

KNOWLEDGE CONSOLIDATION WEBINAR SERIES

Developing a shared understanding of the Far Eastern Himalayan Landscape

Compendium of abstracts

Organised by

International Centre for Integrated Mountain Development
Far Eastern Himalayan Landscape Initiative

Contents

PAGE 5

Background

PAGE 5–8

About the webinar series

Episode 1: Exploring future investment in biodiversity research and monitoring

Episode 2: Strengthening biodiversity conservation

Episode 3- Nature-based solutions and innovations for sustainable livelihoods

Objectives

Episode 1- Abstracts

PAGE 9

Cryptic species diversification of the *Pedicularis siphonantha* complex (Orobanchaceae) in the Mountains of Southwest China since the Pliocene

– *Rong Liu, Hong Wang, Jun-Bo Yang, Richard T. Corlett, Christopher P. Randle, De-Zhu Li and Wen-Bin Yu*

PAGE 11

Developing effective targets for climate and biodiversity

– *Alice C. Hughes*

PAGE 12

Darwin Wasp inventory of the Eastern Himalaya: 5,000 species ahead?

– *Alexey Reshchikov*

PAGE 14

30 years of land use land cover changes in the Far Eastern Himalayan Landscape (HI-LIFE)

– *Fawaz Parapurath, Bishal Kumar Majhi, Mahendra Singh Lodhi, Mriganka Shekhar Sarkar*

PAGE 16

Crop diversity and its importance: A case study from Changlang district, Eastern Arunachal Pradesh

– *Diana Ethel Amonge and Mahendra Singh Lodhi*

PAGE 18

Orchids of Changlang District of Arunachal Pradesh

– *K. Chowlu and Khyanjeet Gogoi*

PAGE 19

Mammalian diversity and distribution of Namdapha Tiger Reserve with respect to its conservation issues

– *Tajum Yomcha, Awadhesh Kumar, Padma Raj Gajurel*

PAGE 21

Native orchid diversity of Northern Myanmar: Conservation and research status

– *Saw Lwin*

PAGE 23

An ethnobotanical market survey of wild medicinal and edible plants in Longling, Yunnan, China

– *Wei Fang*

PAGE 24

Medicinal plants used by Kachin people in Northern Myanmar

– *Pyae Phyto Hein*

PAGE 25

Biotracks: An effective tool for biodiversity field survey

– *Xu Zhoufeng*

PAGE 26

Episode 2 - Abstracts

PAGE 27

Floral biodiversity conservation and forest management in the Eastern Himalayan Landscape under changing climate

– *K.S. Kanwal*

PAGE 29

The 10th anniversary of the scientific description of the black snub-nosed monkey (*Rhinopithecus strykeri*): A set of new management strategies for saving this critically endangered primate from extinction

– *Yin Yang, Aung Ko Lin, Paul A. Garber, Zhipang Huang, Yinping Tian, Alison Behie, Frank Momberg, Cyril C. Grueter, Weibiao Li, Ngwe Lwin, Wen Xiao*

PAGE 31

Identifying transboundary conservation priorities in a biodiversity hotspot of China and Myanmar: Implications for data poor mountainous regions

– *YinYang, Guopeng Ren, Wenjuan Li, Zhipang Huang, Aung Ko Lin, Paul A. Garber, Chi Ma, Shaoliang Yi, Frank Momberg, Ying Gao, Xinwen Wang, Guangsong Li, Alison Behie, Wen Xiao*

PAGE 33

Defining recent fire regime in the mountains of Northwest Yunnan using 30 years of fire records derived from Landsat timeseries

– *Davide Fornacca, Rongxing Wang, Rong She, Caicai Zhang, Xiaoyan Yang, Wen Xiao*

PAGE 34

Local people's preferences toward improving ecosystem services of Moeyungyi wetland in Myanmar: A choice experiment approach

– *Hsu Sandar Aung and Yohan Lee*

PAGE 35

Conservation investment plan of the Htamanthi Wildlife Sanctuary and sustainable financing options for protected areas in Northern Myanmar

– *Min Hein Htike*

PAGE 37

Residents' preferences toward wetland conservation: A case study from India

– *Supriya Hazarika, Kishor Goswami*

PAGE 39

Degradation of Loktak Lake, Manipur: A study of environmental perceptions

– *Brema.J, Srinithisathian.S*

PAGE 41

Episode 3- Abstracts

PAGE 42

Building competency of local bird guides for community-based avitourism: A case study from hotspot areas around Gaoligong National Park

– *Yang Jianmei*

PAGE 43

The uses of fig (*Ficus*) by five ethnic communities in Southern Shan State, Myanmar

– *Aye Mya Mon*¹, *Shi Yinxian*, *Yang Xuefei*, *KPyae Phyo Hein*, *Thaung Naing Oo*, *Cory W. Whitney*, and *Yang Yongping*

PAGE 45

Socio-cultural diversity of ethnic communities in and around Namdapha National Park

– *Chandamita Das*, *Mahendra S. Lodhi*^{*} and *Diana Ethel Amonge*

PAGE 47

Tourism as a nature-based solution for sustainable development in Chittagong Hill Tracts (CHT), Bangladesh

– *Md. Anowar Hossain Bhuiyan*

PAGE 49

Circular bioeconomy for sustainable development in The Himalayas

– *Debomitra Sil*

PAGE 51

Reconsideration of Erhai Lake governance

– *Na Li*

Background

ICIMOD has been promoting the landscape approach to address the shared conservation and development challenges that transcend national boundaries. Our Landscape Initiative for the Far Eastern Himalaya (HI-LIFE) has served as a platform for regional cooperation by supporting joint research, facilitating policy dialogue, and promoting the sharing of information, innovative approaches, and best practices.

2022 is a crucial year for global biodiversity conservation and sustainable development, as the CBD CoP15 conference ‘Ecological Civilization: Building a Shared Future for All Life on Earth’ will endorse the Post 2020 Global Biodiversity Framework, chart out the roadmap, and set new targets for the next decade. Sharing knowledge and information will be the first step towards this ‘shared future’.

About the webinar series

In this regard, HI-LIFE with partners – G.B. Pant National Institute for Himalaya Environment, North East Unit, India; Kunming Institute of Botany, CAS, China; Forest Department, Ministry of Natural Resources and Environmental Conservation, Myanmar; and the Southeast Biodiversity Research Institute, Myanmar – hosted a series of webinars for scientists, policymakers, practitioners, and funding agencies that have worked in or might be interested in the landscape. The webinars focused on approaches and best practices in biodiversity conservation, ecosystem management, new technologies, and nature-based solutions.

EPISODE 1

Exploring future investment in biodiversity research and monitoring

The first episode of the webinar series aims to identify key biodiversity knowledge gaps, set priorities for research, and explore future investments in biodiversity research and monitoring. The Far Eastern Himalaya Landscape (FEHL) is a biodiversity-rich transboundary landscape that stretches across parts of China, India, and Myanmar. The landscape has diverse flora and fauna

from three bio-geographic regions and a high proportion of rare, endemic, vulnerable, and endangered species. It harbours at least 12 Important Bird Areas, 8 of the Global 200 Ecoregions, and is home to at least 240 mammals, 800 bird species, and 6,000 vascular plant species with a high degree of endemism and threatened species. About 50.1% of the landscape is protected (nature reserves, wildlife sanctuaries, and national parks) by the governments of China, India, and Myanmar. The FEHL is also home to diverse ethnic communities with unique sociocultural traditions. Given its significance, this is a priority area for conservation and investments in research and monitoring.

EPISODE 2

Strengthening biodiversity conservation

The second episode of the webinar series will provide a platform for sharing policies, experiences, emerging issues, collaborative opportunities, research findings, new ideas and technologies, technical guidelines, and approaches to biodiversity conservation and protected area management, transboundary collaboration, and community conservation.

Biodiversity in the Far Eastern Himalaya Landscape (FEHL) is threatened by land-use change, habitat fragmentation, climate change, biological invasions, poaching and wildlife trade, excessive exploitation of forest products, and lack of transparency in the trade of biological products. The transboundary nature of the landscape adds to the complexity and challenges surrounding biodiversity conservation.

