

GERMAN-VIETNAMESE LONG-TERM COOPERATION BETWEEN THE COLOGNE ZOO AND THE INSTITUTE OF ECOLOGY AND BIOLOGICAL RESOURCES IN TERMS OF HERPETODIVERSITY RESEARCH AND CONSERVATION

Thomas Ziegler^{1,2}, Truong Quang Nguyen³

¹Cologne Zoo

²Institute of Zoology, University of Cologne

³Institute of Ecology and Biological Resources,
Vietnam Academy of Science and Technology

Herpetodiversity research

“You can only protect what is well known to you”, thus, we jointly plan and perform field excursions and diversity research since long to investigate herpetofaunal communities of poorly known regions in Vietnam and since recently also in Laos. The outcomes of our integrative taxonomic analyses, viz. the combination of morphological and molecular datasets are publications of herpetofaunal lists for such regions, reserves or provinces, including first regional or country records of species or even new species discoveries (Ziegler & Nguyen 2015). Also species group revisions and positioning of poorly known or newly described species in phylogenetic trees help to better understand diversity and uncover cryptic, viz. hidden diversity. For example, our team has discovered and so far described about 60 new species of amphibians and reptiles from Vietnam in the past two decades and more than 20 new species of herpetofauna from Laos in the past seven years (Nguyen & Ziegler 2012; Ziegler 2012, 2016; Luu et al. 2016) (Fig. 1).



Figure 1: **The Waza Treefrog (*Gracixalus waza*), a recently discovered anuran species from northern Vietnam.**

Photo: Truong Q. Nguyen



Figure 2: **The Psychedelic Rock Gecko (*Cnemaspis psychedelica*), an endemic species for Vietnam; we have studied the population status and built up a conservation breeding program. Photo: Thomas Ziegler**

Natural history research

Once species are documented for or described from a certain region, ecological research comes to the fore. Conservation based ecological research helps to answer questions related to habitat requirements, microhabitat use or population size, to name only a few approaches (Bernardes et al. 2012, 2013; Loos et al. 2012; Rauhaus et al. 2012; Ngo et al. 2016a, 2016b).

Application of species distribution models is also a helpful tool to identify distribution ranges, finding so far overlooked populations, assessing potential influences on population longevity for example through global climate change and estimating the threat potential of invasive species (van Schingen et al. 2014a, Vences et al. 2017). Focal species in our research group in terms of ecological analyses so far were the Psychedelic Rock Gecko (*Cnemaspis psychedelica*) (Fig. 2), the Cat Ba Tiger Gecko (*Goniurosaurus catbaensis*), the Vietnamese Crocodile Lizard (*Shinisaurus crocodilurus vietnamensis*) and Crocodile Newts (*Tylototriton vietnamensis*, *T. ziegleri*) (Bernardes et al. 2012, 2013, van Schingen et al. 2014b, 2015, Ngo et al. 2016a, 2016b).

Conservation

In situ: Afore mentioned conservation based diversity research and ecological analyses are the base for defining new priority areas for conservation, upgrade of already existing protected areas or creation of new reserves. For example, the former Phong Nha Nature Reserve in central Vietnam, where our working group has discovered more than a dozen of new vertebrate species, meanwhile has been extended to the Phong Nha - Ke Bang National Park and also became UNESCO World heritage site. Based on our field research, population analyses and species distribution modelling we recently have officially proposed in the international journal *Revue Suisse de Zoologie* to create a corridor between existing protected areas and to establish a new reserve for a just recently discovered population of the threatened Vietnamese Crocodile Lizard (*Shinisaurus crocodilurus vietnamensis*) near the border with China (van Schingen et al. 2016a). Another example is the establishment of the Ban Soc protected area in the end of 2016, based on our rediscovery of the Siamese Crocodile (*Crocodylus siamensis*) in central Lao's Khammouane Province (Ziegler et al. 2015) (Fig. 3).



