

# Headlines Himalaya

February 1 – February 15 (2021)

No. 637-638

Editorial Team: Chandani K.C. and Shova Adhikari

For the 637<sup>th</sup>-638<sup>th</sup> issues of Headlines Himalaya, we reviewed journal articles from seven sources and selected 23 researches from five countries. We selected eight researches from Nepal and 15 researches from other Himalayan countries (India, China, Bhutan and Pakistan).

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## NEPAL

*GEOMETRIC MORPHOMETRIC ANALYSES DEFINE RIVERINE AND LACUSTRINE SPECIES FLOCKS OF HIMALAYAN SNOWTROUT (CYPRINIDAE: SCHIZOTHORAX) IN NEPAL*

*MULTILOCUS PHYLOGENY SUGGESTS A DISTINCT SPECIES STATUS FOR THE NEPAL POPULATION OF ASSAM MACAQUES (MACACA ASSAMENSIS): IMPLICATIONS FOR EVOLUTION AND CONSERVATION*

*INTERVENTION OF CLIMATE-SMART PRACTICES IN WHEAT UNDER RICE-WHEAT CROPPING SYSTEM IN NEPAL*

*FOREST COVER CHANGE AND ECOSYSTEM SERVICES: A CASE STUDY OF COMMUNITY FOREST IN MECHINAGAR AND BUDDHASHANTI LANDSCAPE (MBL), NEPAL*

*MORPHOLOGICAL AND WOOD ANATOMICAL TRAITS OF RHODODENDRON LEPIDOTUM WALL EX G. DON ALONG THE ELEVATION GRADIENTS IN NEPAL HIMALAYAS*

*NEPALESE LANDSLIDE INFORMATION SYSTEM (NELIS): A CONCEPTUAL FRAMEWORK FOR A WEB-BASED GEOGRAPHICAL INFORMATION SYSTEM FOR ENHANCED LANDSLIDE RISK MANAGEMENT IN NEPAL*

*ASSESSMENT OF CHANNEL SHIFTING OF KARNALI MEGAFAN IN NEPAL USING REMOTE SENSING AND GIS*

*POTENTIAL MODIFICATION OF GROUNDWATER ARSENIC REMOVAL FILTER COMMONLY USED IN NEPAL: A REVIEW*

## INDIA

*GIS- AND AHP-BASED LAND SUITABILITY ANALYSIS OF MALUS DOMESTICA BORKH. (APPLE) IN WEST KAMENG DISTRICT OF ARUNACHAL PRADESH, INDIA*

*HOT AND COLD BACTERIA OF SIKKIM: BIODIVERSITY AND ENZYMOLOGY*

*RELIGIOUS TOURISM AND SUSTAINABLE DEVELOPMENT: PERSPECTIVES FROM HILL STATES IN INDIA*

CAMERA TRAP BASED MONITORING OF A KEY WILDLIFE CORRIDOR REVEALS OPPORTUNITIES AND CHALLENGES FOR LARGE MAMMAL CONSERVATION IN ASSAM, INDIA

ASSESSMENT OF WOODY SPECIES DIVERSITY AND COMPOSITION ALONG A DISTURBANCE GRADIENT IN BEHALI RESERVE FOREST OF BISWANATH DISTRICT, ASSAM, INDIA

PHYSICOCHEMICAL, MICROMERITICS, BIOMEDICAL, AND PHARMACEUTICAL APPLICATIONS OF ASSAM BORA RICE STARCH

PHENOLOGY DETERMINES LEAF FUNCTIONAL TRAITS ACROSS RHODODENDRON SPECIES IN THE SIKKIM HIMALAYA

**CHINA** RESPONSES OF SOIL INSECT COMMUNITIES TO ALPINE WETLAND DEGRADATION ON THE EASTERN QINGHAI-TIBETAN PLATEAU, CHINA

CLIMATE AND LANDSCAPE CONTROLS ON SPATIO-TEMPORAL PATTERNS OF STREAM WATER STABLE ISOTOPES IN A LARGE GLACIERIZED MOUNTAIN BASIN ON THE TIBETAN PLATEAU

SPATIOTEMPORAL PATTERN OF VEGETATION ECOLOGY QUALITY AND ITS RESPONSE TO CLIMATE CHANGE BETWEEN 2000–2017 IN CHINA

**BHUTAN** CONSERVATION OF THREATENED AND UNDER-REPRESENTED SPECIES OF PLANTS

NON-VIOLENT TECHNIQUES FOR HUMAN-WILDLIFE CONFLICT RESOLUTION

EXPLORING THE RISE OF EXPENDITURE REVIEWS AS A TOOL FOR MORE EFFECTIVE BIODIVERSITY CONSERVATION AND THE PROTECTION OF ECOSYSTEM SERVICES

**PAKISTAN** IMPACT OF URBANIZATION ON GROUNDWATER LEVELS IN RAWALPINDI CITY, PAKISTAN

THE PRECAMBRIAN HAZARA FORMATION FROM HAZARA MOUNTAINS, NORTHERN PAKISTAN

## Nepal-Himalaya

### GEOMETRIC MORPHOMETRIC ANALYSES DEFINE RIVERINE AND LACUSTRINE SPECIES FLOCKS OF HIMALAYAN SNOWTROUT (CYPRINIDAE: SCHIZOTHORAX) IN NEPAL

