. Poaching of tigers and deer continues – in such a large area of forest there will always be hunters and traders who gamble they can escape detection. But, providing we maintain a presence, large-scale poaching in key areas is hopefully a thing of the past.



By intervening quickly we always hope to avoid having to catch and relocate a "conflict" tiger (© FFI/TNKS).

This programme is founded on partnership, not only with KSNP but also our donors; the technical support from zoos, particularly zoo veterinarians, has been vital. Zoos have provided technical training to TPCU and national park rangers, with the Zoological Society of London running a veterinary workshop with Fauna & Flora International using Jambi Zoo's facilities and training from Taman Safari Indonesia and the International Zoo Veterinary Group. Australia Zoo has also provided veterinary training and tools – dart guns, anaesthetics and antibiotics. Our zoo partners routinely offer technical advice on confiscated wildlife and wildlife emergencies. Zoos have also been significant donors; 21st Century Tiger, whose funding comes in large part from zoos, has been a supporter since 2001, including during the tiger conservation campaign of the European Association of Zoos and Aquaria (EAZA) in 2002 to 2004. The project is also one of the Australasian Regional Association of Zoological Parks and Aquaria's (ARAZPA) approved conservation projects. Zoos in both regions continue their support. Two TPCU are supported via 21st Century Tiger – one of them fully funded by the Dreamworld Foundation – and another team is supported by Australia Zoo. *Ex situ, in situ*, partners with one purpose – conservation.



Biodiversity conservation projects



Rangers discuss possible causes of human–tiger conflict with villagers and how to prevent future problems (© FFI/TNKS).

Protecting and conserving Sumatran tiger in such a vast landscape requires sustained effort and networking with many different organisations and institutions. We have shown that it is possible to reduce threats to a critically endangered species. The question now is whether the People’s Republic of China will continue to resist businessmen’s demands to legalise trade in tiger bone and whether the more responsible plantation companies can drive industry acceptance that surviving forests in Sumatra, especially tiger habitat, should be conserved for future generations and not trashed for short-term commercial benefit.

Partner institutions involved in this conservation project include 21st Century Tiger, Australia Zoo Wildlife Warriors Worldwide, Busch Gardens, Dreamworld Foundation, Save the Tiger Fund of the National Fish and Wildlife Foundation, U.S. Fish & Wildlife Service Tiger & Rhinoceros Fund, Zoological Society of London, EAZA member zoos, ARAZPA member zoos and the Indonesian Department of Forestry.



Debbie Martyr trained and worked as an investigative news reporter in London before moving to Sumatra to lead a small team conducting biodiversity assessments in and around Kerinci

Seblat National Park between 1995 and 2000 with the support of Fauna & Flora International. She helped to design and form the team for the Kerinci Seblat tiger protection and conservation programme in 2000 and is the team’s technical advisor.



Dian Risdianto was seconded to the Kerinci Seblat tiger protection and conservation programme by the national park authority in 2004 as Jambi field coordinator. In 2007/2008 he was awarded

a scholarship by the BP Conservation Programme to take an M. Sc. degree in conservation biology at the University of Indonesia and returned to the programme in 2009 as field manager. During his time with the programme, he has led eight successful operations resulting in the arrest of tiger poachers or traffickers.



Esther Conway has been half of the 21st Century Tiger administration team since 2006. Her skills and dedication have helped to ensure that 21st Century Tiger has been able to support this project

continually from 1997 to the present.

The bearded vulture: the Alpine region’s perfect flagship species

Species	Bearded vulture (<i>Gypaetus barbatus</i>)
Range	North Africa to central Europe to central Asia
Population	55,000
Threats	Poisoning, habitat destruction



© Goldau Landscape and Animal Park



Biodiversity conservation projects



Three-day-old bearded vulture fledgling with a second egg still in the nest (© Goldau Landscape and Animal Park).



Transport of two bearded vultures for release in the Swiss National Park (© Goldau Landscape and Animal Park).

The bearded vulture (*Gypaetus barbatus*) originally spread from North Africa to Mongolia, with separate sub-species occurring in Ethiopia and South Africa. In 1913, the last bearded vulture was killed in the Alps. As the bearded vulture insulates its nest with lamb wool and is often seen flying with such, it was erroneously believed to predate on lambs. Unimaginably, bounties were paid for the killing of these birds.

Various biological oddities are responsible for the now increased popularity of the species. Although it is a bird of prey, it does not hunt but scavenges. Its main nutritional item is bones. It dyes its plumage, which is an innate behaviour. It mates and then incubates the eggs during winter in the steepest cliffs possible. The apparent cannibalism (the killing of the twin and its consumption afterwards) makes it a biblical bird. Its flight games with conspecifics as well as with eagles are spectacular. Therefore, the bearded vulture is commonly regarded as a flagship species of the Alpine region.

The first reintroduction of the bearded vulture into the Alps was attempted by Carl Stemmler as early as 1922. In 1974, the first *ex situ* breeding of the bird succeeded at Innsbruck Zoo (Austria). The reintroduction programme then started in 1978. The aim was to establish an Alpine population of about 300 birds. These released birds were expected to connect to the existing populations in Corsica (France) and the Pyrenees of Spain and France. Furthermore, post-release monitoring was meant to aid the collection of further facts and figures about bearded vultures for research purposes.

Various zoos put their bearded vultures at the disposal of the project. Dr Hans Frey of the University of Veterinary Medicine Vienna coordinated the breeding efforts and established a breeding centre at Haringsee (Austria). Further breeding centres followed in Haute-Savoie (France), Goldau (Switzerland), Guadalentin and Valcallant (both Spain). Local government bodies identified appropriate release sites, taking into consideration the necessary requirements such as historic occurrence, nutrition, thermal conditions and acceptance by the local inhabitants.



Adult and juvenile bearded vulture with marked feathers (© Daniel Hegglin).

It was decided that the birds are to be released using the so-called hacking method. When the captive-bred birds are 90 days old – that is before they are fledged – they are put in an artificial nest in the assigned reintroduction area. This allows the young and inexperienced birds to memorise the habitat characteristics of their new home for about 30 days. At the age of around 120 days the young birds then leave the nest, although they remain within its vicinity for some time. The birds were marked by bleaching individual feathers, making them individually identifiable until moulting. The first release occurred at Rauris in the Hohe Tauern National Park (Austria) in 1986. Others followed, for example in Haute-Savoie in 1987, in the Swiss National Park in 1991 and in the Parco Naturale dell'Argentera (Italy) in 1994. By 2009 a total of 163 bearded vultures were reintroduced into the Alps. Another project was started in Andalusia (Spain) in 2007 with the release of 13 bearded vultures. The estimated project costs add up to €25 million.