Figure 3: Our Laotian-Vietnamese-German Siamese Crocodile conservation team (from left to right: Sisomphone Soudthichak, Truong Q. Nguyen, Sengdeuane Wayakone and Thomas Ziegler) in December 2016 at the newly established “Khammouane Siamese Crocodile Conservation Area Ban Soc”, central Laos. Photo: Thanousone



Figure 4: The Melinh Station for Biodiversity of the Institute of Ecology and Biological Resources. Photo: Thomas Ziegler

Ex situ: Important in country *ex situ* measures are developing and maintaining breeding and rescue stations in Vietnam such as the Me Linh Station for Biodiversity of the Institute of

Ecology and Biological Resources (IEBR) or the Dau Tieng Centre of Wildlife at Risk (Fig. 4). In these stations confiscated wildlife can be housed, treated and in the best case released to nature again. These stations, regulated under joint MoU's, further serve as important breeding centres where also basis research can be conducted. In the jointly developed amphibian station of IEBR, which subsequently was relocated to the Me Linh Station, 14 poorly known amphibian species could be successfully reared or bred in the past years and their breeding biology and larval development studied (Nguyen et al. 2009, Nguyen & Ziegler 2012, Ziegler 2010, 2012, 2015, Ziegler et al. 2011, Ziegler & Nguyen 2015, 2016, Bernardes et al. 2017). Besides consultancy and realization of modern and species-appropriate facility building also regular staff training belongs to our joint project activities in Vietnam. Also networking with other facilities and stations is important to get animals placed at the most suitable places. Currently we also advise the Vietnam National Museum of Nature of the Vietnam Academy of Science and Technology in the establishment of a country wide rescue station in Vietnam.

Together with Dr. Minh D. Le from the Vietnam National University Hanoi, we currently conduct a genetic screening of Siamese Crocodiles (*Crocodylus siamensis*) held in zoos in Vietnam (Saigon Zoo, Hanoi Zoo) and Laos (Lao Zoo) to identify purebred individuals (Fig. 5). Although considerable amounts of the species are now held on commercial crocodile farms in Southeast Asia, the genetic integrity of the Critically Endangered *C. siamensis* has been compromised by widespread hybridization with other crocodile species. Once purebred individuals among zoo collections in Vietnam and Laos have been identified, assurance colonies can be built up and subsequently offspring can be used for future release and restocking measures in the wild, respectively.



Figure 5: Individual marking and genetical screening by the Laotian-Vietnamese-German team to proof purity of breeding of a young Siamese crocodile at the Lao Zoo, Vientiane, Laos. Photo: Jay



Figure 6: Newly built monitor lizard facilities at the Me Linh Station for Biodiversity. Photo: Anna Rauhaus

A conservation breeding program for the endemic Psychedelic Rock Gecko has been established together with Wildlife at Risk in southern Vietnam (Ziegler et al. 2016b). There and in the Melinh Station also facilities for confiscated monitor lizards have been built up recently (Ziegler et al. 2016a) (Fig. 6). IEBR currently also houses the only *ex situ* assurance colony in a world wide scale of the recently described Vietnamese Crocodile Lizard (*Shinisaurus crocodilurus vietnamensis*), an endemic taxon for Vietnam (Ziegler & Nguyen 2015, van

Schingen et al. 2016b, Ziegler et al. 2016a) (Fig. 7). But breeding facilities for the Vietnamese Crocodile Lizard, which is threatened by extinction through habitat loss and collection for the pet trade, were not only built up at the Melinh Station but currently are also developed at the Cologne Zoo. In the Terrarium section of the Cologne Zoo further species from Vietnam are successfully held and bred, for example the Vietnamese Mossy Frog (*Theioderma corticale*) and the Helmeted Toad (*Ingerophrynus galeatus*), which are listed as Endangered and Vulnerable, respectively, in the Vietnam Red Data Book (2007).

Policy

The diversity and natural history research data obtained through our herpetological team were also crucial to include threatened taxa from Vietnam into the IUCN Red List of Threatened Species, such as the Psychedelic Rock Gecko (*Cnemaspis psychedelica*), the Cat Ba Tiger Gecko (*Goniurosaurus catbaensis*), and the Crocodile Lizard (*Shinisaurus crocodilurus*) which all were included as Endangered (Nguyen et al. 2014, 2016a, 2016b) (Fig. 7).



Figure 7: Vietnamese Crocodile Lizard (*Shinisaurus crocodilurus vietnamensis*) at the Melinh Station for Biodiversity. Photo: Thomas Ziegler

Our working group also has substantially contributed towards the recent upgrade of the Crocodile Lizard from Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) to Appendix I and the first inclusion of the Psychedelic Rock Gecko on CITES Appendix I. We are in close exchange with authorities and ministries both in Germany and Vietnam to set the course for future conservation activities and measures. We further provide administrative assistance in identification of confiscated amphibians and reptiles in Vietnam and Germany and helping to place them.