Binod Regmi, Marlis R. Douglas, David R. Edds, and Michael E. Douglas

*Aquatic Biology* 30: 19-31

Freshwater fishes in the river and lake systems in the Himalayas and Tibetan Plateau are morphologically diverged but the evolutionary relationship of putative subspecies separated in these freshwater systems has not been explored. Snowtrout (*Schizothorax* spp.) are minnows (Cyprinidae) broadly distributed in Asia. Body shapes of 3 Lake Rara (northwest Nepal) endemics (*S. macrophthalmus*, *S. nepalensis*, *S. raraensis*) and 2 widely distributed riverine species (*S. progastus*, *S. richardsonii*) across 3 drainages in Nepal (i.e. Karnali, Gandaki, and Koshi Rivers) were studied using geometric morphometry. Data were derived from museum voucher specimens/tissues collected in 1984-1986 and 1996 (Lake Rara). Cartesian coordinates of 18 anatomical points (Type I landmarks) from 528 individuals were digitized; shape variation was then quantified with principal component analysis and

visualized with thin-plate splines derived from a Procrustes analysis. Models of shape variation (i.e. taxonomy versus geography) were tested with a multivariate analysis of variance and a morphological distance matrix. Phylogeographic relationships were examined with a haplotype network (N = 115) derived from 1140 base pairs of the mitochondrial DNA cytochrome *b* gene, and selected GenBank sequences (N = 5). Koshi River snowtrout diverged morphologically from conspecifics, consistent with the phylogeographic data. In contrast, Gandaki and Karnali River snowtrout grouped by morphotype (up- versus downstream) irrespective of geographic origin, yet clustered separately within the haplotype network. Lake Rara snowtrout were morphologically but not genetically distinct, due to incomplete lineage sorting. Morphological and genetic variability in *Schizothorax* from Nepal represent a mosaic driven by isolation (= vicariance) and specialization (= adaptation), with taxonomy insufficiently reflecting diversity. Additional data are required to appropriately derive management and effective conservation plans.

Further reading: <https://doi.org/10.3354/ab00737>

### **MULTILOCUS PHYLOGENY SUGGESTS A DISTINCT SPECIES STATUS FOR THE NEPAL POPULATION OF ASSAM MACAQUES (*MACACA ASSAMENSIS*): IMPLICATIONS FOR EVOLUTION AND CONSERVATION**

Laxman Khanal, Mukesh Kumar Chalise, Peng-Fei Fan, Randall C. Kyes, and Xue-Long Jiang

*Zoological Research* 42: 3-13

Phylogenetic relationships within the *sinica*-group of macaques based on morphological, behavioral, and molecular characteristics have remained controversial. The Nepal population of Assam macaques (*Macaca assamensis*) (NPAM), the westernmost population of the species, is morphologically distinct but has never been used in phylogenetic analyses. Here, the phylogenetic relationship of NPAM with other congeners was tested using multiple mitochondrial and Y-chromosomal loci. The divergence times and evolutionary genetic distances among macaques were also estimated. Results revealed two major mitochondrial DNA clades of macaques under the *sinica*-group: the first clade included *M. thibetana*, *M. sinica*, and eastern subspecies of Assam macaque (*M. assamensis assamensis*); the second clade included *M. radiata* together with species from the eastern and central Himalaya, namely, *M. leucogenys*, *M. munzala*, and NPAM. Among the second-clade species, NPAM was the first to diverge from the other members of the clade around 1.9 million years ago. Our results revealed that NPAM is phylogenetically distinct from the eastern Assam macaques and closer to other species and hence may represent a separate species. Because of its phylogenetic distinctiveness, isolated distribution, and small population size, the Nepal population of *sinica*-group macaques warrants detailed taxonomic revision and high conservation priority.

For further reading: [10.24272/j.issn.2095-8137.2020.279](https://doi.org/10.24272/j.issn.2095-8137.2020.279)

### **INTERVENTION OF CLIMATE-SMART PRACTICES IN WHEAT UNDER RICE-WHEAT CROPPING SYSTEM IN NEPAL**

Janma Jaya Gairhe, Mandeep Adhikari, Deepak Ghimire, Arun Khatri-Chhetri, and Dinesh Panday

*Climate* 9: 19

Besides a proper agronomic management followed by Nepalese farmers, wheat (*Triticum aestivum* L.) production has been severely affected by changing climate. There are many interventions, including climate-smart practices, to cope with this situation and possibly enhance crop and soil productivity. Field experiments were set up in a randomized complete block design with six treatments (TRT) with four replications in three locations (LOC) during wheat-growing seasons in Nepal from 2014 to 2016. Treatments included (i) Controlled Practice (CP), (ii) Improved Low (IL), (iii) Improved High (IH), (iv) Climate Smart Agriculture Low (CSAL), (v) Climate Smart Agriculture Medium (CSAM), and (vi) Climate Smart Agriculture High (CSAH), whereas those LOC were Banke, Rupandehi and Morang districts. There was a significant main effect of TRT and LOC on grain yield and a significant interaction effect of TRT × LOC on biomass yield in 2014–2015. About 55.5% additional grain yield was produced from CSAM treatment compared to CP in 2014–2015. Among locations, grain yield was the highest in Banke (3772.35 kg ha<sup>-1</sup>) followed by

Rupandehi (2504.47 kg ha<sup>-1</sup>) and Morang districts (2504.47 kg ha<sup>-1</sup>). In 2015–2016, there was a significant interaction effect of TRT × LOC on grain and biomass yields. The highest grain yield was produced from CSAH treatment in Banke district in 2015–2016. Overall, grain yield and other parameters showed a better response with either of the climate-smart interventions (mostly CSAH or CSAM) despite variability in geography, climate, and other environmental factors indicating the potential of climate-smart practices to improve wheat production in southern plains of Nepal.