Community participation in biodiversity conservation is extremely important in the FEHL as many areas outside the Protected Area (PA) network are rich in biodiversity, and various ethnic groups have customary institutions and a wealth of traditional knowledge related to biodiversity and stewardship.

As a result of global efforts for strengthened conservation, national policies, legal frameworks, and institutions governing biodiversity conservation in China, India, and Myanmar have undergone drastic changes in the past decade. At the same time, PA management and wildlife conservation have been transformed by new technologies and approaches such as geospatial technologies, artificial intelligence, camera trapping as well as citizen engagement in patrolling, monitoring, surveys, information processing, and public outreach.

Nature-based solutions and innovations for sustainable livelihoods

The proposed CBD Post 2020 Global Biodiversity Framework envisages a world where humans exist in harmony with nature, and where “by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet, and delivering benefits essential for all people”.

A range of factors threaten the sustainable development of people in the Far Eastern Himalaya. They include declining ecosystem services, environmental degradation, climate change, natural disasters, poverty, food insecurity, and inadequate infrastructure and services.

Integrating biodiversity conservation and local development has always been a challenge, especially in a priority conservation area like the Far Eastern Himalaya Landscape (FEHL). Nature-based solutions can help us protect, sustainably manage, and restore ecosystems while addressing societal challenges such as climate change, biodiversity loss, and poverty and inequality. They offer opportunities to meet critical needs of society as well as build long-term environmental and economic resilience.

In this third Webinar, participants shared case studies, experiences and innovative practices from the landscape and adjacent areas. The focus was on nature-based solutions that can help address challenges such as poverty, disasters, erosion, pest infection, pollution, and extreme weather while promoting biodiversity.

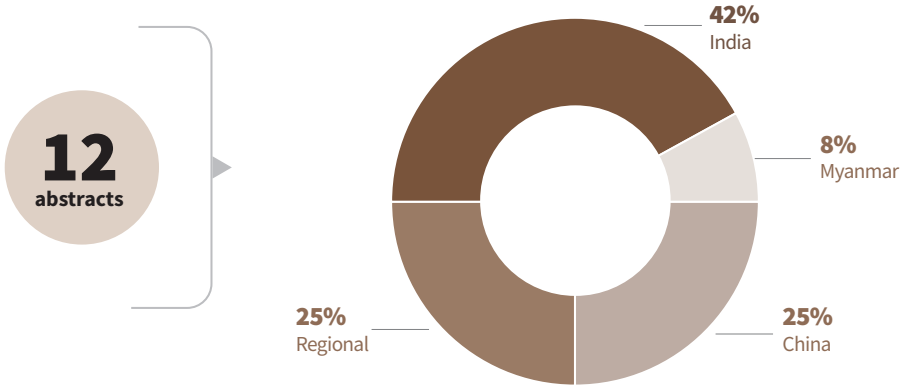
Objectives

- Share the current understanding of biodiversity, ecosystems, and socioeconomic aspects, and deepen the overall understanding of the landscape
- Inform policymakers, Protected Area managers, development workers, and conservation practitioners about new technologies, tools, approaches and best practices in ecosystem management and sustainable development
- Identify gaps and emerging areas for regional collaboration to achieve the goals of the CBD post-2020 Global Biodiversity Framework
- Strengthen and widen partnerships and regional cooperation for the conservation and sustainable development of the Far Eastern Himalaya Landscape (FEHL)

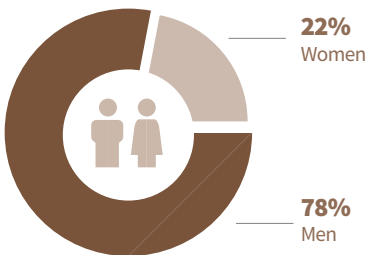
EPISODE 1
Abstracts

12 Abstracts

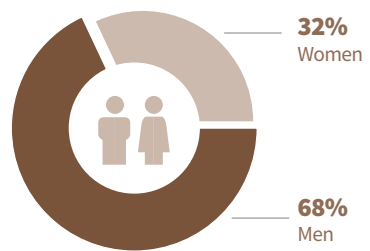
Geographic area of research



Authorship



Presenters



Cryptic species diversification of the *Pedicularis siphonantha* complex (Orobanchaceae) in the Mountains of Southwest China since the Pliocene

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Abstract

Morphological approaches often fail to delimit species in recently derived species complexes. This can be exacerbated in historical collections which may have lost key features in specimen preparation and preservation. Here, we examine the *Pedicularis siphonantha* complex, endemic to the Mountains of Southwest China. This complex is characterized by its red/purple/pink and long tubular corolla and twisted, beaked galea. However, herbarium specimens are often difficult to identify to species. Molecular approaches using nrITS or nrITS + ptDNA have been successfully used for species identification in *Pedicularis*. To resolve taxonomic confusion in the *P. siphonantha* complex, we reconstructed phylogenies of the complex using nrITS and four plastid DNA loci (*matK*, *rbcL*, *trnH-psbA*, and *trnL-F*). To recover as much of the phylogenetic history as possible, we sampled individuals at the population level. Topological incongruence between the nrITS and ptDNA datasets was recovered in clades including two widely distributed species, *P. milliana* and *P. tenuituba*. Based on morphological, geographical, and genetic evidence, we suggest that hybridization/introgression has occurred between *P. milliana* and *P. sigmoidea*/*Pedicularis* sp. 1 in the Yulong Snow Mountain of Lijiang, northwest Yunnan, and between *P. tenuituba* and *P. leptosiphon* in

Ninglang, northwest Yunnan. After removing conflicting DNA regions in *P. dolichosiphon* (nrITS) and *P. milliana* (ptDNA), the concatenated nrITS and ptDNA phylogenies distinguish 11 species in the *P. siphonantha* complex, including two undescribed species, from the Jiaozi and Yulong Snow Mountains, respectively. Phylogeographical analyses indicate that the *P. siphonantha* complex originated south of the Hengduan Mountains, expanding north to the Himalayas and the Yunnan-Guizhou Plateau. Moreover, uplift of the Qinghai-Tibet Plateau and climate oscillations may have driven further diversification in the complex.

Keywords: *Pedicularis siphonantha* complex; phylogenetic conflict; phylogenetic delimitation; speciation; introgression; Mountains of Southwest China

Source: <https://www.frontiersin.org/articles/10.3389/fpls.2022.811206/full>

Developing effective targets for climate and biodiversity

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Abstract

While the Paris Agreement target for climate has gained considerable traction, developing an equivalent target for biodiversity has so far proven elusive. Integrating different types of data, this paper explores how biodiversity and climate synergies can enable the development of targets that benefit both. Furthermore, whilst concepts such as ecological civilisation have been developed, their ultimate success will rely on how they are translated into action. The paper demonstrates how complementary data, which reflects service provision and sensitivity as well as biodiversity can, be integrated to enable the development of targets that provide multiple benefits. With these complementary targets, we have a better chance at fulfilling future goals and at garnering wider support from the public. Finally, the paper discusses the next steps for making these targets entirely actionable and thus safeguarding biodiversity in the future.

Keywords: conservation; SDGs; Post-2020 target; ecological civilisation; spatial prioritisation

Darwin Wasp inventory of the Eastern Himalaya: 5,000 species ahead?