Environmental education

To inform the general public, schools and authorities about species decline in Vietnam, in particular based on the example of the Vietnamese Crocodile Lizard, our team so far has developed logos, posters and brochures. A new panel system with the comic strip figure “Shini”, created by Cologne Zoo’s terrarium keeper Christian Niggemann, informs school classes and visitors at the Melinh Station for Biodiversity about the Crocodile Lizard conservation project, and a new environment exhibition, jointly developed with the Friedrich-Ebert-Stiftung (FES) Office Hanoi and Cologne Zoo’s educationist Ruth Dieckmann, has been opened at the Melinh Station in winter 2016 (Fig. 8). Guided tours about project activities and conservation measures are both conducted at the Melinh Station in Vietnam and at the Terrarium of the Cologne Zoo, which focuses on Southeast Asian species. Most recently a computer terminal was established by Frogs & Friends e.V. at the Cologne Zoo’s Terrarium section where visitors can select and watch documentary films about our work in Vietnam and in particular in the Melinh Station (films are also available at <http://reportagen.frogs-friends.org/de/vietnam>) (Fig. 9). The public is further informed through regular press releases about our joint project activities, and by both popular and scientific articles and papers. We also give presentations to the public, within

scientific congresses and furthermore lectures about our project work within a joint student course conducted once per year at the Institute of Ecology and Biological Resources. Further student courses are held in Germany at the universities of Cologne and Bonn, with Vietnam's herpetodiversity and conservation as one of the focal topics.



Figure 8: Newly established environmental exhibition for school classes and visitors at the Melinh Station for Biodiversity. Photo: Thomas Ziegler



Figure 9: Modern computer terminal established by Frogs & Friends e.V. at the Cologne Zoo's Terrarium section, where visitors can select and watch documentary films about our project work in Vietnam. Photo: Thomas Ziegler

Promotion of young scientists

In the context of our student courses both in Germany and Vietnam we aim at building up a new generation of researchers and conservationists (Fig. 10). By supervision of student theses we can not only further invest into young scientists but at the same time increase conservation based research outcomes which are needed for future protection measures. Our students do not only conduct field work but also laboratory work and work in stations such as the study of the breeding biology and larval development of poorly known amphibians. We encourage and support bilateral exchange through mutual visits and research stays.



Figure 10: Joint student course at IEBR, Hanoi. Photo: Anna Rauhaus

Acknowledgements: We thank (in alphabetical order) Marta Bernardes (Cologne), Prof. Dr. Michael Bonkowski (Cologne), Dr. Dang Gia Tung (Hanoi), Dang Huy Phuong (Hanoi), Dr. Dang Tat The (Hanoi), Ruth Dieckmann (Cologne), Dr. Ha Quy Quynh (Hanoi), Christopher Landsberg (Cologne), Dr. Le Duc Minh (Hanoi), Le Quang Tuan (Hanoi), Dr. Le Trung Dzung (Hanoi), Ass. Prof. Dr. Le Xuan Canh (Hanoi), Dr. Luu Quang Vinh (Hanoi), Dr. Frank Mutschmann (Berlin), Ngo Ngoc Hai (Hanoi), Ngo Thi Hanh (Hanoi), Dr. Nguyen Thien Tao (Hanoi), Ass. Prof. Dr. Nguyen Trung Minh (Hanoi), Nguyen Vu Khoi (Ho Chi Minh City),