For further reading: <https://doi.org/10.3390/cli9020019>

### **FOREST COVER CHANGE AND ECOSYSTEM SERVICES: A CASE STUDY OF COMMUNITY FOREST IN MECHINAGAR AND BUDDHASHANTI LANDSCAPE (MBL), NEPAL**

Sushila Rijal, Kuaanan Techato, Saroj Gyawali, Nigel Stork, Megh Raj Dangal, and Sutinee Sinutok

*Environmental Management* 2021: 1-11

The community-based forest management program has been successful in the conservation of forest cover in Nepal. We investigated forest cover change for the Mechinagar and Buddhashanti Landscape (MBL) area within the Jhapa district, Nepal, during 1990–2019 using Landsat images and GIS tools and valued the major ecosystem services (ES) of Kalika Community-managed Forest (KCF) within the MBL landscape using the economic approach–market price method (revealed price). Land cover analysis of the MBL area indicated that over the study period, there were increases in urban/built-up areas, forest, and tea plantations, and declines in cultivated land, shrub, barren land, water body, and grassland areas. In particular, forest cover increased by 8.6% from 41.5 sq.km to 45.1 sq.km, due to the conversion of 3.9 sq.km cultivated land and 2.4 sq.km shrub into forest cover. KCF, the selected case study area for ES valuation, has been successful in providing noticeable economic benefits from provisioning and cultural services. Of the provisioning services, wood and timber make the largest contribution with an average revenue collection of Nepali Rupees (NRs) 3091.4 thousands followed by non-timber forest products (NRs 883.1 thousands) and firewood (NRs 524.3 thousands), respectively, while ecotourism-based income is also important (NRs 458.4 thousands) and is increasing in later years. As monitoring forest cover in a rapidly changing landscape and evaluating the ES of the community-managed forest cover are imperative for sustainable environmental planning and policy formulation, these research outputs are expected to be a significant benchmark for planners, policy makers, and future researchers.

For further reading: <https://doi.org/10.1007/s00267-021-01430-9>

### **MORPHOLOGICAL AND WOOD ANATOMICAL TRAITS OF *RHODODENDRON LEPIDOTUM* WALL EX G. DON ALONG THE ELEVATION GRADIENTS IN NEPAL HIMALAYAS**

Mohan Pandey, Mitra Lal Pathak, and Bharat Babu Shrestha

*Arctic, Antarctic, and Alpine Research* 53: 35-47

Though variability in morphological features along the environmental gradients has been extensively studied, less information is available on possible adaptations and trends of anatomical features. We examined the variation in morphological and stem anatomical features of a widely distributed (2,200–5,300 m a.s.l.) *Rhododendron lepidotum* across elevation gradients in Langtang and Sagarmatha National Parks of Nepal Himalayas. Plant samples in each site were collected from three elevation bands (ca. 3,000, 4,000, and 5,000 m a.s.l.). In both study sites, all morphological features measured had their highest value at the lowest elevation and vice versa. Vessel density of basal stem increased but diameter and area of xylem vessels, and length of vessel element and fiber tracheids decreased as elevation increased. Similarly, height and the number of cells in uniseriate rays and height, width, area, and density of multiseriate rays also decreased toward the highest elevation. However, anatomical features of the ultimate branch did not show any distinct pattern with elevation. Morphological features showed more plasticity than anatomical features along the elevation gradients. Decreased plant height, individual leaf

area, specific leaf area, and the existing trade-off relationship between vessel diameter and density could have supported a wide distribution of *R. lepidotum* in Nepal Himalayas.

Further reading: <https://doi.org/10.1080/15230430.2020.1859719>

### **NEPALESE LANDSLIDE INFORMATION SYSTEM (NELIS): A CONCEPTUAL FRAMEWORK FOR A WEB-BASED GEOGRAPHICAL INFORMATION SYSTEM FOR ENHANCED LANDSLIDE RISK MANAGEMENT IN NEPAL**

Sansar Raj Meena, Florian Albrecht, Daniel Hölbling, Omid Ghorbanzadeh, and Thomas Blaschke

*Natural Hazards and Earth System Sciences* 21: 301–316

Comprehensive and sustainable landslide risk management, including the identification of areas susceptible to landslides, requires responsible organisations to collaborate efficiently. Landslide risk management efforts are often made after major triggering events, such as hazard mitigation after the 2015 Gorkha earthquake in Nepal. There is also a lack of knowledge sharing and collaboration among stakeholders to cope with major disaster events, in addition to a lack of efficiency and continuity. There should be a system to allow for landslide information to be easily updated after an event. For a variety of users of landslide information in Nepal, the availability and extraction of landslide data from a common database are a vital requirement. In this study, we investigate the requirements to propose a concept for a web-based Nepalese landslide information system (NELIS) that provides users with a platform to share information about landslide events to strengthen collaboration. The system will be defined as a web GIS (geographic information system) that supports responsible organisations in addressing and managing different user requirements of people working with landslides, thereby improving the current state of landslide hazard and risk management in Nepal. The overall aim of this study is to propose a conceptual framework and design of NELIS. A system like NELIS could benefit stakeholders involved in data collection and landslide risk management in their efforts to report and provide landslide information. Moreover, such a system would allow for detailed and structured landslide documentation and consequently provide valuable information regarding susceptibility and hazard and risk mapping. For the reporting of landslides directly to the system, a web portal is proposed. Based on field surveys, a literature review and stakeholder interviews, a structure of the landslide database and a conceptual framework for the NELIS platform are proposed.

Further reading: <https://doi.org/10.5194/nhess-21-301-2021>

### **ASSESSMENT OF CHANNEL SHIFTING OF KARNALI MEGAFAN IN NEPAL USING REMOTE SENSING AND GIS**

Biplob Rakhali, Tirtha Raj Adhikari, Sanjib Sharma, and Ganesh R. Ghimire

*Annals of GIS* 2021: 1-12

River flow exhibits morphological changes over time. The shifting of river channels is a common natural phenomenon which often poses risk to life and property. Channel shifting is mostly associated with weak geology, extreme floods, and land cover alterations. Here we assess the changing morphology of the largest depositional landform in Nepal, called the Karnali Megafan, over the period of 1977–2013. We applied geographic information system (GIS) and remote sensing techniques to analyse the spatiotemporal changes in the Karnali Megafan. We obtained historical channel information from Landsat Operational Land Imager (OLI) and the Thermal InfraRed Sensor (TRIS) satellite image, Landsat Enhanced Thematic Mapper Plus (ETM+), Thematic Mapper (TM) and Multispectral Scanner (MSS) for years 1977, 1990, 2000, 2010 and 2013. The channel shifting depicts a generally increasing trend in the right branch while the trend is less prominent in the left branch. We find that the extreme rainfall and flooding contribute to channel shifting in the Karnali Megafan. This study identifies the channel shifting spatiotemporal trends along the Karnali Megafan and are of practical use in developing and implementing appropriate river management strategies.