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Abstract

Many biodiversity inventories provide limited insight because they focus on small taxonomic groups or limited geographic ranges. Here, we report on the size and composition of the Eastern Himalaya Darwin Wasp fauna. Our results are based on our data sample spanning almost half a decade and the massive inventory of the Northwestern Yunnan insect fauna. The Darwin wasps (Hymenoptera: Ichneumonidae) is the most species rich family of Hymenoptera, and one of the largest insect families. It has been roughly estimated that there are about 100,000 species worldwide, which probably means that less than 30% have been described to date. A large amount of work is needed to fill this gap. Yunling Mountains Region of Yunnan, where we did our sampling, is part of the major Three Parallel Rivers Region, where three biodiversity hotspots overlap: Himalaya, Southwest Mountains of China, and Indo-Burma. To put things into perspective, 4121 species of Darwin wasps have been registered in Germany, while in Yunnan Province, which is roughly equal in size, only 250 species have been recorded to date. The field campaign involved the deployment of 46 Malaise traps at three latitudinal transects across the region for five years (2017-2022). We obtained over 900 trap/month. The resulting collection is a valuable resource for entomological and ecological studies, particularly given the huge need for base data for analysing insect decline and climate change. We extracted 16,000 specimens of Darwin wasps but extrapolation methods suggest that the material sampled comprises around 40,000 specimens. The material is dominated by subfamilies Campopleginae and Orthocentrinae. We suggest that there are 5000 species of Darwin wasps in Northwestern Yunnan. Of those 4750 species (95%) were unknown at the start of the inventory and 1190 (23.8%) still await discovery. Thus, current knowledge of Darwin wasp fauna from the Eastern Himalaya is strongly biased taxonomically and ecologically. We analyse studies of latitudinal gradients in the size and composition of known Mesoamerican Darwin wasps and show that several patterns contradict the data on Eastern Himalayan Darwin wasps,

perhaps because of similar knowledge biases. Addressing these biases is critical for understanding insect communities and the ecosystem services they provide. Our results underline the need to broaden the taxonomic scope of insect monitoring efforts, especially in light of recent studies that show global insect decline.

Keywords: Darwin wasp, Ichneumonidae, Yunling Mountains, biodiversity, Malaise trap

30 years of land use land cover changes in the Far Eastern Himalayan Landscape (HI-LIFE)

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Abstract

Land cover information allows us to gauge the impact of human activity on natural landscapes.

It is now possible to accurately detect man-made changes in large landscapes using the Google Earth Engine platform. We computed the Land Use Land Cover (LULC) changes over the past 30 years in the well-known global biodiversity hotspot, the HI-LIFE landscape, which shares boundaries with three countries, namely India, China and Myanmar. We used Landsat 5 and Landsat 8 satellite imagery from 1990, 2000, 2010 and 2020 with different band combination strategies to produce and evaluate land cover maps of HI-LIFE. We used three machine-learning algorithms, namely classification regression trees, random forest, and support vector machine, to classify land cover for each year. The land cover classes were Snow, Barren Land & Rocks, Agriculture, Built-Up Areas, Dense Forest, Open Forest, and Water Bodies. Confusion Matrix was used to classify land cover by using the different algorithms of each year. The Kappa co-efficient value yielded 0.85, 0.86, 0.89 and 0.91 for 1990, 2000, 2010 and 2020, respectively, for the best classified image. The results show some settlement expansion, mainly in the China part of HI-LIFE, which is mostly covered with mountains, hills, barren lands and rocks. Despite moderate settlement expansion, more changes from open forests to dense forests are observed in the Chinese part of HI-LIFE. Decrease in vegetative cover was mainly noticed in the Indian HI-LIFE region, where the land earlier designated as dense forest and open forest has been transformed into agricultural land and a few built-up areas. This is largely a result of population growth, which in turn can be attributed to increasing demand for food, livelihood and employment. Settlement and agricultural expansion is minimal in the Myanmar part of HI-LIFE compared to that in India and China. In general, there has been a significant shift from barren lands to built-up areas and agricultural lands without much harm to

the forest cover for the past 30 years, from 1990 to 2020. There has been a shift from open to dense forest for the past 30 years, from 1990 to 2020. Potential factors influencing the shift or transformation are mainly climatic parameters, anthropogenic factors, mining, forest fires, etc.

This study could help in formulating conservation plans and aid the efforts of regional landscape managers and planners to restore and secure critical forested and wildlife habitats of the HI-LIFE region. In particular, our LULC map from the current year will be a key resource for forest managers while prioritising conservation zones and making sustainable development plans.

Keywords: Google Earth Engine; LULC; Confusion Matrix; Kappa Coefficient; smile cart; Smile Random Forest; LIBSVM

Crop diversity and its importance: A case study from Changlang district, Eastern Arunachal Pradesh

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Abstract

Crop diversity is fundamental to food security. It is the foundation of agriculture. The evolution and adaptation of crops is critical for meeting the ever-increasing demand for nutritious and sustainably produced food for the growing human population. At present, the greatest challenges faced by the world are food insecurity and hunger. These challenges could be significantly minimized by diversifying crop resources and producing varied foods that are nutritious, affordable and easily accessible to poor and vulnerable populations. As per the Second Global Plan of Action by FAO, 2011, besides providing the biological foundation for food production and security, crop diversity also contributes to economic development. Changlang district which lies in the south-eastern corner of Arunachal Pradesh, is very rich in biodiversity and natural wild edible resources. Most of the indigenous communities of the district live in villages, and agriculture is one of their main occupations.

A household survey on crop diversity was carried out in 69 households in the year 2020 in Deban area within Miao Circle of Changlang district. To gain better knowledge on crop diversity in the district, six villages, viz. Bodhisatta, Bodhisatta II, M'Pen II (7th, 8th, 9th mile), and Lama under Miao Circle were selected.

The survey yielded information related to various cultivated and non-cultivated food items. Under cultivated crops, 28 different food items (viz. cereals = 3, fruits = 4, vegetables = 17, and spices = 4) belonging to 16 families were recorded of which most plant spp. belonged to Brassicaceae family (5) followed by Curcubitaceae (4) and Solanaceae (4). Under non-cultivated items, 16 wild edible plant species were documented of which 3 were unidentified and 13 belonged to 11 families. Among the wild edible plant resources, besides food value, some had economic (13 plant spp.), medicinal (4 plant spp.) and traditional value (3 plant spp.). During a Diversity Fair programme, we recorded 16 varieties of paddy (including local variety) and

6 varieties of maize. Such diversity is important for agriculture as more varieties promote better resistance against pest and diseases, drought, and poor yield. In this regard, more intensive research and nutritional analysis is needed to ensure that crops with better qualities are well managed and conserved for sustainability.

The study shows the availability of diverse plant species, highlighting the importance of crop diversity in combating hunger, poverty and health problems. It also highlights the need to conserve traditional crops (that are highly rich in nutrition) for the cultural survival of particular tribes or communities.

Keywords: Crop diversity, alternative source, cultivated crops, uncultivated crops, food security.

Orchids of Changlang District of Arunachal Pradesh

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Abstract

More than 1200 orchid species are distributed throughout India, especially in the wet tropics where humidity is maximum with high rainfall. The highest diversity of orchids is recorded in the tropical belt, which harbours the largest population of epiphytic orchids. Changlang district of Arunachal Pradesh, is endowed with rich diversity of flora and fauna. The district is surrounded by hills in the southeast and is bordered by Myanmar and Lohit district. The only National Park of the state i.e., Namdapha National Park, is in the district. It is the largest protected area of the country with an area of 1985 km² (the core area is 1808 km² and the buffer zone 177 km²). So far 220 species of orchids have been documented from this district, which account for 36% of the state. These include several rare orchid species, such as *Paphiopedilum fairrieanum*, *Paphiopedilum venustum*, *Vanda coerulea*, *Dendrobium williamsomii*, and *Aerides rosea*, among others.

All the orchids found in the district are listed based on physical survey and consultation with different literatures. Also, we assess the threats faced by orchids to find out whether they are due to natural causes or manmade ones. In Arunachal Pradesh, there is an urgent need to conserve these species for the future. The local inhabitants of the district are not aware of the importance of orchid. We recommend that the state forest department, other government organizations and NGOs organize local seminars to create awareness about the importance of orchid and their conservation.

