

A Proposal for Expanding Capacity for Conservation Science Education in the Tropical Asia-Pacific Region

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Conservation science in the tropical Asia-Pacific region confronts a wide range of challenges that go far beyond the basic issues of conservation or science. These challenges have many dimensions: biogeographic, cultural, linguistic, political, and religious. The region has no unifying language or culture. While the general high level of endemism and complex biogeography is well known, particularly in the archipelago, the anthropogenic differences among neighboring countries can also be quite profound. Because the region hosts such a phenomenal diversity of biology and humanity, conservation biologists working there need a unique set of skills to navigate these many challenges. The Program for Field Studies at the Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences has initiated a set of courses aimed at graduate students in the region to foster the development of a regional network of young scientists. Direct interaction and collaboration during international field courses among students from the many countries of the region is an effective way to create such a network. We hope that the PFS office can serve as an impetus for the growth of a consortium of international courses that can bring together the many experts and institutions to inspire and educate the enthusiastic spirit of the young conservation biologists in the region.

保护生物学在热带亚太地区所面临的广泛挑战已超越了保护工作和科学本身的范畴。这些挑战表现在包括地域、文化、语言、政治及信仰的多个维度上。热带亚太地区的生物地理特点和特有物种的丰富度众所周知，尤其是在群岛区域，同时这个地区众多国家之间的人文差异也具有相当的复杂性。正是由于生物和人文领域的高度多样性，在这里工作的保护生物学家需要具备一套全面的技能来应对各种挑战。中国科学院西双版纳热带植物园热带亚洲考察研究项目为培养本地区保护生态学科的研究生，在本地区形成一个训练有素的青年科学家网络，已建立起一套培训课程。学员们在参与国际化的野外培训班过程中进行交流与合作，结果证实这是建立一个国际网络的有效手段。我们希望热带亚洲考察研究项目作为促成一个国际性培训合作团体的原动力，能将更多本领域的顶尖专家和院校联合起来，为热带亚太地区培育一代充满热情的青年保护生物学家。

Tropical rain forests comprise over 50% of Earth's terrestrial biodiversity and are a major focus of global conservation efforts. The rainforests of tropical Asia, in particular, harbor a large fraction of the Earth's terrestrial biodiversity in a relatively small area (Wright, 2005). Extending to the island of Papua and the northern margin of Australia in the east, to the Western Ghats and the island of Sri Lanka in the west, these forests cross a remarkable landscape with a deep and varied biogeographic history. Here, two ancient biota are slowly merging at Wallace's Line (Hall and Holloway 1998; Morley 2000). The Asian rainforests also represent the only tropical region where a large area of forest has connected equatorial regions with the subtropical and temperate biomes, allowing for mixture over long periods of geological time across these strong environmental gradients (Heaney, 1991; Voris, 2000; Cannon et al. 2009).

Unfortunately, the region is also infamous for its continued high rates of forest conversion and degradation (Sodhi, Koh, Brook et al., 2004, Laurance & Useche 2009, Harrison, in press). Extrapolating current rates into the future indicates that we will be the last generation of scientists to study these rainforests in their 'natural' condition, where community species composition and physical structure are a result of long historical processes and not the direct and indirect effects of human management. Already less than 1% of tropical Asia harbors an intact faunal community (Morrison 2005). We are witnessing the extinction of wilderness across the region.

For conservation efforts to be effective, the globalization of biological research is required, in parallel with the globalization of human economies and cultures. Adequate infrastructural investment, particularly in

terms of local human capability, by the international conservation community is required. We need to train graduate students for the coming challenges, pool our resources, maximize synergies, and share our accumulated knowledge and expertise more effectively. The creation of a regional network of young scientists in the Asia-Pacific region would reflect the biological connectivity among the many countries. Improved coordination among organizations would more efficiently employ limited resources and enable us to provide more and better educational opportunities for graduate students in tropical ecology, conservation, and natural resource management from the tropical Asian region.



Figure 1. Activities during the Advanced Fieldcourse in Ecology and Conservation - XTBG 2010. Course Opening. Participants came from ten countries: Argentina, Benin, Cambodia, Cameroon, China, India, Indonesia, North Korea, Sri Lanka and Thailand.