Release into the wild is an important public and media event like here in Italy's Val di Martello (© Goldau Landscape and Animal Park).

Fortunately, the first breeding in the wild was successful in Haute-Savoie in 1997. The following year a second brood was sighted in Bormio (Italy). In total, 69 birds have hatched in the Alps of Italy, France and Switzerland up until 2009. A total current population size of about 120 individuals originating from the reintroduction programme and an unknown number of surviving naturally born individuals can be assumed. In addition, the current counts show 25 bearded vultures in Corsica, 14 in Crete (Greece) and around 450 in the Pyrenees.



Breeding enclosure for bearded vultures (© Goldau Landscape and Animal Park).

The rearing of bearded vultures in breeding centres over the years has also led to new research results. Eggs are not being robbed, but burst eggs are eaten by their parents within a few minutes. Hatchling assistance may be necessary. Infections of the umbilical cord occasionally lead to losses. The rearing by wet-nurses and the hacking method are successful. Nowadays the monitoring is being coordinated and is highly effective. The movements of individual birds can be followed on the Internet by means of satellite telemetry. Thanks to this technique individual birds can be rescued if necessary. The genetic variability of the Alpine population is larger than in the Spanish population. In the future young birds can be genetically sexed before being taken to specific release areas. Pairs have more genetic exchange in nature than previously assumed. Genetic investigations even helped to categorise bearded vultures from various museums.

The success of this project was only possible thanks to the support of the many local communities and conservation organisations involved. Life Projects of the European Union have on several occasions supported international scientific studies. Furthermore, organisations such as Eulen- und Greifvogelschutzverein Österreich, Stiftung Pro Bartgeier, Foundation for the Conservation of the Bearded Vulture, Frankfurt Zoological Society, WWF Austria, University of Veterinary Medicine Vienna, University of Zurich, Agence pour l'Étude et la Gestion de l'Environnement (now called Asters), Ecogenics and national parks in Austria, France, Germany, Italy and Switzerland are all engaged in this conservation project.



Bearded vulture enclosure with exhibition (© Goldau Landscape and Animal Park).

Zoos provide their establishments for the rearing of juvenile bearded vultures. Very importantly, zoos also inform the public about the plight of bearded vultures. In the future this will be even more important as recent use of poison for various predators has caused victims amongst the vulture population. Here, extensive educational information is required. Zoos involved in the project reach an estimated 20 million visitors per year. By keeping bearded vultures together with mountain hares (*Lepus timidus*) in the same enclosure at Goldau Landscape and Animal Park, thousands of visitors learned that the birds are scavengers and do not kill live prey. In addition, a permanent exhibition allows visitors to watch the breeding, hatching, feeding and growing of juvenile birds. These are lifelong experiences that can influence a visitor's attitude towards the conservation of bearded vultures. People who are interested in further information are provided with publications and can take part in guided tours and workshops run by the zoo. This is a way to show that the bird's living space depends on an intact mountain ecosystem.

The reintroduction of the bearded vulture in the Alps can be assumed a success. For about 10 more years there should be releases in specific sites in the Alps. The original ambition to connect the Alpine population with the birds in Spain will most probably be achieved. Additional information of the public about possible future release sites (in the Balkans and Sardinia) is important. Securing the future of the small population in Corsica is urgent. The use of poison for feral dogs and grey wolves (*Canis lupus*) causes great concern among the people in charge, as this method causes unwanted victims among bearded vultures and other raptors. Again, it is very important to inform local inhabitants and to prosecute the suspects. The lingering poisoning by lead ammunition is another problem that must be solved immediately. It will be important that the remnants of lead-contaminated kills in areas with bearded vultures are buried by the hunters. Efforts are under way in this regard.



Biodiversity conservation projects



Exhibition on the return of the bearded vulture
(© Goldau Landscape and Animal Park).



Dr **Felix Weber** studied veterinary medicine at the University of Berne. Between 1975 and 1979 he studied endoparasite infections in ungulates at Goldau Landscape and Animal Park for his thesis. Between 1977 and 1990 he was partner in an animal clinic. He became a member of the administrative board of Goldau Landscape and Animal Park in 1978 and director in 1990, a position from which he retired in April 2009.

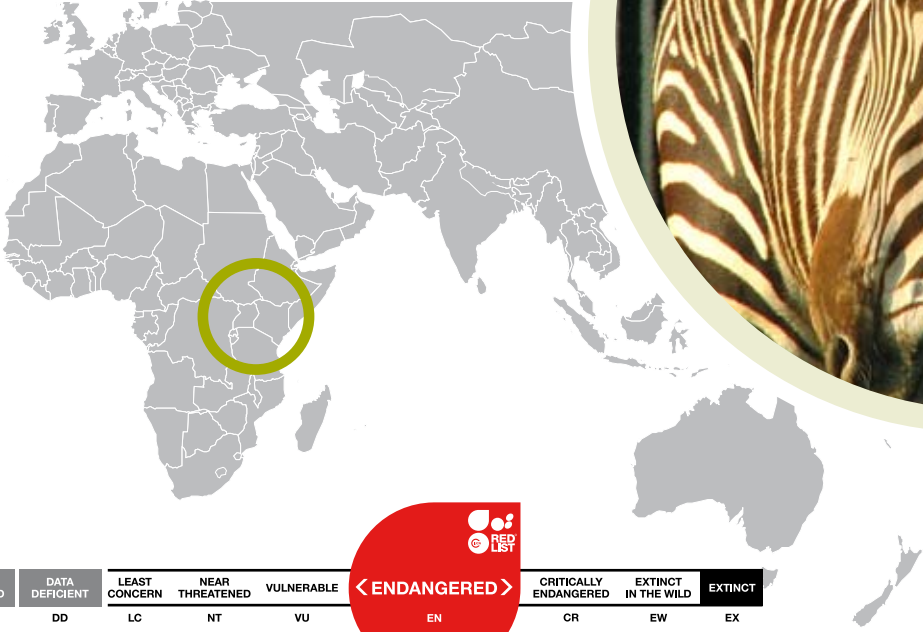
The following zoos are involved in the European Endangered Species Programme for the bearded vulture in 2009: Alma Ata, Antwerp, Berlin (animal park and zoo), Berne, Belgrade, Chomutov, Fauconery du Puy, Goldau, Hanover, Helsinki, Innsbruck, Jerez, La Garenne, Liberec, Monticello, Moscow, Nikolaev, Nuremberg, Ostrava, Parco Natura Viva, Parco Paradiso, Prague, Poznań, Riga, San Diego, Stuttgart, Vienna, Tallinn, Walsrode and Wuppertal.