Ass. Prof. Dr. Nguyen Van Sinh (Hanoi), Christian Niggemann (Cologne), Prof. Theo Pagel (Cologne), Pham The Cuong (Hanoi), Dr. Pham Van Anh (Son La), Phung My Trung (Ho Chi Minh City), Anna Rauhaus (Cologne), Dr. Dennis Rödder (Bonn), Ulrich Schepp (Bonn), Nicole Schneider (Cologne), Ass. Prof. Dr. Sengdeuane Wayakone (Vientiane), Sisomphone Soudthichak (Khammouane), Thi An Hang (Hanoi), Dr. Tran Anh Thi Dao (Ho Chi Minh City), The (Ho Chi Minh City), Tri Cao (Ho Chi Minh City), Dr. Mona van Schingen (Cologne), Prof. Dr. Miguel Vences (Brunswick), and Dr. Vu Van Lien (Hanoi). Many thanks also to the authorities in Vietnam and Laos, including the nature reserve administrations, forest protection departments, ranger stations and stations, without their support our research and conservation activities would not have been possible. For financial support we thank the Amphibian Conservation Fund of German Zoo Associations and private participants in the German-speaking region as well as Stiftung Artenschutz, Cologne University, Cologne Zoo, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), EXOMED (Berlin), Federal Agency for Nature Conservation (BfN), Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), European Union of Aquarium Curators (EUAC), European Association of Zoos and Aquaria (EAZA), Friedrich-Ebert-Stiftung (FES) Vietnam Office, German Society of Herpetology and Terrarium Science (DGHT), Idea Wild, IEBR, Kölner Kulturstiftung der Kreissparkasse Köln, Nagao Natural Environment Foundation, Nederlands-Belgische Schildpadden Vereniging, Rufford Small Grants, SERA, Vietnam Academy of Science and Technology, and Zoologische Gesellschaft für Arten- und Populationsschutz (ZGAP). Cologne Zoo is partner of the World Association of Zoos and Aquariums (WAZA): Conservation projects 07011, 07012 (Herpetodiversity Research, Amphibian and Reptilian Breeding and Rescue Stations).

REFERENCES

1. **Bernardes M., Rauhaus A., Michel C., Pham C. T., Nguyen T. Q., Le M. D., Pasmans, F., Bonkowski, M. & Ziegler T., 2017.** Larval development and breeding ecology of Ziegler's Crocodile Newt, *Tylototriton ziegleri* Nishikawa, Matsui and Nguyen, 2013 (Caudata: Salamandridae), compared to other *Tylototriton* representatives. *Amphibian and Reptile Conservation* 11(1): 72-87.
2. **Bernardes M., Rödder D., Pham C. T., Nguyen T. Q. & Ziegler T., 2012.** Integration of species distribution modeling with in situ research for the conservation of the endemic Vietnamese crocodile newt (*Tylototriton vietnamensis*). *Froglog* 20(5): 21-23.
3. **Bernardes M., Rödder D., Nguyen T. T., Pham C. T., Nguyen T. Q. & Ziegler T., 2013.** Habitat characterization and potential distribution of *Tylototriton vietnamensis* in northern Vietnam. *Journal of Natural History*, <http://dx.doi.org/10.1080/00222933.2012.743611>.
4. **Loos J., Wehrden H. V., Dang K. N. & Ziegler T., 2012.** Niche segregation in microhabitat use in of three sympatric *Cyrtodactylus* in the Phong Nha - Ke Bang National Park, central Vietnam. *Herpetological Conservation and Biology* 7(1): 101-108.
5. **Luu V. Q., Bonkowski M., Nguyen T. Q., Le M. D., Ngo H. T., Schneider N. & Ziegler T., 2016.** Evolution in karst massifs: Cryptic diversity among bent-toed geckos along the Truong Son Range with descriptions of three new species and one new country record from Laos. *Zootaxa* 4107(2): 101-140.
6. **Ngo H. N., Nguyen T. Q., Nguyen T. V., Barsch F., Ziegler T. & van Schingen M., 2016a.** First population assessment of the endemic insular Psychedelic Rock Gecko (*Cnemaspis psychedelica*) in southern Vietnam with implications for conservation. *Amphibian and Reptile Conservation* 10(2): 18-26.