For further reading: <https://doi.org/10.1080/19475683.2021.1871950>

## POTENTIAL MODIFICATION OF GROUNDWATER ARSENIC REMOVAL FILTER COMMONLY USED IN NEPAL: A REVIEW

Haribansha Timalisina, Bandita Mainali, Michael J. Angove, Takeshi Komai, and Shukra Raj Paudel

*Groundwater for Sustainable Development* 12: 100549

Groundwater arsenic contamination is a serious concern in many countries around the globe because of the noxious impacts of arsenic on human health. In Nepal, contamination has seriously affected many districts of Terai region, leading to significantly increased risks of cancer and mass poisoning. Whilst many technologies have been available to remove arsenic from contaminated water, the Kanchan Arsenic Filter (KAF) still stands ahead in terms of efficiency, affordability, operation and maintenance. However, some recent studies have revealed poor performance of KAF, and highlighted the need to improve performance. This paper proposes a slight modification in KAF design with integration of a human hair layer, and the replacement of iron nails in the system with iron mesh. The authors reviewed the potential adsorption mechanisms and suitability of a hair layer on integration to existing arsenic removal filter. Hair contains a large quantity of keratin protein containing sulfhydryl amino acid (cysteine) which has a strong binding affinity for As(III). This review suggests that such a modification to the KAF filter could be effective, but further experimental evidence is required.

For further reading: <https://doi.org/10.1016/j.gsd.2021.100549>

### India-Himalaya

#### GIS- AND AHP-BASED LAND SUITABILITY ANALYSIS OF *MALUS DOMESTICA* BORKH. (APPLE) IN WEST KAMENG DISTRICT OF ARUNACHAL PRADESH, INDIA

Karma Chozom and Gibji Nimasow

*Applied Geomatics* 2021: 1-12

Crops grow best in locations where conditions meet their growth requirements like elevation, slope, aspect, soil, land cover, and many other climatic factors. So, a land suitability analysis (LSA) of *Malus domestica* in West Kameng district of Arunachal Pradesh, India, was attempted using an integrated approach of Analytical Hierarchy Process (AHP), Weighted Overlay Analysis (WOA), and Geographic Information System (GIS). Based on literature survey and farmer's opinion, the elevation, slope, aspect, annual temperature, rainfall, soil type, soil drainage, and land use/land cover (LULC) criteria were considered important for *M. domestica* cultivation in the area. AHP method was applied to score the criteria using available literature and interview with the local experts. Elevation scored the highest weight of 0.321 followed by temperature with 0.243. The weights of other criteria in parenthesis are slope and LULC 0.13 each, aspect and rainfall 0.060 each, and soil type and soil drainage 0.028 each. The results showed that 8.12% (392.98 km<sup>2</sup>) of the study area is highly suitable for *M. domestica* cultivation while 20.59% (996.08 km<sup>2</sup>) is not suitable. Rest of the area constituting 71.28% (3448.35 km<sup>2</sup>) was found moderately or marginally suitable. However, the study reveals that the current suitable areas are mostly underutilized. Thus, greater efforts to increase the area under crop might ensure higher productivity in the future. The methods and techniques used in this study can be efficiently replicated to assess the land suitability of other important horticultural and agricultural crops.

Further reading: <https://doi.org/10.1007/s12518-021-00354-7>

## **HOT AND COLD BACTERIA OF SIKKIM: BIODIVERSITY AND ENZYMOLOGY**

Sayak Das, Mingma Thundu Sherpa, Ishfaq Nabi Najar, and Nagendra Thakur

*Bioprospecting of Enzymes in Industry, Healthcare and Sustainable Environment* 269-289

The obnubilated macrocosm of microbes are influential, herculean, and is an enigma to us “the humans” — supposedly the wisest species to be evolved ever. The insane ability of microorganisms to survive, adapt, and utilize or metabolize, on every possible nook on earth is like a whodunit and supreme mastery. Their hejira from humans and also the ability to “live-out and live within” us hoodwinking our defence system is shrouded and veiled. In, Sikkim, the north-eastern state of India, diversified micro-flora, and fauna thrive in almost the entire landscape. It is a privilege to have both the extreme conditions of life here at Sikkim—HOT and COLD! The glacier hosts psychrophiles and the hot spring incubates thermophiles. Thus, the exploration of extremozymes from both these special ecology is one of our prime research interests. In this chapter, we have discussed briefly about our research findings on bacterial diversity at hot springs and glaciers of Sikkim. Among hot springs, we have discussed our studies from Borong, Dzongu, Polok, Reshi, Yumthang, and Yume Samdung whereas among glaciers, we have focused on Changme Khang, Changme Khangpu, Chumbu, and Kanchengayao. Some potential bacteria as polyextremophiles have also been highlighted.