Ultimately, we need more young professional scientists who have the necessary skills to integrate environmental and economic issues within the context of their national policies and global trends. These young scientists should come from both academic and managerial positions, with backgrounds in basic or applied research. These students should be enthusiastic enough to tackle daunting environmental issues by combining research with policy development. Unfortunately,

opportunities for education and training in the conservation, research, and management of tropical natural resources, has not fulfilled the demand for training, especially at the graduate level. The few available courses usually have five-fold more applicants than places. Organizations have run regular graduate-level courses for tropical biology and conservation in the Neotropical (e.g. Organization for Tropical Studies, or OTS) and African regions (e.g. Tropical Biology Association, or TBA). Both of these programs have made substantial contributions, over the decades, to increase local capacity for conservation and natural resource management. They have also spawned a generation of natural history researchers and have been successful in stimulating international collaborative research.

The need for a network of young conservation scientists in the Asia-Pacific region

A major challenge in creating such a regional network in tropical Asia is the substantial diversity, particularly in terms of culture, language, political systems, and religion. While the Indonesian and Malaysian languages share similar roots and are largely intelligible to one another, the other countries share only English as a common language, which is spoken by a relatively small fraction of people. However, the religious differences are probably more profound than the linguistic differences, as the countries of the Asian tropics include major populations of Muslims, Buddhists, Christians, and Confucianists. Moreover, these more widespread belief systems are often layered over a wide variety of local animistic belief systems. While English can function as an international language, identifying and accepting 'universal' religious principles is considerably more difficult, particularly

towards environmental ethics and natural resource management. Clearly, religion has a major impact on the relationship between humans and nature, how policies are developed, and the utilization of wilderness.

Many of these differences are best overcome through personal contact and direct interaction, particularly among young professionals who were born into a global world where communication easily crosses international borders and distance has lost some of its meaning. A regional training course would play a critical role, allowing the students to get past preconceptions and prejudices, to develop trust and understanding across languages and religions, and to share experiences and discover similarities. After they return home, these young professionals will work in a variety of settings, from local non-governmental organizations to tenured civil servants in governmental ministries. A growing network of young professionals could create an information-sharing system about the main issues and threats. Morale is also important to conservation and simple discussion with peers who have similar experiences and ambitions can be a great support.



Figure 2. Activities during the Advanced Fieldcourse in Ecology and Conservation - XTBG 2010. Plant identification workshop.

Such a network would also address many of the biological and environmental realities of tropical Asia. Many countries share the same natural resources, like the Mekong River among many Indochinese countries and the island of Borneo among Indonesia, Malaysia, and Brunei. Natural resource policies in these countries have various upstream and downstream effects. Several groups have recognized the need for coordination among countries in their environmental policies. For example, the Asian Development Bank and its Greater Mekong Subregion project aims to create a common policy environment across the subregion and to establish a network of nature reserves and biodiversity corridors. Students who attend the types of courses and workshops described here will become scientists and environmental policy makers who can fit into these regional efforts.

In terms of basic research, alumni from these courses will also facilitate cross-border coordination of research efforts and the creation of databases containing compatible informatic resources with more effective data- and sampling-sharing mechanisms. The world is experiencing a fundamental change in the way in which data and information is managed, stored, and distributed. Environmental scientists and conservation biologists ought to learn to exploit these technological changes to improve the effectiveness of their message and the implementation of reasonable management.

Overview of field course experiences in tropical Asia

One of the largest problems in tropical Asia is the shortage of well trained local conservation managers and researchers and the funds to support their activities. The conservation tasks are real, substantial, and

constantly evolving. Colleagues working in tropical Asia have often expressed the need for more and better graduate-level training opportunities, and several institutes have run independent courses for limited periods of time, including the Diversities in Western Pacific and Asia (DIWPA) courses in Sarawak (1995), Thailand (1996) and Australia (1997), and the Center for Tropical Forest Science – Arnold Arboretum (CTFS-AA) courses in Peninsular Malaysia (2001, 2003, 2008), Sarawak (2004), Thailand (2005), Sri Lanka (2006) and Yunnan, China (2007). While these courses have been quite successful, a stable program with sufficient funding to support their activities would allow students to plan sufficiently ahead, so they may obtain funding to attend these training activities. It would also bring together the experience and expertise gained from currently separate efforts. Previous courses run by individual universities and networks have typically provided considerable scholarship support so that students from poor countries can attend, but these scholarships increase the price of the courses considerably. To improve the likelihood that a program can remain stable and well-funded, we would expect students from more wealthy countries to subsidize students from less wealthy countries. Moreover, to meet the demand for field-based courses, a considerable expansion in the course offerings each year is required.