Keywords: Orchids, Changlang, threats, conservation

Mammalian diversity and distribution of Namdapha Tiger Reserve with respect to its conservation issues

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Abstract

Northeast India is a mega-biodiversity centre, which forms a significant portion of both the Himalaya and Indo-Burma biodiversity hotspots. This region is comprised of eight states, the largest among which is Arunachal Pradesh, with a geographical area of 83,743 km². Located at the foothills of the Eastern Himalaya, the state harbours large patches of evergreen rainforest with huge habitat diversity and many rare, threatened and endemic flora and fauna. About 13 protected areas are spread across the state, which plays a significant role in in-situ conservation of biological diversity. Among these protected areas, Namdapha National Park (NNP), which also serves as a Tiger Reserve, is one of the oldest protected areas of the state and known for exceptional biological diversity. The park harbours a wide range of habitats with distinct types of speciation, including many endemic and threatened species communities, which are often limited to a particular area.

The NNP covers an area of 1985 km² (the core area is 1808 km² and the buffer zone is 177 km²), with an altitudinal variation ranging from 200–4571 masl. The park is situated in Changlang district of Arunachal Pradesh, between 27°15'30" to 27°39'40" N latitude and 96°15'02" to 96°58'33" E longitude near the international border with Myanmar. Camera trapping exercise was carried out on expedition mode from 19 November 2020 till 30 April 2021 for a period of six months. The selected study sites were divided into various 2X2 grids using QGIS and topo sheets. Based on the accessibility and communication in the park area, four different study sites, namely Happy Valley and Deban beats under Miao wildlife range, Kamala Valley beat under Gandhigram Wildlife Range, and Ranijheel beat under Namdapha Wildlife Range, were selected for the monitoring of tiger and prey base species. The exercise covered different tiger habitats ranging from subtropical to alpine, with altitudinal gradients ranging from 355 masl up to 3494 masl (snow-clad Daphabum range). A total of 45 camera traps (Browning trail cameras and Cuddeback digital camera traps) were deployed across the study area during 1513 trap nights. Various sites were selected for installing the camera traps, which included areas near the edge of waterholes and areas where indirect evidences

like scats, pugmark and rake marks were observed. Our camera trapping exercise resulted in a capture of 24,062 photos over a period of six months during 1513 trap nights. Further analysis has revealed a capture of 34 different species overall, which include six (6) large carnivore species, seven (7) herbivore species, two (2) species of primates, six (6) species of birds (see Table 3), and many small carnivores including the rare sun bear. Among the listed mammalian species three (3) were Endangered, eight (8) were Vulnerable, and thirteen (13) belonged to the Least Concern category, as per the IUCN Red List 2021.

Keywords: Mammals; diversity; conservation issues; Namdapha TR; eastern Himalaya

Native orchid diversity of Northern Myanmar: Conservation and research status

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Abstract

About 841 wild orchid taxa are distributed in Myanmar, in which about 10% is endemic. Myanmar is still rich in wild orchid taxa due to the very wide variation in latitude, altitude and climate within the country, though some disturbances have occurred. Despite its rich orchid diversity, Myanmar is among the Asian countries with the least information on orchid. Various wild orchids are spread across the seven states and seven regions of the country, which include Himalayan temperate forests in the north, tropical rainforests in the south, evergreen forests and deciduous forests in the east and west, and mangrove and tidal forests in Delta and Coastal areas. Kachin State, the northern part of the country, can be recognized as the origin and centre of CITES Appendix (1) orchid, *Paphiopedilum wardii*. Myanmar Forest Department, the local NGO Myanmar Floriculturist Association and Singapore Botanic Gardens have done many orchid surveys in Hponkan-razi Wildlife Sanctuary, Inndaw Gyi Wildlife Sanctuary and Putao Area of Kachin State since 2010. The joint research team recorded many new orchids from Myanmar as well as discovered several new orchid species. The members of the team published articles in well-recognized scientific journals, bulletins and magazines. In addition, from 2015 to 2018, the Forest Department, Myanmar Floriculturist Association and the New York Botanical Garden conducted some orchid research as part of their Flora Surveys in Hkakabo-razi National Park. Research teams from the Forest Department and the Chinese Academy of Sciences also did many orchid surveys in Northern Myanmar and discovered new orchid species. Four sets of wild orchid samples with flowers as well as small parts of leaves were collected for DNA research. Three sets of collected orchid plants were dried for herbarium sheets and one set of orchid was sent to the Forest Department nursery for further conservation and research. All collected orchid plants and flowers were photographed, measured and their descriptions recorded. Their localities (GPS position) were also recorded. Fresh flowers were put in 70% alcohol bottles and kept in the

herbarium. Orchid surveys were conducted in Hkakabo-razi National Park, Hponkan-razi Wildlife Sanctuary, Inndaw Gyi Wildlife Sanctuary, Putao and surrounding areas.

The surveys found previously unrecorded species of orchids from Myanmar.. This shows that mutual cooperation and joint efforts by national and international researchers can help expand knowledge about orchid diversity and its conservation.

In northern Myanmar, so far there is no evidence that orchids have been collected for foreign export. It is noted that those engaged in orchid trade are orchid enthusiasts from Kachin State, who sell the product to other states and regions. Myanmar Forest Department and Myanmar Floriculturist Association are now actively working with other local NGOs to raise awareness about orchid conservation and promote orchid research in Kachin State.

Keywords: Endemic, orchid taxa, CITES, DNA, conservation awareness

An ethnobotanical market survey of wild medicinal and edible plants in Longling, Yunnan, China

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Abstract

Market reflects the current situation of plants used by local people and market survey can provide important information for the development and conservation of such plants. Longling County, which lies in the southern part of Gaoligong Mountains, is a priority conservation area but not many ethnobotanical studies have been conducted in the area. This study aims to identify wild medicinal and edible plants from the area that are sold in the market as well as assess their sustainability and document traditional knowledge surrounding such plants. Market survey was carried out in September 2021. Eight markets and 306 stalls were surveyed from seven townships. We documented traditional knowledge by interviewing stallholders and villagers around the market and collected voucher specimen from the markets and the field. Frequency of occurrence (FO) was applied to evaluate high frequency species. We considered parts used, collection status and the level of endangerment of wild medicinal and edible plants when assessing sustainability. A total of 79 medicinal and edible plants were documented. Five species with higher frequency were *Trachycarpus fortunei* (FO=66), *Padus napaulensis* (FO=34), *Pinus armandii* (FO=32), *Diplazium esculentum* (FO=24) and *Macropanax dispermus* (FO=23). *Dendrobium chrysotoxum*, *Bletilla formosana*, *Bletilla ochracea*, *Nervilia mackinnonii* and *Paris mairei* are rare and endangered species. This study reveals the diversity and the sustainability status of wild medicinal and edible plants sold in the markets of Longling. An effective way to balance local livelihoods and conservation might be to exploit and utilise functional wild vegetable or fruit such as *Trachycarpus fortunei* and *Padus napaulensis*. Long-term market monitoring and plant resource survey are recommended, especially for endangered species.

Keywords: Medicinal plants, market, traditional knowledge

Medicinal plants used by Kachin people in Northern Myanmar

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Abstract

Traditional medicinal plants have important health benefits and healing properties. They are a vital element of the culture and everyday life of indigenous and tribal communities. This paper focuses on medicinal plants used by the Kachin people in Kachin state of Myanmar. Based on interviews with 82 informants from eight villages in three townships, we documented and assessed the Kachin community's traditional knowledge of medicinal plants. The assessment was done based on the use reports (URs) for each species. The ailments they reported were classified as per the standard categories of the International Classification of Primary Care-2 (ICPC-2) system. A total of 117 medicinal plant species with a total of 642 URs and 72 medicinal uses related to 17 disease categories were documented. The most used medicinal plants were from Fabaceae and Lamiaceae families. The most cited species based on URs were *Tinospora cordifolia* (Willd.) Hook.f. & Thomson (URs = 39), *Oroxylum indicum* (L.) Kurz (URs = 28), *Aquilaria malaccensis* Lam. (URs = 26), *Chromolaena odorata* (L.) R. M. King & H. Rob. (URs = 24), and *Chloranthus elatior* Link. (URs = 22). The most prevalent disease category was digestive disorders, which were treated by 47 medicinal plants with 142 URs. Leaves were the most used plant part; decoction was the dominant method of preparation; and oral consumption was the most frequent administration method. The study revealed the Kachin people's traditional knowledge of diverse medicinal plant species and their uses for treating a wide range of health problems.