For further reading: [https://doi.org/10.1007/978-981-33-4195-1\\_13](https://doi.org/10.1007/978-981-33-4195-1_13)

## **RELIGIOUS TOURISM AND SUSTAINABLE DEVELOPMENT: PERSPECTIVES FROM HILL STATES IN INDIA**

Dhwani Gambhir, Ahmad Mohd Khalid, and Seema Sharma

*Handbook of Sustainable Development and Leisure Services 2021: 273-287*

Sustainable Development is the prime global concern encompassing economic, social and environmental aspects. The attainment of the UN Sustainable Development Goals (SDGs) in developing countries is pivotal to the cause. Leisure, including tourism, has a deep connection with the SDGs’ agenda. Tourism influences not only the well-being and quality of life of people, but also has a significant socio-economic and environmental impact. It is one of the fastest growing industries. Religious and spiritual tourism is a niche segment in the tourism industry. It has been prevalent around the world since ancient times. It plays a significant role in developing countries, such as India, which has a rich, multi-cultural and religious heritage. Religious tourism must be promoted in a manner that assists in sustainable development. A case for the North-Indian hilly states of Himachal Pradesh and Uttarakhand, popularly known as ‘Dev Bhoomi’—Abode of the Gods, is presented. The states have a significant share of the religious and spiritual tourism in India. A qualitative and descriptive study using primary and secondary sources discusses the impact of this niche segment on the sustainability aspects in these states. In addition, suggestions to promote religious tourism while maintaining socio-economic and ecological balance in such difficult terrains are presented.

For further reading: [https://doi.org/10.1007/978-3-030-59820-4\\_18](https://doi.org/10.1007/978-3-030-59820-4_18)

## **CAMERA TRAP BASED MONITORING OF A KEY WILDLIFE CORRIDOR REVEALS OPPORTUNITIES AND CHALLENGES FOR LARGE MAMMAL CONSERVATION IN ASSAM, INDIA**

Pallabi Chakraborty, Jimmy Borah, Pranab Jyoti Bora, Soumen Dey, Tridip Sharma, Lalthanpuia, and Sarkam Rongphar

*Tropical Ecology* 2021: 1-11

To assess the corridor’s functionality and prioritize protection of one of the corridors connecting Kaziranga National Park and the forests of Karbi Anglong District in Assam, India, we conducted a camera-trap study from

2011 to 2016. A total of 10,895 trap nights revealed 39 mammal and avian species, several of which were new records for the area. Relative Abundance Index was calculated as a measure of photo-capture rates from the photographic events, and annual trend for selected species and seasonal trend for elephants were analyzed. The indices showed that elephants used the corridor patch most frequently (RAI = 8.81), followed by hog deer (RAI = 2.77), while hog badgers were most rarely recorded (RAI = 0.02). Seasonality of the movement pattern of elephants showed increased use during the monsoon season. Records of nine individual tigers and six individual leopards, along with other rare and endangered species indicate functionality and regular use of the critical corridor by wildlife, crossing over between Kaziranga and Karbi Anglong hills, maneuvering through the busy National Highway—37 that cuts across the historically connected landscape. The results obtained from the study can be used to prepare a conservation action strategy to secure the corridor for safe passage of wildlife.

For further reading: <https://doi.org/10.1007/s42965-020-00138-x>

#### **ASSESSMENT OF WOODY SPECIES DIVERSITY AND COMPOSITION ALONG A DISTURBANCE GRADIENT IN BEHALI RESERVE FOREST OF BISWANATH DISTRICT, ASSAM, INDIA**

Dipankar Borah, Biswajit Das, Sumpam Tangjang, Abhaya Prasad Das, and Anatoliy A. Khapugin

*Ecological Questions* 32: 1-25

The present study was carried out in Behali Reserve Forest, a semi-evergreen forest of Assam, India to record and analyze the woody species diversity and community characteristics using random sampling. Altogether, 35 quadrats (20 m × 20 m) were randomly established and studied from August 2018 to April 2019 spreading across nine study sites. A total of 128 (118 identified and 10 unidentified) woody species from 83 genera and 43 families were found in the sampled area of 1.4 ha. Lauraceae with 19 species was the richest family by species followed by Euphorbiaceae and Phyllanthaceae (eight species each). Altogether, 787 individuals were recorded from the sampled plots and the stand density ranged between 250 individuals × ha<sup>-1</sup> to 725 individuals × ha<sup>-1</sup> with mean stand density of 543 individuals × ha<sup>-1</sup>. Species-wise density analysis revealed that *Magnolia hodgsonii* (96.43 individual's × ha<sup>-1</sup>) has the maximum tree density. Plot wise analysis showed that *Dikal* (58.32 m<sup>2</sup> × ha<sup>-1</sup>) recorded the maximum basal area as well as the equitability index of 0.95. In Serelia, we recorded the highest Simpson index (0.92), Shannon H index (2.76), Brillouin index (2.11), Menhinick (3.49), Margalef (5.29) and Fisher alpha index (26.59). In Radhasu, we recorded maximum evenness (0.90), dominance (0.58) and Berger-Parker index (0.65). The maximal values of Chao index (38.53) was recorded in Hatimara. Our study also revealed that diversity was maximal for the community under medium level of disturbance in the reserve, while communities under the lowest and highest disturbance pressure had minimal diversity. The Behali Reserve Forest exhibited a great species richness (118 species), mean basal area (44.42 m<sup>2</sup> × ha<sup>-1</sup>) and stand density (in total, 788 individuals per study area of 1.4 ha) compared to the other forests of the northeastern region of India.

For further reading: <http://dx.doi.org/10.12775/EQ.2021.009>

#### **PHYSICOCHEMICAL, MICROMERITICS, BIOMEDICAL, AND PHARMACEUTICAL APPLICATIONS OF ASSAM BORA RICE STARCH**

Pratap Kalita, Abdul Baquee Ahmed, Abhinab Goswami, Saikat Sen, and Raja Chakraborty

*Evidence Based Validation of Traditional Medicines* 2021: 817-828

In current times the utilization of the natural starches in various aspects like as pharmaceutical, biomedical, food materials, etc. due to their uniqueness properties. Assam bora rice starch is a promising biopolymer as well as bio-carrier in different aspects. Natural starch as well as modified starch was being used abundantly as natural polymers in different drug delivery systems. The prime advantages of using natural starches are low cost, easily available, renewability, etc. Starch obtained from Assam bora rice is having potential applications in pharmaceutical industries such as excipients and binder and disintegrates in tablet formulations, as an active drug



carrier in nano, microformulations, and controlled drug delivery formulations. Assam bora rice starch as a native starch is having maleate particles which are often used for drug delivery carrier in the field biomedical application. The reasons behind this were due to their non-toxicity, biocompatibility, and inexpensive nature. In this chapter, we specially focus on Assam bora rice starch to profile its different applications along with physicochemical and powder flow properties which drastically affect the compactness of the starch granules.