Martha Fischer
Saint Louis Zoo

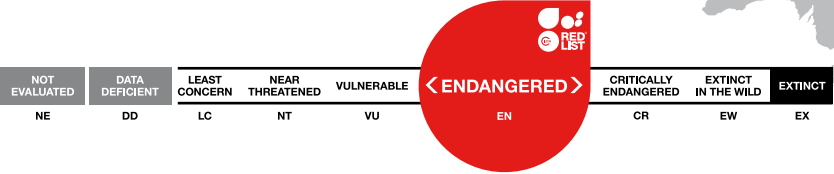
Belinda Low
Grevy's Zebra Trust

What's black and white and endangered all over? Together, we can conserve Grevy's zebra in Kenya and Ethiopia

Species	Grevy's zebra (<i>Equus grevyi</i>)
Range	Kenya, Ethiopia
Population	2,500
Threats	Habitat destruction, competition, poaching, disease



© Kate Reed





Grevy's zebra crossing a road in Kenya (© Jeffrey Bonner).

The largest of all wild equids, the Grevy's zebra (*Equus grevyi*), is now considered "endangered" across its range, with less than 150 in Ethiopia and the remainder, perhaps 2,400, in northern Kenya. Grevy's zebras are distinguished from other zebras by the intricate pattern of narrow black and white stripes on their skins. Unfortunately, this same trait made Grevy's zebra highly prized by trophy hunters in the past; thankfully, such trophy hunting has been outlawed for decades, but illegal poaching for food and medicinal purposes has continued to drive this species towards the precipice of extinction. The process has been accelerated by critical range reduction and competition over scarce resources accompanied by an unprecedented influx of humans and their domestic livestock. In addition, there has been a significant, very recent decline in the species in northern Kenya due to disease and drought. These factors have combined to produce a devastating depopulation of this distinctive species, an alarming decline estimated to be as much as 87% over the last three decades.

The conservation of the Grevy's zebra requires commitment and coordination among many partners locally and internationally. Like many species facing an uncertain future in the wild, the Grevy's zebra is being cooperatively managed and bred in international zoo programmes to ensure that the herds in human care remain genetically and demographically viable for future generations. The cooperation and transfer of Grevy's zebras among zoos and between regionally managed programmes guarantee the continued success of the global zoo population.



Grevy's zebra scout collecting data in northern Kenya (© Belinda Low).

Grevy's zebra in Kenya (© Diane Wilson).

In tandem with their *ex situ* conservation efforts, international zoos are playing a key role in Kenya and Ethiopia by providing financial support and fundraising assistance for Grevy's zebra *in situ* conservation initiatives. As providers of a wide range of invaluable knowledge and experience, international zoos also give technical support and training in many disciplines to Grevy's zebra field conservation and research programmes. The donation of second-hand equipment in good condition, such as laptop computers and cameras, is yet another way in which zoos are offering resources that otherwise might not be available to communities and thus are enhancing the core operations of community-run conservancies.

Since 2004, dozens of international zoos have become collaborative partners in field conservation programmes in the effort to save Grevy's zebra. With this continued commitment, the combination of global cooperative zoo programmes, heightened international awareness to the plight of the endangered Grevy's zebra and increased field conservation partnerships will save this magnificent species from extinction.

With less than a half of a per cent of the Grevy's zebra range falling within official protected areas, this species' survival depends heavily upon the attitudes and engagement of people in community areas. Towards this end, in 2007 the Grevy's Zebra Trust, an independent wildlife conservation organisation based in Kenya, was established to address the urgent need to conserve Grevy's zebra in the community rangelands of Ethiopia and Kenya. The Grevy's Zebra Trust is working holistically to secure critical resources and safeguard this species from extinction across its range by engaging communities in Kenya and Ethiopia in the protection and monitoring of Grevy's zebra.



Biodiversity conservation projects



Belinda Low meeting with community members of West Gate in Kenya (© Martha Fischer).

Because the future of the Grevy’s zebra hangs in the balance, it is critical to monitor the populations within community areas. The Grevy’s Zebra Trust facilitates a collaborative initiative called the Grevy’s zebra scout programme in the community areas of northern Kenya. This programme employs women and men of the communities that share land with Grevy’s zebras to collect data on the distribution and abundance of the zebras. This successful programme provides the benefit of equal-opportunity employment in the participating communities, a direct and tangible community incentive to support conservation activities.

The positive effect of the Grevy’s zebra scout programme is evident not only on the ground where you can now regularly see livestock and Grevy’s zebra sharing resources in communities where the programme is active, but it is also evident in the attitudes of community members, as noted in the following quote by Chereb Lechooriong, a Grevy’s zebra scout from the Sessia community:

“Since the project started we have been seeing the goodness of the work and we enjoy it. We are learning more and didn’t know the importance of Grevy’s zebra at the beginning. Before the project started, Grevy’s zebras were afraid of livestock and people but now they are not afraid. Even the herders accept them to pass next to them. Monitoring of Grevy’s zebra was the responsibility of the scouts, but now it has become the responsibility of the whole community and they report sightings to the scouts.”



Samburu women and girls dancing in West Gate community (© Martha Fischer).

The information gathered by the Grevy’s zebra scouts guides the local conservation plans of the community-led conservancies so that community members themselves have the opportunity to make recommendations on ways to reduce competition between Grevy’s zebra and livestock.