Keywords: Medicinal plants, health, traditional knowledge

Biotracks: An effective tool for biodiversity field survey

Xu Zhoufeng

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Abstract

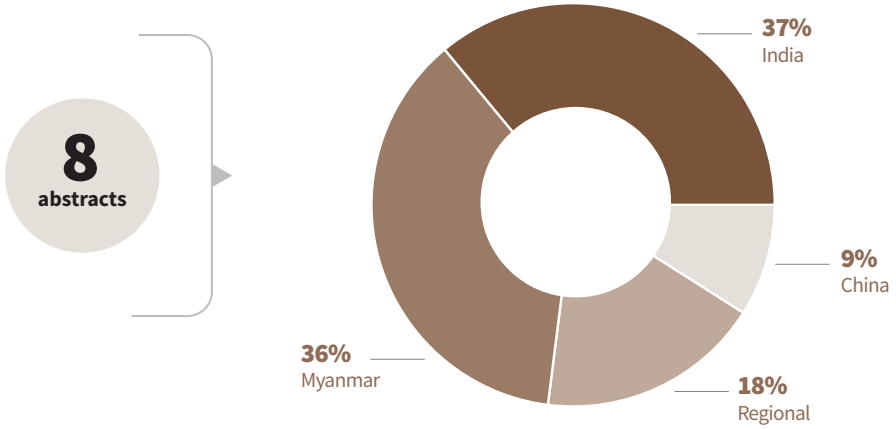
We believe that the public is an important player in the life system, so if we can guide the public to participate in the conservation and research of biodiversity, it will greatly expand the researcher's vision and research value. In addition, the efficiency and quality of traditional fieldwork should be enhanced by the latest technology, which can significantly improve the work efficiency and quality of researchers. To that end, we have launched a pilot research project called Biotracks in China. The project aims to assess the feasibility of a new app called Biotracks, which can assist them in their work and allow them to share information and work together for a common goal. Biotracks is now being widely used for scientific field surveys and public nature observation in China. The project has given us a new way of thinking about large-scale biodiversity research, and it needs to be shared and discussed further.

Keywords: Biodiversity, biotracks, field survey

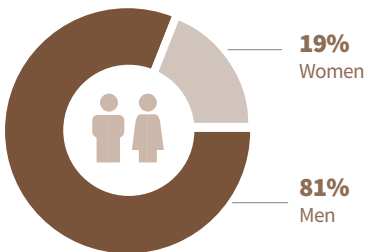
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Abstracts

8 Abstracts

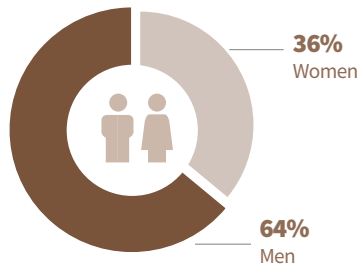
Geographical area of research



Authorship



Presenters



Floral biodiversity conservation and forest management in the Eastern Himalayan Landscape under changing climate

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Abstract

The Eastern Himalaya region of the country includes the seven sister states (Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura) along with Sikkim and the Hilly areas of West Bengal, constituting about 8% of the country's total geographical area. The region includes parts of the Indo-Burma and Eastern Himalayan biodiversity hotspots. The Eastern Himalayan landscape is popularly known as 'the cradle of flowering plants' and 'the botanist's paradise' as it contains nearly 50% of the total flowering plant species of the country. The flora of the region comprises about 7500 flowering plants, 700 orchid species, 63 bamboo species, 64 citrus species, 28 conifers, 500 mosses, 700 ferns, 728 lichen species and over 800 medicinal plant species. The floral wealth of the region still remains underexplored due to its remoteness, inaccessibility, tough topography and harsh climatic conditions, even though the state holds great potential for new plant discoveries. Indigenous communities are highly dependent on plant biodiversity and forest resources for sustenance and livelihood. The region harbors many rare, threatened, endangered and endemic species. However, its rich biodiversity is highly sensitive to threats associated with climate change. The region is characterized by a large rural population (around 80%), low population density, a large percentage of indigenous tribal communities (more than 200 tribal groups), and a large, forested area (65%). Analysis of long-term temperature data from the Eastern Himalaya indicates a distinctly rising trend in surface air temperatures. Empirical scientific studies have projected that temperature in the region may rise by 1.80C to 2.10C and the intensity of rainfall is likely to increase by 0.3–3% by the next decade. The biological resources of the region are facing numerous anthropogenic threats aggravated by climate change impacts. There is an urgent need for policy actions that promote the conservation and sustainable use of valuable forest and floral biodiversity of the Eastern Himalayan landscape.

In addition to policy interventions, consolidated climate change mitigation and adaption strategy is also urgently required with wider participation of community, government, and all other stakeholders.

Keywords: Eastern Himalayan landscape, floral biodiversity, conservation, forest management, climate change, adaptation and mitigation

The 10th anniversary of the scientific description of the black snub-nosed monkey (*Rhinopithecus strykeri*): A set of new management strategies for saving this critically endangered primate from extinction

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<https://pubmed.ncbi.nlm.nih.gov/35262940/>

Abstract

Traditionally, the genus *Rhinopithecus* (Milne-Edwards, 1872, Primates, Colobinae) included four allopatric species restricted in their distributions to China and Vietnam. In 2010, a fifth species, the black snub-nosed monkey (*Rhinopithecus strykeri*), was discovered in the Gaoligong Mountains located on the border between China and Myanmar. Despite the remoteness, complex mountainous terrain, dense fog, and armed conflict that characterize this region, over the past decade Chinese and Myanmar scientists have begun to collect quantitative data on the ecology, behaviour and conservation requirements of *R. strykeri*. In this presentation, we will review existing data and present new information on the life history, ecology, and population size of *R. strykeri*. We discuss these data in the context of past and current conservation challenges faced by *R. strykeri*, and propose a series of both short-term and long-term management actions to ensure the survival of this critically endangered primate species. Specifically, we will recommend that the governments and stakeholders in China and Myanmar formulate a transboundary conservation

agreement that includes a consensus on bilateral exchange mechanisms, scientific research and monitoring goals, local community development, and cooperation to prevent the hunting of endangered species and cross-border forest fires. These actions will contribute to the long-term conservation and survival of this critically endangered species.

Keywords: conservation; extinction risk; Myanmar snub-nosed monkey
Rhinopithecus strykeri; poverty; transboundary

Source: <https://pubmed.ncbi.nlm.nih.gov/35262940/>

Identifying transboundary conservation priorities in a biodiversity hotspot of China and Myanmar: Implications for data poor mountainous regions

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Abstract

Difficult-to-study species that inhabit inaccessible terrain present significant challenges in obtaining accurate ecological, distributional, and conservation information. To address these challenges, we used an effective set of time- and cost-efficient methods including interview-based surveys assisted by Google Earth 3D maps to document the distributional range of 32 native animal taxa in the biodiversity rich but difficult-to-access Gaoligong Mountains (GLGMS), located on the northern Sino-Myanmar border. Five threatened flagship species, including the black snub-nosed monkey (*Rhinopithecus strykeri*), the Skywalker hoolock gibbon (*Hoolock tianxing*), Shortridge's langur (*Trachypithecus shortridgei*), Sclater's monal (*Lophophorus sclateri*) and the Mishmi takin (*Budorcas taxicolor*) were selected for intensive surveys and used as surrogate taxa to study community biodiversity. Field surveys of each species were conducted to determine their presence/absence and to confirm the reliability of species distribution data obtained from interview-based surveys. Multicriteria Decision Analyses were used along with data on habitat suitability (MAXENT) to prioritise transboundary conservation areas. Our results indicate that approximately 83.4% (10,398.7 km²) of the remaining habitat with high biodiversity conservation value in the GLGMS is unprotected. This includes six large zones located along the northern Sino-Myanmar border, separated by rivers and human settlements. These areas should be designated as a transboundary World Nature Heritage Site, national parks, or wildlife sanctuaries. This study presents a reliable, rapid and integrative method

for developing informed policies for conservation prioritisation in data poor areas, which can be applied successfully to assess conservation priorities in other mountainous regions where obtaining data on biodiversity is difficult.