For further reading: [https://doi.org/10.1007/978-981-15-8127-4\\_39](https://doi.org/10.1007/978-981-15-8127-4_39)

### **PHENOLOGY DETERMINES LEAF FUNCTIONAL TRAITS ACROSS *RHODODENDRON* SPECIES IN THE SIKKIM HIMALAYA**

Shweta Basnett and Soubadra M. Devy

*Alpine Botany* 2021: 1-10

Elevation gradients provide an ideal setting to infer species' functional trait responses to predicted future climate change. In plants, leaf functional traits help assess their capacity to cope with varying resources. Variation in abiotic conditions over short vertical distances can influence plant phenology, particularly leafing and flowering durations, and leaf functional traits at both inter- and intra-specific levels. However, studies examining relationships between leaf functional traits and phenology duration along elevation gradients are limited. We tested the relationship between leaf size, leaf thickness, specific leaf area, and leafing durations in 10 *Rhododendron* species in the Sikkim Himalaya. All the investigated traits varied significantly across species, but intra-specific variation in functional traits was observed only among a few. Leaf size and thickness showed significant negative relationships with elevation and a comparative phylogenetic method exhibited a strong relationship between leaf traits and leafing duration. We observed higher leaf thickness and size in species with longer leafing durations and less overlap in leafing and flowering durations. In contrast, species with shorter leafing durations and relatively more overlap in their flowering and leafing durations showed lower leaf thickness and leaf size. Leaf traits such as leaf thickness and leaf size also exhibited a strong phylogenetic signal across 10 *Rhododendron* species. Overall, from our findings, we infer that along an elevation gradient, the magnitude of leaf trait responses to future increases in temperature may vary depending on species phenology durations and phylogeny.

For further reading: <https://doi.org/10.1007/s00035-020-00244-5>

## **China Himalaya**

### **RESPONSES OF SOIL INSECT COMMUNITIES TO ALPINE WETLAND DEGRADATION ON THE EASTERN QINGHAI-TIBETAN PLATEAU, CHINA**

Xue Wei and Pengfei Wu

*European Journal of Soil Biology* 103: 103276

The wetlands on Earth are under different levels of degradation, and over half of them have even been lost during the 20th century. However, the response of soil insect communities to alpine wetland degradation is unknown, particularly in the Zoigê wetland, which spanning northern Sichuan, southern Gansu and Qinghai Provinces of China. Four habitats, including wet meadows, grassland meadows, moderately degraded meadows and severely degraded meadows, were selected in the Zoigê wetland, and the soil insect communities, plant communities and soil properties were investigated from April 2009 to October 2011. Diptera larvae and Coleoptera were the most abundant taxa. The soil insect taxonomic composition in the severely degraded meadows was clearly different from these of the others. The soil insect abundance significantly increased in the grassland meadows and declined

in the severely degraded meadows. Similar response was found for the abundance of the Diptera larvae. The taxonomic richness and diversity of the soil insect community declined significantly in the severely degraded meadows, as well as the abundances of Coleoptera larvae and adults. The plant community and soil physicochemical properties together determined the spatial distributions of the soil insect communities, and the available soil P and K and vegetation height were the main factors that determined the abundances and diversities of the soil insect communities. Our observations demonstrated that the soil insect communities were sensitive to alpine wetland degradation, which suggests that there are drastic changes in ecological function during wetland degradation.

For further reading: <https://doi.org/10.1016/j.ejsobi.2020.103276>

### **CLIMATE AND LANDSCAPE CONTROLS ON SPATIO-TEMPORAL PATTERNS OF STREAM WATER STABLE ISOTOPES IN A LARGE GLACIERIZED MOUNTAIN BASIN ON THE TIBETAN PLATEAU**

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*Science of The Total Environment* 771: 144799

The spatio-temporal variations of stream water stable isotopes are often assumed to follow atmospheric moisture transport over the Tibetan Plateau (TP). However, the isotopic composition of streamflow can be modified by the extensive variation in landscape properties in large glacierized mountain basins. In this study, the isotopic composition of stream water and its dominant controls in terms of spatial variation and potential water sources of rainfall, snow and glacier melt, and groundwater are analyzed based on synoptic water sampling from September 2018 to August 2019 over the Lhasa River basin (LRB) in the Southern TP. Results showed that: (1)  $\delta^{18}\text{O}$  variation in stream water is linearly proportional to longitude and latitude in the north. This spatial pattern is primarily controlled by cold mountainous environments, where stream water  $\delta^{18}\text{O}$  is more depleted and d-excess is higher towards the northwest and higher elevation in glacier-fed streams. Glacial melt could contribute considerably to streamflow generation, especially in the late monsoon season. (2) In the south, stream water  $\delta^{18}\text{O}$  does not simply follow depleted  $\delta^{18}\text{O}$  in precipitation along the strengthened Indian monsoon moisture gradient, but is enriched by strengthened local moisture recycling and increased groundwater contributions. The rainfall recharge is highly regulated and mixes with storage before it reaches the mainstem of the river. (3) The seasonal variations of stream water  $\delta^{18}\text{O}$  and d-excess are distinct, resulting from different contribution sources and catchment controls. In the pre-monsoon season, the strongest local moisture recycling obscures any simple stream water isotope lapse with elevation. These identified source areas and seasonal variations in the isotopic composition in stream water of LRB help us understand diverse water sources and flow paths to streams in this complex environment, which is a prerequisite for projecting potential future change.