Also through the Grevy’s Zebra Trust, Grevy’s zebra ambassadors are employed from remote communities in northern Kenya where Grevy’s zebras are most threatened and where awareness of their conservation is low. The role of the Grevy’s zebra ambassadors is threefold: to carry out routine security patrols to enhance the safety of the zebras and other wildlife, to collect field data on Grevy’s zebra in order to inform local conservation strategies and to consistently raise awareness among and engage their fellow community members in the importance of conserving the species. Grevy’s zebra ambassadors facilitate regular informal meetings with community members they come into contact with on their daily patrols and, more formally, hold annual meetings with their communities to facilitate knowledge exchange, track programme progress, share recommendations and receive direct input into local conservation plans.



Grevy's zebras in West Gate Conservancy in Kenya (© Martha Fischer).

To ensure continued community support for Grevy's zebra conservation, the Grevy's Zebra Trust holds community awareness workshops that are designed for knowledge exchange and discussion on Grevy's zebra conservation. Successful educational outreach also requires broad connections at many levels, and action by children is one of the most effective ways to initiate change in the behaviour of adults. The Grevy's Zebra Trust awards secondary school bursaries (scholarships) to promising students from communities that host Grevy's zebra populations. The pastoral communities of northern Kenya are economically marginalised and this type of support to the education of their children is highly valued; it builds the capacity of the future generation and is a major catalyst in changing attitudes towards wildlife.

"There are opportunities that are arising from this project that are good. Nkai (Samburu god) has given us that heart of taking care of wildlife and people are supporting us to do this. Let's come together, work together and be united." These are the inspiring words of Rikapo Lenti-yoo, the coordinator for the Grevy's zebra scout programme, when he was asked to share his thoughts on the programme, the community conservancies and their partnerships with zoos.

Successful ongoing programmes like the Grevy's zebra scout programme exemplify the kind of holistic and synergistic approach that community conservation is all about. The communities have embraced the notion that what is good for the wildlife can be very good for the community. With continued investment into community-led conservation programmes and into specific activities that address the threats facing Grevy's zebra, there is hope for this species in its native range.

And in the case of Grevy's zebra, community conservation is not limited to Africa. After only a short period of time, the ongoing campaign to raise awareness of Grevy's zebra within the zoo community has piqued the interest and encouraged the involvement of many individuals and zoological organisations internationally. As a result, responsiveness to the issues facing Grevy's zebra has risen to a high level and the global perception of this species has changed drastically. It is now realised that Grevy's zebras are a treasure that warrants conservation attention and investment both in our zoo community and in the wild.

We deeply appreciate the exceptional commitment to Grevy's zebra conservation by the following institutions that support the Grevy's Zebra Trust: African Wildlife Foundation, American Association of Zoos and Aquariums' Equid Taxon Advisory Group, Brevard Zoo Conservation Fund, California Desert Chapter of AAZK, Chicago Zoological Society/Chicago Board of Trade, Cleveland Metroparks Zoo, Dallas Zoo, Denver Zoological Society, Detroit Zoological Society, Disney Worldwide Conservation Fund, Earthwatch Institute, Environmental Systems Research Institute, Fauna Research Inc., Gilman International Conservation/White Oak Conservation Centre, Jackson Zoo, Jacksonville Zoo, James Warwick Photography, Kenya Wildlife Service, Lewa Wildlife Conservancy, Los Angeles Zoo & Botanical Gardens, Greater Los Angeles Zoo Association, Marwell Preservation Trust, Mohamed bin Zayed Species Conservation Fund, Mulhouse Zoo, Oakar Services, Oklahoma City Zoo, Oklahoma City Zoo AAZK, Oregon Zoo Foundation's Future for Wildlife Conservation Fund, Northern Rangelands Trust, Phoenix Zoo, Prince Bernhard Fund for Nature, Princeton University, Riverbanks Zoo, Sacramento Zoo, Saint Louis Zoo AAZK, Saint Louis Zoo's WildCare Institute, Sea World & Busch Gardens Conservation Fund, Sedgwick Co. Zoo, Toronto Zoo, U.S. Agency for International Development, Utah's Hogle Zoo, Wildlife Conservation Network, Zoological Society of San Diego and Zürcher Tierschutz.



Martha Fischer holds a B. Sc. degree in animal science from the University of Missouri – Columbia. She started out her career as an antelope area keeper at Saint Louis Zoo over 23 years ago and has enjoyed serving as the zoo's curator of mammals/ungulates and elephants for over 13 years. She champions one of the 12 centres within the WildCare Institute and serves as director for the Centre for Conservation in the Horn of Africa. She chairs the board of trustees for the Grevy's Zebra Trust.



Belinda Low holds an M. Sc. degree in conservation biology from the University of Kent. She started working in Grevy's zebra conservation at the Lewa Wildlife Conservancy in 2001. Moving on to the Northern Rangelands Trust in 2005, she developed the northern rangelands endangered species programme, which began the crucial expansion of Grevy's zebra conservation into community-owned lands where the majority of the remaining animals reside. This work led to the founding of the Grevy's Zebra Trust, for which she serves as executive director.

WAZA

conservation projects

Below we provide a comprehensive list of all 163 conservation projects branded by the World Association of Zoos and Aquariums (WAZA) up until September 2009, starting with the project number (first two digits indicate year of branding), followed by the name and a short description of the project. Organisation(s) implementing the project are indicated in parentheses. Asterisks indicate projects that responded to our questionnaire survey to evaluate the conservation impact of these projects (see chapter by Gusset & Dick in this book). The evaluation included projects up to number 09001. Projects reaching top impact scores in our evaluation are highlighted in colour: **blue** indicates projects that reached maximum scores and **red** indicates projects with the second highest possible score. Visit the conservation section on the WAZA website (www.waza.org) for further details about the projects.