Keywords: flagship species, local ecological knowledge, MAXENT, multi-criteria decision analysis, conservation planning, transboundary conservation

Source: <https://www.sciencedirect.com/science/article/pii/S2351989419303580>

Defining recent fire regime in the mountains of Northwest Yunnan using 30 years of fire records derived from Landsat timeseries

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Abstract

It is important to understand how fire interacts with ecosystem structures and processes as well as climate and socio-economic factors, and how these interactions have changed over time. Such understanding is essential for predicting future shifts of fire patterns and assessing risks for the environment, wildlife and human health. In China, only a few studies have attempted to describe current or historical fire regimes, and they generally encompassed broad regions at relatively coarse spatial resolution or specific case studies at the single burn scale. Little is known about fire patterns in important ecological areas such as the mountains of northwest Yunnan, a region affected by a high number of small seasonal fires. Following a comprehensive conceptual model of fire regime and using a dataset of fire occurrences extracted from 30 years of Landsat data, we described the recent fire history of this mountainous region. The dataset revealed a net decrease of fires following a fire ban in the late 1980s but with recurring peaks every ten years. Several areas experienced recurrent fires and the characteristic shrubby vegetation type dominated by the serotinous *Pinus yunnanensis* has recovered very quickly. The region has many fire-adapted ecosystems that need to be taken into account for more effective fire management policies.

Keywords: fire pattern, small fires, complex landscape, controls of fire

Local people's preferences toward improving ecosystem services of Moeyungyi wetland in Myanmar: A choice experiment approach

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Abstract

Using a choice experiment method, this study investigates residents' preferences toward improving ecosystem services and estimates willingness to pay for better management options in a protected area of Myanmar. A face-to-face field survey was performed in 2021 in the Moeyungyi Ramsar Site, a unique wetland ecosystem that has significant ecological functions and provides natural benefits to the local communities. The results revealed that the respondents have the highest preference for the provision of food followed by water quality as they heavily depend on these attributes for their daily life. Local communities are willing to contribute 57,747 kyats per household every year for excellent conditions for the provision of food. This study also shows respondents' positive attitude towards conserving biodiversity and enhancing recreation. Wetland policy makers in Myanmar should take far-reaching steps to develop a restoration plan that can enhance provisioning services of Moeyungyi wetland and improve water quality.

Keywords: choice experiment, conditional logit model, residents' preferences, willingness-to-pay, Moeyungyi wetland, Myanmar

Conservation investment plan of the Htamanthi Wildlife Sanctuary and sustainable financing options for protected areas in Northern Myanmar

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Abstract

The Htamanthi Wildlife Sanctuary was home to Sumatran Rhinoceros until not too long ago. However, it remains a stronghold of many other rare wildlife species. These include seven wild cat species, including tigers, and their prey; one of Myanmar's most threatened bird species, White-winged Duck; as well as important populations of hornbills, River Terns, and rare migratory species. The extensive areas of largely pristine forest and natural vegetation in Htamanthi Wildlife Sanctuary (WS) generate many valuable 'ecosystem services' – the benefits that nature provides to people. Htamanthi WS forms one of the main watershed areas for Chindwin, one of Myanmar's largest river systems. As such, it plays a key role in providing a freshwater source for local people and wildlife, as well as many downstream water consumers, including city-dwellers, farmers, and industries. In addition, protecting steep mountain slopes and riverbanks against erosion, and protecting forests, and other natural vegetation also contributes to carbon sequestration and storage, helping mitigate the effects of global warming and climate change. Both the Conservation Investment Plan and the five-year Management Plan seek to ensure that these critical values are sustained and improved over the long term for the benefit of both current and future generations. Without adequate funding, there is a real risk that this unique environmental treasure, and the habitats, species, and ecosystem services it contains, will be lost forever. A shortage of funding for conservation remains a concern worldwide, including in Myanmar, and Htamanthi WS also faces this challenge. A new management plan for Htamanthi WS has just been developed. It includes a clear programme of activities for the next five years for managing the wildlife sanctuary and conserving its habitats and species. Adequate budget and resources are required to carry out these activities. Currently, funding is still heavily dependent on limited government budget allocations. It is important to broaden and diversify Htamanthi WS's financing base, both to ensure that sufficient funds are available to cover the immediate costs of implementing

the management plan and to create a stable, secure, and sustainable basis for conservation for the future. The Conservation Investment Plan provides the background and rationale for generating this funding. Once sufficient funds are available, Htamanthi WS will be able to secure a sustainable future – one in which local communities are connected to their rich natural heritage and have adequate access to food, education, livelihoods, and a greater role in managing their own resources and sustaining Myanmar's tiger population.

Keywords: CIP, Htamanthi, tiger, sustainable financing, protected area management

Residents' preferences toward wetland conservation: A case study from India

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Abstract

Wetland ecosystems are an essential part of the natural green infrastructure in urban habitats as they provide economic benefits and support human well-being. Wetlands can be a source of wealth and economic growth when protected and managed sustainably. Residents, directly or indirectly dependent upon the wetland ecosystem services, are important stakeholders who can contribute to the wetlands' protection. This study attempts to identify the factors responsible for residents' willingness to pay (WTP) to preserve a peri-urban wetland, the Deepor beel, located in the northeastern region of India. It also investigates how the WTP among different groups of users varies according to their dependency on the wetland services.

This study is based on primary data collected from a questionnaire survey of the residents of the surrounding areas of Deepor beel wetland from February to March 2021. We selected the open-ended payment card approach of the contingent valuation method (CVM) that allowed the respondents to express the amount they were willing to pay for the betterment of the wetland, thereby revealing the respondents' level of WTP. A payment card presented to respondents listed six bid amounts from INR 0 to INR 500. For estimation of the factors affecting residents' WTP, we applied the Tobit model (Feng et al., 2018)

$$WPT = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \dots + \alpha_n X_n + \mu \quad (1)$$

where WTP denotes the compensation that the residents are willing to pay, α_0 is a constant, α_n is the regression coefficient for the explanatory variables X_n , and μ is the residual term.

The results show that among the directly dependent group, the socio-economic variable

household income significantly affects the WTP of residents, and among the variables describing the residents' perception of the wetland, the water quality of Deepor beel and hope for profitable tourism development were found to be significant. Whereas, for the indirectly dependent residents, the variables age, household income, educational qualification, and employment status of the respondents significantly affect the amount the residents are willing to pay. However, none of the variables describing the residents' perception of the environmental quality of Deepor beel were found to be significant for this category of respondents

There are limited studies on the factors that influence residents' WTP for the protection of the wetland ecosystem. This study attempts to fill that gap in the literature. We found that the educated and employed residents are willing to pay more to protect the Deepor beel ecosystem. These results could help policymakers and concerned authorities to design appropriate conservation and developmental plans for the wetland, taking local residents' concerns into consideration.

Keywords: wetland, contingent valuation, payment card, willingness to pay, ecosystem services

Degradation of Loktak Lake, Manipur: A study of environmental perceptions

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Abstract

Loktak Lake in the State of Manipur is one of the three Ramsar Sites in Northeast India. The lake was designated a Ramsar Site on 23 March 1990. The Loktak wetland is unique for many reasons, such as its floating vegetal mass, locally called 'phumdis'; the endangered Sangai deer (brow antlered deer – *Cervus eldi eldi*) that live on the floating phumdis; and the human-nature interface that makes the wetland ecologically fragile and sensitive. The lake has rich biodiversity consisting of a wide range of vegetation, water fowls, reptiles, and numerous other animals besides Sangai deer. The catchment areas draining into Loktak Lake have been denuded of its vegetal cover due to deforestation and shifting (jhum) cultivation.