The Program for Field Studies in Tropical Asia

In 2010, the directors of XTBG agreed to support an office for The Program for Field Studies in Tropical Asia (PFS-TropAsia - www.pfs-tropasia.org). This office was established to form an international consortium of institutions and universities and to provide high quality and affordable training courses for young conservation

scientists from across the Asia-Pacific region, similar to OTS and TBA. Several meetings have also been held at the Asia-Pacific chapter meetings of the Association for Tropical Biology and Conservation (ATBC-AP), where the program has received broad support. Indeed most of our resource staff has been recruited from the ATBC-AP.

The program office has already supported several training courses. We hosted the third Advanced Fieldcourse in Ecology and Conservation – XTBG (AFEC-X), initiated by the Xishuangbanna Tropical Botanical Garden (XTBG) and the Ecological Evolution group (Figure 1). In 2010, a grant from the Asia-Pacific Network for Global Change Research (APN) supported a six-week field course in Indonesia (July-Sept.), organized by the PFS office, in collaboration with the University of Indonesia and the ATBC-AP. In association with the annual ATBC-AP meetings, the program has also run shorter training courses on Experimental Design & Data Analysis and Scientific Paper Writing (2010 and 2011). These courses were expanded in 2010 to include both Basic and Advanced levels.



Figure 3. Activities during the Advanced Fieldcourse in Ecology and Conservation - XTBG 2010. Participants walking to the field site.

The training courses run by PFS-TropAsia target graduate entry-level students (MSc or

1st year PhD) and equivalent level participants from government research organizations, universities, and NGOs, focusing on students from the tropical Asian-Pacific region. Currently, a major element of the program is the advanced fieldcourse (AFEC-X), which is an intensive course in field research methods, research design, sampling and analysis (<http://www.pfs-tropasia.org/fieldcourse-modules/advanced-fieldcourse-on-ecology-conservation/>) held at XTBG. (Figures 3, 4) Participants receive lectures from leading experts, participate in group discussions on both the theory and practice of ecological and conservation research. (Figure 2) Participants also gain practical research experience by designing and conducting independent projects at several long-term field stations situated in tropical Yunnan, China and supported by XTBG-CAS. Students present the results of their research at a symposium on the final day of the course and publish their written reports in the form of Course Proceedings. (Figure 5) Students are also encouraged to go on and publish their results wherever possible (e.g. Zhang et al. 2010, Sreekar et al. 2010, Beaudrot et al. 2011). PFS-TropAsia is currently developing other field courses in Thailand and Indonesia with the ultimate aim of holding three courses annually. However, these efforts will depend on receiving stable funding, either through consortium members or significant financial backer.

The Experimental Design and Data Analysis course on the other hand, is a six-day workshop to teach concepts in experimental design and sampling and how to analyze data using R – a free open source statistical computing program. In conjunction with the statistics workshop, the Scientific Paper Writing workshop covers the process of how to prepare a good poster, ethical questions

surrounding the publication “game”, and the review process. It is targeted at people with limited or no publishing experience. PFS-TropAsia is also considering other types of short courses, such as courses in tropical plant identification, integrating social and natural science research for ecosystem services, and wildlife monitoring techniques.

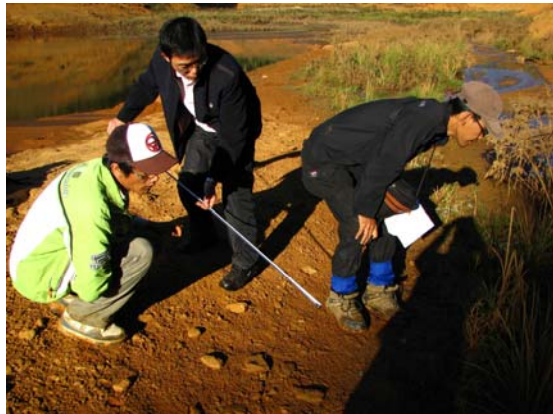


Figure 4. Activities during the Advanced Fieldcourse in Ecology and Conservation - XTBG 2010. A group of participants surveying invasive plants.

During the first two years of the AFEC-X course and the APN-funded course in Indonesia, a total of 68 participants from 15 countries have attended, with most of them from Southeast Asia. Our courses also have a regular pool of instructors from international institutions with a broad range of expertise. These instructors volunteer their time to teach in the field courses, receiving only travel and living expenses. While the students benefit from both the classroom and field work, these courses also greatly enhance international collaboration and cultural exchange, reflecting the national and ethnic diversity of the region. The program maintains and grows its network of course instructors and alumni through an alumni website (<http://www.pfs-tropasia.org/alumni/>). Building on these successes, the AFEC-X course recently received accreditation from the Graduate

University of the Chinese Academy of Sciences.