- **03001** | Scharnstein Waldrapp Project: to establish a migratory colony of northern bald ibises in Austria (waldrappteam.at)*
- **03002** | **Gobi B Takhi Project: to re-establish Przewalski's horses in Mongolia by means of reintroduction (International Takhi Group)***
- **04001** | Luambe Conservation: to support and develop Luambe National Park in Zambia (Luangwa Wilderness)*
- **04002** | Altyn Emel Przewalski's Horse Project: to re-establish Przewalski's horses in Kazakhstan by means of reintroduction (Munich Zoo)
- **04003** | Grünau Waldrapp Project: to establish a non-migratory colony of northern bald ibises in Austria (Konrad Lorenz Research Station)*
- **04004** | Proyecto Eremita: to breed and reintroduce northern bald ibises into their former range in Spain (Jerez Zoological-Botanical Gardens and Junta de Andalucía)*
- **04005** | Proyecto Titi: to promote the survival of cotton-top tamarins in Colombia by means of environmental education (Baranquilla Zoo and Disney's Animal Kingdom)
- **04006** | Baranquilla Pet Parrot Campaign: to promote the survival of parrots in Colombia by means of environmental education (Baranquilla Zoo)
- **04007** | Tonkin Snub-nosed Monkey Conservation: to conserve Tonkin snub-nosed monkeys in Vietnam (Münster Zoo, Zoological Society for the Conservation of Species and Populations and Westphalian Society for Conservation)*
- **04008** | Endangered Primate Rescue Centre: to rescue and breed confiscated primates and to conduct primate field surveys in Vietnam (Frankfurt Zoological Society)*
- **04009** | **Cat Ba Langur Conservation Project: to promote the survival of Cat Ba langurs in Vietnam (Münster Zoo and Zoological Society for the Conservation of Species and Populations)***
- **04010** | Angkor Centre for the Conservation of Biodiversity: to increase awareness of and breed endangered species in Cambodia (Münster Zoo and Zoological Society for the Conservation of Species and Populations)*
- **04011** | International Centre for the Conservation of Turtles: to establish a breeding and education centre for Asian turtles in Germany (Münster Zoo)*
- **04012** | **Philippine Spotted Deer Conservation: to breed and promote the survival of Philippine spotted deer in the Philippines (Zoological Society for the Conservation of Species and Populations and Fauna & Flora International)***
- **04013** | Bshar el Kh-ir Project: to breed and reintroduce northern bald ibises into their former range in Morocco (Waldrapp Working Group)
- **04014** | Hainan Gibbon Research and Conservation: to study and promote the survival of Hainan gibbons in China (Zoological Society of Paris)
- **04015** | **Langur Reintroduction: to rehabilitate and release confiscated langurs in Vietnam (Cologne Zoo)***
- **04016** | **Tree Kangaroo Research and Conservation: to study and promote the survival of tree kangaroos in Papua New Guinea (Tenkile Conservation Alliance)***
- **04017** | Gobi B Khulan Project: to study and promote the survival of Asiatic wild asses in Mongolia (International Takhi Group)*
- **04018** | Bosawas Centre for Mesoamerican Conservation: to study and promote the survival of wildlife in Nicaragua (Saint Louis Zoo)*
- **04019** | **Galapagos Centre for Avian Health: to assess disease risks for birds on Ecuador's Galapagos Islands (Saint Louis Zoo, University of Missouri – St. Louis and Charles Darwin Foundation)***



Biodiversity conservation projects

- **04020** | Tai Forest Chimpanzee Conservation: to promote the survival of western chimpanzees in Côte d'Ivoire both *in situ* and *ex situ* (Wild Chimpanzee Foundation and Leipzig Zoo)*
- **04021** | West African Primate Conservation Action – WAPCA: to promote the survival of monkeys in Ghana (WAPCA)
- **04022** | Pinnewela Elephant Orphanage: to rescue and breed Asian elephants in Sri Lanka (Vienna Zoo)*
- **04023** | Bearded Vulture Reintroduction: to breed and reintroduce bearded vultures into their former range in the Alps (Stiftung Pro Bartgeier, Foundation for the Conservation of the Bearded Vulture and Frankfurt Zoological Society)*
- **04024** | [Grevy's Zebra Conservation: to promote the survival of Grevy's zebras in Kenya \(Grevy's Zebra Trust\)*](#)
- **04025** | Humboldt Penguin Conservation Centre: to promote the survival of Humboldt penguins in Peru (Brookfield Zoo, Philadelphia Zoo and Saint Louis Zoo)
- **04026** | Roan Antelope Reintroduction: to breed and reintroduce roan antelopes into their former range in Swaziland (Back to Africa and Big Game Parks)*
- **04027** | Sable Antelope Reintroduction: to breed and reintroduce sable antelopes to supplement stocks in South Africa (Back to Africa)
- **05001** | Hellbender Conservation Centre: to breed and reintroduce hellbenders to supplement stocks in the USA (Saint Louis Zoo)
- **05002** | American Burying Beetle Conservation Centre: to survey existing populations and reintroduce captive-bred American burying beetles into their former range in the USA (Saint Louis Zoo)*
- **05003** | Manatee Conservation Centre: to establish a rehabilitation facility and information centre for manatees in Venezuela (Dallas World Aquarium)
- **05004** | Sundance Project: to increase awareness of wildlife in Zimbabwe by means of environmental education (Sundance Wildlife Park)
- **05005** | African Penguin Conservation: to rescue, rehabilitate and release African penguins in South Africa (Southern African Foundation for the Conservation of Coastal Birds)*
- **05006** | European Bison Reintroduction: to breed and reintroduce European bison into their former range in Slovakia (Goldau Landscape and Animal Park)
- **05007** | European Bison Reintroduction: to breed and reintroduce European bison into their former range in Romania (Goldau Landscape and Animal Park and Berne Animal Park)*
- **05008** | Wattled Crane Recovery Programme: to breed, study and promote the survival of wattled cranes in South Africa (Endangered Wildlife Trust and Johannesburg Zoo)*
- **05009** | White Stork Conservation: to provide nesting sites for white storks in Switzerland (Basel Zoo, Zurich Zoo and Langen Erlen Animal Park)*
- **05010** | Small Carnivore Conservation Centre: to rescue, breed and increase awareness of small carnivores in Vietnam (Cuc Phuong National Park)*
- **05011** | Australian Orang-utan Project: to promote the survival of orang-utans in Indonesia and Malaysia (Perth Zoo, Adelaide Zoo and National Zoo and Aquarium)*
- **05012** | Masoala Conservation: to support Masoala National Park in Madagascar both *in situ* and *ex situ* (Madagascar National Park Service, Wildlife Conservation Society and Zurich Zoo)*
- **05013** | Alpine Ibex Reintroduction: to reintroduce captive-bred Alpine ibexes into their former range in Italy (Parco Naturale Regionale delle Prealpi Giulie)
- **05014** | African Wildlife Disease Database: to create a disease database for wildlife in South Africa (National Zoological Gardens of South Africa)*
- **05015** | Betampona Conservation: to manage and support Betampona Natural Reserve in Madagascar (Madagascar Fauna Group and Madagascar National Park Service)*
- **05016** | Ivoloia Conservation and Training Centre: to support a conservation and training centre in Madagascar (Madagascar Fauna Group and Madagascar National Park Service)*
- **05017** | Alpine Ibex Reintroduction: to breed and reintroduce Alpine ibexes to supplement stocks in Austria (Innsbruck Zoo)*
- **05018** | Black Stork Reintroduction: to reintroduce captive-bred black storks into their former range in Italy (Parco Lombardo del Ticino)
- **05019** | Cheetah Research and Conservation: to study and promote the survival of cheetahs in Zimbabwe (Marwell Zimbabwe Trust)
- **05020** | Rhino Conservation: to promote the survival of black and white rhinos in Zimbabwe (Marwell Zimbabwe Trust)
- **05021** | Small Antelope Research and Conservation: to study, breed and increase awareness of various small antelope species in Zimbabwe (Marwell Zimbabwe Trust)
- **05022** | African Wattled Crane Programme: to monitor the status and threats to the survival of wattled cranes across Africa (International Crane Foundation and Endangered Wildlife Trust)*
- **05023** | Cheetah Research and Conservation: to conserve cheetahs in Botswana by means of research, community outreach and environmental education (Cheetah Conservation Botswana)*
- **05024** | Humpback Dolphin Project: to decrease by-catch and increase awareness of humpback dolphins in South Africa (Endangered Wildlife Trust)
- **05025** | Riverine Rabbit Conservation: to promote the survival of riverine rabbits in South Africa (Endangered Wildlife Trust)*
- **05026** | Oribi Conservation: to promote the survival of oribi in South Africa (Endangered Wildlife Trust)*
- **05027** | Asian Rhino Project: to provide funding for on-ground operations to conserve the three rhino species across South-East Asia (Asian Rhino Project)*
- **05028** | [Western Swap Tortoise Breeding for Release Programme: to breed and reintroduce western swamp tortoises into their former range in Australia \(Perth Zoo\)*](#)
- **05029** | [Numbat Breeding for Release Programme: to breed and reintroduce numbats into their former range in Australia \(Perth Zoo\)*](#)
- **05030** | [Dibbler Breeding for Release Programme: to breed and reintroduce dibblers into their former range in Australia \(Perth Zoo\)*](#)