Loktak Lake includes the floating park, Keibul Lamjao National Park (KLNP), which has a total area of 40 km² with 21.91 km² covered by phumdi. Before the construction of the barrage, there was no obstruction for the flow of water through and out of the lake. During summer, the water level decreases and the phumdi touches the lakebed, drawing sufficient nourishment from the lake bottom. The Ithai barrage, which is constructed in the southern part of the lake, reduced the flushing of water in the southern zone of the lake. Also, due to rapid changes in the hydrology caused by the construction of barrages and dams, the lake faces problems like siltation and flooding of the surrounding area. Progressive degradation of Loktak Lake and its unique ecosystem has caused concern among the local communities, the government, civil society and the general public.

Our study attempted to understand the dynamic changes in the water spread area of Loktak Lake in order to understand the environmental perspectives. We used SAR data along with ESA-SNAP tool to extract water surface features from the data.

Based on the rainfall analysis conducted in nine districts within the Loktak sub-basin, it is evident that flooding occurred in the western, Heirok, and Sekmai sub-basins during monsoons. The most significant changes in the water spread area in

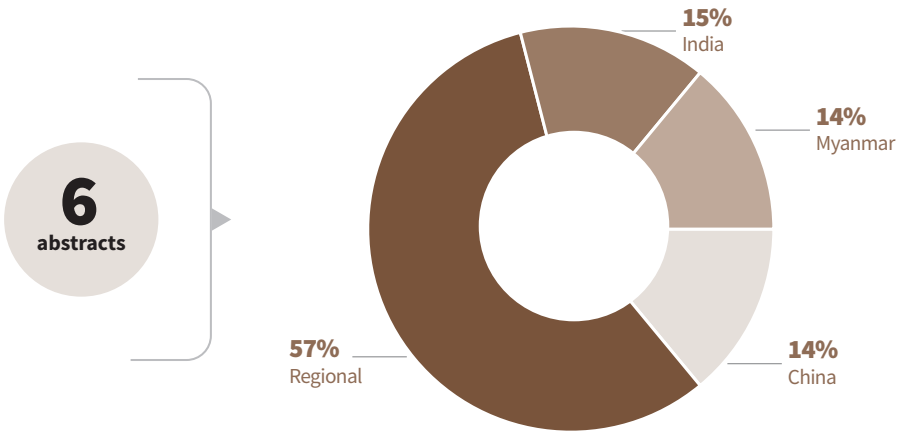
Loktak Lake occurred in July, which has an impact on the aquafarms surrounding the lake, leading to submergence. The vegetative health of the sub-basin has deteriorated over time, with the worst years being 2000-2010. Although the area with high-density vegetation increased in 2015, there are no indications of high density vegetation in 2020. One of the key reasons for the decline of Shanghai deer is the deterioration of vegetation health. The LULC change reveals that the rate of settlements (12.31) has increased over time. The area of the vegetation (phumdi and forest) shrunk by 1.34%. Crop fields in the western sub-basins, Heirok and Sekmai, were inundated in July between 2015 and 2020 as per the study. The livelihood of local communities and the ecosystems surrounding Loktak Lake are severely affected by the construction of Ithai barrage though it was constructed 40 years ago.

Keywords: ecosystem, degradation, lake, vegetation

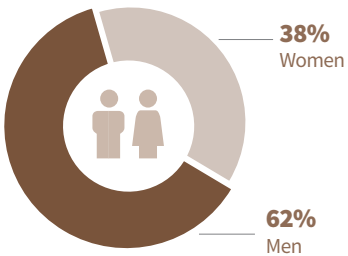
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Abstracts

6 Abstracts

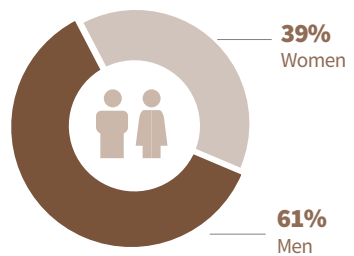
Geographical area of research



Authorship



Presenters



Building competency of local bird guides for community-based avitourism: A case study from hotspot areas around Gaoligong National Park

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Abstract

In recent years, community-based avitourism has emerged as an opportunity to boost the economy of underdeveloped mountainous areas in the western part of China, which is endowed with abundant bird resources. Members of local communities could earn an income by working as bird guides for birdwatchers. Bird guide competency can play a vital role in ensuring a positive birding experience. Do birdwatchers get quality services from local bird guides in community-based tourism destinations in western China? What competencies should a local bird guide have? What gaps should a training programme for local bird guides aim to fill? To answer the questions, we conducted a qualitative research in two birding hotspots in Gaoligong Mountains using methods such as on-the-spot observation, questionnaires, and interviews. By coding qualitative data obtained from such stakeholders as bird watchers, local bird guides, professional bird guides, and non-ornithologists, we produced a system of local bird guides' competency items.

Keywords: bird, tourism, national park, economy

The uses of fig (*Ficus*) by five ethnic communities in Southern Shan State, Myanmar

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Abstract

Most regions of Myanmar fall within the Indo-Burma Biodiversity Hotspot and are threatened with biodiversity loss. Development of a comprehensive framework for sustainable development is crucial. Figs are ecological keystone species within these regions and are also important for traditional spiritual food and health uses, which often have accompanying conservation practices. The traditional use and management of figs may offer clues to help guide the development of national policies for sustainable development. In this study, we performed both key informant and semi-structured interviews with 114 informants from five ethnic groups in Southern Shan State, Myanmar. The reported uses were categorized according to local practices and recipes. For the assessment of conservation practices, informants were asked about trends in conservation status over the past 10 years and any conservation-related customs and practices. The common quantitative ethnobotany indices: the use report (UR) and use value (UV) were applied for data analysis of fig uses and conservation actions. Informants reported the uses of eight fig species (*Ficus auriculata*, *F. concinna*, *F. geniculata*, *F. hispida*, *F. racemosa*, *F. religiosa*, *F. semicordata*, and *F. virens*). *F. geniculata* and *F. virens* were most useful (UR = 228) and were used by all five ethnic groups, corresponding to a high use value (UV = 2). Seven species reported treatments of 16 health problems. Household consumption, economic and sacred uses were accompanied by sustainable practices of harvest and protection of figs. Traditional taboos, in situ and ex situ conservation were common especially for highly demanded species (*F. geniculata* and *F. virens*) and the sacred fig *F. religiosa*. Findings suggest that figs are useful for food (all informants) and medicine (13.16% of the informants) in the study area. Traditional taboos, in situ and ex situ conservation practices help to maintain sustainable utilization of locally important figs. Our study is an early

contribution to the traditional knowledge of edible figs in Myanmar. Although similar uses have been reported in neighboring countries for seven of the fig species, the ethnobotanical use of *F. concinna* is novel in this study.

Keywords: Ficus, Ethnobotany, Traditional knowledge, Conservation, Myanmar

<https://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-020-00406-z>

Socio-cultural diversity of ethnic communities in and around Namdapha National Park

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Abstract

The north-eastern region of India is the homeland of a large number of tribes and communities. The state of Arunachal Pradesh (the land of the dawn lit mountains) is one of the most pristine areas in Northeast India. The tribal hill villages in the state are quite different from the rest of the country. They are unique in social, cultural, and economic characteristics. The indigenous people of Arunachal Pradesh have a rich weaving and craft tradition. Each tribe has a distinct type of handloom. Most handlooms and handicraft items are made of cane and bamboo, which is easily available in the local forest.

To better understand the socio-cultural diversity of communities in and around Namdapha National Park (NNP), a study was carried out in 2020 in the Chakma, Lama and Singpho communities in Miao Circle of Changlang district. Situated in Changlang district in Miao Circle of Arunachal Pradesh, Namdapha National Park is a biodiversity hotspot and an important part of the Far Eastern Himalaya - India. The park enjoys the dual status of national park and tiger reserve. This is one of the largest protected areas (1985 km² with 177 km² buffer zone) in the state.