For further reading: <https://doi.org/10.1016/j.scitotenv.2020.144799>

### **SPATIOTEMPORAL PATTERN OF VEGETATION ECOLOGY QUALITY AND ITS RESPONSE TO CLIMATE CHANGE BETWEEN 2000–2017 IN CHINA**

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*Sustainability* 13: 1419

Vegetation ecology quality (VEQ) is an important indicator for evaluating environmental quality and ecosystem balance. The VEQ in China has changed significantly with global warming and gradual intensification of human activities. It is crucial to research the spatiotemporal characteristics of VEQ and its response to climate change in China. However, most previous studies used a single indicator to reflect VEQ in China, which needs to combine the effects of multiple indicators to reveal its variation characteristics. Based on the six remote sensing indicators, fractional vegetation cover, leaf area index, net primary productivity, vegetation wetness, land surface temperature, and water use efficiency of vegetation, the vegetation ecology quality index (VEQI) was constructed

by principal component analysis in this paper. The spatio-temporal distribution and trend characteristic of VEQ within disparate ecosystems in China from 2000 to 2017 were studied. How continuous climate change affected VEQ over time was also analyzed. The results showed that the differences in spatial distribution between the excellent and poor VEQ regions were significant, with the proportion of excellent regions being much larger than that of poor regions. The VEQ has been ameliorated continuously during the past 18 years. Simultaneously, the VEQ would be ameliorated persistently in the future. Differences in the distribution and variation trend of VEQ occurred in disparate ecosystems. The VEQ of broadleaved forest was the best, while that of shrubs and arctic grassland ecosystem was the worst. The VEQ characteristics were different in disparate climate zones, with the best VEQ in the tropical monsoon climate zone and the worst in the plateau mountain climate zone. Except for desert vegetation and paddy field-dominated vegetation, VEQ of other ecosystems were significantly negatively correlated with altitude. Generally, moderate precipitation and temperature were favorable to improve VEQ in China. VEQ during the peak growing season was negatively correlated with temperature and positively correlated with precipitation, and the influence of precipitation on VEQ was stronger than that of temperature. Our results can be used to enact relevant management measures and policies.

For further reading: <https://doi.org/10.3390/su13031419>

## Bhutan-Himalaya

### CONSERVATION OF THREATENED AND UNDER-REPRESENTED SPECIES OF PLANTS

Ugyen Tshewang, Michael Charles Tobias, and Jane Gray Morrison

*Bhutan: Conservation and Environmental Protection in the Himalayas* 2021: 303-322

This chapter highlights some of the most important discussions on the ecological significances and conservation needs of the threatened species of plants in Bhutan that prioritizes 13 critically endangered, 20 endangered, and 15 vulnerable and the under-represented or lesser known bryophytes and the timber species of Bhutan. As assessed in the previous chapter, a total of 35 vascular plants species were either critically endangered or endangered with extinction that warrant immediate conservation actions, comprising ten species in Orchidaceae, three species in Asclepiadaceae, two species in Papaveraceae, two species in Rosaceae, two species in Scrophulariaceae, and one species each in the following families: Acanthaceae, Rubiaceae, Schisandraceae, Actinidiaceae, Aquifoliaceae, Boraginaceae, Cyperaceae, Fabaceae, Hypericaceae, Labiatae, Polygonaceae, Primulaceae, Solanaceae, Taxaceae, Thymelaeaceae, and Valerianaceae. A monolytic species *Brugmansia suaveolens* (an herb) also known as *Datura suaveolens* under the family Solanaceae is considered extinct as discussed earlier; and the extinction of such species appears to be driven by low genetic diversity (Spielman D, Brook BW, Frankham R. Most species are not driven to extinction before genetic factors impact them. *Proc Natl Acad Sci U S A* 101(42): 15261–15264, 2004). However, there are reports from India that some species that were considered possibly extinct actually re-emerged in different locations, even after some 80 years of the plant having been presumed extinct (Yadav SR, Chandore AN, Nimbalkar MS, Gurav RV. Reintroduction of *Hubbardia heptaneuron* Bor, a critically endangered endemic grass in Western Ghats. *Curr Sci* 96(7): 879–880, 2009). Such records certainly provide possibilities of re-emergence of the one extinct orchid species *Eulophia stenopetala* Lindl and the other narcotic species (extinct in wild) normally used as ornamental plant *Brugmansia suaveolens* (Willdenow) Berchtold & Presl. The extinct orchid species used to be found in the dry hills of Thinleygang area in Punakha District at 1800 m elevation used to be flowering in May (Pearce NR, Cribb PJ. The orchids of Bhutan: flora of Bhutan volume 3 part 3. Royal Botanic Garden Edinburgh and Royal Government of Bhutan, Edinburgh and Thimphu, p 57, 2002), while the species that is extinct in wild, *Brugmansia suaveolens* (Willdenow) Berchtold & Presl, used to be located in southern Bhutan at low elevation and subtropical climate, previously spotted in Samchi District Chipuwa Khola) and Sarbhang District in

Surey village of Geylegphu area (Grierson AJC, David Long DG. Flora of Bhutan volume 2, part 3. RBGE and RBG, Edinburgh and Thimphu, p 1068, 2001).