- **05031** | **Frog Research and Breeding: to build a safety net for frogs in Australia by means of research and breeding (Perth Zoo)***
- **05032** | Grey Partridge Reintroduction: to reintroduce captive-bred grey partridges into their former range in Switzerland (Swiss Ornithological Institute)
- **05033** | Western Pond Turtle Recovery Programme: to breed and reintroduce western pond turtles to supplement stocks in the USA (Woodland Park Zoo and Oregon Zoo)
- **05034** | Oregon Silverspot Butterfly Recovery Programme: to breed and reintroduce Oregon silverspot butterflies to supplement stocks in the USA (Woodland Park Zoo and Oregon Zoo)
- **05035** | Painted Dog Conservation Project: to protect and increase the range and numbers of African wild dogs in Zimbabwe (Painted Dog Conservation)
- **05036** | **Virgin Islands Boa Reintroduction: to breed and reintroduce Virgin Islands boas into their former range in the U.S. Virgin Islands (Toledo Zoo)***
- **05037** | Jambi Tiger Project: to study and promote the survival of Sumatran tigers in Indonesia (Zoological Society of London and Global Tiger Patrol)*
- **05038** | **Tiger Protection and Conservation Units: to conserve Sumatran tigers in Indonesia by means of effective law enforcement and conflict mitigation (Fauna & Flora International)***
- **05039** | Addax and Oryx Reintroduction: to breed and reintroduce addaxes and scimitar-horned oryxes into their former range in Tunisia (Sahara Conservation Fund)*
- **05040** | European Mink Reintroduction: to breed and reintroduce European minks into their former range in Estonia (Tallinn Zoo)*
- **05041** | Barn Owl Reintroduction: to breed and reintroduce barn owls to supplement stocks in the Czech Republic (Ostrava Zoo)*
- **05042** | Alpine Ibex Reintroduction: to breed and reintroduce Alpine ibexes into their former range in Austria (Munich Zoo)
- **06001** | Tomato Frog Research: to study the distribution and life history of tomato frogs in Madagascar (Museo Regionale di Scienze Naturali Torino and Gondwana Conservation and Research Cologne)*
- **06002** | Puerto Rican Crested Toad Species Survival Plan: to breed and reintroduce Puerto Rican crested toads into their former range in Puerto Rico (Association of Zoos and Aquariums)
- **06003** | Mabula Ground Hornbill Project: to promote the survival of southern ground hornbills in South Africa (Mabula Ground Hornbill Research and Conservation)
- **06004** | Djibouti Conservation: to conserve and increase awareness of biodiversity in Djibouti (Landau Zoo and Djibouti Nature)*
- **06005** | El Valle Amphibian Conservation Centre: to breed and reintroduce amphibians into their former range in Panama (Houston Zoo)*
- **06006** | Malayan Sunbear and Bearded Pig Research: to study the effects of selective logging on Malayan sunbears and bearded pigs in Malaysia (University of Montana)*
- **06007** | Malayan Flying Lemur Research: to study locomotor behaviour and feeding ecology of Malayan flying lemurs in Singapore (University of California)*
- **06008** | South-East Asian Frog Research: to study reproductive variation in frogs in Singapore and Thailand (University of California)*
- **06009** | Malayan Pangolin Research: to study habitat preference and spatial ecology of Malayan pangolins in Singapore (National University of Singapore)*
- **06010** | **Proboscis Monkey Research: to study the distribution, abundance and conservation status of proboscis monkeys in Malaysia (University of Malaysia)***
- **06011** | Land Snail Research: to study land snail endemism in Malaysia and Singapore (National University of Singapore)*
- **06012** | Cape Griffon Vulture Conservation: to promote the survival of Cape griffon vultures in Namibia (Rare and Endangered Species Trust)*
- **06013** | Frigate Island Beetle Reintroduction: to breed and reintroduce Frigate Island beetles into their former range in the Seychelles (Zoological Society of London)*
- **06014** | Field Cricket Reintroduction: to breed and reintroduce field crickets into their former range in the UK (Zoological Society of London)*
- **06015** | **Pacific Tree Snail Reintroduction: to breed and reintroduce Pacific tree snails into their former range in French Polynesia (Zoological Society of London and French Polynesian Government)***
- **06016** | Black-footed Cat Research: to study the ecology, reproduction and health of black-footed cats in South Africa (Cologne Zoo)*
- **06017** | Amphibian Conservation: to conserve amphibians in Colombia by means of breeding, research and environmental education (Zurich Zoo and Cali Zoo)
- **06018** | Cheetah Research and Conservation: to study and breed cheetahs of northern African origin (Observatoire du Guépard en Régions d'Afrique du Nord)*
- **06019** | Green Toad Reintroduction: to breed and reintroduce green toads to supplement stocks in Sweden (Nordens Ark and Universeum Gothenburg)
- **06020** | Peregrine Falcon Reintroduction: to breed and reintroduce peregrine falcons to supplement stocks in Sweden (Nordens Ark)
- **06021** | White-backed Woodpecker Reintroduction: to breed and reintroduce white-backed woodpeckers to supplement stocks in Sweden (Nordens Ark)
- **06022** | Voronosy Project: to promote the survival of waterbirds in Madagascar (Landau Zoo and Walsrode Bird Park)*
- **06023** | Humboldt Penguin Conservation: to promote the survival of Humboldt penguins in Chile (Sphenisco)*
- **06024** | De Wildt Cheetah Project: to conserve cheetahs in South Africa by means of breeding, research and environmental education (De Wildt Cheetah and Wildlife Trust)
- **06025** | Argali Research and Conservation: to study and conserve argali in Mongolia (Argali Wildlife Research Centre, Denver Zoological Foundation, Mongolian Academy of Sciences and Mongolian Conservation Coalition)*