Developing a field course program consortium in Tropical Asia

PFS-TropAsia was initiated with the vision of forming a consortium of universities, research institutes, governmental and non-governmental organizations from across the tropical Asia-Pacific region to run the above mentioned courses. Through financial contributions from all consortium members, the program hopes to achieve a sustainable level of funding and expand the number and topics of shorter workshop type courses. Essentially, each consortium member would be represented on the program board, which would develop the basic policy of the program. Although the PFS-TropAsia secretariat is currently at XTBG-CAS, as the founding member of the consortium, the program must be a truly collaborative effort with ownership belonging equally to all consortium members. The program is currently in discussion with several potential partners, including the World Agroforestry Centre (ICRAF), Center for International Tropical Forestry (CIFOR), King Mongkut’s University of Technology in Thonburi, Thailand, and the University of Gajah Mada, Indonesia.



Figure 5. Activities during the Advanced Fieldcourse in Ecology and Conservation - XTBG 2010. Course symposium, where each group presented their independent projects to a formal audience.

Optimally, the regional consortium would offer two to three long (six weeks) field courses annually that would be based consistently at the same locations and utilize a small number of long-term field sites. These field courses require a great deal of logistic support and coordination and returning to the same few sites creates efficiencies that are not possible when the field course site is moved from country to country and field site to field site. Additionally, the students could participate in long-term research projects, like forest restoration efforts or climate change monitoring, to build a temporal depth of data and knowledge so that subsequent students, over a decade, can directly measure the changes in the ecosystem.

The program would also continue to offer shorter specialty courses according to demand, resources and instructor availability. Associating these courses with various regional meetings, like the annual meetings of the ATBC-AP, is an effective way to minimize travel expenses and to broaden contact with students and instructors in the host countries.

Challenges and next steps

A major challenge in developing a regional course is meeting the educational needs of students from a wide range of backgrounds and experiences. For example, some students arrive very well versed in advanced statistical analysis and phylogenetic interpretation of results while other students have already specialized on some particular organism and have considerable taxonomic skills. Most students do not have comprehensive training and have substantial gaps in their knowledge of scientific research methods. Student experience and ability often varies widely in terms of knowledge of the basic scientific literature and using large public databases. Cultural

differences in the students' approach to the educational process and their response to peer review can make discussion difficult. Fortunately, most young people today are quite knowledgeable about internet resources and social media, quickly picking up new ideas and techniques. Finally, because English is the dominant language of science today, the students must have adequate English fluency to fully participate and take advantage of the courses. The applicant pool needs to be carefully screened to balance representation of students from different countries and backgrounds with appropriate levels of previous training and expertise to contribute to and benefit from the course.

Ultimately, the fundamental challenge will be to create a self-sustaining, self-funded organization that can coordinate the type of graduate education program in ecology and conservation that we have described here. While XTBG has taken a first step in this direction with the creation of the PFS-Tropical Asia office and the AFEC-X course, many questions remain. While the Chinese economy and development will dominate the region over the coming decades, its current monetary policies make these types of international educational activities somewhat difficult. For example, because currency conversion and money transfers are tightly regulated, visa regulations are strict and can change suddenly, and access to natural areas is tightly controlled. Unfortunately, one faces similar problems in most countries in the region, as learned from our experiences in Indonesia and elsewhere. Basing the field courses regularly in the same locations should ease these problems over time as trust and understanding increases among the various players in the situation.

Finally, the consortium must attract partners who are willing to commit sufficient funds and resources to create a stable curriculum. Additional courses can be made available as extra funds and instructors become available. The funding level for any one institution will not be substantial, probably in the range of 20,000 USD per year, with guaranteed participation of 3-4 students and the possible contribution from their educational staff. Ultimately, mechanisms need to be established so that a reserve fund can be accumulated and built up into a financial cushion for the program. The administration of this fund and its long-term use would have been detailed by the founding members of the consortium.