The villages selected for the study were M'Pen II (7th mile, 8th mile and 9th mile sub-villages), Lama Village, Budhisatta, Lewang, and Phup. Questionnaire survey on religious practices and taboos and on handloom and handicraft were carried out. A total of 13 respondents of 45-64 years were interviewed. Under religious beliefs, the Chakmas, Lamas and Singphos all followed Buddhism, though the school of Buddhism varied. For example, the Chakma people follow the Theravada Buddhism; the Lama people follow Mahayana Buddhism, and the Singpho people follow the Hinayana school of Buddhism. Thus different schools of Buddhism were followed within an area of less than 100 sq.km. In terms of handloom and handicraft, different communities have distinct styles of weaving and making

handicraft. The study revealed that for the conservation and preservation of any indigenous community, it is important to gain in-depth knowledge of their social and cultural life.

Keywords: tribes, religion, handloom, handicraft, Namdapha National Park

Tourism as a nature-based solution for sustainable development in Chittagong Hill Tracts (CHT), Bangladesh

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Abstract

The Chittagong Hill Tracts (CHT) of Bangladesh possess a balanced natural diversity with the presence of tribal culture, ethnicity, social cohesion, and ecosystem. The region has rich natural and environmental resources: hills, forests, rivers, lakes, diverse flora and fauna, and outstanding scenic beauty. The CHT provides a significant natural resource both upstream and downstream that contributes to economic enhancement, environmental protection, ecological sustainability, and human wellbeing. The population of this region is more than 1.6 million which includes 12 ethnic communities with unique cultural diversity and traditions. About 95% of land areas of this region are not suitable for intensive agriculture due to remoteness and inaccessible landscape. This region has possibilities for several nature-based solutions such as agrobiodiversity in farming, horticulture, high-value products, forest resources, livestock, fisheries, freshwater resources, micro-enterprises, watershed restoration, cultural diversity, and recreational opportunities. All these nature-based services are suitable for tourism activities as well as ensuring sustainable development in this region. The present study identifies the potentialities of tourism activities based on nature-based services that can ensure sustainable development in CHT. The study proposed a framework that shows that nature-based services can improve the tourism value chain in this region through market linkage, coordination, and value addition. The present study considered two tourism richer Upazilas namely, Bilaichari and Thanchi from Rangamati and Bandarban districts respectively in the CHT region of Bangladesh as the study location. A non-probability convenience sample design has been adopted to identify 200 respondents from the local communities who are engaged in tourism-related occupations. A questionnaire survey had been conducted with a semi-structured questionnaire for primary data collection. Selected respondents were asked to provide their opinion on several statements regarding sustainable development through tourism activities. The study postulates and evaluated the latent variable constructs and uses factor

analysis to identify the latent construct that may imply the dimensions of the associated nature-based solution. The study revealed that tourism activities can reduce poverty, create employment, increase income generation, and thus ensure social benefits for local people. Environmental well-being such as biodiversity conservation, and sustainable agriculture practice, reducing soil erosion and creating effective management of resources and ecosystem are some significant positive consequences of tourism development. However, the absence of an effective plan and strategy, less awareness, lack of facilities and infrastructure, and poor market access are the existing barriers to sustainable tourism development in CHT. Several initiatives should be taken for utilizing the nature-based solution to enhance tourism activities which can ensure sustainable development in study areas. The necessary initiatives are proper policy and mass awareness, infrastructure development, promoting local culture and traditions, natural resource management, and ensuring effective marketing.

Keywords: Chittagong Hill Tracts, Sustainable Development, Tourism

Circular bioeconomy for sustainable development in the Himalayas

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Abstract

The Himalayan topography has seen centuries-old intermingling of nature and humans, though the current scenario has created disruption of its pristine balance. The often-occurring climate disasters, landslides and cloudbursts are a pointer to the future and the severe pressure such events would place on the already fragile ecosystems. Joint efforts are being made by both government and independent organizations to reverse the damage done by unsustainable growth because of growing local economies. One such pathway that is still emerging combines the two concepts of circularity and bioeconomy of the region. The Center for International Forestry Research defines a circular bioeconomy as an organized system which focuses on renewable natural capital and waste minimization. It advocates partnerships in the developing regions based on local needs, urban-rural interactions, and variegation. A successful system here could be one that converges the multiple demands of sustainable resource management, climate change mitigation, financial improvements, and conservation efforts. Demonstrated below are some examples collated from two such organizations: CHINAR and Grassroots India where alternative sustainable energy systems were explored from a technical perspective. [(1) Biomass segregated from municipal waste, forestry and sludge turned into manure and biogas (by gasification) (Prashant Malik M. A., 2021) - Storage battery costing \$78,964 and energy 0.192\$/kWh saved 27.7 Mt of CO₂/year compared to a setup driven by diesel. (2) Traditional power generation with solar and hydropower through limited infrastructure and finances. It also included transportation, power, and heat. (Ashish Gulagi, 2021) - Reduced GHG emissions by 67% and expenditure of 90 Euro/MWh in 2015 to 90 Euro/MWh by 2050. (3) Hybrid energy system in Western Himalayas using gasifier-based pine needles burning in gasifier and Photovoltaic/Biomass gasifier/Grid. (Prashant Malik M. A., 2020) - Cheap energy source and reduces forest fires as the resin is highly inflammable. The system suppresses about 27.8 Mt CO₂ emissions.] A possible way to evaluate these demonstration models is by exploring innovative solutions

and reflecting on the problem at hand. The table below is indicative in nature [(1) Biomass - open burning/poor awareness/breathing problems among women and children/potential resources discarded as waste slurry - government intervention/encouraging enterprises in green technologies/organic manure generated with economic benefits which is also eco-friendly (2) Hydropower - upstream flooding / downstream water shortage - afforestation upstream for watershed management/ drip irrigation (3) Hybrid Energy Microgrids - low scheme awareness / cloudy weather/lag in initiative execution - Microenterprise encouragement / incentivization (4) Land use for Agriculture - specificity of growth conditions in crops / lowering of species diversity in Central Himalayas - community forestry / indigenous mixed cropping systems / preventing monocultures (5) Women and Children - time consumed by duties like collecting fuelwood and water / health problems due to indoor smoke - accessibility to clean water, smokeless stoves, education, essential healthcare / self-help groups for financial independence] The results indicate the potential via propagation of incentivised ecosystem-based adaptation and greener consumption-production chains which, while ensuring sustainable livelihoods, are critical for preserving biodiversity and addressing climate change.

Keywords: Bioeconomy, Sustainability, Conservation, Climate, Energy

Reconsideration of Erhai Lake governance

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Abstract

The Erhai Lake is an important highland lake in the mountains of southwest China, and the management of the Erhai Sea is a key project of the Chinese government. Historically, the Erhai watershed has had extensive paddy fields, and the natural terrain of the mountainous landscape has been used to rationalize the use of water and achieve sustainable development. Contemporary governance measures, however, do not fully draw on this traditional wisdom of the unity of heaven and man. In the contemporary trend of social and technological development, it is possible to find a nature-based solution for the governance of the Erhai Lake by combining traditional Chinese wisdom with modern development needs. The Erhai watershed can be divided into two layers along an altitude gradient. The upper layer is higher in elevation and has a more primitive lifestyle, free of industrial pollution, where residents can directly access mountain springs and drain their domestic water directly into farmland, making full use of water sources while creating a landscape composed of channels, wetlands, and organic farmland together. The lower elevation, close to the waters of the Erhai Sea, is a modern urban area where residents can choose well water or tap water, and sewage is treated mainly by engineering and does not enter the Erhai watershed directly. The above idea of Erhai governance can maintain the living habits of residents and preserve traditional Bai culture, while achieving landscape diversity and enabling residents to enjoy quality ecosystem services. The realization of Nature Based Solutions requires multidisciplinary integration such as environmental science, ecology, and humanities.

Keywords: The Erhai Lake; landscape diversity; culture conservation; Nature Based Solutions

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