Biodiversity conservation projects

- **o6o26** | Moose Conservation: to maintain habitat heterogeneity at a biosphere reserve in Germany by grazing with moose (Research Network "Moose in Lusatia")*
- **o6o27** | Taipei Frog Research and Conservation: to promote the survival of Taipei frogs in Taiwan by means of research, habitat restoration and environmental education (Taipei Zoo)*
- **o6o28** | Grey Nurse Shark Research: to establish assisted reproductive technology in grey nurse sharks in Australia (UnderWater World and Melbourne Aquarium)
- **o6o29** | Mongolian Hedgehog Research: to study the life history and co-existence of hedgehogs in Mongolia (Denver Zoological Foundation, Mongolian Academy of Sciences and Mongolian Conservation Coalition)*
- **o6o3o** | Cinereous Vulture Research: to study the ecology of cinereous vultures in Mongolia (Denver Zoological Foundation, Mongolian Conservation Coalition, Mongolian Academy of Sciences and National University of Mongolia)*
- **o6o31** | Maned Wolf Conservation: to promote the survival of maned wolves and other carnivores in Argentina by involving local people (Asociación Huellas)*
- **o7oo1** | Rocky Mountain Carnivore Research: to study carnivore complex dynamics in the USA (Denver Zoological Foundation and Rocky Mountain National Park)*
- **o7oo2** | Olive Baboon Research: to study venereal disease in olive baboons in Tanzania (University of Giessen)
- **o7oo3** | Chiloe Small Cetacean Project: to promote the survival of dolphins in Chile by means of research and environmental education (Yaqu Pacha)*
- **o7oo4** | Bonobo Education Project: to increase awareness of bonobos in the Democratic Republic of Congo (Awely)*
- **o7oo5** | **Life Raft for Frogs: to promote the survival of amphibians in Ecuador by means of breeding, research and environmental education (Pontificia Universidad Católica del Ecuador)***
- **o7oo6** | **Zambian Biodiversity Project: to explore, document and explain animal biodiversity in Zambia (Zoological Research Museum Alexander Koenig Bonn)**
- **o7oo7** | **European Tree Frog Reintroduction: to reintroduce captive-bred European tree frogs into their former range in Switzerland (Goldau Landscape and Animal Park)***
- **o7oo8** | **Tayja-Saruta Project: to promote the survival of lowland tapirs in Ecuador both *in situ* and *ex situ* (Osnabrück Zoo)***
- **o7oo9** | **Wildlife Rescue and Release Programme: to establish a rescue centre to shelter, rehabilitate and release confiscated animals in Vietnam (Cologne Zoo)***
- **o7o1o** | **Forest Protection Programme: to protect pristine forests in Vietnam by means of effective law enforcement (Cologne Zoo)***
- **o7o11** | **Herpetodiversity Research: to study the diversity and ecology of amphibians and reptilians in Vietnam (Cologne Zoo)***
- **o7o12** | **Amphibian and Reptilian Breeding Station: to establish a breeding station for amphibians and reptilians in Vietnam (Cologne Zoo)***
- **o7o13** | **Oriental Pied Hornbill Research: to study the breeding behaviour of Oriental pied hornbills in Singapore both *in situ* and *ex situ* (Jurong Bird Park)***
- **o8oo1** | **Gyps Vulture Reintroduction: to breed and reintroduce three species of gyps vultures to supplement stocks in India, Nepal and Pakistan (Zoological Society of London)***
- **o8oo2** | **Midwife Toad Research: to study the genetics and diseases of midwife toads in Switzerland (University of Zurich)***
- **o8oo3** | **Marine Otter Conservation Programme: to promote the survival of marine otters in Peru by means of research and environmental education (Pro Delphinus)***
- **o8oo4** | **Wildlife Rescue and Conservation Association – ARCAS: to rescue, rehabilitate and release confiscated animals in Guatemala (ARCAS)***
- **o8oo5** | **Snow Leopard Enterprises: to increase rural people's quality of living and protect the snow leopard and its prey in Mongolia and Kyrgyzstan (International Snow Leopard Trust)***
- **o8oo6** | **European Otter Conservation: to analyse the causes of extinction to take measures for the return of European otters in Switzerland (Pro Lutra Foundation)***
- **o8oo7** | **Amphibian Conservation: to promote the survival of amphibians in Switzerland by means of research and environmental education (Zurich Wilderness Park Foundation)**
- **o8oo8** | **Indian Rhino Vision 2020: to promote the survival of Indian rhinos in India (WWF India, Government of Assam and International Rhino Foundation)***
- **o8oo9** | **African Elephant Research: to study tuberculosis in African elephants in Tanzania (Kronberg Zoo and Wuppertal Zoo)**
- **o8o1o** | **Cross River Gorilla Conservation: to promote the survival of cross river gorillas in Nigeria and Cameroon (Wildlife Conservation Society)***
- **o8o11** | **Red Caps Programme: to monitor, understand and resolve human–wildlife conflicts in Nepal by training local people (Awely)***
- **o8o12** | **Nouabalé–Ndoki Conservation: to support and develop Nouabalé–Ndoki National Park in the Democratic Republic of Congo (Wildlife Conservation Society)***
- **o8o13** | **Black Rhino Reintroduction: to breed and reintroduce black rhinos into their former range in Tanzania (Dvůr Králové Zoo)***
- **o8o14** | **Amphibian Conservation: to rehabilitate and manage a pond area to provide breeding sites for amphibians in Germany (Landau Zoo and City of Landau)**
- **o8o15** | **Amur Leopard Conservation: to promote the survival of Amur leopards in China and Russia both *in situ* and *ex situ* (Amur Leopard and Tiger Alliance)***
- **o8o16** | **Midwife Toad Conservation: to provide breeding sites for midwife toads in Germany (Wuppertal Zoo)***
- **o8o17** | **Northern White Rhino Reintroduction: to breed and reintroduce northern white rhinos into their former range in Kenya (Dvůr Králové Zoo)***
- **o8o18** | **Armenian Viper Research: to study range sizes, movement patterns and genetic diversity in Armenian vipers in Armenia (Saint Louis Zoo)***