References

- Beaudrot, L., Y. Du, A.R. Kassim, M. Rejmánek, & R.D. Harrison. (2011). "So epigeal termite mounds increase the diversity of plant habitats in a tropical rain forest in Peninsular Malaysia." *PloS ONE*, 6: e19777.
- Brook, B.W., N.S. Sodhi, & C.J.A. Bradshaw. (2008). "Synergies among extinction drivers under global change." *Trends in Ecology & Evolution*. 23: 453-460.
- Cannon, C.H., R.J. Morley, A.B.G. Bush. (2009). "The current refugial rainforests of Sundaland are unrepresentative of their biogeographic past and highly vulnerable to disturbance." *Proceedings of The National Academy of Sciences of The United States Of America*. 106: 11188-11193.
- Hall, R., J.D. Holloway. (1998). *Biogeography and Geological Evolution of Southeast Asia*. Backhuys.
- Harrison, R.D. (2012) Emptying the forest: Hunting and the expiration of wildlife from tropical nature reserves. *BioScience*. 61(11): 919-924.
- Heaney, L.R. (1991). "A Synopsis Of Climatic And Vegetational Change In Southeast-Asia." *Climatic Change*. 19: 53-61.
- Laurance, W.F. & D.C. Useche, D. (2009). *Environmental Synergisms and Extinctions of Tropical Species*
- Morley, R.J. (2000). *Origin and evolution of tropical rain forests*. Wiley, Chichester; New York.
- Morrison, J.C., W. Sechrest, E. Dinerstein, D.S. Wilcove, J.F. Lamoreux. (2007). "Persistence of large mammal faunas as indicators of global human impacts." *Journal of Mammology*. 88: 1363-1380.
- Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca, & J. Kent. (2000). "Biodiversity hotspots for conservation priorities." *Nature*. 403: 853-858.
- Sinergismos Ambientales y Extinciones de Especies Tropicales. *Conservation Biology*. 23: 1427-1437.
- Sodhi, N.S., L.P. Koh, B.W. Brook, & P.K.L. Ng. (2004). "Southeast Asian biodiversity: an impending disaster." *Trends in Ecology & Evolution*. 19: 654-660.
- Sreekar, R., N.T.P. Le, & R.D. Harrison. (2010). "Vertebrate assemblage at a fruiting fig (*Ficus caulocarpa*) in Maliau basin, Malaysia." *Tropical Conservation Science*. 3: 218-227.

Voris, H.K. (2000). "Maps of Pleistocene sea levels in Southeast Asia: shorelines, river systems and time durations." *Journal of Biogeography*. 27: 1153-1167.

Wright, S.J. (2005). "Tropical forests in a changing environment." *Trends in Ecology & Evolution*. 20: 553-560.

Zhang, L., S. Nurvianto, & R.D. Harrison. (2010). "Factors affecting the distribution and abundance of *Asplenium nidus* L. in a tropical lowland rainforest in Peninsular Malaysia." *Biotropica*. 42: 464-469.



Charles Cannon has been studying tropical biology since 1987, when he spent a year at a remote research site in the Gunung Palung National Park, Kalimantan, Indonesia, studying primate behavior and tropical ecology. This opportunity was supported by the Research Experience for Undergraduates program at the U.S. National Science Foundation. After completing his PhD at Duke University on the phylogeography and evolution of tropical Asian oaks, he has continued to publish on a wide range of topics concerning tropical Asian forests in general. His experience clearly illustrates the importance of education and research opportunities early in a student's career in shaping their ideas, priorities, and focus.



Rhett D. Harrison is an Associate Professor at Xishuangbanna Tropical Botanical Garden, Chinese Academy of Science. His research interests include co-evolutionary biology, in particular the fig - fig wasp interaction, and conservation biology. He has taught graduate-level courses in the Asia-Pacific region since 2001.



Lan Qie originally came from a background of electronic and biological engineering. It was the passion to work as a field biologist that made her decide to start a career in Ecology. As challenging as it was, her background in engineering also gave her a number of advantages. She was fortunate enough to attend the six-week field course at XTBG in 2007, which helped me to build the knowledge foundation in Ecology as well as basic skills in statistics. She recently concluded my PhD at National University of Singapore. Her research focuses on forest fragmentation and community disassembly, island biogeography, ecological roles and conservation of arthropods in the tropics.



Ferry Slik's research is focused on trying to understand spatial and temporal patterns in plant distributions. This is done this with the help of remote sensing (GIS), molecular techniques and spatial and temporal modeling. One of his main research themes is how global change will affect plant communities and vegetation patterns. Based on research results he tries to suggest optimum conservation strategies that integrate economic and social development with environmental sustainability.



Jin Chen is director of Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, and principle investigator of the Ecology &

Evolution of Plant-animal Interaction Group. His group's current interests focus specifically on the following questions: 1) How do plant-animal interaction complexes contribute to the creation and maintenance of biodiversity in above and below ground ecosystems? 2) To what extent are interacting plants and animals co-evolutionarily adapted to and shaped by each other? 3) How do plant-animal interactions respond to changing environments? Their study systems include animals such as frugivorous birds, rodents, ants and spiders, and plants such as figs, pines and *Tacca* spp.