Further reading: [https://doi.org/10.1007/978-3-030-57824-4\\_7](https://doi.org/10.1007/978-3-030-57824-4_7)

### **NON-VIOLENT TECHNIQUES FOR HUMAN-WILDLIFE CONFLICT RESOLUTION**

Ugyen Tshewang, Michael Charles Tobias, and Jane Gray Morrison

*Bhutan: Conservation and Environmental Protection in the Himalayas* 2021: 71-153

For many centuries, humans and wildlife species have co-existed through domestication and protection of habitats. However, because of competition due to a perception of limited natural resources, the Human-Wildlife Conflict ('HWC') has become a serious global issue, including in Bhutan, posing a grave concern to the conservationist, agriculturist, public and policy makers worldwide. This chapter provides a situational analysis of the HWC in the global context, and its specific importance to the prevailing circumstances in certain parts of Bhutan, pertaining to the policies and strategies, preventive, mitigation, and response measures of such conflicts. Simultaneously, a detailed study of the HWC was conducted at Jomotshangka Wildlife Sanctuary, which encompasses three types of vegetation. Assessment of a global literature review and good practices, and results of a case study have been used to develop a road map of the HWC resolution in Bhutan using non-violent deployable techniques and Buddhist perspectives as preventive and mitigation measures.

Further reading: [https://doi.org/10.1007/978-3-030-57824-4\\_3](https://doi.org/10.1007/978-3-030-57824-4_3)

### **EXPLORING THE RISE OF EXPENDITURE REVIEWS AS A TOOL FOR MORE EFFECTIVE BIODIVERSITY CONSERVATION AND THE PROTECTION OF ECOSYSTEM SERVICES**

Morrison Rachel, Bullock Craig, and Lynn Deirdre

*Ecosystem Services* 47: 101241

How much money is being spent on conserving biodiversity? Is it enough? Who is funding national biodiversity conservation and what sort of actions receive the most funding? How can we find synergies between the financing of biodiversity and of ecosystem services? Historically these sorts of questions have been hard to answer. The introduction of the Convention on Biological Diversity's Resource Mobilisation Strategy with new requirements to monitor finance for biodiversity is, for the first time, driving efforts to track finance for conservation through National Biodiversity Expenditure Reviews (NBERs). In theory, this can help inform strategies to upscale resources for biodiversity conservation. However, NBERs also present methodological challenges, while their value remains untested. Using Ireland as a case study, this paper explores the uses of NBERs, examines their methodological challenges and discusses their potential implications for national biodiversity strategies. The findings reveal that the process of tracking financial flows requires the division of biodiversity finance in a way that may not reflect its complex character. Moreover, the focus on allocation and distribution of finance can be at the expense of understanding the effectiveness of biodiversity spending. Nevertheless, in the context of the promotion of market-based approaches, providing an evidence base for whether, where and when resource mobilisation is needed can be argued to be a step in the right direction.

For further reading: <https://doi.org/10.1016/j.ecoser.2020.101241>

**Pakistan- Himalaya**

**IMPACT OF URBANIZATION ON GROUNDWATER LEVELS IN RAWALPINDI CITY, PAKISTAN**

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*Pure and Applied Geophysics* 178: 491-500

Variations in the rate of urbanization directly impact groundwater levels and quality. Therefore, the present study examines the relationship between changes in land-use and land-cover (LULC) and groundwater drawdown in Rawalpindi, Pakistan. Landsat images, i.e., Operational Land Imager (OLI), Thematic Mapper (TM), and Enhanced Thematic Mapper Plus (ETM+), were downloaded for the years 1991, 1997, 2007, 2010, and 2017. The study area was classified using the normalized difference vegetation index (NDVI) and normalized difference built-up index (NDBI) to create three classes, i.e., urban area, vegetation, and barren land. The groundwater level in the study area for the year 2017 was obtained using an electrical resistivity survey (ERS) with a Schlumberger configuration. The data obtained were interpreted using IX1D iteration software. The results of NDBI and NDVI showed that the urban area increased by 37.89% during the period 1991–2017, at the expense of vegetation. Similarly, the groundwater level was found to decrease at a rate of 1.38 m per annum. If the same trend prevails, the groundwater level will decrease to approximately 160 m from the natural ground surface by the end of this century. The results of the present study may be used for the formulation of policy and proper planning prior to any major developmental project to control the impact of LULC changes on water resources in the future.

For further study: <https://doi.org/10.1007/s00024-021-02660-y>

#### **THE PRECAMBRIAN HAZARA FORMATION FROM HAZARA MOUNTAINS, NORTHERN PAKISTAN**

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*Arabian Journal of Geosciences* 14: 1-17

The late Neoproterozoic Hazara Formation along the Lora Maqsood Road near Haripur, Lesser Himalayas, North Pakistan, is studied for sedimentology, petrography, and major and trace element analysis to determine the paleoenvironment, provenance, paleoweathering intensity, and tectonic settings. The Hazara Formation is characterized by greywacke sandstone, siltstone, shale, argillite, claystone, limestone, and coarsening and finning upward turbidite lithofacies. Based on bedding style, grain size, and sedimentary structures, 11 types of lithofacies were identified within the sequence. The macroscopic studies indicate that the sequence has undergone through slight metamorphism although the texture is altered sedimentary features and bed geometries are well preserved. Compaction seems to affect the part of argillaceous sediments of an enormous thickness of the Hazara Formation to make slate-like appearance which may preferably be called argillites. The same effect is seen on sandstone to make it so hard to name it orthoquartzite. Petrographic analysis of limestone reveals that the limestone is micritic in nature; stylolites and pressure solution structures are also present in the limestone. The petrographic analysis of sandstone categorized it as feldspathic greywacke in the QFR diagram. The quartz content is higher in sandstone and may reach to 70% which indicates a weathered felsic source. The petrographic analysis suggests a continental block provenance with stable craton and an uplifted basement source. The Chemical Index of Alteration and the Chemical Index of Weathering values indicate moderate to high weathering conditions with a warm and moist climate in the source region. A sedimentary-tectonic model based on the geochemical data of sandstone indicates deposition along with active continental margin tectonic settings. The paleocurrent flow analysis indicates that the dominant source region of the sediments of the Hazara Formation was situated south to southeast, which may probably be the central Indian craton, Aravali orogeny, and Bundelkhand craton of southern India.

For further reading: <https://doi.org/10.1007/s12517-021-06496-7>