- **08019** | Partners in Conservation: to address the bushmeat trade and deforestation in Rwanda and the Democratic Republic of Congo by means of environmental education and fundraising (Columbus Zoo and Aquarium)*
- **08020** | Amphibian Conservation: to rehabilitate and manage a sand pit to provide breeding sites for amphibians in Germany (Bischofswerda Animal Park)
- **08021** | Titicaca Water Frog Research: to assess the threats and conservation status of Titicaca water frogs in Bolivia (Species Conservation Foundation and Asociación Armonía)*
- **08022** | Amphibian Conservation: to provide breeding sites for amphibians in Germany (Düsseldorf Aquazoo)*
- **08023** | Amphibian Conservation Centre: to establish a breeding, research and education centre for amphibians in Germany (Düsseldorf Aquazoo)*
- **08024** | Javan Warty Pig Conservation Breeding Programme: to breed and increase awareness of Javan warty pigs in Indonesia (Cikananga Species Conservation Centre and Indonesian Research Centre for Biology)*
- **08025** | Amphibian Conservation: to restore spawning ponds for amphibians in Germany (Biosphere Reserve Oberlausitzer Heath and Pond Area)*
- **08026** | Amphibian Reintroduction: to breed and reintroduce amphibians into their former range in Germany (Nuremberg Zoo)*
- **08027** | Amphibian Conservation: to restore and manage habitat for amphibians in Germany (Nordhorn Animal Park)*
- **08028** | Conservation Area Management: to manage a conservation area in Germany by grazing with an old sheep breed (Nordhorn Animal Park)*
- **08029** | Tropical Forest Conservation: to rehabilitate and protect tropical forests in the Philippines to mitigate climate change and conserve biodiversity (Katala Foundation)*
- **08030** | European Pond Terrapin Conservation: to introduce a nest adoption scheme to promote the survival of European pond terrapins in Austria (Vienna Zoo)*
- **08031** | Dja Periphery Community Project: to work with local communities to build capacity and reduce unsustainable resource use in Cameroon (Bristol Conservation and Science Foundation)*
- **08032** | African Penguin Conservation: to establish new breeding colonies of African penguins in South Africa (Bristol Conservation and Science Foundation)*
- **09001** | Hamster Conservation Plan: to support and improve the survival of common hamster populations in Germany (City of Mannheim)*
- **09002** | Bushmeat Project: to address the illegal, commercial bushmeat trade in Cameroon (Ape Action Africa and Bristol Conservation and Science Foundation)
- **09003** | Programme Sahamalaza – Iles Radama: to advance the understanding and conservation of lemurs in Madagascar (Association Européenne pour l'Étude et la Conservation des Lémuriens)
- **09004** | Eurasian Spoonbill Conservation: to restore habitat for and monitor populations of Eurasian spoonbills in Croatia (Lonjsko Polje Nature Park)
- **09005** | Resource Management System: to design and implement a management system for waste and sustainable water use in Colombia (Santacruz Zoological Foundation)
- **09006** | Osununú Conservation: to protect a native forest in combination with local development in Argentina (Temaiken Foundation)
- **09007** | Lowland Tapir Conservation Initiative: to establish long-term tapir research and conservation programmes in Brazil (Instituto de Pesquisas Ecológicas)
- **09008** | Tree Kangaroo Conservation Programme: to foster wildlife and habitat conservation and support local community livelihoods in Papua New Guinea (Woodland Park Zoo)
- **09009** | Tamar Wallaby Reintroduction: to breed and reintroduce tamar wallabies into their former range in Australia (Mainland Tammar Recovery Team)
- **09010** | Greater Bilby Reintroduction: to breed and reintroduce greater bilbies into their former range in Australia (South Australian Greater Bilby Recovery Team)
- **09011** | Rock Wallaby Reintroduction: to breed and reintroduce brush-tailed rock wallabies into their former range in Australia (Victorian Brush-tailed Rock Wallaby Recovery Team)
- **09012** | Kimberley Conservation: to establish baseline ecological data and identify biodiversity hotspots in this wilderness region of Australia (Conservation Ark and Dunkeld Pastoral Company)
- **09013** | Wombat Research and Conservation: to study the ecology, reproduction, assisted breeding and genetics of hairy-nosed wombats in Australia (Conservation Ark)
- **09014** | Djibouti Conservation Programme: to conserve biodiversity in Djibouti by means of exemplary actions of protection and development (Beauval Zoo, Association Decan, Association Territoires Responsables)
- **09015** | Dorcas Gazelle Reintroduction: to re-establish dorcas gazelles in the Senegal by means of reintroduction (Spanish Research Council)
- **09016** | African Elephant and White Rhino Semen Bank: to establish a semen bank for African elephants and white rhinos from South Africa (Beauval Zoo and Institute for Zoo and Wildlife Research Berlin)



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