7. **Ngo H. N., Ziegler T., Nguyen T. Q., Pham C. T., Nguyen T. T., Le M. D. & van Schingen M.,** 2016b. First population assessment of two cryptic Tiger geckos (*Goniurosaurus*) from northern Vietnam: Implications for conservation. *Amphibian and Reptile Conservation* 10(1): 34-45.
8. **Nguyen T. Q., Dang T. T., Pham C. T., Nguyen T. T. & Ziegler T.,** 2009. Amphibian breeding station in Hanoi: a trial model for linking conservation and research with sustainable use. *Froglog* 91: 12-15.
9. **Nguyen T. Q., Hamilton P. & Ziegler T.,** 2014. *Shinisaurus crocodilurus*. - The IUCN Red List of Threatened Species 2014: e.T57287221A57287235.
10. **Nguyen T. Q., Ngo H. N., van Schingen M. & Ziegler T.,** 2016a. *Goniurosaurus catbaensis*. - The IUCN Red List of Threatened Species 2016: e.T18917684A18917688.
11. **Nguyen T. Q., Ngo H. N., Ziegler T. & van Schingen M.,** 2016b. *Cnemaspis psychedelica*. The IUCN Red List of Threatened Species 2016: e.T97210381A97210384.
12. **Nguyen T. Q. & Ziegler T.,** 2012. Amphibian research and conservation in Vietnam. *Froglog* 20(5): 21-23.
13. **Rauhaus A., Gawor A., Perl R. G. B., van der Straeten K., Karbe D., Pham C. T., Nguyen T. Q. & Ziegler T.,** 2012. Larval development, stages and an international comparison of husbandry parameters of the Vietnamese Mossy Frog *Theloderma corticale* (Boulenger, 1903) (Anura: Rhacophoridae). *Asian Journal of Conservation Biology* 1(2): 51-66.
14. **van Schingen M., Ha Q. Q., Pham C. T., Le T. Q., Nguyen T. Q., Bonkowski M. & Ziegler T.,** 2016a. Discovery of a new crocodile lizard population in Vietnam: Population trends, future prognoses and identification of key habitats for conservation. *Revue Suisse de Zoologie* 132(2): 241-251.
15. **van Schingen M., Ihlow F., Nguyen T.Q., Ziegler T., Bonkowski M., Wu Z. & Rödder D.,** 2014a. Potential distribution and effectiveness of the protected area network for the crocodile lizard, *Shinisaurus crocodilurus* (Reptilia: Squamata: Sauria). *Salamandra* 50(2): 71-76.
16. **van Schingen M., Le M. D., Ngo H. T., Pham C. T., Ha Q. Q., Nguyen T. Q. & Ziegler T.,** 2016b. Is there more than one Crocodile Lizard? An integrative taxonomic approach reveals Vietnamese and Chinese *Shinisaurus crocodilurus* represent separate conservation and taxonomic units. *Der Zoologische Garten* 85: 240-260.
17. **van Schingen M., Pham C. T., An H. T., Bernardes M., Hecht V., Nguyen T. Q., Bonkowski M. & Ziegler T.,** 2014b. Current status of the Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 in Vietnam with implications for conservation measures. *Revue Suisse de Zoologie* 121(3): 425-439.
18. **van Schingen M., Pham C. T., An H. T., Nguyen T. Q., Bernardes M., Bonkowski M. & Ziegler T.,** 2015. First ecological assessment of the endangered Crocodile Lizard *Shinisaurus crocodilurus* Ahl, 1930 in Vietnam: Microhabitat characterization and habitat selection. *Herpetological Conservation and Biology* 10(3): 948-958.
19. **Vences M., Brown J. L., Lathrop A., Rosa G. M., Cameron A., Crottini A., Dolch R., Edmonds D., Freeman K. L. M., Glaw F., Grismer L. L., Litvinchuk S., Milne M. G., Moore M., Solof J. F., Noel J., Nguyen T. Q., Ohler A., Randrianantoandro C., Raselimanana A. P., Van Leeuwen P., Wogan G. O. U., Ziegler T., Andreone, F. &**

- Murphy R. W.**, 2017. Tracing a toad invasion: lack of mitochondrial DNA variation, haplotype origins, and potential distribution of introduced *Duttaphrynus melanostictus* in Madagascar. *Amphibia-Reptilia* 38 (2): 197-207.
20. **Ziegler T.**, 2010. Amphibian and reptilian diversity research, conservation and breeding projects in Vietnam. In: Dick, G. & M. Gusset (Eds.): Building a future for wildlife: zoos and aquariums committed to biodiversity conservation. WAZA Executive Office, Gland: 117-122.
21. **Ziegler T.**, 2012. Erforschung und Erhalt der Artenvielfalt: Neue Wege des Kölner Zoos in Südostasien [Research and conservation of species diversity: New ways of Cologne Zoo in Southeast Asia]. *Zeitschrift des Kölner Zoo* 55(3): 111-130.
22. **Ziegler T.**, 2015. *In situ* and *ex situ* reptile projects of the Cologne Zoo: implications for research and conservation of South East Asia's herpetodiversity. *International Zoo Yearbook* 49: 8-21.
23. **Ziegler T.**, 2016. Two decades of herpetodiversity research in Vietnam and Laos: A review of a German-Vietnamese long-term cooperation. Proceedings of the 3rd National Scientific Conference on Amphibians and Reptiles in Vietnam, Hanoi, 26 November 2016, Publishing House for Science and Technology: 5-18.
24. **Ziegler T., Dang T. T. & Nguyen T. Q.**, 2011. Breeding, natural history and diversity research: Ex situ and in situ Asian amphibian projects of the Cologne Zoo and the Institute of Ecology and Biological Resources. In: Das, I., Haas, A. & A. A. Tuen (Eds.): Biology and conservation of tropical Asian amphibians. Proceedings of the Conference "Biology of the amphibians in the Sunda region, South-east Asia", Sarawak, Malaysia, 28-30 Sept. 2009. Institute of Biodiversity and Environmental Conservation, University Malaysia Sarawak, Kota Samarahan: 137-146.
25. **Ziegler T., Luu V. Q., Soudthichak S. & Nguyen T. Q.**, 2015. Rediscovery of the Siamese crocodile (*Crocodylus siamensis*) in Khammouane Province, central Lao PDR. *Crocodile Specialist Group Newsletter* 34(3): 11-13.
26. **Ziegler T. & Nguyen T. Q.**, 2015. Neues von den Forschungs- und Naturschutzprojekten in Vietnam und Laos [News from the research and conservation projects in Vietnam and Laos]. *Zeitschrift des Kölner Zoos* 58(2): 79-108.
27. **Ziegler T. & Nguyen T. Q.**, 2016. The Vietnamese Crocodile Lizard represents a separate taxonomic unit: implications for conservation. *WAZA News* 3/16: 35-36.
28. **Ziegler T., Rauhaus A., Mutschmann F., Dang P. H., Pham C. T. & Nguyen T. Q.**, 2016a. Building up of keeping facilities and breeding projects for frogs, newts and lizards at the Me Linh Station for Biodiversity in northern Vietnam, including improvement of housing conditions for confiscated reptiles and primates. *Der Zoologische Garten* 85: 91-120.
29. **Ziegler T., Rauhaus A., Nguyen K. V. & Nguyen T. Q.**, 2016b. Building of a conservation breeding facility for the Psychedelic Rock Gecko (*Cnemaspis psychedelica*) in southern Vietnam. *Der Zoologische Garten N.F.* 85: 224-239.

HỢP TÁC DÀI HẠN GIỮA VƯỜN THÚ COLOGNE VÀ VIỆN SINH THÁI VÀ TÀI NGUYÊN SINH VẬT TRONG NGHIÊN CỨU ĐA DẠNG VÀ BẢO TỒN CÁC LOÀI BÒ SÁT VÀ LƯỠNG CƯ

Thomas Ziegler và Nguyễn Quảng Trường

TÓM TẮT

Bài báo này tóm lược một số kết quả của chương trình hợp tác dài hạn giữa Vườn thú Cologne, CHLB Đức và Viện Sinh thái và Tài nguyên sinh vật, Hà Nội, Việt Nam. Chúng tôi thực hiện chương trình hợp tác nghiên cứu về khu hệ lưỡng cư và bò sát ở Việt Nam và gần đây đã mở rộng địa bàn nghiên cứu sang Lào. Bằng cách kết hợp giữa nghiên cứu phân loại học và sinh thái học, chúng tôi mong muốn góp phần cung cấp cơ sở khoa học cho công tác bảo tồn loài. Các biện pháp bảo tồn nguyên vị bao gồm xây dựng Khu bảo tồn mới dựa trên những dẫn liệu mới từ kết quả nghiên cứu thực địa, các biện pháp bảo tồn chuyển vị bao gồm xây dựng các trung tâm cứu hộ và nhân nuôi bảo tồn, xây dựng các chương trình nhân nuôi sinh sản và lên kế hoạch thả lại tự nhiên để phục hồi quần thể. Nhóm nghiên cứu của chúng tôi cũng tham gia xây dựng các chính sách thông qua tư vấn khoa học cho các cơ quan quản lý ở các Bộ ngành, xây dựng hồ sơ đưa các loài vào Danh lục Đỏ IUCN, phụ lục CITES hoặc các loài ưu tiên bảo tồn cấp quốc gia. Các lĩnh vực hợp tác lâu dài khác bao gồm đào tạo, tập huấn và hỗ trợ các nhà khoa học trẻ.